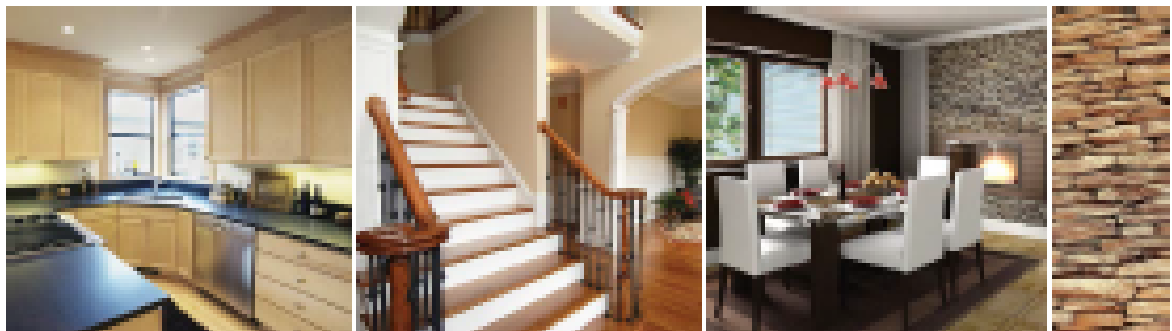


# *SimaPro*® **Guide**



**Produced by:  
Team EcoBalance**

**Worcester  
Polytechnic  
Institute  
2014**



Used as reference to the Worcester Polytechnic Institute Interactive Qualifying Project; A Solar Decathlon Materials Selection Study. Performed at the Luzern University of Applied Sciences and Arts.

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Compiled April, 29<sup>th</sup> in conjunction with SimaPro<sup>®</sup>7 wood tutorial.

In order to combat the steep learning curve that SimaPro® is notorious for we have created a guide to learn basic commands, input data, and produce calculations. This guide does not assess the methodology of LCA, those can be found in the literature review. The process that we based the guide off of is turning a felled tree into lumber planks used in creating a shed.

### **Starting a New Project:**

Firstly you will need to create a new project. Upon start-up, SimaPro® will prompt you to open a new project or continue an older one. Select “new project” and name it what you please. In this case we will call it Felled Tree.

Before starting any new LCA project you need to understand the goal and scope of your project. This is important to keep in mind throughout the whole process because SimaPro® is extremely granular and it will be easy to get caught up inputting data that is unnecessary to the project.

### **Selecting a Library:**

In this section, you can define which libraries you want to use for each of your projects. They are intended to be used as resources that you can use in all your projects and that are not intended to be edited. If a certain item or material from a library needs to be customized for your project, copy that item and edit it accordingly.

### **Process 1: Entering a Felled Tree:**

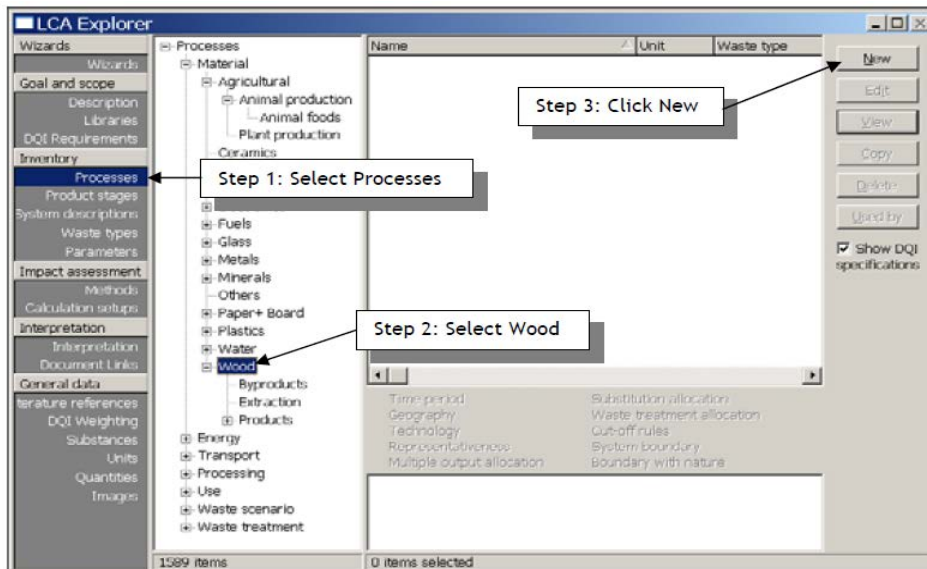
The scope of this guide has been defined to include the woods life cycle starting from a fallen tree, to the end of its life.

We will take 1.25 tons of wood from a felled tree. We will assume that only the trunk of the trees will be used and any branches or leaves will be left in the forest from which this is being gathered. As part of the scope we will take into account any machines (i.e. chainsaws) needed to gather this given amount of wood.

Now follow the three steps, which are also shown in the figure below:

1. Click on Processes in the LCA Explorer window.

2. Click on the category Wood.
3. Click new and a new and empty process record will appear.

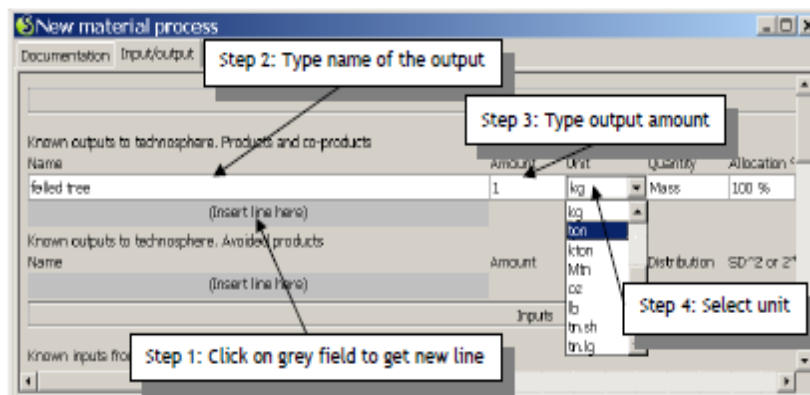


### Process Outputs:

The new material process window will have four tabs, for this click the Input/Output tab second in from the left.

Follow the four steps shown in this figure:

1. Double click on the white field under the “known outputs to technosphere, Products and co-products” section and a new line will appear.
2. Enter the text “Felled tree” in the section under “Name”.
3. Enter the number 1 under ‘Amount’.
4. Double click in the field under “unit” and choose ton by using the pull-down option. SimaPro® can convert units, so it understands that you now have just entered an output of 1 ton of felled trees.



