Flow Mapping in openLCA

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Prepared by:

Michael Srocka (GreenDelta), Sarah Cashman (ERG), Ashley Edelen (ERG), Ben Young (ERG), Andreas Ciroth (GreenDelta), Wesley Ingwersen (U.S. EPA)

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Key Terms

flow conversion – *verb*. The process of converting one flow to another flow. In this document this only applies to elementary flows.

mapping – *noun*. A series of correspondences between two flows, a source flow and a target flow. *verb*. The process of creating a correspondence between source and target flows.

Section 1: Instructions for using the Flow Mapping Feature in openLCA

The Flow Mapping feature in openLCA allows users to convert elementary flows within existing databases to user-specified elementary flows embedded in a user-provided dataset. Conversion of a flow automatically replaces all instances of the flow in the openLCA database, such as in processes and LCIA methods. This is a helpful feature if openLCA users want to ensure consistent nomenclature is used in their database. Such consistency allows for interoperability between life cycle inventory processes and life cycle impact assessment methods. These instructions describe the conversion process within openLCA with an example database and user-provided flows and mappings. The stepwise approach to complete this conversion is as follows:

1. Open the openLCA database containing the elementary flows that you wish to convert. It is recommended that users save a copy of their database before the conversion for reference.

2. Before starting the conversion process, users can select a sample process and view existing elementary flows. Remember this process and come back to check it after the conversion is complete to ensure the mapping was completed correctly.
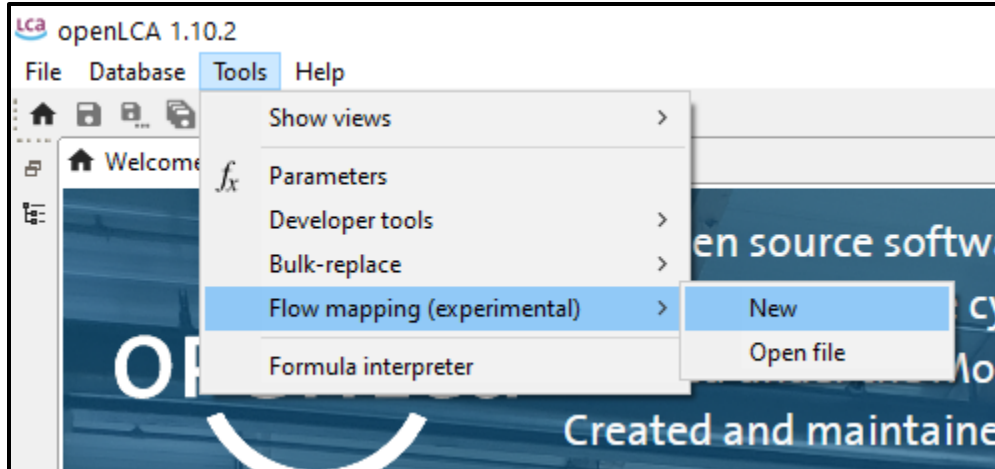

The user has two options for flow conversion, one by using an existing mapping, and the other through creation of a new mapping. Section 2 of this document describes flow conversion using an existing mapping, and section 3 describes creation of a new mapping.

Section 2: Flow Conversion using an Existing Mapping

Existing flows that are to become target flows and the mapping files linking source and target flows must be generated in the openLCA JSON-LD format for use in openLCA. Generating these mappings in this format is highly technical; the JSON-LD must contain the relevant information for source and target flow lists as a series of FlowMapEntries. The fedelemflowlist Python package generates Federal LCA Commons elementary flows and mappings in the JSON-LD format. We draw on this tool in these instructions to demonstrate use of a pre-generated flows and mappings JSON-LD archive. Instructions for creating a JSON-LD mapping file are available on the Federal LCA Commons Elementary Flow List project GitHub site Wiki under Mapping a Dataset. Once you have a JSON-LD file of the desired mapping, you can proceed.

