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.

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

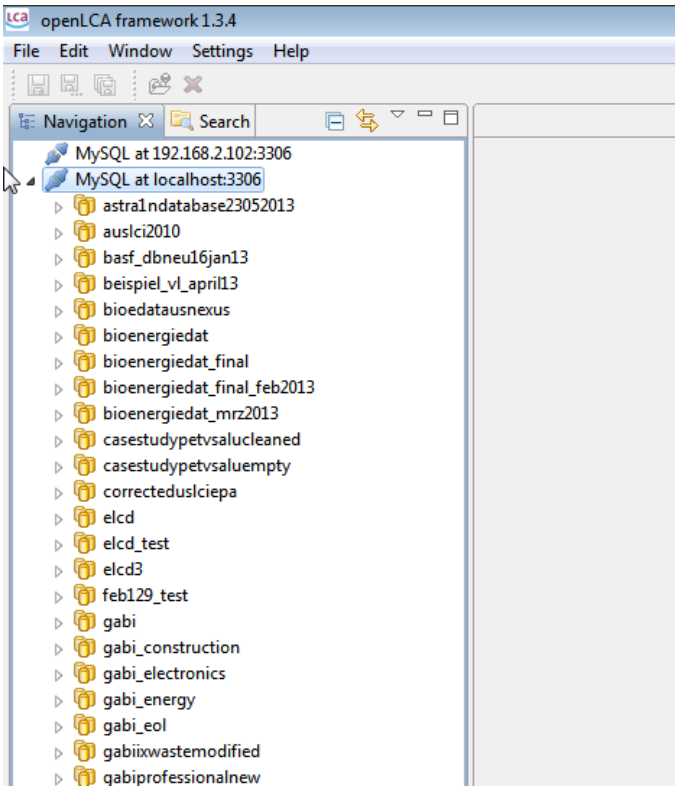
created system) are available individually, while in SimaPro, the network is always calculated ‘in one go’.

3 Test details

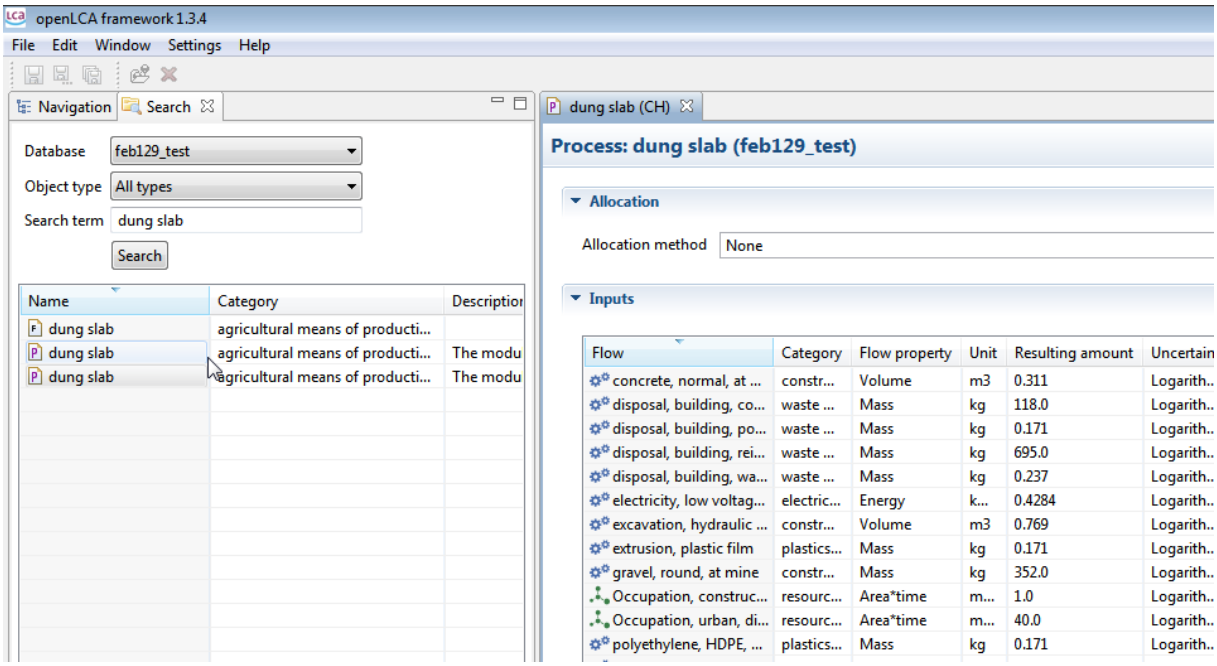
3.1 openLCA 1.3.4

3.1.1 Creating a product system

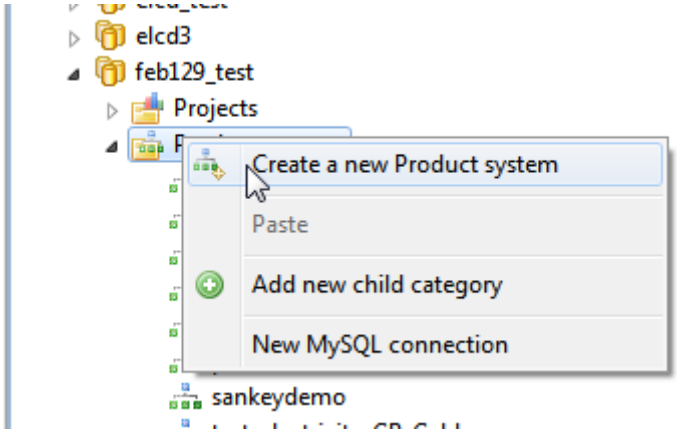
For openLCA 1.3.4, a database is selected, …



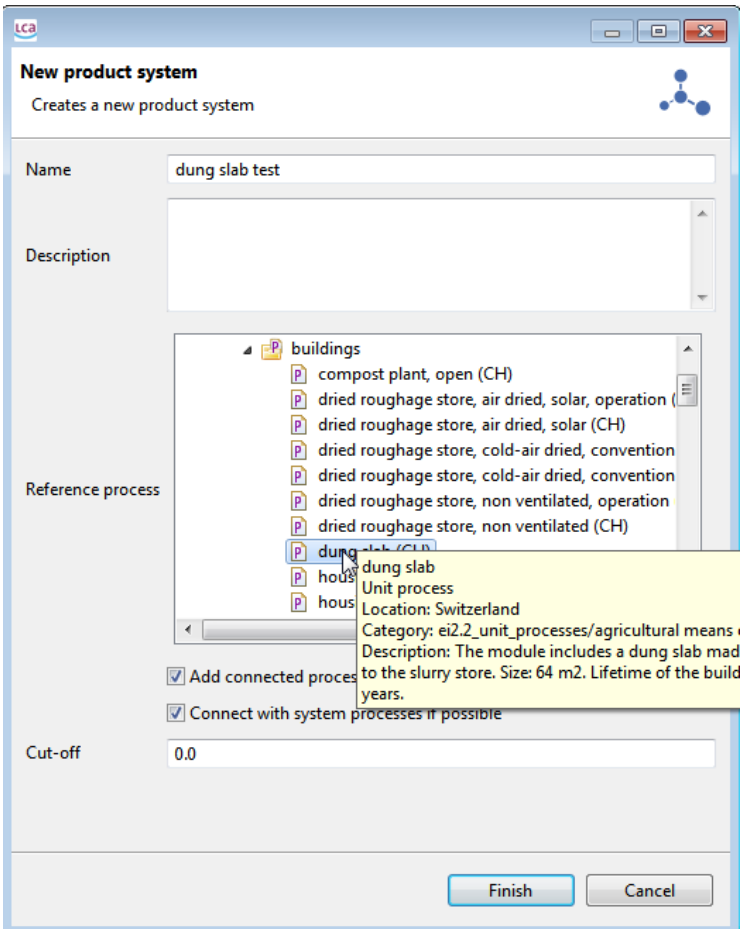
… in the database, the unit process is chosen (here from the search window), it is opened for inspection,



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



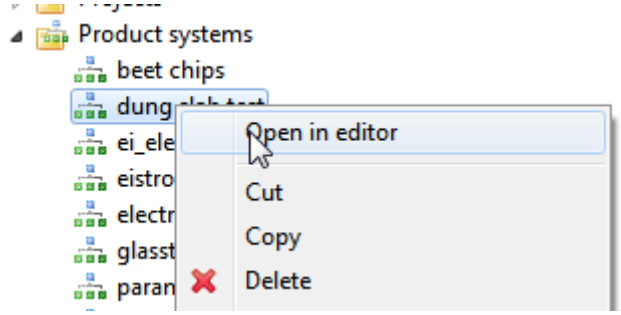
For the product system, the reference process needs to be selected…



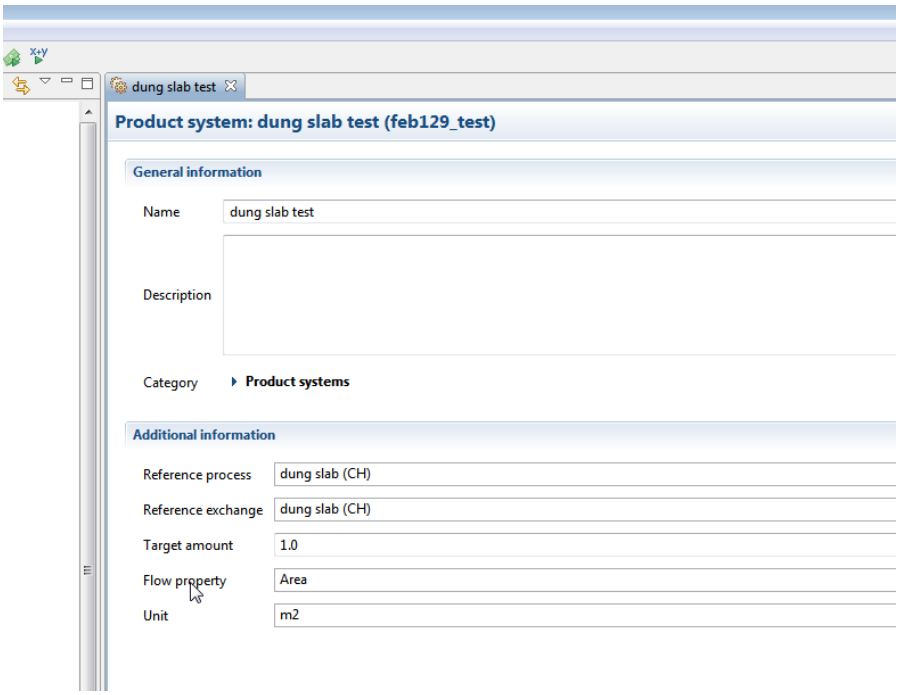
Clicking on finish creates the product system, as a life cycle model of all the connected processes, and opens it also. This takes 19.14s altogether, from clicking on the finish button until the product system is open.

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.

