How to Export from SimaPro to ILCD packages

A Guide for SimaPro 9

SimaPro

Title: How to Export from SimaPro to ILCD packages

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About SimaPro

SimaPro was developed by PRé with the goal of making sustainability a fact-based endeavor. PRé has been a leading voice in sustainability metrics and life cycle thinking development for nearly 30 years, pioneering the field of environmental and social impact assessment. We develop tools that help you create value and drive sustainable change.

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Fact-based sustainability

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1 Overview

What you will learn	How to export system processes from SimaPro to ILCD format
Required entry level	Intermediate (make sure you know what characterization factors in an LCIA method are, that you have read the Guide for EF compliant data sets [1] so you know what the EF nomenclature and LCIA are. Ideally you should also have a copy of the EF reference package [2] on your computer so you can check if the flows you are using are characterized in EF)
Recommended reading	SimaPro System vs. Unit Processes [3] Guide for EF compliant data sets [1] We recommend you download a copy of the EF reference package [2] for the EF version number you are using for getting metadata
Project needed	None
Approximate time needed	30 minutes

Don't use export to ILCD if you want to transfer data from between SimaPro installations

The EF nomenclature does not cover all the substances, types of emission/extraction (compartment), and geographies that can be selected in SimaPro, therefore unfortunately, but unavoidably, some information is lost. The export matches substances where this can be done unambiguously, and generalizes in many cases where it is not, but in some cases this is not possible.

We recommend you **export your SimaPro database or export to SimaPro files** if you simply want to transfer data from one SimaPro installation to another. This will preserve the information from your modelling.

The ILCD format is useful for transferring data between different types of software, and making it accessible to all users.

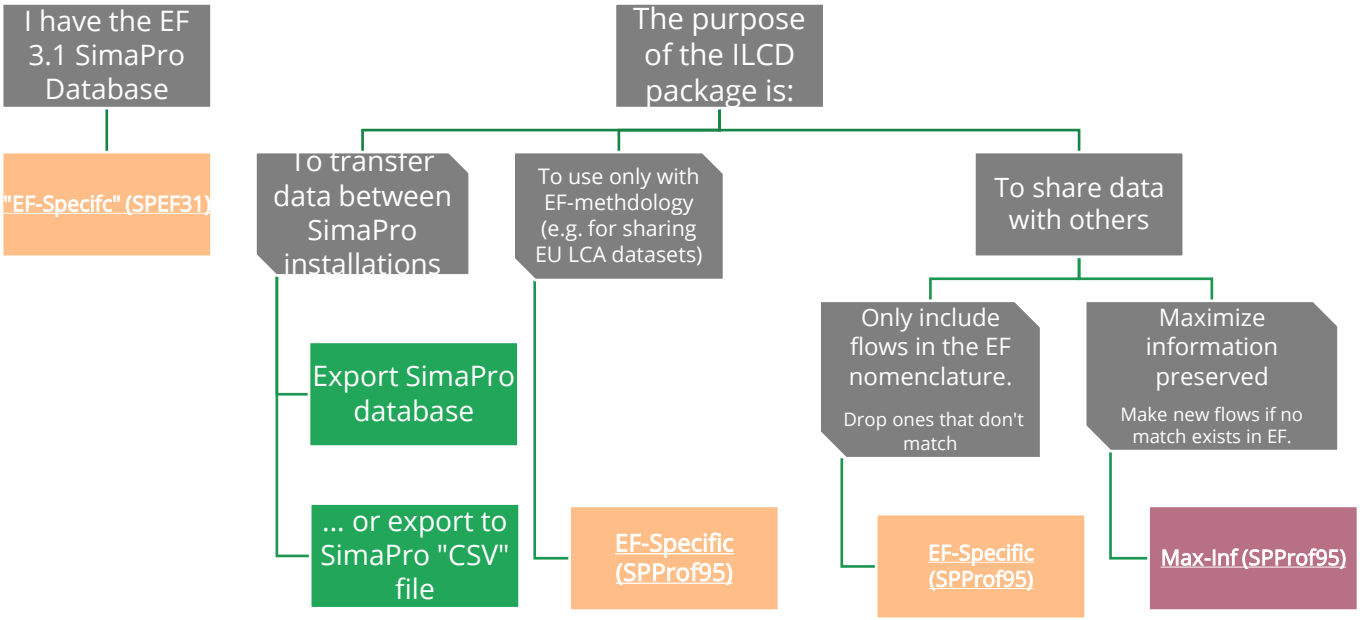
2 Glossary

- *ILCD* (International Reference Life Cycle Data System), a file format for LCA data
- *EF (Environmental Footprint)* : can mean one of two things
    - A **nomenclature system** (list of elementary flows permitted) for an LCA dataset
    - An **LCIA methodology**, to be used only with datasets containing only elementary flows in the EF nomenclature system

      Note that EF 3.0 and EF 3.1 substance nomenclature are identical, only the associated LCIA methodology differs
- *Elementary flow :* See *Substance*
- *LCI*, *Life Cycle Inventory*: a list the flows/processes used in an LCA
- *LCIA methods*: Life Cycle Inventory Analysis method, such as the Environmental Footprint LCIA method or ReCiPe
- *Main compartment*: The way in which emission/extraction of a substance occurs. For instance, carbon dioxide" can be emitted to air (SimaPro main compartment "Airborne emissions" /"air" in the mapping file), water or soil. It can also be a Raw material. A SimaPro main compartment is analogous to class 1 categories in EF nomenclature, with the exception of raw materials, which map either to EF categories "Resources" or "Land use" depending on the sub-compartment selected in SimaPro.
- *Sub-compartment*: The way in which a resource is extracted from, or emitted to, the environment, within a given compartment (see "*main compartment*"). This decides which characterization factor is chosen. For example, an LCA calculation may need to calculate the impacts of carbon dioxide emitted to the *sea*, *lake*, and the *long-term* impact on *river water* separately. In SimaPro these would be represented by setting main compartment to "Waterborne emissions", and sub-compartments to "ocean", "lake" and "river, long-term". The "*(unspecified)*" sub-compartment in SimaPro corresponds to leaving the sub-compartment blank on the input/output tab when editing a process, and gives the general characterization factor if it is characterized. A SimaPro sub-compartment corresponds to EF class 2 categories in EF nomenclature, with the exceptions noted above (see "*main compartment*")
- *Substance:* is the extraction of a resource from the natural world, or an emission into the natural world. Examples include raw iron ore extracted from the ground, or carbon dioxide emitted to air. Waste flows, non-material emission (e.g. sound), and social issues are also regarded as substances in SimaPro. This differs from a product flow in which is a substance created/processed in the technosphere and exchanged within the technosphere. A SimaPro *substance* is directly equivalent to the concept of an *elementary flow* in EF terminology published by the European Commission [4].

