

GaBi databases 2016 (Service Pack 30) in openLCA



Version: openLCA 1.5.0/openLCA 1.6.0 beta 1

Date: 23 February 2017

Author: Cristina Rodríguez

GreenDelta GmbH, Müllerstrasse 135, 13349 Berlin, Germany; gd@greendelta.com

GreenDELTA

Content

1	GaBi databases 2016 – What’s new?	3
2	GaBi databases 2016 in openLCA	3
2.1	General modelling	5
2.2	Transport modelling.....	7
2.3	Waste Modelling	11
2.4	EPD Datasets	14
3	Feedback & Contact	15

1 GaBi databases 2016 – What’s new?

As explained by [thinkstep](#), the new GaBi databases 2016 include:

- More than 1,600 new LCI datasets have been added:
 - The GaBi Professional database grew considerably, with 154 scope 2 & 3 electricity datasets, 88 associations, 42 future grid mixes, 14 capital goods datasets and parametrized plans and 3 waste water treatment parameterized plans.
 - The Construction extension database grew by: 50 EPDs, 660 European Construction datasets
 - 377 US LCI datasets were added, along with 88 new thinkstep datasets
Additional LCI content was added to: Renewables, Electronics, Plastics and Intermediates
 - The total number of datasets is now in excess of 10,000
- All supply chains recalculated.
- Broad refresh of data across all branches accounting for changes in methodologies, technologies and political developments.
- Compliance and standardization concerning ISO, EN, ILCD, PEF is addressed.
- Documentation more detailed than ever (data, method, application for standards, review process, QA routine, changes with upgrade)

For further details about the content in the new GaBi databases, and explanation on their modelling principles, you can check [GaBi’s website](#).

2 GaBi databases 2016 in openLCA

Several modifications from the original ILCD package provided by thinkstep to GreenDelta were carried out during the implementation of the database in openLCA:

- Refactoring of categories in some elements of the database: the original ILCD package contained a structure of categories with duplicate folders or inconsistent organization (Figure 1).



Figure 1. Actors' category in the original GaBi database (left) and after refactoring (right)

- Adapt the GaBi datasets to the modelling requirements of openLCA (e.g. selection of quantitative references in those processes without a reference product stated in the original ILCD file, waste modelling, etc.). See [sections 2.3](#) and [2.4](#) for further details.
- Addition of dummy processes and setting of default providers for waste flows to facilitate the automatic creation of product systems (see [section 2.3](#) for more information).
- Refactoring of sources to avoid multiple entries with the same content (Figure 2).

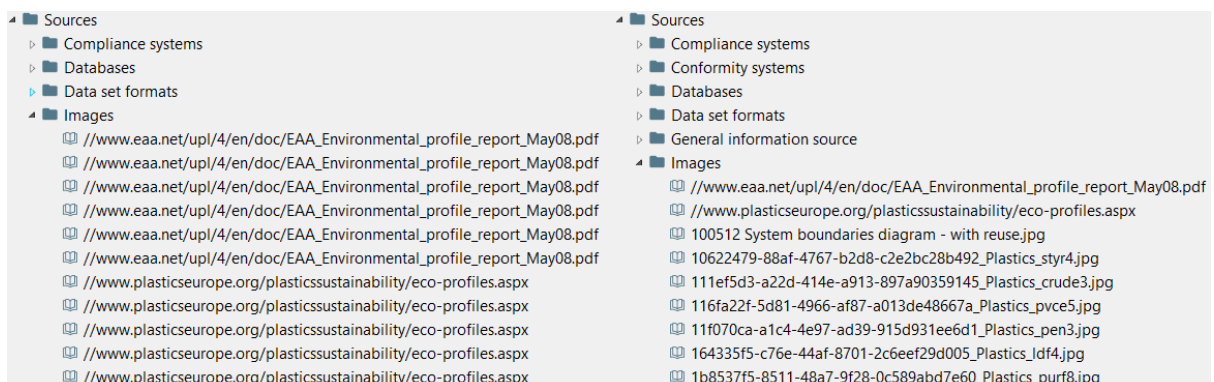


Figure 2. Multiple sources referring to the same content in GaBi original ILCD files (left) and after refactoring (right)

- Mapping of the elementary flows to openLCA's reference data. This allows to combine different databases from openLCA Nexus in a more consistent way, as well as use the openLCA LCIA methods package available in the openLCA website¹.

