GaBi 2021.2 databases in openLCA

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Content

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1 GaBi databases

This document aims to guide the use of GaBi 2021.2 databases in openLCA. These databases have been released/developed by Sphera in 2021[1], and they were adapted to openLCA software. Therefore, all the modifications made in these databases in order to be compatible with openLCA are also explained. The list of GaBi 2021.2 databases available in Nexus website[2] to be used in openLCA (as zolca file) is available hereunder:

- Professional database 2021.2
- Lean database 2021.2
- Indian database 2021.2
- Extension database XXII_ carbon composites 2021.2
- Extension database XXI_ India 2021.2
- Extension database XX_ food & feed 2021.2
- Extension database XVIII_ NREL USLCI integrated 2021.2
- Extension database XVII_ full US 2021.2
- Extension database XVI_ seat covers 2021.2
- Extension database XV_ textile finishing 2021.2
- Extension database XIX_ bioplastics 2021.2
- Extension database XIV_ construction materials 2021.2
- Extension database XII_ renewable materials 2021.2
- Extension database XI_ electronics 2021.2
- Extension database X_ machining processes 2021.2
- Extension database VIII_ coating 2021.2
- Extension database VII_ plastics 2021.2
- Extension database VI_ precious metals 2021.2
- Extension database V_ nonferrous metals 2021.2
- Extension Database IXb_ end of life parameterised models 2021.2
- Extension database IXa_ end of life 2021.2
- Extension database IV_ aluminium 2021.2
- Extension database III_ iron and steel 2021.2
- Extension database II_ energy 2021.2
- Extension database Ib_ inorganic intermediates 2021.2
- Extension database Ia_ organic intermediates 2021.2
- Extension database XIII_ ecoinvent integrated v3.7.1 2021.2

2 GaBi databases in openLCA

GaBi databases are created with the LCA software GaBi [3]. 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 manually creates the connections in the supply chains in the model graph; automatic connections are not feasible. That is one reason why most of the GaBi databases datasets 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.

Due to all the abovementioned conditions, it is strongly recommended to create the product systems only linking the default providers for GaBi databases in openLCA, or to uncheck the “auto-link processes” box. Therefore, when creating new product systems, please remember to select the “Only link default providers” option in the product system wizard (Figure 1) for provider listing. In the case of selecting the “prefer default providers” option in the product system wizard for provider listing, please check the model graphs to eliminate the unwanted providers to avoid miscalculations in the impact assessment. GaBi processes cannot be calculated through the “Direct Calculation” option in openLCA.

