

Life Cycle Costing in SimaPro

Andreas Ciroth, Juliane Franze, GreenDeltaTC Berlin

August 2009

ciroth@greendeltatc.com, franze@greendeltatc.com

1	Background.....	2
2	LCC in SimaPro - Basics	2
2.1	Adding a new method "LCC"	3
2.1.1	Adding impact categories.....	3
2.1.2	Specifying the damage assessment.....	4
2.1.3	Specifying the calculation of LCC.....	5
2.2	Editing specified costs.....	5
2.3	Adding economic issues to processes.....	6
2.4	Calculating life cycle costs.....	7
3	LCC in SimaPro – Special topics	8
3.1	Dealing with cost fluctuations.....	8
3.2	Discounting	9
3.3	Detailed cost inventories	10
4	Conclusions.....	10
5	References	10

1 Background

Life Cycle Costing (LCC) is an assessment of all costs related to a product or service, over the entire life cycle, from production over use until disposal. LCC has a long tradition in industry, especially for those products that have a long life time and/or high maintenance, use or disposal costs. Motivation in these cases comes from both the user and the producer of these products. For the user, the purchase price is only a small share of all costs the product will have, and the overall costs are therefore more important for the purchase decision; for the producer, Life Cycle Costs are a way to demonstrate that more effort for the production “pays off”, by reduced use or maintenance costs or disposal costs.

In combination with a Life Cycle Assessment that investigates the environmental impact of a product or service, LCC can serve to address the economic dimension of sustainability (e.g. Klöpffer Renner 2008). Further, LCC together with LCA is part of many eco-efficiency approaches. Very similar to a Life Cycle Assessment, also for the Life Cycle Costing goal and scope (system boundaries, the object of study, allocation, “impact assessment”), and other aspects need to be specified and aligned with the decisions taken for the Life Cycle Assessment in order to obtain an overall consistent analysis.

A SETAC Working Group has developed from 2002 until 2006 a methodology for LCC that is meant to be applied in parallel to an LCA, called “Environmental LCC”. The method tries to take into account both the broad business experience in “conventional LCC” and the specific requirements and learnt lessons from LCA. Not the least, aim is to provide an LCC methodology that can be efficiently and consistently combined with LCA.

The result is available as a report and book (Hunkeler et al. 2008). Basically, an Environmental LCC analysis has a similar structure as a Life Cycle Assessment that is conducted in parallel, and shall have the same functional unit. The life cycle and system boundaries need to be equivalent, but not necessarily the same as different processes may have different relevance for the environment and for the cost part. For example, research and development will rarely be considered in an LCA, while it is commonly taken into account in LCC. Further, Environmental LCC can be performed from the viewpoint of different “life cycle actors” (as: producers, product buyers, or End-of-Life actors).

Since both Environmental LCC and LCA are of a similar structure and can even be interpreted together, it makes sense to conduct both in one software. Aim of this paper is to investigate if, and how far, this is possible in SimaPro. This is interesting since there is very little information on the topic so far.

