GreenDelta

sustainability consulting + software

Addressing data quality challenges for Open Source LCA software developers

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Dr. Andreas Ciroth

GreenDelta GmbH

Content

- “open source LCA” = openLCA
- Data quality: some notes
- How data quality is addressed in openLCA
- Outlook


“open source LCA” = openLCA

“open source LCA” = openLCA
(for this presentation)

- openLCA: powerful, versatile, free and open source LCA and sustainability assessment software, developed by GreenDelta since 2007
- www.openLCA.org
- Most users worldwide of all LCA software systems (we think..), growing
- But of course:
  - “SimaPro is the leading LCA software solution” (https://simapro.com/about/)
  - “GaBi ist die meist verwendete Nachhaltigkeitssoftware für die Ökobilanzierung von Produkten“ (http://www.gabi-software.com/deutsch/software/gabi-software/)

Data quality

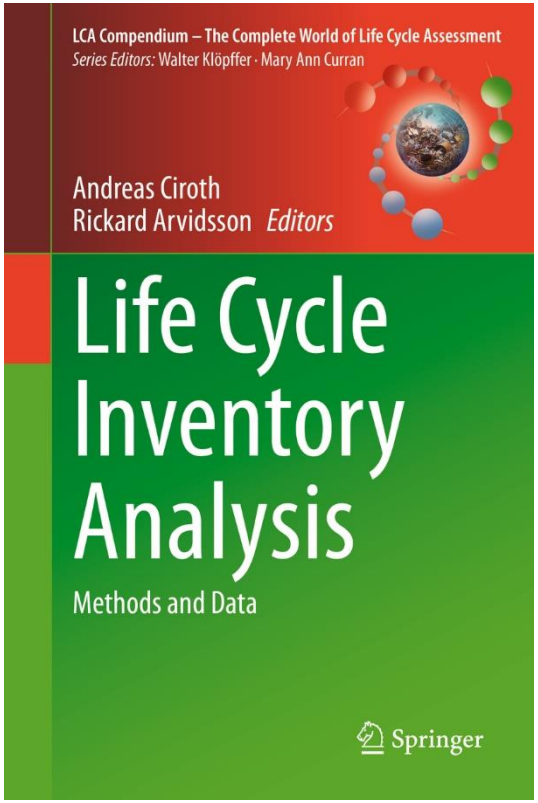
Data quality
(some notes)

- ISO 14040: fit for purpose
- For datasets, two faces:
  - When creating the dataset
  - When using the dataset

(→ Janus face)

Ciroth, A.: Data Quality, ch. 5 in Life Cycle Inventory Analysis, Ciroth / Arvidsson (edts.), Springer, 2021

(data quality, some more details)



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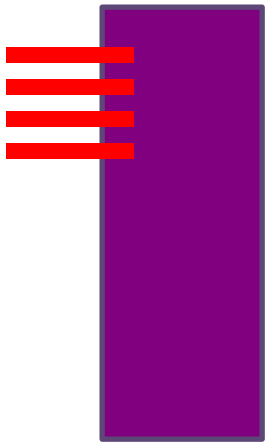
Data quality indicators from the database are not the full picture

- Different application cases (different location, reference year, carbon accounting method, ...)
- Inter-dataset inconsistency cannot be documented per dataset
- E.g., ecoinvent: tyre wear emissions not provided for some street transport processes

Where is data quality measured and documented?

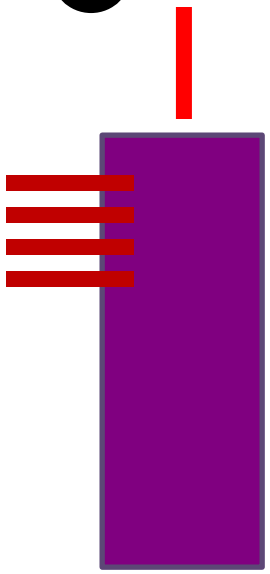
1. All the exchanges of a unit process → ecoinvent



a unit process dataset

Where is data quality measured and documented?

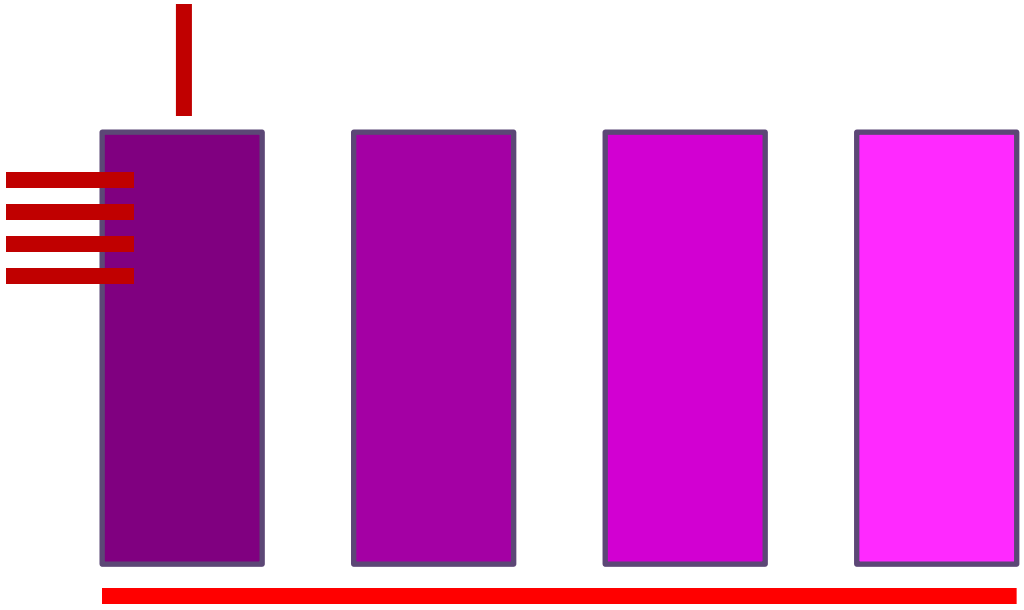
❷ A process dataset, meta data → US EPA



a unit process dataset

Where is data quality measured and documented?

❸ A process dataset against other process datasets (→ UN GLAD; underdeveloped)



unit process datasets

E.g., ecoinvent: tyre wear emissions not provided for some street transport processes