1. Select **Tools → Flow Mapping (Experimental) → Open file**. Navigate to the JSON-LD file location within Windows Explorer and select **Open** in Windows Explorer. The other flow mapping menu option available in openLCA is used to generate a new mapping directly in openLCA based on flow attributes. This alternative option is described further in section 3 'Flow Conversion using a New Mapping'.
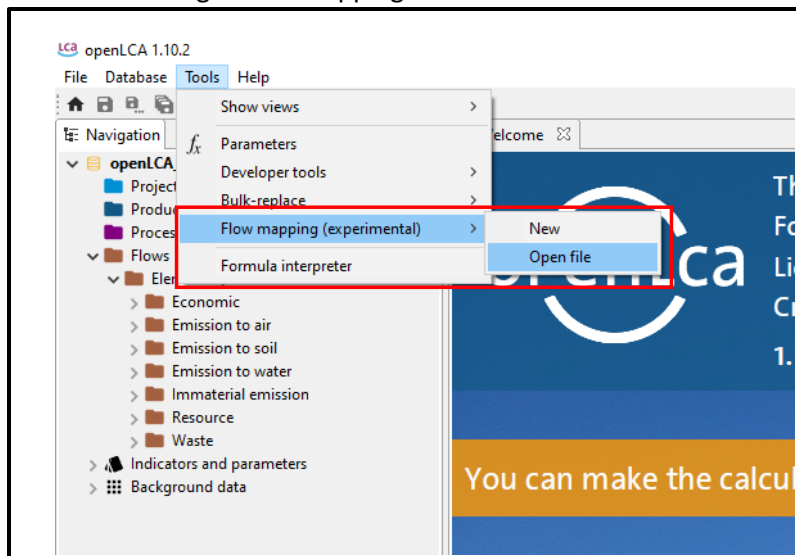
2. Select **Open mapping definition**. **Open mapping definition** should indicate the JSON-LD mapping file that will be used for mapping. Select **OK**.
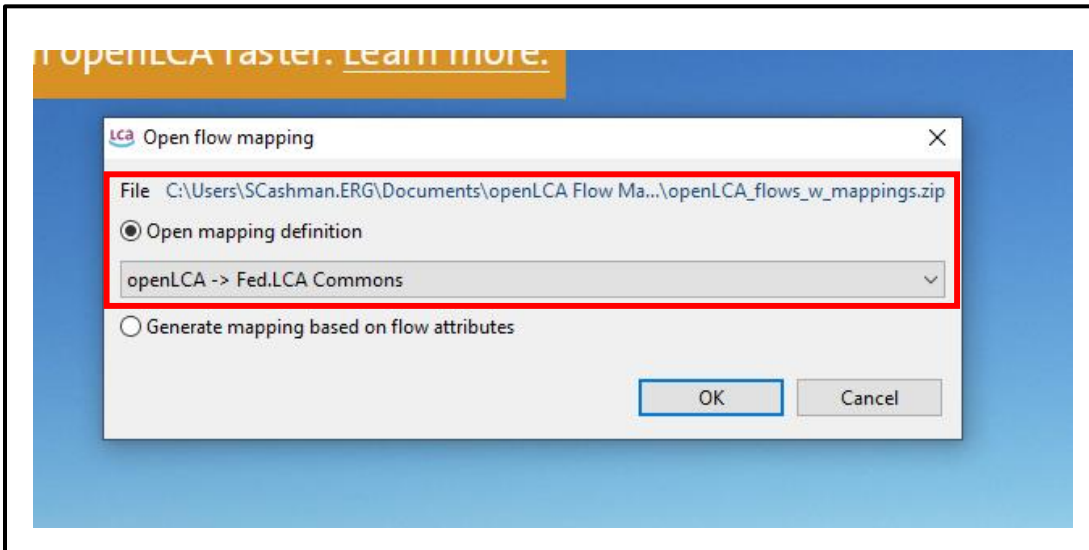

