ecoinvent v.3.4 in openLCA

Software version:	openLCA 1.6.3
Report version:	2
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Content

1 ecoinvent v.3.4 – What's new?

The ecoinvent v.3.4 database was released on the on the 4th October 2017 and included major updates and additions, such as[1]:

- **Updates and Extensions of Electricity Market Data** In the attributional system models, market compositions are available for all 142 countries which are part of the IEA statistics: 100% of (statistically represented) global electricity generation is covered by country-specific market data.
- **Indian Electricity by State and Grid** The electricity production in the ecoinvent database is not just updated on a regular basis, but new geographies are added and existing geographies are divided into smaller geographical regions to provide more detail. India is the seventh largest country in the world (by area), with a booming economy. As such, the role of India is becoming increasingly important when assessing the environmental impacts of the supply chains of many products. That is why more than 160 new electricity production datasets and markets for the 29 states and 5 electricity grids in India were introduced in ecoinvent v3.4.
- **Natural gas**: More than 100 datasets composing the European supply chains (all imports of natural gas to European countries) were updated. With this version, the database consistently reflects the most current technology and supply mixes in all the European countries and their major suppliers.
- **Chemical products**: With the update of more than 120 datasets and the introduction of 50 new products, ecoinvent significantly extended the coverage of the chemical sector. Version 3.4 includes more recent data for main exchanges, such as heat and electricity, as well as production volumes, CAS numbers, formulas, etc.
- **Recycling of PE and PET** New datasets covering the sorting and recycling of post-consumer polyethylene (PE) and polyethylene terephthalate (PET) packaging materials are now included in version 3.4. These new datasets broaden the range of waste fractions and recycling activities covered by the database.

[1] Taken from http://www.ecoinvent.org/database/ecoinvent-34/new-data-in-ecoinvent-34/new-data-in-ecoinvent-34.html

2 Unique and interesting properties and features of the ecoinvent database, continued from version 3.3

Several aspects are worth being noted about the ecoinvent database. They have been provided also with previous versions of the database. These include:

- three different "system model" which reflect different allocation and cut-off rules, and rules for modelling end of life and recycling
- every process dataset is available as unit process and as system process (with very few exceptions) in each of the three system models;
- a separate documentation, as a short pdf report, is available for each data set
- costs are provided for all products, with exception of waste flows and products from recycling

For more information about the content and methodology of ecoinvent v.3.3 database, please check the ecoinvent website about ecoinvent 3.4, and the report of changes for ecoinvent 3.4 from the ecoinvent website.

3 ecoinvent v.3.4 in openLCA

As in previous ecoinvent 3 versions, six data packs generated by the ecoinvent Centre from the undefined ecoinvent database are provided containing the three different system models, all as unit and aggregated (system) processes:

- Allocation, allocation at the point of substitution[2] (unit and system[3] processes)
- Allocation, cut-off by classification (unit and system processes)
- Consequential long-term (unit and system processes)

In addition, access to older versions of the ecoinvent database is also provided when purchasing ecoinvent v.3.4 in openLCA Nexus.

All the different data packs can be used as independent databases in openLCA or combined together, if necessary[4]. Moreover, a combined package for unit and system processes with LCIA method pack is available as well.

Ecoinvent v.3.4 is implemented for openLCA 1.6.3. As with the previous release of ecoinvent in openLCA, the number of product flows is reduced since openLCA allows the same product to appear several times in input or output of a process data set. Consequently, there is only one product flow needed for electricity (of a certain voltage) for example. With the providing process

[2] In ecoinvent 3.1 and previous versions, this system model was named "allocation, default"

[3] Named "LCI" in the data files

[4] It is recommended to always import the data pack of smaller size into the bigger one to reduce the time of the import (e.g. unit process data files into LCI data files).

together, the link between one process and the other becomes unique. This makes modeling more powerful and flexible. Moreover, openLCA includes an advanced **Life Cycle Costing** feature which, in addition to the price data of products included in ecoinvent v.3.4, allows you to calculate the net added value and the life cycle costs of ecoinvent product systems. Furthermore, openLCA includes the possibility of accessing internet sources directly from the source editor. The PDF **data set documentation files**, as well as the unit process (UPR), system process (LCI) and Life Cycle Impact Assessment (LCIA) web pages of the ecoinvent website can be easily accessed for all processes, they are provided as sources in the openLCA databases. Also, as in previous versions, comments for all the exchanges, if included in the original EcoSpold2 files, are now visible in the Inputs/Outputs tab of the processes.

In addition, other improvements carried out for previous ecoinvent versions during their implementation in openLCA are also included in ecoinvent v.3.4: update of the names of the activities to simplify the modelling of new processes and results analysis, update of identifiers of the activities to allow the combination of different system models and process types in a single openLCA database, addition of the values of missing text variables in the metadata fields, refactoring of categories in the allocation models, etc.

3.1 Product flows with multiple providers

In older versions of openLCA (i.e. 1.5.0 beta 1 and previous), a product flow could not be used multiple times in the same process with different providers. As this is the case in most of the activities of ecoinvent 3 (e.g. several electricity flows provided by different electricity markets), it was not possible to have a single product flow produced by multiple activities in the ecoinvent database in openLCA. Consequently, there were several product flows with the same name, location and category but produced by different processes. For instance, “electricity, high voltage” was the reference product of 1,702 processes in the ecoinvent v.3.2, allocation at the point of substitution system model, and, therefore, it was included as 1,702 different flows in openLCA[5] (Figure 1).

[5] In order to facilitate the selection of products, the name of the provider was added in the product name in the openLCA version of ecoinvent v.3.2 (i.e. “product name | provider name”).

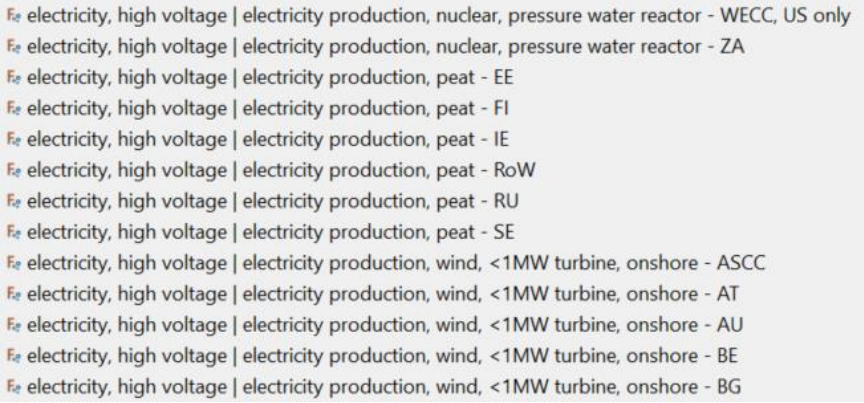


Figure 1: Example of ecoinvent v.3.2 different products with the same name but produced by different processes in openLCA 1.5

However, in ecoinvent 3.4 a unique flow "electricity, high voltage" is included (Figure 2).

