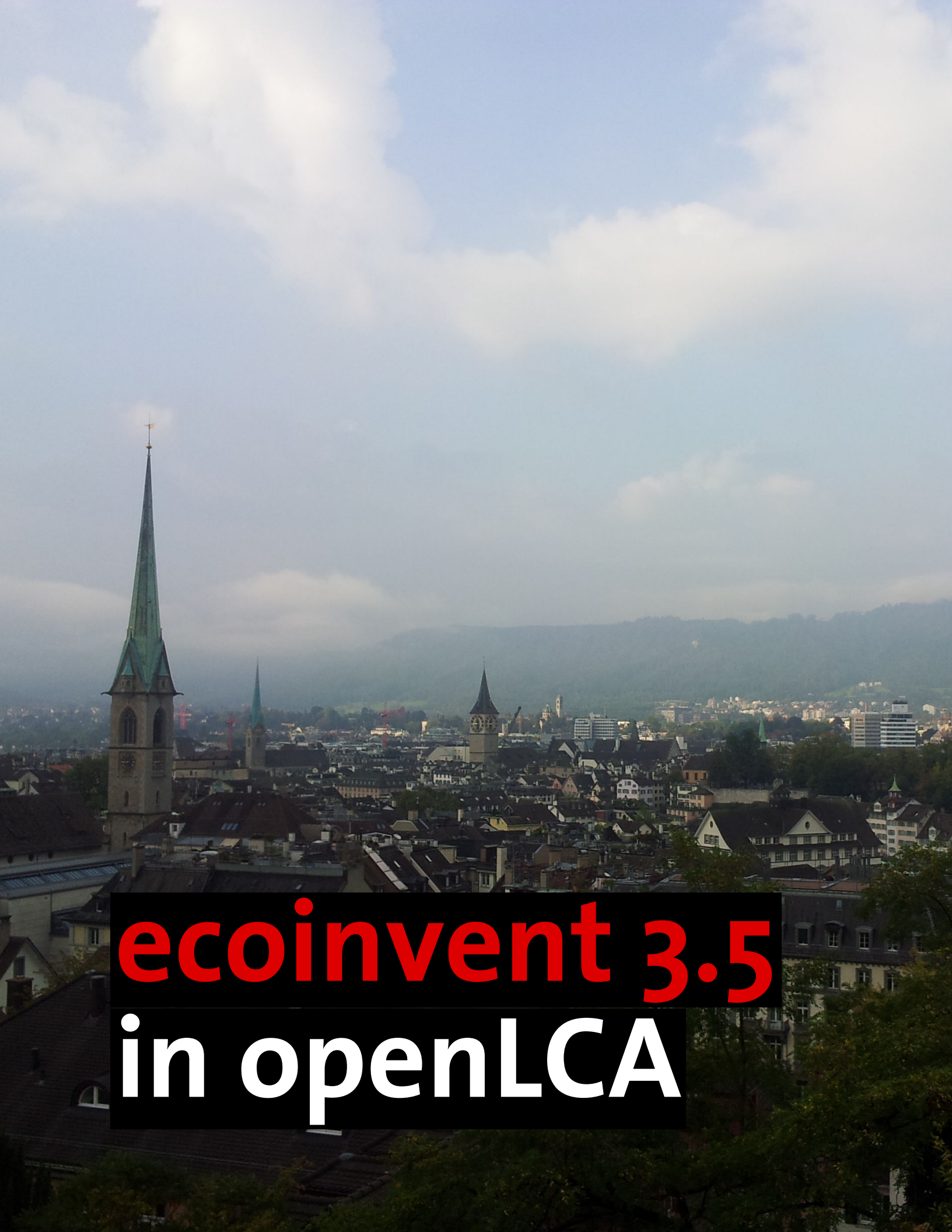
ecoinvent 3.5
in openLCA

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A transparent unit process based life cycle inventory database

Version: 1.4

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Date: 3rd December, 2018

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What is new in ecoinvent 3.5

The latest version of the ecoinvent[1] database features more than 2000 new, revised and updated datasets across five sectors as well as improved representations of supply chains. Version 3.5 was released on 23rd August, 2018. The fifth update of ecoinvent version 3 includes over two thousand new and updated datasets related to aquaculture and fish capture, waste treatment, hard coal and aluminium supply, pulp and containerboard production. Moreover, the overall representation of supply chains was improved.
Please note that the following two paragraphs are quoted from the ecoinvent website:
https://www.ecoinvent.org/database/ecoinvent-35/ecoinvent-35.html (accessed 23.11.2018)

