SimaPro 5

Tutorial

The 'Wood example'

product ecology consultants

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1 Introduction in to the tutorial

1.1 The goal of this tutorial

LCA is a skill you learn by doing. Therefore, in this tutorial we aim to provide you your first experiences with LCA and SimaPro, by taking you through a simplified example.

Of course, you need to know some basic theory and concepts. These are described in the User manual chapter 1 to 5. This tutorial is written under the assumption that you understand the basic concepts as inventory, impact assessment and for instance system boundaries and allocation. In the tutorial, we will of course use these terms, but we will not provide too many explanations. The aim of the tutorial is thus to become acquainted with the way you can develop an LCA in SimaPro, and it is not about LCA theory.

Going through this tutorial requires about 2 hours. However, you can take more time to experiment with other assumptions, with refinements etc. To run the tutorial you need to have a demo version or a registered version of SimaPro 5.1 and up.

> Please be aware that if you have a demo version, you can only save processes 16 times. This should be enough to run this tutorial, unless you save processes more than once.

1.2 The example

Let us assume you want to make an LCA of a simple wooden shed, produced to be used in a private garden. The shed is made of just two materials: wood and some steel for the nails and other metal parts. There is no packaging. We also assume there is no wood preservation or paint, there are no windows, no doors and there is no heating or lighting. It's just a simple shed.

There are three basic parts in this modelling exercise:

1. In order to model this we need to enter some processes that describe the environmental impact of cutting a tree and sawing planks in a sawmill. For simplicity, we do what you may never do, that is to ignore the impact of woodcutting on the biodiversity in the wood. For the steel used in the shed, we shall use some data already available.
2. Another important part is to describe the end of life of the shed. For that, we will demonstrate some of the unique and advanced features in SimaPro to model waste scenarios. In this example, we will use the assumption that 40% of the wood is burned in open fireplaces at peoples home and that 60% is landfilled in a modern landfill.
3. Once we have developed the production and the end of life scenarios, we will develop the specification of the shed (the assembly) and the life cycle.

During the modelling, we will of course encounter some methodological issues. However, these will not be thoroughly analysed here. We refer to the User guide chapters 1 to 5 for further information. The data we use for this LCA are not the best and most representative available, and they are by no means complete. The purpose is to exercise, and not to provide you with data.

2 Preparation for data entry

2.1 Starting a registered version of SimaPro

Upon start up, SimaPro will prompt you to open a project. Select the "Tutorial with the wood example" from the list, and press the "open" button. Please ignore the following paragraph.

2.2 Starting from the SimaPro demo version

As long as you do not have entered the license code provided by PRé, SimaPro will run in demo mode. In this mode you can still run this example. SimaPro allows you to save processes 16 times. The example requires you to save 9 processes. You still have 7 spare "saves" to correct errors or to perform a sensitivity analysis. After 16 times you are still able to run the demo and view the results, but there is no way to make changes (re-installing the demo will not help).

When you start the demo, it will ask you to register or run in demo mode. Choose demo. Next, it will ask you which version of SimaPro to use. Choose the "analyst" version. After that, it will ask you to run the guided tour with the coffee machine or the wood example. Choose the wood example and read the welcome message.

Go to the File menu and select Open project; select the "Tutorial with wood example" from the list and press the Open button. Now follow the instructions in paragraph 2.3.

2.3 Starting the wood example project

SimaPro organizes all the data you enter into "projects". This is very useful if you run more than one LCA project, as you can keep all data separate. (By the way, in the Demo and Light version you cannot create your own projects).

A project has 4 different sections (see the menu on the left side):

1. Goal and scope. Here you describe the purpose of the project and you can set your preferred data quality standards for the project.
2. Inventory: here you enter and edit your data, as we shall see in the next chapter.
3. Impact assessment, here you can edit, enter and select impact assessment methods.
4. Scripts. Here you define wizards like user interfaces for the less experienced users. The step-by-step menu of the introduction to SimaPro, and the guided tour with coffee are examples of this feature.

2.4 Goal and scope

The initial stage in LCA is to go through the "Goal & Scope Definition", namely define all the practical details related to the project. It might seem a short and easy step, however, it is highly important, since aspects defined in this step appear in all stages of the LCA and are relevant to the product life cycle. In this example, in order to keep our focus on how entering data and building up new processes in a SimaPro can be executed, we have defined these parameters in advance, so that they are already filled in. Please take some time to see how this is done.

2.4.1 Description

Under the description tab, you find information on the goal and most important choices. The text fields refer to the obligatory issues you need to describe according to ISO 14041. You can cut and paste these texts to your word processor if required. You may the arrow keys to run through the description menu.

2.4.2 Libraries

In this section, you can predefine which libraries you want to use for this project. Libraries are a special type of project. They are intended to be used as a resource that you can use in all your projects. They are not intended to be edited. In case you need to edit an item that is in a library, you can copy the item to your project. After that, you can edit the item. In this way, you keep your libraries untouched for other projects. In this project, we only need the Buwal database and the Methods database.

> *Keep the selection as it is; if you select additional libraries, or deselect the Buwal or Methods database, you may run into difficulties in the next chapter.*

2.1 Data Quality Requirements

In the "Data Quality Requirements" section, you can fill in specific parameters related to the project we want to create. These requirements are namely time, geography, type, allocation and system boundaries, these terms refer to methodological choices that need to be made in the goal and scope of each LCA.

The purpose of these indicators is to help you to understand to what extent the data from libraries is consistent with the requirements of your own project. Once you have set these data quality indicators (see figure below), later you will see that each process in the library will get a field with a colour that depends on the (mis)match between the data and the desired properties. There are four colours to indicate to which extent a process matches your project requirements. Green colour shows that the material or process chosen is applicable to your project, yellow is quite matching, orange is less close and finally red means that although useable, the process or material is beyond your project requirements (see for example processes/material/chemicals).

In the wood example project, we have already entered the desired data quality, as indicated in the overview below. We will not go into detail about the reasons for each setting. Please refer to the User manual chapter 3 for some more explanation of this concept.

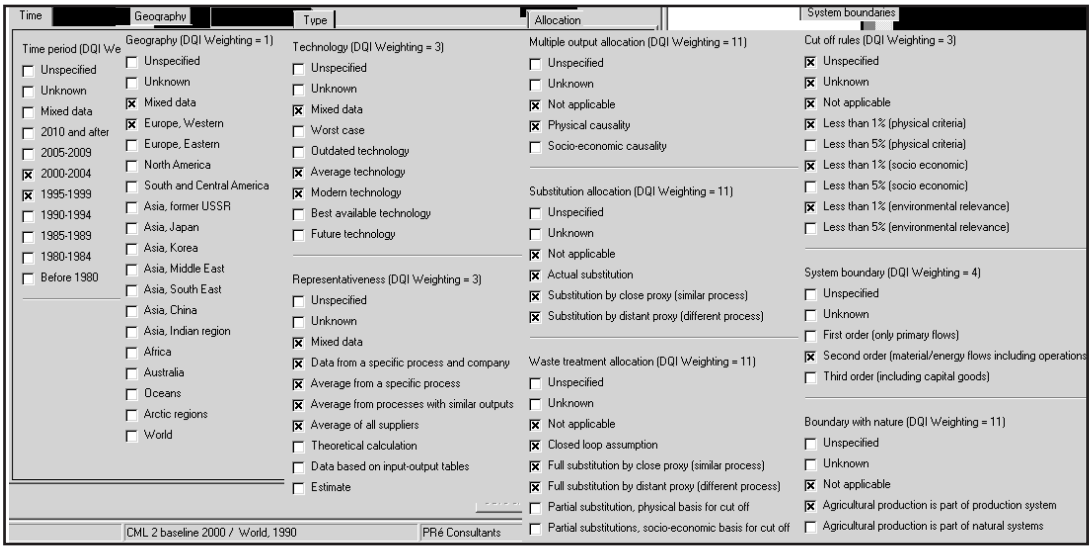

Figure 1
Overview of data quality setting used in this example

3 Production of the planks needed

In this chapter, we discuss how you can actually enter data in the Inventory section of SimaPro. We will concentrate on the production of the sawn planks needed for the shed. For the steel data, we will use existing data in the SimaPro database. In chapter 4, the end of life scenario and its associated impacts will be described. In chapter 5 we will model the complete life cycle.

3.1 Entering process 1: felling the tree

The first process describes the felling of the tree. Before we can enter the data, we will have to collect the data. In this example, we will provide you the following data

- About 1,25 ton of wood is felled to produce a tree trunk of 1 ton, the rest (branches and tops) is left in the forest. We assume these do not cause emissions, as they are part of the natural processes in the forest. In a full LCA, this assumption should be analysed better of course.
- We use a chainsaw for felling the trees. The chain saw data provided in the example are specified as impact per hour. In this example, we use a production rate of 25 ton of wood per hour, which means that for 1.25 ton. We need 3 minutes of chainsaw input. Of course, we could also have entered the amount of fuel for the sawing energy, if this would be available.

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

1. Step 1: click on Processes in the explorer screen.
2. Step 2: click on building material, because wood is used to construct a shed.
3. Step 3: Press new and a new and empty process record will appear.