3 Which mapping file should I use?

There are three mapping files – two for the Professional 9.5 database and one for the SimaPro EF 3.1 SimaPro Database. Which one to choose depends on your use case:



See the table below for more details of differences between the mapping files.

Mapping file	Substance ids, version numbers & names	Geographies for regionalized elementary flows
*SimaProTo**EF31**Mapping_**ef-spec**.xlsx*	EF 3.1 nomenclature	EF 3.1 nomenclature
*SimaProTo**EF31**Mapping_**max-inf**.xlsx*	EF 3.1 nomenclature SimaPro nomenclature, where flow does not exist	All geographies in SimaPro
Naming convention: *SimaProTo**{Nomenclature}**Mapping_**{mapping type}**.xlsx*		

Note:

a) In general if you aim to create EF-compliant datasets use the mapping file for your EF version number ending in "***ef-spec***". If you are exporting data and want to maximise the information from SimaPro retained in the ILCD package, and might use it with other LCIA methods, use ***"max-inf"***.

b) Even with *max-inf* not all information from SimaPro is retained when exporting to ILCD packages, for instance metadata.

c) For instance using *SimaProTo**EF31**Mapping_**ef-spec**.xlsx* will create an ILCD package formatted using the EF 3.1 nomenclature specification, and if the geography does not exist in EF it will be exported to the larger region or *GLO*. The mapping from SimaPro geography to EF geographies can be found in *SimaPro_ILCD_GeographyMappings.xlsx*. The XML file *ILCDLocations_Reference_SimaProProfessional95.xml* (following the ILCD schema) lists the extra locations used by SimaPro (exported when using the max-inf mapping file) following the ILCD schema for location information.

These mapping files only support the export of life cycle inventory data in ILCD format, not metadata

This mapping file will generate working ILCD files, and will ensure that the correct EF flow names (using EF reference package [2]) are used for substances that are included in this file, but does not include all of the metadata that is required for entry-level ILCD requirements and/or EF-compliant datasets. These can be added using the ILCD Editor [4] tool provided by the European Commission or a text editor.

4 About the mapping

This mapping was produced by matching the names, CAS numbers, and our databases to map the two different nomenclatures of SimaPro to those of the EF 3.1 reference package. There are more than 88000 SimaPro substance-compartment combinations that can be selected in SimaPro Professional Database and that are matched by this mapping file with EF elementary flows. These uniquely define which characterization factor, if available, to use when calculating the impact of that flow.

There are 94062 in the EF3.1 reference package. There are substances in SimaPro that are not covered EF 3.1. For instance the SP substance "*copper ore*" cannot be matched, since EF only provides an elementary flow for the *element* copper, and since copper ores vary in composition, there is no rigorous and consistent way to convert 1kg of copper ore into a corresponding amount of copper for every situation. Cases where flows don't match are not only because of lack of number, but also because flows in SimaPro were defined by the creators of the methods which it supports, and these may not be compatible with other nomenclatures. Therefore if you are using substances with no exact match try the *max-inf* version and check if there are impacts on your results (see the box *"Double check your impact assessment results"* below). You may also wish to use the SimaPro EF database instead of the SimaPro Professional database, which only contains flows in the EF nomenclature, but does not support other LCIA methods. For a list of types of flow that are not converted by this mapping, see Section 0.

Since EF has a limited number of geographies, we provide two mapping files for each EF version number:

1. **"ef-spec"**: this only maps to elementary flows and geographies that are in the EF nomenclature. Note that not all flows in the EF nomenclature that are not characterized in the EF method, and also some flows are only characterized for a subset of geographies (see info box below).

2. **"max-inf"**: This maximises the information from SimaPro retained in the exported files, which includes additional geographies covered by SimaPro but not covered by EF, such as International Aluminium Institute regions (IAI) from ecoinvent [5].

Double check your impact assessment results

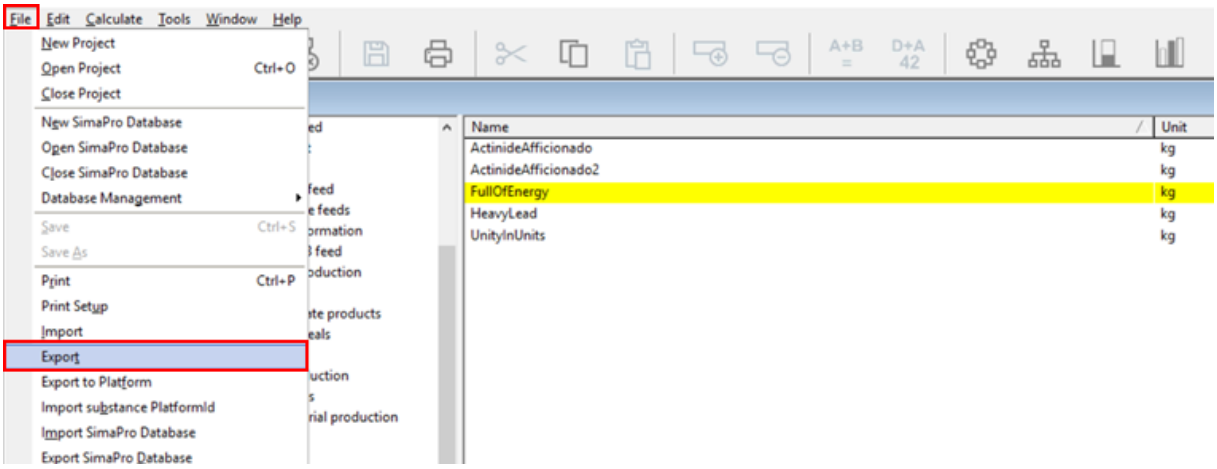
To check if the export has an impact on your results, we recommend you run your calculation in SimaPro before exporting, and then compare with the results using the exported ILCD package and the characterization factors in EF reference package [2] for the EF version number you exported to. Furthermore, some flows are only characterized for a subset of geographies. At the time of writing these characterised geographies are 2 letter ISO codes and unspecified. You can check the "lciamethods_CF" tab in the JRC's Excel workbook, is it possible your flow is not characterized?

A warning will be raised during the export if a SimaPro substance is found for which there is no EF elementary flow in the mapping.

If you are using ef-spec the flows will be removed, if using max-inf new flows will be added, but these will only be characterized by their original methods, and have random UUIDs assigned to them. The user must manually check such flows if they cause issues in other software. This can be done either before export within SimaPro by ensuring there are no non-compliant flows, or after export using a tool such as the European Commission's ILCD Editor.