1.1 New and Updated Data

- **Aquaculture and Fish Capture:** For the **first time**, datasets on aquaculture and fish **capture** are published in ecoinvent. Datasets related to anchovy, hake and tuna capture as well as trout and tilapia **aquaculture**, were added to the database. **Processing** into fish meal and oil, as well as fish processing activities, such as canning, curing and freezing, are also included.
- **Pulp Production and Containerboard:** The pulp sector represents the latest primary data on sulfate pulp production, collected by the **European Pulp Industry Sector Association**. This new data provides a higher level of granularity in the sulfate pulp supply chains. Similarly, the European corrugated board supply chain features the latest data from the **Federation of Corrugated Board Manufacturers**.
- **Aluminium:** The update of the aluminium supply chain features the latest data, provided by the **International Aluminium Institute**. This includes electricity production as well as primary and secondary aluminium production for most regions of the world. New regional datasets for some activities provide an even higher resolution and more transparency in this sector.
- Waste Treatment: The expansion of the waste sector offers 150 **new treatment and disposal activities**, including unsanitary landfill, open burning and open dumping. Additionally, 500 new, country specific **disposal mixes** for common municipal waste fractions are available in 37 European countries, Brazil, Colombia, Peru, India and South Africa.
- Hard Coal: Version 3.5 covers more than **95% of the global hard coal supply chains**. Import and market datasets depict global trade flows and regional hard coal mixes. New data on coal mining in **India** and **South Africa** include different types of mines. Key emissions from mines were updated and consistently implemented for all geographies.
- Continuously updated Electricity Sector: Version 3.5 covers close to 100% of (statistically represented) global electricity generation, comprising 142 countries. Current and projected future electricity mixes are

[1] Gregor Wernet et al. "The ecoinvent database version 3 (part I): overview and methodology". In: *The International Journal of Life Cycle Assessment* 21.9 (Sept. 1, 2016), pp. 1218–1230. ISSN: 1614-7502. DOI: 10.1007/s11367-016-1087-8. URL: https://doi.org/10.1007/s11367-016-1087-8 (visited on 11/23/2018)

available on a country or even more granular, region-specific level. Moreover, new data on **concentrated solar power from parabolic trough and solar towers** was added.

1.2 Version 3 Commitments

- Improved Supply Chain Representation: The existing supply chains in the database were thoroughly reviewed. As a result, over a thousand **links between demanding and supplying activities** have been updated, and hundreds of **new, regional market datasets** have been introduced. With this improvement, supply chains reflect the current reality of global and regional product flows even better.
- Properties: All products and elementary exchanges in ecoinvent version 3 come with at least **six properties**, dry mass, wet mass, water in wet mass, water content, carbon content fossil and non fossil. Additionally, every single product in the database has a **price** that can be used among other things for **economic allocation**.
- System Models: ecoinvent is the only major LCI database supporting three system models: Allocation cut-off by classification, Allocation at the Point of Substitution, and Consequential. In addition, for all version 3 users preferring to have access to unlinked unit processes, ecoinvent offers an undefined version on its website.

1.3 Get ecoinvent 3.5 for openLCA

ecoinvent 3.5 is available for download for openLCA exclusively on https://nexus.openlca.org. **Please note that versions of ecoinvent 3.5 obtained elsewhere, will not be compatible with openLCA.** The ecoinvent licence purchased via nexus.openLCA is downward compatible. Users with an ecoinvent 3.5 license will also receive access to older versions of ecoinvent.

ecoinvent 3.5 in openLCA

Just as previous ecoinvent versions, ecoinvent 3.5 ships in six different database versions: Three different system models each available as unit and system[1] processes.