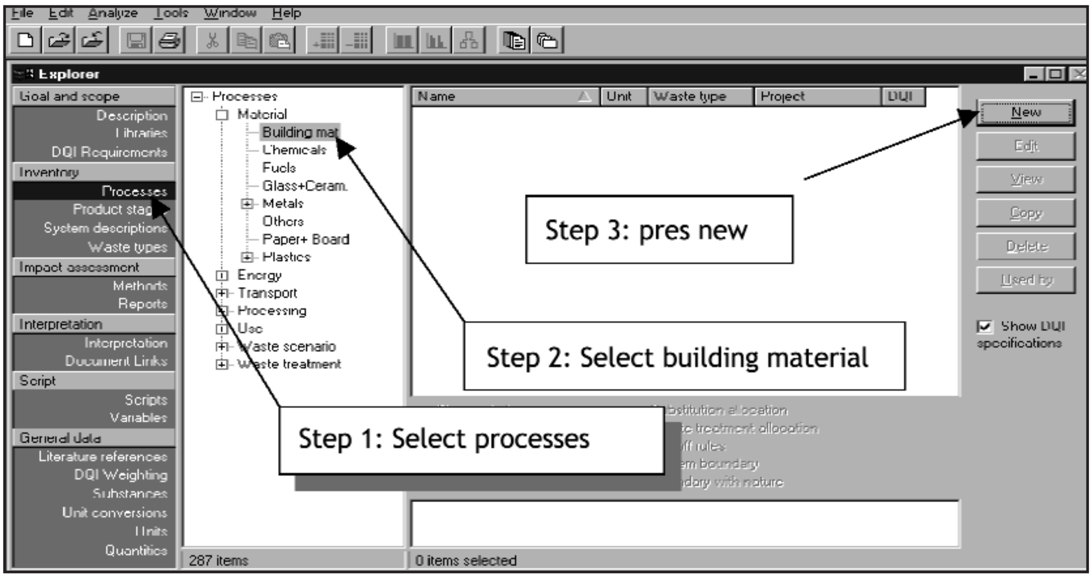

Figure 2
Creating your first new and empty process sheet

3.1.1 Entering process outputs (products)

Figure 3 (see below) shows the top section of the screen that appears. At the top, there are three tabs, giving access to the three different parts of the process record. For now, use the middle tab, input/output.

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". Jump to the next field by using the enter or tab key.
3. Enter the figure 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. If you would have liked to use cubic meters this is also possible, but in that case, you should first change the quantity from Mass to Volume.

You can ignore the high and low volume. This version of SimaPro does not use these fields yet. In the next chapter, we shall also explain the percentage under allocation and the waste type. For now, you can ignore these.

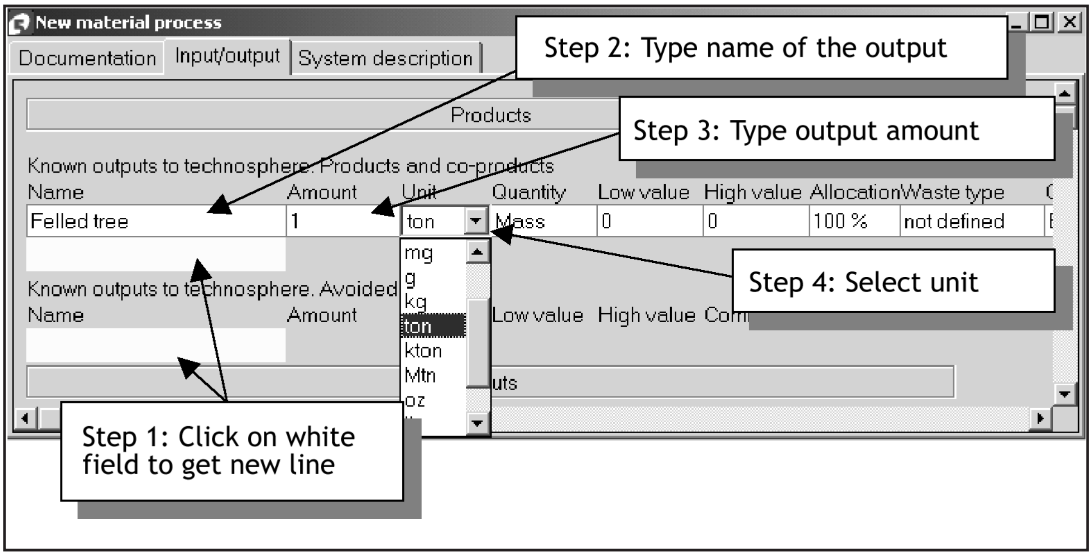

Figure 3
Entering the process output

The next product-input line "Known outputs to technosphere – avoided products" can be ignored, as there are no such products (see also paragraph 4.2, where this option will be used in the landfill process).

3.1.2 Entering inputs

The next section describes the inputs to the process (see the figure below). We will enter data about the amount of wood we will extract form the forests. Note that there are three lines in the record where you can specify inputs:

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. We suggest you specify all inputs with a mass unit in the field under point 2, and all others under this field. This will help you keeping track of the mass balance.

Input from nature resources

The sequence below is the sequence that is generally used in all fields (except for the output fields).

Step 1: create a new line by clicking under "known inputs from nature (resources)"

Step 2: double click in the blue field; a list of predefined resources is presented

Step 3: select wood from the list; you can do this by scrolling, but also by typing "wo"; SimaPro will immediately search for the closest match. If wood would not be present in the list, you can use the 'New' button to create a new resource, however in this example we leave this button.

Step 4: when you found wood, press "Select" (or select by double clicking)

Step 5: enter the amount as 1.25 ton (or 1250 kg); the difference between input and output will be waste from branches

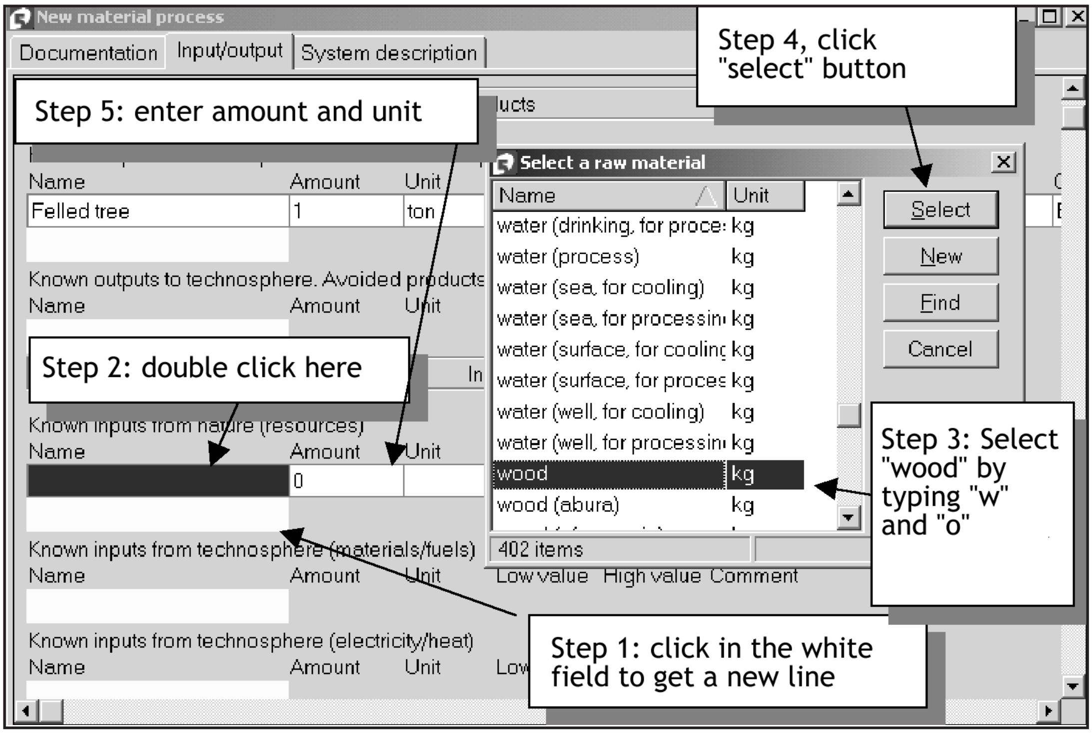

Figure 4
Entering the inputs form nature (resource depletion)

Inputs from technosphere (materials/fuels)

The chain saw needed to cut the tree has already been predefined in the project. We can thus enter this as an input from technosphere. This means that the chain saw process is linked to the process we are creating. This has the benefit that all emissions and resources needed to operate the chain saw are in that specific record and we do not have to (re)enter all emissions in the record.