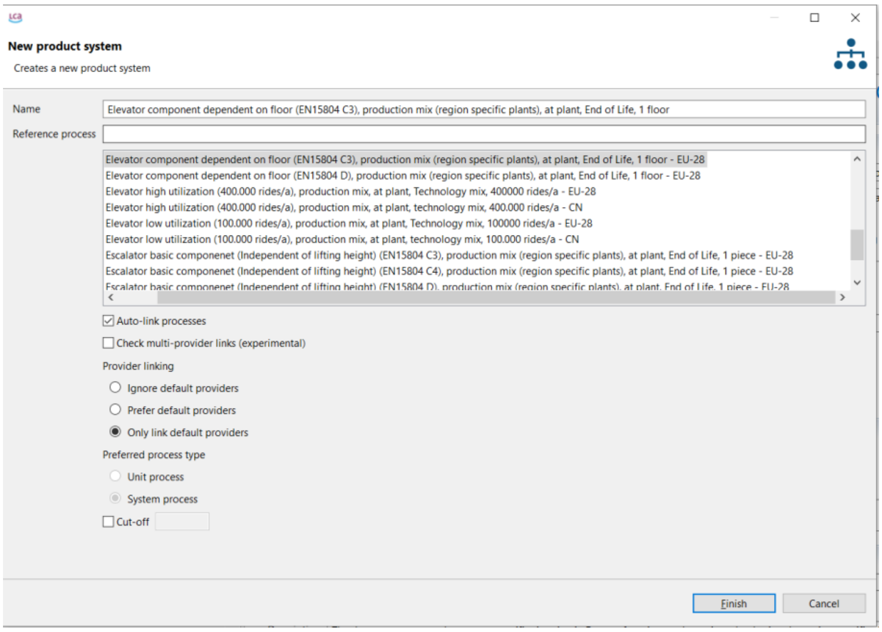


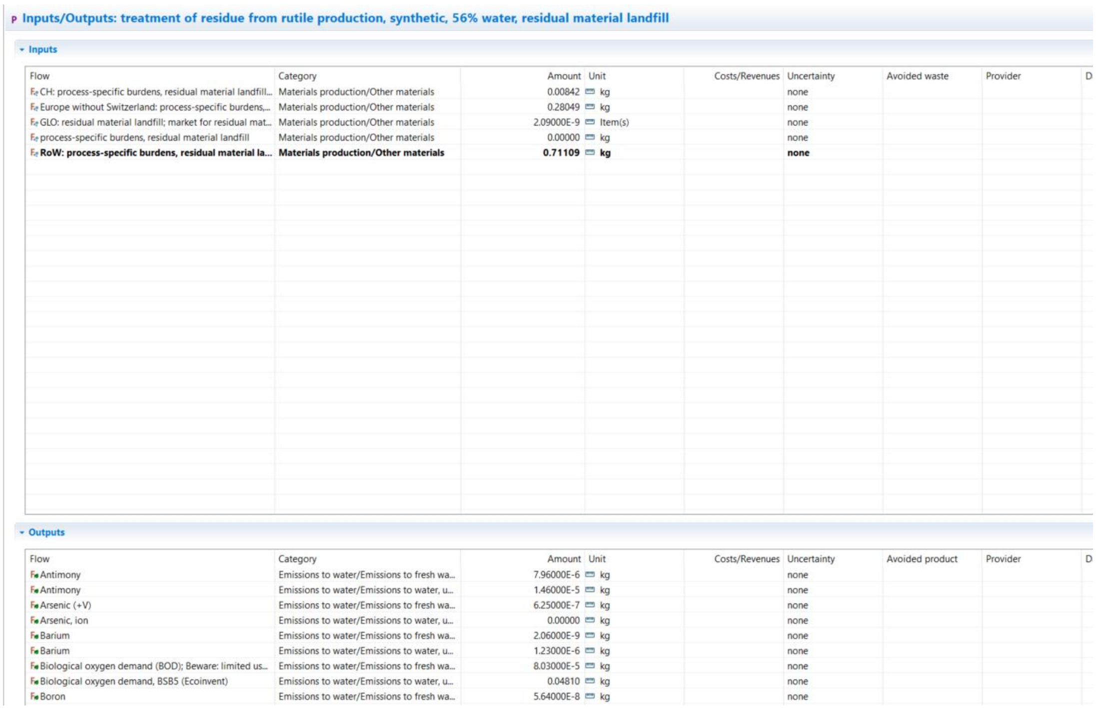
Figure 1: Wizard for creating a product system in openLCA.

For some processes, even selecting “Only link default providers”, openLCA will not finalise the product system creation, or the calculations will fail. These issues happen mainly for the following reasons:

(1) There are some processes in GaBi 2021.2 databases with no inputs/outputs, just parameters.
(2) For some processes, the reference flows are not defined according to openLCA requirements.

In openLCA, product flows on the input side are considered input materials, while on the output side, they are considered a product, by product, and/or avoided product. On the other hand, the waste flows on the output side are considered wastes, which should be connected to waste treatment processes. On the input side, waste flows are raw materials for treatment processes, and they cannot be linked to providers. Therefore, for openLCA calculations, reference flows can be either product flows on the output side or waste flows on the input side. If the reference flows do not respect these conditions, the process cannot be calculated by openLCA.

Appendix 1 summarises the number of processes that cannot be directly calculated due to the abovementioned reasons; one example for each case is given. For this reason, the user should modify the process, selecting the reference flow, in order to allow the calculations. For example, the process “treatment of residue from rutile production, synthetic, 56% water, residual material landfill” (Figure 2) would need to be modified regarding its reference flow.



Inputs/Outputs: treatment of residue from rutile production, synthetic, 56% water, residual material landfill

Inputs

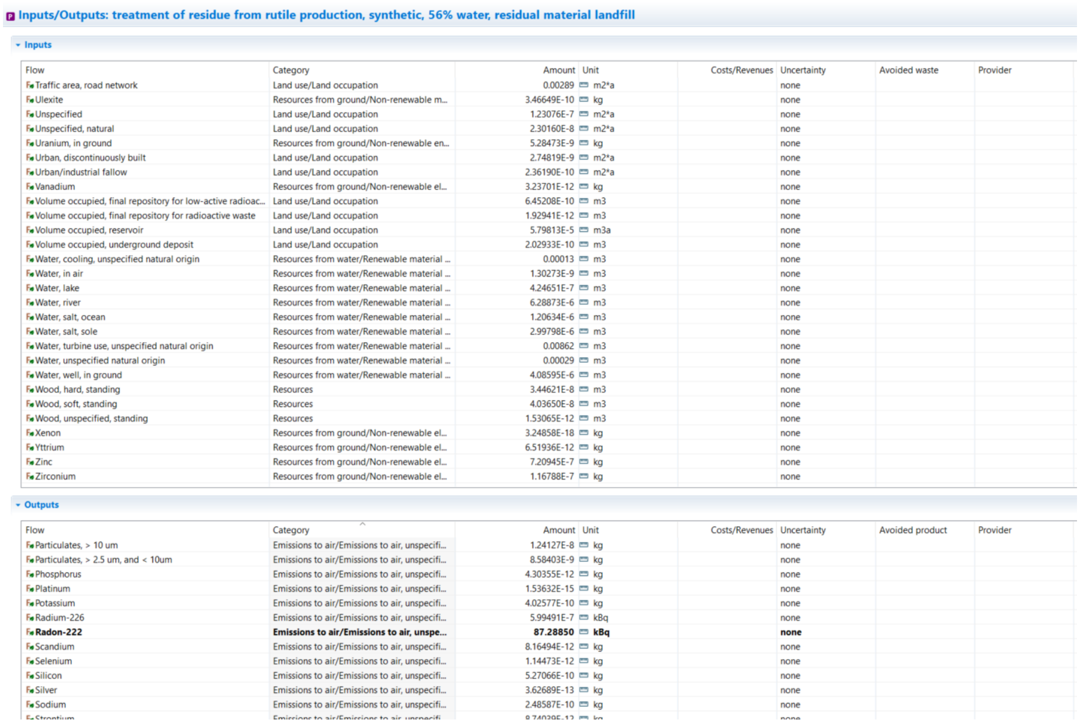
Flow	Category	Amount	Unit	Costs/Revenues	Uncertainty	Avoided waste	Provider	D
CH: process-specific burdens, residual material landfill...	Materials production/Other materials	0.00842	kg		none			
Europe without Switzerland: process-specific burdens,...	Materials production/Other materials	0.28049	kg		none			
GLO: residual material landfill; market for residual mat...	Materials production/Other materials	2.09000E-9	Item(s)		none			
process-specific burdens, residual material landfill	Materials production/Other materials	0.00000	kg		none			
RoW: process-specific burdens, residual material la...	**Materials production/Other materials**	**0.71109**	**kg**		**none**			