- **Cut-Off System Model:** "The underlying philosophy is that a producer is fully responsible for the disposal of its wastes, and that he does not receive any credit for the provision of any recyclable materials."[2]
- **APOS System Model:** "The APOS system model follows the attributional approach in which burdens are attributed proportionally to specific processes."[2]
- **Consequential System Model:** "The consequential system model uses different basic assumptions to assess the consequences of a change in an existing system."[2]

System models in ecoinvent 3 are explained in detail on the ecoinvent website[2]. All six databases can be used individually or in combination [3]. In addition, ecoinvent's Life Cycle Impact Assessment (LCIA) methods are available via openLCA Nexus too. However, the use of the openLCA LCIA method package with more than 70 LCIA methods is also possible. Moreover, to be able to reproduce the LCIA results provided by the ecoinvent Association, a pack with the LCIA methods as implemented the ecoinvent Association is also available for download in openLCA Nexus.

ecoinvent 3.5 regionalised

In the non-regionalised versions of ecoinvent, elementary flows in the inventory of a process are *generic* and not assigned to a specific location (Figure 2.1). In the regionalised versions of ecoinvent, some elementary flows in the inventory of a process are region-specific as indicated by two-letter country codes[4] (Figure 2.2). Region specific elementary flows allow usage of region-specific characterisation/impact factors in Life Cycle Impact Assessment methods (e.g. water flows assigned to water scarce countries have a different impact factor compared to water flows assigned to countries where water is abundant; Figure 2.3).

[1] Life Cycle Inventory (LCI)
[2] https://www.ecoinvent.org/database/system-models-in-ecoinvent-3/system-models-in-ecoinvent-3.html (accessed 23.11.2018)
[3] In openLCA, always import the smaller into the larger database to reduce the import time (typically unit process-based databases into system process-based databases)
[4] ISO 3166-1 alpha-2 (https://en.wikipedia.org/wiki/ISO-3166-alpha-2)

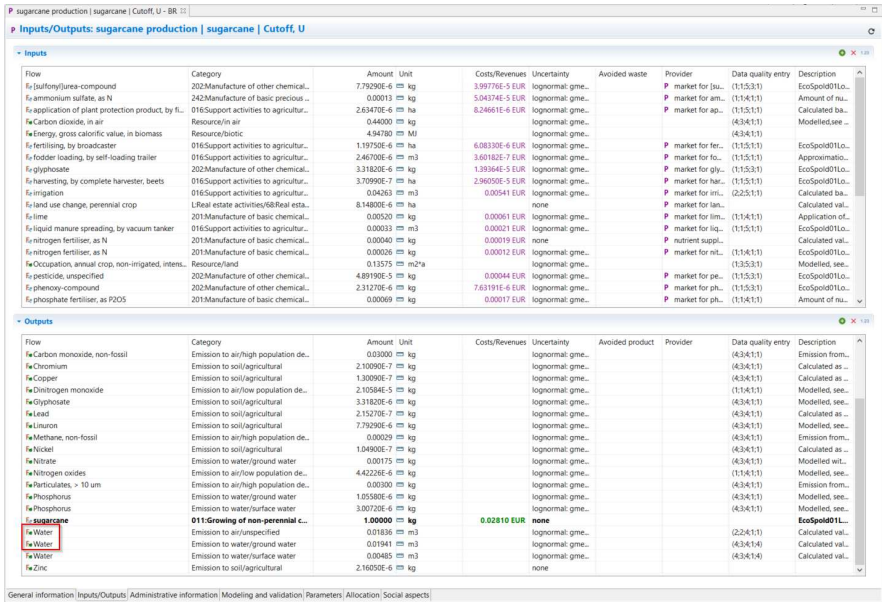

Figure 2.1: Inventory of the process *sugarcane production | sugarcane | Cutoff, U - BR* in *ecoinvent 3.5 cut-off unit processes*.