- Provided

REF_ID	PNAME	FNAME	IS_INPUT	RESULTING_A	NAME
787cc269-d2	transport, freight, light commercial vehicle, EURO1 | transport, freight, light commercial vehicle, EURO1 |	tyre wear emissions, lorry	0	0.00012	kg
01ed5770-6e	transport, freight, light commercial vehicle, EURO2 | transport, freight, light commercial vehicle, EURO2 |	tyre wear emissions, lorry	0	0.00012	kg
05610e24-bd	transport, freight, light commercial vehicle, unregulated | transport, freight, light commercial vehicle, un	tyre wear emissions, lorry	0	0.00012	kg
5f2a6b26-e6	transport, freight, lorry >32 metric ton, EURO1 | transport, freight, lorry >32 metric ton, EURO1 | APOS, U	tyre wear emissions, lorry	0	0.00015	kg
701e35e4-cf	transport, freight, lorry >32 metric ton, EURO2 | transport, freight, lorry >32 metric ton, EURO2 | APOS, U	tyre wear emissions, lorry	0	0.00015	kg
ce6e018b-7e	transport, freight, lorry >32 metric ton, EURO3 | transport, freight, lorry >32 metric ton, EURO3 | APOS, U	tyre wear emissions, lorry	0	0.00017	kg
e1221084-74	transport, freight, lorry >32 metric ton, EURO3 | transport, freight, lorry >32 metric ton, EURO3 | APOS, U	tyre wear emissions, lorry	0	0.00017	kg
75d202a1-36	transport, freight, lorry >32 metric ton, EURO4 | transport, freight, lorry >32 metric ton, EURO4 | APOS, U	tyre wear emissions, lorry	0	0.00017	kg
7da22b9f-1d	transport, freight, lorry >32 metric ton, EURO4 | transport, freight, lorry >32 metric ton, EURO4 | APOS, U	tyre wear emissions, lorry	0	0.00017	kg
3269857a-c4	transport, freight, lorry >32 metric ton, EURO5 | transport, freight, lorry >32 metric ton, EURO5 | APOS, U	tyre wear emissions, lorry	0	0.00017	kg
c9fd3466-f9	transport, freight, lorry >32 metric ton, EURO5 | transport, freight, lorry >32 metric ton, EURO5 | APOS, U	tyre wear emissions, lorry	0	0.00017	kg
6b5a38b3-a2	transport, freight, lorry >32 metric ton, EURO6 | transport, freight, lorry >32 metric ton, EURO6 | APOS, U	tyre wear emissions, lorry	0	0.00017	kg
75dc856f-77	transport, freight, lorry >32 metric ton, EURO6 | transport, freight, lorry >32 metric ton, EURO6 | APOS, U	tyre wear emissions, lorry	0	0.00017	kg
bf5b888b-f3	transport, freight, lorry >32 metric ton, unregulated | transport, freight, lorry >32 metric ton, unregulated	tyre wear emissions, lorry	0	0.00015	kg
e957817b-07	transport, freight, lorry 16-32 metric ton, EURO1 | transport, freight, lorry 16-32 metric ton, EURO1 | APOS,	tyre wear emissions, lorry	0	0.00015	kg
cf7a1c7c-86	transport, freight, lorry 16-32 metric ton, EURO2 | transport, freight, lorry 16-32 metric ton, EURO2 | APOS,	tyre wear emissions, lorry	0	0.00015	kg
b4694c1f-1e	transport, freight, lorry 16-32 metric ton, EURO3 | transport, freight, lorry 16-32 metric ton, EURO3 | APOS,	tyre wear emissions, lorry	0	0.00022	kg
f016da42-5a	transport, freight, lorry 16-32 metric ton, EURO3 | transport, freight, lorry 16-32 metric ton, EURO3 | APOS,	tyre wear emissions, lorry	0	0.00022	kg
bf581918-63	transport, freight, lorry 16-32 metric ton, EURO4 | transport, freight, lorry 16-32 metric ton, EURO4 | APOS,	tyre wear emissions, lorry	0	0.00022	kg
f2126b22-11	transport, freight, lorry 16-32 metric ton, EURO4 | transport, freight, lorry 16-32 metric ton, EURO4 | APOS,	tyre wear emissions, lorry	0	0.00022	kg
38080e54-40	transport, freight, lorry 16-32 metric ton, EURO5 | transport, freight, lorry 16-32 metric ton, EURO5 | APOS,	tyre wear emissions, lorry	0	0.00022	kg
f3be48e9-5e	transport, freight, lorry 16-32 metric ton, EURO5 | transport, freight, lorry 16-32 metric ton, EURO5 | APOS,	tyre wear emissions, lorry	0	0.00022	kg
521af975-9d	transport, freight, lorry 16-32 metric ton, EURO6 | transport, freight, lorry 16-32 metric ton, EURO6 | APOS,	tyre wear emissions, lorry	0	0.00022	kg
e637f3b5-ef	transport, freight, lorry 16-32 metric ton, EURO6 | transport, freight, lorry 16-32 metric ton, EURO6 | APOS,	tyre wear emissions, lorry	0	0.00022	kg
534542d3-ef	transport, freight, lorry 16-32 metric ton, unregulated | transport, freight, lorry 16-32 metric ton, unregula	tyre wear emissions, lorry	0	0.00015	kg
15dd71f0-e2	transport, freight, lorry 3.5-7.5 metric ton, EURO1 | transport, freight, lorry 3.5-7.5 metric ton, EURO1 | AP(	tyre wear emissions, lorry	0	0.00015	kg
7f25c285-2f2	transport, freight, lorry 3.5-7.5 metric ton, EURO2 | transport, freight, lorry 3.5-7.5 metric ton, EURO2 | AP(	tyre wear emissions, lorry	0	0.00015	kg
2238405f-3cc	transport, freight, lorry 3.5-7.5 metric ton, EURO3 | transport, freight, lorry 3.5-7.5 metric ton, EURO3 | AP(	tyre wear emissions, lorry	0	0.00041	kg
c9cf9325-786	transport, freight, lorry 3.5-7.5 metric ton, EURO3 | transport, freight, lorry 3.5-7.5 metric ton, EURO3 | AP(	tyre wear emissions, lorry	0	0.00041	kg
c32e3e7b-8c	transport, freight, lorry 3.5-7.5 metric ton, EURO4 | transport, freight, lorry 3.5-7.5 metric ton, EURO4 | AP(	tyre wear emissions, lorry	0	0.00041	kg
e93789fa-88	transport, freight, lorry 3.5-7.5 metric ton, EURO4 | transport, freight, lorry 3.5-7.5 metric ton, EURO4 | AP(	tyre wear emissions, lorry	0	0.00041	kg
34c9c939-acf	transport, freight, lorry 3.5-7.5 metric ton, EURO5 | transport, freight, lorry 3.5-7.5 metric ton, EURO5 | AP(	tyre wear emissions, lorry	0	0.00041	kg
ce389875-84	transport, freight, lorry 3.5-7.5 metric ton, EURO5 | transport, freight, lorry 3.5-7.5 metric ton, EURO5 | AP(	tyre wear emissions, lorry	0	0.00041	kg
108f29a6-c07	transport, freight, lorry 3.5-7.5 metric ton, EURO6 | transport, freight, lorry 3.5-7.5 metric ton, EURO6 | AP(	tyre wear emissions, lorry	0	0.00041	kg
7db2ba74-27	transport, freight, lorry 3.5-7.5 metric ton, EURO6 | transport, freight, lorry 3.5-7.5 metric ton, EURO6 | AP(	tyre wear emissions, lorry	0	0.00041	kg
eafe548d-c2	transport, freight, lorry 3.5-7.5 metric ton, unregulated | transport, freight, lorry 3.5-7.5 metric ton, unregu	tyre wear emissions, lorry	0	0.00015	kg
65fee428-93	transport, freight, lorry 7.5-16 metric ton, EURO1 | transport, freight, lorry 7.5-16 metric ton, EURO1 | APO	tyre wear emissions, lorry	0	0.00015	kg
7efb62b5-56	transport, freight, lorry 7.5-16 metric ton, EURO2 | transport, freight, lorry 7.5-16 metric ton, EURO2 | APO	tyre wear emissions, lorry	0	0.00015	kg
1174e725-27	transport, freight, lorry 7.5-16 metric ton, EURO3 | transport, freight, lorry 7.5-16 metric ton, EURO3 | APO	tyre wear emissions, lorry	0	0.00023	kg
3b2d90ac-44	transport, freight, lorry 7.5-16 metric ton, EURO3 | transport, freight, lorry 7.5-16 metric ton, EURO3 | APO	tyre wear emissions, lorry	0	0.00023	kg
1f9c33a7-1c	transport, freight, lorry 7.5-16 metric ton, EURO4 | transport, freight, lorry 7.5-16 metric ton, EURO4 | APO	tyre wear emissions, lorry	0	0.00023	kg
71968ccf-e7	transport, freight, lorry 7.5-16 metric ton, EURO4 | transport, freight, lorry 7.5-16 metric ton, EURO4 | APO	tyre wear emissions, lorry	0	0.00023	kg
5a776197-f5	transport, freight, lorry 7.5-16 metric ton, EURO5 | transport, freight, lorry 7.5-16 metric ton, EURO5 | APO	tyre wear emissions, lorry	0	0.00023	kg
646d4962-40	transport, freight, lorry 7.5-16 metric ton, EURO5 | transport, freight, lorry 7.5-16 metric ton, EURO5 | APO	tyre wear emissions, lorry	0	0.00023	kg
04275777-30	transport, freight, lorry 7.5-16 metric ton, EURO6 | transport, freight, lorry 7.5-16 metric ton, EURO6 | APO	tyre wear emissions, lorry	0	0.00023	kg
5e477fc4-c9	transport, freight, lorry 7.5-16 metric ton, EURO6 | transport, freight, lorry 7.5-16 metric ton, EURO6 | APO	tyre wear emissions, lorry	0	0.00023	kg
5aa00730-41	transport, freight, lorry 7.5-16 metric ton, unregulated | transport, freight, lorry 7.5-16 metric ton, unregul	tyre wear emissions, lorry	0	0.00015	kg
6d57f164-fe	transport, freight, lorry with refrigeration machine, 3.5-7.5 ton, EURO3, carbon dioxide, liquid refrigerant,	tyre wear emissions, lorry	0	0.00041	kg
81ec65fc-97	transport, freight, lorry with refrigeration machine, 3.5-7.5 ton, EURO3, carbon dioxide, liquid refrigerant,	tyre wear emissions, lorry	0	0.00041	kg
04d75b5a-73	transport, freight, lorry with refrigeration machine, 3.5-7.5 ton, EURO3, R134a refrigerant, cooling | transp	tyre wear emissions, lorry	0	0.00041	kg
8bddb73a-d7	transport, freight, lorry with refrigeration machine, 3.5-7.5 ton, EURO3, R134a refrigerant, freezing | trans	tyre wear emissions, lorry	0	0.00041	kg
ee533d89-c9	transport, freight, lorry with refrigeration machine, 3.5-7.5 ton, EURO4, carbon dioxide, liquid refrigerant,	tyre wear emissions, lorry	0	0.00041	kg
bdafa55e-91	transport, freight, lorry with refrigeration machine, 3.5-7.5 ton, EURO4, carbon dioxide, liquid refrigerant,	tyre wear emissions, lorry	0	0.00041	kg
a39db7d2-52	transport, freight, lorry with refrigeration machine, 3.5-7.5 ton, EURO4, R134a refrigerant, cooling | transp	tyre wear emissions, lorry	0	0.00041	kg
9fbefc3f-155	transport, freight, lorry with refrigeration machine, 3.5-7.5 ton, EURO4, R134a refrigerant, freezing | trans	tyre wear emissions, lorry	0	0.00041	kg
426e8a9f-ce	transport, freight, lorry with refrigeration machine, 3.5-7.5 ton, EURO5, carbon dioxide, liquid refrigerant,	tyre wear emissions, lorry	0	0.00041	kg

