



Life Cycle Costing Quick Explanation

Two different methods to perform Life Cycle Costing in openLCA

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Content

- 1 Introduction: What is Life Cycle Costing?..... 3
- 2 LCC in openLCA..... 3
 - 2.1 Treating costs like emissions 3
 - 2.1.1 Creating cost flows 3
 - 2.1.2 Adding cost flows to processes 4
 - 2.1.3 New impact category for cost calculation 5
 - 2.1.4 Calculation of LCC..... 5
 - 2.1.5 Comparison of different project costs..... 7
 - 2.1.6 Cost Fluctuations 8
 - 2.1.7 Discounting/Inflation..... 9
 - 2.2 LCC with openLCA cost feature 9
 - 2.2.1 Adding costs to processes 9
 - 2.2.2 Calculation of costs..... 10
- 3 Conclusion 11
- 4 References..... 11
- 5 Contact 11

1 Introduction: What is Life Cycle Costing?

Life Cycle Costing (LCC) is a method of economic analysis for all costs related to product and services throughout the entire life cycle. Traditionally it takes into account mainly investment, operation, maintenance and end of life disposal costs. Including the environmental impacts expressed in monetary terms that may come from Life Cycle Assessment (LCA), LCC can be convenient to address the economic dimension of sustainability (e.g. Klöpffer Renner 2008). A methodology for LCC had developed by SETAC Working Group which is applied in parallel to an LCA called “Environmental LCC”. The aim was to provide methodology to merge traditional LCC with LCA efficiently and consistently. As Environmental LCC and LCA have similar structure, conducting both analysis in one software makes sense. The aim of this paper is to investigate how this is possible with openLCA.

2 LCC in openLCA

Basically, there are two different methods to assess LCC with openLCA.

The first method is very similar to a life cycle assessment approach. Cost flows are created to express the economic impacts and these flows are treated like emissions. These cost flows are added to processes. A new impact assessment method needs to be created to calculate the costs over the life cycle.

The second method uses the cost feature in openLCA. By this feature, costs can be specified for each flow/process and summed up in product system under the fix and variable cost categories.

How to perform an LCC with openLCA is explained more in detail in the following steps.

2.1 Treating costs like emissions

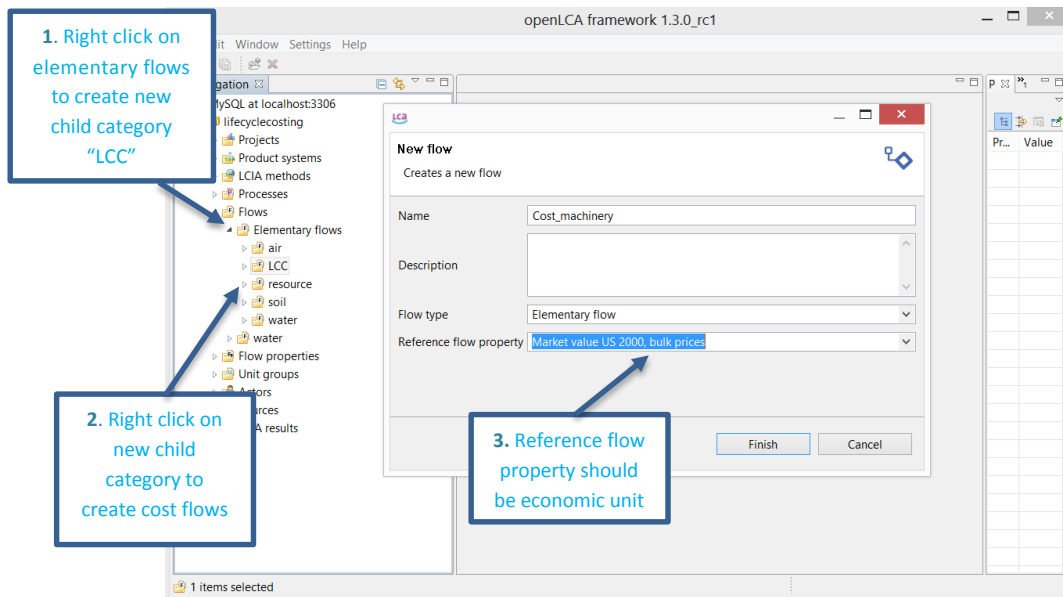
2.1.1 Creating cost flows

Start openLCA and connect to the MySQL database. Create a new database or import an existing database in which you want to conduct LCC study. This is in more detail explained in the openLCA wiki, here: http://openlca.org/documentation/index.php/Getting_started#First_start.

The first step for LCC modelling is to create adequate cost flows for processes. The cost flow should be of an elementary flow type since otherwise they will not be included in the impact assessment methods and results. For creating flows, create a new child category under the flow category, for LCC, and start creating cost flows under this category.