3. Select **Source system** as your existing openLCA database. This can be done by clicking the database icon once. Select **Target system** as your JSON-LD mapping file. This can be done by clicking the paper icon once.
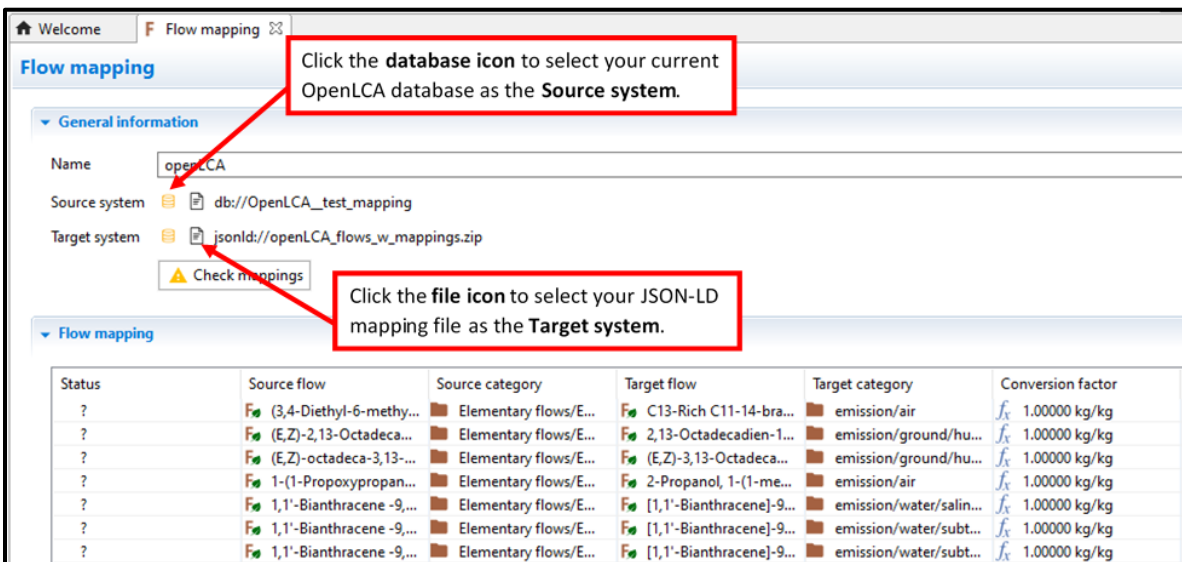
4. Click on the **Check Mappings** button to run a check on the mappings.
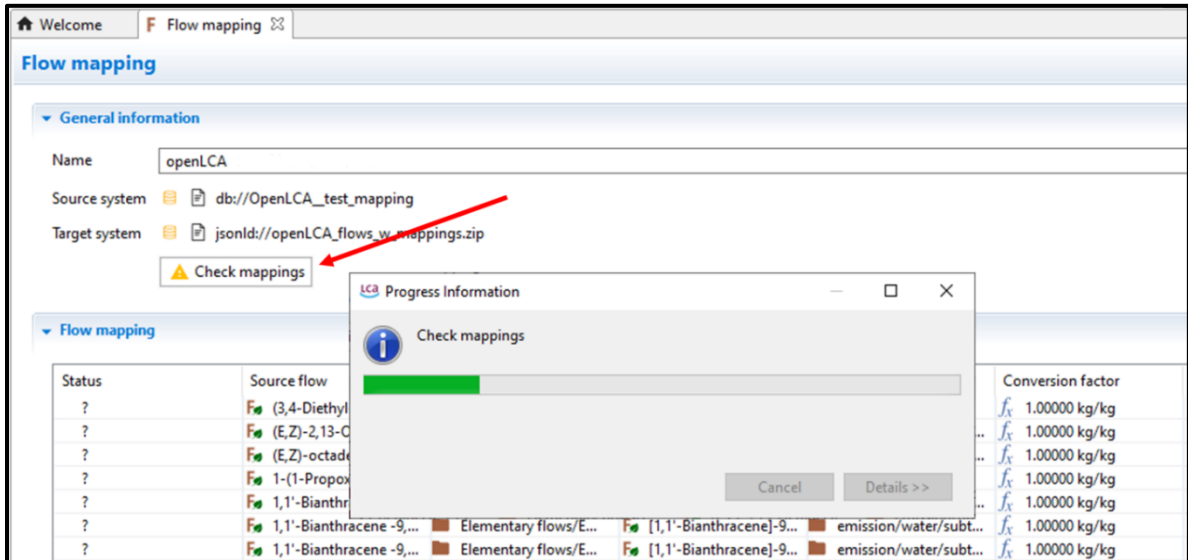
The mapping status will appear in the first column, and a green check mark will show if there is a successful mapping. This indicates the flow is in sync with the database. Error messages will show if there is an issue. Individual flow mappings may fail the check if the Source flow as referenced in the mapping does not exist in the database. This mapping will not be applied.
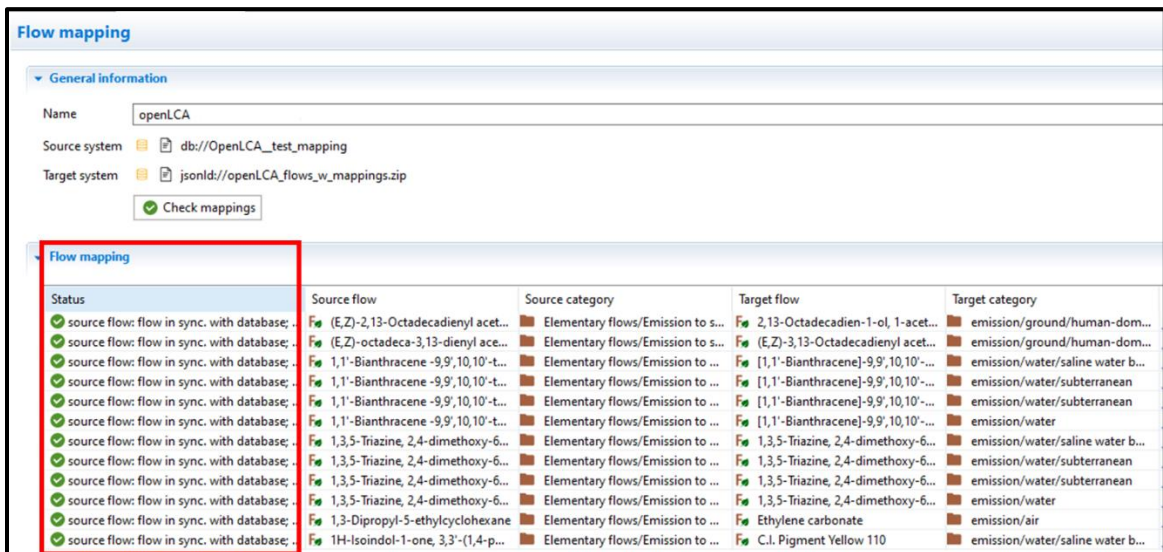

Note *Close-out any processes or methods you wish to apply the mapping to before continuing with step 5.*