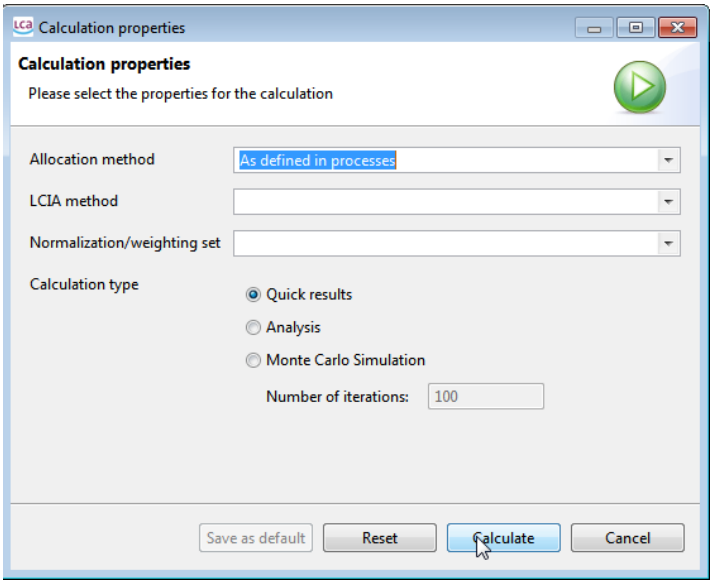


3.1.3 Calculation, ecoinvent 2.2

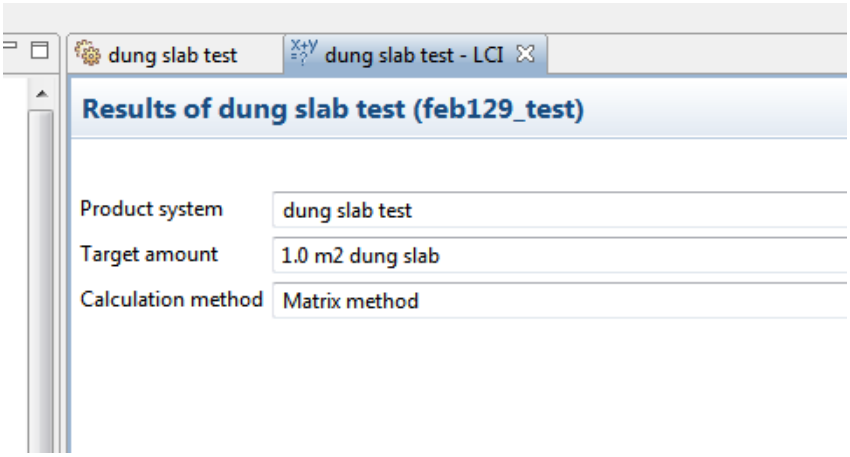
As explained in the introduction, there are two main options available in openLCA for calculating life cycles, a quick calculation and the analysis. Quick calculation only calculates the inventory (and impact assessment category results if an LCIA method is selected). The analysis provides in-depth contribution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

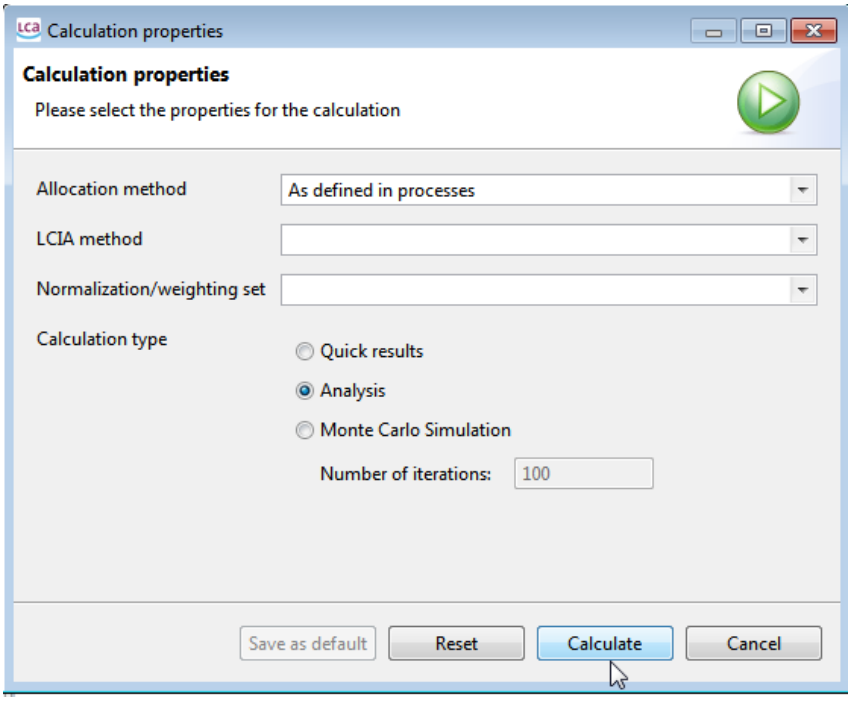
The quick calculation of said product system…

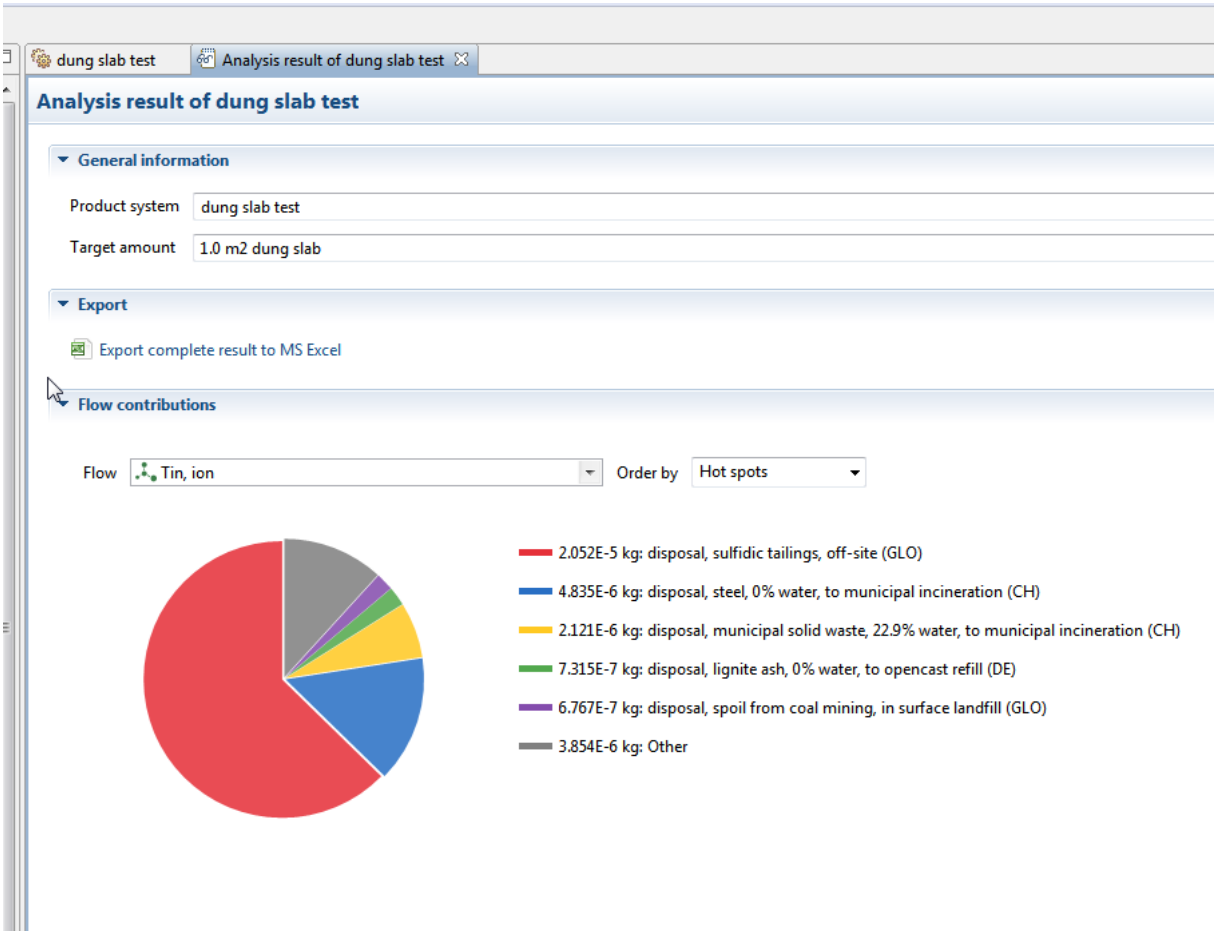


..takes 3.1 seconds..



..while the analysis…





… takes 17.30s.