Outputs

Flow	Category	Amount	Unit	Costs/Revenues	Uncertainty	Avoided product	Provider	D
Antimony	Emissions to water/Emissions to fresh wa...	7.96000E-6	kg		none			
Antimony	Emissions to water/Emissions to water, u...	1.46000E-5	kg		none			
Arsenic (+V)	Emissions to water/Emissions to fresh wa...	6.25000E-7	kg		none			
Arsenic, ion	Emissions to water/Emissions to water, u...	0.00000	kg		none			
Barium	Emissions to water/Emissions to fresh wa...	2.06000E-9	kg		none			
Barium	Emissions to water/Emissions to water, u...	1.23000E-6	kg		none			
Biological oxygen demand (BOD); Beware: limited us...	Emissions to water/Emissions to fresh wa...	8.03000E-5	kg		none			
Biological oxygen demand, BSB5 (Ecoinvent)	Emissions to water/Emissions to water, u...	0.04810	kg		none			
Boron	Emissions to water/Emissions to fresh wa...	5.64000E-8	kg		none			

Figure 2: Example of a process that the reference flow (product flow, as an input) should be modified by the user.

Figure 3 displays another example of process that the reference flow should be modified by the user, as the reference flow is an elementary flow.



Inputs/Outputs: treatment of residue from rutile production, synthetic, 56% water, residual material landfill

Inputs

Flow	Category	Amount	Unit	Costs/Revenues	Uncertainty	Avoided waste	Provider
Traffic area, road network	Land use/Land occupation	0.00289	m2*a		none		
Ulexite	Resources from ground/Non-renewable m...	3.46649E-10	kg		none		
Unspecified	Land use/Land occupation	1.23076E-7	m2*a		none		
Unspecified, natural	Land use/Land occupation	2.30160E-8	m2*a		none		
Uranium, in ground	Resources from ground/Non-renewable en...	5.28473E-9	kg		none		
Urban, discontinuously built	Land use/Land occupation	2.74819E-9	m2*a		none		
Urban/industrial fallow	Land use/Land occupation	2.36190E-10	m2*a		none		
Vanadium	Resources from ground/Non-renewable el...	3.23701E-12	kg		none		
Volume occupied, final repository for low-active radioac...	Land use/Land occupation	6.45208E-10	m3		none		
Volume occupied, final repository for radioactive waste	Land use/Land occupation	1.92941E-12	m3		none		
Volume occupied, reservoir	Land use/Land occupation	5.79813E-5	m3a		none		
Volume occupied, underground deposit	Land use/Land occupation	2.02933E-10	m3		none		
Water, cooling, unspecified natural origin	Resources from water/Renewable material ...	0.00013	m3		none		
Water, in air	Resources from water/Renewable material ...	1.30273E-9	m3		none		
Water, lake	Resources from water/Renewable material ...	4.24651E-7	m3		none		
Water, river	Resources from water/Renewable material ...	6.28873E-6	m3		none		
Water, salt, ocean	Resources from water/Renewable material ...	1.20634E-6	m3		none		
Water, salt, sole	Resources from water/Renewable material ...	2.99798E-6	m3		none		
Water, turbine use, unspecified natural origin	Resources from water/Renewable material ...	0.00862	m3		none		
Water, unspecified natural origin	Resources from water/Renewable material ...	0.00029	m3		none		
Water, well, in ground	Resources from water/Renewable material ...	4.08595E-6	m3		none		
Wood, hard, standing	Resources	3.44621E-8	m3		none		
Wood, soft, standing	Resources	4.03650E-8	m3		none		
Wood, unspecified, standing	Resources	1.53065E-12	m3		none		
Xenon	Resources from ground/Non-renewable el...	3.24858E-18	kg		none		
Yttrium	Resources from ground/Non-renewable el...	6.51936E-12	kg		none		
Zinc	Resources from ground/Non-renewable el...	7.20945E-7	kg		none		
Zirconium	Resources from ground/Non-renewable el...	1.16788E-7	kg		none		