The next sections contain specific information about some of the modifications done, as well as tips and recommendations for the usage of the GaBi databases in openLCA.

2.1 General modelling

GaBi databases are created with the LCA software GaBi and, therefore, the structure of their datasets is, in some cases, highly influenced by the type of modelling carried out in that software. For instance, it includes:

- Graphical modelling: the user creates the connections in the supply chains manually in the model graph; automatic connections are not feasible. That is one reason because most of the datasets included in GaBi databases are either fully aggregated or partially aggregated processes (i.e. creating thousands of linkages manually as when using unit processes might require too much effort).
- The same flow can be generated by multiple processes within the database (e.g. "electricity", by all electricity mixes).
- Default providers cannot be set within the software, neither are supported by ILCD, which is the format used by thinkstep to provide to GreenDelta the datasets.
- Connections between different flows allowed (i.e. different identifiers): To explain it in an easy way: technically, you can connect apples with oranges. Consequently, some flows might be consumed but not generated and vice versa, as they can be linked to flows with different unique identifiers. In openLCA you will need an auxiliary process to relate one flow to the other.

¹ It should be taken into account that some elementary flows could not be mapped and were added new to the reference data. However, the LCIA methods pack available in the openLCA website might refer to an older version of the reference data, and, thus, not including impact factors for those new flows.

Due to all the above mentioned, it is strongly recommended to avoid creating only automatically the product systems using GaBi databases in openLCA. Therefore, if you select the “Add connected processes” option in the product system wizard (Figure 3), please remember to check the created linkages in the “Model graph” tab of the product system editor. Likewise, if you use the “Build supply chain” option from the right-click menu with the model graph.

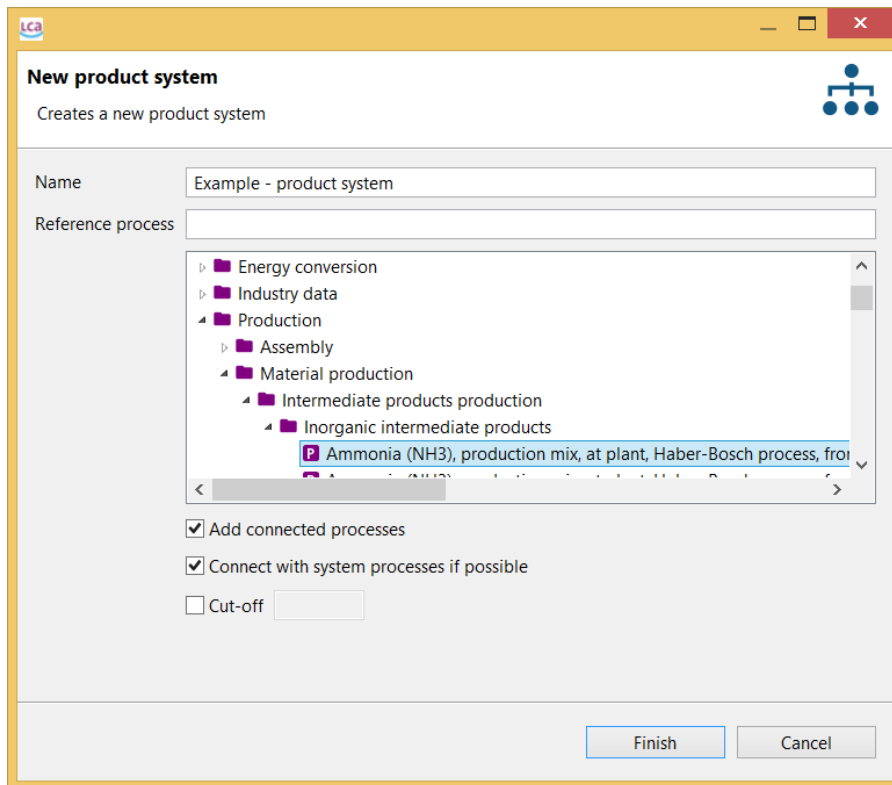


Figure 3. Wizard for creating a product system in openLCA 1.5.0 beta 1

If you want to delete any of the existing connections, right-click on the linking arrow and select “Delete” (Figure 4). For removing multiple connections, you can also right-click on a process or the blank canvass and select “Remove connections”.