The cost flows need to be linked to processes in order to consider them in life cycle models. To do so, either new processes can be created that contain only cost flows, or economic data and cost flows can be mixed with environmental data in existing processes.

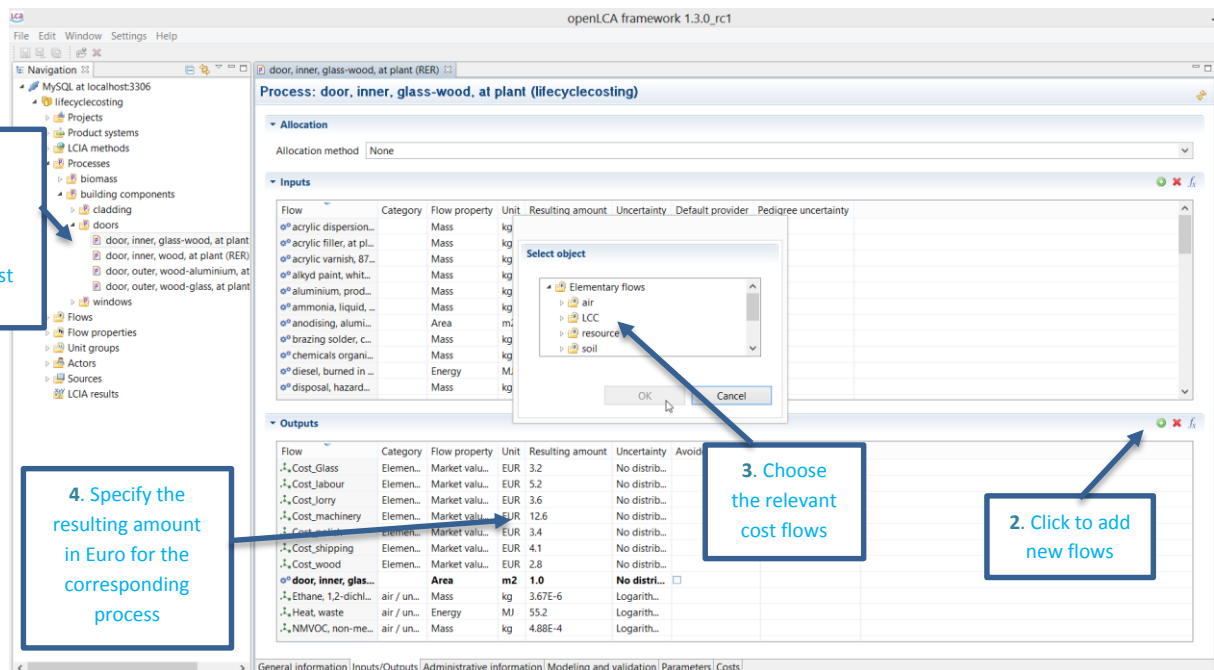
As an example, two processes from the ecoinvent database are chosen (door-inner-glass-wood and door-inner-wood). The respective cost flows are to be created for these processes.



Depending on the desired currency for LCC, you may need additional units. In openLCA, new units can be defined under “unit groups”. When creating a flow, you also need to assign a reference flow property. By default, there is only one economic flow property (suited for cost flows): “Market value US 2000, bulk process”.

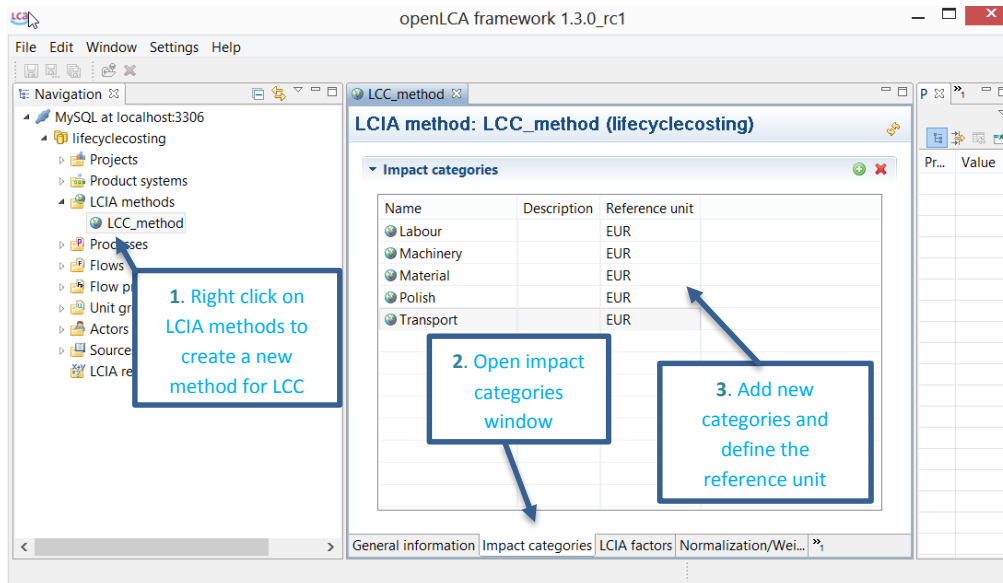
2.1.2 Adding cost flows to processes

For the selected processes, cost flows are added as an output; e.g.: cost of machinery, cost of glass and cost of labour for door-inner-glass-wood process. Note that for this example the prices for the cost flows do not represent the reality.