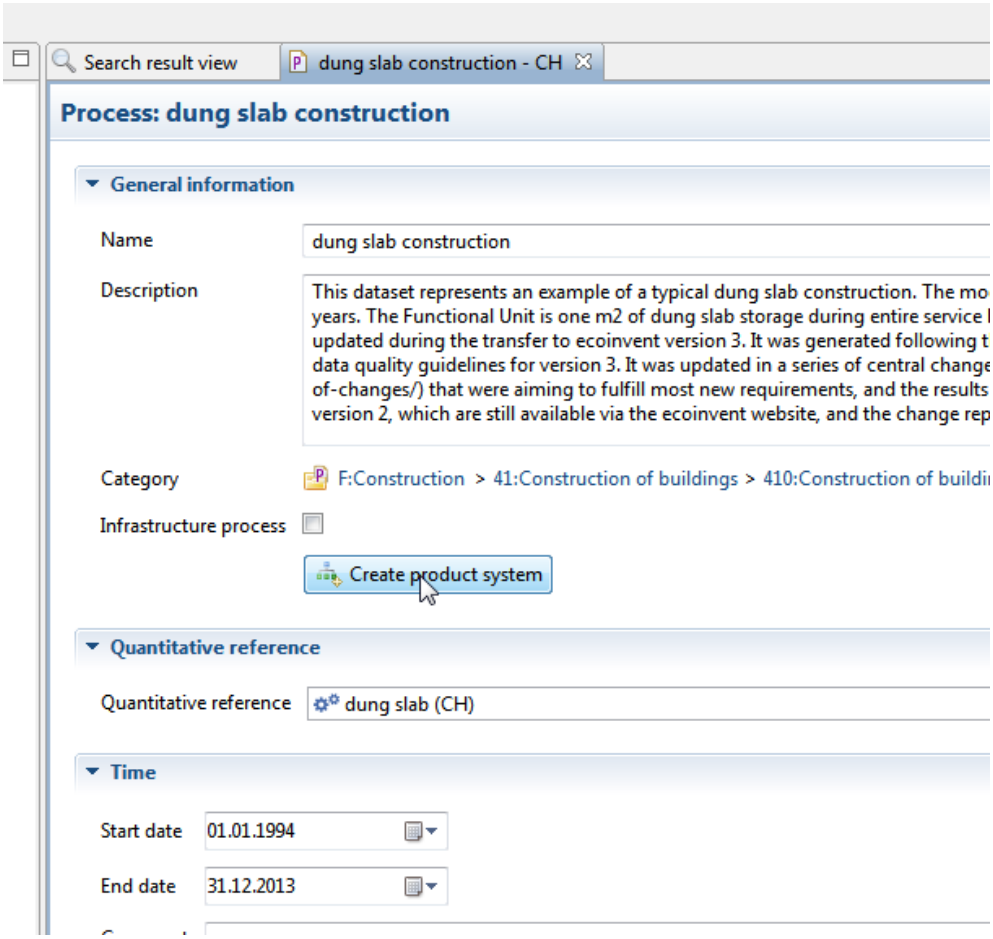
3.2 openLCA 1.4 beta 1

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

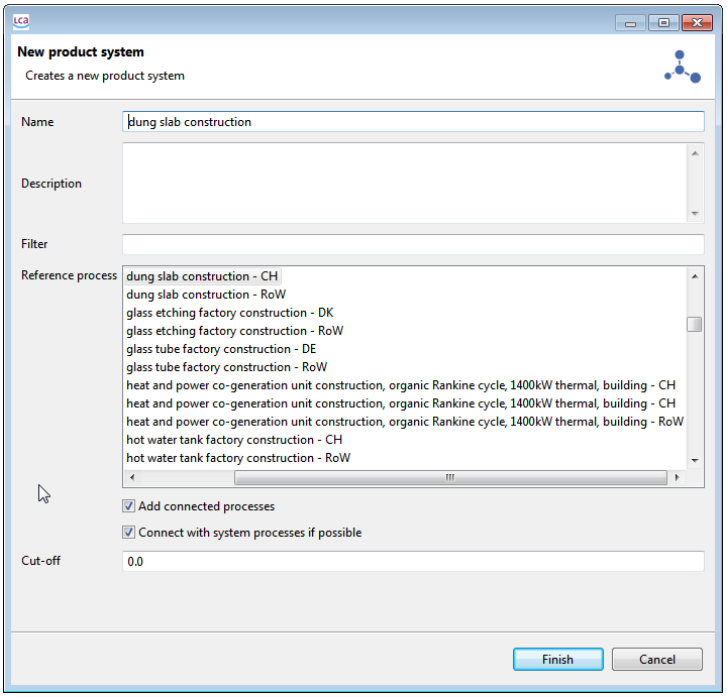
3.2.1 Ecoinvent 3.0.1

3.2.1.1 Creating a product system

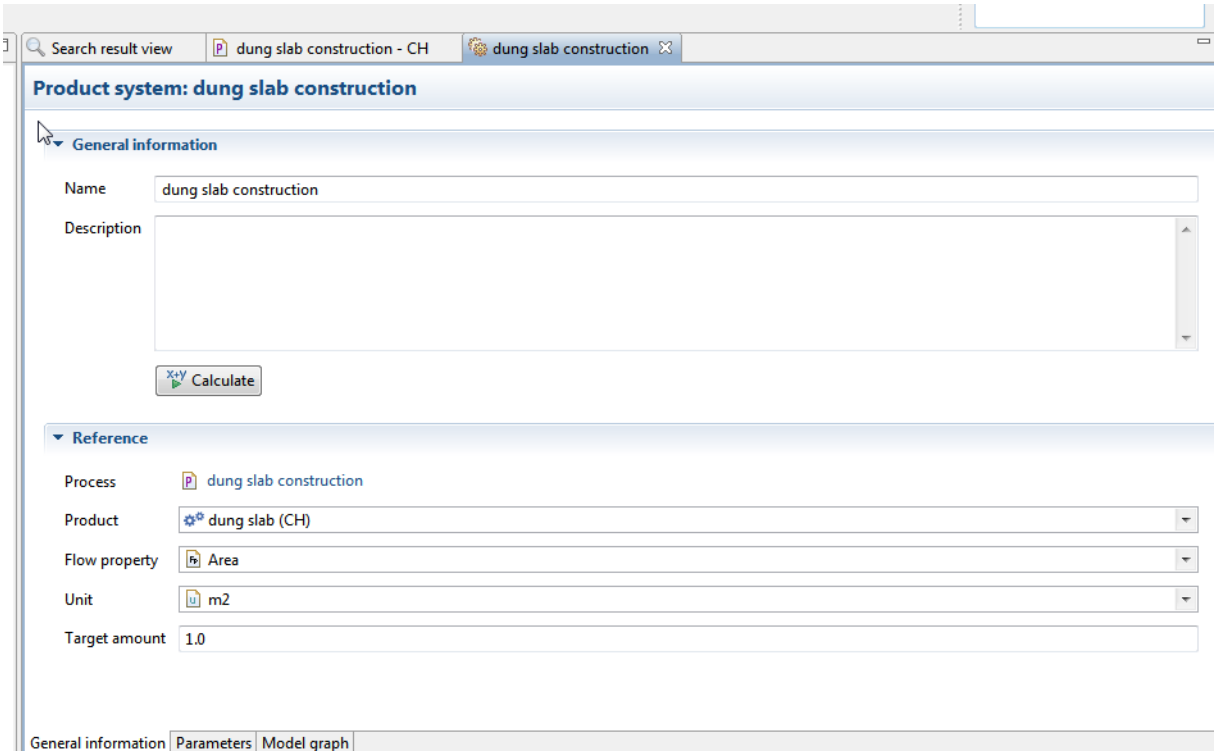
In openLCA 1.4 beta 1, a product system can be created directly from the process..

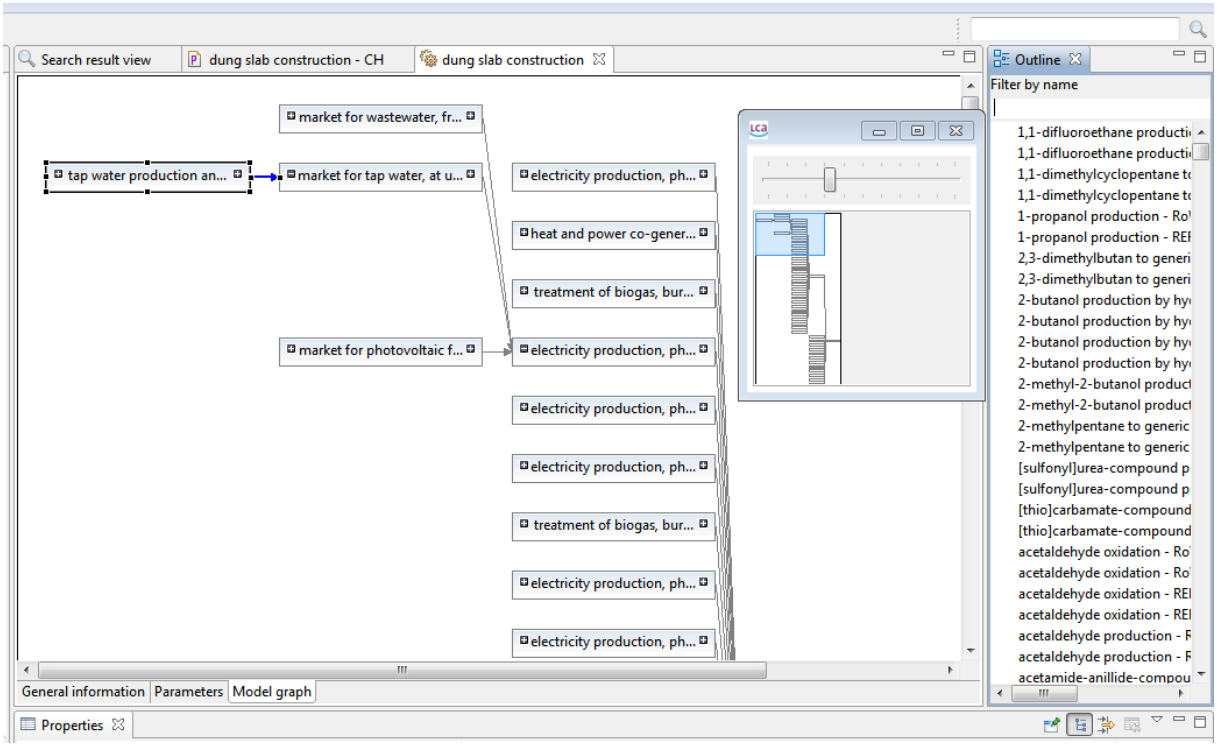


… or as before, with a right-click on the category tree

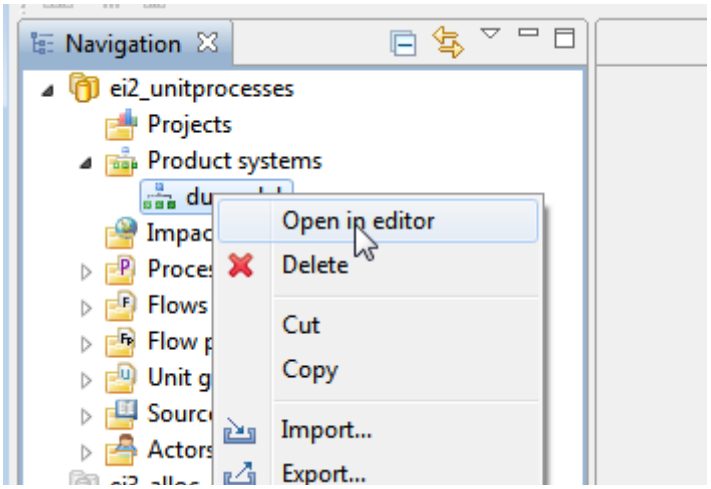


Creating the product system takes 17.25s


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
market for wastewater, fr...
tap water production an...
market for tap water, at u...
electricity production, ph...
heat and power co-gener...
treatment of biogas, bur...
market for photovoltaic f...
electricity production, ph...
electricity production, ph...
electricity production, ph...
treatment of biogas, bur...
electricity production, ph...
electricity production, ph...
Outline
Filter by name
1,1-difluoroethane producti
1,1-difluoroethane producti
1,1-dimethylcyclopentane t
1,1-dimethylcyclopentane t
1-propanol production - Ro
1-propanol production - RE
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 - Ro
acetaldehyde oxidation - RE
acetaldehyde oxidation - RE
acetaldehyde production - R
acetaldehyde production - R
acetamide-anillide-compou
General information
Parameters
Model graph
Properties