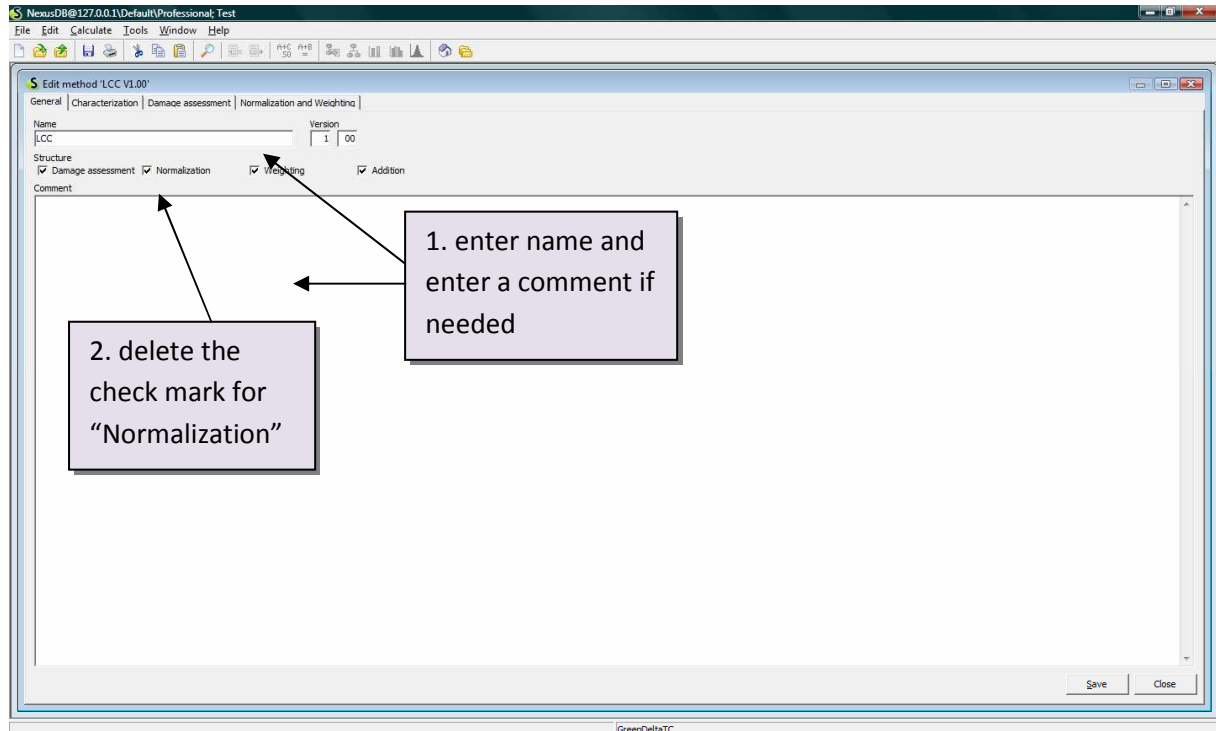
2 LCC in SimaPro - Basics

First steps for conducting an LCC study in SimaPro are straightforward. A new assessment method needs to be created, and then populated with damage categories, subcategories, and flows or “substances” that express economic impacts. Finally, these economic impacts need to be assigned to processes where they occur. With this information, the Life Cycle Costs for a product can be calculated, and the result be displayed in Sankey diagram and in the other interpretation features SimaPro offers.

In the following, these steps will be explained more in detail.

2.1 Adding a new method “LCC”

Open SimaPro and an appropriate database and project. Go to “Methods” and add a new category “Economic”. Click on “New”. Now you can fill in details of the method. Enter a name and comments under the tab “General”; deselect “Normalization”, as normalization is not (commonly) applied in LCC.



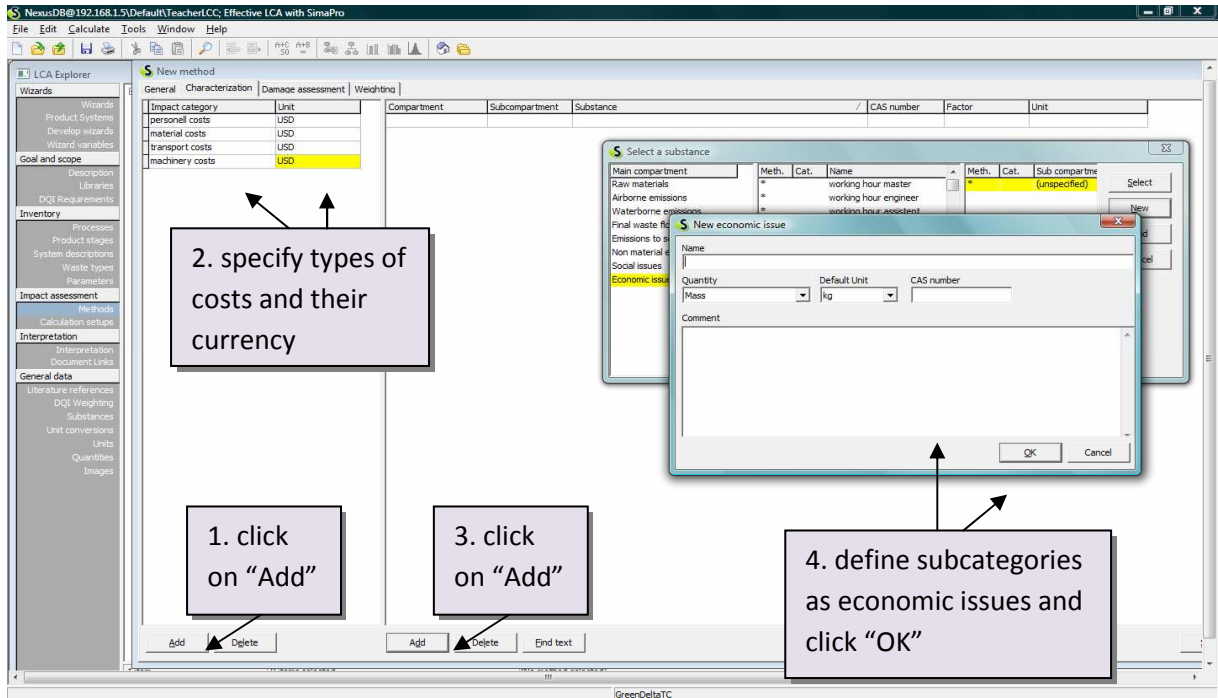
2.1.1 Adding impact categories

In the newly created LCC method, go to the tab “Characterization” and add the required cost types under “Impact category”, together with their unit, i.e. their currency. Examples for cost types are personnel costs or material costs.