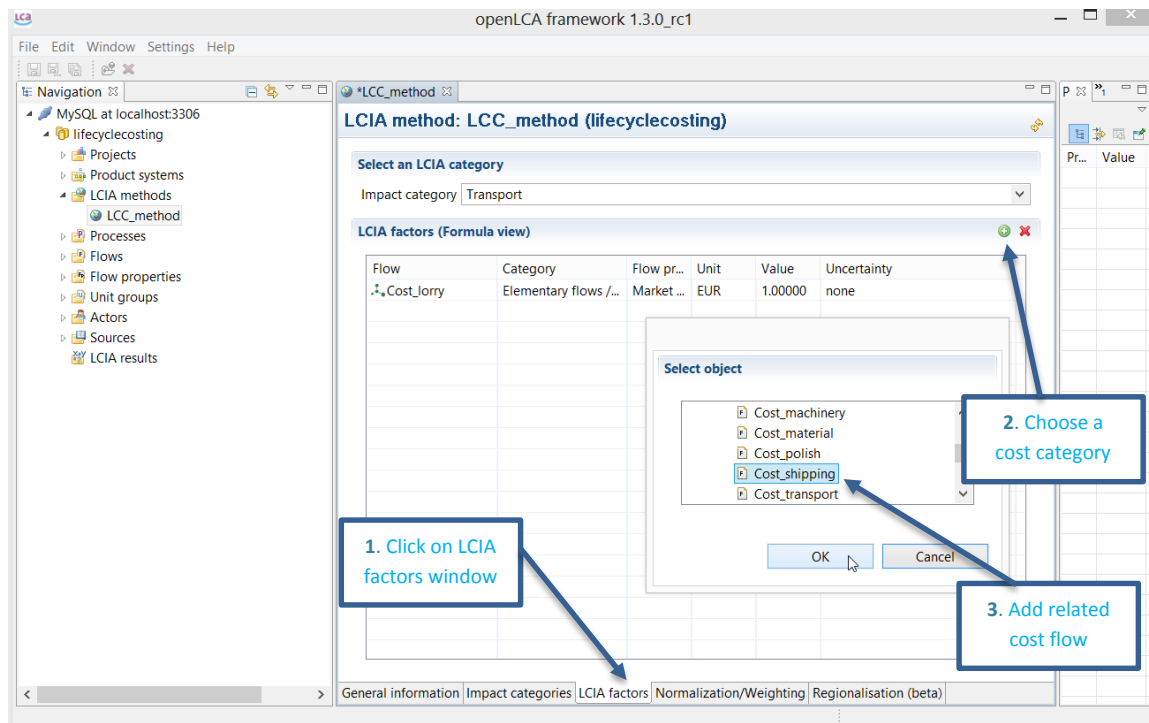


2.1.3 New impact category for cost calculation

If you want to group cost flows or compare two or more different product systems, it is convenient to create a new impact assessment method. For example, you can group transportation cost flows such as lorry and shipping under a transportation cost (impact) category.



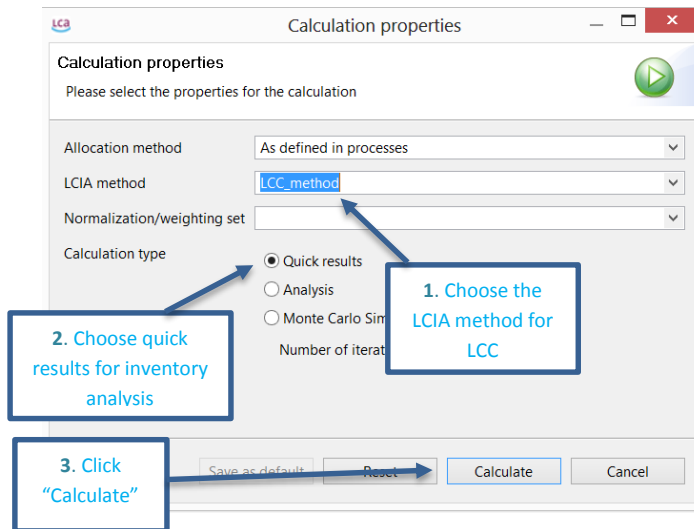
Cost flows should be grouped under cost (impact) categories on the LCIA factors window. Select each cost (impact) category and add corresponding cost flows. As this impact assessment method only adds costs in the same monetary unit, the equivalence factor "value" for each flow should be 1.