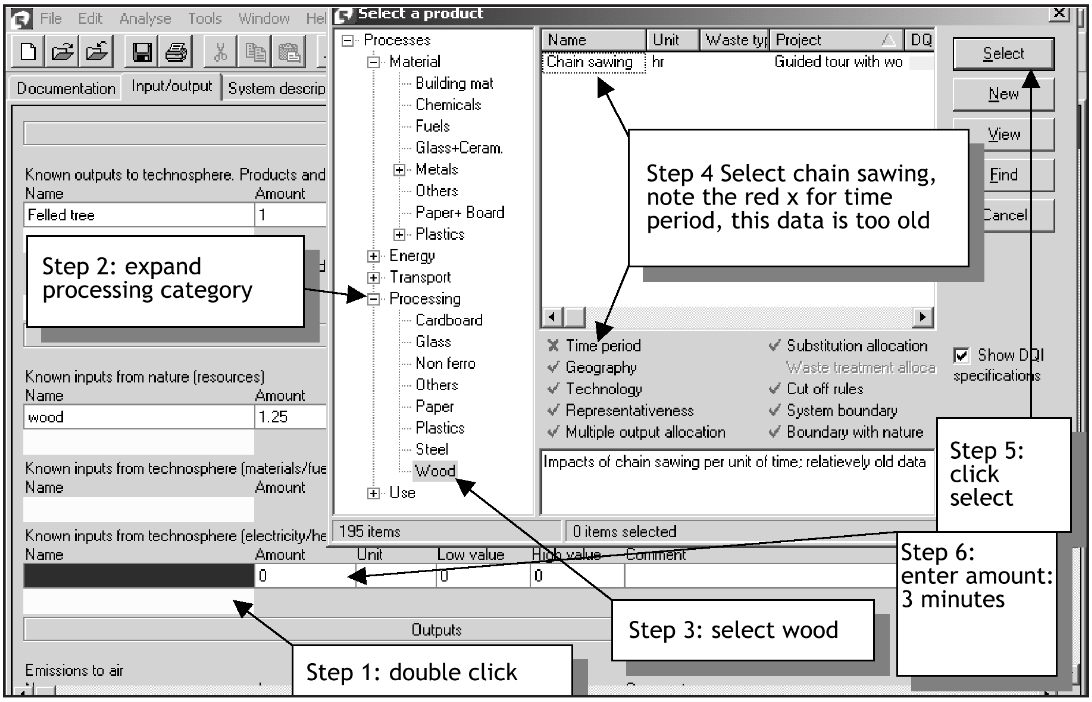

Figure 5
Entering inputs from other processes; in this case the chain saw

Here we repeat the basic procedure, by starting to double click in the last of the three input fields (electricity and heat), as the use of the chain saw will not add to the mass balance of this process. Instead of a list of predefined resources, you get a view in to the list of already available process outputs. The chainsaw process has been defined in the processing section under wood. In this case there is only one process in this subcategory. (If you would not know if and where a process is in the datasets, you could use the "find" button to locate the process).

In the lower part of the selection screen, you can see the data quality indicators. All indicators are green, except for the period. Apparently, this process is older than we defined in the data quality profile. Later we shall see how important this deviation will be.

The process is specified with time (hours) as a unit. We need to input the average time needed to fell 1,25 ton of a tree. The estimate from the wood company is that this is on average 3 minutes (or 0.05 hours). Again, you can use the unit conversion and enter 3 minutes.

Entering emissions and other outputs

The lowest part of the screen is used to specify emissions and wastes. There are six different sections:

1. Emissions to air
2. Emissions to water
3. Emissions to soil (usual to express leaching)
4. Non material emissions, like radiation, noise etcetera
5. Solid emissions, or wastes in solid form, especially intended to monitor the volume or mass of waste (any leaches and emissions from the wastes should be specified in the other categories)
6. Emissions (from this process only) to treatment

The last category is a very powerful feature. You can specify emissions and wastes that are treated in some form of waste treatment or for instance flue gas purification. In this way you can describe very precisely how production wastes are handled.

In this example, we shall only specify the (solid) waste flow from branches that remain in the forest. As stated, the emissions from the chain saw are already specified in the chain saw record and should not be specified here again (this would result in a double count).

The procedure to specify the waste is the same as in the case of resources. It is illustrated with the 3 steps in the figure below. In a similar way, you could add other emissions.

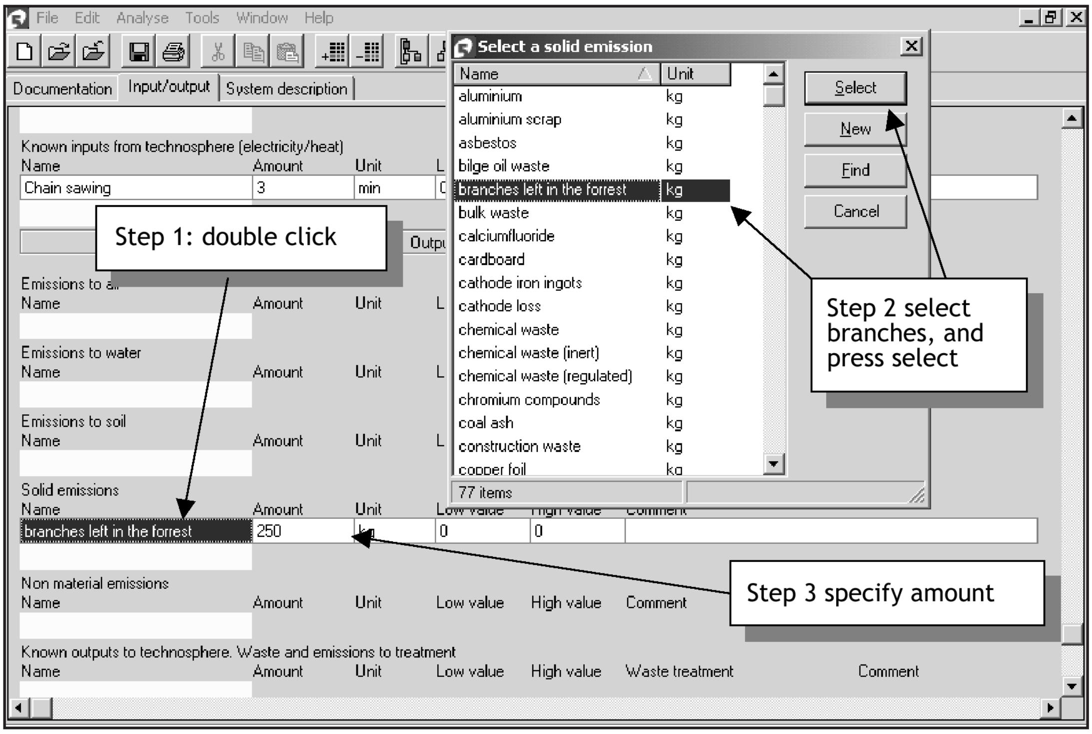

Figure 6
Entering an environmental impact, in this case the waste

3.1.3 Quick feedback, inspect the tree or network.

Now we have entered the data, we can press the button, to get a first look at the network we have created. You do not have to save the process at this time, simply press the button, while the 'planks' process is being edited. The screen will look like the figure below.

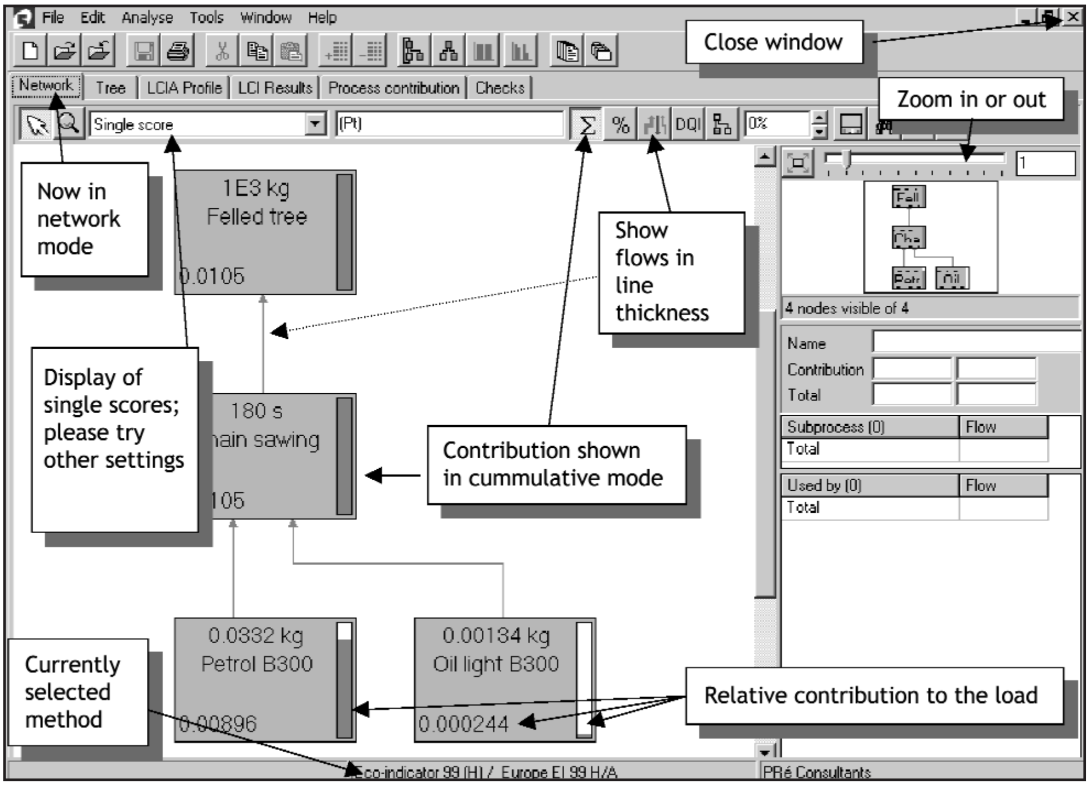

Figure 7
Inspecting the result of your modelling, the felled tree is linked to the chain saw, and the chain saw appears to be linked to fuel and lubrication oil inputs

As you can see, the top process, the felled tree, gets an input from the chain sawing process we have entered. On its turn the chain saw process had two inputs, one for the fuel production and one for the lubricating oil production. As you can see, by entering links between processes, you can build up complete trees.