Outputs

Flow	Category	Amount	Unit	Costs/Revenues	Uncertainty	Avoided product	Provider
Particulates, > 10 um	Emissions to air/Emissions to air, unspecifi...	1.24127E-8	kg		none		
Particulates, > 2.5 um, and < 10um	Emissions to air/Emissions to air, unspecifi...	8.58403E-9	kg		none		
Phosphorus	Emissions to air/Emissions to air, unspecifi...	4.30355E-12	kg		none		
Platinum	Emissions to air/Emissions to air, unspecifi...	1.53632E-15	kg		none		
Potassium	Emissions to air/Emissions to air, unspecifi...	4.02577E-10	kg		none		
Radium-226	Emissions to air/Emissions to air, unspecifi...	5.99491E-7	kBq		none		
Radon-222	**Emissions to air/Emissions to air, unspe...**	**87.28850**	**kBq**		**none**		
Scandium	Emissions to air/Emissions to air, unspecifi...	8.16494E-12	kg		none		
Selenium	Emissions to air/Emissions to air, unspecifi...	1.14473E-12	kg		none		
Silicon	Emissions to air/Emissions to air, unspecifi...	5.27066E-10	kg		none		
Silver	Emissions to air/Emissions to air, unspecifi...	3.62689E-13	kg		none		
Sodium	Emissions to air/Emissions to air, unspecifi...	2.48587E-10	kg		none		

Figure 3: Example of a process that the reference flow (elementary flow, as an output) should be modified by the user.

Considering the example in Figure 4, the selected reference flow is a product flow on the input side. To solve this issue, as the flow name refers to waste, this product flow could be replaced by a waste flow, or a new reference flow (product flow) should be added to the output side.

Inputs/Outputs: Inert matter (Construction waste) on landfill, production mix (region specific sites), at landfill site, landfill including leachate treatment and without pre-treatment, landfill for construction waste

Inputs

Flow	Category	Amount	Unit	Costs/Revenues	Uncertainty	Avoided waste	Provider
River water, regionalized, LV	Resources from water/Renewable ma...	6.14408E-8	kg		none		
River water, regionalized, MK	Resources from water/Renewable ma...	2.00636E-7	kg		none		
River water, regionalized, MX	Resources from water/Renewable ma...	9.46854E-5	kg		none		
River water, regionalized, MY	Resources from water/Renewable ma...	6.70200E-5	kg		none		
River water, regionalized, NG	Resources from water/Renewable ma...	0.00018	kg		none		
River water, regionalized, NL	Resources from water/Renewable ma...	0.00023	kg		none		
River water, regionalized, NO	Resources from water/Renewable ma...	1.08060E-5	kg		none		
River water, regionalized, NZ	Resources from water/Renewable ma...	5.70578E-7	kg		none		
River water, regionalized, PH	Resources from water/Renewable ma...	3.53318E-15	kg		none		
River water, regionalized, PL	Resources from water/Renewable ma...	0.00030	kg		none		
River water, regionalized, PT	Resources from water/Renewable ma...	9.52194E-6	kg		none		
River water, regionalized, RO	Resources from water/Renewable ma...	1.09704E-5	kg		none		
River water, regionalized, RS	Resources from water/Renewable ma...	2.30510E-6	kg		none		
River water, regionalized, RU	Resources from water/Renewable ma...	0.00163	kg		none		
River water, regionalized, SE	Resources from water/Renewable ma...	0.00111	kg		none		
River water, regionalized, SG	Resources from water/Renewable ma...	3.18569E-8	kg		none		
River water, regionalized, SI	Resources from water/Renewable ma...	1.02635E-5	kg		none		
River water, regionalized, SK	Resources from water/Renewable ma...	1.28269E-5	kg		none		
River water, regionalized, TH	Resources from water/Renewable ma...	7.83251E-8	kg		none		
River water, regionalized, TR	Resources from water/Renewable ma...	1.22314E-5	kg		none		
River water, regionalized, UA	Resources from water/Renewable ma...	1.89879E-5	kg		none		
River water, regionalized, US	Resources from water/Renewable ma...	0.00011	kg		none		
River water, regionalized, VE	Resources from water/Renewable ma...	8.56919E-5	kg		none		
River water, regionalized, VN	Resources from water/Renewable ma...	7.96473E-9	kg		none		
River water, regionalized, ZA	Resources from water/Renewable ma...	1.20707E-5	kg		none		
Sea water	Resources from water/Renewable ma...	0.00535	kg		none		
Waste (unspecified)	**Wastes/Post consumer waste**	**1.00000**	**kg**		**none**		

Outputs

Flow	Category	Amount	Unit	Costs/Revenues	Uncertainty	Avoided product	Provider
1,2,3-Trimethylbenzene	Emissions to air/Emissions to air, unsp...	1.33497E-25	kg		none		
1,2-Dibromoethane	Emissions to air/Emissions to air, unsp...	1.68172E-25	kg		none		
1,2-Dibromoethane	Emissions to water/Emissions to fresh...	-5.52404E-24	kg		none		
1,3,5-Trimethylbenzene	Emissions to air/Emissions to air, unsp...	3.22621E-15	kg		none		
1-Butanol	Emissions to air/Emissions to air, unsp...	5.48203E-26	kg		none		
1-Butanol	Emissions to water/Emissions to fresh...	6.81069E-22	kg		none		
1-Butylene (Vinylacetylene)	Emissions to air/Emissions to air, unsp...	1.86540E-13	kg		none		
1-Methoxy-2-propanol	Emissions to air/Emissions to air, unsp...	3.76106E-13	kg		none		
1-Pentanol	Emissions to air/Emissions to air, unsp...	5.81825E-27	kg		none		

Figure 4: Example of a process that the reference flow (product flow, as an input) should be modified by the user.