5. To apply the mapping select **Flow mapping** → **Apply on database**.
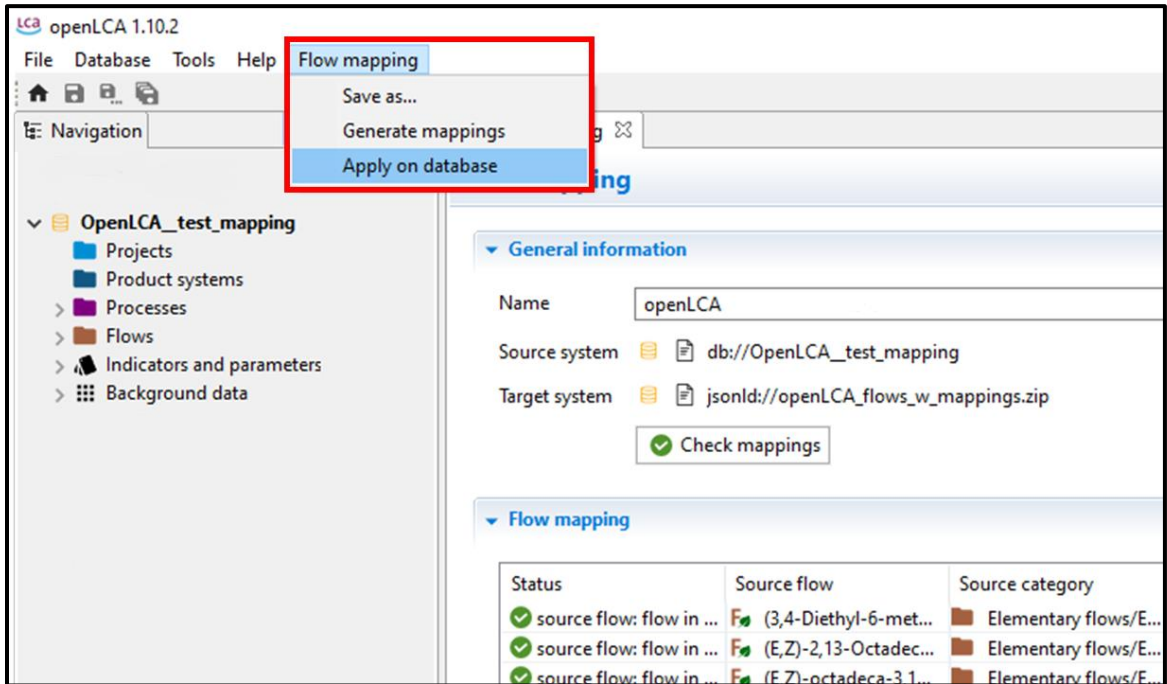
6. You can replace flows in processes, LCIA methods, and flows all in one step by checking the appropriate boxes. Select **Delete replaced and unused flows** to remove the new obsolete flows.
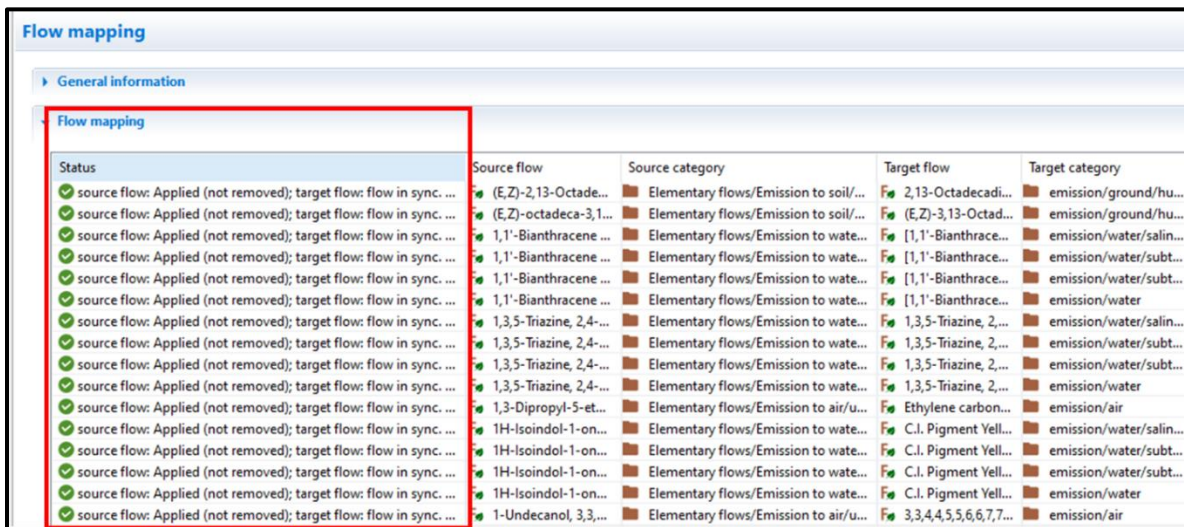
   Note Processes and/or LCIA methods need to be preloaded to this database for flows to be replaced. The mapping feature does not work if there are no processes or LCIA methods in the database.
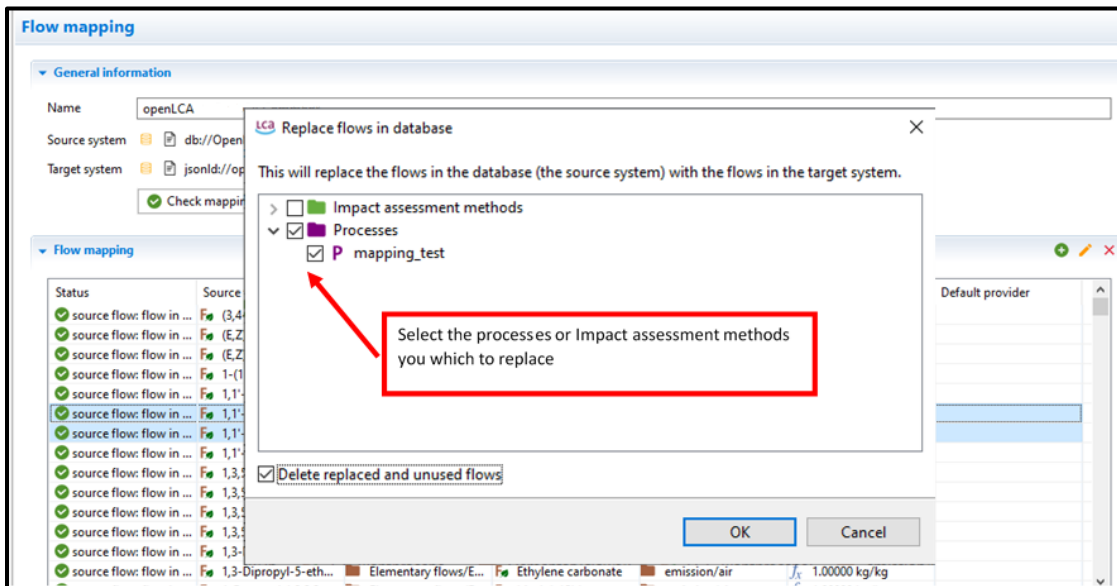
Note It may take several minutes to replace the flows, depending on the size of the database.
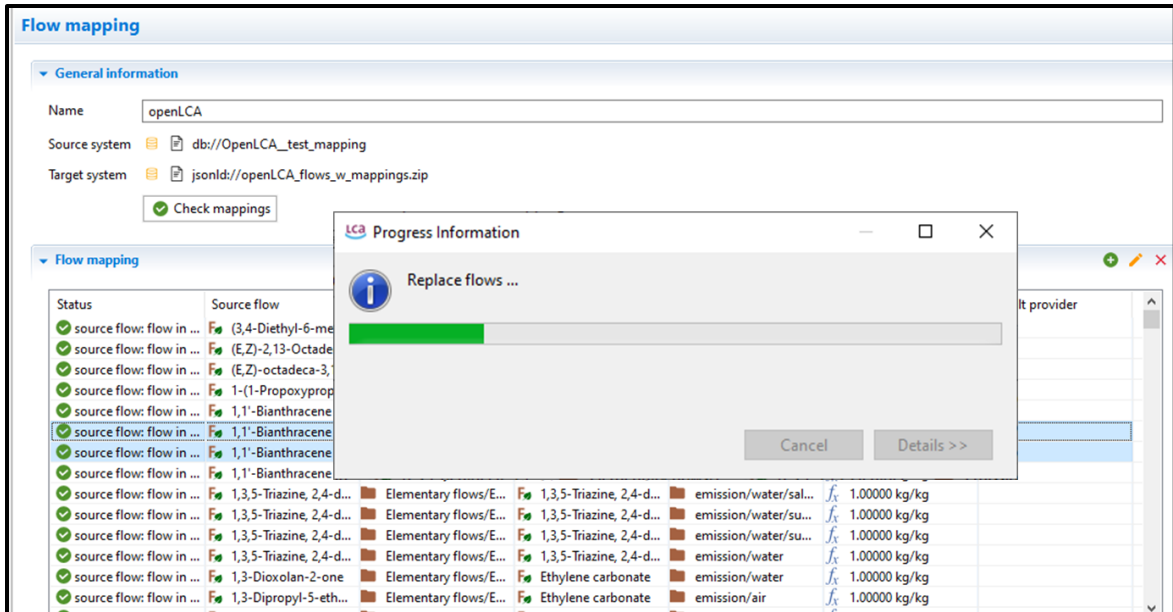
7. Once the mapping is complete, the Flow mapping status will update. If you selected **Delete replaced and unused flows**, then a successful mapping will show that the target mapping was applied to the source flow and removed. If a target flow already exists in the source database, a message will indicate a flow mapping is not necessary.