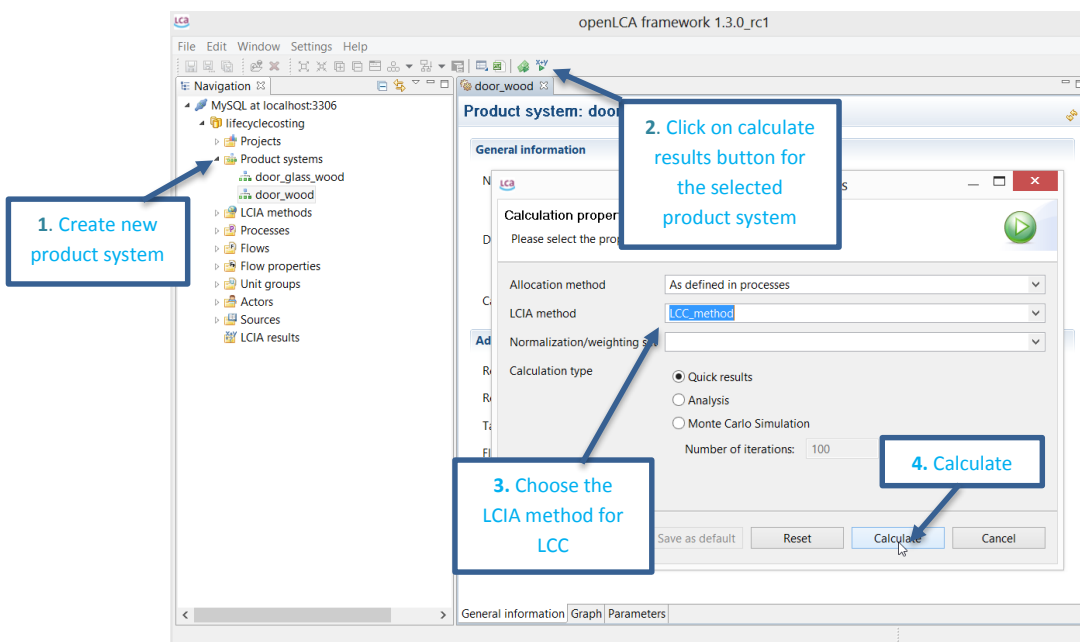
2.1.4 Calculation of LCC

Once all the cost flows are linked with the processes, a life cycle costing can be performed. To perform an example, two product systems are created from door-inner-glass-wood process and

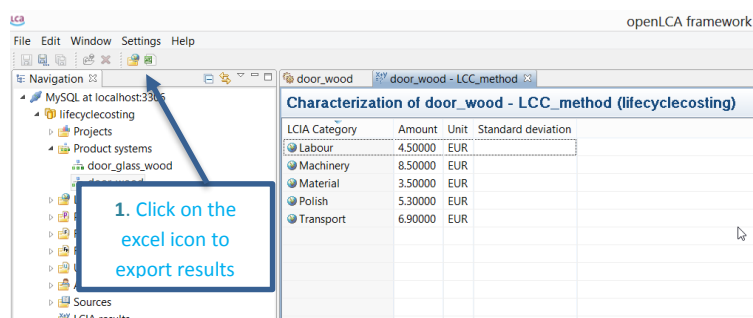
door-inner- wood processes. The cost-related life cycle inventory for a product system can be obtained by choosing the “quick results” calculation type.