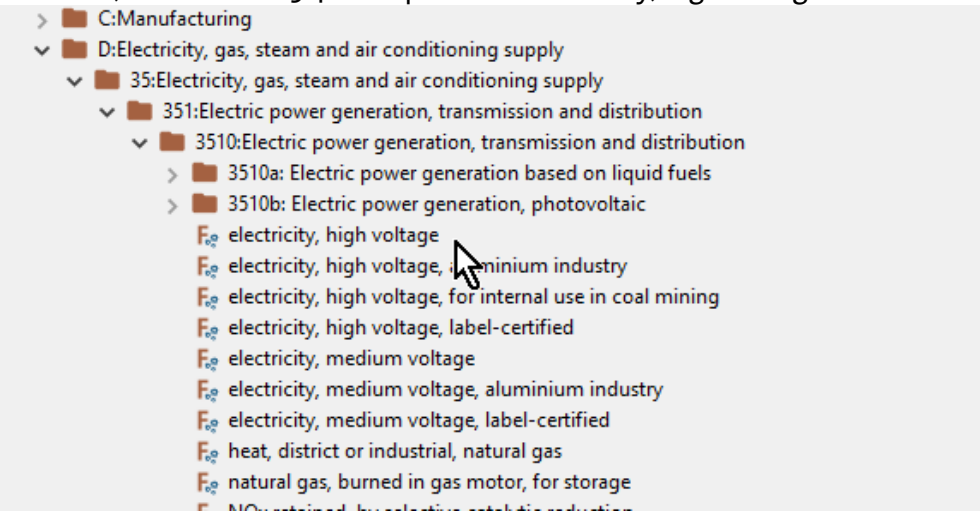


Figure 2: Example of ecoinvent v.3.4 unique products, which can be produced by multiple processes, in openLCA 1.6.3

How is this affecting the **modelling of your own processes** using ecoinvent v.3.4 products? First of all, the selection of the product to be included in your process will be easier due to the reduction in number of flows. Moreover, you will have more flexibility modelling your processes as different providers can be selected for the same exchange, without needing to change the flow too. However, it should be taken into account that as multiple providers might be available per flow, it is recommended to **set always the desired "Default provider"** in the inputs table before creating the product system (Figure 3). That way, when selecting the option "Add connected processes" during the creation of the product system, the supply chain wanted will be added. Otherwise, openLCA will select randomly one of the possible providers for that flow.

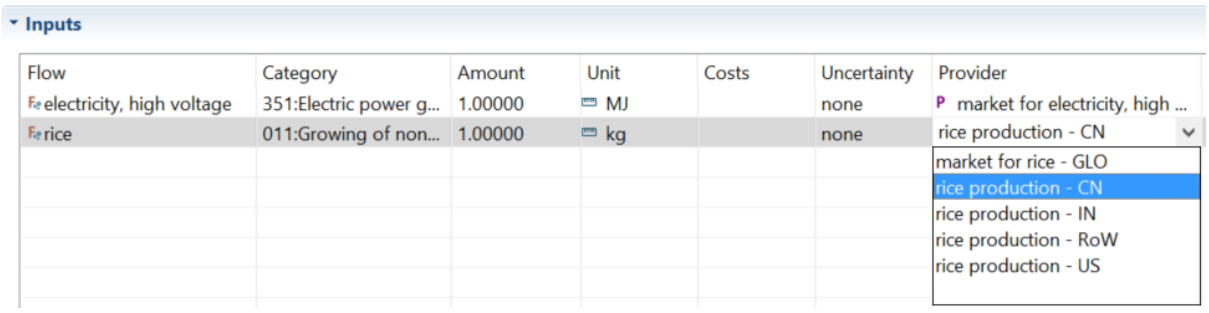


Figure 3: Example of selection of default provider for an ecoinvent v.3.3 product in openLCA 1.5

ecoinvent v.3.4 processes have the default provider always defined for all input products, thus, the connections of the correspondent supply chains will be properly created automatically as in previous versions of the ecoinvent database in openLCA.

3.2 A note on price data

As in previous versions of ecoinvent, the prices are provided per product, and do not differ across different processes or also across different countries. This implies that the prices are the same for unit and system processes, and thus, for system processes, do not reflect life cycle costs but "merely" prices.

Thanks to the life cycle costing features of openLCA, all this information can be used to calculate the net added value of product systems using ecoinvent data. For further details on how to perform such calculations, please check the manual "Life Cycle Costing in openLCA" available in the openLCA website.

3.3 Additional documentation for processes and exchanges

All the ecoinvent v.3.4 processes have four sources in the "Modelling and validation" tab (Figure 4):

- PDF documentation: a report provided by ecoinvent specific of each dataset.
- UPR link: the link to the unit process dataset in the ecoinvent website.
- LCI link: the link to the LCI dataset of that process in the ecoinvent website.
- LCIA link: the link the LCIA dataset of that process in the ecoinvent website.

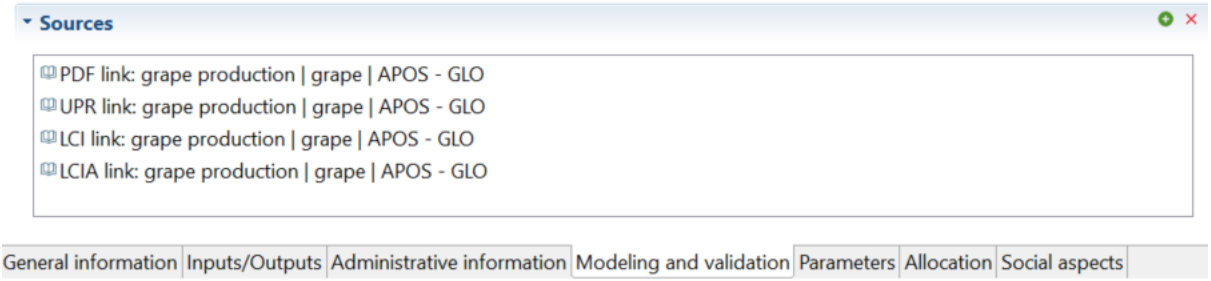


Figure 4: Sources included in ecoinvent v.3.4 for the process "grape production | grape | APOS – GLO" in openLCA 1.6.3

All those sources are stored under "Background data"→ "Sources" and the corresponding category, which equals the process category (Figure 5).

Figure 5: Example of new ecoinvent v.3.4 sources in the navigation pane of openLCA 1.6.3

The source editor in openLCA 1.6.3 is able to access internet links directly from the software. You can select the button "Open" in right of the URL field, and a new tab in your browser will be opened with the corresponding ecoinvent information (Figure 6).

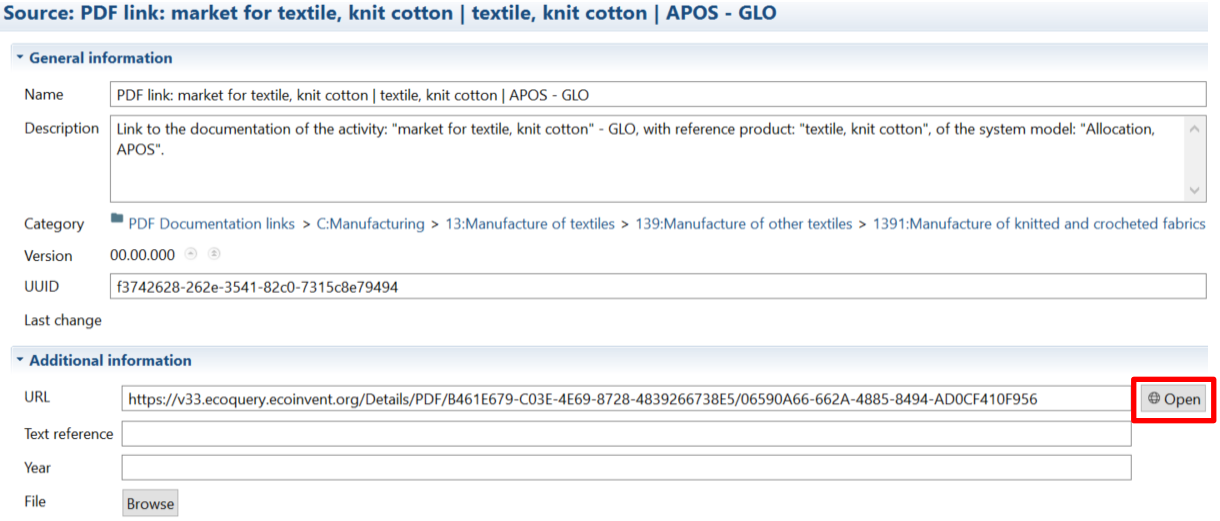


Figure 6: ecoinvent v.3.4 source "PDF link: market for textile, knit cotton | textile, knit cotton | APOS – GLO" in openLCA

Please note that you will need to be logged to the ecoinvent website to access the link. If you weren't logged in, the ecoinvent login page will be shown when clicking "Open" in openLCA. After introducing your login details, you will be redirected to the link included in the source of openLCA. For the PDF documentation, you will be asked if you want to download or open the file.