For each cost type (i.e. “cost impact category”), add subordinated cost items with prices. These cost items are the substances for the (cost) impact category. These cost items should be added in the “economic issues” section of the substances. Revenues can be modeled as negative costs.

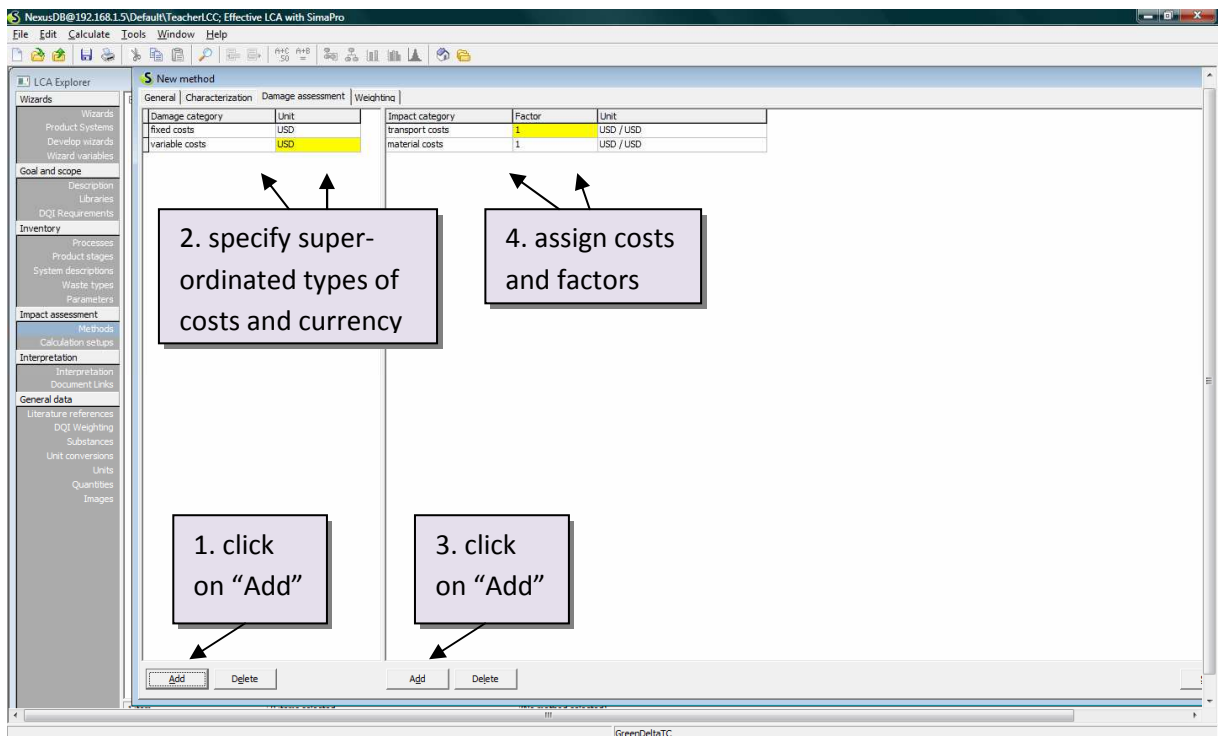
One example for such an economic issue is the plastic type ABS, assigned to the cost type material costs, with 1 USD/kg.

Note that the cost items can become very detailed; for a start, it will probably suffice to enter rather coarse cost items; these may be detailed later in an iteration step once you have a feeling about the importance of different items for the result.