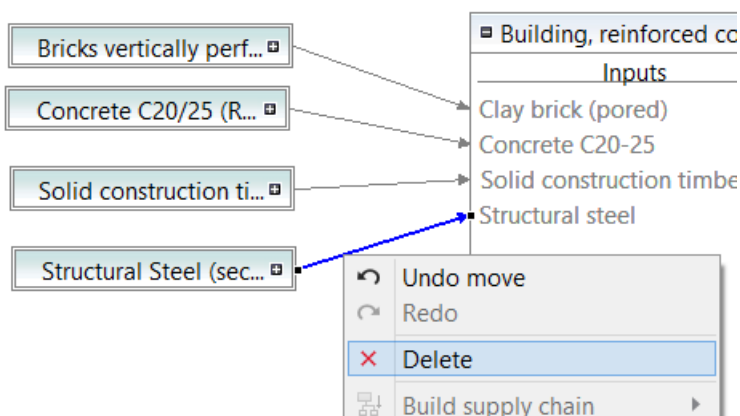


Figure 4. Deleting a connection in the “Model graph” tab of the product system in openLCA 1.5.0 beta 1

If you want to search for different providers/recipients, right-click on the process box and select “Search providers for” or “Search recipients for” and the flow that you want to connect (Figure 5).

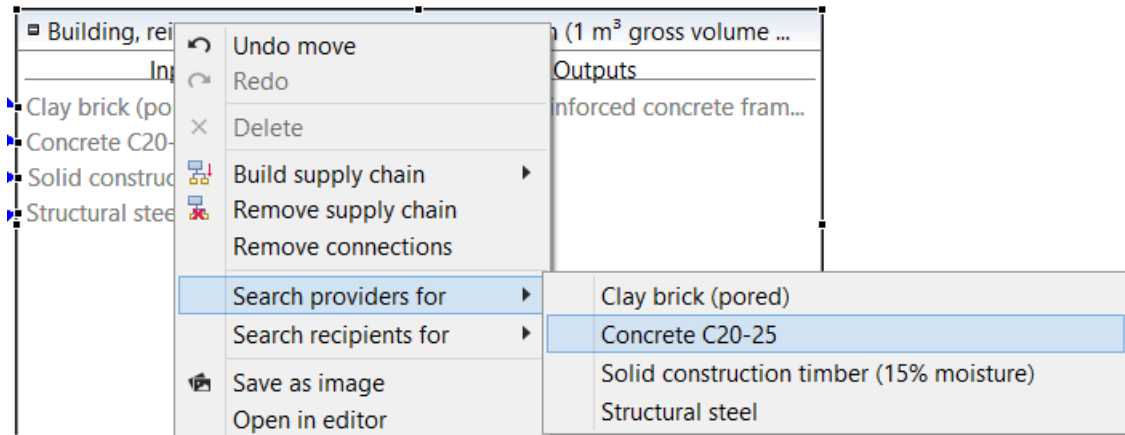


Figure 5. Searching for providers in the “Model graph” tab of the product system in openLCA 1.5.0 beta 1

If you plan to repeat the same connections in several product systems, you can also set the desired providers as default within the process editor (Figure 6), in order to ensure that the connections created automatically with the “Add connected processes” or “Build supply chain” functions are correct.