In addition, the user is responsible for selecting the providers, connecting that flow to the supply chain. If no provider is available or if the available providers do not correspond to the modelling requirements, then the user should create its supply chain.

Besides the highlighted issues regarding the reference flows, which should be modified according to the user requirements, some modifications were needed to prepare GaBi databases to openLCA. GaBi databases contain some functions not available in openLCA, but that work in GaBi software (to see all GaBi functions, please check GaBi manual[4]). One of the most common cases is the use of the function "F_Q_Convert", which converts the amount of one specific flow from a starting size to a target size, as observed in Figure 5 for the calculation of the dependent parameter "diesel_tot" (highlighted in green).

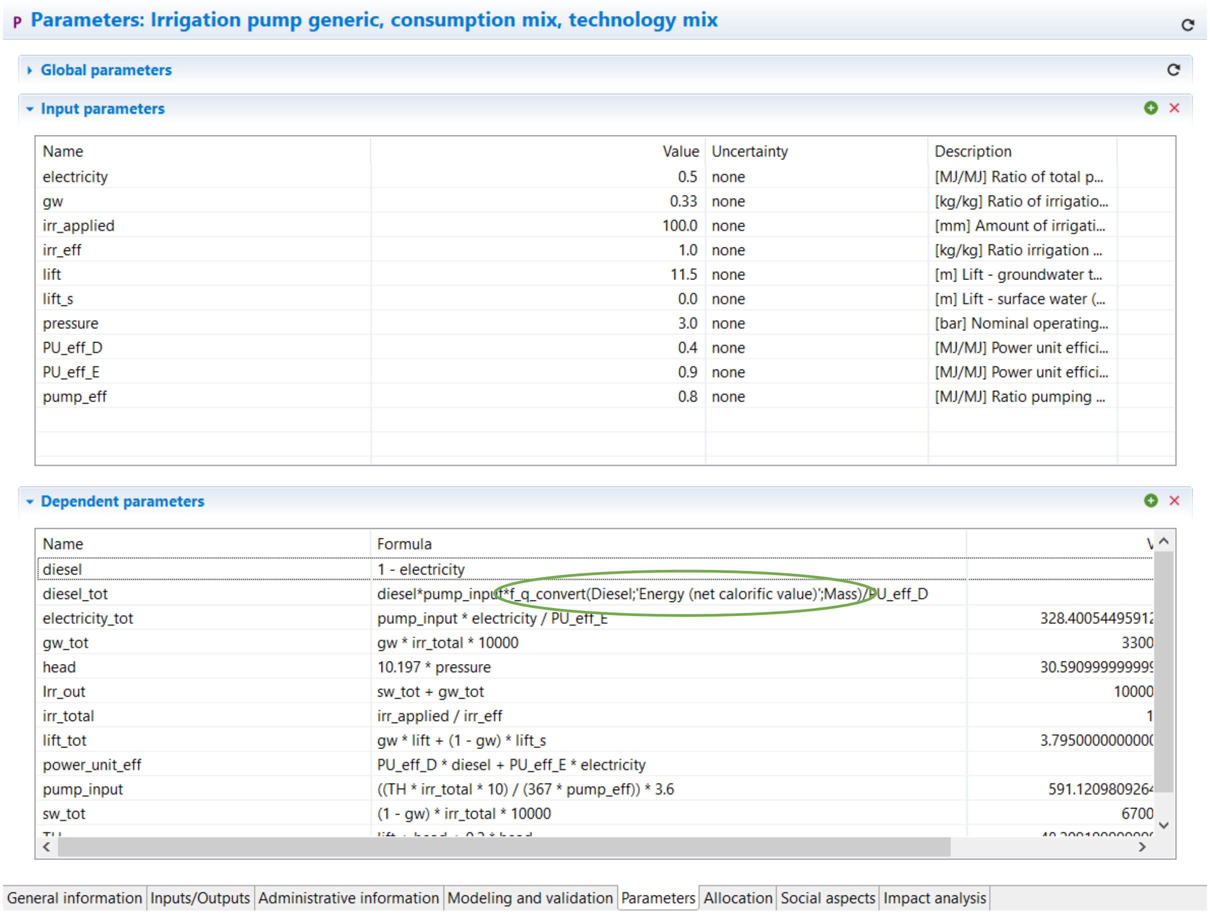


Figure 5: Example of a process originally containing functions not supported by openLCA

To solve this issue, for all the dependent parameters that the function “F_Q_Convert” was applied, the information contained in the Flow property section of openLCA for that specific flow (Figure 6) was applied to replace the use of the function (Figure 7).