8. Users need to close and reopen a database to make sure that the flow mapping has been applied. Users should confirm that the mappings look correct in their processes and/or LCIA methods (*see below for modifications to example process from step 2 in section 1*).

   *Note The flow mapping will not delete any flow folders. Users can manually delete empty flow folders post-mapping.*

Flowable and Flow Category in the example (from **Step 2**) after the mapping.

Section 3: Flow Conversion using a New Mapping

Users can also generate new mappings directly in openLCA rather than using an existing mapping file. This section describes steps for both manually and automatically conducting this mapping directly in openLCA.

1. Select **Tools** → **Flow Mapping (Experimental)** → **New**.
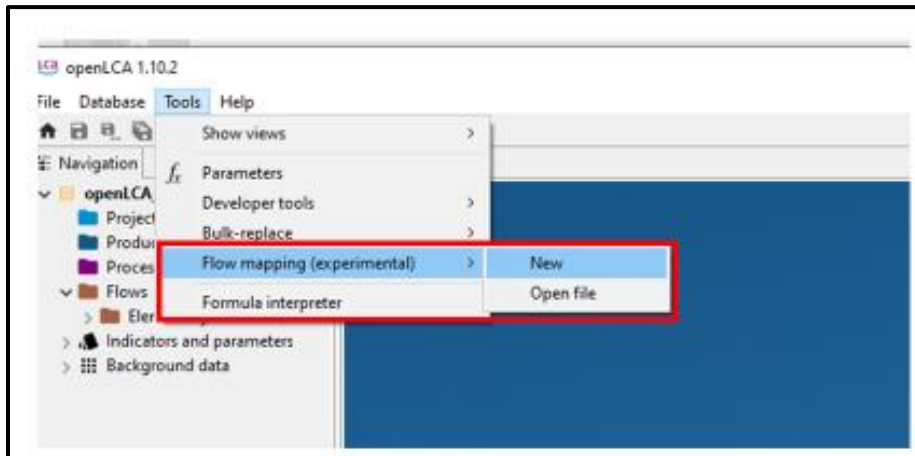
2. The flow mapping screen will appear, requiring the user to select the source and target system. The **Source system** should be the current database, which can be selected by clicking the database icon. If users wish to conduct the mapping using flows contained within their current openLCA database, they can also select the **Target system** as the current database by clicking the database icon. Users can then click the green plus icon to add a mapping. This mapping can be later edited (yellow pencil icon) or deleted (red check mark). Users may also want to try to automatically generate mappings based on a Target system that is different than their current openLCA database. This process is described further in step 10 of this section.
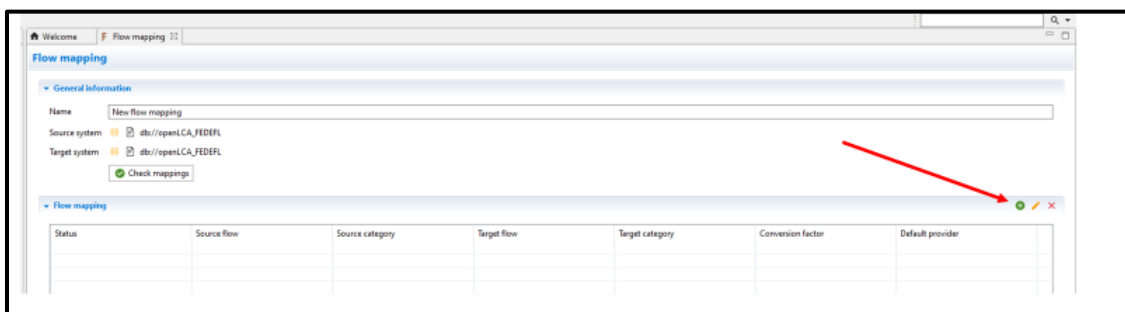