- not provided

PREF	PNAME
b37c148e-02	transport, freight, light commercial vehicle | transport, freight, light commercial vehicle | A
d57266c2-1a	transport, freight, light commercial vehicle | transport, freight, light commercial vehicle | A
10138d21-da	transport, freight, light commercial vehicle | transport, freight, light commercial vehicle | A
ccc7ed67-e5	transport, freight, lorry 28 metric ton, vegetable oil methyl ester 100% | transport, freight, l
584fc575-b1	transport, freight, lorry 28 metric ton, vegetable oil methyl ester 100% | transport, freight, l
4335ccbb-b1	transport, passenger coach | transport, passenger coach | APOS, U
ff5ef059-858	transport, passenger coach | transport, passenger coach | APOS, U
b7c613d6-f1	transport, passenger, bicycle | transport, passenger, bicycle | APOS, U
6faf8b3e-33	transport, passenger, bicycle | transport, passenger, bicycle | APOS, U
ed88c010-f0	transport, passenger, electric bicycle | transport, passenger, electric bicycle | APOS, U
b8711445-b5	transport, passenger, electric bicycle | transport, passenger, electric bicycle | APOS, U
11f843b9-a6	transport, passenger, electric bicycle, label-certified electricity | transport, passenger, elect
22394adf-44	transport, passenger, electric bicycle, label-certified electricity | transport, passenger, elect
d3429762-c2	transport, passenger, motor scooter | transport, passenger, motor scooter | APOS, U
1bda45ac-30	transport, passenger, motor scooter | transport, passenger, motor scooter | APOS, U
07937a77-09	transport, regular bus | transport, regular bus | APOS, U
806c93a2-a9	transport, regular bus | transport, regular bus | APOS, U
31554b6e-ae	transport, tractor and trailer, agricultural | transport, tractor and trailer, agricultural | APOS,
be69db3f-22	transport, tractor and trailer, agricultural | transport, tractor and trailer, agricultural | APOS,
90154a05-58	transport, trolleybus | transport, trolleybus | APOS, U
690b545e-4e	transport, trolleybus | transport, trolleybus | APOS, U

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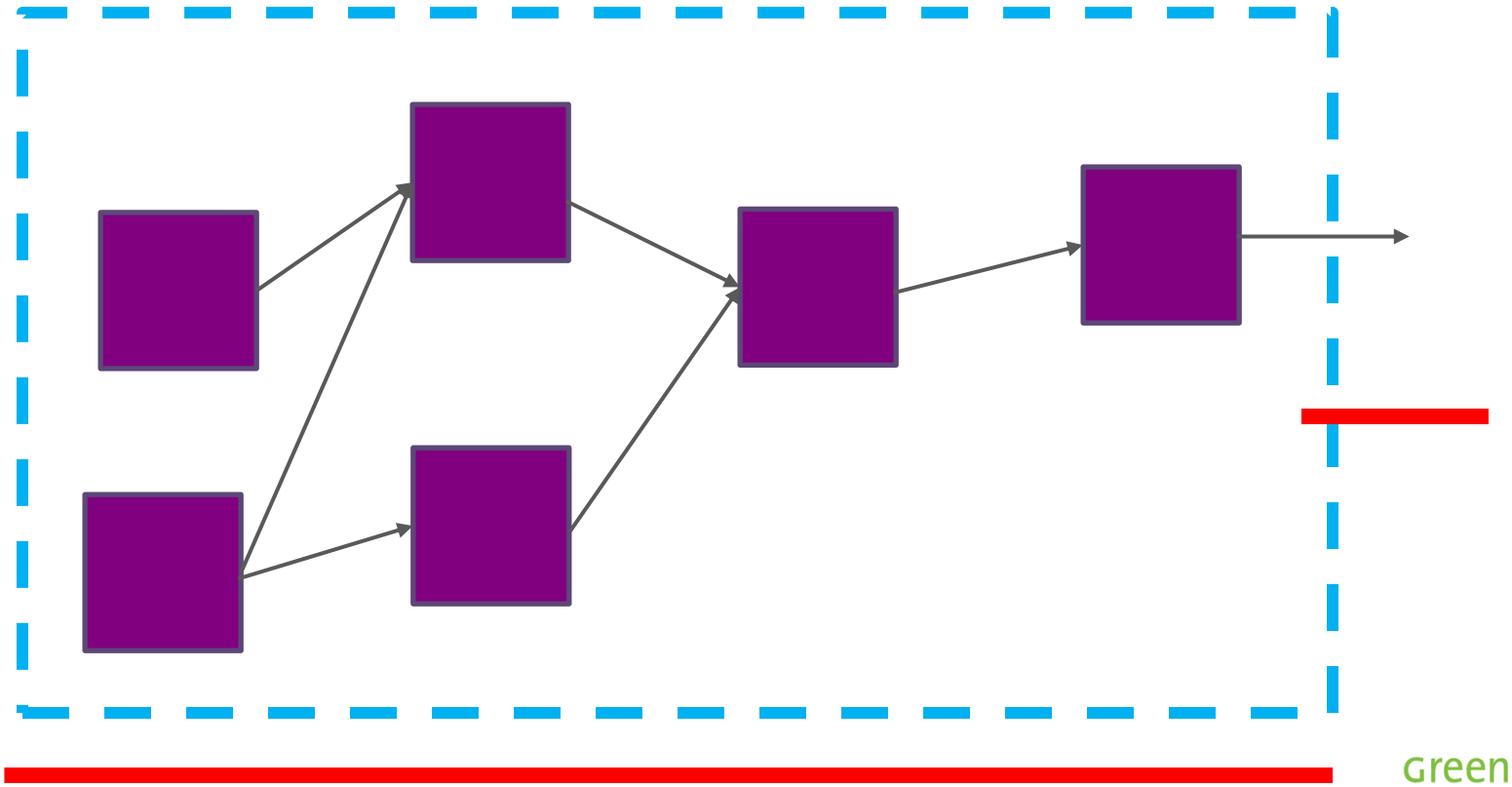
Where is data quality measured and documented?