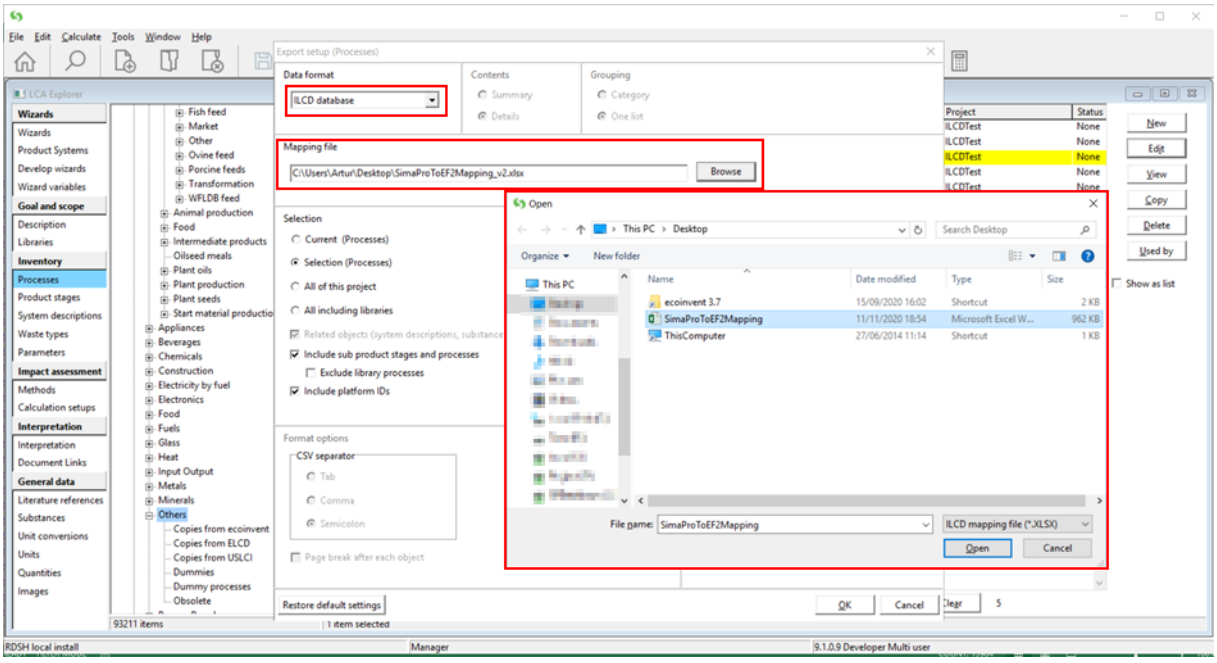
5 How to use the mapping file

1) Download the latest mapping file from the SimaPro website. See above to download the correct version.
2) Select a process(es), or product stage(s) to export and convert it (them) to system processes. For more details on system processes, and a video guide on how to create them, see here [3]
3) Select the system processes from step 2, and choose File->Export in the navigation bar at the top of the Window



Export the mapping file by going to the *"File"* menu

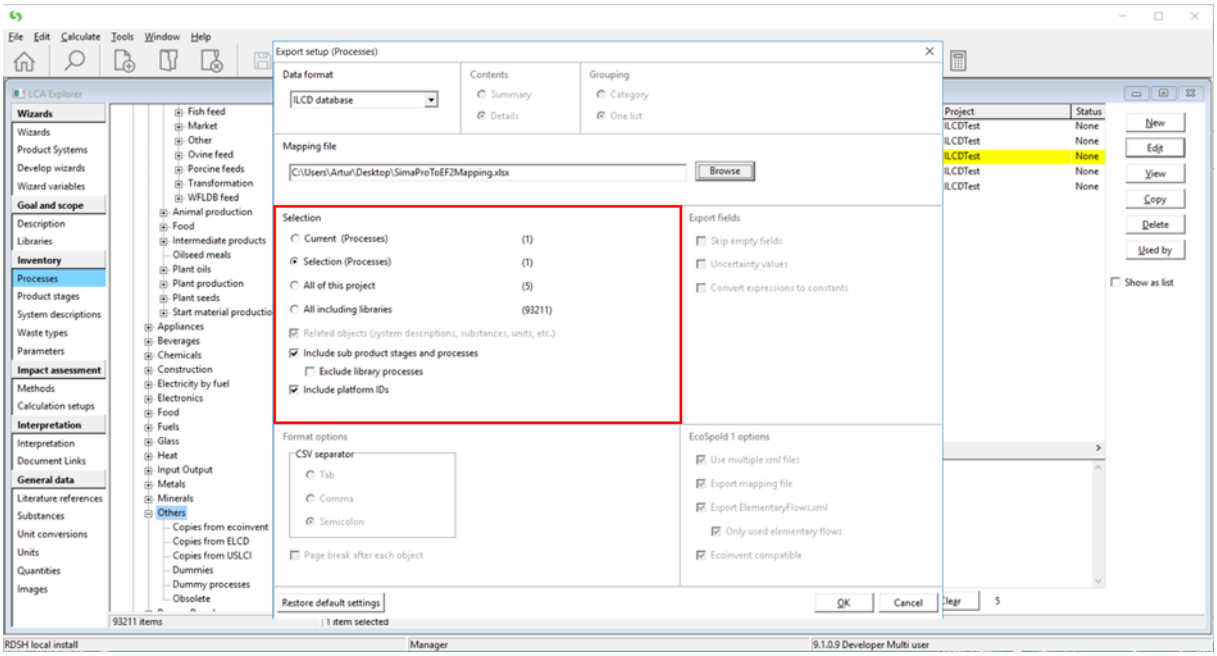
4) Select "ILCD Database" as the data format. In the mapping file input, type in or navigate using the "*Browse"* button to the Excel file you downloaded in the previous step.



Choose the mapping file

5) Choose whether to export only the current process, the selected processes or the entire project. Make sure to only select system processes because the ILCD format does not support the export of disaggregated (i.e. unit) processes. Deselect the options *Include sub product stages and processes* and *Include platform IDs*.

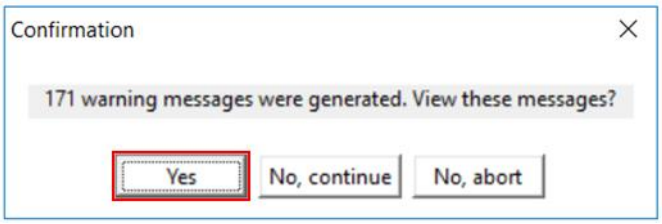
6) Press Ok, select a location to store the ILCD zip files. Don't forget to **put the nomenclature in the name of the file you are making**, to make it easier for the recipient. As soon as you have selected a location in the save dialog (not shown), the export process will begin.