## **Entering Inputs:**

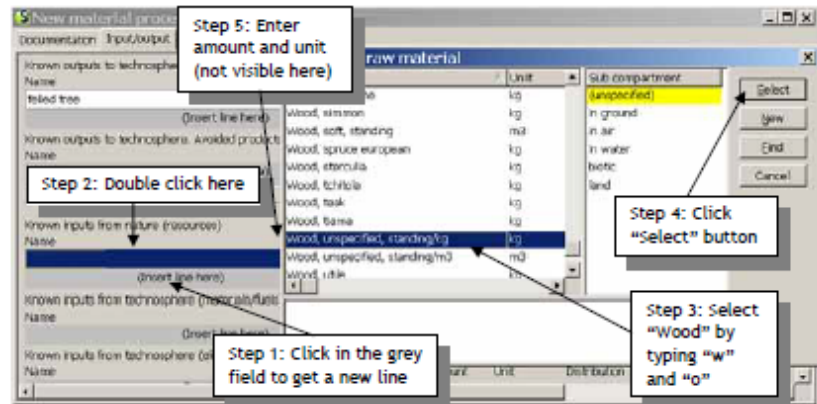
Entering inputs usually should come second, after entering the outputs, when starting a new process because knowing the desired quantities of the outputs will help to know the required amount of input. Note that under the Input option lines there are three pre-established types of inputs. These are Inputs from Nature Resources, Technosphere (materials and fuels), and Technosphere (Electricity and Heat). More detail on each of these is displayed below:

1. Known inputs from nature (resources). Here you can list the resources that are directly taken from the natural resources. In this case, the wood that is extracted from the forest. In a process that describes mining, the ore or metal input would be described here. All data you enter here will be included in the inventory result table.
2. Known inputs from technosphere (materials and fuels). Here you enter inputs that come from other industrial processes and not from nature.
3. Known inputs from technosphere (electricity and heat). This field has the same purpose.

## **Input from Nature Resources:**

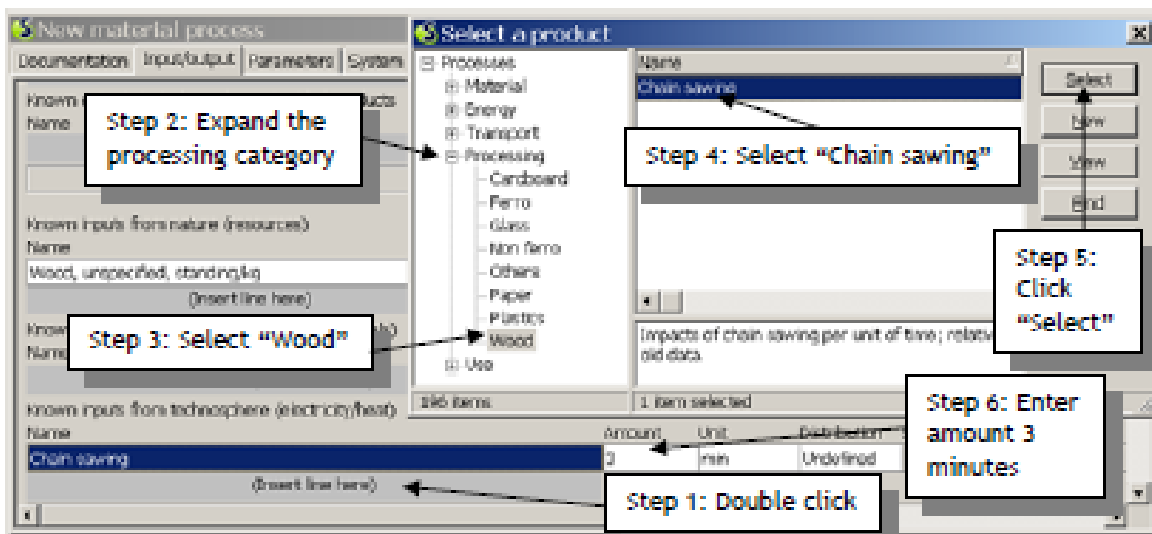
1. Click the grey box (insert line here) under 'known inputs from nature (resources)
2. Double click in the blue field. A list of predefined resources is presented.
3. Select wood from the list. You can do this by scrolling, but also by typing "wood": SimaPro<sup>®</sup> will immediately search for the closest match.
4. When you find "Wood, unspecified, standing/kg", click 'Select' (or double click).
5. Enter the amount as 1.25 tons. The difference between input and output is entered as final waste flow "Wood waste".

Displayed to the right are the steps:



### Inputs from Technosphere (materials/fuels):

Given the scope of the project defined in the beginning of this guide we will take into account the input of materials and fuels need to run a chainsaw. This can be done by following the steps on the screen shot below.

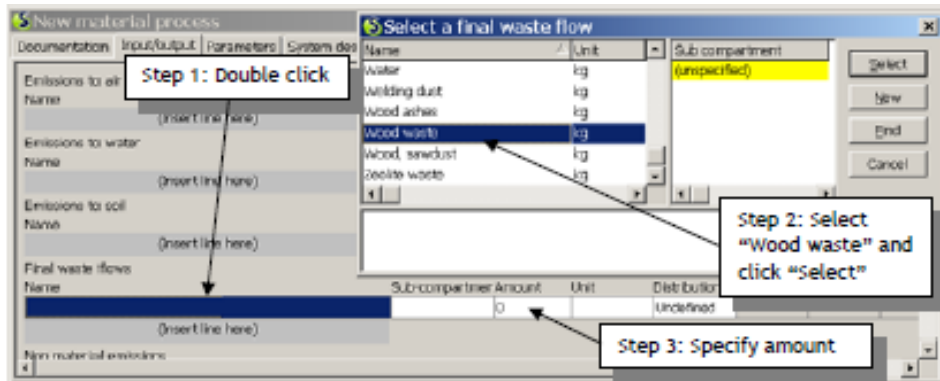


Based on quick research from local wood companies we came up with the estimate that it will take three minutes or 0.05 hours to fell a 1.25 ton tree.

### Entering Emissions and other Outputs:

Below the inputs there are eight different sections to enter more outputs. They are: Emissions to air, Emissions to water, Emissions to soil (usually to express leaching), Final waste flows, or wastes in solid form, Non material emissions, like radiation, noise, etc., Social issues, Economic issues, and Waste and emissions to treatment. As mentioned above we will need to

enter “wood waste” as a known output. Further research will conclude that from a 1.25 ton felled tree, 250 kilograms or .25 tons of wood waste will be created. Image below displays this process.