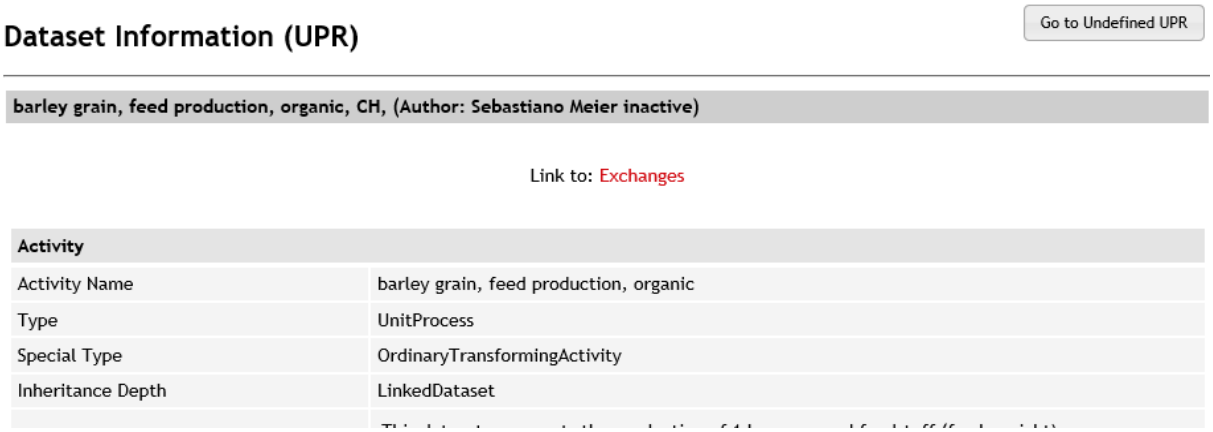


Figure 7: ecoinvent v.3.3 source "UPR link: barley grain, feed production, organic | barley grain, feed production, organic | APOS – CH" in ecoinvent's website

In addition, a field "Description" is available in the Inputs/Outputs tab of the process editor in openLCA, containing additional information about the exchanges as provided in the original ecoSpold2 files of ecoinvent (Figure 8).

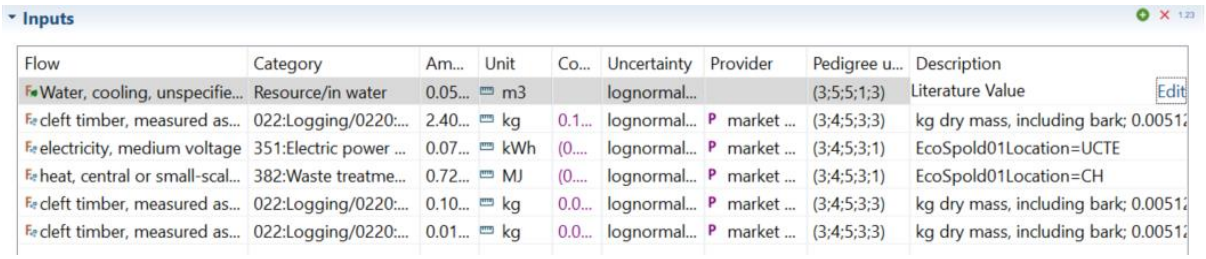


Figure 8: Inputs from "charcoal production | charcoal | cut-off, U" in openLCA 1.5

For long descriptions, you can read and edit their content easily by clicking on the "Edit" button and a pop-up window will be shown (Figure 9).

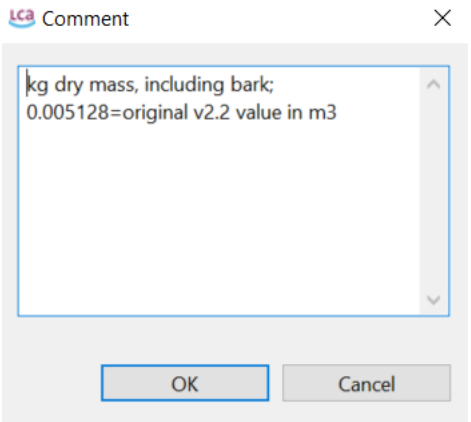


Figure 9: Pop-up window with the exchange description in openLCA

Moreover, some metadata fields had missing text variables or incorrect definition of the content in the original ecoSpold2 files, which made that the data shown after the import in openLCA was not complete. This was corrected also during the implementation and now full comments, technology descriptions, etc. are available.

3.4 Renaming of activities

Some openLCA users pointed out for previous ecoinvent 3 versions that the fact that several processes existed with the same name, location and category but producing different reference products was a limitation for a fast modelling and results analysis. This issue was caused because when applying the different system models in ecoinvent 3, a single undefined activity is split into several new activities producing each of the co-products. However, the name of the original activity is maintained in all of them.

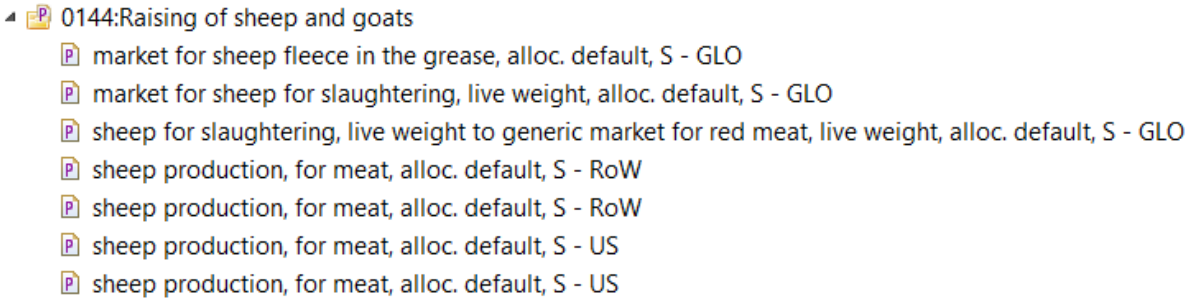


Figure 10: Example of ecoinvent v.3.1, allocation default activities with the same name, location and category in openLCA v.1.4.2

In the new ecoinvent v.3.4 databases, as in v.3.2 and 3.3, the names of the processes have been extended to allow a straightforward identification of each activity without the need of opening the correspondent dataset. The name of the activities in openLCA follows this schema:

Activity name | Reference product name | System model, Process type

The nomenclature used for the system model information is:

- **APOS**: Allocation, allocation at the point of substitution
- **consequential**: consequential long-term
- **cut-off**: Allocation, cut-off by classification

The process types are indicated with “U” for unit processes (i.e. non-aggregated datasets) or “S” for system processes (i.e. LCI results).