4 LC calculation result, system process



How data quality is addressed in openLCA

Addressing data quality in openLCA

- So far:
  - Show data quality assessment done by data provider to user
  - Enable users to define and set up own data quality systems
  - Link data quality with uncertainty where needed
  - Allow calculation of data quality over the life cycle
  - Show in calculation result
  - Find best suited processes (somehow)

Show data quality assessment done by data provider to user

Inputs/Outputs: hard coal, import from AU | hard coal | APOS, U - RLA

Inputs

Flow	Category	Amount	Unit	Costs/Revenues	Uncertainty	Avoided waste	Provider	Data quality e...	Location	Description
hard coal	051:Mining of hard coal/0510:...	1.00200	kg		lognormal: g...		market for...	(3; 5; 5; 5; 2)		Compensatio...
transport, freight train	491:Transport via railways/4912:...	0.20000	t*km		lognormal: g...		market for...	(1; 2; 3; 1; 1)		The weighted ...
transport, freight, sea, bulk c...	501:Sea and coastal water trans...	15.00000	t*km		lognormal: g...		market for...	(3; 3; 3; 1; 1)		Rough estima...

Outputs

Flow	Category	Amount	Unit	Costs/Revenues	Uncertainty	Avoided prod...	Provider	Data quality e...	Location	Description
hard coal	**051:Mining of hard coal/0510...**	**1.00000**	**kg**	**0.03600 EUR**	**none**					
Particulates, > 10 um	Emission to air/unspecified	0.00200	kg		lognormal: g...			(2; 5; 5; 5; 2)		For a lack of ...

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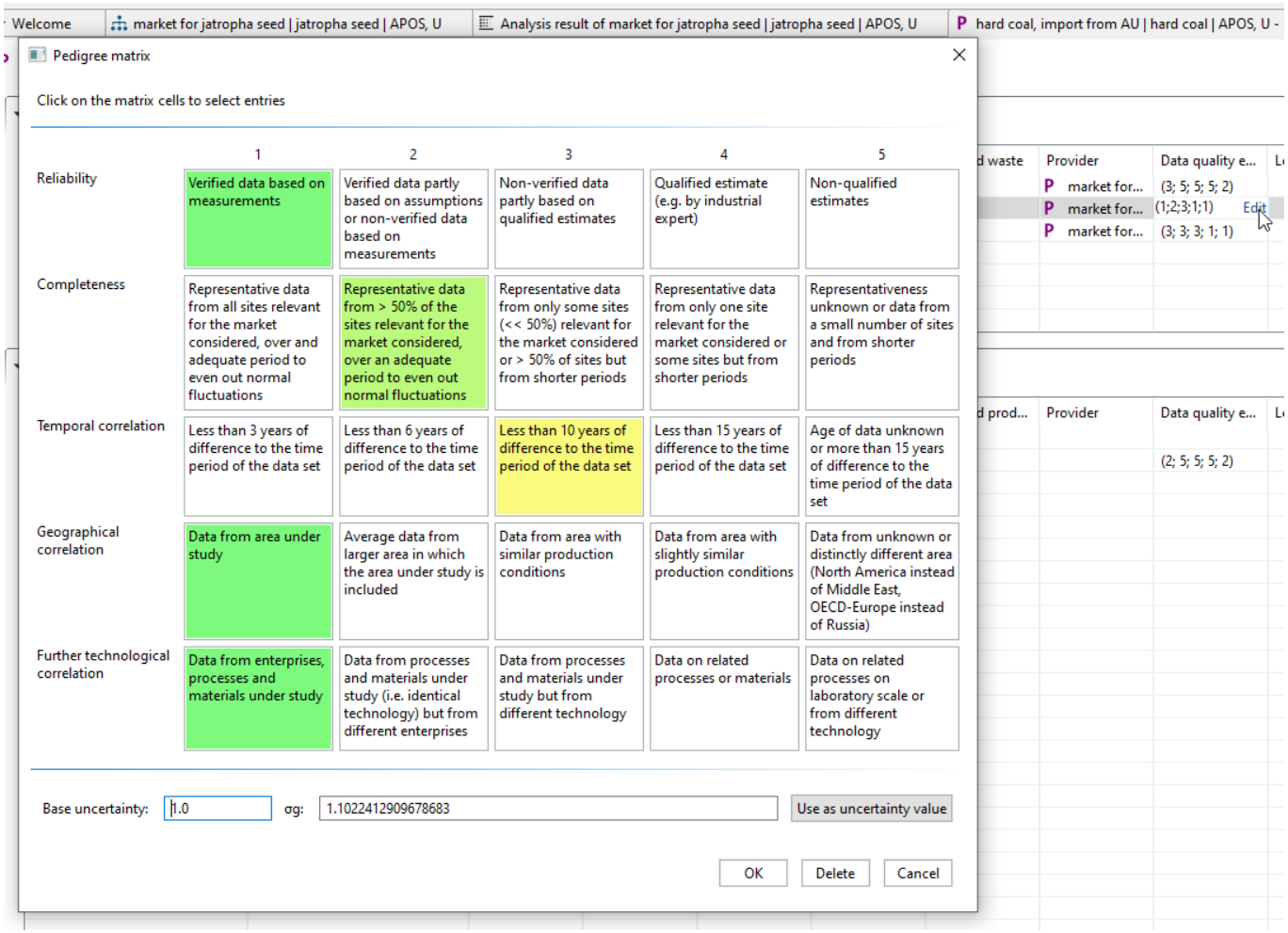
Show data quality assessment done by data provider to user, **editable**