Flow	Category	Amount	Unit	Costs	Uncertain...	Provider	Pedigree ...	De
Clay brick (pored)	Materials/Minerals	Brick	kg		none	ly perforated - EU-27		
Structural steel	Materials/Metals	None						
Concrete C20-25	Materials/Minerals	Bricks vertically perforated (EN15804 A1-A3), production mix, at plant, technology mix, vertically pe						
Solid construction timb...	Materials/Renewa...	Lightweight concrete block, production mix, at plant, expanded clay as base material, Light-weight						

Figure 6. Selecting a default provider in the process editor of openLCA 1.5.0 beta 1

2.2 Transport modelling

GaBi transport processes usually follow the structure represented in Figure 7, i.e. the same flow representing the product transported (i.e. cargo) is included in the dataset as input and output. There are also processes representing for example the usage of a car, where the flow repeated in the input and the output is “vehicle”, being this the car used with the correspondent driving share.

Process: Cargo plane, consumption mix, technology mix, kerosene driven, cargo, 113 t payload

Inputs								
Flow	Category	Amount	Unit	Costs	Uncertainty	Provider	Pedigree ...	Des...
Fe Cargo	Others	1.00000	kg		none			
Fe Kerosene	Crude oil products...	cons_specific_t	kg		none			

Outputs								
Flow	Category	Amount	Unit	Costs/Rev...	Uncertainty	Avoided ...	Pedigree ^	
Fe Cargo	Others	1.00000	kg		none			
Fe Carbon dioxide, biogenic	air/unspecified	$(0.001 * em_{CO2_biotic}) * 1.0$	kg		none			
Fe Methane	air/unspecified	$(0.001 * em_{CH4}) * 1.0$	kg		none			

Figure 7. Example of transport dataset in GaBi databases

This way of modelling allows the user to create the desired transport routes connecting one transport process after the other. In GaBi software, as linkages between different flows is possible (i.e. different identifiers), the cargo flow consumed by the first transport process in the chain can be connected to the product that needs to be transported (e.g. reference product of the manufacturing process). Likewise, the cargo flow produced by the last transport dataset can be connected to the product consumed by the process representing the next phase (e.g. retail process) (Figure 8).

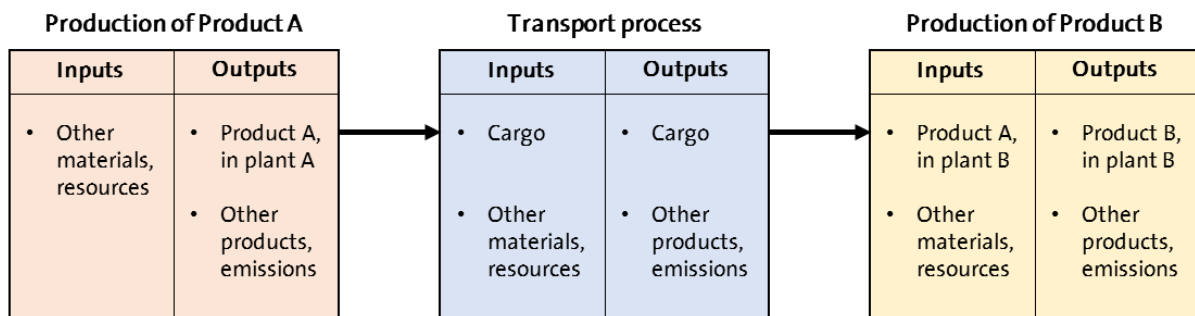


Figure 8. Transport modelling in GaBi software

However, openLCA has the requirement that only equal flows can be linked together in the product system. Thus, different modelling approaches should be followed in order to connect the transport systems with the product before and after being transported. Some of the options might be:

- Option 1: Creation of an auxiliary process for connecting the transport phase, the product to be transported and the transported product consumed by the next phase (Figure 9).