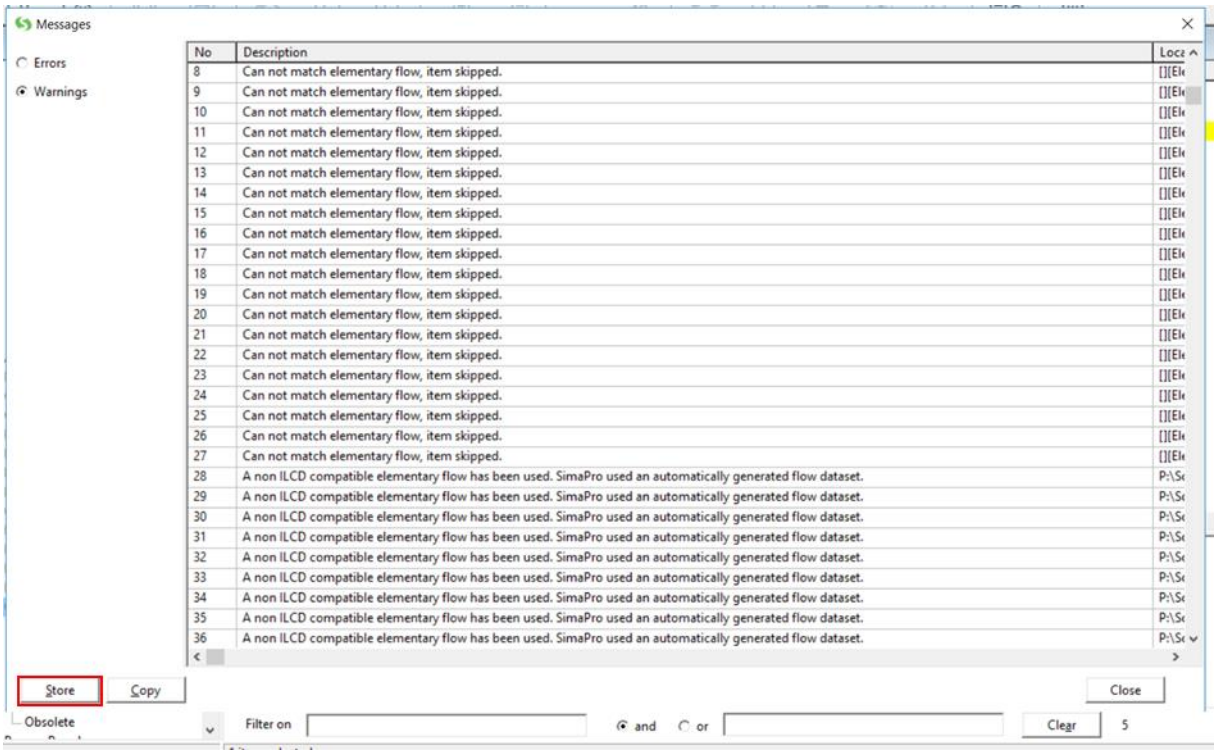
Choose options for export

7) The export will now begin

   a) If you see a warning like this



   Click Yes, and on the *Messages* dialog box press *Store* to store the debugging information. See Section 6 below for information and ways to avoid warnings.



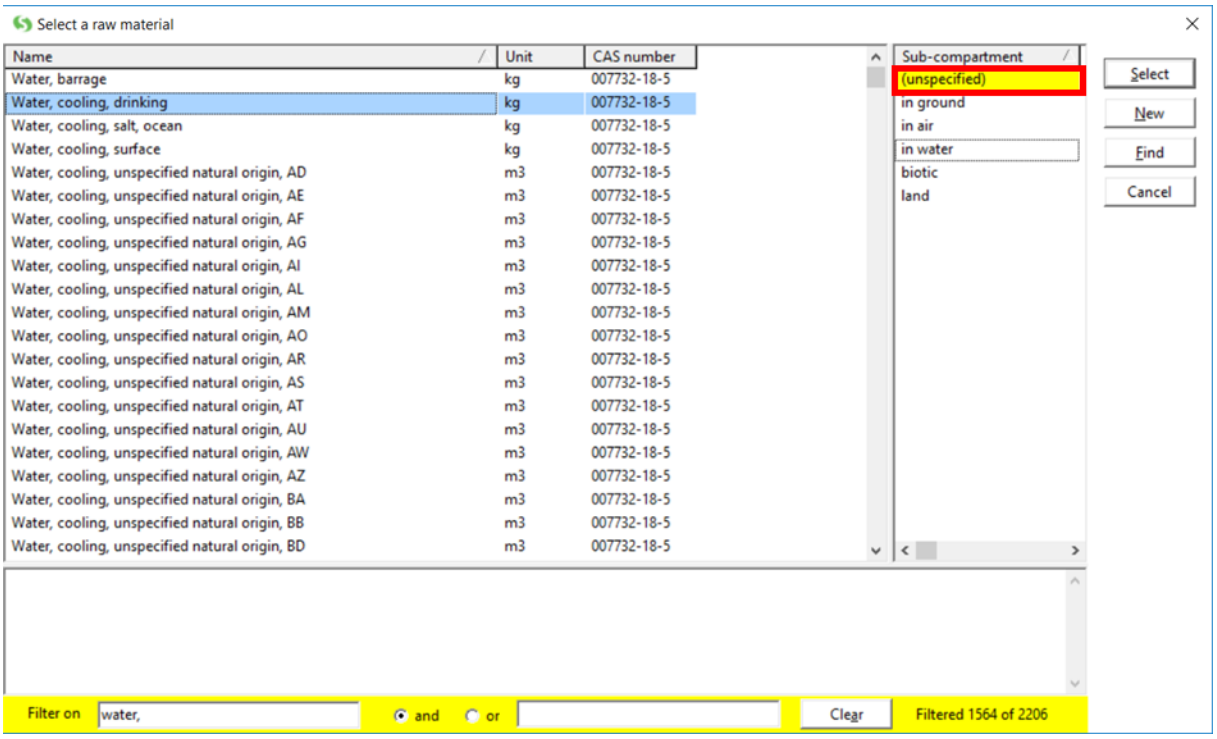
Store the error messages

b) At this point, you have two options:

   i) You proceed with the export. In this case, SimaPro will automatically create an elementary flow in the exported ILCD package and assign it a new random UUID when there is no match in the mapping file.

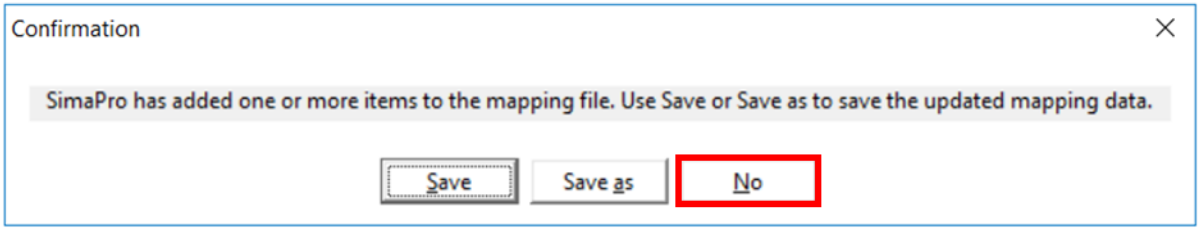
   ii) You store the warnings and search where the substances listed in the warnings are used in your model to 1) either remove them (by editing your model, as in Section 6 below), or 2) change the sub-compartment for one where a mapping exists (see the screenshot), if applicable. Once you have removed all substances listed in the warnings, you start the export functionality again.

c) Press *Close* to continue the export once you completed any of the options i) or ii) above.