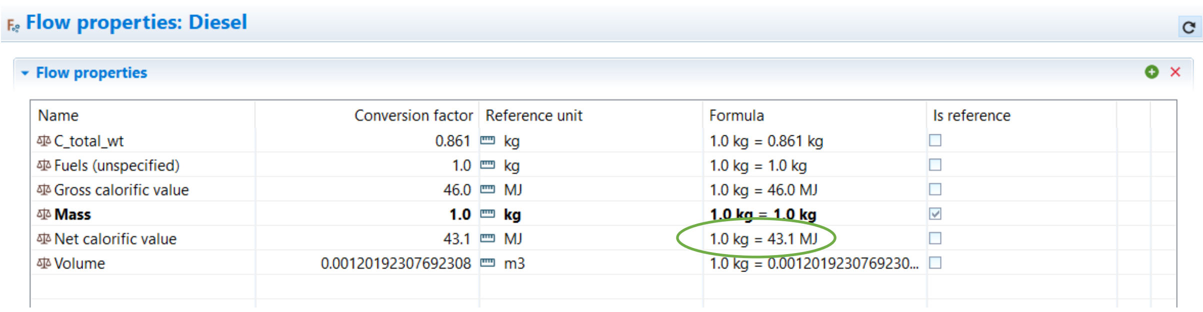
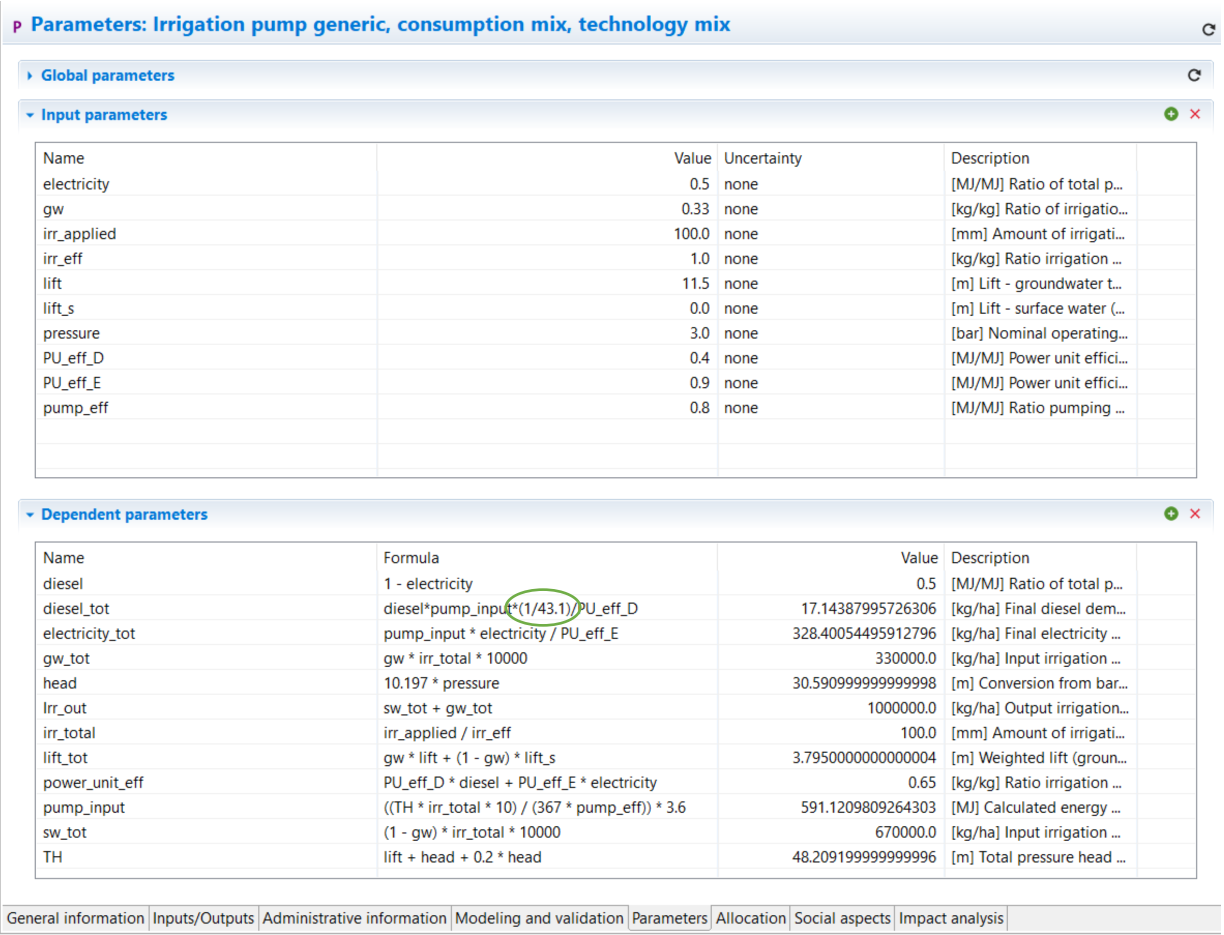


Figure 6: Diesel Flow properties considered to replace the use of the “F_Q_Convert” function



Parameters: Irrigation pump generic, consumption mix, technology mix

Global parameters

Input parameters

Name	Value	Uncertainty	Description
electricity	0.5	none	[MJ/MJ] Ratio of total p...
gw	0.33	none	[kg/kg] Ratio of irrigatio...
irr_applied	100.0	none	[mm] Amount of irrigati...
irr_eff	1.0	none	[kg/kg] Ratio irrigation ...
lift	11.5	none	[m] Lift - groundwater t...
lift_s	0.0	none	[m] Lift - surface water (...
pressure	3.0	none	[bar] Nominal operating...
PU_eff_D	0.4	none	[MJ/MJ] Power unit effici...
PU_eff_E	0.9	none	[MJ/MJ] Power unit effici...
pump_eff	0.8	none	[MJ/MJ] Ratio pumping ...