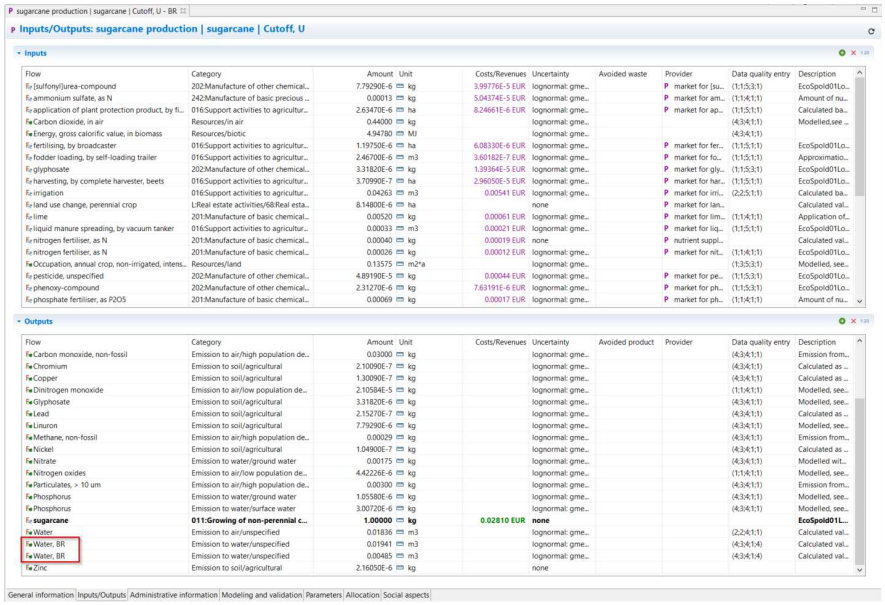

Figure 2.2: Inventory of the process *sugarcane production | sugarcane | Cutoff, U - BR* in *ecoinvent 3.5 cut-off unit processes regionalised*.

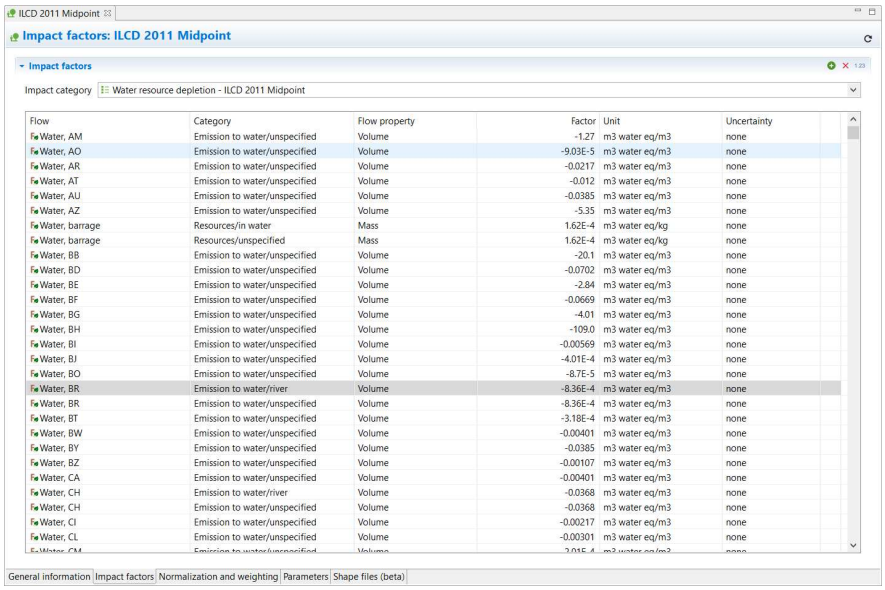

Figure 2.3: The *Water resource depletion* impact category of the *ILCD 2011 Midpoint* LCIA method from the openLCA LCIA method package 2.0.3 features different characterisation/impact factors for region-specific elementary flows.

2.1 Addition and extension of price data

As in the previous ecoinvent 3.4 version, the price information for all the intermediate exchanges provided by ecoinvent 3.5 database were extended during the implementation in openLCA so that all exchanges of products with price data had the correspondent cost/revenue specified. It should be noted that the prices provided by ecoinvent are global prices and technology independent. Thus, the same price has been considered for e.g. *rice production* in the US and India or for *electricity, high voltage* produced by hydropower plants, oil or hard coal.

2.2 Mapping of elementary flows

Just as (almost) all the databases in openLCA Nexus, the elementary flows used in the ecoinvent v.3.5 database were mapped to openLCA reference data. This allows consistency in the elementary flows when combining different inventory databases from Nexus as well as the possibility of using the openLCA LCIA methods pack. If you would like to have the ecoinvent v.3.5 data pack provided in openLCA Nexus without openLCA reference data, please contact GreenDelta GmbH.

2.3 ecoinvent LCIA methods

The ecoinvent LCIA methods packs provided in openLCA Nexus are intended to be used **ONLY** with the correspondent ecoinvent database to reproduce the LCIA results reported by the ecoinvent Association. They should not be used with other databases available in openLCA Nexus as not all the openLCA elementary flows are characterised in these methods but only those flows used by the ecoinvent databases. Documentation of the LCIA

implementation in ecoinvent 3.5 is included in the file provided by the ecoinvent Association on the ecoinvent website.