### Documenting the Process:

The figure below provides an example of how such documentation for this specific record could be entered. Please note the following characteristics:

- The name of the process is not the name that you will find in the list with processes. The name of the process is only there for your own reference.
- Under Data Quality Indicators there are 8 fields you can use to characterize the record. In the figure below, the appropriate settings have been entered.
- The comment field in the bottom will also be shown in the listing of the processes in the explorer. It is useful to add some characteristics that help you to understand the contents of the record.

The image to the right shows how the data should be entered for documentation:

The image shows a detailed documentation form with the following sections and data:

- Documentation** (selected tab):
  - Project: Tutorial with wood example
  - Created on: 4/29/2008
  - Category: Material
  - Last update on: 4/29/2008
  - Process type: Unit process
  - Process identifier: HP6710B-C0946600001
  - Name: Tree falling
  - Status: Finished
  - Image:
- Data Quality Indicators**:
  - Time period: 1995-1999
  - Geography: Europe, Western
  - Technology: Average technology
  - Representativeness: Average from a specific process
  - Multiple output allocation: Not applicable
  - Substitution allocation: Not applicable
  - Cut-off rules: Less than 5% (environmental relevance)
  - System boundary: Second order (material/energy flows including operations)
  - Boundary with nature: Agricultural production is part of natural systems
- Info. process**:
  - Info. process: No
  - Date: 4/29/2008
  - Record: The authors of the tutorial
  - Generator: Your name
- General reference and sources**:
  - Literature reference: (Insert line here)
  - Comment: (Insert line here)
  - Collection method: Taken from literature
  - Data treatment: Simplifications made for didactic purposes
  - Allocation rules: Not applicable
  - Verification: Not done
  - Comment: Very much simplified process describing falling of a tree. The assumption is that the correct management is sustainable, according to FSC guidelines. Do not use in other projects.

## Process Two-Saw Mill (planks):

The next step in this LCA is to define the processes that occur at the saw mill after the tree is harvested. Here the mill will turn the felled tree into planks. As a result of this process we will take into account the amount of the tree that gets disposed of as either saw dust or bark. Start this process the same way as the felled tree; Materials, Wood, New process. In the command box that appears enter the three products that are produced at the mill and the percentages associated with each output;

1. Planks, 50% of the output, 500kg (half a ton)
2. Sawdust, 40% of the output, 400kg
3. Bark, 10% of the output, 100kg

Describing the Outputs:

The multiple outputs will create an allocation problem and this will need to be addressed. To tackle this problem and see the steps to enter the data for each output refer to the screenshot and steps displayed below:

The screenshot shows a software interface for defining a process. It features a table for 'Known outputs to technosphere, Products and co-products' and a 'Select a product' dialog box. Five steps are highlighted with callouts:

- Step 1: Create 3 lines and type output names**: Points to the 'Name' column of the output table.
- Step 2: Enter amounts**: Points to the 'Amount' column of the output table.
- Step 3: Enter allocation percentage**: Points to the 'Allocation %' column of the output table.
- Step 4: Select waste type**: Points to the 'Waste type' column of the output table.
- Step 5: Click under "materials/fuels" and select the "felled tree" process**: Points to the 'Wood' category in the 'Select a product' dialog box.

Name	Amount	Unit	Quantity	Allocation %	Waste type	Category
Planks	500	kg	Mass	50 %	Wood	Wood
Saw dust	400	kg	Mass	40 %	Wood	Wood
Bark	100	kg	Mass	10 %	Wood	Wood

**Hint: Click in grey field to create line**

**Select a product**

- Material
- Agricultural
- Chemicals
- Electronics
- Fuels
- Glass
- Metals
- Minerals
- Other
- Paper & Board
- Plastics
- Wood
- Products

**Step 5: Click under "materials/fuels" and select the "felled tree" process**

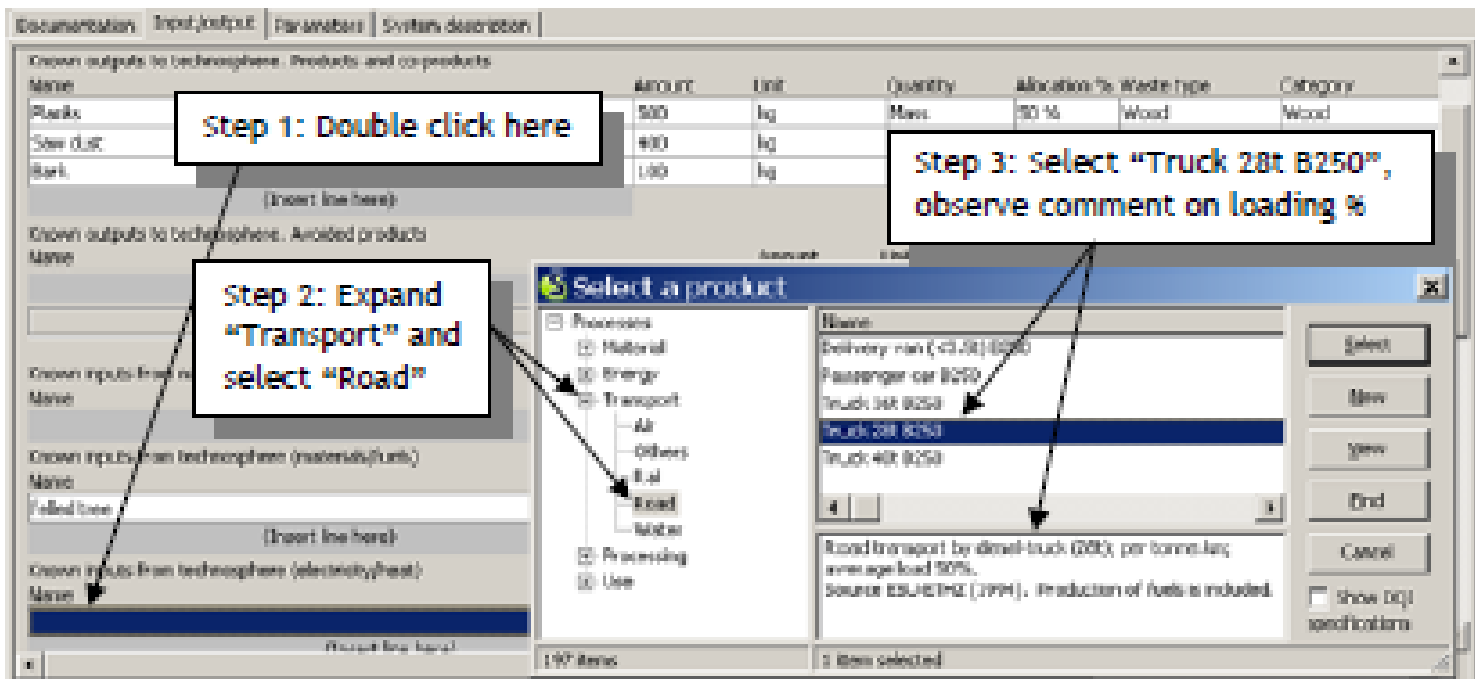
1. Create three lines under “known outputs”, by clicking two times on the “insert line here” field.
2. Type in the names of the three outputs.
3. Enter the allocation percentages, in the figure above this is done according to mass allocation.