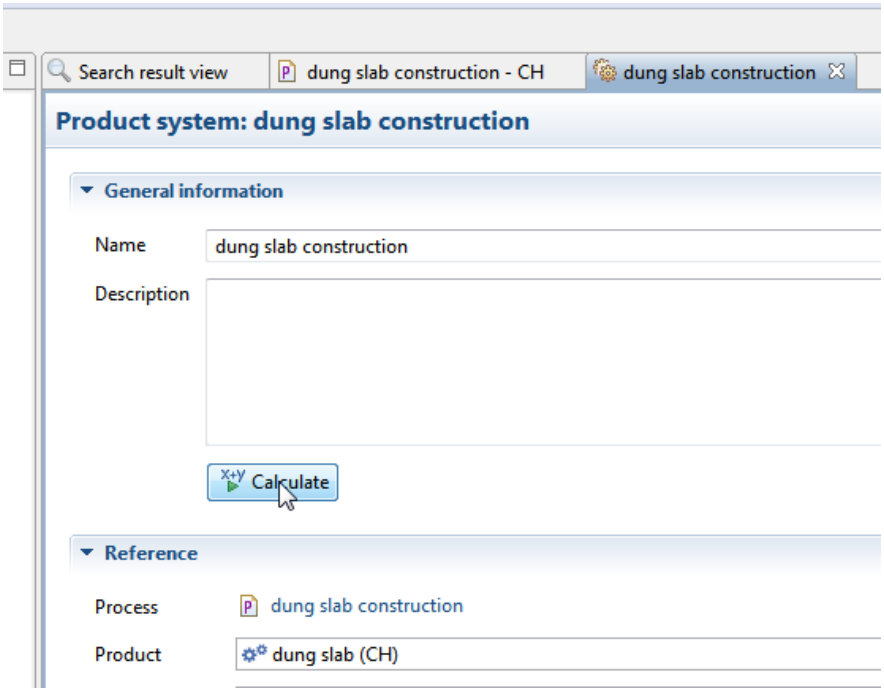
3.2.1.2 Opening a product system

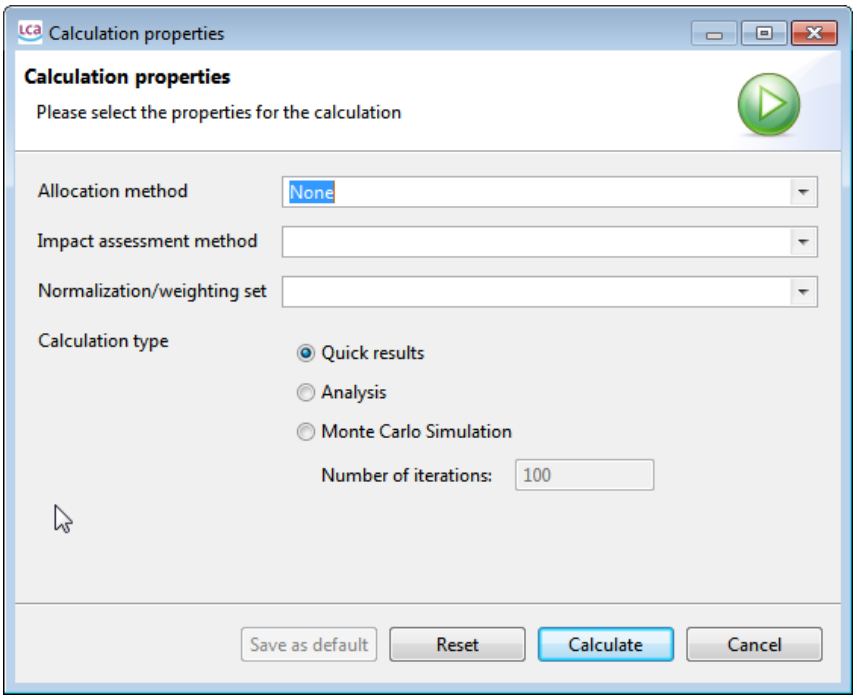


..takes 2.89s

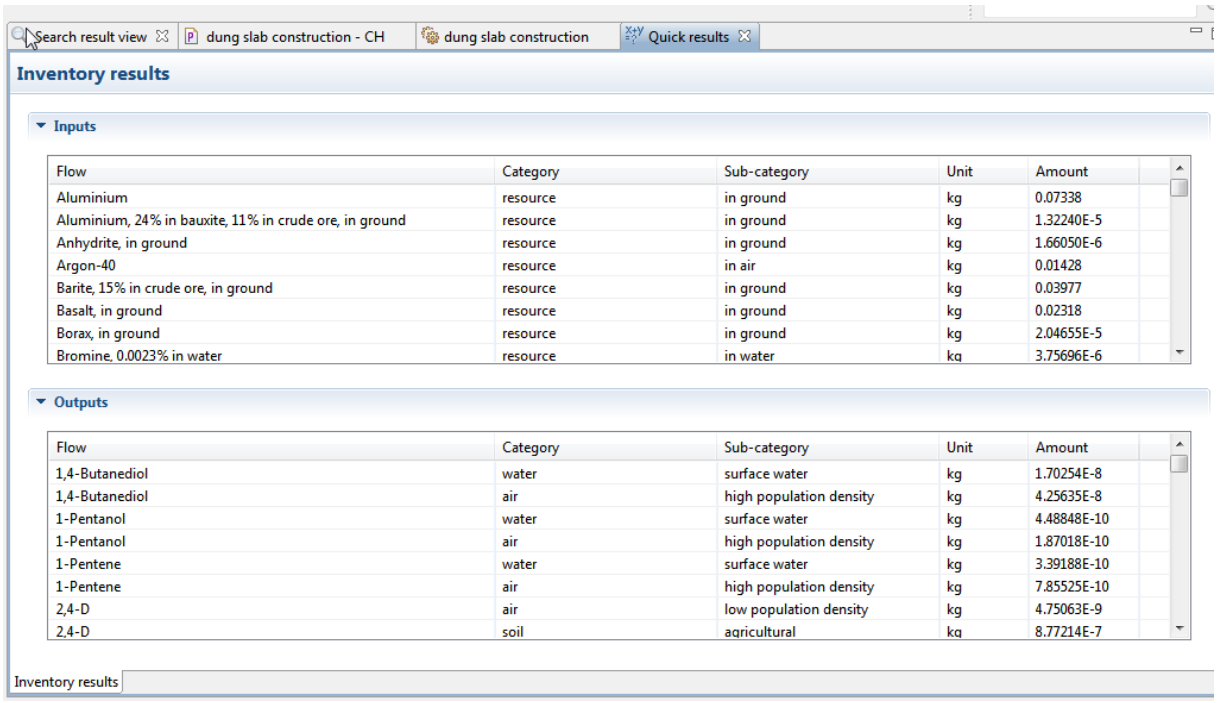
3.2.1.3 Quick calculation

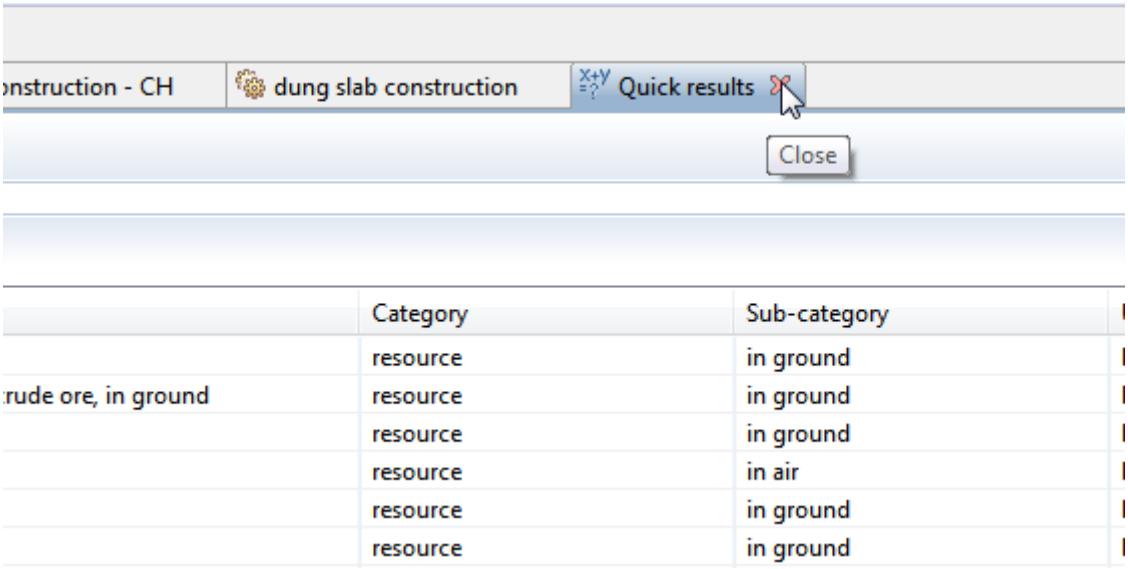
A quick calculation of the product system (only inventory)..





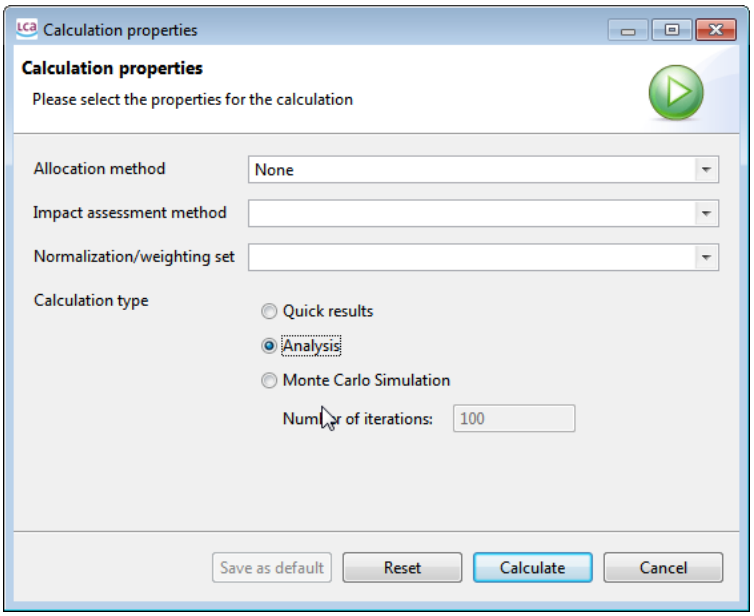
…takes now 18.2 s.