2.4 Compatibility and quality assurance

ecoinvent 3.5 for openLCA has been thoroughly tested and found to be 100% compatible without any constraints. The inventory and impact assessment results calculated for product systems using unit process datasets in openLCA were compared to the LCI and LCIA results published by the ecoinvent Association. The LCI results obtained in openLCA were found to be almost equal to the ecoinvent system processes.

2.5 Memory requirements

When working with ecoinvent 3.5 in openLCA, it is recommended to increased the maximum memory usage of openLCA. Visit https://ask.openLCA.org for instructions [5].

[5] https://ask.openlca.org/594/how-to-assign-more-memory-to-openlca?show=594 (accessed 23.11.2018)

Migrating to ecoinvent 3.5

In order to enable users to import product systems from a previous version of ecoinvent into the newest version of ecoinvent without having to manually re-select all providers, the UUIDs of processes were synchronised among different versions of ecoinvent. This allows users to update models by just importing the foreground system from a previous ecoinvent database into a newer version of ecoinvent (section 3.2, p.10). **Please note that migration will only be supported for ecoinvent databases underlying the same system model** (consequential, cut-off, apos) and process selection (unit or system/LCI)[1] and **openLCA ≥1.7.4**[2] **must be used**.
Before migrating data from a previous version of ecoinvent into ecoinvent 3.5, **backup your databases to assure that no data is lost under any circumstances!**. It should be noted that there is an exception. Some processes that were unit processes in previous ecoinvent versions were turned into system processes in preceding ecoinvent versions. In this case, the different UUIDs were kept and providers have to be selected manually after importing the foreground system.
Tests on three ecoinvent database types indicate that all databases published on *nexus.openLCA.org* after the 14th of March 2018 are compatible for migration (Table 3.1, 3.2 and 3.3). However, it is highly recommended to run a manual compatibility check before migrating (section 3.1, p.8). If the compatibility check turns out negative, please contact GreenDelta GmbH.

Table 3.1: Compatibility check for ecoinvent cut-off unit process databases

Ref_ID/UUID of the reference process	Database file name (*.zolca ending)
c36129c5-3675-3c49-8ee5-4a028faa4c34	ecoinvent_34_cutoff_unit
0cf823d1-02b2-38f4-81e9-20fb6c87c642	ecoinvent_34_cutoff_unit_20180314
0cf823d1-02b2-38f4-81e9-20fb6c87c642	ecoinvent35_cut_off_units_20181129

Table 3.2: Compatibility check for ecoinvent apos unit processes databases

Ref_ID/UUID of the reference process	Database file name (*.zolca ending)
c36129c5-3675-3c49-8ee5-4a028faa4c34	ecoinvent_34_apos_unit
bd7fb9ab-1df8-3e6f-84e5-7f296452d7e5	ecoinvent_34_apos_unit_20180314
bd7fb9ab-1df8-3e6f-84e5-7f296452d7e5	ecoinvent_34_apos_unit_20180420
bd7fb9ab-1df8-3e6f-84e5-7f296452d7e5	ecoinvent35_APOS_Units_20181129

[1] Migration is only supported from *ecoinvent 3.4 APOS unit processes* into *ecoinvent 3.5 APOS unit processes* but not into *ecoinvent 3.5 Consequential unit processes*
[2] http://www.openlca.org/download/

Table 3.3: Compatibility check for ecoinvent apos system/LCI processes databases

Ref_ID/UUID of the reference process	Database file name (*.zolca ending)
326f2545-bdf1-3c58-bd6b-45006630 2d36	ecoinvent_3_3_apos_lci_17
0110cda7-7348-3c94-9473-143a2974a4a9	ecoinvent_34_apos_lci
326f2545-bdf1-3c58-bd6b-45006630 2d36	ecoinvent_34_apos_lci_20180314
326f2545-bdf1-3c58-bd6b-45006630 2d36	ecoinvent35_apos_lci_20181129

3.1 Manual compatibility check

To check if two ecoinvent databases in openLCA feature the same *REF_ID* (*UUID*) either retrieve this information from the *General Information* tabs of the processes or via the openLCA *SQL Query Browser*. In the following two sections, instructions are provided exemplary for both methods for the process *barley grain, feed production | barley grain, feed | Cutoff, S - RoW*.