Dependent parameters

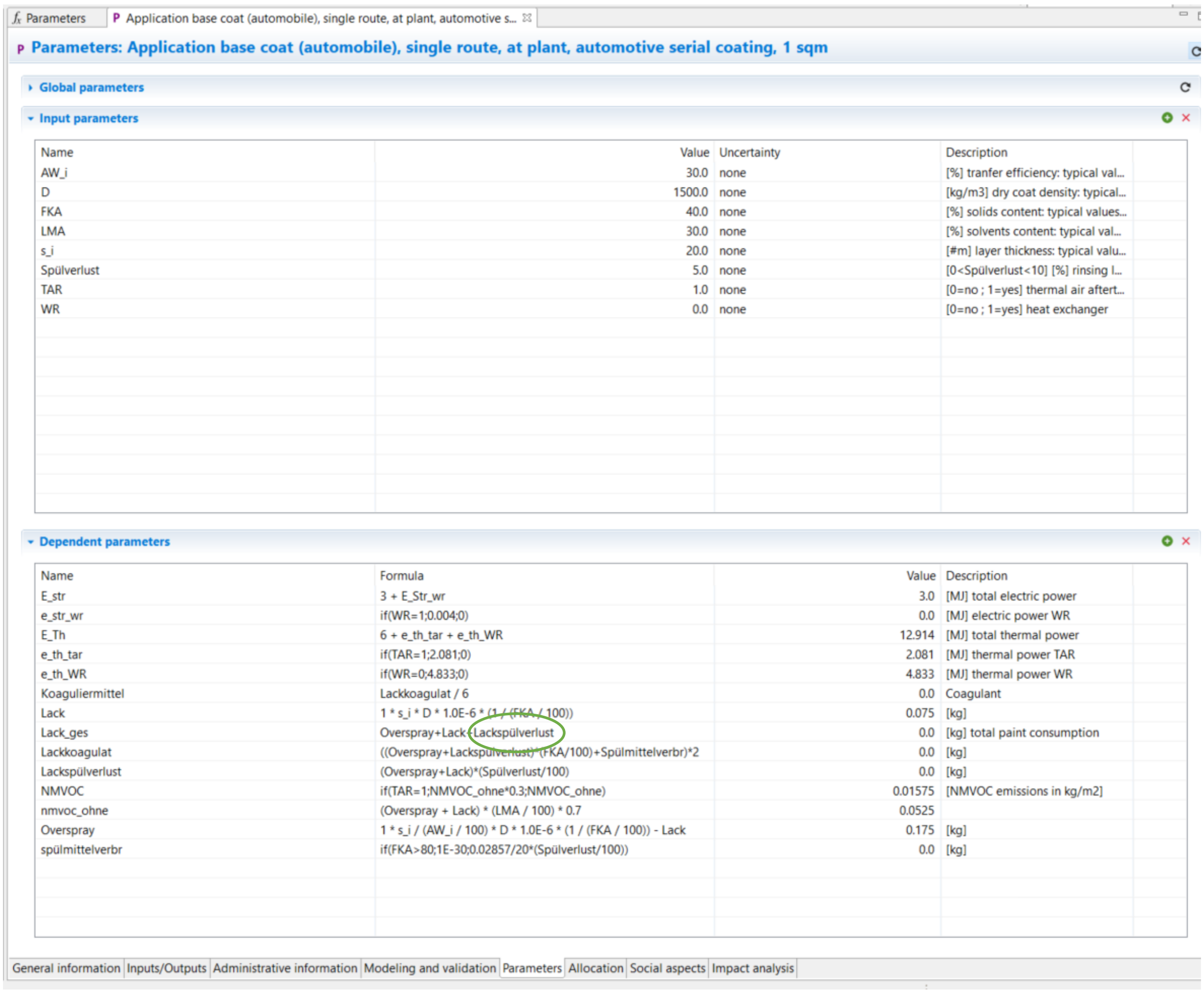
Name	Formula	Value	Description
diesel	1 - electricity	0.5	[MJ/MJ] Ratio of total p...
diesel_tot	diesel*pump_input*(1/43.1)/PU_eff_D	17.14387995726306	[kg/ha] Final diesel dem...
electricity_tot	pump_input * electricity / PU_eff_E	328.40054495912796	[kg/ha] Final electricity ...
gw_tot	gw * irr_total * 10000	330000.0	[kg/ha] Input irrigation ...
head	10.197 * pressure	30.590999999999998	[m] Conversion from bar...
Irr_out	sw_tot + gw_tot	1000000.0	[kg/ha] Output irrigation...
irr_total	irr_applied / irr_eff	100.0	[mm] Amount of irrigati...
lift_tot	gw * lift + (1 - gw) * lift_s	3.7950000000000004	[m] Weighted lift (groun...
power_unit_eff	PU_eff_D * diesel + PU_eff_E * electricity	0.65	[kg/kg] Ratio irrigation ...
pump_input	((TH * irr_total * 10) / (367 * pump_eff)) * 3.6	591.1209809264303	[MJ] Calculated energy ...
sw_tot	(1 - gw) * irr_total * 10000	670000.0	[kg/ha] Input irrigation ...
TH	lift + head + 0.2 * head	48.209199999999996	[m] Total pressure head ...