2.1.2 Specifying the damage assessment

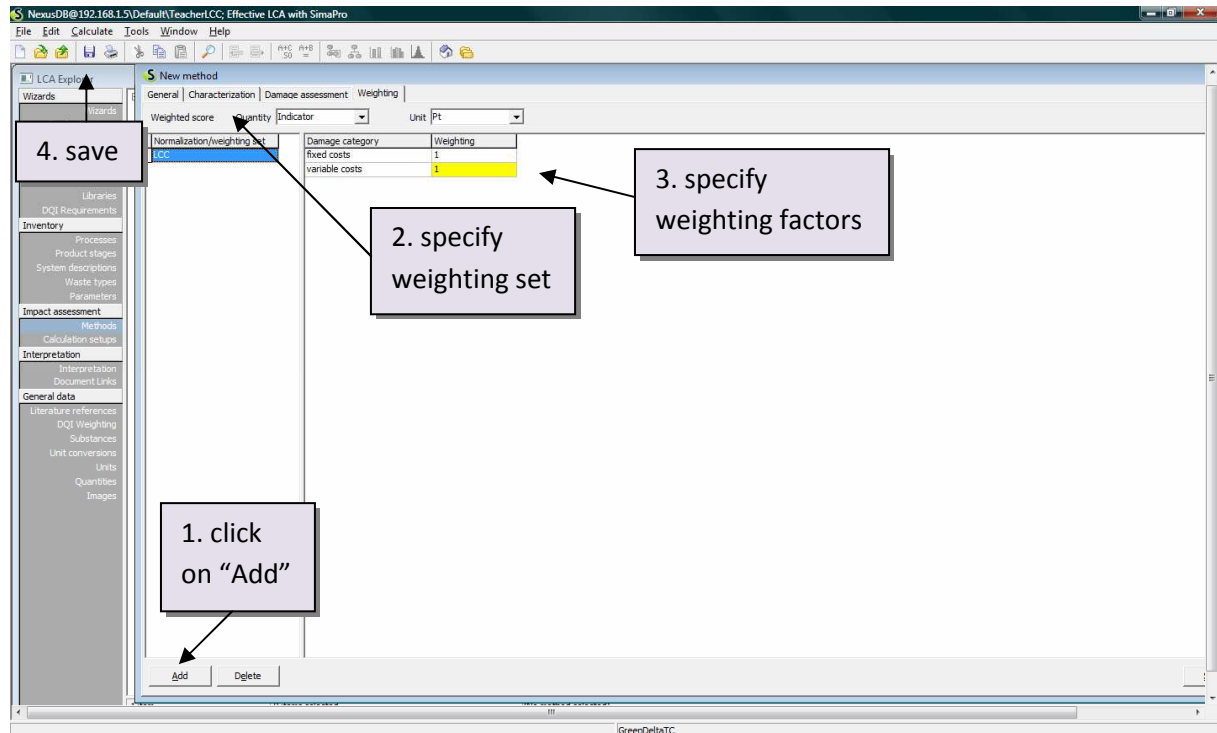
As a next step, go to the tab "Damage assessment" and define top level cost categories as "Damage category". An example could be fixed and variable costs. Assign then the already existing cost types (personnel costs, material costs, etc., as given in characterization) to the damage categories. Specify also a unit and a conversion factor. In the easiest case, everything is in one currency and at one time; the factor will then be 1.



2.1.3 Specifying the calculation of LCC

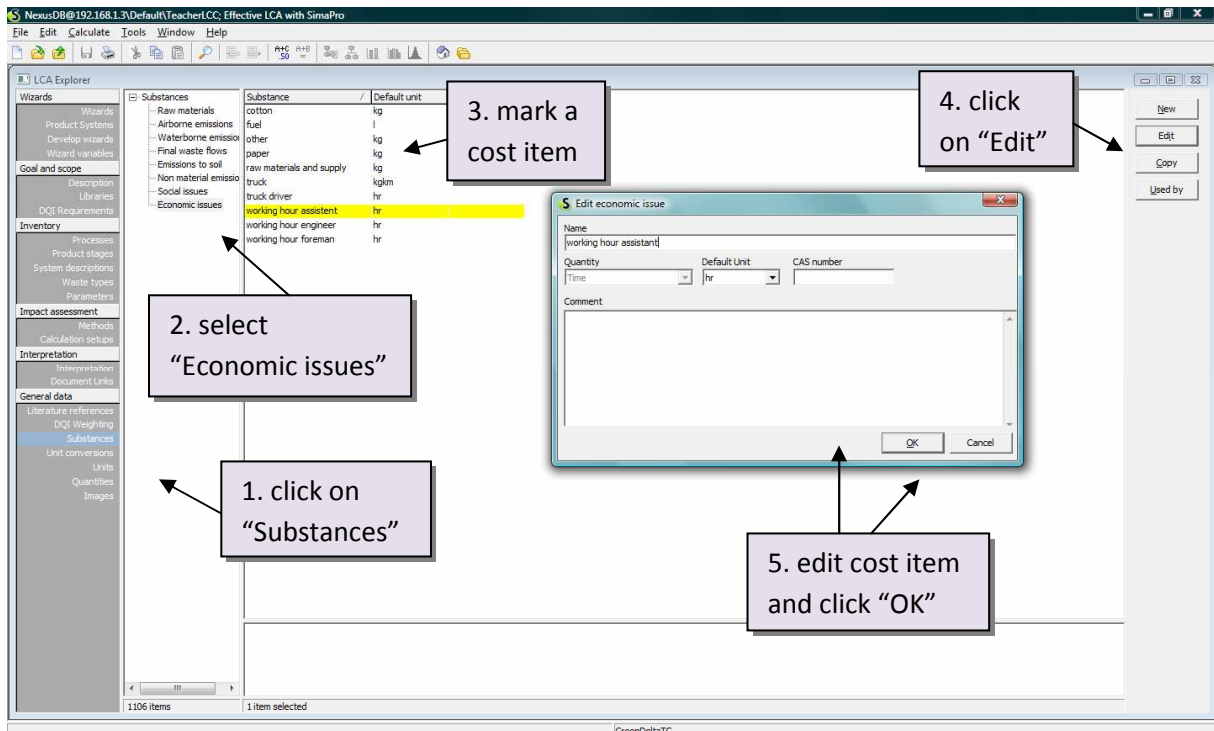
In the LCC method, go to the last tab “Weighting”. Define here how the top level cost categories (the cost categories in the damage assessment) shall be aggregated. Enter for each a weighting factor. Enter “1” for simple addition of all cost categories, which is often a useful approach. If you want to implement discounting or increasing prices, see chapter 3.2.