4. Click under the waste type column and select wood. Below the purpose of this is explained.
5. Click under 'Materials and fuels'. A selection box will appear, from which you can select the felled tree process. If you cannot see it there, use the "Find" button. To produce 1 ton of products (planks, sawdust and bark) and to have enough wood to burn wood for process energy (250 kg), we need an input of 1.25 tons of felled tree.

### Adding Electricity, Transport and Emissions from the Mill:

Energy and transport are added in the same way as the felled tree. We assume a transport distance of 200 km between the forest and the saw mill. For transport we assume that a 28 ton truck is used, with a load factor of 50% because the return trip will be empty.



When entering emissions from electricity it is important to use the standard from whichever country you will be performing the LCA in. In our case we will use the Union for the Coordination of Production and Transmission of Electricity (UCPTE), this is the European standard when it comes to producing electricity, averaged off of European electrical grid data at medium voltage. Their estimation of sawing energy is 150 kWh (kilowatt hours). To take into account of emission from the wood burning we place the following values into the "emissions to air":

- 450 kg Carbon dioxide
- 2,9 kg Carbon monoxide
- 500 g Nitrogen dioxide
- 540 g Particulates, <10 µm
- 100 g Sulphur dioxide

Emissions to Air displayed below:

Documentation		Input/output		Parameters		System description	
Pilled tree		1.25	ton	Undefined			
(insert line here)							
Known inputs from technosphere (electricity/heat)							
Name	Amount	Unit	Distribution	SO <sub>2</sub> or 2*SO <sub>4</sub> Mn	Plic		
Truck 20t 8250	250	kWh	Undefined				
(insert line here)							
Outputs							
Emissions to air							
Name	Sub-compartment	Amount	Unit	Distribution	SO <sub>2</sub> or 2*SO <sub>4</sub> Mn	Plic	
Carbon dioxide, biogenic		450	kg	Undefined			
Carbon monoxide, biogenic		2.9	kg	Undefined			
Nitrogen dioxide		500	g	Undefined			
Particulates, < 10 µm		540	g	Undefined			
Sulfur dioxide		100	g	Undefined			
(insert line here)							
Emissions to water							
Name	Sub-compartment	Amount	Unit	Distribution	SO <sub>2</sub> or 2*SO <sub>4</sub> Mn	Plic	
(insert line here)							
Emissions to soil							
Name	Sub-compartment	Amount	Unit	Distribution	SO <sub>2</sub> or 2*SO <sub>4</sub> Mn	Plic	
(insert line here)							

## Documenting Process 2:

In order to finish up the Saw Mill Process you do the same type of documentation as the felled tree. The information is displayed by the screen shot below:



The screenshot shows a software interface for documenting a process. The interface is divided into several sections:

- Documentation** (selected tab):
  - Project: Tutorial saw wood example
  - Created on: 5/6/2009
  - Category: Material
  - Last update on: 5/6/2009
  - Process type: Unit process
  - Process identifier: HPI:71382146960009
  - Name: sawmill
  - Status: Finished
  - Image: A small image showing a sawmill and a stack of wood.
- Data Quality Indicators**:
  - Time period: 2000-2004
  - Geography: Europe, Western
  - Technology: Average technology
  - Representativeness: Average from processes with similar outputs
  - Multiple output allocation: Physical causality
  - Substitution allocation: Not applicable
  - Cut-off rules: Less than 5% (environmental relevance)
  - System boundary: Second order (material/energy flows including operators)
  - Boundary with nature: Not applicable
  - Intra. process: No
  - Date: 5/6/2008
  - Record: The authors of the tutorial
  - Generator: Your name
- General reference and sources**:
  - Literature reference: (Insert line here)
  - Collection method: Taken from literature
  - Data treatment: Simplifications made for didactic purposes
  - Allocation rules: Mass has been used to allocate the environmental load over sawdust, planis and bark
  - Verification: Not done
  - Comment: Production of planis, sawdust and bark from felled trees. Example for didactic purposes only; do not use in other projects

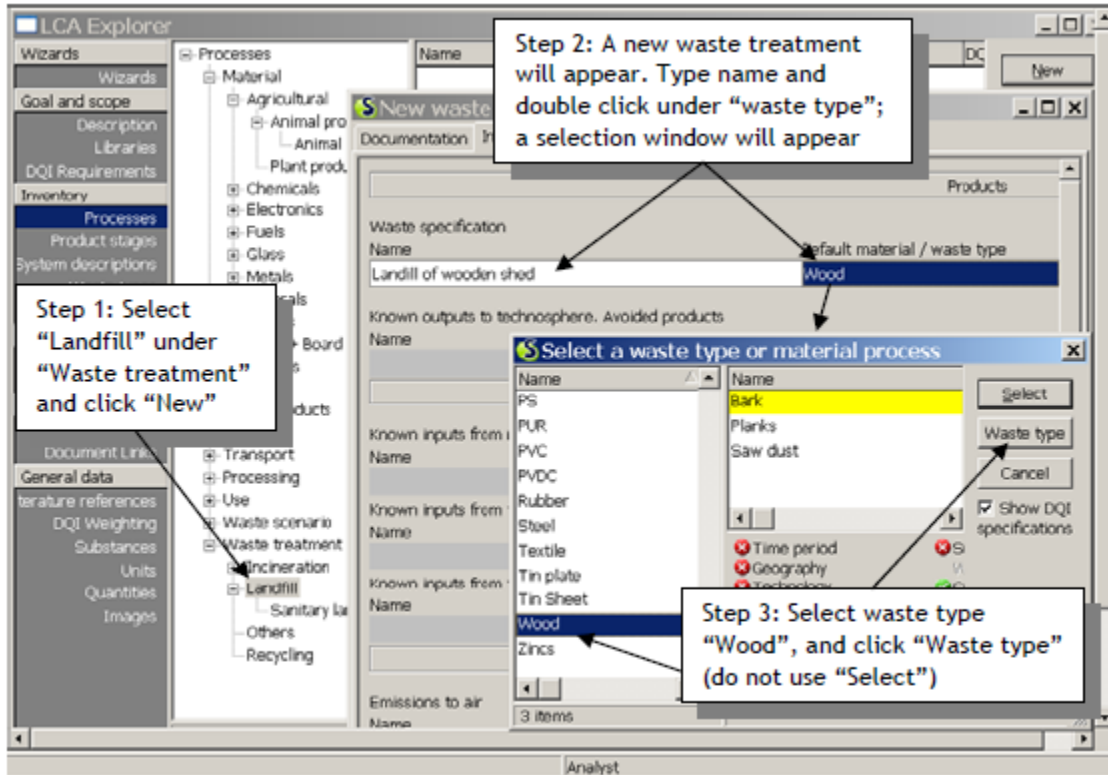
## Waste Disposal and End of Life Scenarios

Now that the modeling for wood plank production is complete. In this section we will define and create a post-consumer waste scenario. The two materials that will make up the shed are the wooden planks as defined before, and steel parts used to conjoin the planks. For example nails and screws.