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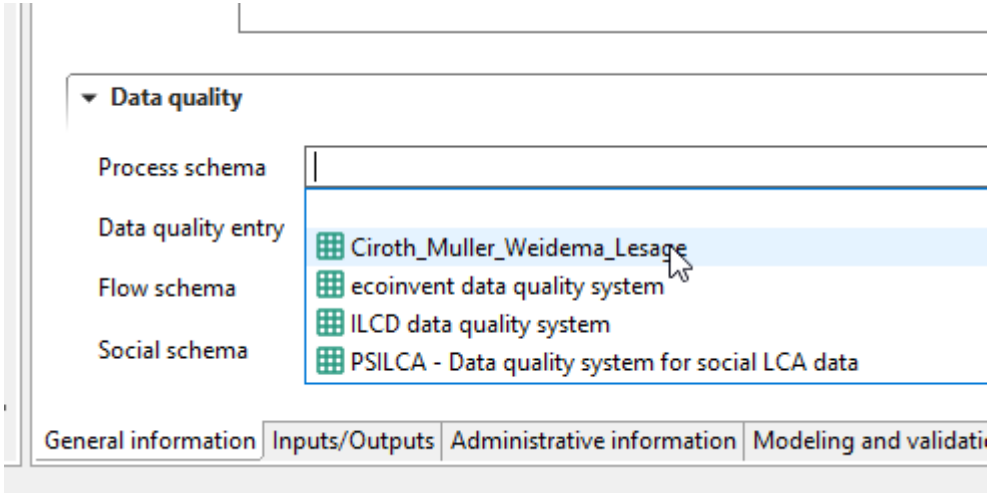
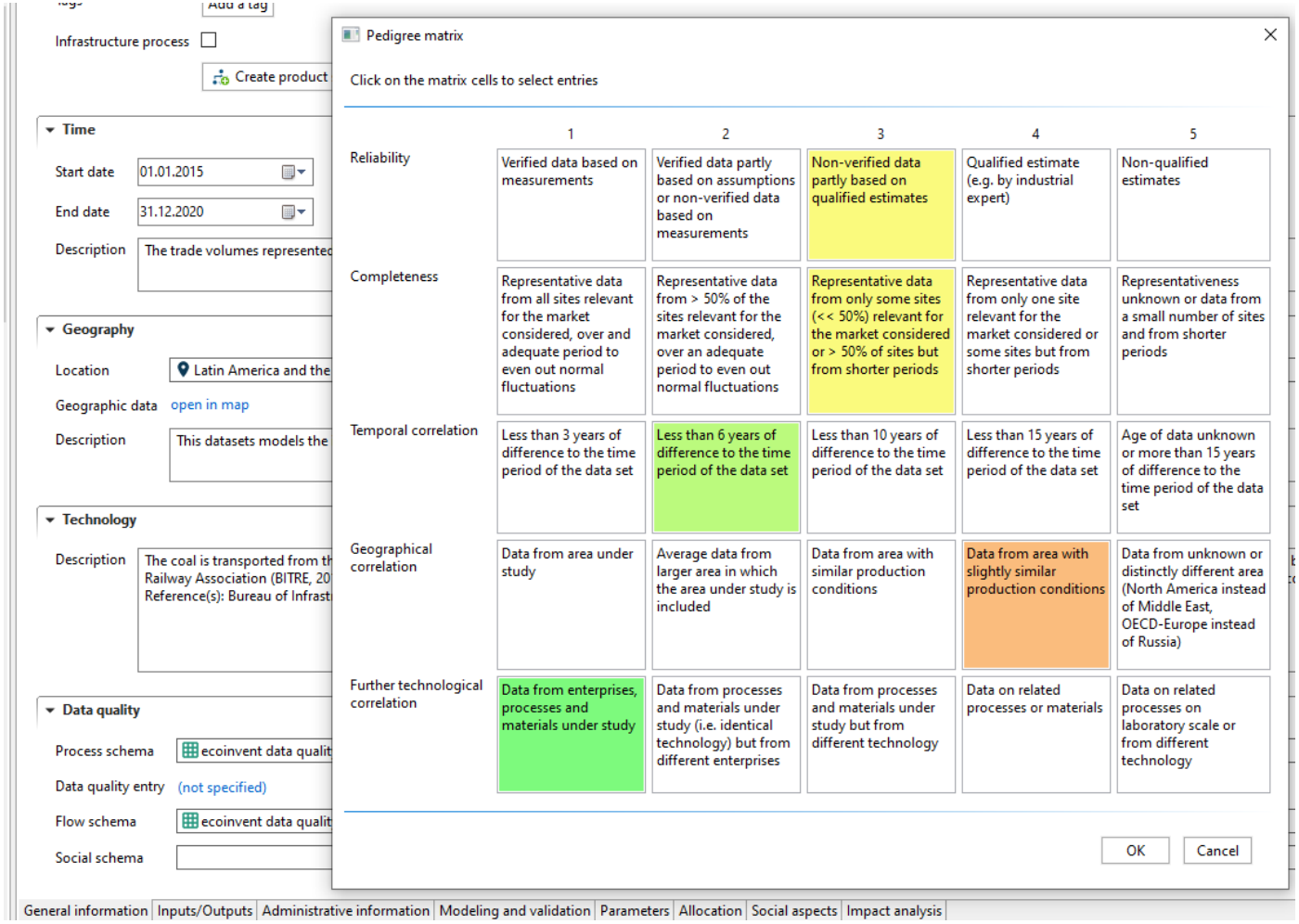
Show data quality assessment done by data provider to user, **editable**



Show data quality assessment done by data provider to user, **editable**



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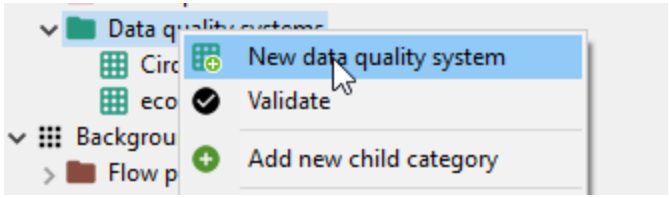
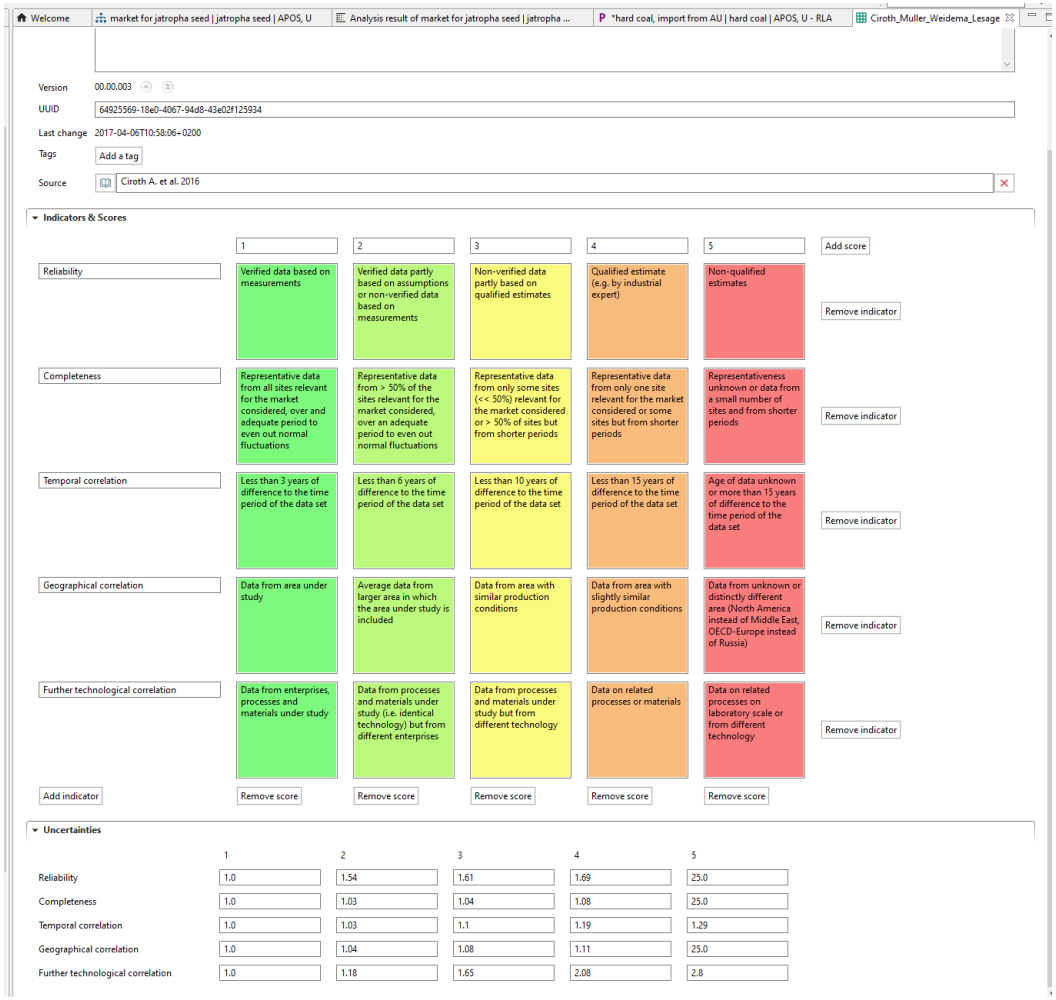
Enable users to define and set up own data quality systems