General information | Inputs/Outputs | Administrative information | Modeling and validation | Parameters | Allocation | Social aspects | Impact analysis

Figure 7: Example of a process that the Function “F_Q_Convert” was replaced by numbers, according to the Flow Properties

In Appendix 2, the original inputs of the “F_Q_Convert” function are available. The selected numbers applied to replace this function for each parameter in each process (and its respective database) are also available. Other functions were not replaced, as it was not identified a problem in calculating the parameters when these other functions were applied.

However, some parameters in databases “ Extension database X_ machining processes 2021.2” and “Extension database VIII_ coating 2021.2” contain the characters “ä”,”ö”, and “ü” (Figure 8). In the current openLCA version (1.10.3), these letters can not be applied in formulas. Hence, they were replaced by “ae”, “oe”, and “ue”, respectively.



Parameters | Application base coat (automobile), single route, at plant, automotive s...

Parameters: Application base coat (automobile), single route, at plant, automotive serial coating, 1 sqm

Global parameters

Input parameters

Name	Value	Uncertainty	Description
AW_i	30.0	none	[%] tranfer efficiency: typical val...
D	1500.0	none	[kg/m3] dry coat density: typical...
FKA	40.0	none	[%] solids content: typical values...
LMA	30.0	none	[%] solvents content: typical val...
s_i	20.0	none	[#m] layer thickness: typical valu...
Spülverlust	5.0	none	[0<Spülverlust<10] [%] rinsing l...
TAR	1.0	none	[0=no ; 1=yes] thermal air aftert...
WR	0.0	none	[0=no ; 1=yes] heat exchanger

Dependent parameters

Name	Formula	Value	Description
E_str	3 + E_Str_wr	3.0	[MJ] total electric power
e_str_wr	if(WR=1;0.004;0)	0.0	[MJ] electric power WR
E_Th	6 + e_th_tar + e_th_WR	12.914	[MJ] total thermal power
e_th_tar	if(TAR=1;2.081;0)	2.081	[MJ] thermal power TAR
e_th_WR	if(WR=0;4.833;0)	4.833	[MJ] thermal power WR
Koaguliermittel	Lackkoagulat / 6	0.0	Coagulant
Lack	1 * s_i * D * 1.0E-6 * (1 / (FKA / 100))	0.075	[kg]
Lack_ges	Overspray+Lack+Lackspülverlust	0.0	[kg] total paint consumption
Lackkoagulat	((Overspray+Lackspülverlust)*(FKA/100)+Spülmittelverbr)*2	0.0	[kg]
Lackspülverlust	(Overspray+Lack)*(Spülverlust/100)	0.0	[kg]
NMVOC	if(TAR=1;NMVOC_ohne*0.3;NMVOC_ohne)	0.01575	[NMVOC emissions in kg/m2]
nmvoc_ohne	(Overspray + Lack) * (LMA / 100) * 0.7	0.0525	
Overspray	1 * s_i / (AW_i / 100) * D * 1.0E-6 * (1 / (FKA / 100)) - Lack	0.175	[kg]
spülmittelverbr	if(FKA>80;1E-30;0.02857/20*(Spülverlust/100))	0.0	[kg]

General information | Inputs/Outputs | Administrative information | Modeling and validation | Parameters | Allocation | Social aspects | Impact analysis

Figure 8: Example of parameters with “ä”,”ö”,”ü”.

Most GaBi databases also contain Data Quality information (on a process level) and this information was also implemented in GaBi databases for openLCA. For some processes in these databases, more than one type of data quality is available (e.g., from an internal and external review). However, openLCA structure only allows the implementation of one data quality entry on a process level. For that reason, for processes containing more than one data quality, an average of the data quality for each indicator was performed. In case one of the reviews has a data quality for one indicator that is not available for the other, then an average was not calculated, and the value assigned by the only reviewer that analysed that indicator/score is selected.

For the databases “Extension database XXII_ carbon composites 2021.2” and “Extension+database+XIII_+ecoinvent+integrated+v3.7.1+2021.2”, the data quality is not available, and, for this reason, it is also not possible to find the data quality of the processes within these databases in openLCA.

3 Database combination

Inventory: Since the nomenclature of the elementary flows in GaBi databases is different from other LCI databases, it should not be combined with other databases from nexus.openLCA.org.

Impact Assessment: The method package for GaBi methods is available separately on nexus.openLCa.org, containing a set of LCIA methods that fit the elementary flows in the database.

Data quality systems: ILCD Data Quality System implemented.

4 References

(1) Sphera. GaBi LCA databases https://gabi.sphera.com/databases/gabi-databases/ (accessed Aug 26, 2021).

(2) GreenDelta GmbH. openLCA Nexus https://nexus.openlca.org/databases (accessed Aug 26, 2021).

(3) Sphera. GaBi Solutions https://gabi.sphera.com/deutsch/index/ (accessed Aug 26, 2021).

(4) Sphera. GaBi Manual https://gabi.sphera.com/fileadmin/GaBi_Manual/GaBi_6_manual.pdf (accessed Sep 1, 2021).

5 Feedback & Contact

If you have other questions not addressed by this document, or should you need further clarifications on any of the points commented, then please contact us:

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