Now the LCC method is specified. Click the save button and close the method window.



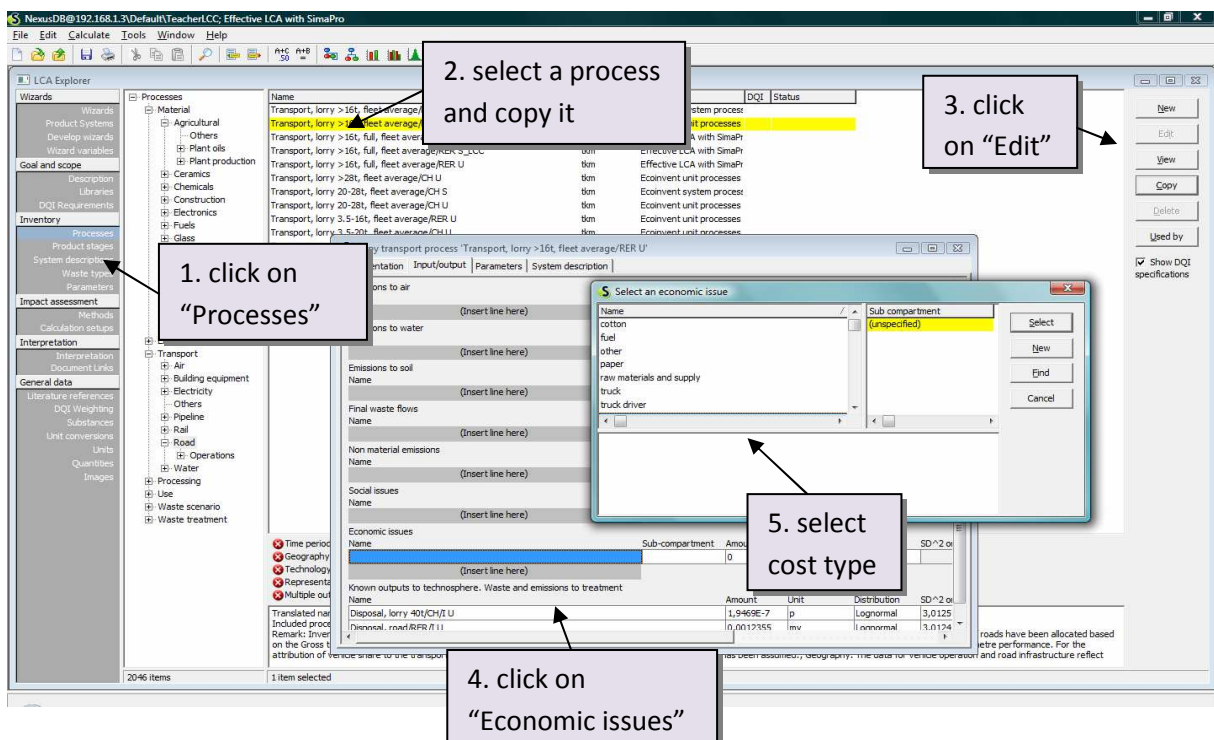
2.2 Editing specified costs

Editing the economic issues specified in the LCC method later is also possible. To do so, open “Substances” from the LCA Explorer, and then go to the category “Economic issues”. Here you can find and edit all cost items.