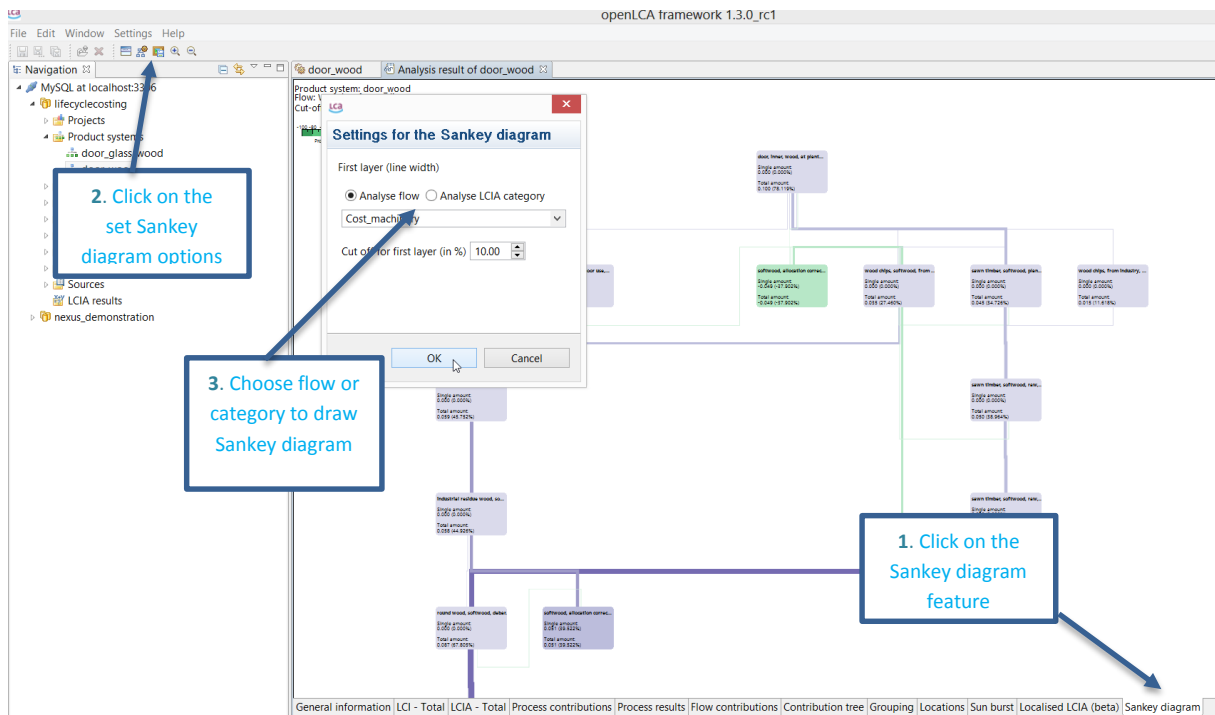
To obtain the results grouped under cost categories, click on the ‘calculate results’ button and choose the cost assessment method.



Absolute results can be obtained and exported to Excel.



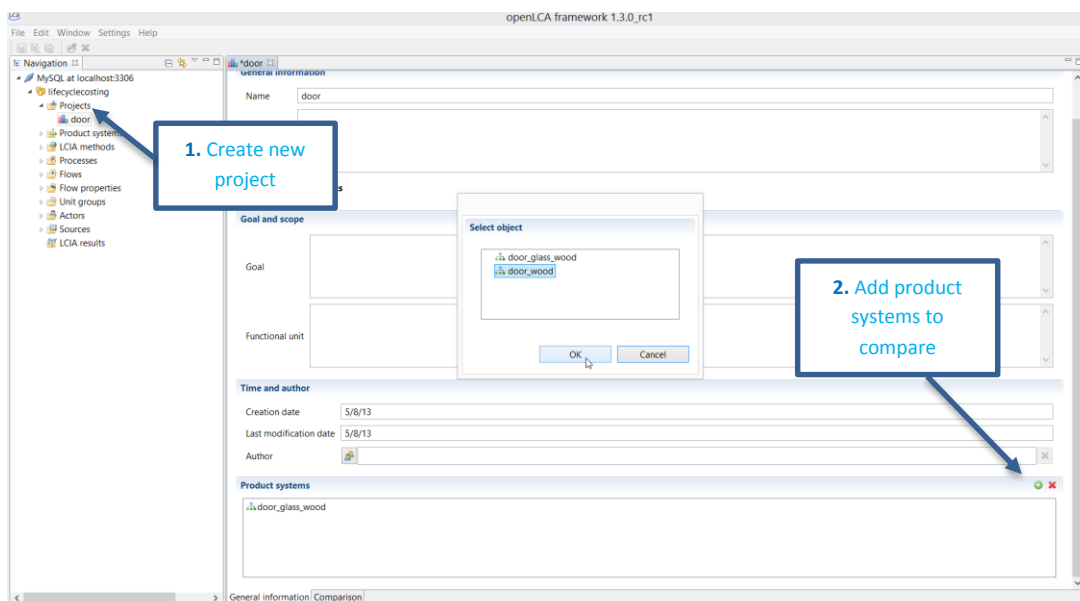
OpenLCA draws a Sankey diagram of the product system. This diagram is a graphical illustration of the impacts of different flows in the product system. For LCC, it will show the contribution of cost flows throughout the total cost.