You can also play around using zooming options and other features. We will not discuss all the features of this screen, but mention a few. The small bar graphs in the processes and the line thickness display the contribution to the total environmental load. How this load is calculated depends on the impact assessment method that is currently selected (see bottom of the screen) and on which level the method is used. In this figure, the total (weighted) Eco-indicator score is used, but you can also select alternatives, like using the climate change impact category indicator result. You can experiment with this setting as much as you want.

If you have selected another impact assessment method that does not have a single score, SimaPro will choose one of the impact categories to be displayed. You can return to the process sheet by closing the window with the tree.

3.1.4 Documenting a process

Now use the "documentation" tab. In the documentation tab, you can specify all types of characteristics of this process record.

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. SimaPro uses the outputs as you specified on the other tab as a label. In fact, 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. SimaPro will match the information you provide here with the Data Quality indicators, set in you project goal and scope (see paragraph 2.1). If the match is perfect, the process will get a green label, if one or more mismatches occur, a yellow, orange or red label will be presented. 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 exact contents of the record.

Please enter the data as presented below:

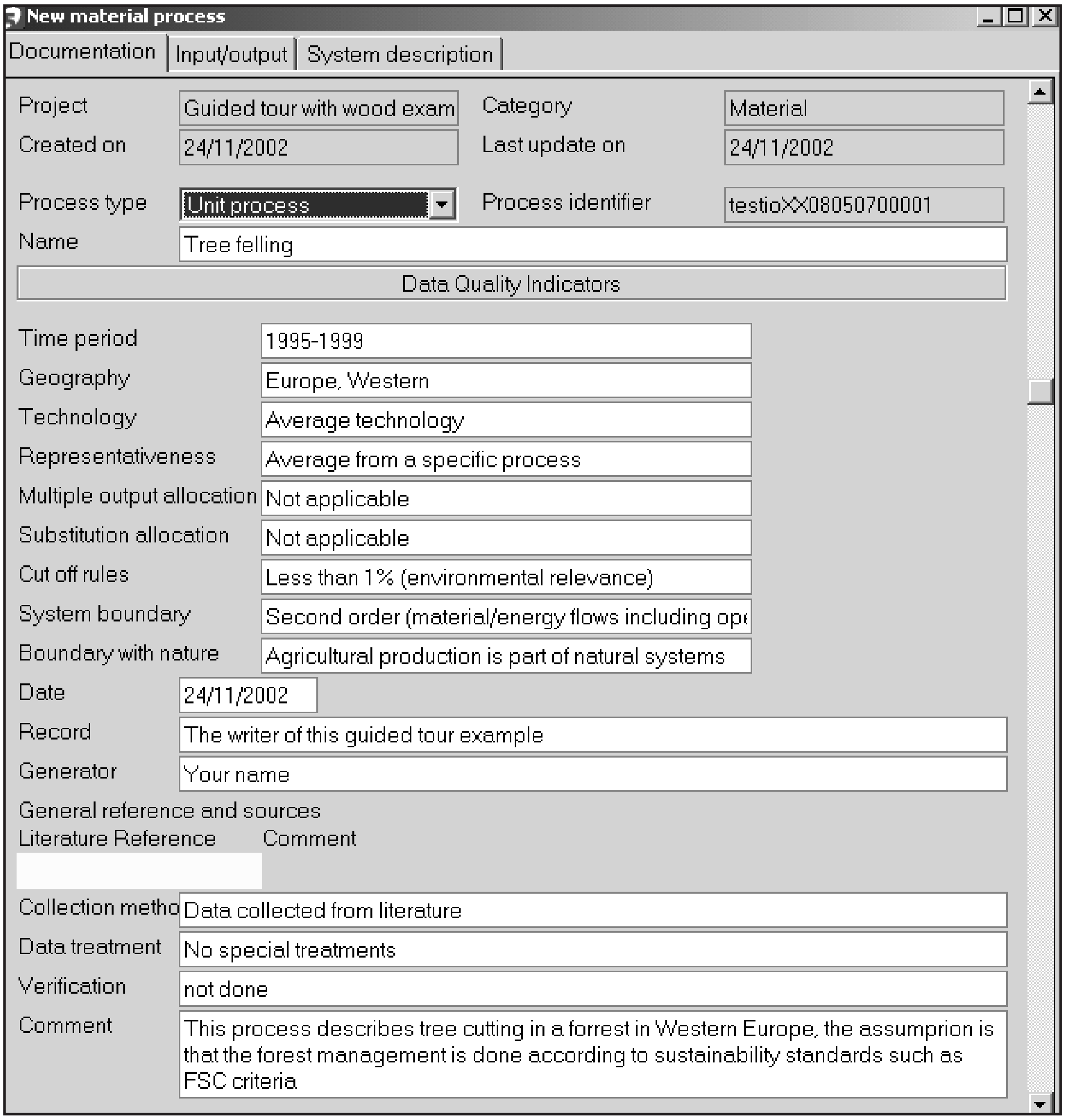

Figure 8
Documentation of the 'felled tree' process

3.1.5 System description

The third tab at the top of the process record is called system description. In this example, it is not used and in fact not needed. System models are used when a process record does not describe a single "Unit process", but a combination of unit process, a so-called "system". For example, the Steel processes in the Buwal database describe the complete steel production process in a single record, while in fact the steel production process contains many unit processes. By presenting this data, much of the transparency within the processes is lost. To partially compensate that, the System description provides about the way the process was built. We suggest you inspect some of these system descriptions in the Buwal or other databases at a later stage.
Again, this information is not needed here, as we are building "unit processes".

3.1.6 Saving data

Press the button with the small diskette symbol to safe the data you have entered. You can now close the process record window in the normal way. You will get back to the process index, and you will see that felled tree process is now stored under building materials.

Important message for users of the SimaPro 5.1 demo version
In this example, you will need to create and store new processes and product stages. After installing a demo version, you can only save 10 changes. After saving 10 times, the demo can still be used to view results, but there is no way to add or edit data in the databases

3.2 Process 2 – Sawmill ('planks')

Our next aim is to define the sawmill process, where logs are turned into planks, bark and sawdust. In order to do that, we have to create a new process. This is done in the same way as described above, so, while in building materials, select "new", and again an empty process record will appear.

- This process will convert the felled trees into three products:
  1. Planks, about 50% of the output
  2. Sawdust, about 40% of the output
  3. Bark, about 10% of the output
- Some remaining wood (250 kg) is used within the sawmill process to dry the wood. This drying process will result in some emissions to air.
- Furthermore, we will enter the transport needed between the place of felling and the sawmill. Like in the case of the chainsaw, we will link a process describing the environmental load of a truck to the sawmill process.
- Finally, we shall enter the electricity use in the sawmill, also using an already predefined process record describing electricity production.

3.1.7 Describing the three outputs, waste types and allocation percentages

The fact that the sawmill has three outputs creates an allocation problem. The environmental load of the felling, the transport and the sawmill itself must be allocated over three different outputs: planks, sawdust and bark. In this example, we shall use the mass as an allocation basis. This means that 50% of the environmental load will be allocated to the planks, 40% will be allocated to the sawdust and 10% to the bark.
An alternative solution would be to use the value of the three products as an allocation basis. As wood will generate about 80% of the value, with sawdust generating about 20%, while the bark will create virtually no value, the allocation percentages would be 80% for the planks and 20% for the sawdust.

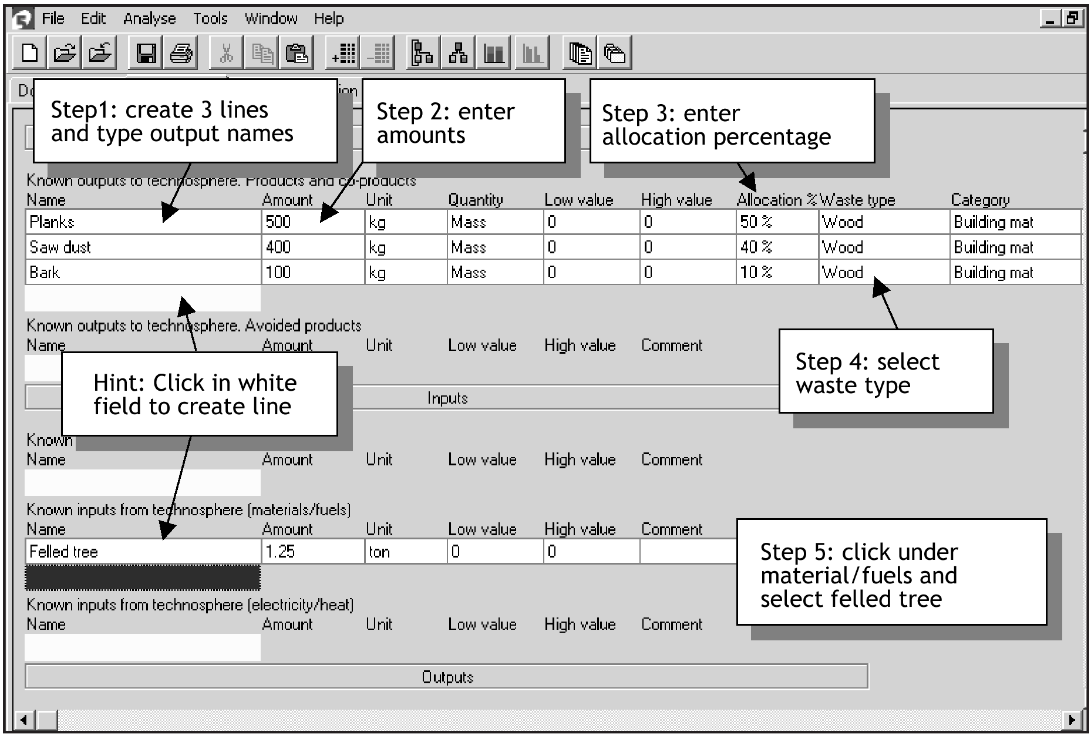

Figure 9
The three outputs of the sawmill, and the input of felled trees

The procedure is now as follows:

- Step 1: create three lines under "known outputs", by clicking three times on the white field
- Step 2: type in the names of the three outputs
- Step 3: enter the allocation percentages, in the figure above this is done according to the mass, you can also use the economic allocation
- Step 4: click under the waste type column and select wood, below the purpose is explained
- Step 5: click under "Materials and fuels". A selection box will appear, from which you can select the felled tree. This is the record we made in the previous paragraphs. If you cannot find it, use the "Find" button.