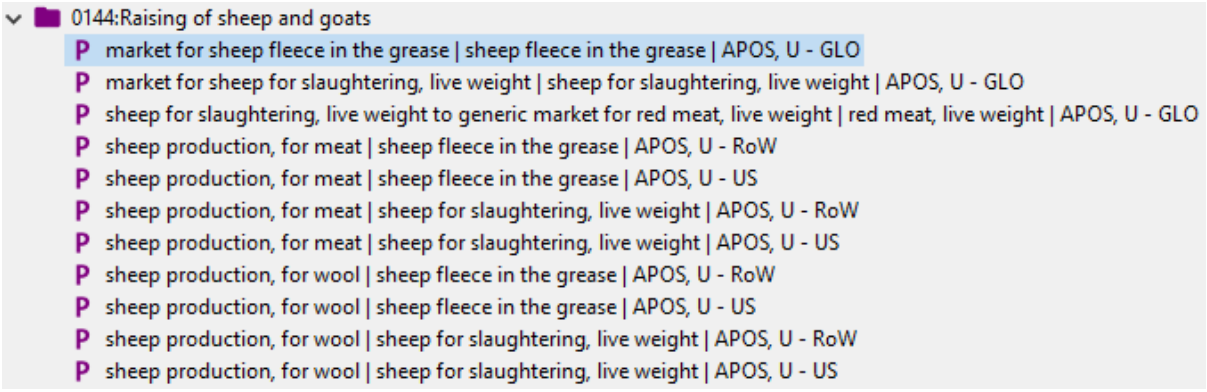


Figure 11: Example of ecoinvent v.3.4, allocation at the point of substitution activities in openLCA v.1.6.3

The information of the system model and the process type is added because users can combine different data packs together in a single openLCA database (e.g. consequential long-term unit and system processes; three system models together; etc.). More information is provided in section 3.5.

Developer box 1: Rewriting activities to their original ecoinvent names

In case you were interested in using the original ecoinvent names, that is, without the additional information described in the sections above, you can use the following Python script:

- **Rewriting activities and intermediate exchanges to their original ecoinvent names:**

```
import org.openlca.io.KeyGen as keygen

def change_process_name(process):
  old_name = process.name
  i = old_name.find('|')
  new_name = old_name[0:i-1]
  process.name = new_name
  olca.updateProcess(process)

olca.eachProcess(change_process_name)
```

Note: This code will delete also the information regarding the system model and process type (i.e. U, S). If you want to add later that information, you can use the following Python script:

- **Adding system model and process type information to original ecoinvent activity names:**

```
import org.openlca.io.KeyGen as keygen

# define the system model and process type here
system_model = 'conseq. long-term'
process_type = 'U'

def change_name(process):
  old_name = process.name
  new_name = '%s, %s, %s' % (old_name, system_model, process_type)
  process.name = new_name
  olca.updateProcess(process)

olca.eachProcess(change_name)
```

If you want to have the additional information in the description fields like in version 3.1, you can use the next script to include the reference product name in the activity's description.

- **Add reference product information to the activity descriptions:**

```
import org.openlca.io.KeyGen as keygen

def extend_descriptions(process):
  process_name = process.name
  process_location_code=process.location.code
  process_description = process.description
  new_process_description = 'Reference product: "%s - %s". %s' %(flow_name,
flow_location_code, process_description)
  process.description = new_process_description
  olca.updateProcess(process)

olca.eachProcess(extend_descriptions)
```

3.5 Update of UUIDs

Previous versions of ecoinvent in openLCA included already the possibility of combining different system models and process types within a single openLCA database, as explained in this video. This feature has been maintained in ecoinvent v.3.4: The Universally Unique Identifier (UUID) of the activities in openLCA are different between system models and process types. This is necessary because if a process with the same identifier exists already in the database, it will not be added during the import.

3.6 Refactoring of categories

The activities and product flows are categorized following the correspondent sectors IDs as included in ecoinvent's metadata, with the idea to provide an easy navigation through the database, as shown in Figure 12.

Figure 12: Overview of some process categories in ecoinvent v.3.4, allocation, cut-off by classification in openLCA v.1.6.3

3.7 Mapping of elementary flows

As with almost all the databases provided in openLCA Nexus, the elementary flows used in the ecoinvent v.3.4 database were mapped to openLCA reference data. This allows more consistency in the elementary flows when combining different inventory databases from Nexus, as well as the possibility of using the openLCA LCIA methods pack.

Several new elementary flows were added to the openLCA flow list because no match could be found in the existing reference list. It should be noted that the openLCA LCIA methods pack has not yet been updated yet to include these[6], but the flows are contained in the ecoinvent LCIA package (see 3.8). All added elementary flows are shown in Table 1.

Table 1. Elementary flows added to the openLCA reference flows lists

SUPERCATNAME	CATNAME	FLOWNAME	REF_ID	FLOW_TYPE
Unmapped flows	air, unspecified	Amine oxide	b157329c-4179-5491-97c4-649900954ffa	ELEMENTARY_FLOW
Unmapped flows	air, unspecified	Bromopropane	f2e4394f-61bb-5493-983d-d3d5b7b96a41	ELEMENTARY_FLOW
Unmapped flows	air, unspecified	Dichlorodimethylsilane	9547aff9-e1fc-5fad-a674-9b9a9fdb1c9c	ELEMENTARY_FLOW
Unmapped flows	air, unspecified	Dimethyldichlorosilane	d0cde0b1-afcc-5179-8895-0aacba2e15a1	ELEMENTARY_FLOW
Unmapped flows	air, unspecified	Ethylene	90f722bf-cb9b-571a-88fc-34286632bdc4	ELEMENTARY_FLOW
Unmapped flows	air, unspecified	Lauric acid	b0d2b7b9-c76d-50d4-b776-b9419ae83abe	ELEMENTARY_FLOW
Unmapped flows	air, unspecified	Octaethylene glycol monododecyl ether	3135755c-1082-5c68-9290-55b858fd7ff2	ELEMENTARY_FLOW
Unmapped flows	air, unspecified	Trisodium phosphate	094310bb-49db-5b2d-ae1b-e7b4ffca1d03	ELEMENTARY_FLOW
Unmapped flows	social, unspecified	residual wood, dry	2c350340-c73c-4f08-855d-35924b1284eb	ELEMENTARY_FLOW
Unmapped flows	social, unspecified	venting of argon, crude, liquid	6ccd9417-aa87-480b-8306-b95c1765e884	ELEMENTARY_FLOW
Unmapped flows	social, unspecified	venting of nitrogen, liquid	a8102643-320a-4044-9e2c-547e29b35898	ELEMENTARY_FLOW
Unmapped flows	soil, agricultural	Fosetyl	794a9d6b-1ed0-486b-a6a9-d8a575c0aa9a	ELEMENTARY_FLOW
Unmapped flows	water, surface water	Oils, non-fossil	8244db98-b33f-4f4e-98e5-39dd130a1713	ELEMENTARY_FLOW
Unmapped flows	water, unspecified	1,3-Dioxolan-2-one	5b7d620e-2238-5ec9-888a-6999218b6974	ELEMENTARY_FLOW
Unmapped flows	water, unspecified	2,4-di-tert-butylphenol	e3d35475-3f5c-5099-9506-8cc81a188fb1	ELEMENTARY_FLOW
Unmapped flows	water, unspecified	2-chlorobenzaldehyde	2b8204fa-c9bf-5465-9aa2-d79024a19b1a	ELEMENTARY_FLOW
Unmapped flows	water, unspecified	Aluminium hydroxide	7b192eb2-644e-544a-9299-4a79cb4dd479	ELEMENTARY_FLOW
Unmapped flows	water, unspecified	Bicarbonate, ion	26e10723-d896-54ec-ab5b-5a4804d2f9ba	ELEMENTARY_FLOW
Unmapped flows	water, unspecified	Bromopropane	f918799d-98d3-5d5d-b02f-480b340d038c	ELEMENTARY_FLOW
Unmapped flows	water, unspecified	Decanoic acid	185d4f1e-6d28-551b-8951-672805c4d8e5	ELEMENTARY_FLOW
Unmapped flows	water, unspecified	Dimethyl hexanediol	2649e223-09c0-5ced-9604-6cd6332e7cf9	ELEMENTARY_FLOW
Unmapped flows	water, unspecified	Dimethyl hexynediol	95a9f739-736a-57fe-b592-dfb52251ef1e	ELEMENTARY_FLOW
Unmapped flows	water, unspecified	Dimethyldichlorosilane	4c8e3c03-0943-5ddd-aa22-c0314291fdf9	ELEMENTARY_FLOW
Unmapped flows	water, unspecified	Diphenylether-compound	1d8560a8-23e0-57f0-ade2-69103c953de8	ELEMENTARY_FLOW
Unmapped flows	water, unspecified	Elemental carbon	3ff3231e-3c38-5a47-a6fd-821d11c599e0	ELEMENTARY_FLOW
Unmapped flows	water, unspecified	Glucose	c082af51-1644-52fc-b49d-5b6c65eb1865	ELEMENTARY_FLOW
Unmapped flows	water, unspecified	Lauric acid	4dc5b593-5953-57de-b908-c3c34a558f40	ELEMENTARY_FLOW
Unmapped flows	water, unspecified	Oxygen	c2fa3c88-ff02-5b95-8f4a-8fa1e5183873	ELEMENTARY_FLOW