3.1.1 Compatibility check via the SQL Query Browser

Open the openLCA *SQL Query Browser* (Figure 3.1) and run the following code in both versions of your database to retrieve the *REF_ID* (UUID) of the processes *barley grain, feed production | barley grain, feed | Cutoff, S - RoW* (if the returned *REF_IDs* are the same, JSON-LD export/import should be applicable; p.10):

```
select ref_id from tbl_processes where name like 'barley grain, feed production |
barley grain, feed%' and f_location = (select id from tbl_locations where code =
'RoW')
```

Figure 3.1: The *SQL Query Browser* in openLCA is accessible via the main menu *Window -> Developer tools -> SQL*.

3.1.2 Compatibility check via the General Information tab

Open the *General Informationt* tab of the same process in both versions of your ecoinvent database and compare the field *UUID* (Figure 3.2 and Figure 3.3). If both UUIDs are the same, JSON-LD export/import should be applicable (p.10).

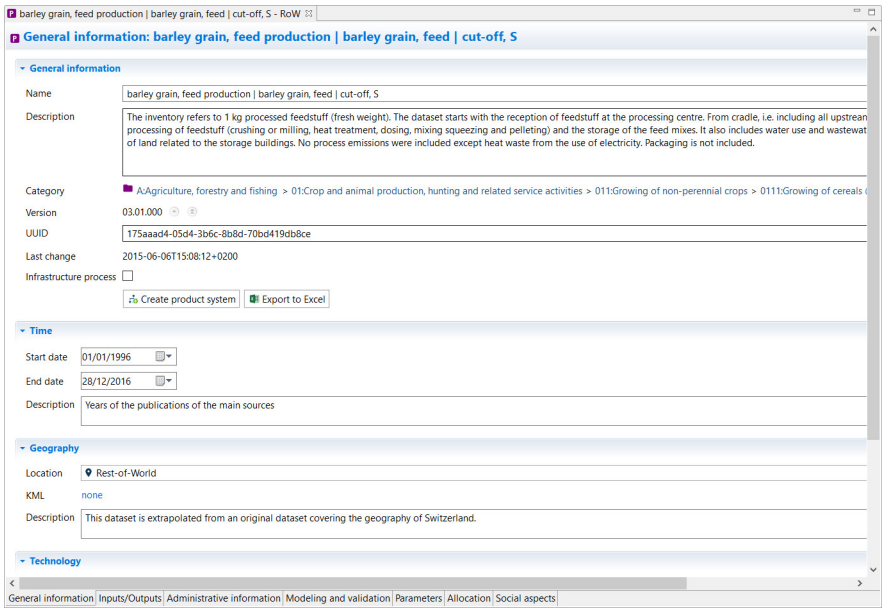

Figure 3.2: The General Information tab for the process *barley grain, feed production | barley grain, feed | Cutoff, S - RoW* in ecoinvent 3.3 (system model cut-off; LCI). The process has the REF_ID *175aaad4-05d4-3b6c-8b8d-70bd419db8ce* which is the same as in ecoinvent 3.5 (system model cut-off; LCI).