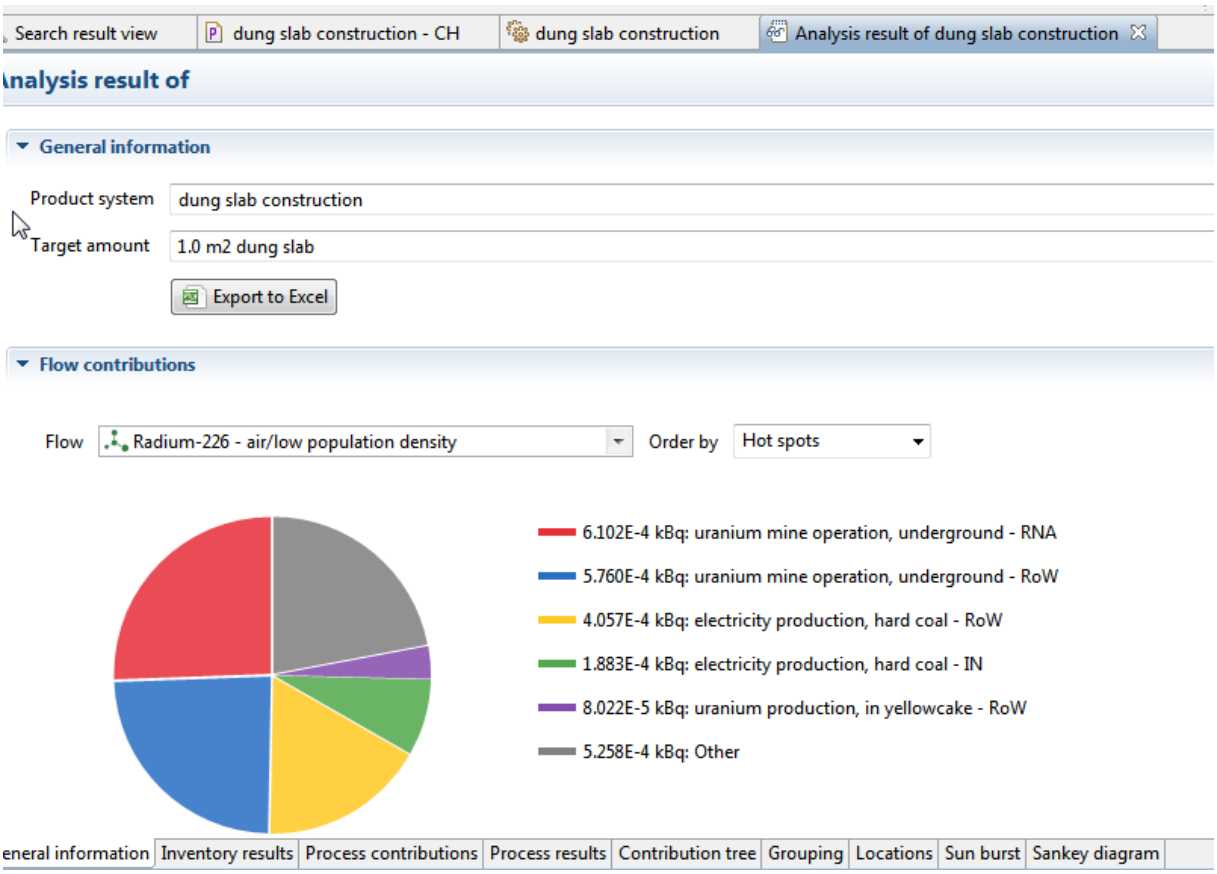




3.2.1.4 Analysis

An analysis of the same product system takes 94.48s.

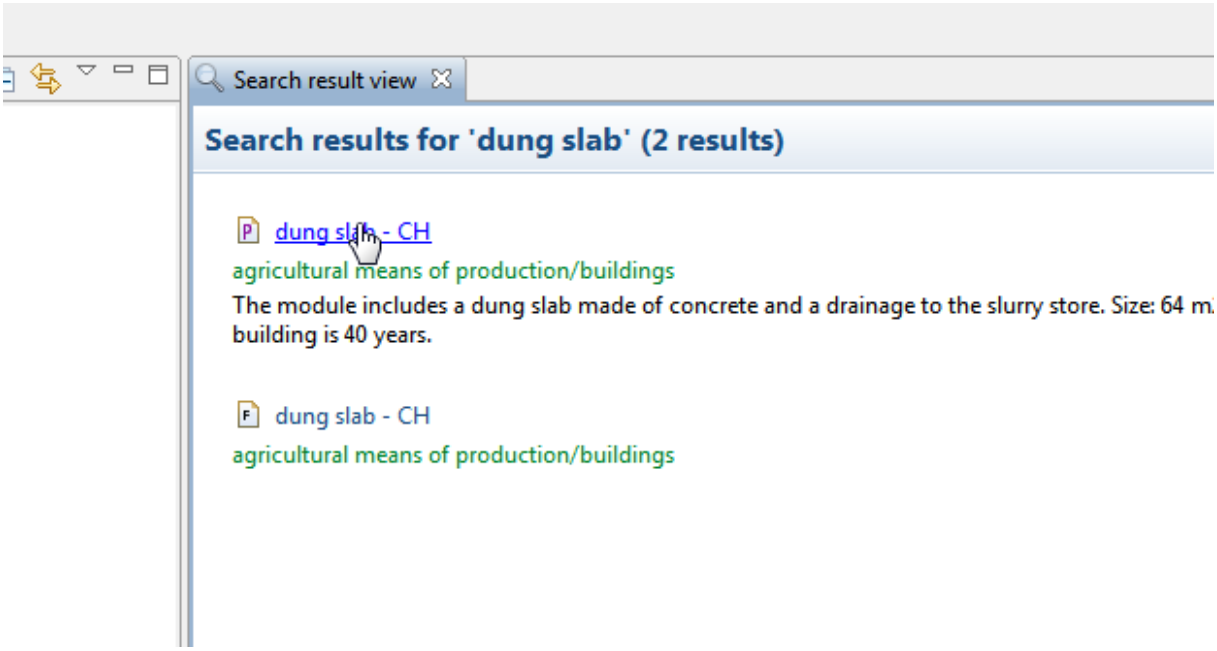


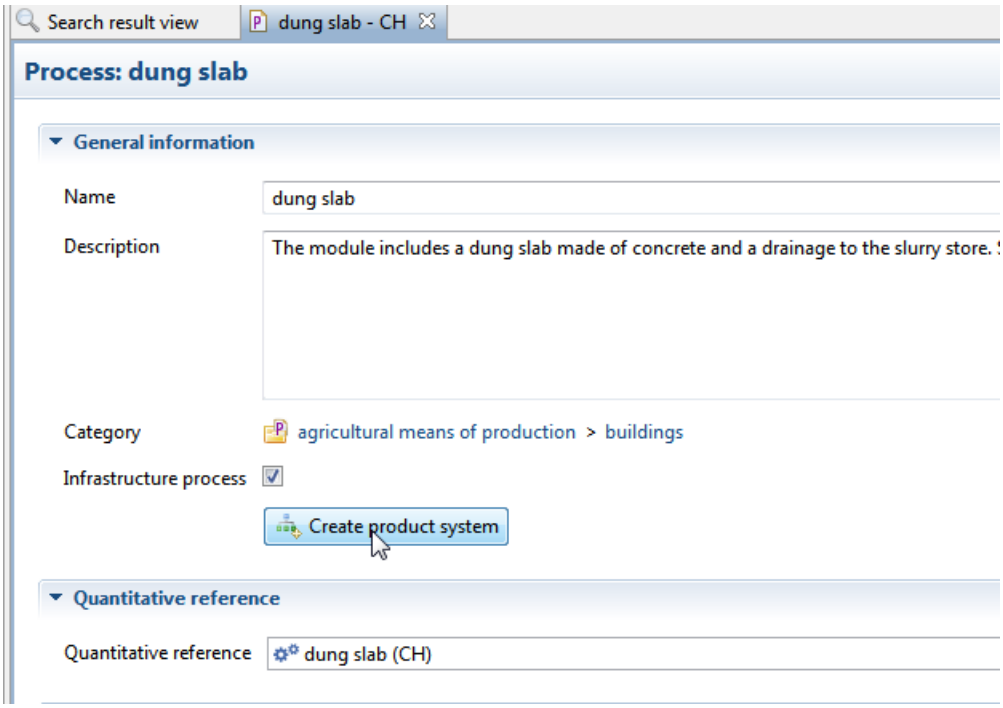


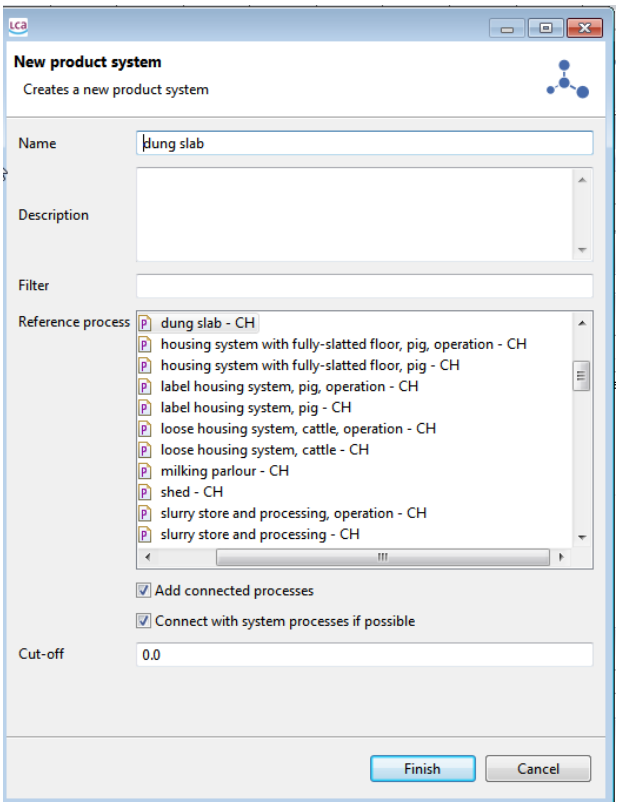
3.2.2 Ecoinvent 2.2

3.2.2.1 Creating a product system

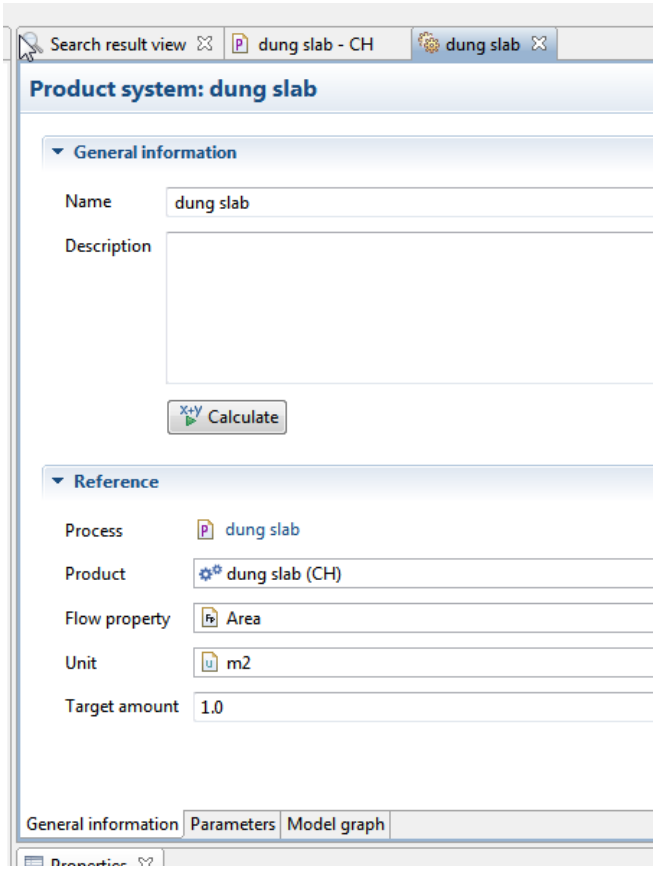
For ecoinvent 2.2, creating the product system…




Search result view
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)