3. When adding a new mapping, the user needs to select the source flow and the target flow by clicking the blue **-none-** link, as shown below. While the example shown here is for elementary flows, flow mapping can also be conducted for product flows directly within openLCA.
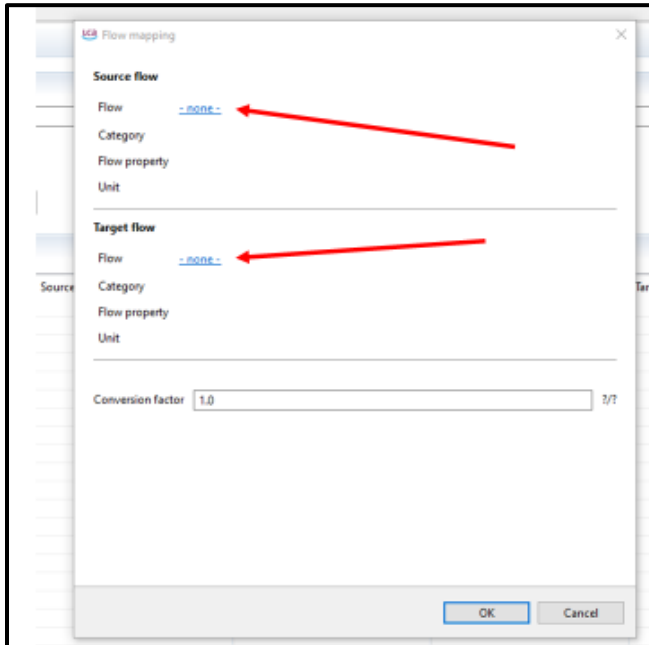
4. When selecting the source or target flows, openLCA will collect flows and build the flow tree. Users can then navigate to the desired source and target flows by expanding the folder structure in the tree or typing the flow name into the filter box. In this example, we are replacing a more generic nitrogen oxide air emission flow with a more specific nitrogen dioxide air emission flow, both available within our current openLCA database.
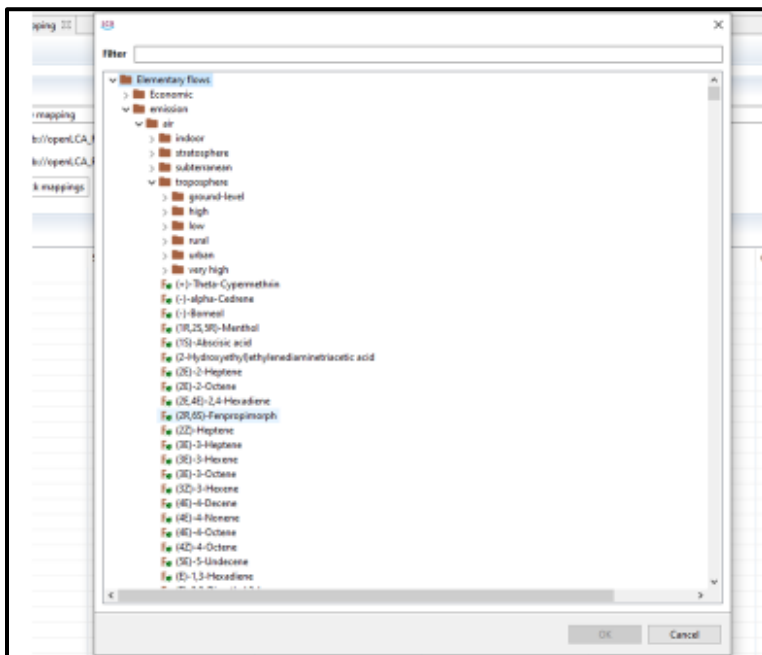
5. The user selection of the source and target flows will appear. openLCA also provides the functionality to specify the conversion factor. The conversion factor is based on the flow property and unit of the source and target flows. If the new mapping is correct, the user can select **OK**.
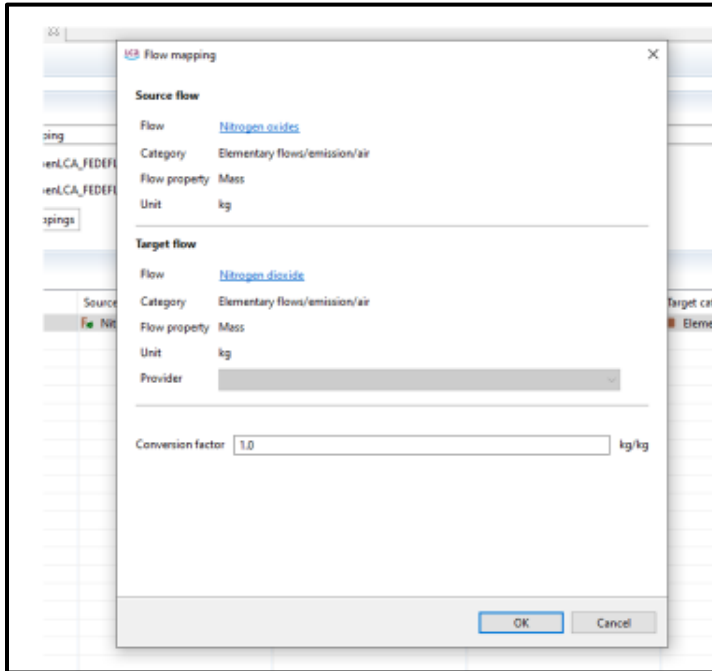
6. The new mapping will appear in the main flow mapping tab and the status will indicate that the mapping was edited or checked manually. Users can always highlight the mapping and select the yellow pencil icon to edit the mapping again. Users can add as many new mappings to this tab at one time as needed by repeating steps 2 through 5.
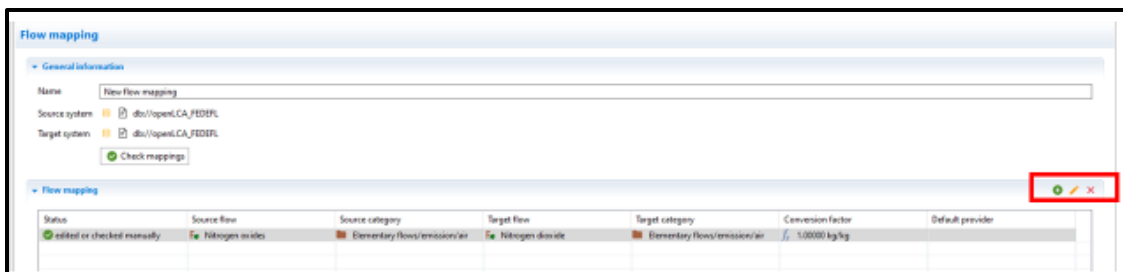
7. Before applying the mappings, users can check a process that has the original flow name, so they can return to the process to make sure the mapping worked successful. Here we have an example process showing an output of *nitrogen oxides* to *emission/air*.