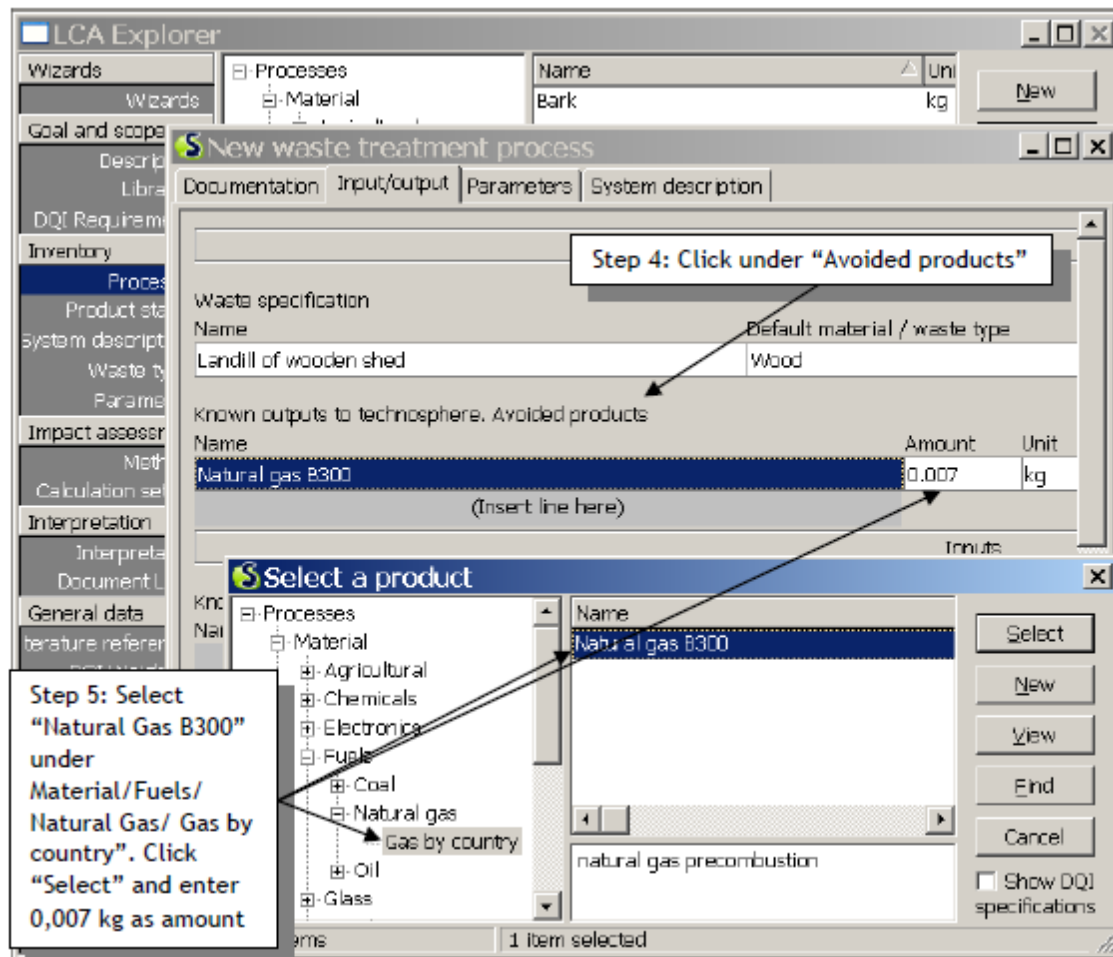
Standard with waste processes in Europe 40% of reused wood is burned in homes and 60% of wood is dumped in modern landfills. Using the full methodology of LCA we can conclude that the burned wood will provide no contribution to room heating, due to lack of proper ventilation in chimneys, and about a third of the methane produced by landfill due to the wood will be used as fuel. This information can be taken into account later in the analysis.

## Waste Treatment for Landfill:

First end of life scenario that we walk through will be relocating the wood waste to a landfill. Data and steps to complete this process are displayed below.



1. Go to waste treatment under Processes, select the Landfill category. Click on the 'New' button on the right hand side to create a new and empty waste process.
2. Enter the name of the waste treatment 'Landfill of wooden shed'. In a waste treatment the input determines the use of the process. Enter 1 kg as amount.
3. Now double click under "Default material/waste type", to get another selection box. Here you define for which waste types this process is valid. Select wood from the list of already defined waste types. Click 'Waste Type' to select the waste type of the wood.
4. Click under Known outputs to technosphere, avoided products. A selection box will appear.
5. Select Natural Gas B300 from Materials/Fuels/Natural Gas/Gas by country. 0,007 kg methane is used for energy production.



6. Enter under Known inputs from technosphere, Materials/Fuels the transport for the distance between the municipal waste collection centre and the landfill (Truck 16T BUWAL250 under Transport, Road). To transport 1 kg over 20 kilometres we need a transport amount of  $0,001 \text{ ton} \times 20 \text{ km} = 0,02 \text{ ton-kilometres}$ .
7. Now enter the emission of the methane that is not collected (0,002 kg) and the total Carbon dioxide emissions (0,5 kg).
8. Finally document this process the same way as before.

Inputs

Known inputs from nature (resources)  
Name (Insert line here)

Known inputs from technosphere (materials/fuels)  
Name Amount Unit Distribution SD^2 or 2^4 Min

Truck 16t B250	0.02	tkm	Undefined	
----------------	------	-----	-----------	--

(Insert line here)

Known inputs from technosphere (electricity/heat)  
Name (Insert line here)

Outputs

Emissions to air  
Name Sub-compartment Amount Unit Distribution SD^2 or 2^4 Min

Methane, biogenic		0.002	kg	Undefined	
Carbon dioxide, biogenic		0.5	kg	Undefined	

(Insert line here)

Emissions to water

**Step 6: Enter transport between the municipal waste collection point and landfill (20km)**

**Step 7: Enter remaining methane leakages and the total CO2 emissions**

### Modelling the Impacts of the Open Fire:

When modeling the impacts of this open incineration we assume that there is no useful by-products. Below is the new process box for open incineration.