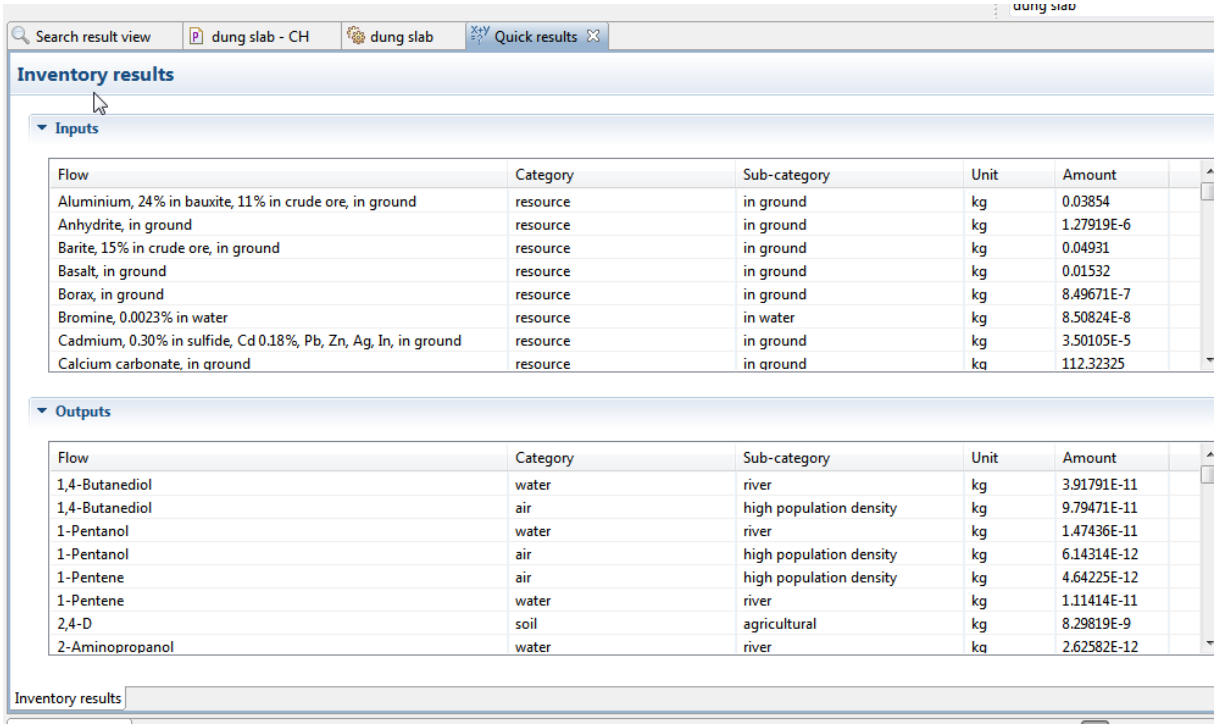

New product system
Creates a new product system
Name
dung slab
Description
Filter
Reference process
dung slab - CH
housing system with fully-slatted floor, pig, operation - CH
housing system with fully-slatted floor, pig - CH
label housing system, pig, operation - CH
label housing system, pig - CH
loose 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.

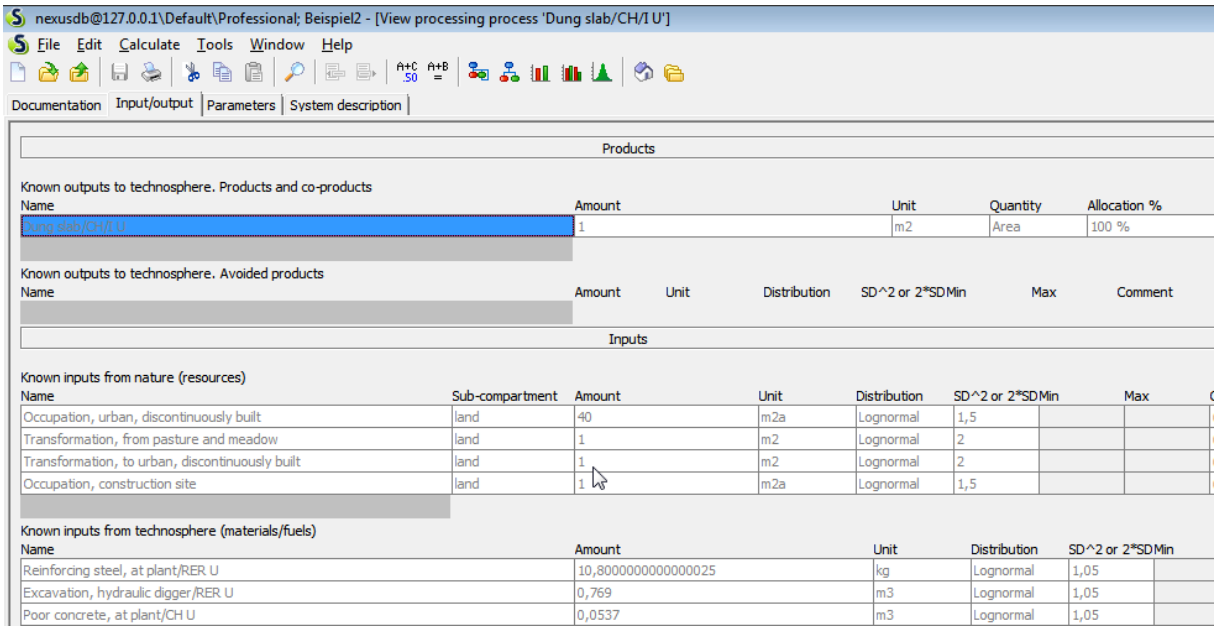


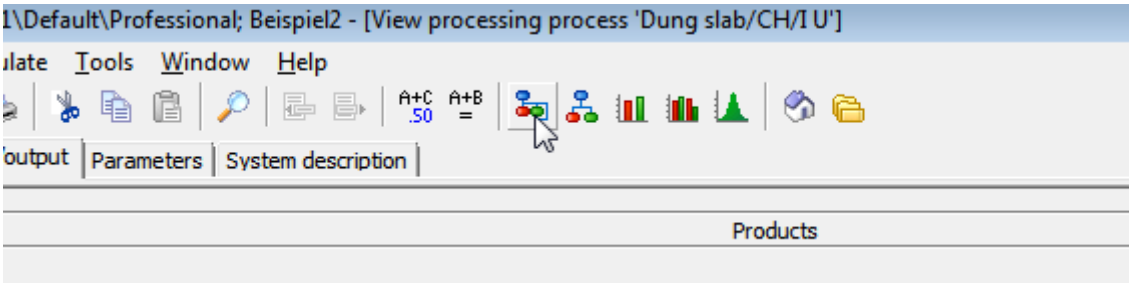
3.2.2.3 Analysis

Also the analysis is quite fast and requires 4.32s.