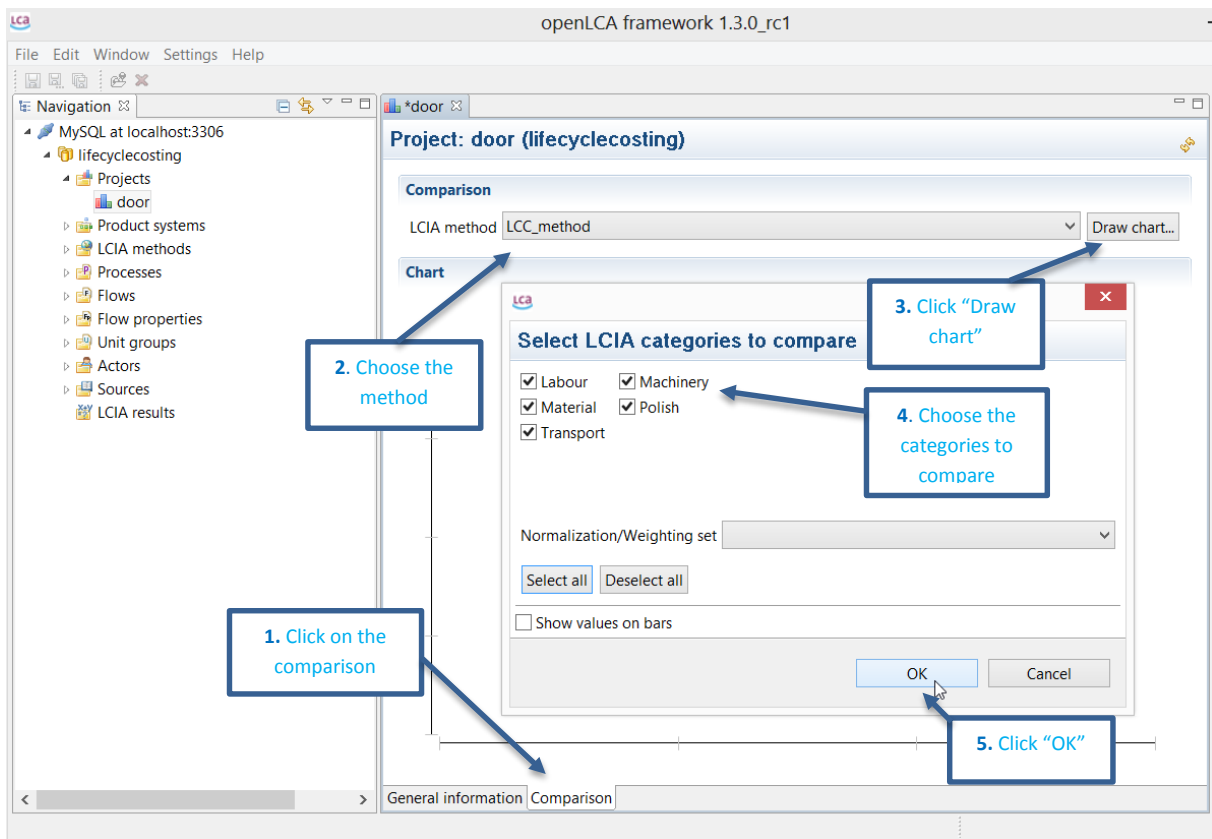
By clicking on the upper left corner of the diagram, or by selecting "Set sankey diagram options" in the menu, you can edit the Sankey diagram. You can select a flow or/and an LCIA category to be displayed in the Sankey diagram, and also set and change a cut-off threshold.

2.1.5 Comparison of different project costs

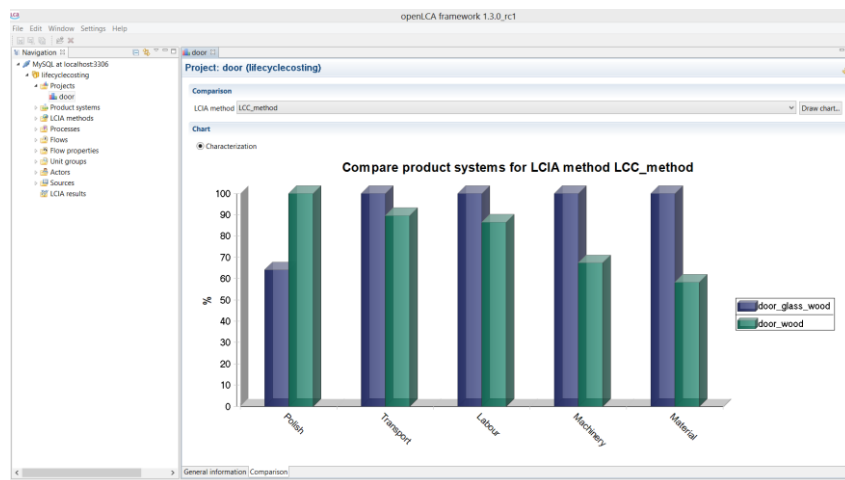
In order to compare the Life Cycle Costs of different product systems, a project has to be created. Product systems (e.g.: door-glass-wood and door-wood) should be added on the general information tab of the project window.