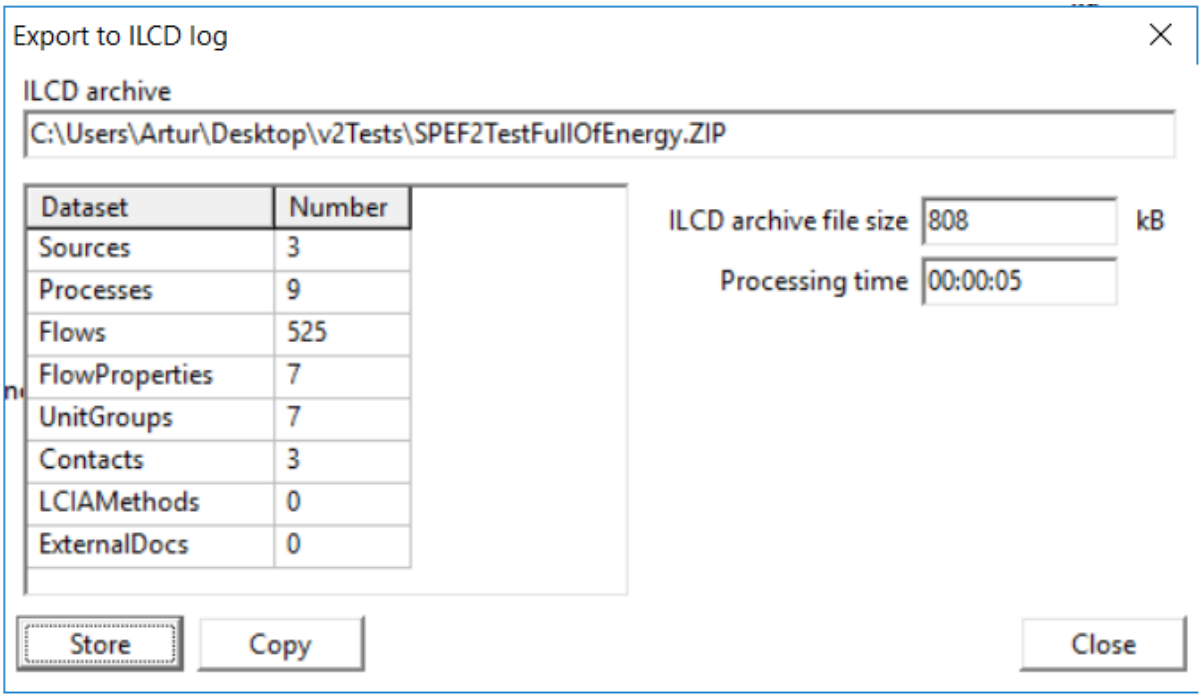
Option 2: Changing the sub-compartment, so that the mapping can work correctly

d) You will then be prompted if you want to save a modified mapping file containing the substances added that had no match. Selecting *Save* will create a mapping file that adds non-EF compliant flows found in the mapping with randomly generated UUIDs. Therefore, **we recommend selecting *No*** because so the mapping file remains the same for next time you run the mapping. Regardless of which button you press, the export will continue and export an ILCD package data.



Do not click *Save*, as this will modify the original mapping file. Click *No*

8) The *"Export to ILCD Log"* dialog shows useful information about the export, including ILCD file size and number of elementary flows/processes exported. You may choose to *Store* this information if you find it useful, but it is not necessary if you only want the ILCD file. The ILCD package has already been saved at this point.



The Export to ILCD log shows information about the export

9) If you are using max-inf

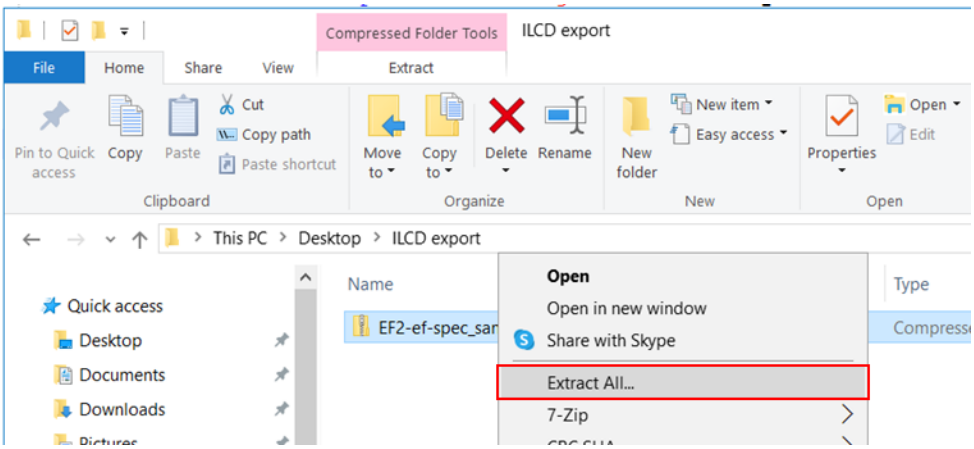
   a) Unless you encountered errors or warnings, the ILCD export is now complete. If you did encounter warnings/errors, please see below for common errors/warning messages and how to fix them.

10) If you are using ef-spec, all flow-compartment combinations for which there was no adequate EF match were mapped to the same substance `refObjectId="00000000-0000-0000-0000-000000000000"`. This is the only non EF-compliant flow in your ILCD package. Below you see the instructions on how to delete it.

   a) NOTE: These instructions are for Notepad++ on Windows. For mac/Linux, you can follow along using a similar text editor (with regex capabilities) and the command line.