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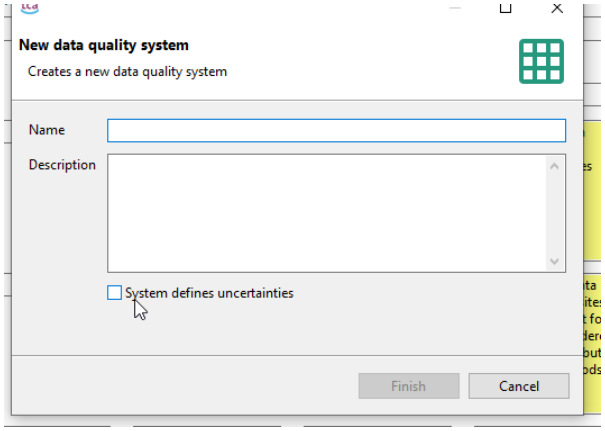
Link data quality with uncertainty where needed

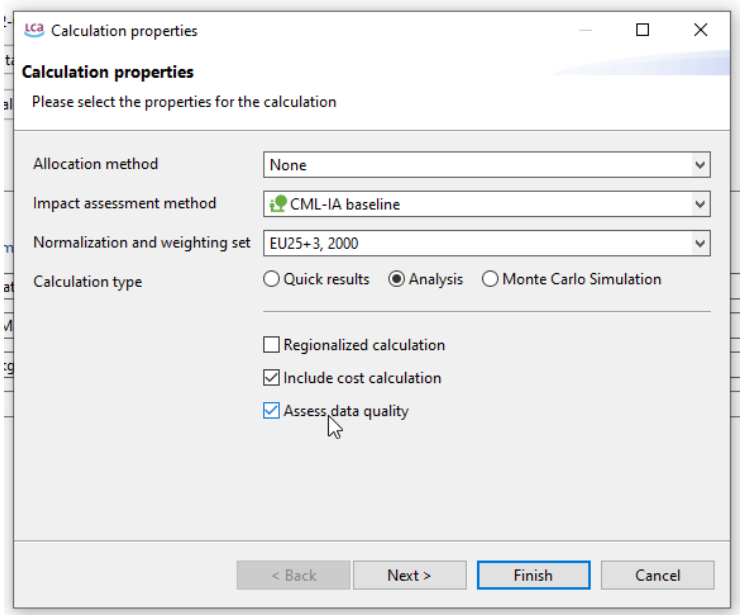


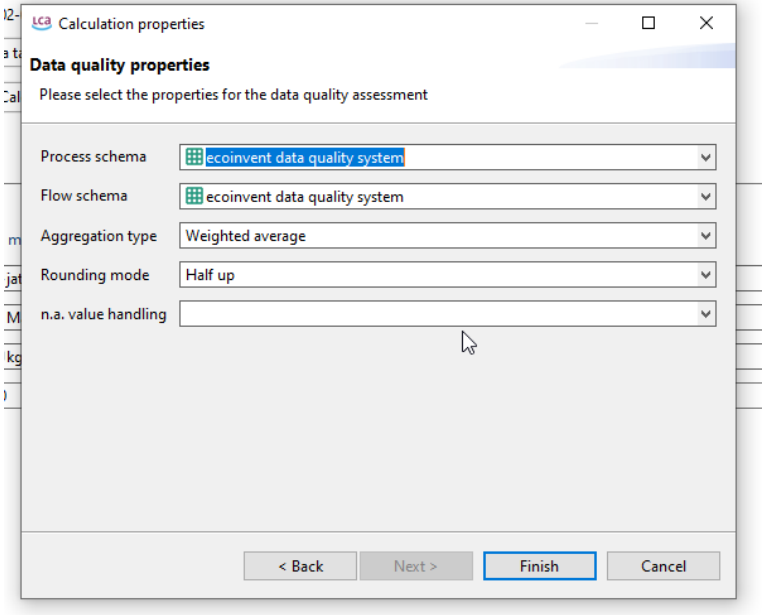
Uncertainties

	1	2	3	4	5
Reliability	1.0	1.54	1.61	1.69	25.0
Completeness	1.0	1.03	1.04	1.08	25.0
Temporal correlation	1.0	1.03	1.1	1.19	1.29
Geographical correlation	1.0	1.04	1.08	1.11	25.0
Further technological correlation	1.0	1.18	1.65	2.08	2.8

(of course, whether this linkage makes sense is a separate discussion)

Allow calculation of data quality over the life cycle





Allow calculation of data quality over the life cycle, show in calculation result

market for jatropha seed | jatropha seed | APOS, U

Inputs

Name	Category	Sub-category	Amount	Unit	R	C	T	G	F
Aluminium, in ground	Resource	in ground	0.00059	kg	2	2	3	1	1
Anhydrite, in ground	Resource	in ground	1.41165E-8	kg					
Antimony, in ground	Resource	in ground	2.40713E-9	kg	2	2	5	5	1
Argon-40	Resource	in air	4.25638E-5	kg	1	1	5	1	1
Arsenic, in ground	Resource	in ground	6.07274E-8	kg	1	2	1	1	1
Barium, in ground	Resource	in ground	0.00040	kg	4	4	5	5	1
Basalt, in ground	Resource	in ground	0.00015	kg	3	4	5	4	3
Beryllium, in ground	Resource	in ground	9.92897E-10	kg	3	2	3	5	1
Borax, in ground	Resource	in ground	6.59611E-7	kg	4	3	5	4	5
Bromine, in water	Resource	in water	8.79379E-8	kg	4	5	3	4	1
Cadmium, in ground	Resource	in ground	4.57994E-8	kg	1	3	3	1	1
Calcite, in ground	Resource	in ground	0.01680	kg	3	3	4	4	3
Calcium, in ground	Resource	in ground	5.22240E-5	kg	1	3	3	1	1
Carbon dioxide, in air	Resource	in air	2.04857	kg	4	3	3	5	1
Carbon, organic, in soil or biomass stock	Resource	in ground	9.84245E-5	kg	2	2	4	2	1
Carnallite	Resource	in water	9.20673E-7	kg	5	4	5	4	4

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Allow calculation of data quality over the life cycle, show in calculation result