You can choose the specific categories to compare selected product systems.



The results are obtained as bar chart.



The comparison that is shown is based on the characterization, according to the LCC LCIA method. But if you tick Normalization/Weighting set on “select LCIA categories to compare” window, normalization, weighting or single score results can be obtained.

2.1.6 Cost Fluctuations

Costs often vary. There are several ways in openLCA to express this volatility of costs. For one, openLCA enables uncertainty modelling by editing the uncertainty distribution of LCIA factors. This gives the opportunity to model the fluctuations in the market. By choosing the Monte Carlo

Simulation calculation type in the start calculation menu, these fluctuations are taken into account and allow calculating a result that reflects these uncertainties and variations in cost data.

Another way to model cost fluctuations could be by editing the pedigree matrix for cost flows added to processes. However, the current pedigree matrix, as it is implemented in openLCA, reflects the uncertainty for environmental data, according to ecoinvent. A new pedigree matrix should be created to reflect the uncertainty for costs. This has already been described in literature (Ciroth2008).

2.1.7 Discounting/Inflation

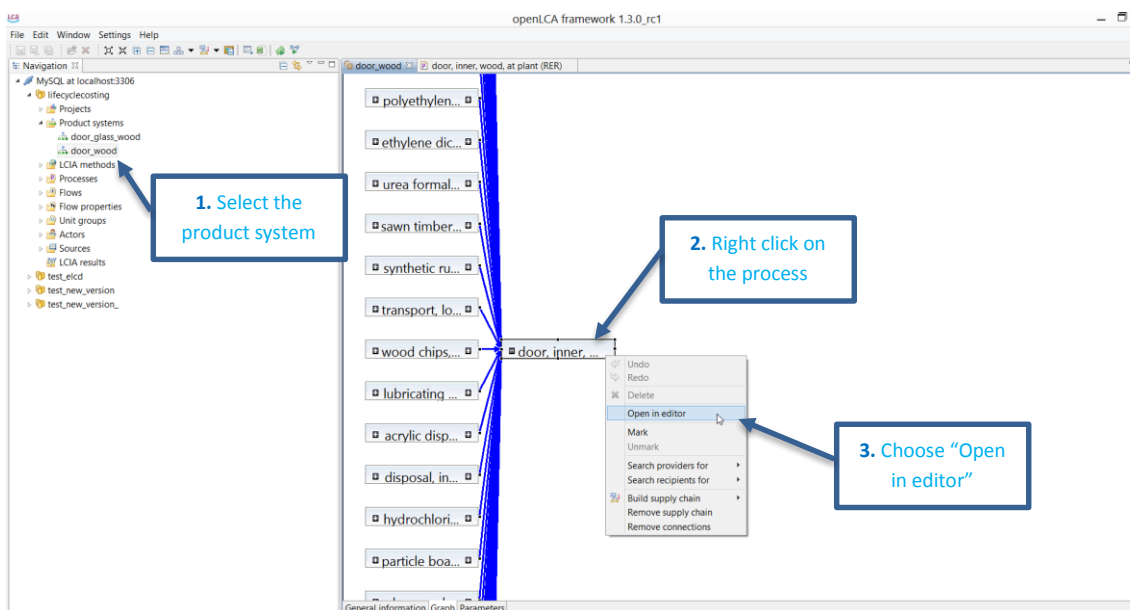
Modelling of discounting or inflation is also possible with openLCA by applying normalization. If you go to the tab “Normalization/Weighting” of the LCC impact assessment method, it is possible to define normalization factors for each impact category. To apply this economic effect, impact categories should have a time reference.

2.2 LCC with openLCA cost feature

Adding costs information to each flow/process through the whole product system makes sense when an inventory for costs is available as part of the environmental inventory. Otherwise it is easier to follow a methodology that adds costs as cost categories on the process level, starting from the last process of the chain and going backwards in the supply chain. This second approach will be described in the following.