   Note Users should ensure they do not close out of the flow mapping window during this step.

8. Users can then navigate back to the flow mapping window and select **Flow mapping → Apply on database** (see step 5 of section 2). Users can then select where in the current openLCA database the flows should be replaced. Select **Delete replaced and unused flows** to remove the original source flows that are no longer used from the master flow list.
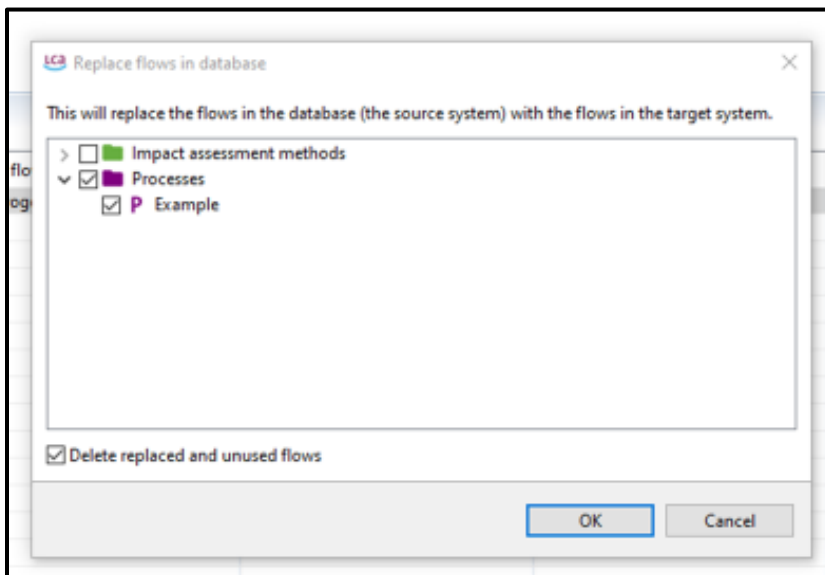
9. Users can navigate back to their example process to ensure the mapping worked correctly. They will need to close and reopen the process to make sure the mapping was successful. In this example process, the *Nitrogen oxides emissions/air* has been replaced with *Nitrogen dioxide emission/ai*r.


10. Users may also want to try to generate new mappings automatically. In openLCA, the **Generate mappings** function tries to automatically find for each flow in the Source system a corresponding flow in the Target system. It should be possible to use JSON-LD packages, a database, or an ILCD package as source or target system for this.