If you are interested in having the ecoinvent v.3.4 data pack provided in openLCA Nexus without openLCA reference data, please contact us.

3.8 ecoinvent LCIA methods

For the databases, a specific ecoinvent Life Cycle Impact Assessment (LCIA) method pack is available on Nexus, provided by us for free. We converted an excel file published by the ecoinvent centre; the previous EcoSpold1 implementation by the ecoinvent centre was not available any more.

The ecoinvent LCIA methods packs provided in openLCA Nexus are intended to be used ONLY with the correspondent ecoinvent database in order to reproduce the LCIA results reported by

[6] This is planned for February 2018

the ecoinvent Centre. They should not be used with other databases available in Nexus as not all the openLCA elementary flows are characterised in them, only those used by the ecoinvent databases.

Documentation of the LCIA implementation in ecoinvent v.3.4 is included in a report that is linked to the respective source in openLCA (Figure 13). It is included in the database, thus opens without internet access, but of course it is also available on the ecoinvent website.

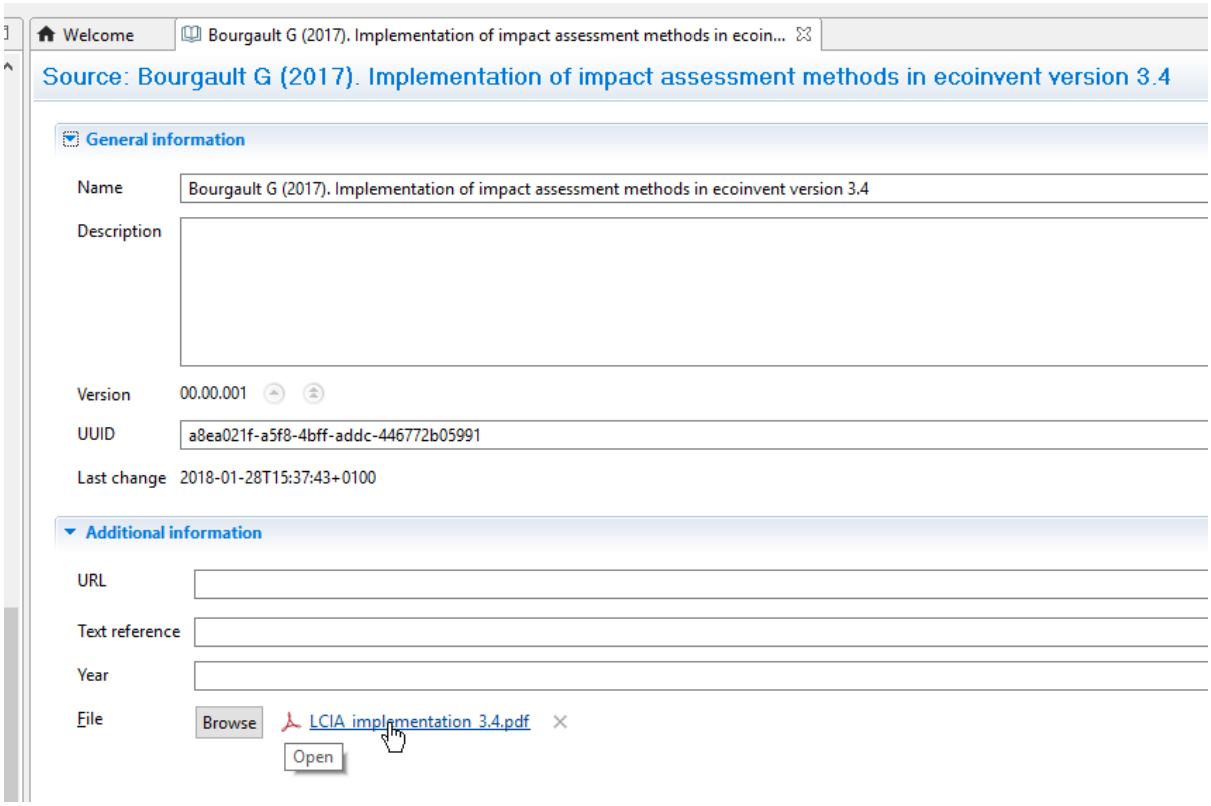


Figure 13: Direct link to the LCIA method report from the source in openLCA

For additional information regarding the implementation of LCIA methods by the ecoinvent Centre, please check:

Hischier R., Weidema B., Althaus H.-J., Bauer C., Doka G., Dones R., Frischknecht R., Hellweg S., Humbert S., Jungbluth N., Köllner T., Loerincik Y., Margni M., and Nemecek T. (2010) Implementation of Life Cycle Impact Assessment Methods. Final report ecoinvent v2.2 No. 3. Swiss Centre for Life Cycle Inventories, Dübendorf, CH.

4 Converting own datasets from ecoinvent v.3.2 (to ecoinvent v.3.3 +)

As mentioned previously in this report, the ecoinvent v.3.3 and 3.4 identifiers could not be updated to match with those in ecoinvent v.3.2 as multiple products from ecoinvent v.3.2 correspond to a single ecoinvent v.3.3 / 3.4 flow (see section 3.1 for details). However, a Python script has been created to facilitate the conversion between ecoinvent v.3.2 and v.3.3; it works both for 3.3 and 3.4. The procedure would be (here with ecoinvent 3.3):

1. Download the zip file “Convert own datasets from ecoinvent v.3.2 to ecoinvent v.3.3” available in Nexus (i.e. ecoinvent v.2.2&v.3.3 → Database details → Additional documentation).
2. Extract the content of the zip file.
3. Activate the openLCA database containing your own processes using ecoinvent v.3.2 products.
4. Open the Python file “Conversion of ecoinvent v.3.2 to v.3.3.py” with a text editor (e.g. NotePad+), copy the content and paste it into the Python editor of openLCA (i.e. Window → Developer tools → Python).
5. Update the directories in the Python script for the other files included in the zip (i.e. “mapping_ei32_to_ei33.csv” and “categories_ei33.csv”). Please, note that the name of the file must also be included.
6. Update the directory where you want to store the conversion reports. Please, note that only the directory where you want to store the files should be written ending with “/”. The names of the files generated will be report_conversion_other_processes.csv" (i.e. for your own processes) and “report_conversion_ecoinvent_3_2_processes.csv”.
7. Run the Python script in openLCA (i.e. green arrow in tool bar).
8. Once the conversion is finished, you can export your processes, product systems and projects using the JSON LD format (i.e. File→Import→JSON LD → select the specific datasets that you want to convert).
9. Download from openLCA Nexus the ecoinvent v.3.3 data pack you are interested in (e.g. ecoinvent 3.3 – consequential long-term LCI) and import the file into openLCA.
10. Import the JSON LD exported in step 8 into the new ecoinvent 3.3 database (i.e. File→Import→JSON LD import).