Please note that we do NOT fill in anything under resources, the extraction of wood from the forest is already taken into account in the feeling tree process, and should not be repeated (it would result in a double count). You can also see that we put in 1.25 ton, while the felling of the tree was defined for one ton. SimaPro will automatically multiply all inputs by 1.25, so you do not need to pay attention to this.

The use of waste types

In step 4, you were instructed to set the waste type to wood. Waste types can be seen as a label that is added to a material output. As we will see later, these labels are used in the post consumer waste scenarios. It helps SimaPro to recognise, which emissions are to be allocated to a material that is incinerated or landfilled.

The idea behind this concept is that in principle all woods have more or less similar emissions in the waste phase. Similarly, all steels will have similar impacts. By using a standard waste type label, we avoid the task of making specific waste scenarios for every material that is added to the database. As we will explain, you do not have to use the waste types, if you consider these are too coarse. You can indeed also develop a waste scenario for a specific material.

Waste types do not always have to be specified. Only materials that are specified in the description of the assembly or subassembly need to have a waste type. The felled trees do not need a waste type, as the consumer will not dispose of felled trees but of planks and perhaps sawdust or bark.

Another example, if a consumer disposes of a plastic bag, SimaPro needs to know that this plastic belongs to the waste type plastic, or more specific, polyethylene. SimaPro does not have to take into account that this material was oil before it was turned into plastic. The oil that went into the plastic does not have to have a waste type. However, if in doubt, always try to specify the waste type, because it will never harm.
As we shall see SimaPro checks, each time a calculation has been added if materials, that should have a waste type specification, indeed have that specification.

Adding electricity, transport and emissions
Energy and transport are added in the same way as the felled tree. We will assume a transport distance of 200 km, between the felling and the sawmill, and we will assume that a 28-ton Truck is used, that is loaded for 50%, because the return trip will be empty.

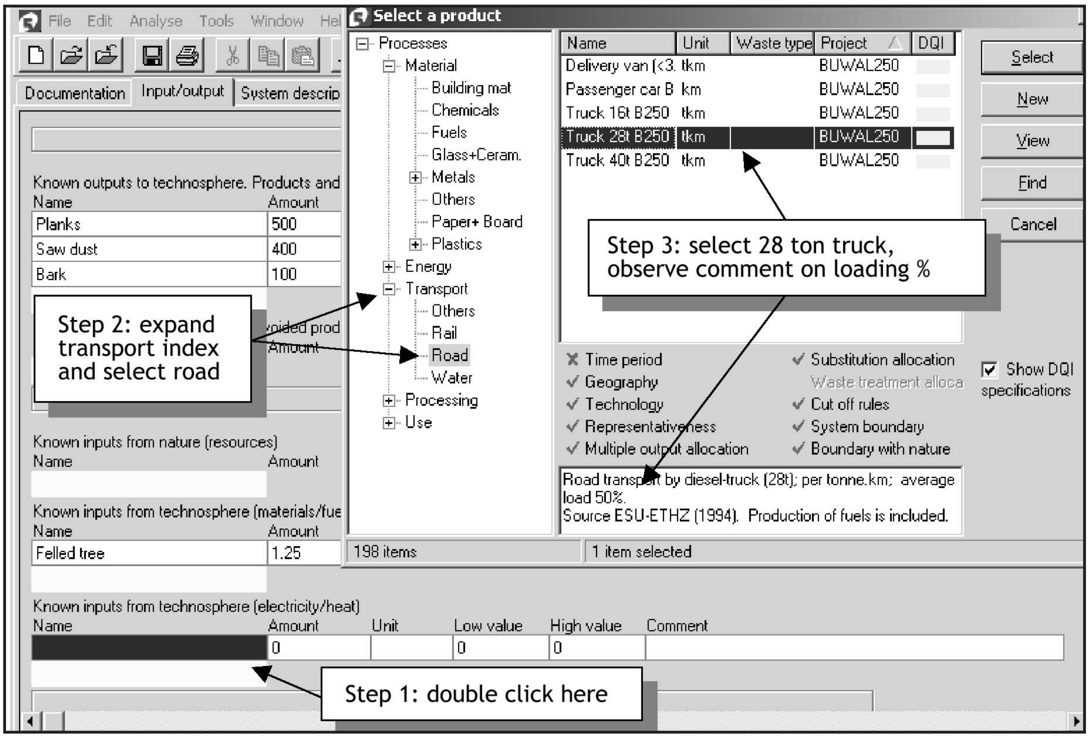

Figure 10
Entering the transport data

The transport process is specified as ton-kilometre (tkm). One ton-kilometre means the transport of one ton over 1 kilometre, or 1 kg over 1000 km, or any other combination that has the same product of distance and weight. In this case, 1.25 ton is transported over 200 km, so you should enter 250 tkm, as quantity.
Electricity can be entered in the same way. We suggest you take the UCTPE electricity record. The UCTPE is the European organization of electricity producers, so this record has average European data. You will find this record at the bottom of the list under Electricity B250. Different data sources estimate the sawing energy at about 150 kWh per ton output, so you can specify 150 kWh.

As explained the emissions from transport and electricity are already in the process records you made the links to. However, the emissions for burning of 250 kg wood for drying must still be added. Please add:

- 450 kg CO2 (non fossil)
- 2,9 kg CO
- 540 g dust (PM10)
- 500 g NO2
- 100 g SOx

The resulting record should look like the figure below (top of the record not shown)

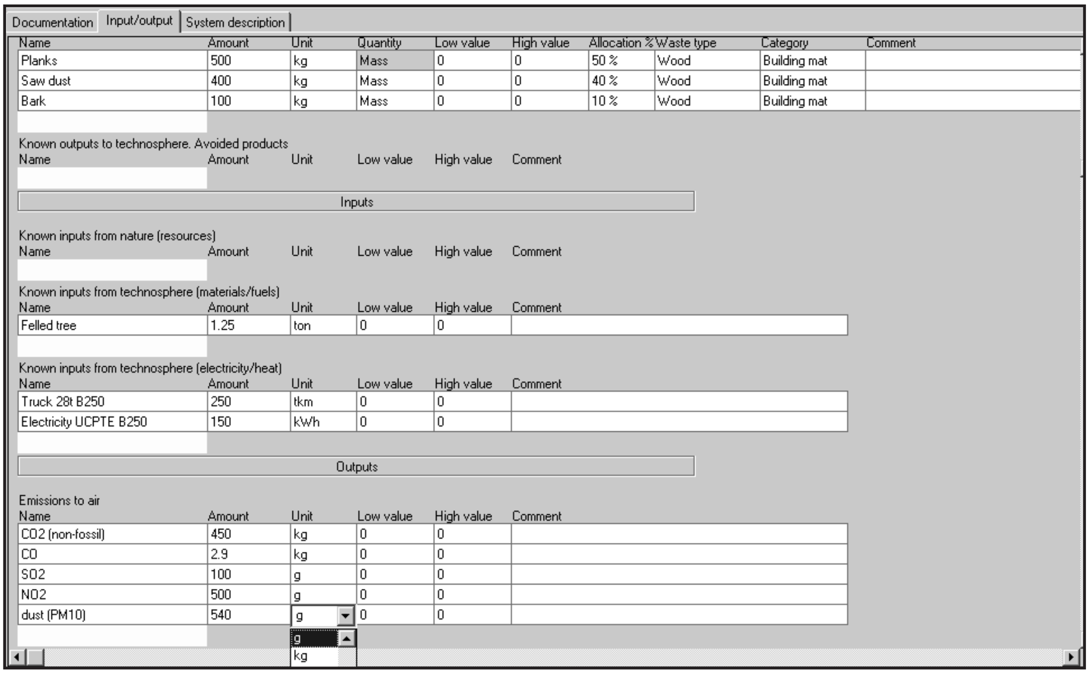

Figure 11
Entering the emissions form the combustion of some of the wood residues for drying

3.1.8 Inspecting the tree

Like in the previous record, we can now quickly inspect the network, by pressing the button; the following screen will appear, after it gave a warning that not all processes fit in the screen.