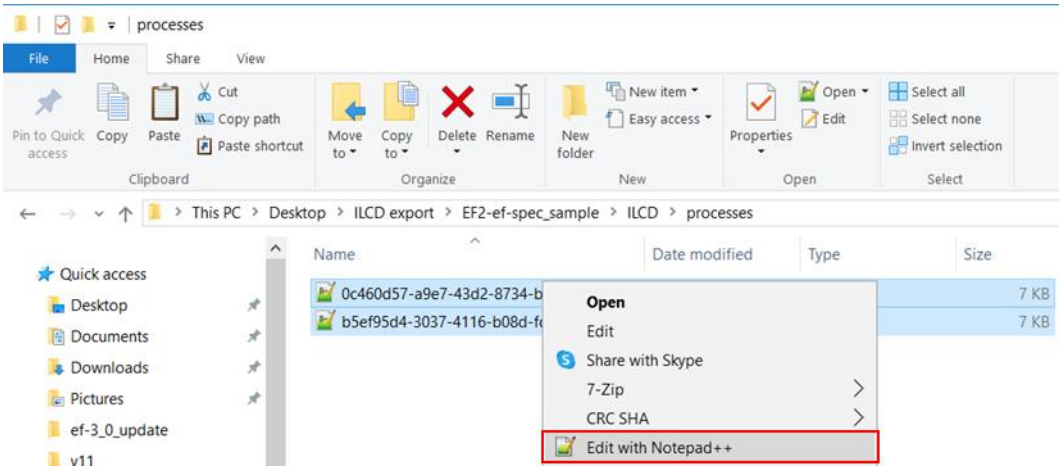
   b) Download and install Notepad++

   c) Open the location where you saved the package in File Explorer



   d) Extract the package (Windows: right click > *"Extract all"*)

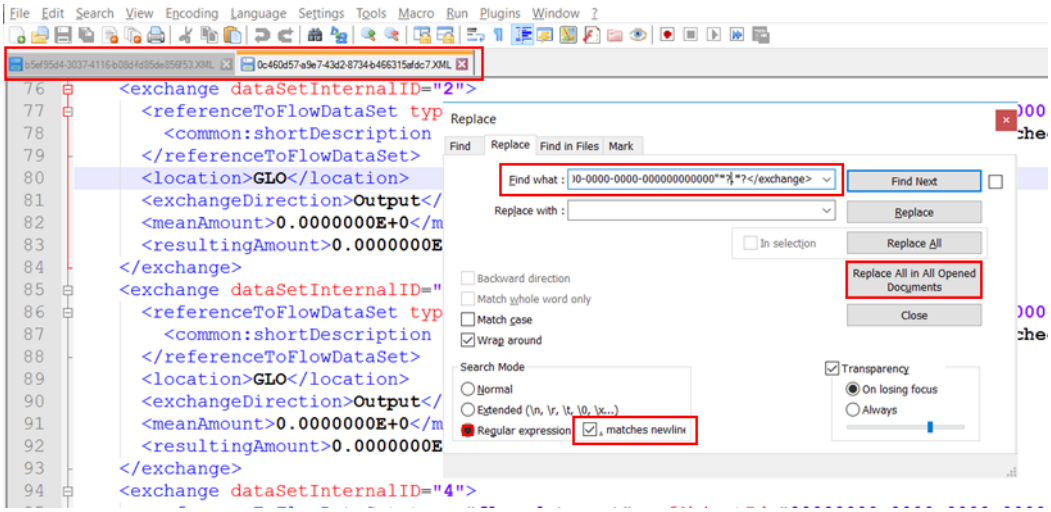
e) Open the extracted folder and navigate to {PACKAGE NAME}/ILCD/processes. Selected them all and right click and select *"Edit with Notepad ++"*



f) Press *CTRL+H* to search and replace and *Copy>Paste* the following code into the *Find what* text box

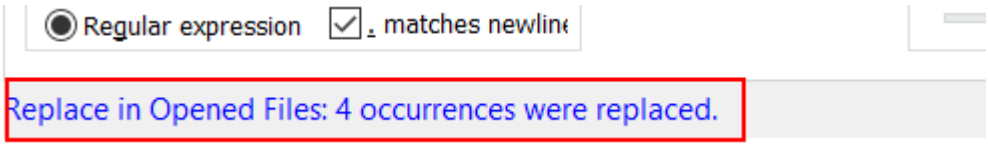
```
<exchange dataSetInternalID="\d">.{0,10}<referenceToFlowDataSet
type="flow data set" refObjectId="00000000-0000-0000-0000-
000000000000"*?.*?</exchange>
```

Make sure that Search mode is set to *"Regular expression"* and *". matches newline"* is selected (as in the picture).



g) Click "*Replace All in All Opened Documents*". This will remove any reference to substances that are not in the EF nomenclature. The blue text at the bottom left corner will inform you how many occurrences have been replaced. You can check which substances are not supported in EF by checking the name field in the mapping.

Life Cycle inventories are highly interlinked, but many substances are used in very small amounts, the number of results does not necessarily determine how much your LCIA calculation results are affected by the export. Be sure to check the exported file in another software to check your results.



h) Click "*Replace All in All Opened Documents*". This will remove any reference to substances that are not in the EF nomenclature. The blue text at the bottom left corner (see figure below) will inform you how many occurrences have been replaced. You can check which substances are not supported in EF by checking the name field in the mapping.

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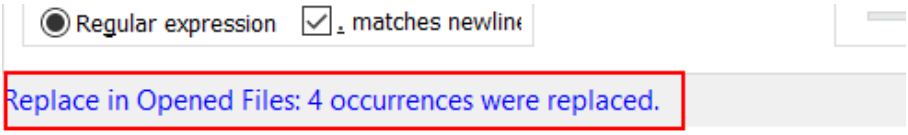
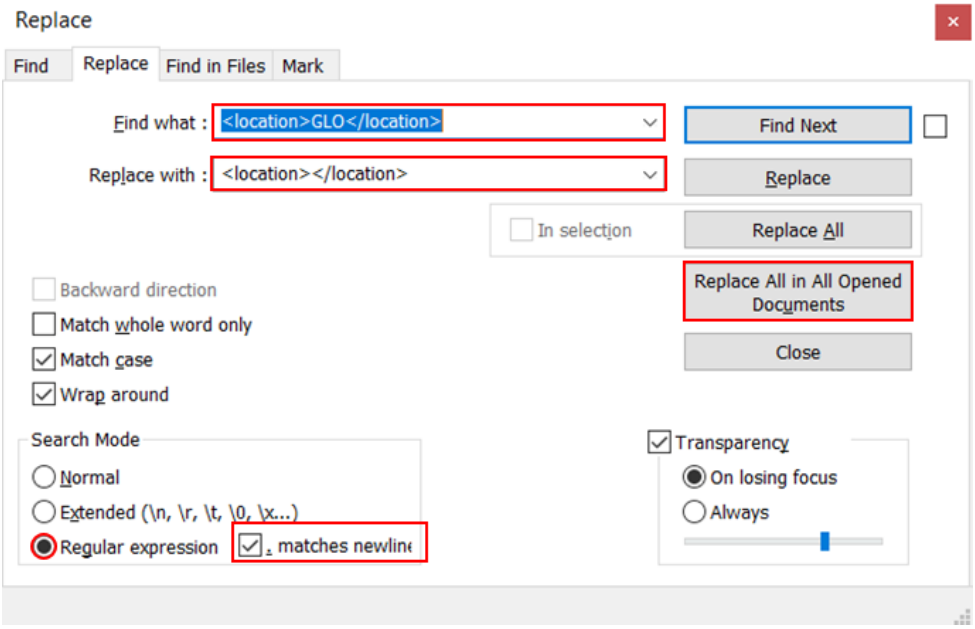