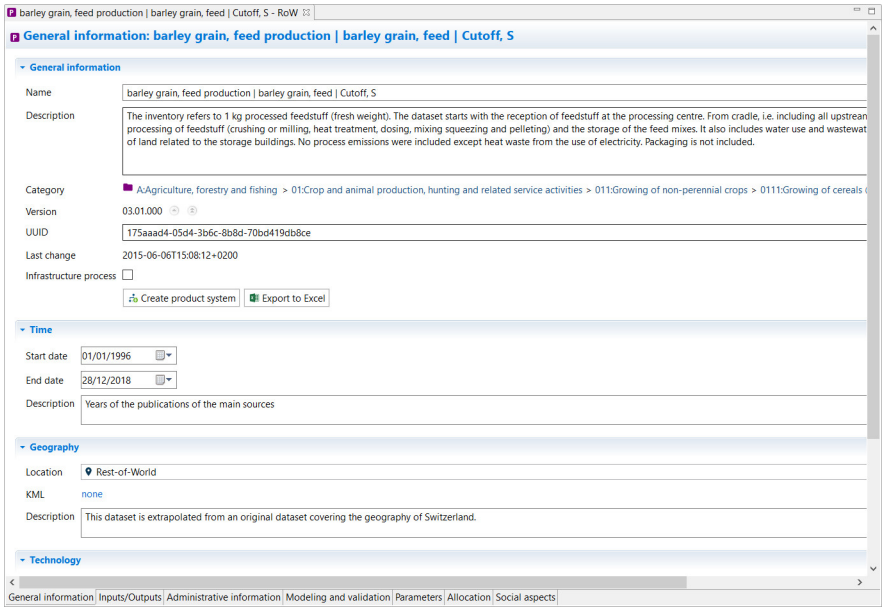

Figure 3.3: The General Information tab for the process *barley grain, feed production | barley grain, feed | Cutoff, S - RoW* in ecoinvent 3.5 (system model cut-off; LCI). The process has the REF_ID *175aaad4-05d4-3b6c-8b8d-70bd419db8ce* which is the same as in ecoinvent 3.3 (system model cut-off; LCI).

3.2 Export and import between different versions of ecoinvent

Before exporting and importing data sets between different versions of ecoinvent, perform a compatibility check and create backups (p. 8).

3.2.1 Export

Open the ecoinvent database from which you want to import data by double-clicking on it. Right-click onto the database and select *Export*. Choose the *JSON-LD* export wizard in the folder openLCA and click *Next*. Select the data sets which you would like to export (Figure 3.4). **Make sure that you do not accidentally select all processes in your database as this will prolong the export (and subsequently the import) extremely.** Select the a file path for saving the JSON-LD file and click *Finish*.

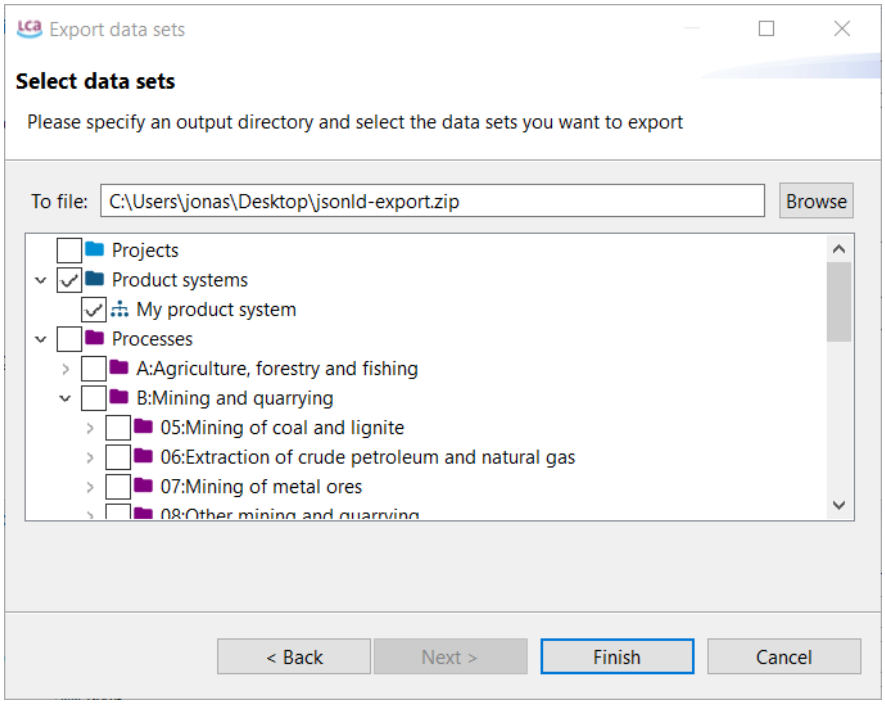

Figure 3.4: Right-click onto an open database in openLCA to open an export wizard.

3.2.2 Import

Open the ecoinvent database into which you want to import exported JSON-LD data by double-clicking on it. Right-click onto the database and select *Import*. Select the *Linked Data (JSON-LD)* import wizard and click *Next* (Figure 3.5). Choose the directory where the JSON-LD *.zip file which you would like to import is saved and select it in the right column. Click on *Next* to open the import settings and select *Never update a data set that already exists* (Figure 3.6).