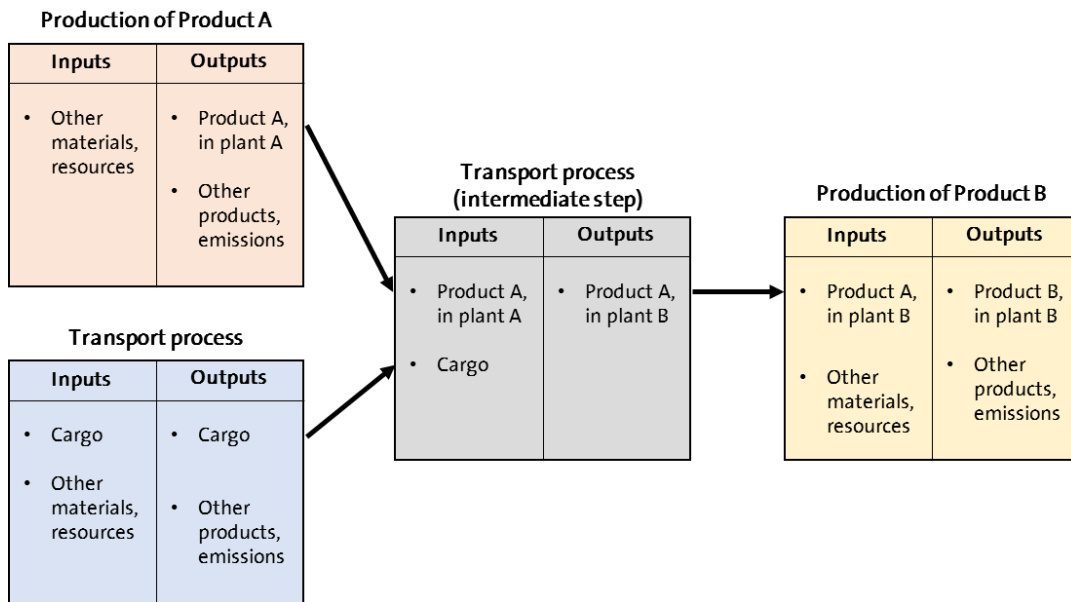


Figure 9. Option 1 suggested for transport modelling using GaBi databases in openLCA.

- **Option 2:** Creation of two auxiliary processes to relate the product with the cargo flow, and vice versa. The new process will contain the flow representing the material to be transported as input and the cargo flow as output, with equal amounts. Likewise, another process with cargo as input and the material at the final destination as output will also be needed (Figure 10).