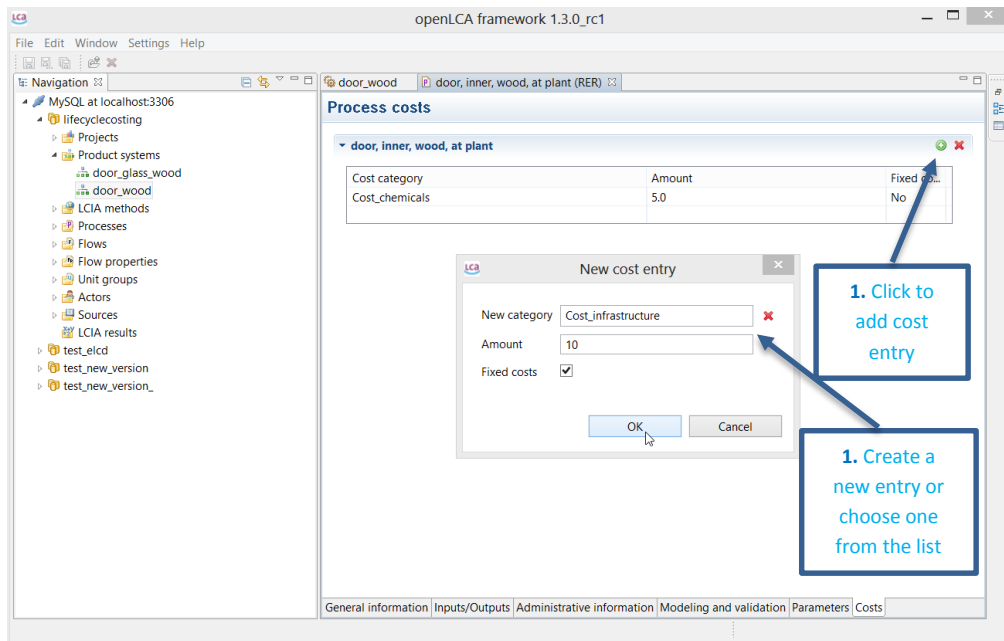
2.2.1 Adding costs to processes

Go on the product system graph window. If we use the same product system of the previous method, double click on the door-wood product system and choose the graph feature on the product system window. The links in between processes can be seen. Right click on one process and choose “open in editor”. Once the process window is opened, related cost categories can be created and added to process.



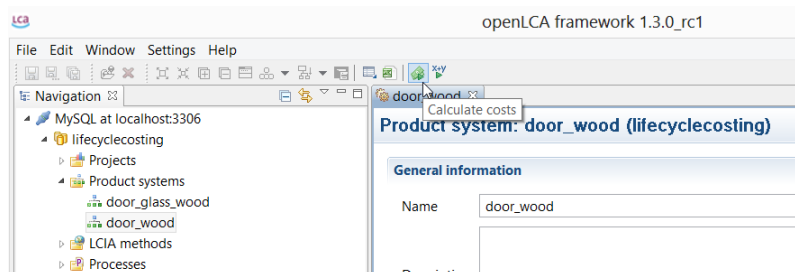
Go on the costs feature of the selected process. Here, new cost entries can be created or existing ones can be added. If a fixed cost box is not clicked, the cost entry will be added under variable costs.

For example, for door-wood process, the infrastructure costs can be fixed cost while vanishing is variable cost.

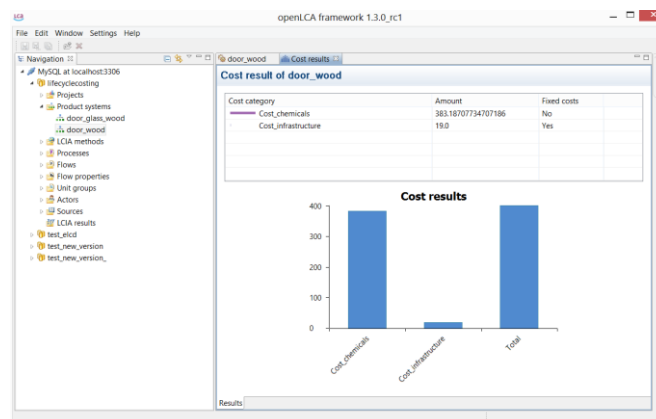


2.2.2 Calculation of costs

The costs that are added on the process level will be summed up for the product system under two main categories as fixed costs or variable costs. By clicking the 'calculate costs' icon (not the usual calculate icon), the cost calculation can be performed for the product system.



The results will be shown as a bar chart.



This method does not allow the calculation for cost fluctuations or inflation/discounting yet.

3 Conclusion

LCC can be performed in openLCA, stand alone, but also, and especially, together with an (environmental) Life Cycle Assessment. There are two main approaches for dealing with life cycle costs in openLCA. The first method, treating costs as elementary flows, is pretty straightforward to implement and use. It also allows to perform advanced cost calculations such as discounting or inflation. On the other hand, the second method, process costs, can be used easily in parallel to a data inventory creation.

At the moment, cost datasets are not available in ecoinvent (2.2) or other databases. Although it might change in near future, especially with ecoinvent 3, building a cost inventory at present needs considerable effort. Therefore it is recommended to build, for a practical case study, the cost inventory on a generic level and detail where relevant, for foreground processes.

4 References

Klöpffer, W.; Renner, I. (2008): Life-Cycle Based Sustainability Assessment of Products. Chapter 5 in: Schaltegger, S.; Bennett, M.; Burritt, R.L.; Jasch, C. (Eds.): Environmental Management Accounting for Cleaner Production. Springer, pp. 91-102

5 Contact

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