Waste specification

Name	Default material / waste type	Amount	Unit	Quantity	Cr
Open fire fuelled by material from shed	Wood	1	kg	Misc	In

Known outputs to technosphere - Avoided products  
Name Amount Unit Distribution SD^2 or 2^4SD Min Max Co

(Insert line here)

Inputs

Known inputs from nature (resources)  
Name Sub-compartment Amount Unit Distribution SD^2 or 2^4SD Min

(Insert line here)

Known inputs from technosphere (materials/fuels)  
Name Amount Unit Distribution SD^2 or 2^4SD Min Max Co

(Insert line here)

Known inputs from technosphere (electricity/heat)  
Name Amount Unit Distribution SD^2 or 2^4SD Min Max Co

(Insert line here)

Outputs

Emissions to air  
Name Sub-compartment Amount Unit Distribution SD^2 or 2^4SD Min

Carbon dioxide, biogenic		1.2	kg	Undefined	
Carbon monoxide, biogenic		50	g	Undefined	
NMVOC, non-methane volatile organic compounds, unspecified origin		27.5	g	Undefined	
PAH, polycyclic aromatic hydrocarbons		40	mg	Undefined	
Particulates, < 10 um		2.5	mg	Undefined	
Nitrogen dioxide		2	g	Undefined	

## Waste Scenarios:

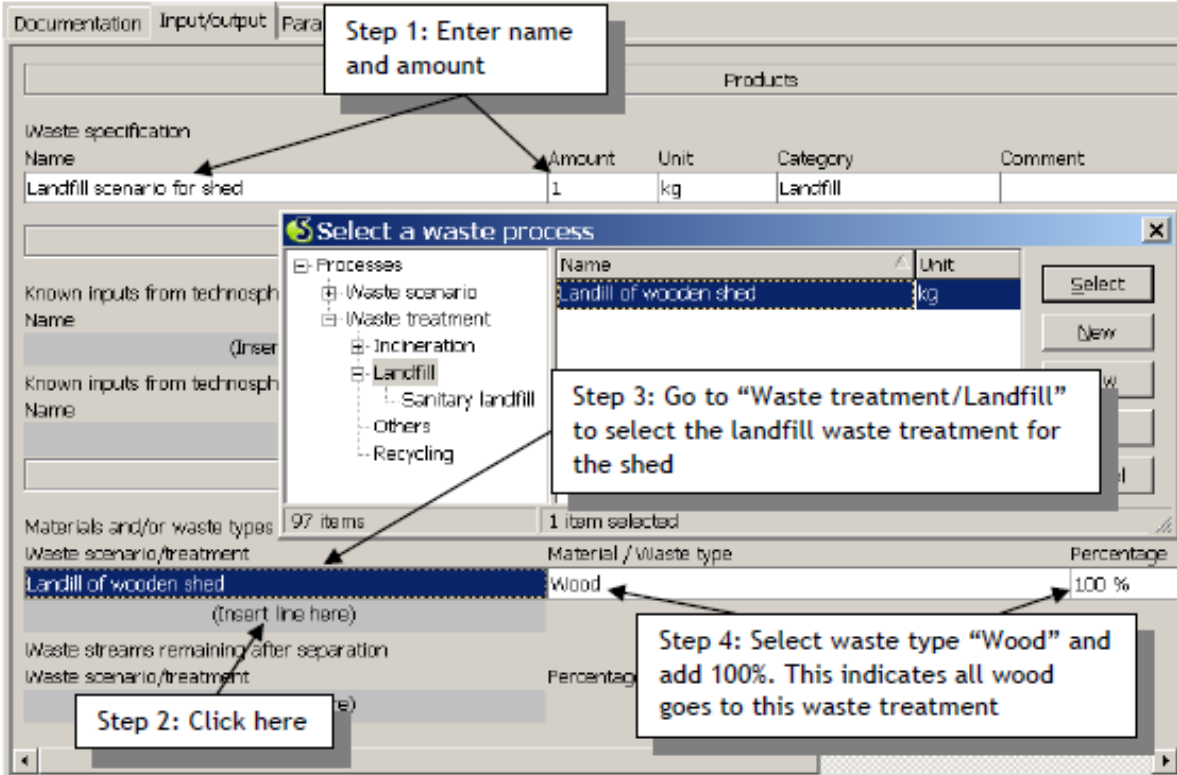
With the waste treatments created we continue on to the waste scenarios. They are:

1. One for landfill
2. One for the open fire
3. One that splits up the waste between open fire and landfill

## LandFill:

We will ensure that the wood is sent to the waste treatment landfill for wood and nails and other metal parts will be sent to a predefined treatment facility for steel. Steps below show how to input information for Landfill.

1. Enter the name of this scenario and the amount
2. Click under Materials and/or Waste Types separated from waste stream, indicated in the figure below
3. Select the landfill waste treatment we just created
4. Select the waste type "Wood" as we have done before and enter 100%



The screenshot displays a software interface for configuring waste scenarios. It features several key components:

- Waste specification table:** A table with columns for Name, Amount, Unit, Category, and Comment. The entry "Landfill scenario for shed" is shown with an amount of 1 and unit of kg.
- Select a waste process dialog:** A dialog box with a tree view of processes. The "Landfill" process is selected, and "Landfill of wooden shed" is chosen in the list.
- Materials and/or waste types table:** A table with columns for Waste scenario/treatment, Material / Waste type, and Percentage. The entry "Landfill of wooden shed" is selected, with "Wood" as the material and "100 %" as the percentage.

Annotations with arrows indicate the following steps:

- Step 1:** Enter name and amount (pointing to the "Name" and "Amount" fields in the "Waste specification" table).
- Step 2:** Click here (pointing to the "Materials and/or waste types" section header).
- Step 3:** Go to "Waste treatment/Landfill" to select the landfill waste treatment for the shed (pointing to the "Landfill" process in the dialog).
- Step 4:** Select waste type "Wood" and add 100%. This indicates all wood goes to this waste treatment (pointing to the "Wood" material and "100 %" percentage in the table).