Name	Category	Sub-category	Amount	Unit	R	C	T	G	F
Aluminium, in ground	Resource	in ground	0.00059	kg	2	2	3	1	1
bauxite mine operation | bauxite | APOS, U - GL	072:Mining of no...	0729:Mining of other non...	0.00056	kg	2	2	3	1	1
cobalt production | nickel, class 1 | APOS, U - G	072:Mining of no...	0729:Mining of other non...	1.10321E-5	kg	1	2	1	1	1
cobalt production | sulfuric acid | APOS, U - GL	072:Mining of no...	0729:Mining of other non...	5.33297E-6	kg	1	2	1	1	1
cobalt production | copper concentrate, sulfide	072:Mining of no...	0729:Mining of other non...	2.86128E-6	kg	1	2	1	1	1
cobalt production | copper, anode | APOS, U - (	072:Mining of no...	0729:Mining of other non...	2.59837E-6	kg	1	2	1	1	1
cobalt production | ferronickel | APOS, U - GLO	072:Mining of no...	0729:Mining of other non...	1.46648E-6	kg	1	2	1	1	1
zinc mine operation | zinc concentrate | APOS,	072:Mining of no...	0729:Mining of other non...	1.02078E-6	kg	1	3	3	1	1
zeolite production, powder | zeolite, powder | A	202:Manufacture ...	2023:Manufacture of soap...	7.02606E-7	kg					
cobalt production | copper, cathode | APOS, U	072:Mining of no...	0729:Mining of other non...	6.50234E-7	kg	1	2	1	1	1
cobalt production | electrolyte, copper-rich | AF	072:Mining of no...	0729:Mining of other non...	5.07718E-7	kg	1	2	1	1	1
zeolite production, powder | zeolite, powder | A	202:Manufacture ...	2023:Manufacture of soap...	3.46913E-7	kg					
zinc mine operation | lead concentrate | APOS,	072:Mining of no...	0729:Mining of other non...	2.02837E-7	kg	1	3	3	1	1
cobalt production | nickel concentrate, 16% Ni	072:Mining of no...	0729:Mining of other non...	1.47542E-7	kg	1	2	1	1	1
zinc mine operation | copper concentrate, sulfi	072:Mining of no...	0729:Mining of other non...	1.28613E-7	kg	1	3	3	1	1
cobalt production | cobalt | APOS, U - GLO	072:Mining of no...	0729:Mining of other non...	1.26925E-7	kg	1	2	1	1	1

GreenDelta

Allow calculation of data quality over the life cycle, show in calculation result

Impact analysis: EF 3.0 Method (adapted)

Subgroup by processes ☑ Don't show < 1 %

Name	Category	Inventory result	Impact factor	Impact result	Unit	R	C	T	G	F
Ionising radiation				0.04134	kBq U-235 eq	1	1	5	2	1
Climate change				1.45100	kg CO2 eq	3	3	5	4	2
Resource use, minerals and metals				1.29883E-5	kg Sb eq	3	1	2	2	1
Human toxicity, cancer - inorganics				2.56851E-18	CTUh	2	3	1	4	3
Photochemical ozone formation				0.00406	kg NMVOC ...	2	3	5	3	2
Ecotoxicity, freshwater - inorganics				20.92396	CTUe	1	1	5	5	2
Eutrophication, marine				0.00641	kg N eq	2	3	5	3	2
Resource use, fossils				12.24467	MJ	2	2	5	3	2
Human toxicity, non-cancer - inorganics				4.71327E-9	CTUh	2	2	5	4	2
Eutrophication, freshwater				0.00069	kg P eq	1	1	3	1	1
Human toxicity, cancer - metals				5.08230E-9	CTUh	4	5	5	5	5
Climate change - Fossil				1.44824	kg CO2 eq	3	3	5	4	2
Human toxicity, non-cancer - metals				1.97186E-7	CTUh	4	5	5	5	5
Human toxicity, non-cancer				2.02688E-7	CTUh	4	5	5	5	5
Acidification				0.04672	mol H+ eq	3	3	5	3	2
Ecotoxicity, freshwater - organics				1.80870	CTUe	3	3	4	2	2
Climate change - Biogenic				0.00126	kg CO2 eq	3	2	5	3	2
Climate change - Land use and LU change				0.00151	kg CO2 eq	4	3	5	3	2
Ozone depletion				8.37845E-8	kg CFC11 eq	2	3	5	5	3
Human toxicity, non-cancer - organics				6.20786E-10	CTUh	3	2	5	4	3
Ecotoxicity, freshwater - metals				121.00749	CTUe	2	3	5	5	4
Human toxicity, cancer				5.61501E-9	CTUh	4	4	5	5	4
Water use				3.10997	m3 depriv.	3	3	4	3	2
Particulate matter				3.46113E-7	disease inc.	3	3	4	3	2
Ecotoxicity, freshwater				143.57039	CTUe	2	3	5	5	4
Human toxicity, cancer - organics				5.32712E-10	CTUh	1	1	5	1	1
Land use				206.83832	Pt	1	1	3	1	1
Eutrophication, terrestrial				0.19726	mol N eq	2	3	5	3	1

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Allow calculation of data quality over the life cycle, show in calculation result

Impact analysis: EF 3.0 Method (adapted)

Subgroup by processes ☑ Don't show < 1 %

Name	Category	Inventory result	Impact factor	Impact result	Unit	R	C	T	G	F
Ionising radiation				0.04134	kBq U-235 eq	1	1	5	2	1
Climate change				1.45100	kg CO2 eq	3	3	5	4	2
Resource use, minerals and metals				1.29883E-5	kg Sb eq	3	1	2	2	1
P copper mine operation and beneficiation, sulfide ore | copper concer	072:Mining of non-ferrous metal ores / 0729:Mining of othe...			2.88545E-6	kg Sb eq	3	1	1	1	1
P copper mine operation and beneficiation, sulfide ore | copper concer	072:Mining of non-ferrous metal ores / 0729:Mining of othe...			1.38280E-6	kg Sb eq	3	1	1	1	1
F Tellurium, in ground	Resource / in ground	2.51991E-8 kg	40.70000 kg Sb eq/kg	1.02560E-6	kg Sb eq	3	1	1	1	1
F Copper, in ground	Resource / in ground	0.00011 kg	0.00137 kg Sb eq/kg	1.45828E-7	kg Sb eq	3	1	1	1	1
F Selenium, in ground	Resource / in ground	3.75005E-7 kg	0.19400 kg Sb eq/kg	7.27509E-8	kg Sb eq	3	1	1	1	1
F Gold, in ground	Resource / in ground	1.01386E-9 kg	52.00000 kg Sb eq/kg	5.27209E-8	kg Sb eq	3	1	1	1	1
F Silver, in ground	Resource / in ground	3.65436E-8 kg	1.18000 kg Sb eq/kg	4.31215E-8	kg Sb eq	3	1	1	1	1
F Molybdenum, in ground	Resource / in ground	2.38921E-6 kg	0.01780 kg Sb eq/kg	4.25279E-8	kg Sb eq	3	1	1	1	1
P copper mine operation and beneficiation, sulfide ore | copper concer	072:Mining of non-ferrous metal ores / 0729:Mining of othe...			1.01177E-6	kg Sb eq	3	1	1	1	1
P gold mine operation and gold production, unrefined | gold, unrefine	072:Mining of non-ferrous metal ores / 0729:Mining of othe...			7.38046E-7	kg Sb eq	2	1	3	5	1
F Gold, in ground	Resource / in ground	1.41932E-8 kg	52.00000 kg Sb eq/kg	7.38046E-7	kg Sb eq	2	1	3	5	1
P zinc mine operation | zinc concentrate | APOS, U - GLO	072:Mining of non-ferrous metal ores / 0729:Mining of othe...			7.06708E-7	kg Sb eq	1	3	3	1	1
P copper mine operation and beneficiation, sulfide ore | copper concer	072:Mining of non-ferrous metal ores / 0729:Mining of othe...			7.02794E-7	kg Sb eq	3	1	1	1	1
P copper mine operation and beneficiation, sulfide ore | copper concer	072:Mining of non-ferrous metal ores / 0729:Mining of othe...			5.43365E-7	kg Sb eq	3	1	1	1	1
P copper mine operation and beneficiation, sulfide ore | copper concer	072:Mining of non-ferrous metal ores / 0729:Mining of othe...			5.19641E-7	kg Sb eq	3	1	1	1	1
P copper mine operation and beneficiation, sulfide ore | copper concer	072:Mining of non-ferrous metal ores / 0729:Mining of othe...			5.06873E-7	kg Sb eq	3	1	1	1	1
P copper mine operation and beneficiation, sulfide ore | copper concer	072:Mining of non-ferrous metal ores / 0729:Mining of othe...			4.32309E-7	kg Sb eq	3	1	1	1	1
P copper mine operation and beneficiation, sulfide ore | copper concer	072:Mining of non-ferrous metal ores / 0729:Mining of othe...			4.14739E-7	kg Sb eq	3	1	1	1	1
P silver-gold mine operation with refinery | gold | APOS, U - RoW	072:Mining of non-ferrous metal ores / 0729:Mining of othe...			4.04860E-7	kg Sb eq	2	4	5	5	1
F Gold, in ground	Resource / in ground	4.20854E-9 kg	52.00000 kg Sb eq/kg	2.18844E-7	kg Sb eq	2	4	5	5	1
F Silver, in ground	Resource / in ground	1.57641E-7 kg	1.18000 kg Sb eq/kg	1.86016E-7	kg Sb eq	2	4	5	5	1
P copper mine operation and beneficiation, sulfide ore | copper concer	072:Mining of non-ferrous metal ores / 0729:Mining of othe...			3.51246E-7	kg Sb eq	3	1	1	1	1
P copper production, cathode, solvent extraction and electrowinning p	242:Manufacture of basic precious and other non-ferrous m...			2.18783E-7	kg Sb eq	2	2	5	1	1
P phosphate rock beneficiation | phosphate rock, beneficiated | APOS,	089:Mining and quarrying n.e.c. / 0891:Mining of chemical a...			1.76761E-7	kg Sb eq	1	2	5	3	1
P silver mine operation with extraction | lead concentrate | APOS, U - P	072:Mining of non-ferrous metal ores / 0729:Mining of othe...			1.72006E-7	kg Sb eq	3	3	3	1	1
P gold production | gold | APOS, U - AU	072:Mining of non-ferrous metal ores / 0729:Mining of othe...			1.50958E-7	kg Sb eq	3	3	5	1	1
P gold-silver mine operation with refinery | gold | APOS, U - RoW	072:Mining of non-ferrous metal ores / 0729:Mining of othe...			1.48679E-7	kg Sb eq	3	4	5	5	1
P molybdenite mine operation | copper concentrate, sulfide ore | APOS	072:Mining of non-ferrous metal ores / 0729:Mining of othe...			1.44936E-7	kg Sb eq	2	2	5	1	1
P zinc mine operation | lead concentrate | APOS, U - GLO	072:Mining of non-ferrous metal ores / 0729:Mining of othe...			1.40428E-7	kg Sb eq	1	3	3	1	1
P chromite ore concentrate production | chromite ore concentrate | AF	072:Mining of non-ferrous metal ores / 0729:Mining of othe...			1.34081E-7	kg Sb eq	2	2	5	1	1
Human toxicity, cancer - inorganics				2.56851E-18	CTUh	2	3	1	4	3
Photochemical ozone formation				0.00406	kg NMVOC ...	2	3	5	3	2
Ecotoxicity, freshwater - inorganics				20.92396	CTUe	1	1	5	5	2
Eutrophication, marine				0.00641	kg N eq	2	3	5	3	2
Resource use, fossils				12.24467	MJ	2	2	5	3	2
Human toxicity, non-cancer - inorganics				4.71327E-9	CTUh	2	2	5	4	2
Eutrophication, freshwater				0.00069	kg P eq	1	1	3	1	1
Human toxicity, cancer - metals				5.08230E-9	CTUh	4	5	5	5	5