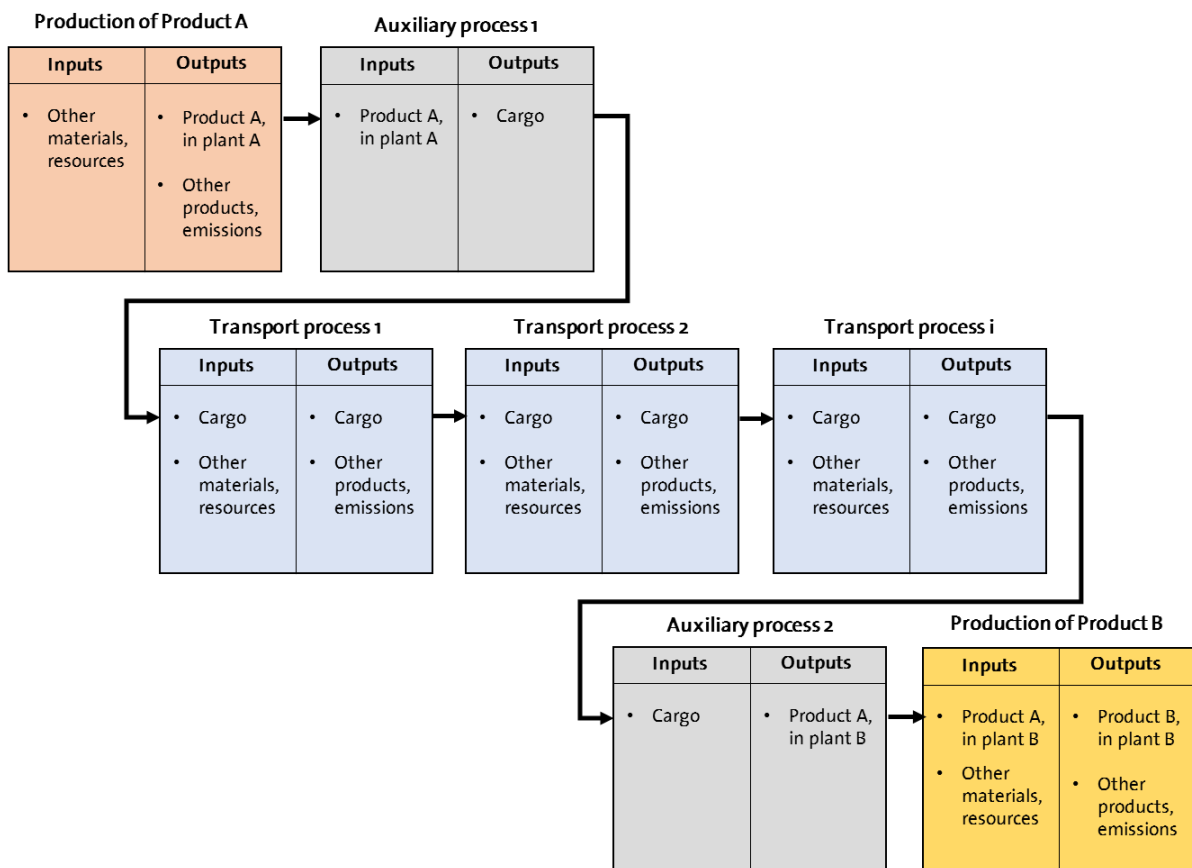


Figure 10. Option 2 suggested for transport modelling using GaBi databases in openLCA.

- **Option 3:** Include the transport in the production/use/disposal process dataset. This approach will be similar to the transport modelling followed in other databases such as ecoinvent. The cargo flow added as input in the correspondent process with amount equal to the product to be transported will have as provider the last transport process of the chain you created. Consequently, the product in the e.g. manufacturing process will not represent the “product, at plant” but “product, at destination”. This will be connected to the next process of the LCA directly. The cargo input flow of the first transport process in the chain you created will remain unconnected. You can also connect it to a “Dummy” process (i.e. no impact associated with it; it will contain only the cargo flow as output) if you want to avoid the flow to be listed in the inventory results (Figure 11).

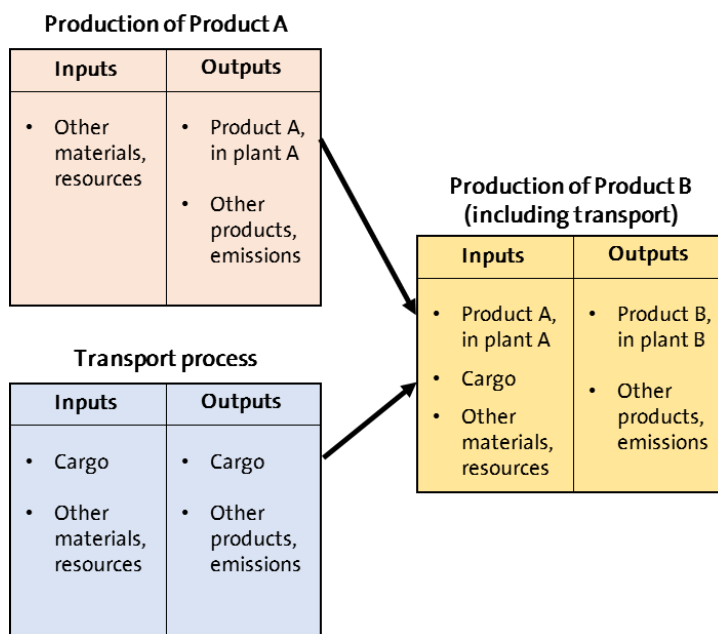


Figure 11. Option 3 suggested for transport modelling using GaBi databases in openLCA.

Note: If you use the features to create connections automatically in the product system, loops within the same transport process might be created, leading to errors in the calculation (i.e. the provider for the cargo input is the cargo output of the same process). Therefore, please check the linkages in your product system afterwards, or model the chain yourself within the model graph (e.g. right click on the process and select “Search providers/recipients for” for each flow). You can delete connections by selecting “Remove connections” within the model graph right-click menu.