2.3 Adding economic issues to processes

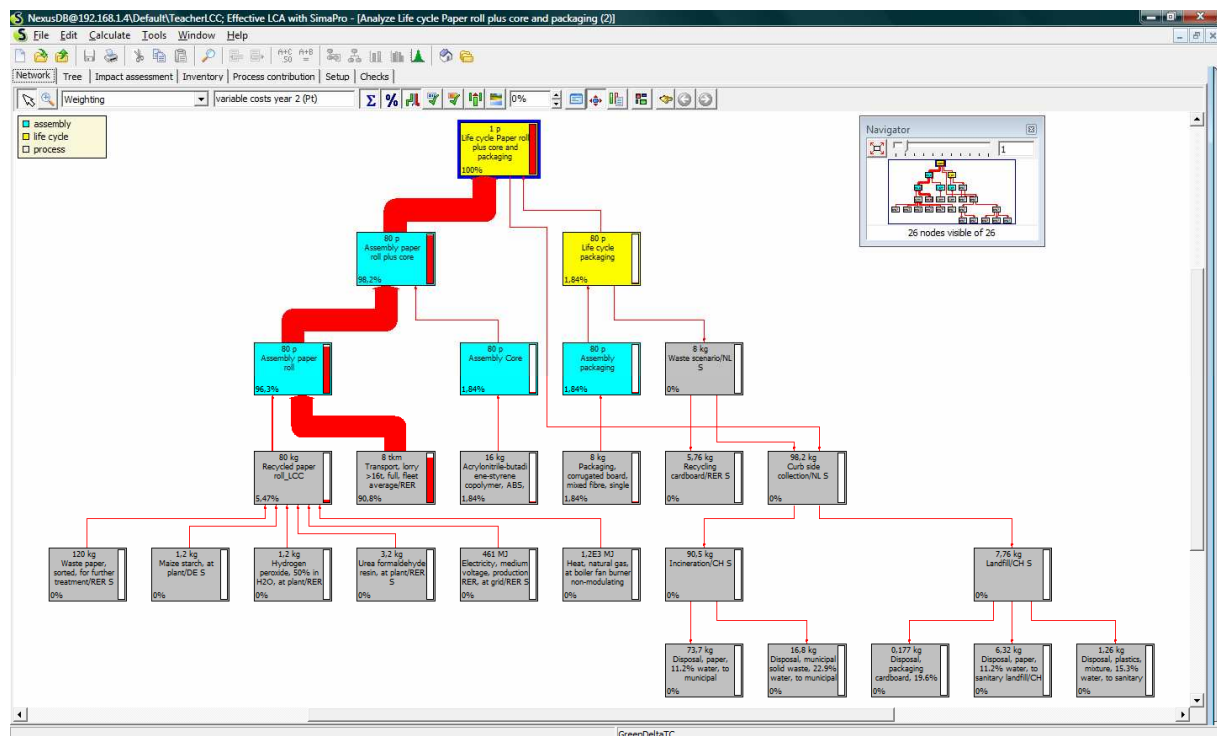
Adding economic issues to the processes in your project is the core of Life Cycle Modeling. From the software side, it is very simple. Edit the process where you want to add cost information, and then specify each economic issue, under, evidently, "economic issues". While in the assessment method, economic issues are defined as costs or revenues per reference unit, the reference unit being either mass or energy or time, on the process level, the economic issues need to be given as per reference unit, i.e. the time, mass, or energy needed by the process.