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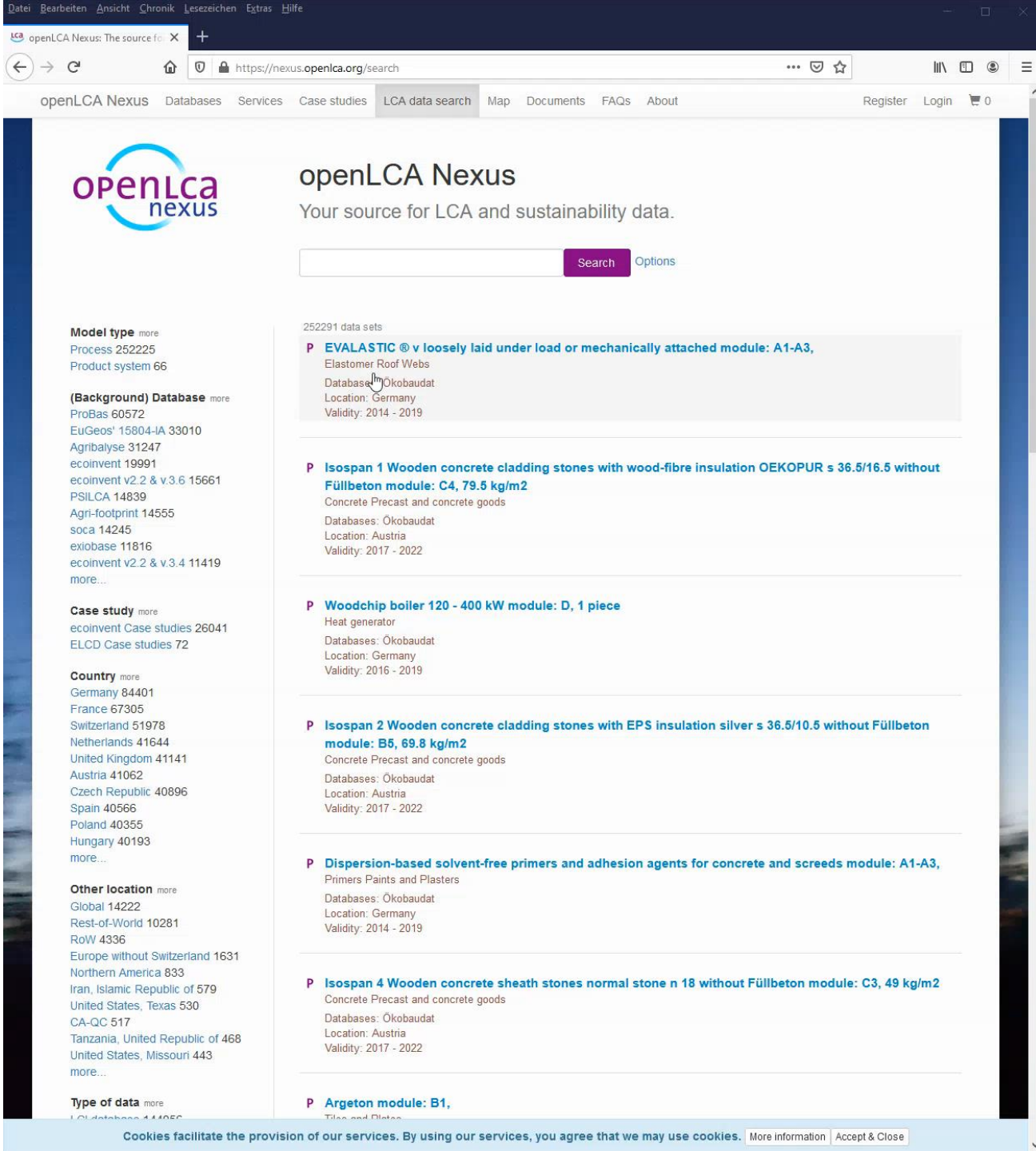
Allow calculation of data quality over the life cycle, show in calculation result

- (e.g., Agribalyse, manually calculated estimate of data quality for assumed most relevant parts of a life cycle, in excel → not necessary)

Find best suited processes (somehow), via GLAD criteria in openLCA Nexus




Outlook

Outlook: data quality in openLCA

- We are doing not so bad, but
  - Capacity building
  - User defined fitness for purpose
  - Real uncertainty
  - A challenge: full system compliance (EF, etc. -> cheat, “quality-washing”, ..)

GreenDelta

sustainability consulting + software

Thank you!

Contact
Dr. Andreas Ciroth
ciroth@greendelta.com

GreenDelta GmbH
Kaiserdamm 13, 14057 Berlin
www.greendelta.com