During the import, as the ecoinvent v.3.2 products and process UUIDs were previously modified to the ecoinvent v.3.3 identifiers, those processes and flows existing in both versions will be mapped to v.3.3. The correspondence file provided by the ecoinvent Centre was used for the mapping. However, it should be noted that there are some activities/products that could not be included in the automatic mapping during the import. Consequently, they will be imported to the new database, and further conversion work would be needed. Those are:

- Activities/products replaced by more than 1 activity/product in ecoinvent v.3.3
- Activities/products which have been deleted in v.3.3

Moreover, there are some activities/products mapped differently depending on the system model. Therefore, it is strongly recommended, if you have combined multiple ecoinvent v.3.2 system models or unit and LCI datasets into the openLCA database, to have all the default providers set for the ecoinvent products used in your own processes.

If your database contains also product systems or projects, these will also be imported.

It is also possible to export your processes or product systems, for example, as **ILCD format i**n step 8 and import them into the new database. The flows and processes existing in both databases will be mapped to the ecoinvent v.3.2 datasets. However, due to limitations in the

format, the information regarding the default providers in the process datasets will be lost. Moreover, if a product flow used in the process dataset is not included in v.3.2 or there is not a direct match to the new product flows, there will not be a provider for that flow unless the correspondent ecoinvent v.3.2 producing process is also included in the file imported.

If you were interested in GreenDelta carrying out the complete conversion of your datasets or assist you with the conversion, please contact us.

5 Quality assurance

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 Centre. As it can be observed in the example plotted in Figure 14, the LCI results obtained in openLCA were almost equal[7] to the ecoinvent system processes, with the exception of the social flows in the consequential model; however, as explained in section 6.1, ecoinvent recommends to ignore those flows in the current database.

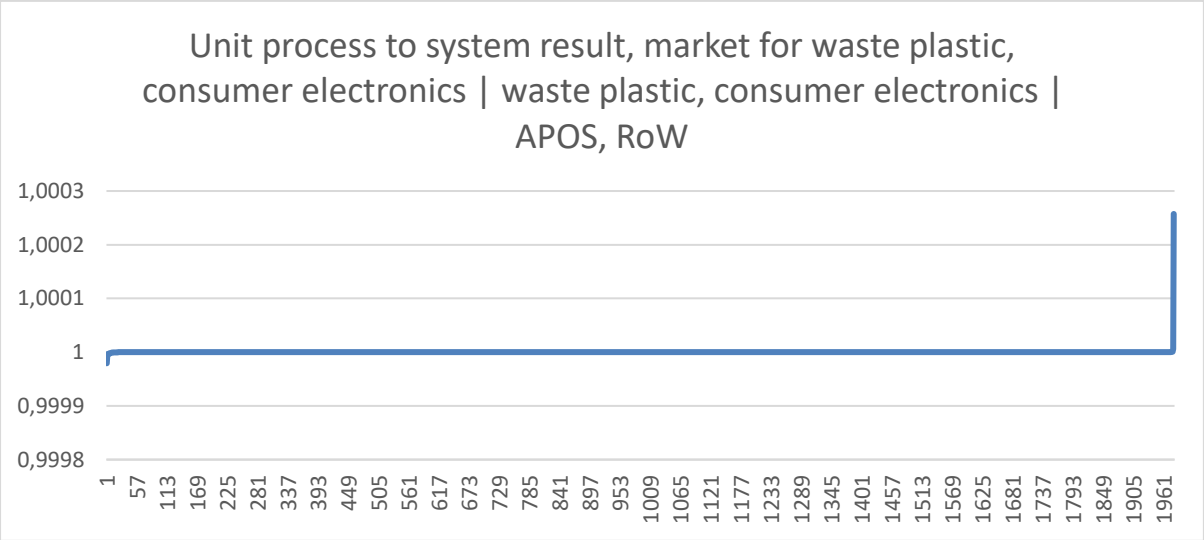


Figure 14. Ratio unit process LCI results to LCI process for "market for waste plastic, consumer electronics | waste plastic, consumer electronics | APOS - RoW", ecoinvent v.3.4, openLCA v.1.6.3 (i.e. ratio of 1 represents equal inventory values), sorted

6 Known issues, limitations

6.1 Database

- The **input exchanges listed in Table 2 were changed in the consequential long-term system model**; basically, the two products are only produced by the same process, with amount on

[7] Slight differences might be caused by rounding during the calculation

the input and output side. In consequence, these two products cannot be produced from the system model, and two new products, "...input", were added[8].

Table 2. modified input exchanges in the consequential long-term system model

Intermediate exchange	Activity	Location	Amount	Unit
residual wood, dry	market for residual wood, dry	GLO	1	m^3
venting of nitrogen, liquid	market for venting of nitrogen, liquid	GLO	1	kg

This was necessary due to an error in the original EcoSpold2 files, where the default providers indicated for the exchanges were activities not producing those product flows. This issue will be fixed by the ecoinvent Centre in next versions of the ecoinvent database.

- According to ecoinvent, the following **social flows included in the consequential, long-term system model should be ignored:** "residual hardwood, wet", "residual softwood, wet", "residual wood, dry", "venting of argon, crude, liquid" and "venting of nitrogen, liquid". The inventory results for these flows obtained using product systems with unit processes will not match the LCI results provided by ecoinvent.
- **No mathematical relations (i.e. parameters) are included** in the openLCA data packs because they refer to the undefined activities, that is before allocation, and may not be reflecting the amounts in the dataset any more. If you are interested in checking them anyway, you can review the EcoSpold2 files available in the ecoinvent website[9].

Other known issues of the ecoinvent v.3.3 database are listed in the ecoinvent website.

6.2 openLCA

Exchange properties: In many cases, there are different properties specified for the different exchanges which are not flow-specific, but exchange-specific in the original ecoSpold2 files (e.g. carbon content, water content, price, etc.). Currently, it is not possible to display in openLCA this information, so it is recommended to the users interested in it to review the EcoSpold2 files available for download in the ecoinvent website.

Memory: With an increased ecoinvent database size, the new product systems in openLCA typically have about 11,000 processes and about 100,000 connections. This can be seen when enabling the "statistics" sheet for product systems, in preferences.

[8] In the openLCA ecoinvent 3.3 version, the same issue existed which is obviously an ill-specified model; then, these flows were deleted in the openLCA implementation; however, since openLCA can deal with products in the inventory which are not produced by a process, the newly added "input" products reflect better the real model we think

[9] Login information to the ecoinvent website is provided after the ecoinvent license is granted in Nexus, except for the yearly licences.