Documentation | Input/output | Parameters | System description

**Step 5: Add a link to "Landfill ECCS steel B250(1998)"; you can find this under "Waste treatment/Landfill/Sanitary Landfill"**

Waste specification

Name	Amount	Unit	Distribution	SD^2 or 2* Min	Comment
Landfill scenario for shed	1	kg	Landfill		

Inputs

Known inputs from technosphere (materials/fuels)

Name	Amount	Unit	Distribution	SD^2 or 2* Min	Y
(insert line here)					

Known inputs from technosphere (electricity/heat)

Name	Amount	Unit	Distribution	SD^2 or 2* Min	Y
(insert line here)					

**Step 6: Add a link to landfill of tin plate**

**Step 7: Specify waste types and add 100%**

Materials and/or waste types separated from waste stream

Waste scenario/treatment	Material / Waste type	Percentage
Landfill of wooden shed	Wood	100 %
Landfill ECCS steel B250(1998)	ECCS steel	100 %
Landfill Tin plate B250 (1998)	Tin plate	100 %
(insert line here)		

Waste streams remaining after separation

Waste scenario/treatment	Percentage	Comment
Unspecified	100 %	All materials that do not belong to one of the waste types go to Unspecified. Please beware, this treatment does not have any emissions, so normally you should not see it in the tree

**Step 8: Add a link to "Unspecified"; you can find this under "Waste treatment/Others"**

All materials with waste type wood that enter this record are sent to the waste treatment landfill of wooden shed. All metals with waste types ECCS steel are sent to the landfill of ECCS steel waste treatment and all metals with the waste type tin plate are sent to the landfill for tinned steel. All other materials are sent to the waste treatment "Unspecified".



### Waste Scenario for Open Fire:

Go to Waste scenario, select category Incineration and create a record as below. For the steel, we use already predefined records.

Documentation		Input/output		Parameters		System description	
Products							
Waste specification							
Name	Amount	Unit	Category	Comment			
Open fire waste scenario for shed	1	kg	Incineration				
Inputs							
Known inputs from technosphere (materials/fuels)							
Name	Amount	Unit	Distribution	SD <sup>2</sup> or 2* Min	Max		
(Insert line here)							
Known inputs from technosphere (electricity/heat)							
Name	Amount	Unit	Distribution	SD <sup>2</sup> or 2* Min			
(Insert line here)							
Outputs							
Materials and/or waste types separated from waste stream							
Waste scenario/treatment	Material / Waste type			Percentage			
Open fire fuelled by material from shed	Wood			100 %			
Inch. ECCS steel 1995B250(98)	ECCS steel			100 %			
Inch. Tin plate 1995 B250(98)	Tin plate			100 %			
(Insert line here)							
Waste streams remaining after separation							
Waste scenario/treatment	Percentage	Comment					
Unspecified	100 %						
(Insert line here)							

Finally, we develop a waste scenario that splits the waste stream into two:

1. 40% is used in open fires
2. 60% is sent to the landfill

Please note that in this stage we take into account the transport by car as well, because it has an impact substantial to that of the landfill.

The screenshot shows a software interface with three main sections: 'Waste specification', 'Inputs', and 'Outputs'. A 'Select a waste process' dialog box is open over the 'Outputs' section.

**Step 1: Enter name and amount. 200 kg per trip**

This callout points to the 'Waste specification' table. The table has columns for Name, Amount, Unit, Category, and Comment. The first row contains: 'Waste scenario for shed', '200', 'kg', 'Others', and an empty comment field.

Name	Amount	Unit	Category	Comment
Waste scenario for shed	200	kg	Others	

**Step 2: Add transport assuming the user will drive 10 km with a car to transport 200 kg to the municipal waste collection point**

This callout points to the 'Inputs' section, specifically the 'Known inputs from technosphere (electricity/heat)' table. The table has columns for Name, Amount, Unit, Distribution, and SD^\*2 or 2^\* Min. The first row contains: 'Passenger car B250', '10', 'km', 'Undefined', and an empty SD field.

Name	Amount	Unit	Distribution	SD^*2 or 2^* Min
Passenger car B250	10	km	Undefined	

**Step 3: Add the two waste scenarios and percentages**



This callout points to the 'Outputs' section, specifically the 'Materials and/or waste types separated from waste stream' table. The table has columns for Waste scenario/treatment, Material /Waste type, and Percentage. Two rows are shown: 'Landfill scenario for shed' (All waste types, 60%) and 'Open fire waste scenario for shed' (All waste types, 40%).

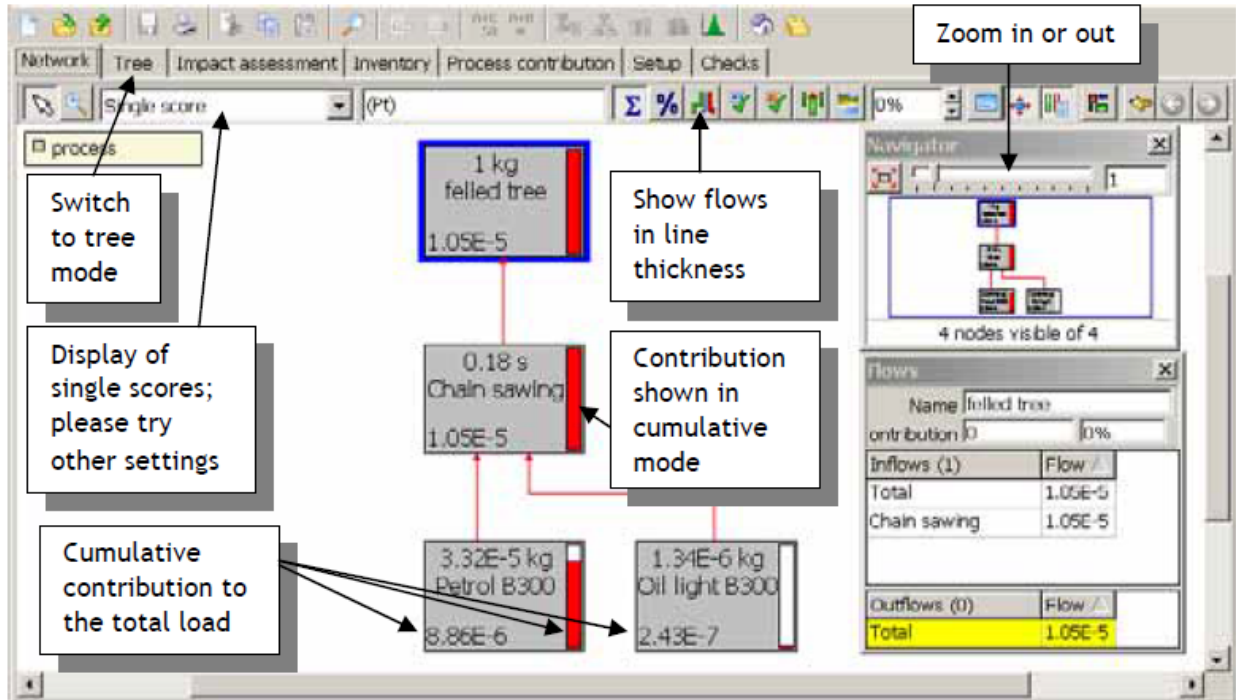
Waste scenario/treatment	Material /Waste type	Percentage
Landfill scenario for shed	All waste types	60 %
Open fire waste scenario for shed	All waste types	40 %

The 'Select a waste process' dialog box is open, showing a tree view of processes. The 'Open fire waste scenario for shed' process is selected in the list. The dialog also has a table with columns for Name and Unit, and buttons for Select, New, View, Find, and Cancel.