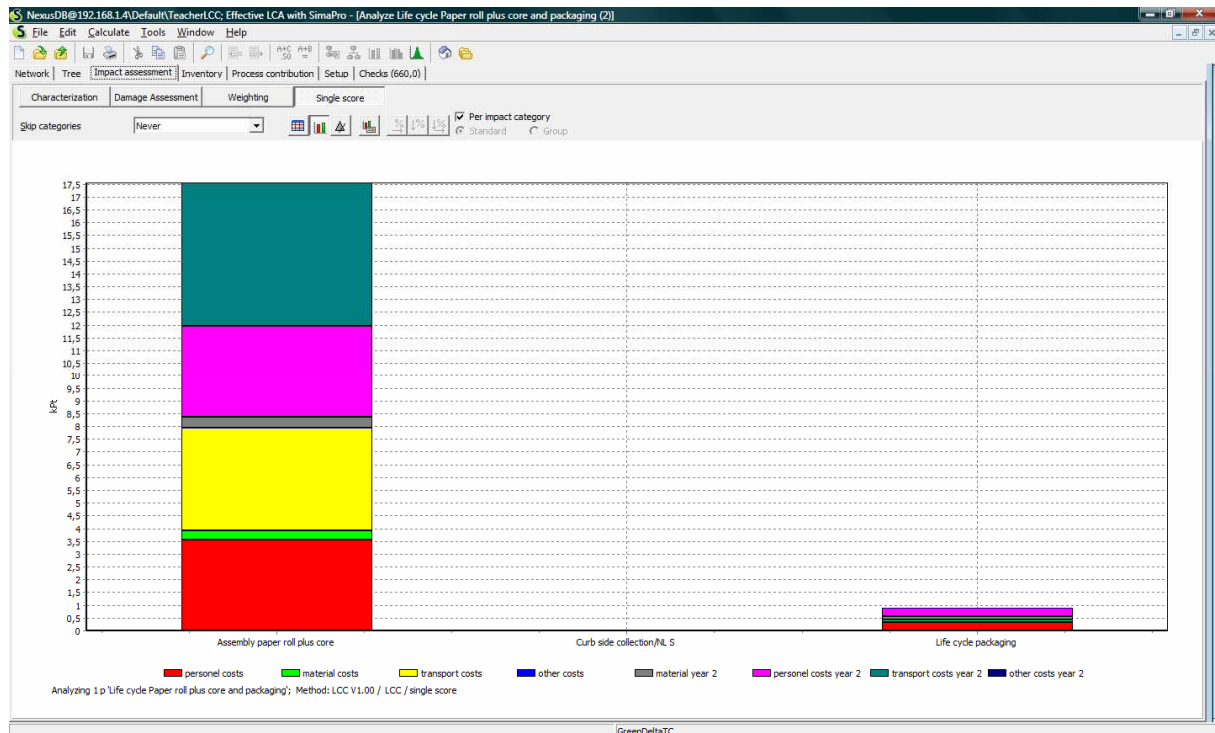


Add economic issues to all processes in your life cycle, where relevant. You may have processes with only economic issues and no (relevant) environmental issues, as research, or infrastructure processes.

2.4 Calculating life cycle costs

Once the life cycle with cost information is modeled and the LCC method is specified, Life Cycle Costs can be calculated and displayed in SimaPro just as any other method results. Simply select the LCC method as “method” in a calculation setup. Note that in the result, not only the overall life cycle costs but also top level cost categories and other cost types as specified are available and can be displayed and analyzed, for example in the Sankey diagram.





3 LCC in SimaPro – Special topics

Modeling the basic life cycle costing in SimaPro is relatively straightforward. In practical applications, some additional aspects might be of relevance and deserve therefore attention. The following will be discussed:

- dealing with cost fluctuations
- discounting
- dealing with detailed cost inventories.

3.1 Dealing with cost fluctuations

Unlike characterization factors for impact assessment models, costs and revenues are results of markets, and can vary strongly. To model these fluctuations, a natural way would be to assign uncertainty figures to the economic issues. However SimaPro does not provide uncertainty modeling for the impact assessment (and that is where we have put the costs as assessment factors of mass or energy or time unit). Also, parameters are not available at the impact assessment side which prevents automated cornerstone scenario calculations.

A workaround is to provide uncertainty information at the process level. Since in the LCC result, relative costs from the impact assessment (the LCC method) are multiplied by the amount given on the process level, this can provide the same result; however, care needs to be taken to transfer the probability distribution correctly from e.g. costs-per-mass to mass, in view of a differing data level. And besides, making the demand for a specific material mass of a process uncertain instead of reflecting the uncertainty in the prices is far from an elegant modeling approach.

A slightly more intelligent workaround would be to specify the uncertainty in a parameter in SimaPro, and multiply the economic issue with this parameter. This way, the uncertainty is not mixed

with the mass or other quantitative unit of the economic issue. Yet still, uncertainty from information based on price fluctuations needs to be correctly transformed to the uncertainty used for these parameters¹.