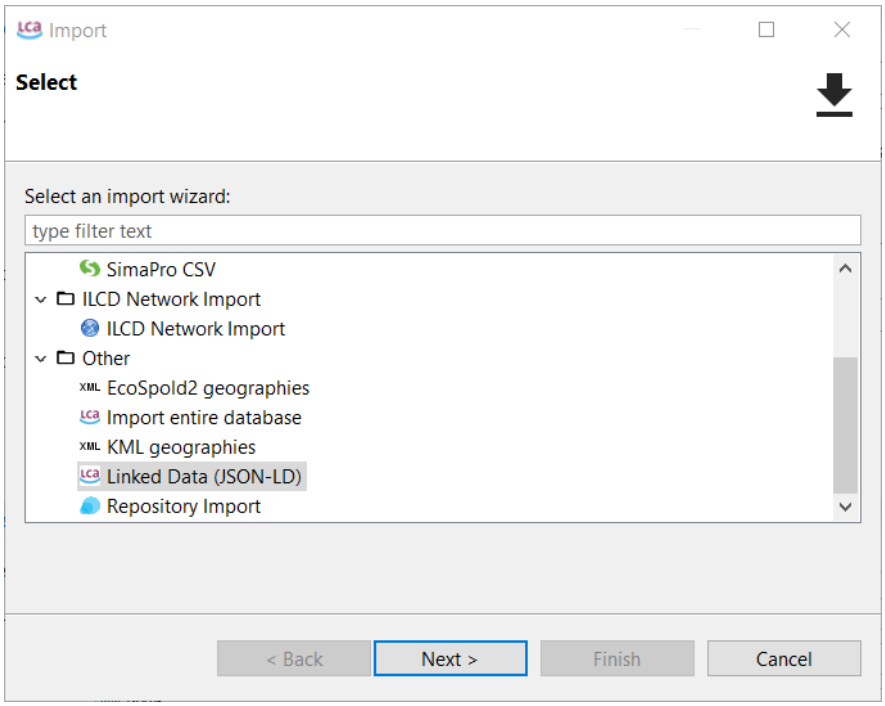

Figure 3.5: Right-click onto an open database in openLCA to open an import wizard.

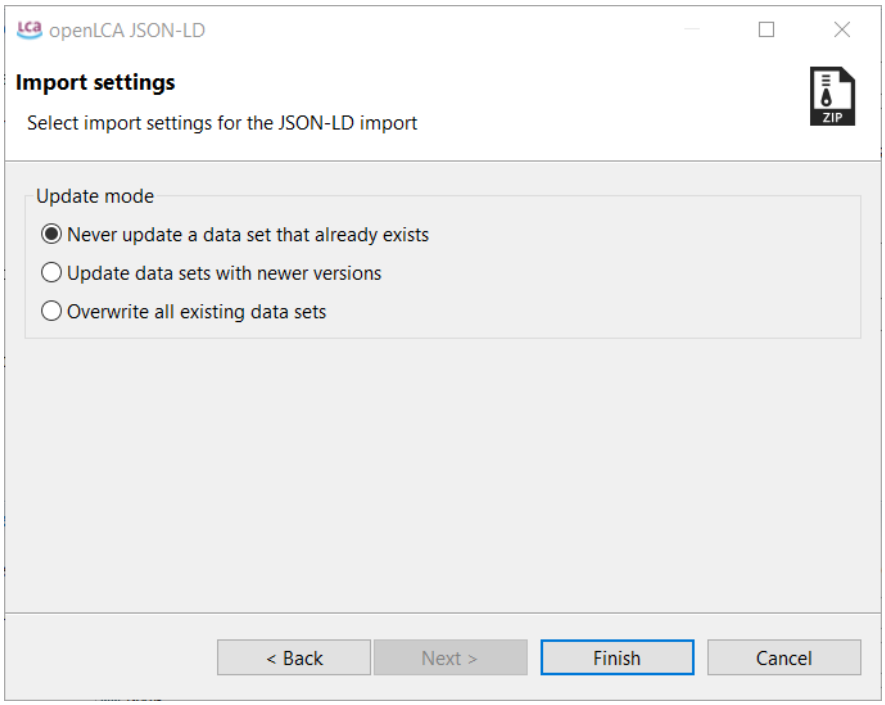

Figure 3.6: Select *Never update a data set that already exists* in the import settings.

Support

GreenDelta GmbH, developer of openLCA, offers openLCA users prioritised and guaranteed professional openLCA support via the GreenDelta helpdesk: https://www.openlca.org/service-contracts/. Public (*User2User*) support for openLCA is available via https://ask.openlca.org/.

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