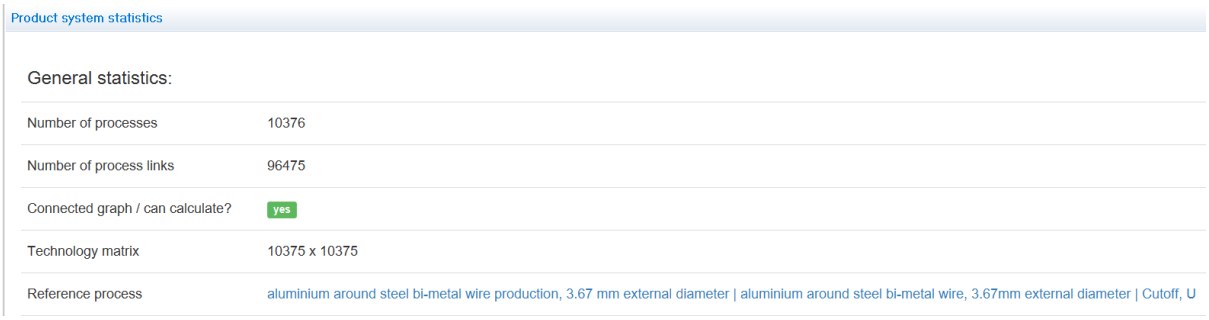


Figure 15. Statistics for the product system created for aluminium around steel bi-metal wire production, 3.67 mm external diameter

openLCA is able to handle these systems efficiently, which means an acceptable calculation time, and also memory requirements (about twice as fast as other LCA softwares which are unit process based); however, to calculate a full model, **6GB of RAM** should be available, which means that the 64 bit version of openLCA should be used. Also, openLCA should be granted this memory, in preferences.

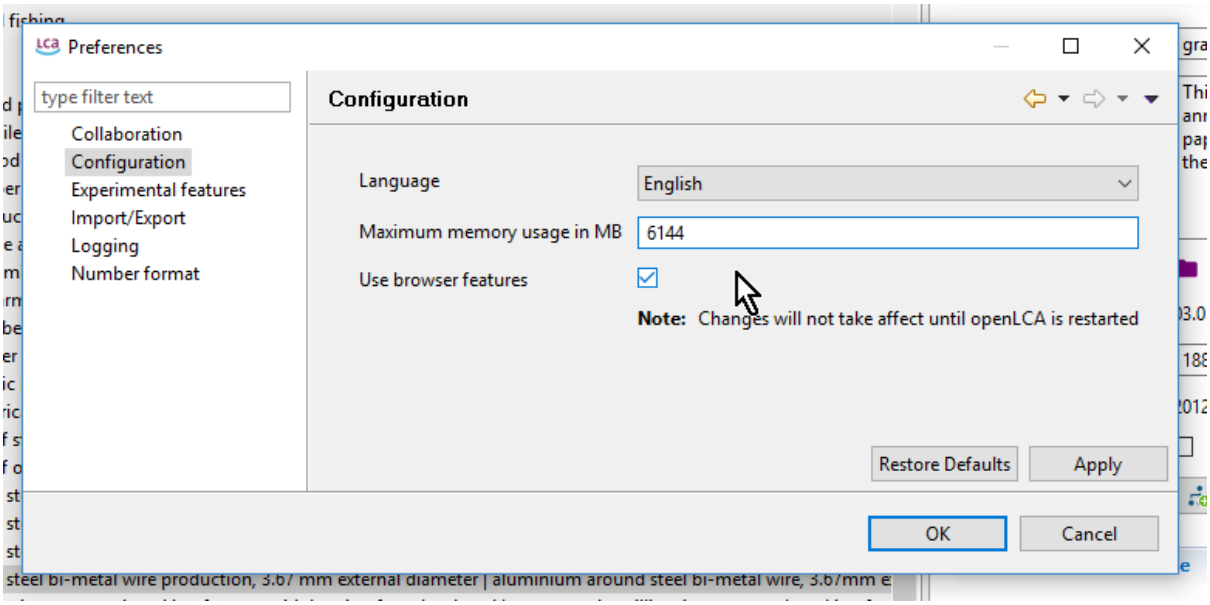


Figure 16. specifying the maximum memory openLCA can use

If this is not possible, openLCA allows to specify a **cut-off when creating the product system**, which both reduces the number of processes and the number of connections (and also the result, of course, but for smaller cut-offs the impact should not be dramatic. You can control the impact by checking the system process result.

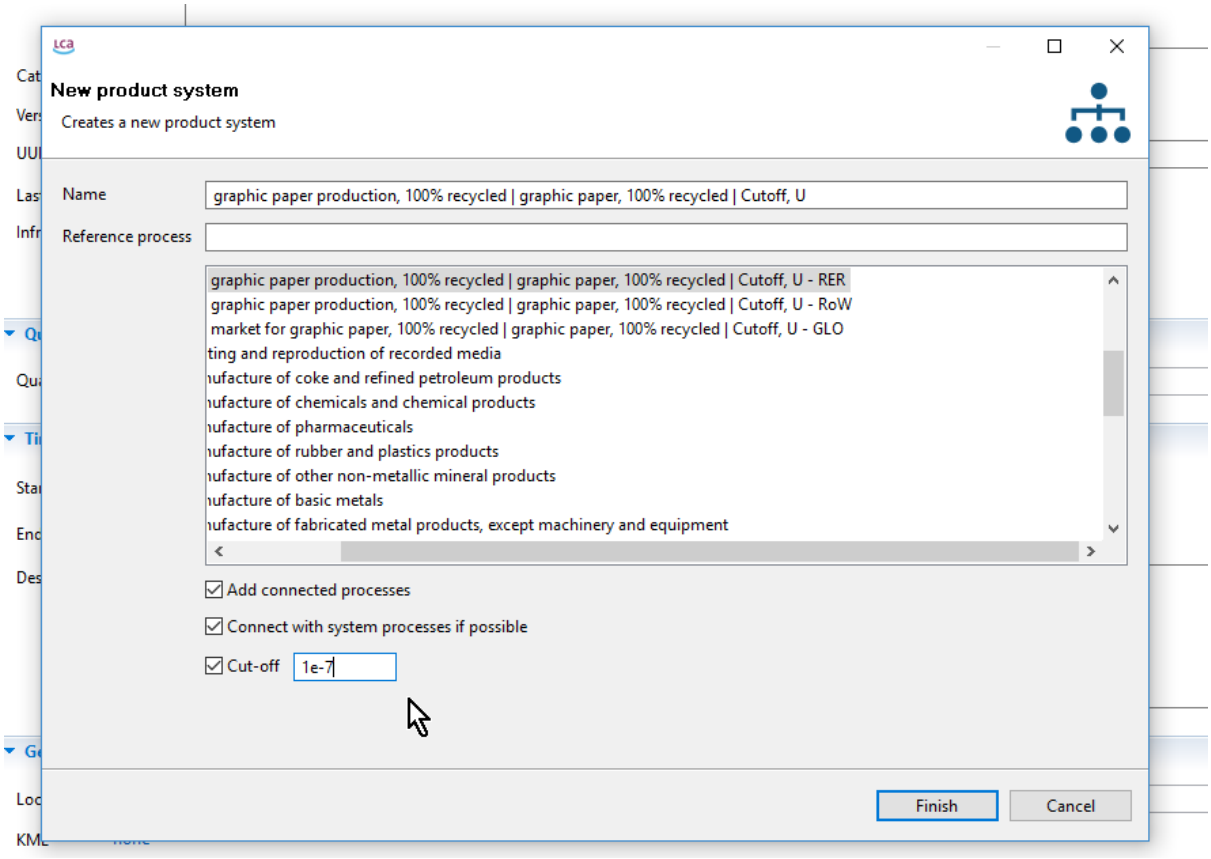


Figure 17. Setting a cut-off when creating a product system

As a third option, **system processes** can be used to create a model. The product system should then not created automatically but in the model graph, thus unclick “add connected processes” in the new product system dialog (Figure 17).

7 Migration of processes from ecoinvent 3.3 to ecoinvent 3.4

To enable users to import their product systems in the newest version of ecoinvent without having to manually select all providers again, the UUIDs from ecoinvent 3.3 processes were synchronised with ecoinvent 3.4, this way it is possible to update models by just importing the foreground system from ecoinvent 3.3 into the new database.