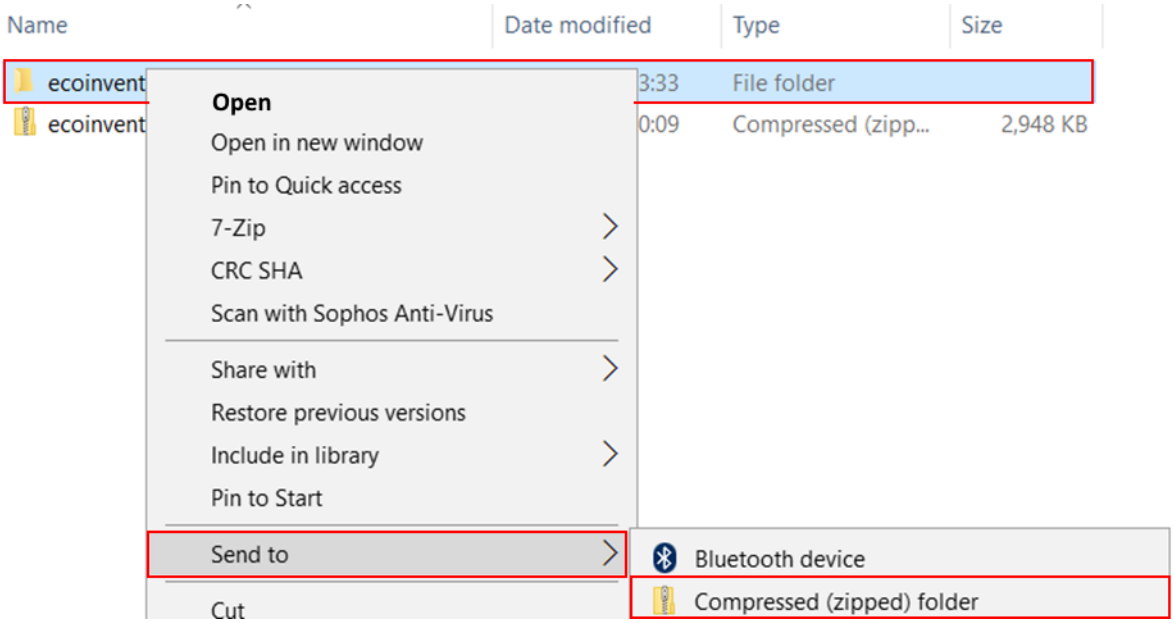
11) Do another find and replace with all flows as follows (see screenshot):

a) Find what: `<location>GLO</location>`

b) Replace with `<location></location>`



12) Now zip the entire folder



6 Common errors/warning messages and how to fix them

Warning/Error Description	Action
"A non-ILCD compatible elementary flow has been used, SimaPro used an automatically generated dataset"	There is **no known corresponding ILCD flow** in the EF nomenclature. SimaPro generates a new one to ensure that links are not broken and mass balance is conserved. If an EF-compliant dataset is required, we recommend to ***Store*** **the warning messages**, and using the list exported as a text file, to remove substances from the model (in SimaPro) which have no corresponding EF. Alternatively, you can continue the export and edit the exported ILCD files using an external tool.
"Can not match elementary flow, item skipped"	**Continue export, no action required.** This warning simply means that the mapping file includes more substances than are used in the database. Check that you are using **the latest version of the SimaPro Professional**

	database (you can check this by going to ***File > Database Management > Properties***)
“Cannot find product category. Used default product category.”	Known issue. This warning indicates that the product category is not matched, so it will be put under a general product category. It should not affect calculation results
“Process doesn't have a process name and therefore the name of the first output product is used for the ILCD process dataset.”	**Continue export, no action required.** This warning simply means that the process doesn’t have a process name (in the Documentation tab). This is a required field in ILCD, so it used the first product in the output. If you created the process yourself, don’t forget to add a name, but it should not be an issue. Also, check that you are using **the latest version of the SimaPro Professional** database (you can check this by going to ***File > Database Management > Properties***)
“Text is too long, therefore the text is truncated”	Known issue. Maximum length of text that SP can export is 500 characters. If the name is important for the project **try shortening text**, or inserting into the XML files using a text editor/ILCD Editor after export.
“Can't delete temporary directory” / “Can’t delete temporary file”	Make sure you do not have any programs using your AppData folder (e.g. security software) and try again
“Project parameter not supported” /”Database parameter not supported” / “Warning when evaluating numeric expression”	Check the parameters in your project do not have any errors in the name/formula
'Unknown flow type, item skipped	Check you are using the latest version of SimaPro and ILCD mapping file
'Unsupported flow type, item skipped	Check you are using the latest version of SimaPro and ILCD mapping file
'Can not match elementary flow, item skipped	Check you are using the latest version of SimaPro and ILCD mapping file
'Elementary flow on row %s already specified on row %s	Check you are using the latest version of SimaPro and ILCD mapping file
'Unknown process type	Check you are using the latest version of SimaPro and ILCD mapping file
'Can not match SimaPro unit, item skipped	Check you are using the latest version of SimaPro and ILCD mapping file
'Can not match ILCD unit, item skipped	Check you are using the latest version of SimaPro and ILCD mapping file

'Can not match waste-flow category-id, item skipped	Check you are using the latest version of SimaPro and ILCD mapping file
'Can not match unit, item skipped	Check you are using the latest version of SimaPro and ILCD mapping file
'Unit on row %s already specified on row %s	Check you are using the latest version of SimaPro and ILCD mapping file
'SimaPro unit name in flow mapping table doesn't match flow unit in SimaPro process	Check you are using the latest version of SimaPro and ILCD mapping file
'Mapping unit and flow unit'	Check you are using the latest version of SimaPro and ILCD mapping file
'Cannot find product category id	Check you are using the latest version of SimaPro and ILCD mapping file
'Unknown main compartment	Check you are using the latest version of SimaPro and ILCD mapping file
'Unknown sub compartment	Check you are using the latest version of SimaPro and ILCD mapping file
'Cannot find SimaPro compartments'	Check you are using the latest version of SimaPro and ILCD mapping file
'Main compartment and sub-compartment'	Check you are using the latest version of SimaPro and ILCD mapping file
'Invalid category id'	Check you are using the latest version of SimaPro and ILCD mapping file
'Id changed of flow dataset with equal product name'	Note any id(s) that have changed in the warning message and check if it needs to be corrected in your exported ILCD package
'New Id, Old Id, baseName, treatmentStandardsRoutes, mixAndLocationTypes and flowProperties'	Check you are using the latest version of SimaPro and ILCD mapping file