    To begin this automatic mapping process, users should export the database with the flows they want to map to as the target system, shown here using a JSON-LD format. This will become the **Target system** for mapping. Right click the database name and select Export. In this example, we are exporting a database that contains the openLCA reference flow list to map to, but this is applicable for any database that contains a user's target flows.
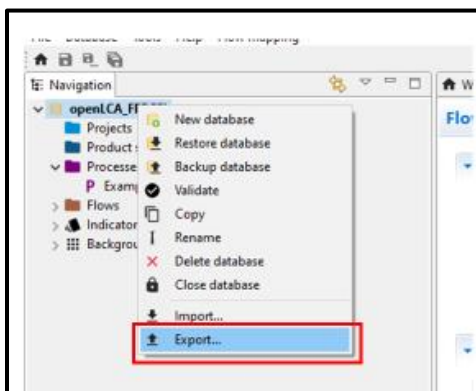
11. Users can then navigate to the openLCA JSON-LD export option, click **Next** to select the components of the database to export (must include flows), and then navigate to the folder on their computer to save the JSON-LD file then select Finish.
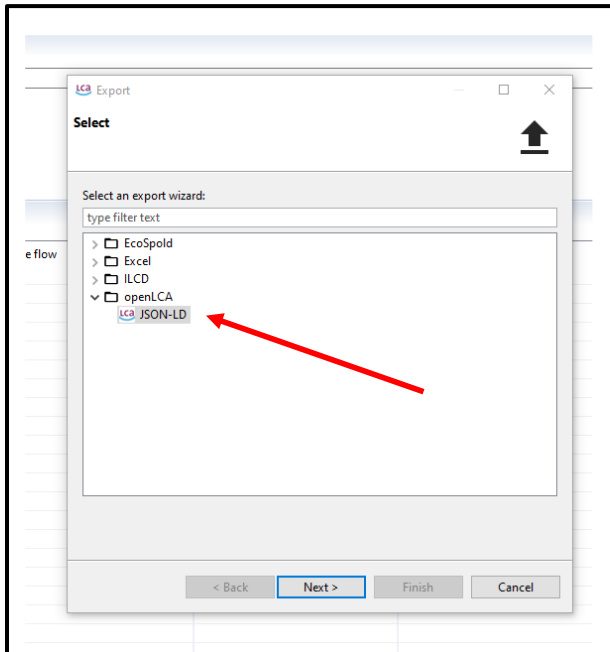

12. Open the openLCA database for which you wish to map to the flows embedded in the JSON-LD exported in step 11 (i.e. the Source system). In this example, we start with a database containing the U.S. EPA's USEEIO Model. Select **Tools** → **Flow Mapping (Experimental)** → **New**. The current openLCA database can be selected as the **Source system** by clicking on the database icon and the JSON-LD file exported in the previous section (the openLCA reference flow list) can be selected as the **Target system** by clicking on the paper icon. Navigate back to Flow mapping and select **Generate mappings**, as depicted below.
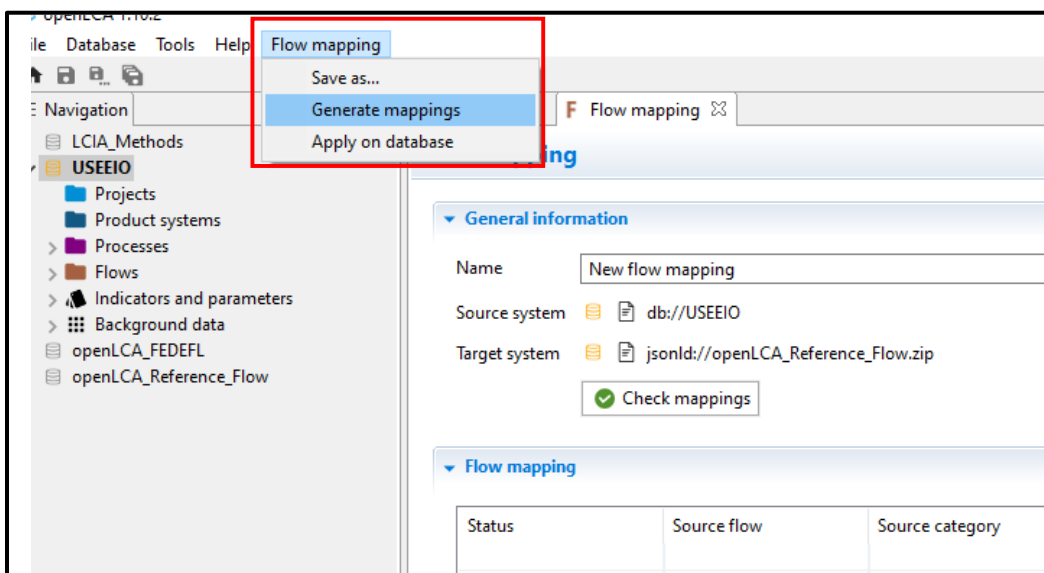
13. openLCA will ask if you want to try to generate mappings for all unmapped flows of the source system. Select **Yes**. openLCA will then try to generate mappings automatically.
Note *It may take several minutes for these mappings to be automatically generated.*
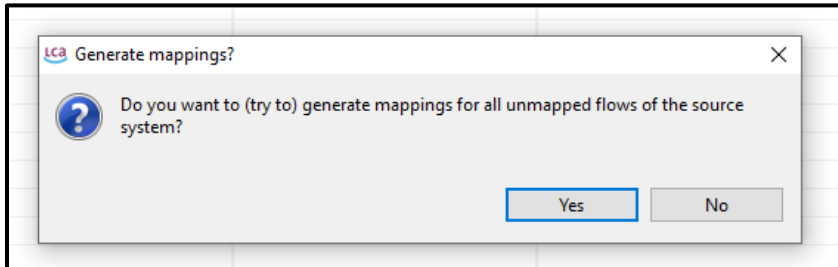
14. The openLCA flow mapping window will then display the results of the attempt to conduct automatic mappings. It will try to map both elementary flows and product flows, as shown below. A warning will be provided in the window if there is a potential mapping issue. In the example below, warnings indicate that the target system flow is using a different unit. Users can edit the mapping (yellow pencil) to provide additional information such as conversion factors for the mappings. Users can also delete the individual mappings if not relevant. For example, users may not want to map product flows (i.e., Technosphere flows) to elementary flows. Once the user has reviewed the mappings, the mapping can be applied to the database (see step 5 of section 2).