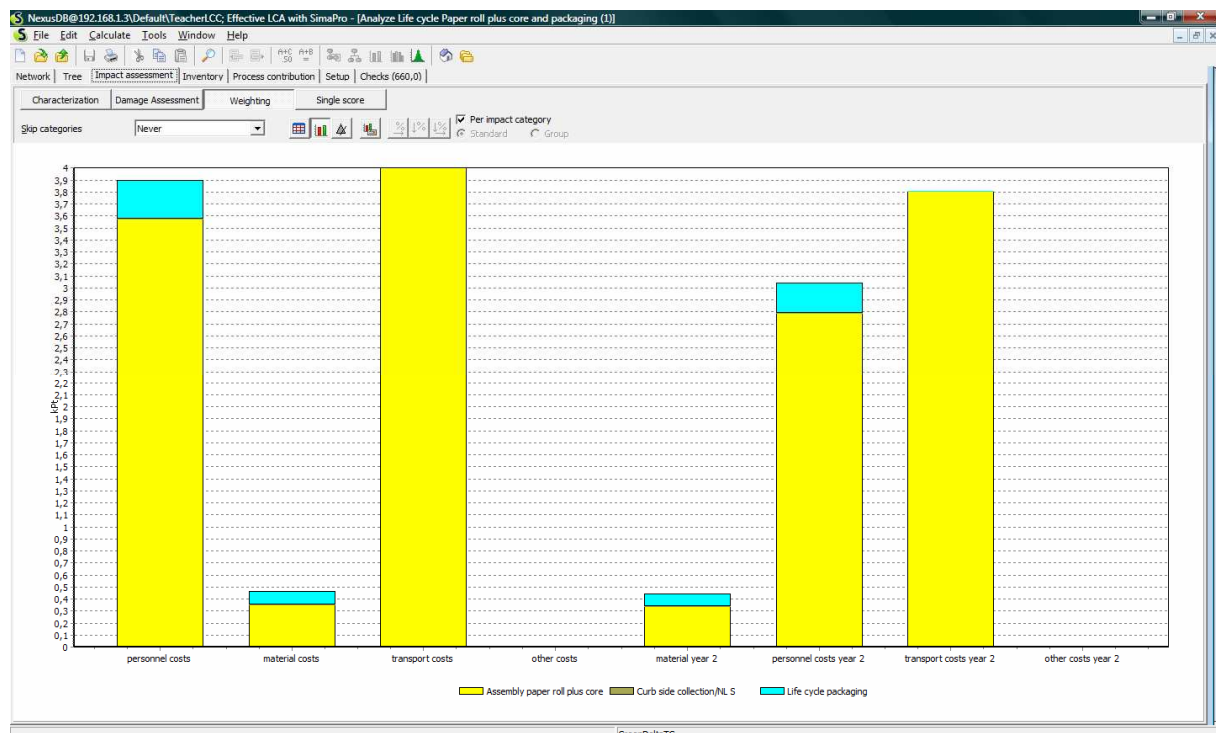
3.2 Discounting

There is a lot of discussion whether in an LCC that is conducted in parallel to an LCA, cost figures should be discounted or not. LCA results will rarely be discounted. On the other side, in conventional LCCs, costs are usually discounted.

There are several ways to consider cost discounting in LCC, in SimaPro.

One possibility is to define damage categories *per year*, e.g. fixed costs year 1, fixed costs year 2, and so on. Then, instead of aggregating each damage category with a factor of one, as done in the basic approach described in section 2.4, the damage categories should be aggregated with a lower factor that expresses the discounting. Since the aggregation factor cannot be parameterised in SimaPro, the correct factor needs to be calculated outside of SimaPro. The calculation should be documented in the comment field near the aggregation factor.

The bar chart below shows an example for discounted material, personnel and transport costs in year 1 and year 2.



¹ Thanks to Mark Goedkoop for this suggestion!

3.3 Detailed cost inventories

Real cost inventories can easily become as detailed as LCA inventories. Input/output data aside, there are at present no default cost entries available in ecoinvent or other SimaPro databases. While this might change, this means that building a detailed cost inventory is at present quite an effort.

It is therefore recommended to specify the economic issues on a rather coarse level (e.g., “steel” instead of all different steel prices), and only deviate from this principle in those cases that are relevant for the result.

From the LCA inventory, different more detailed materials should be aggregated for the economic issue using parameters, in order to link the economic and the environmental inventory in SimaPro.

4 Conclusions

LCC can be performed in SimaPro, stand-alone, but also, and especially, together with an (environmental) Life Cycle Assessment. The basic LCC approach is pretty straightforward to implement and use. This is a bit surprising since there is very few information so far about using LCC in SimaPro.

On a more advanced level, some specific approaches of LCC are possible to apply but rather via workarounds: Discounting and dealing with cost fluctuations and cost uncertainties are probably the most striking ones. Changes in the SimaPro software are needed to provide more straightforward approaches here. For discounting and uncertainty analysis of costs, needed changes are probably rather little effort.

At present, no cost data are available in ecoinvent or other SimaPro databases, besides input/output tables. While this might change in near future, building detailed cost inventories means currently effort. It is therefore recommended to build the cost inventory in principle on a rather generic level, and detail where relevant.

5 References

Hunkeler et al. 2008: Hunkeler, D., Rebitzer, G., Lichtenvort, K. (eds.): Environmental Life Cycle Costing. Lead authors: Ciroth, A.; Hunkeler, D.; Huppes, G.; Lichtenvort, K.; Rebitzer, G.; Rüdener, I.; Steen, B; Taylor & Francis 2008

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