7 Methodology

1) The EF reference packages contain flows with identical names and compartments, but with different UUIDs. In these cases, there is no unique way to map. The mapping is therefore done by first:
   a) Checking whether one of the duplicated EF flows is characterized.
   b) If yes, then choose the flow with the higher characterization factor in the category in which it is characterized. If the characterization factor is the same for both, then the first one in the list is chosen.
2) SimaPro substances for which there is a EF elementary flow in the same main compartment, but not in the exact sub-compartment:
   a) First, check if there is a flow in an unspecified sub-compartment. If so, match this

i) E.g. SP substance "*"Aerosols, radioactive, unspecified/Airborne emissions "Aerosols, radioactive, unspecified/Emissions to air/Emissions to non-urban"* ->" Aerosols, radioactive, unspecified/Emissions to air/Emissions to air, unspecified"

Procedure for matching substances in the ***unspecified*** sub-compartment in SimaPro:

1. If there is an unspecified sub-compartment in the EF list, this sub-compartment is selected
2. If there is no unspecified sub-compartment in the EF list, the sub-compartment for which there is a match, if there is exactly one sub-compartment, is selected
3. If there is no unspecified sub-compartment in the EF list, and there are multiple sub-compartments, the sub-compartment with the highest characterization factor is selected
4. For duplicates where there is a *different* characterization factor: the sub-compartment with the highest characterization factor (in the EF method) is selected
5. For duplicates where there is no characterization factor in EF. Since both are equally valid, the first one in the list is selected. If the exported package is used with a different LCIA calculation engine than EF, the flow still exists in the mapping.

Procedure for matching substances that are ***not*** in the unspecified sub-compartment in SimaPro:

1. If there is an exact match to the name, main and sub-compartment in the EF list, the mapping matches the sub-compartment for which there is a match
2. If there is a matching EF substance in the unspecified sub-compartment in the EF list, mapping matches to the generic "unspecified" EF sub-compartment
3. Otherwise the substances is excluded from the mapping. A warning is raised during export "A non-ILCD compatible elementary flow has been used, SimaPro used an automatically generated dataset"

8 Substances that cannot be exported to EF

Professional 9.5 substances that have no mapping to the EF 3.1 database can be found by filtering for substances that have the uuid "00000000-0000-0000-0000-000000000000 " in the max-inf mapping file.

The following table gives a few examples of where the mapping may be unable to match to an elementary flow in EF 3.1 nomenclature, and how you may correct these, if they have an influence on your LCA calculations.

SimaPro substance (issue)	Comment
Cobalt ore (ores are not mapped)	EF only provides pure elements or the compounds, but not generic ores, which may have varied compositions of the primary substance extracted from them. Where compositions are provided in the SimaPro substance name, the primary element in the ore is chosen as an EF flow, but where it is unspecified you should consider what is most appropriate in your instance (for instance if you purchase ore from a given geographical region, perhaps an ore with a particular

	composition is more common?). We recommend replacing any use of these substances as in the example below 1. 100kg *"Cobalt ore"* (SP substance) -> WARNING "A non-ILCD compatible elementary flow has been used" + SimaPro automatically creates a non-EF flow 2. Replace *"Cobalt ore"* with *"Cobalt, Co 5.0E-2%, in mixed ore"*, and run mapping again 3. 100kg *"Cobalt, Co 5.0E-2%, in mixed ore"* (SP substance) -> 0.05kg *"cobalt"* (EF flow) (exported correctly)
Uranium, 560 GJ per kg under Raw materials/land (Raw materials in the wrong sub-compartment)	For SimaPro raw materials, the sub-compartment determines not only the ILCD sub-compartment, but also the main compartment, for example SimaPro's sub-compartment *"Raw materials/land"* -> ILCD main compartment *"Land use/"*. If you have a model where there is a substance for which there no matching ILCD flow in this ILCD main compartment, the mapping will raise a warning. If in doubt **leave the sub-compartment blank or *"(unspecified)"*** when editing a process. The mapping will then choose the matching ILCD sub-compartment if there is one, or the more generic sub-compartment (e.g. (unspecified)) if there are multiple matches. 1. 1kg *"Uranium, 560 GJ per kg" (which has accidently been put in the sub-compartment "land")* -> WARNING "A non-ILCD compatible elementary flow has been used" This is because sub-compartment "land" is only to be used for *land use/ land transformation* (in units of m^2a or m^2), whereas the substance "Uranium, 560 GJ per kg" refers to a given mass of uranium (in units of mass), and so is better matched to an ILCD "*resource*". 2. Replace sub-compartment *"land"* with *"(unspecified)" (or "in ground")*, and run mapping again 3. 1kg *"Uranium, 560 GJ per kg"* (under *Raw material/(unspecified)*) (SP substance) -> 560 000 MJ *"uranium"* (under *"Non-renewable resources from ground, unspecified"*) (EF flow). The flow is mapped successfully

Any substance not in the SimaPro Professional database	The mapping only covers the substances used in the latest SimaPro Professional database, please make sure you are using the latest version of SimaPro. If a substance is not the SimaPro Professional database, it will cause the "A non-ILCD compatible elementary flow has been used, SimaPro used an automatically generated dataset" warning at export, and automatically generate a non-EF flow to preserve mass-balance.
Any substance that is generated by the user	See above. The name-maincompartment-subcompartment triple is a unique identifier for flows, and so any substances not in the original database (or from an old version of SimaPro) will not be mapped if not in the mapping

9 Known issues

1. In SimaPro 9, a known issue in the way in which 1 kBq is stored while being processed means that a scaling needs to be artificially applied in the export, which is achieved by setting SimaPro units to mBq and ILCDUnits to 1 in the mapping file. **Do not edit** the ElemCnv tab of the spreadsheet for radioaactive flows, **nor** the information in the UnitCnv tab, otherwise the values in the ILCD package exported will be incorrect.
2. When calculating results of ILCD datasets that have been exported from SimaPro with Look@LCI, substance flows of the GLO geography will not get characterized. The reason is that Look@LCI recognizes substance flows with the GLO geography only when the location field is left empty. A workaround to enable correct results calculation with Look@LCI is to use the "Find in files" function of Notepad++ and to replace all occurrences of "<location>GLO</location>" with "<location></location>" in all process datasets.

References

[1] S. Fazio *et al.*, *Guide for EF compliant data sets.* 2020.

[2] European Commission, 'EF Developer Tools', *European Platform on Life Cycle Assessment*. https://eplca.jrc.ec.europa.eu/LCDN/developerEF.xhtml (accessed Nov. 13, 2020).

[3] 'SimaPro Help Center | Creating a system level process from a unit level process.', *PRé Sustainability*. https://support.simapro.com/s/article/How-can-I-create-a-system-level-process-from-a-unit-level-process (accessed Nov. 13, 2020).

[4] European Commission, 'ILCD Developer Tools', *European Platform on Life Cycle Assessment*. https://eplca.jrc.ec.europa.eu/LCDN/developerILCD.xhtml (accessed Nov. 13, 2020).

[5] 'Ecoinvent geography definitions — Ecoinvent-geo 2.0 documentation'. https://geography.ecoinvent.org/ (accessed Sep. 17, 2020).