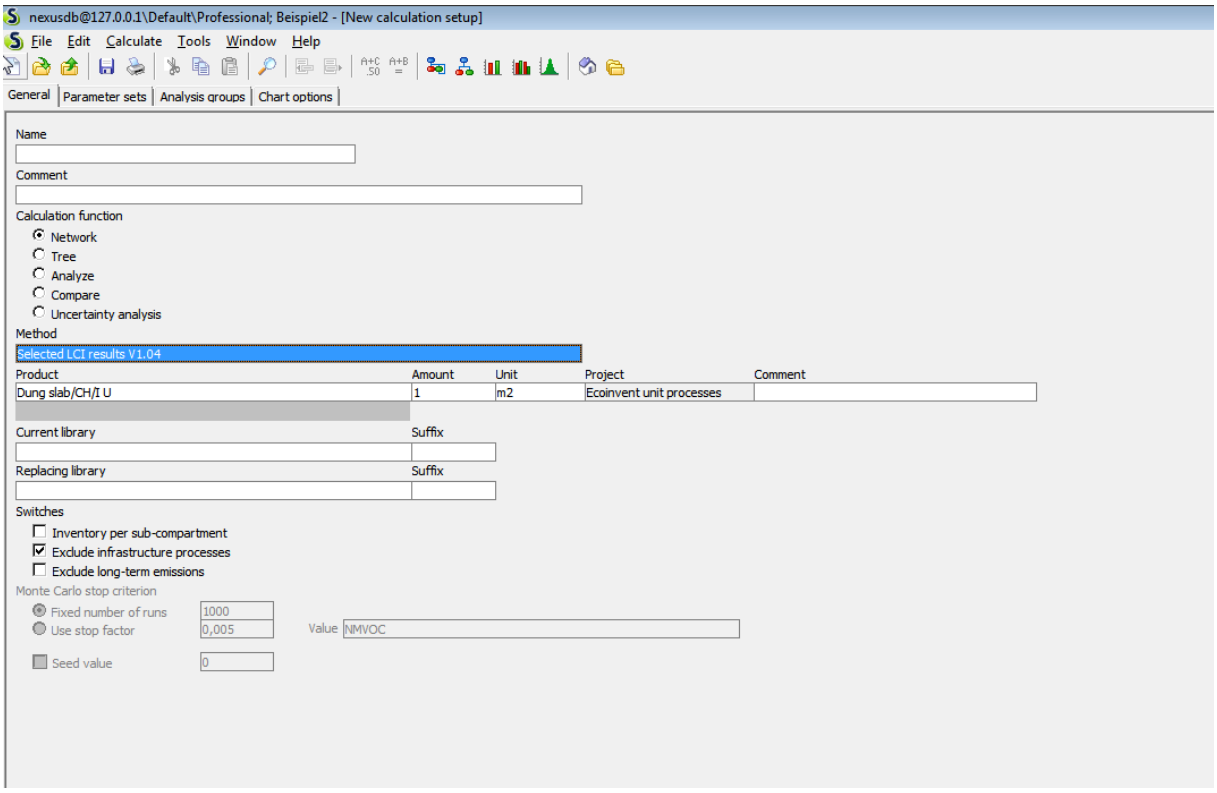
3.3 SimaPro 7.3.3 MU Developer

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…

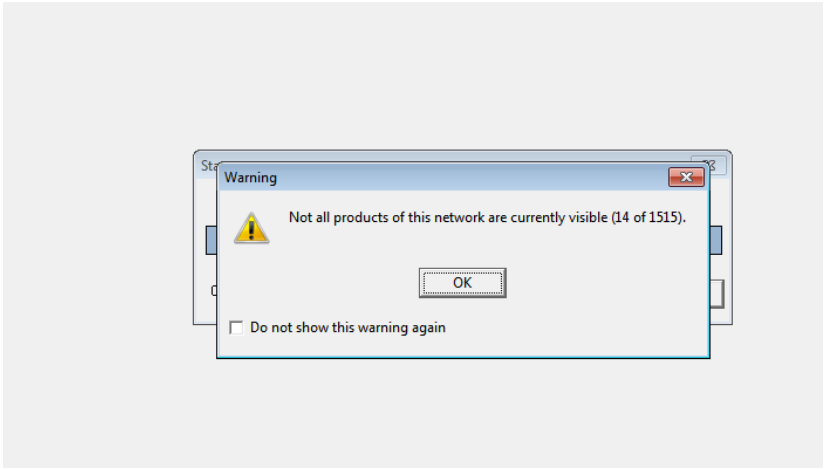


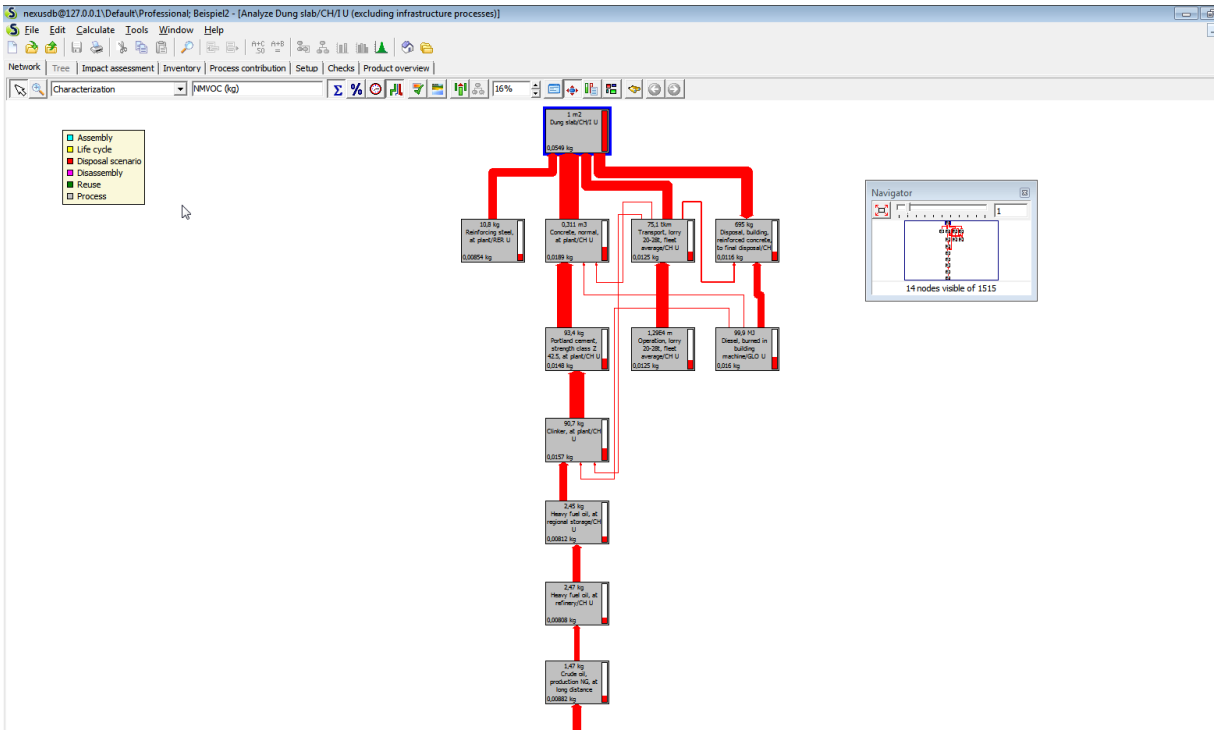


..since it is not possible in SimaPro to have no LCIA method, ‘selected LCI results’ is taken.



Time required for calculating the network is 12.55 seconds.