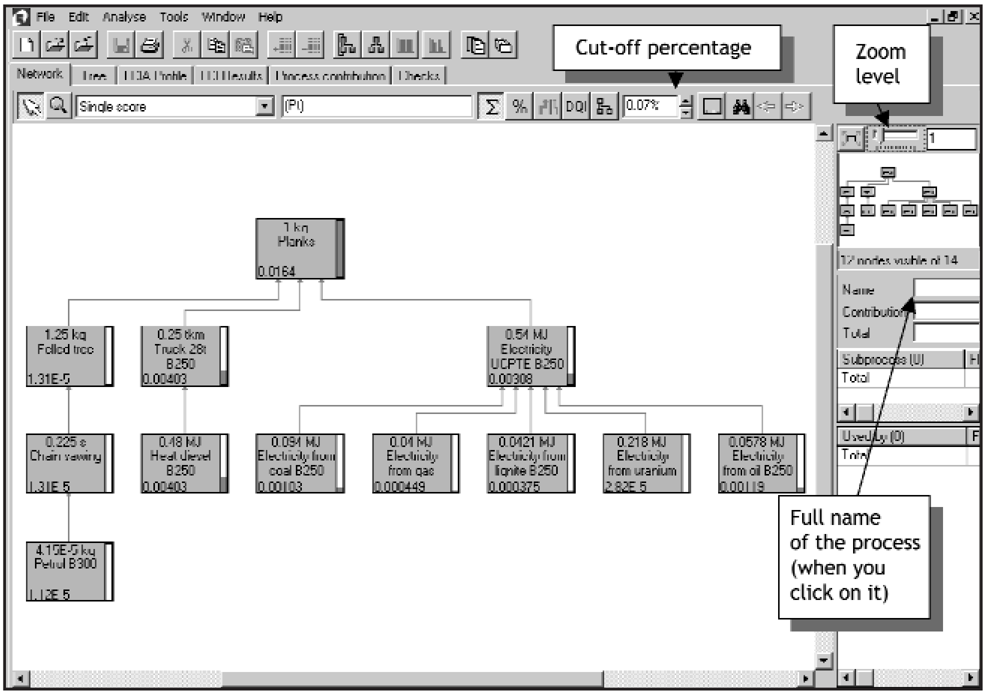

Figure 12
Inspecting the result of your modelling after entering the chainsaw process

SimaPro automatically calculates a cut-off to suppress processes that contribute very little to the overall result. (Typically, only 12 processes are shown; however, you can change that default in the options setting in the tool menu). To determine the relevance, it uses the impact assessment method that you have currently selected and the level setting. Of course, the cut-off only affects the display, not the results. Please feel free to experiment with the cut-off setting.

The top process is the Planks process. In fact, SimaPro could have taken another name, as sawdust and bark, but as a default, it takes the first product you specify. Below the Planks, you see the felled tree, the transport and the electricity. The electricity is split up in different types of power plants.

Hint: depending on the zoom level and resolution of your monitor, you may not be able to see the full name of the processes. If you click on a process the full name will appear on the right hand side of the screen

3.1.9 Documentation

You can finish the record by entering the documentation.

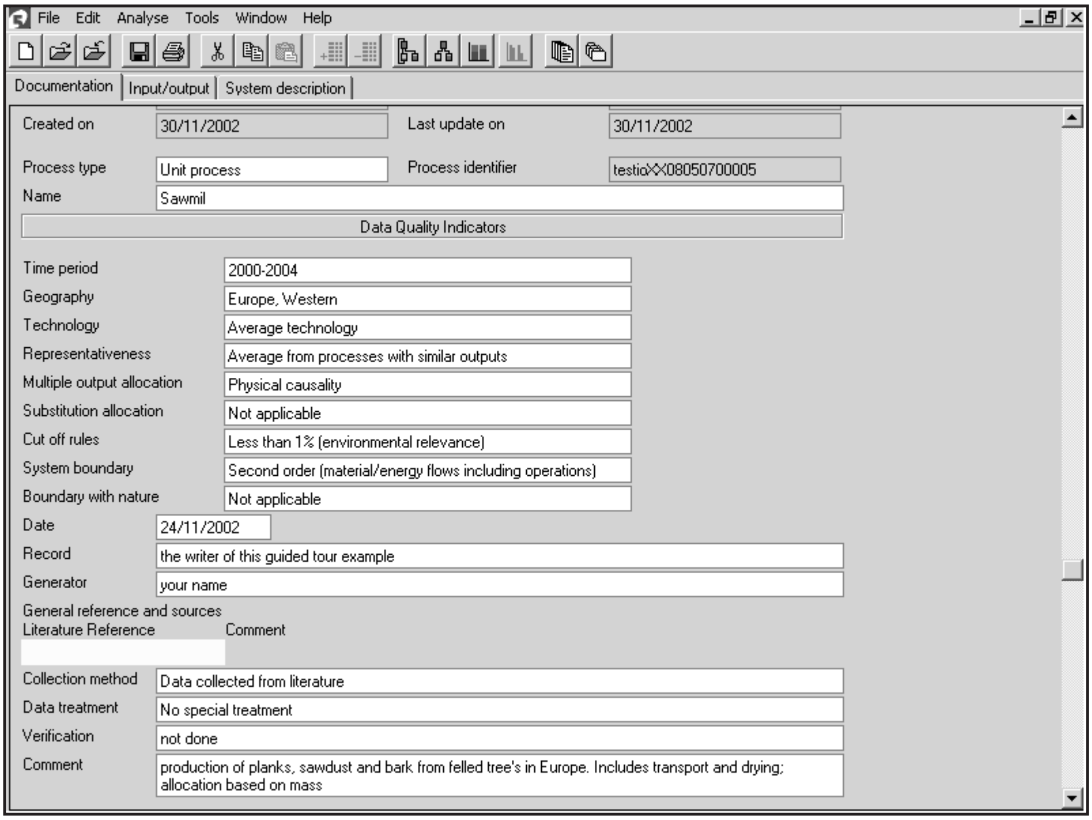

Figure 13
Entering the documentation of the chainsaw process

Now you can save and close this record. You will note that suddenly the number of process has become 4, as all the three outputs appear as a separate material, while in fact they refer to the same process.

4 Waste treatment and waste scenarios

We have created the model for the production, now it is time to look at the end of life, and develop a waste scenario. For many commonly used materials, SimaPro has more or less standard data, but for this tutorial, it is useful to develop your own simplified scenario for post consumer waste. Although we have not defined the shed itself, it will only contain two materials:

1. The planks we have defined in the previous chapter
2. Steel parts, like nails, screws and other metal construction parts

This means that the waste model should at least contain data on the end of life of both wood and steel.

This tutorial is not aiming to be sophisticated in any way, but just complex enough to show the main features. The characteristics of the scenario are as follows:

- 40% of the wood is burned in open fires at peoples home. In this case, we assume a zero contribution to room heating. As such, stoves are very inefficient and in fact cause large energy losses when the stoves are not working properly due to the uncontrolled ventilation through the chimneys. Of course in a real LCA this issue deserves further attention.
- 60% of the wood is dumped in a modern landfill. Again for simplicity, we assume that this landfill has collection system for methane and that 31% of this methane is used as fuel.

4.1 Some backgrounds

4.1.1 Describing the waste scenarios

When we analyse this scenario, we will see that we need to split the waste in different routes. The first split is between 40% burning in open fires, and 60% landfills.

A second split is between the wood and the nails. Although we cannot assume that the consumer will indeed take out the nail, for our modelling purpose it is very useful, as steel behaves differently than wood when it is burned. As we explained above we will use the so-called waste types to make this split. In landfill a similar split should be made, but for now we ignore this.

SimaPro has a powerful tool to model such splits, the 'Waste Scenario'. The waste scenario can be used as a generic splitter, and a waste type specific splitter (wood and nails). However, before we model these, we should also discuss how we model the emissions form the waste.

4.1.2 Describing the impacts of waste treatments

Waste scenarios only describe where the waste flows go, and not the emissions that come form the waste treatment. To describe these, SimaPro has another type of box under the inventory menu, the Waste Treatment. A waste treatment record contains data on the emissions from for instance a waste incinerator or a landfill.

For this example, we need the waste treatments:

- A waste treatment that describes the emissions from the stove when the wood is burned
- A waste treatment that describes the emissions from the stove if steel nails are burned (if any)
- A waste treatment that describes the emissions from the landfill

4.1.3 The positive impacts of some waste treatments

Wood in a landfill will slowly decompose and form methane and CO2 in the first 150 years. About 20% will not decompose and form a final weight. The methane part (about 56%) can form a potentially high impact on global warming, as the release of 1 kg contributes over 20 times as much to climate change as the release of 1 kg CO2. For this reason landfills are being equipped with a methane collection system.

In this example, we assume that 53% of the methane that is formed in the landfill is collected, of which 31% is used as fuel, and 22% is burned without useful application. This figure is the average for Switzerland and can be considered as relatively high. By using the methane as fuel, we may assume less conventional energy is needed. In this case, we assume that less natural gas is burned.

To model the useful application of waste or by products SimaPro has an "avoided products" option. If you enter a certain amount of natural gas here, SimaPro will subtract the emissions and resource use associated with the production of natural gas. In ISO terms, this principle is referenced to as expansion of system boundaries (see chapter 3 of the user manual for some more explanation).

4.2 Waste treatment record for Landfill

Waste treatment records can be found at the bottom of the inventory processes menu. The way to create them and enter data is quite similar to making material processes.

Please, enter the data as presented in the figure below. On the following page, the step-by-step procedure (step 1, 2 and 3) is presented.