2.3 Waste Modelling

In the original GaBi datasets, the wastes² generated in a process were included as positive outputs, and waste treatment processes had the waste to be treated as a positive input. In order to meet current openLCA requirements³ (i.e. there should always be an output product flow as quantitative reference in the process; processes cannot be added downstream of the reference process in the product system), some modifications were applied during the implementation of the GaBi databases in openLCA. These are:

1. Wastes not consumed as raw materials in any process of the GaBi databases (i.e. only produced): They were moved from the output to the input side of the generating process with the sign changed.
2. Wastes also consumed as raw materials in at least one process of the GaBi databases: they were kept as outputs with the same amount in the processes generating them, and as inputs in the process consuming them.
3. Wastes treated in a waste treatment process: if they were the reference flow of the dataset, they were moved to the output side of the waste treatment dataset with changed sign (i.e. negative sign) and selected as quantitative reference.

How should the wastes be connected to the correspondent waste treatment in openLCA?

- **Wastes not considered as raw material by any process** (thus, included in openLCA as negative inputs) can be connected to the waste treatment by selecting this as provider in the product system. This is the same way of modelling wastes as in the ecoinvent 3 database. As the flow has negative sign both in the process which generates it and in the waste treatment, the impacts of the treating the waste will be added to the overall result of the system. It might be possible that there is not waste treatment with reference flow equal to the waste generated in the process. However, this can be solved by creating auxiliary processes matching the waste generated with the

² In this section, “waste” refers to all non-elementary flows included in the “Production residues of the life cycle” and “Deposited goods” categories within the GaBi databases.

³ Modifications in the openLCA core are planned for future versions of the software in order to allow more flexible modelling.

correspondent waste treatment (e.g. “Sulphuric acid – Hazardous waste” could be treated by the process with “Hazardous waste (unspec.)” as reference) (Figure 12).

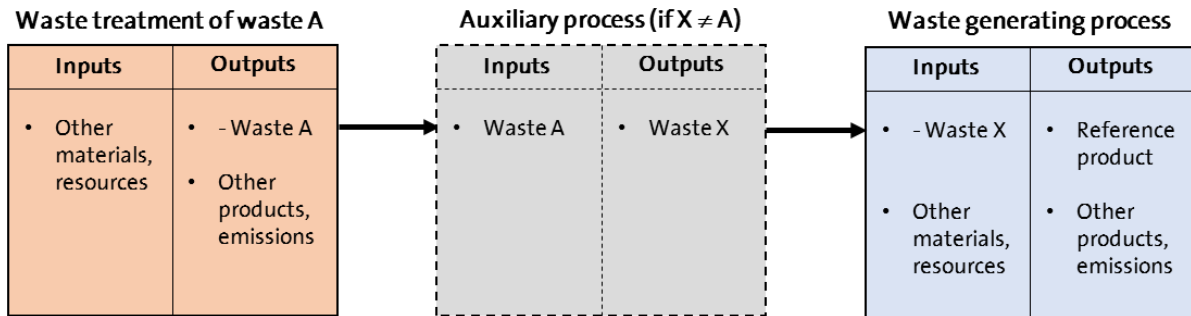


Figure 12. Connection of wastes to the correspondent waste treatment if they are not considered as valuable substance by any process using GaBi databases 2016 in openLCA.

Note: “Dummy” processes created by GreenDelta during the implementation were set as default providers of the wastes included as inputs in the processes. This intends to reduce the creation of misleading connections in the product system when selecting the available features of creating automatically the supply chains. You can change the default providers in the process datasets or create different connections in the model graph. It should be taken into account that thinkstep, provider of GaBi, considers that many of the waste flows remaining in the datasets from industry partners are there due to the lack of suitable provider within the database in the time of creating the aggregated/partially-terminated datasets.

- **Wastes which can be considered either as wastes or as by-products** (i.e. they are valuable substances for other process), can be linked to the waste treatment if necessary by selecting the check box “avoided product” in the process generating them (Figure 13). That way, the software will consider them as negative inputs, and consequently the results will be equal as in the previous case. Unfortunately, it is currently not possible to set a default provider for avoided products, so the waste treatment should be linked/checked in the model graph.