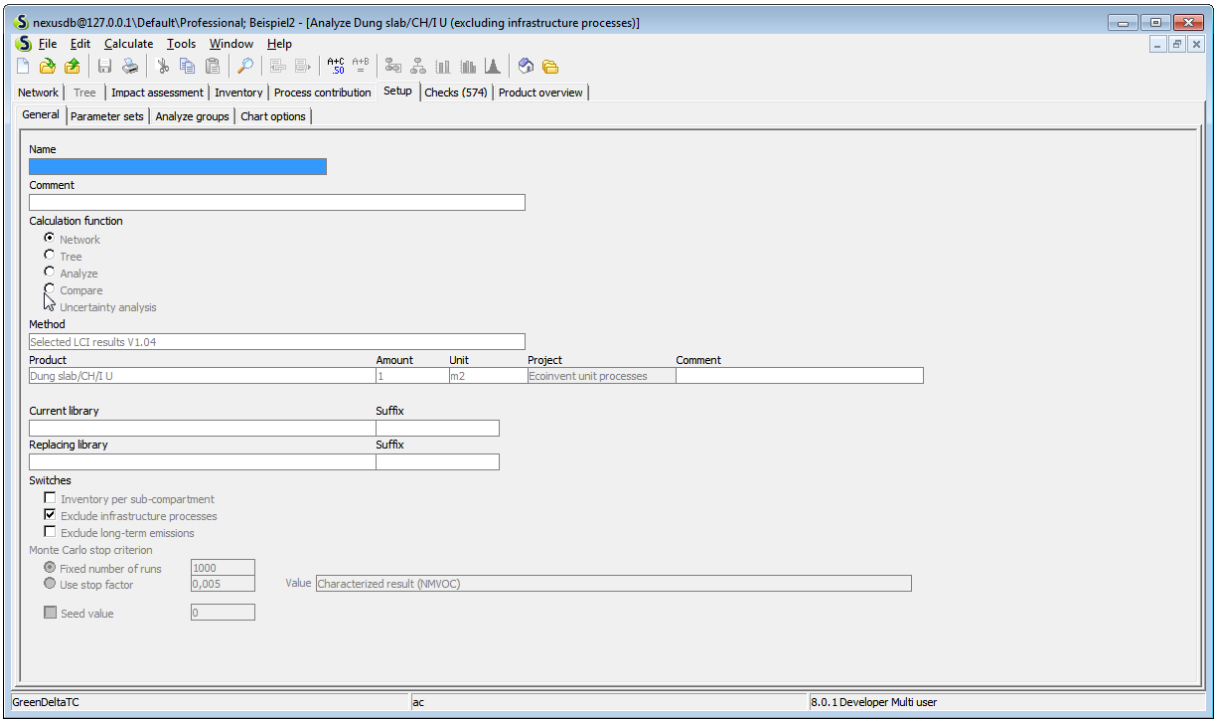


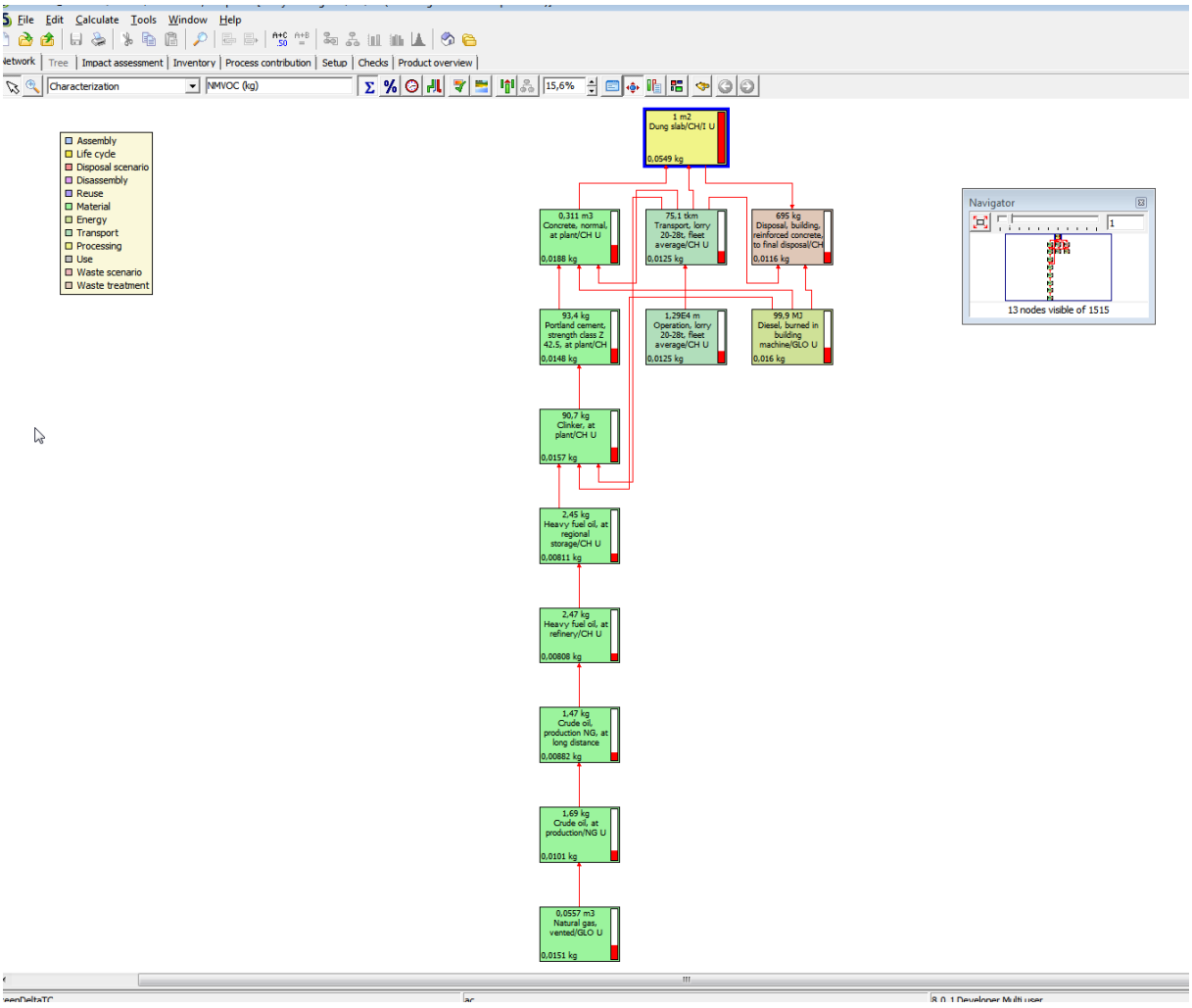


3.4 SimaPro 8.0.0 MU Developer

3.4.1 Ecoinvent 2.2

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

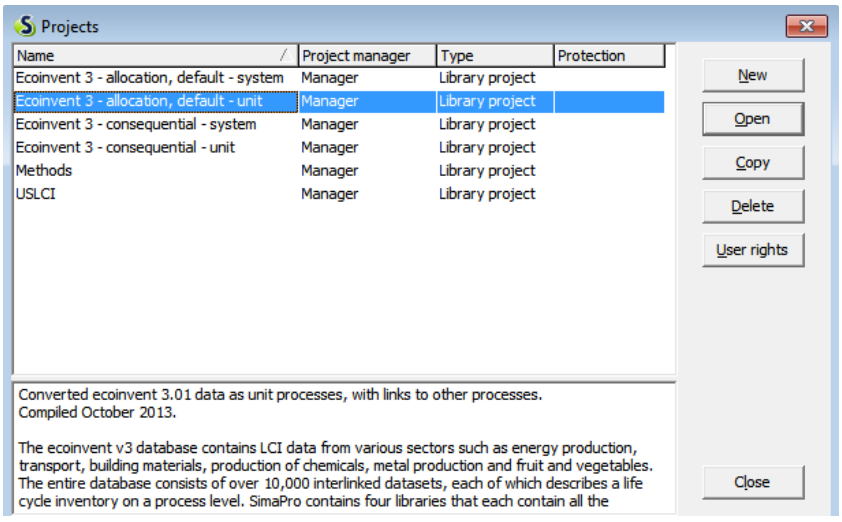




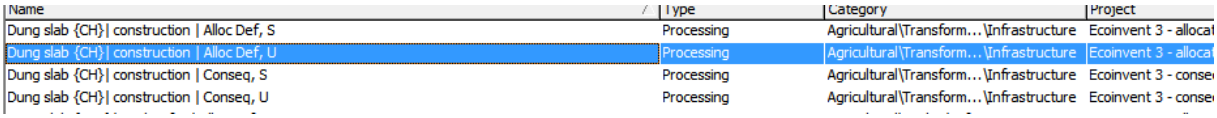
Required time is 11.8s

3.4.2 Ecoinvent 3.0.1

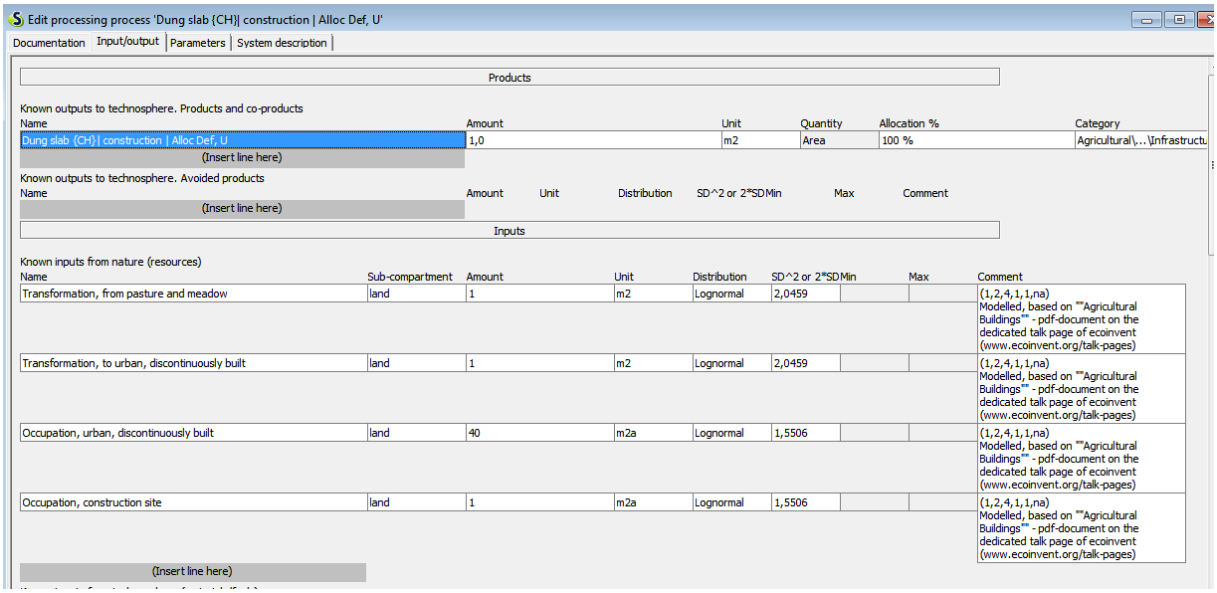
For ecoinvent 3, the calculation is performed using the ecoinvent unit process default allocation library;



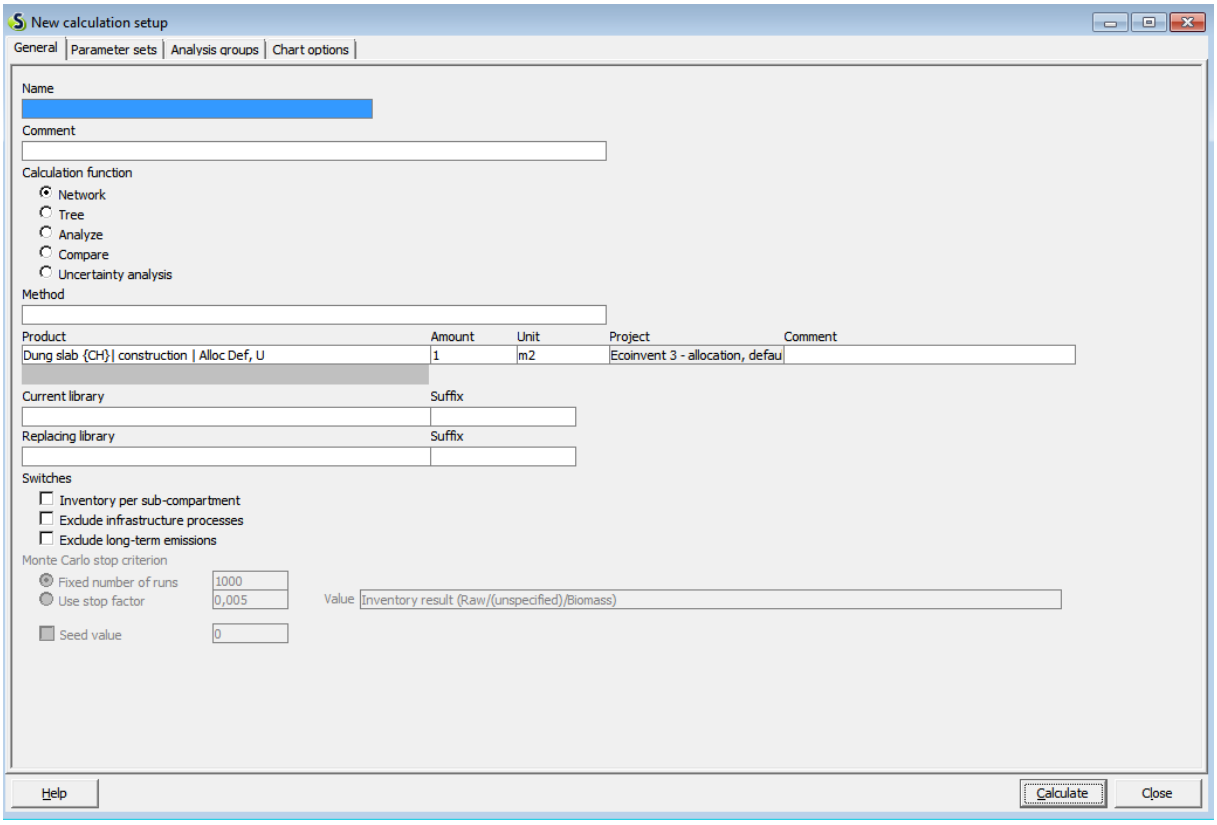
the “dung slab” process is selected again..



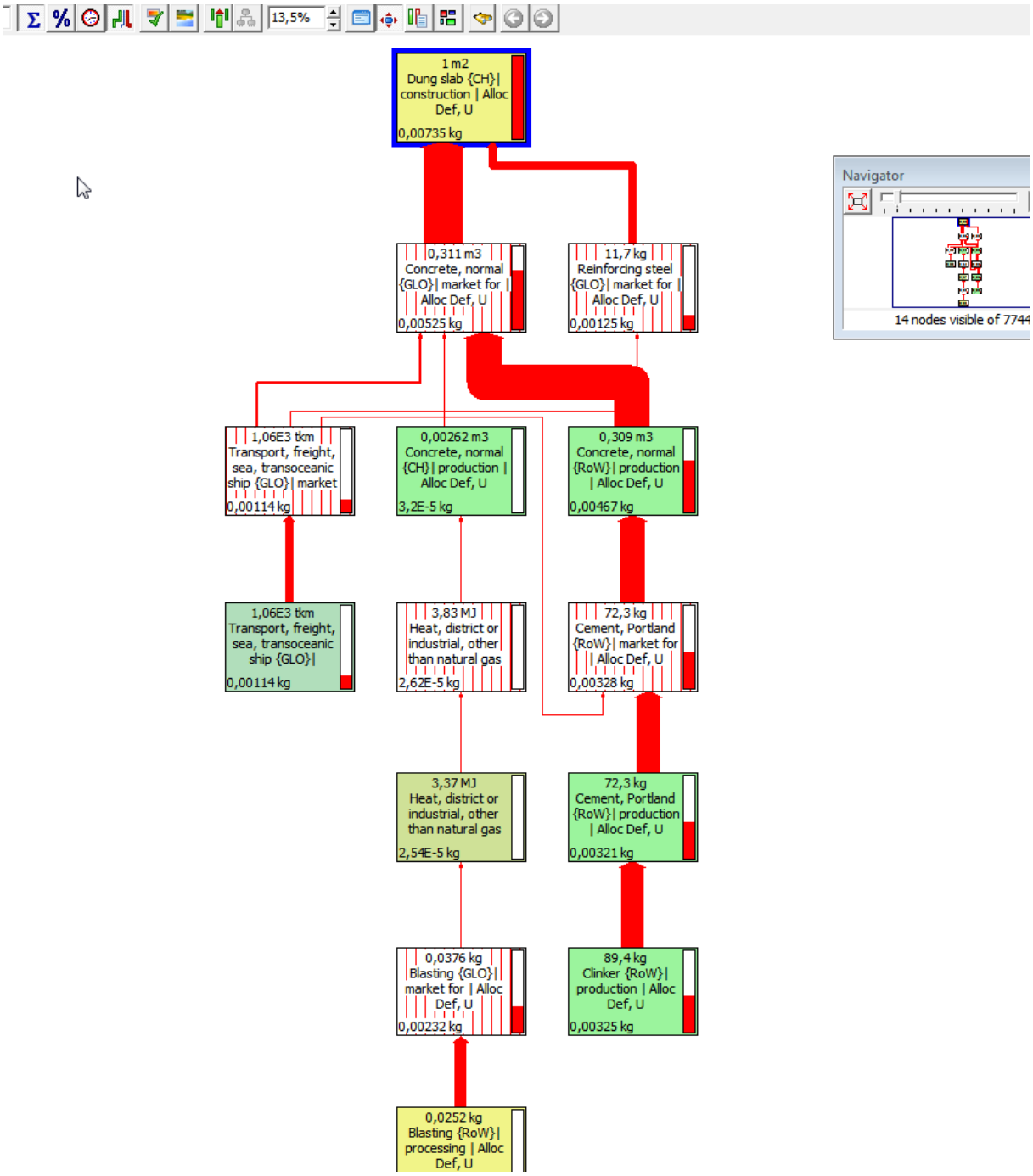
Name	Type	Category	Project
Dung slab {CH}| construction | Alloc Def, S	Processing	Agricultural\Transform...\Infrastructure	Ecoinvent 3 - allocat
Dung slab {CH}| construction | Alloc Def, U	Processing	Agricultural\Transform...\Infrastructure	Ecoinvent 3 - allocat
Dung slab {CH}| construction | Conseq,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



..and a network is calculated without inventory…



..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-ter	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-ter	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-ter	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-ter	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-tern	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 -> 1
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 -> 1
SP8.0.1	ei2	analysis		Carbon dioxide,	Raw	in air	kg	0,980385		1	
SP8.0.1	ei2	analysis		Silicon	Water	groundwater, long-tern	kg	0,358592		1	
SP8.0.1	ei2	analysis		Uranium-238	Water	ocean	kBq	0,000381		1	