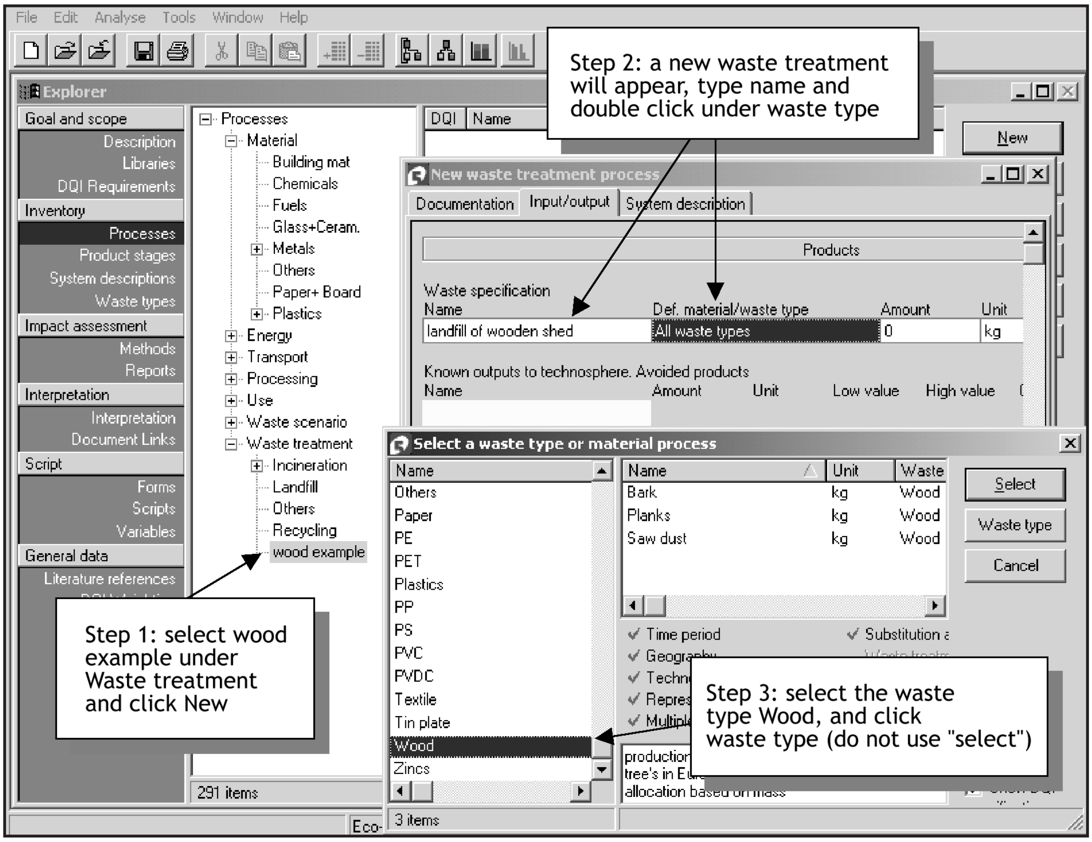

Figure 14
Entering the input to a waste treatment process, and specifying for which waste type this process is valid

- Step 1: Go to waste treatment and take the wood example category; click on the "New" button on the right hand side to create a new and empty process.
- Step 2: Enter the name of the waste scenario 'landfill of wooden shed'. Please note that this is the name referring to the input and not to the output of the process. Enter 1 kg as amount of this sheet. In a waste treatment the input determines the use of the process. Now double click under "Def. material/waste type", to get another selection box. Here you define for which waste types this process is valid. As the name suggest, you can also choose to make this waste type only valid for one particular material.
- Step 3: Define; select wood from the list of already defined waste types. You will note that "our processes" plank, sawdust and bark will appear in the right hand screen, indicating that these processes are defined with the waste type "wood". As explained under step 2, you may also choose to select "planks" instead of the waste type wood.

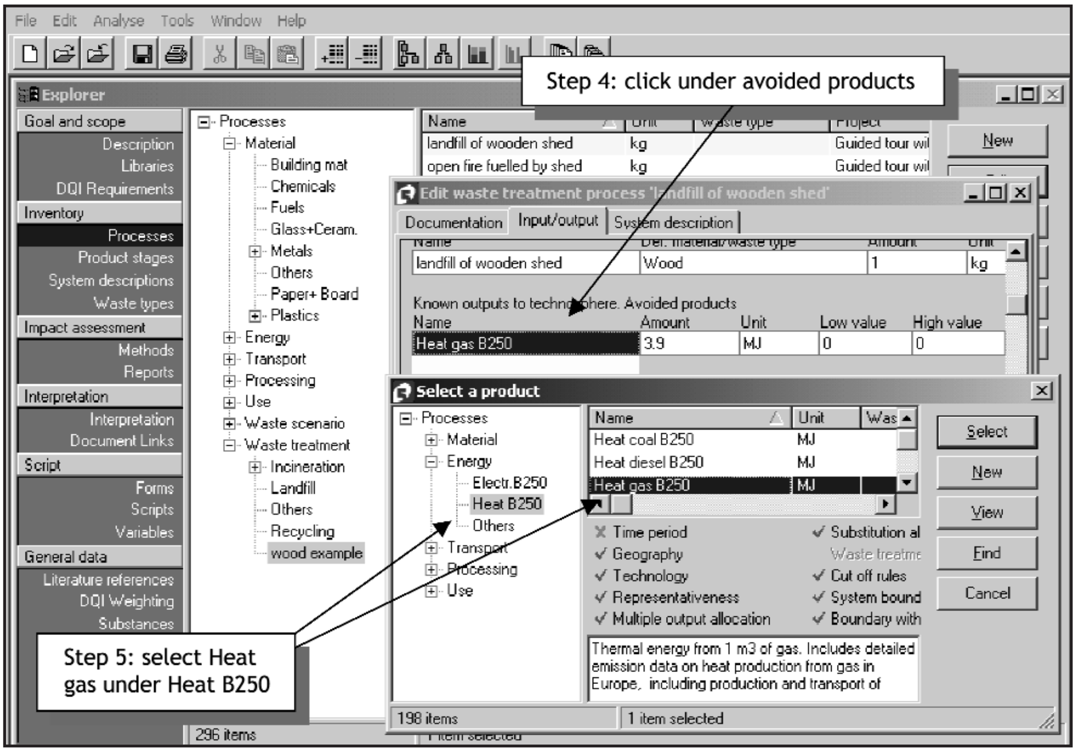

Figure 15
Entering data on the avoided emissions.

- Step 4: Click under Known outputs to technosphere, avoided products. A selection box will appear.
- Step 5: Select "Heat gas" under Energy, Heat B250. 0.07 kg methane is used for energy production. Given the density of methane (0.72 kg/m3) 0.097 m3 gas is avoided, which equals 3.9 MJ energy (see comment box in the Buwal sheet for Heat gas and the amount of energy produced).
- Step 6: enter in materials/fuels the transport for the distance between the municipal waste collection centre and the landfill (16t truck). To transport 1 kg over 20 kilometres, we need a transport amount of 0.001 ton x 20 km = 0.02 ton-kilometre.
- Step 7: now enter the emission of the methane that is not collected (0.1 kg) and the total CO2 (0.54 kg).

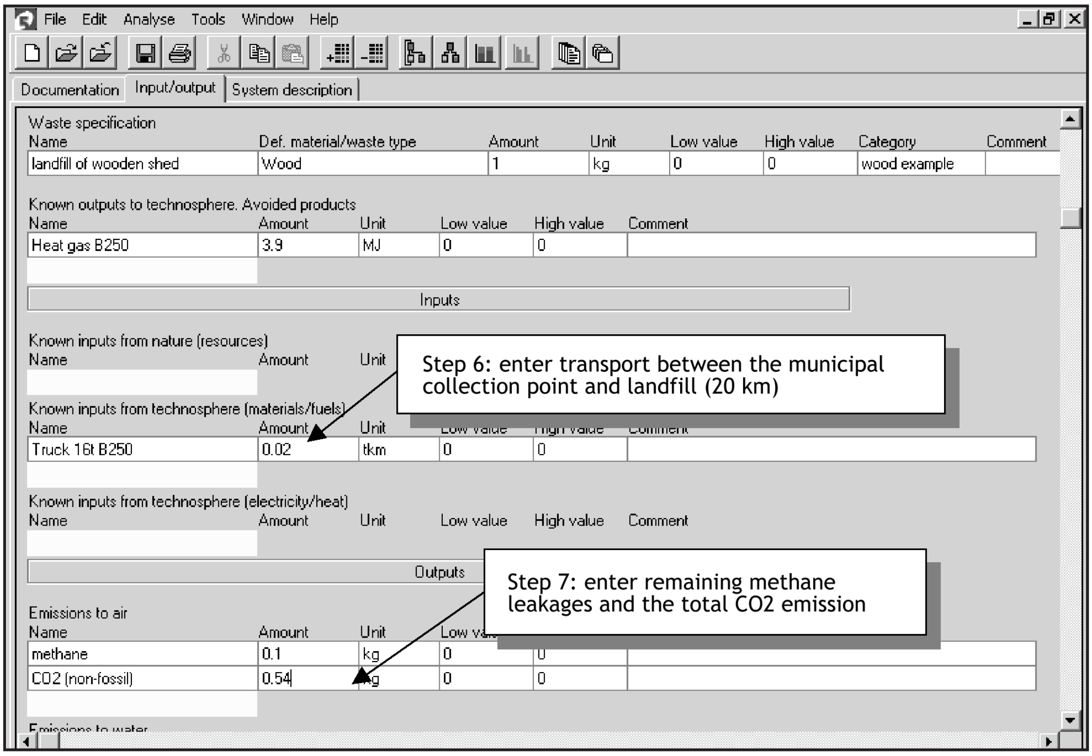

Figure 17
Entering transport and some emissions

You could also specify some remaining waste under solid emissions, but if we assume that all the wood will be decomposed, we do not have to do this, as there will be no remaining waste on the long term. Some practitioners do also register the 1 kg of landfilled waste, because they want to report the short-term waste problem. The choice is up to you.