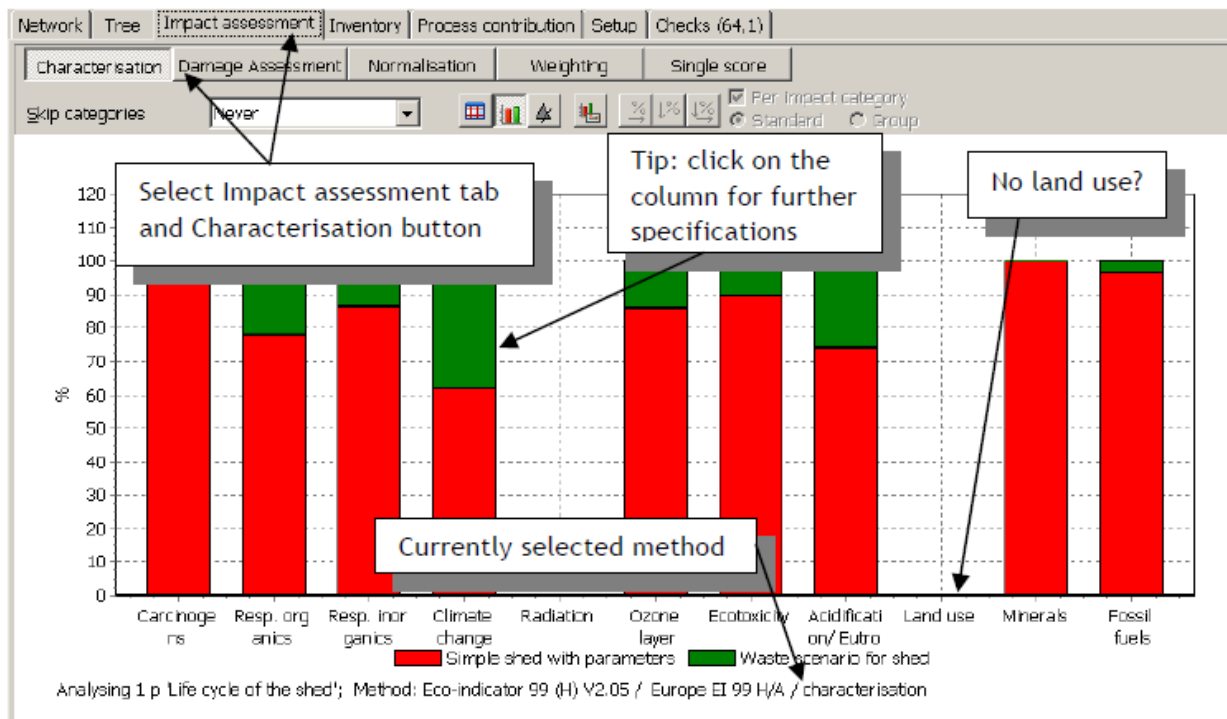
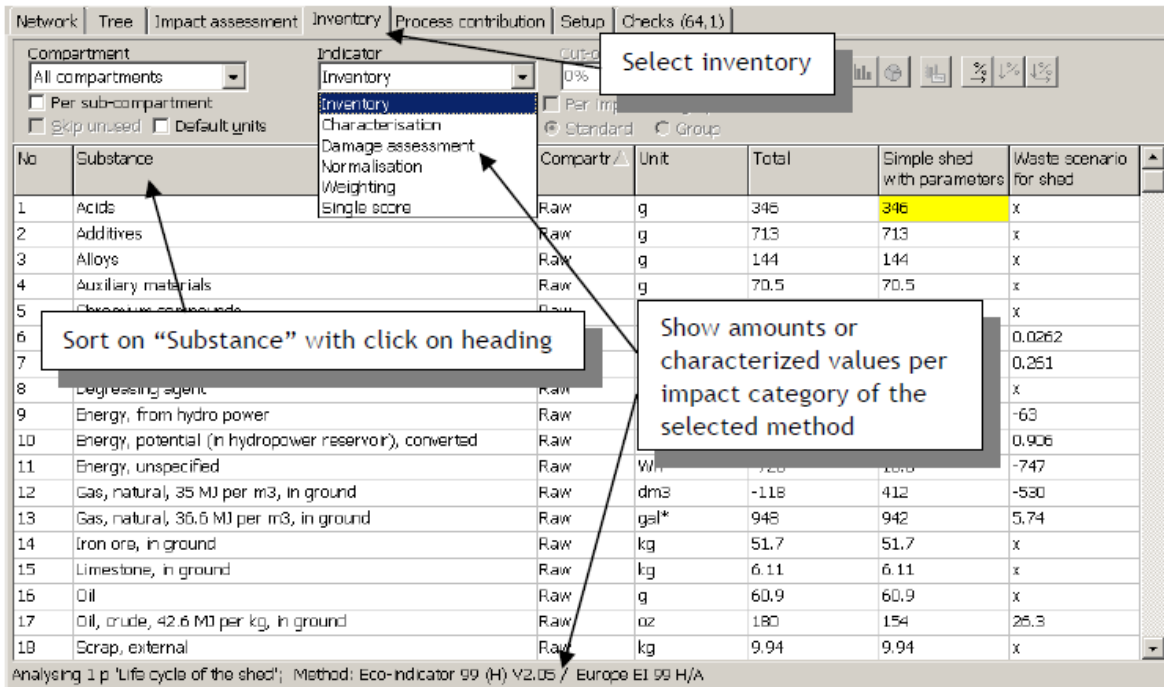
Name	Unit
Incineration B250 (98)	kg
Incineration B250 (98) avoided	kg
Open fire waste scenario for shed	kg

## Impact Assessment and Comparisons:

At any point during the evaluation phase you can click on the Tree or Network functions. First by clicking on the  button or  and then navigating through the tabs you can look at the tree or network for any of the processes that have been created.



The two captured screen images below shows how to view an individual materials impact assessment.



## Final Tree Display:

Finally when everything is entered under the Simple Shed project you can inspect all elements and play around with the zoom functions. The zoom will allow the granularity to be set for viewing pleasure. The final product should look similar to what we have displayed below.