Outputs						
Flow	Category	Amount	Unit	Costs/Rev...	Uncertainty	Avoided product
Magnesium	Materials/Metals	1.00000	kg		none	
Water vapour	air/unspecified	0.00123	kg		none	
Water (waste water, untreated)	Production residues in life cycle	0.00698	kg		none	<input checked="" type="checkbox"/>

Figure 13. Selection as “avoided product” of a waste, which in some datasets is consumed as raw material, in order to link it to the correspondent waste treatment process.

How should the wastes considered as a valuable substance in other process be connected to the correspondent provider in openLCA?

You can connect the consumed waste to the desired provider in the same way as for other intermediate product of the dataset, for instance by selecting “Search providers for” in the model graph and add and connect the desired process. Please, remember to set the allocation method and factors if a multi-output process is used as provider. By default, like in the case of the wastes to be treated, the “dummy” processes created by GreenDelta have been set as providers. You can change the default provider within the process dataset, or select a different provider in the model graph of the product system.

How should the wastes be connected to a credit process (e.g. open loop recycling) in openLCA?

Original credit GaBi datasets had the structure represented in Figure 14. They were modelled this way in order to connect the output waste generated in another process to the positive input flow and account the benefits of using the scrap instead of primary metal in e.g systems with open-loop recycling.

Process: No. 1 steel - scrap credit (open loop), production mix, at plant, market averag

▼ Inputs						
Flow	Category	Amount	Unit	Costs	Uncertainty	Provider
Fe Steel plate	Materials/Metals	-1.0 * ratio	kg		none	
Fe Steel scrap	Production residu...	1.00000	kg		none	

Figure 14. Example of “Scrap credit (open loop)” process dataset In the original files from GaBi

In order to adapt these processes to openLCA’s requirements, the scrap flow was moved to the output side of the credit process with negative sign and selected as quantitative reference (Figure 15). The output waste in the producing process⁴ can be linked to the crediting process by selecting the check-box “Avoided product”. That way system expansion will be applied and the impact of the primary metal production will be subtracted in the results.

⁴ This kind of flows remain in the output side after the changes mentioned at the beginning of this section as they are consumed as raw materials by other processes of the database.

Process: No. 1 steel - scrap credit (open loop), production mix, at plant, market average

▼ Inputs							
Flow	Category	Amount	Unit	Costs	Uncertainty	Provider	Ped
Fe Steel plate	Materials/Metals	-1.0 * ratio	kg		none		

▼ Outputs							
Flow	Category	Amount	Unit	Costs/Rev...	Uncertainty	Avoided ...	Ped
Fe Steel scrap	Production residu...	-1.00000	kg		none		

Figure 15. Example of “Scrap credit (open loop)” process dataset In the openLCA version of the GaBi databases

2.4 EPD Datasets

In the XIV extension and the Professional database, there are datasets following the standard EN15804 for Environmental Product Declarations (EPDs) of the construction sector. C Modules represent the end of life phase of the LCA, whereas module D “includes any declared benefits and loads from net flows leaving the product system that have not been allocated as co-products and that have passed the end-of-waste state in the form of reuse, recovery and/or recycling potentials”. In general, C1 to C3 datasets contain the same flow as input and output in the GaBi datasets, allowing the connection of the different modules one after the other. However, modules C4 and D⁵ have originally in GaBi only the input product flow, and no output apart from the elementary flows or wastes generated within the process. As a reference output product is currently needed in openLCA, and we wanted to maintain the possibility of linking the modules with the previous ones, a new “dummy” flow representing each EPD dataset with no reference output was added.

It should be taken into account that openLCA offers also the [EPD Editor](#) for calculating EPD results according to the EN 15804 standard.

⁵ Datasets referring to other EPD modules (e.g. C3) follow for some materials also the same structure as C4, D modules. For them, the same approach was followed as for C4 and D modules during the implementation in openLCA.

3 Feedback & Contact

If you have other questions not addressed by this report, need further clarifications on any of the points commented, or have comments about the GaBi databases in openLCA, please contact us:

Tel. +49 30 48 496 – 030

Fax +49 30 48 496 – 991

gd@greendelta.com

GreenDelta GmbH

Müllerstrasse 135

D-13357 Berlin, Germany

www.greendelta.com

GreenDELTA