However, some unit processes from ecoinvent 3.3 became system processes in ecoinvent 3.4 in this case the different UUIDs were kept, hence the providers have to be manually selected after importing the foreground system.

The Figure 18 below shows one example process “TestProcess” created in ecoinvent 3.3 and imported in ecoinvent 3.4 without losing the providers.

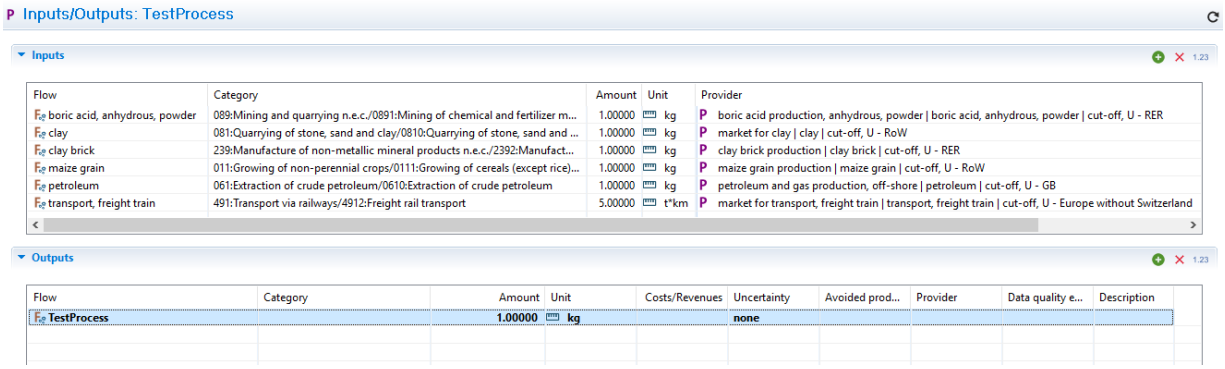


Figure 18: Test process created in ecoinvent 3.3 cutoff unit process and exported in JSON-LD format.

Important: This is only possible between the same type of databases, for instance between 3.3 and 3.4 cut-off or between 3.3 and 3.4 APOS databases.

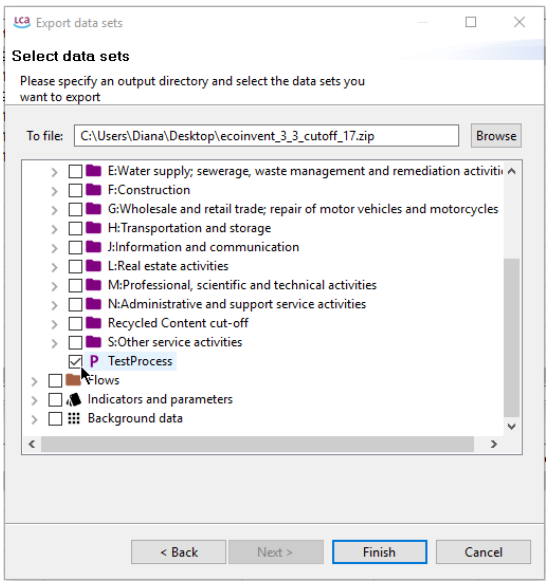


Figure 19: „TestProcess“ export from ecoinvent 3.3 database in JSON-LD format.

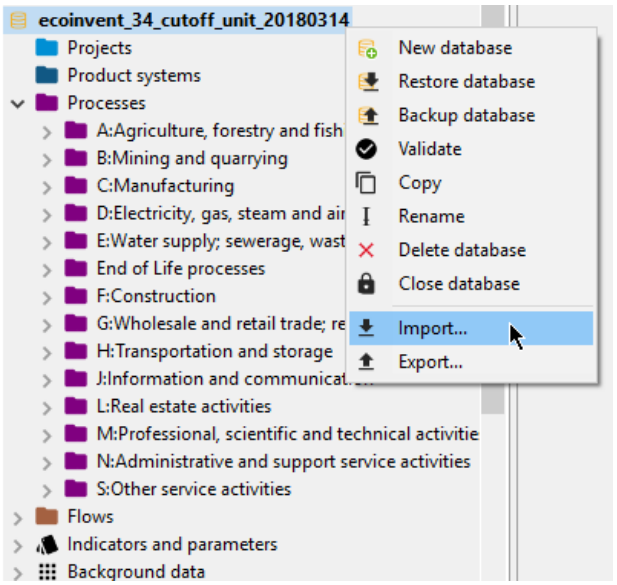
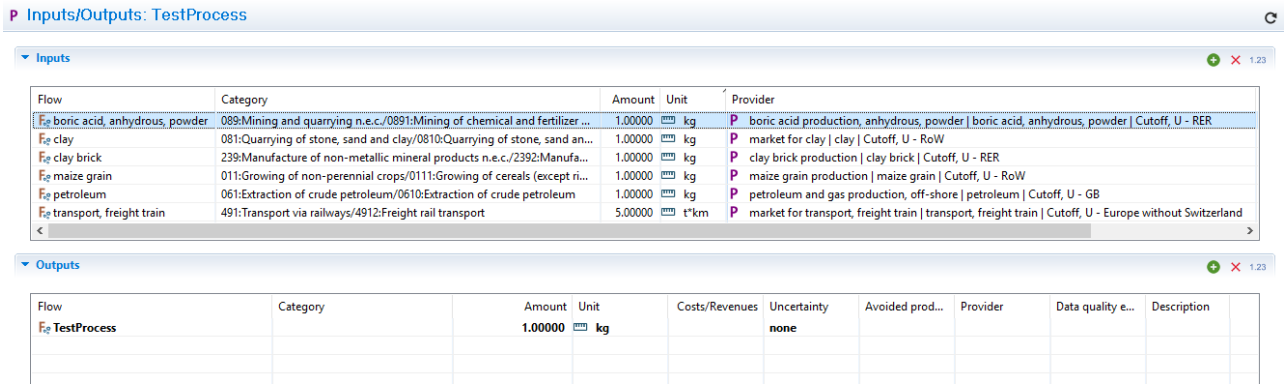


Figure 20: Importing of „TestProcess“ into ecoinvent 3.4 cut-off unit process database.

Once the process is imported it can be opened in the process editor and the providers settled in 3.3 will still be settled but with 3.4 processes like in *Figure 21:* as long as it does not fall in the special case highlighted above.

Figure 21: „TestProcess" imported into ecoinvent 3.4 cut-off unit process database.



8 Summary

The ecoinvent v.3.4 in openLCA contains all the numerous updates and new data from the ecoinvent Centre, as well as the following benefits:

- Extended cost/revenue data in the ecoinvent v.3.4 database that can be used with the new Life Cycle Costing features of openLCA 1.6.3.
- Possibility of using the same flow with multiple providers in a process, which simplifies the modelling of your own processes using ecoinvent products.
- Easy access from openLCA to the PDF reports and links to ecoinvent's web pages of the unit process dataset, LCI and LCIA results per process.
- Possibility of combining different system models and process types in a single openLCA database.
- Guidelines for conversion of processes using ecoinvent v.3.2 intermediate exchanges to ecoinvent v.3.4.
- More user-friendly naming of activities.
- Access to the pack of LCIA methods as implemented by the ecoinvent Centre, in order to reproduce their LCIA results.
- Possibility of using the openLCA LCIA methods pack thanks to the mapping of elementary flows to the openLCA reference list.

If you have other questions not addressed by this report, need further clarifications on any of the points commented, or have comments about the ecoinvent v.3.4 database in openLCA, please contact us.