You can now document the record, using the documentation tab, as we have described before. There is now one new data quality indicator: Waste treatment allocation. Here you can specify that we do indeed use full substitution.

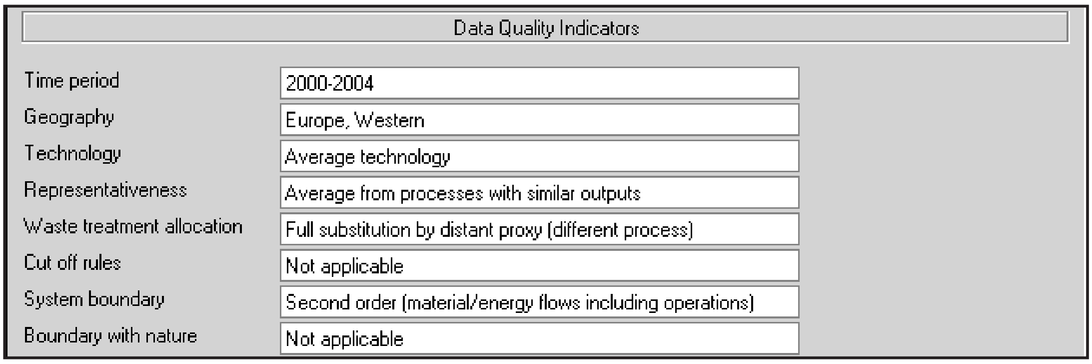

Figure 18
the data quality indicators for this waste treatment

You can close the process and check the tree or network again.

4.3 A waste treatment record for the open fire

In case of the open fire, the waste treatment is a bit easier to enter. We assume no useful by-products that result in avoided emissions. If the open fireplace would be replaced by a well-designed wood stove, we should model the savings on the central heating as an avoided product.

Please fill in a new record as in the example below. The airborne emissions come from the Dutch emission registry (not all emissions are entered).

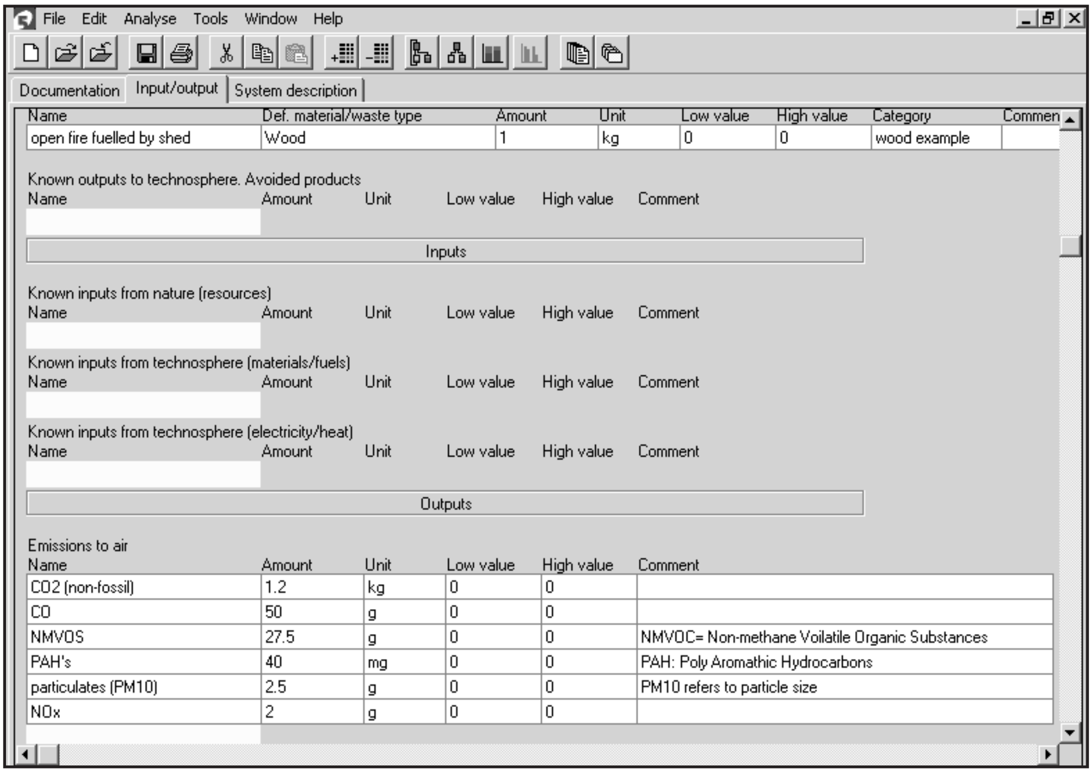

Figure 19
Entering the data for the open fire place

You can now also document this record, as we have done in the earlier processes.

4.4 Waste scenarios

Now we have the waste treatments, we can specify the waste scenarios. The scenarios describe how much of the waste goes to which treatment. We need three scenarios:

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

4.4.1 Waste scenario for landfill

As mentioned above, in real life, the material send to landfill is not split. However, for the modelling it is very useful to use a waste scenario as a 'splitter' to ensure wood is sent to the waste treatment for wood, while nails and other metal parts are sent to an already predefined waste treatment for steel.

Go to Waste scenarios (in the processes menu) and subcategory wood example, and click 'new' to get an empty waste treatment record, now we can fill in the data:

Step 1: enter the name of this scenario and the amount
Step 2: click in the one but lowest white square as indicated in the figure below
Step 3: select the landfill waste treatment we just created
Step 4: select the waste type "wood" as we have done before and enter 100%
The data we just entered will be interpreted as follows: All wood coming into this waste scenario is send to the waste treatment record "landfill of wooden shed".

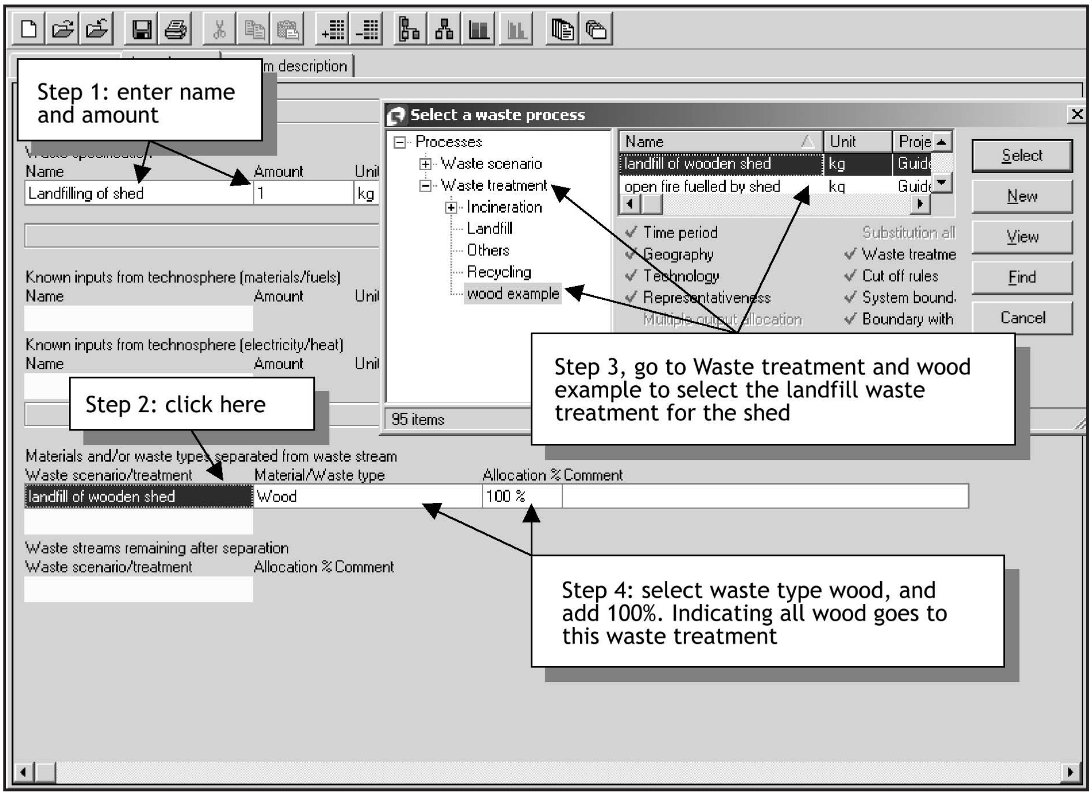

Figure 20
Entering the name and one of the outputs of a waste scenario

In the same way, we can now enter the destination of the metal parts. An unfortunate complexity is that in the Buwal library two waste types for steel are used; one for ECCS steel and one for tinned steel. As we have not yet decided, which steel will be used, it is safe to include both steels. As a rule, it is better to include all waste fractions, but in this example, we will stick to using only wood and the two steels.
We do not have to predefine a waste treatment for the steel, as that is already available in the Buwal library.

The following figure shows how you can enter the rest of the data.

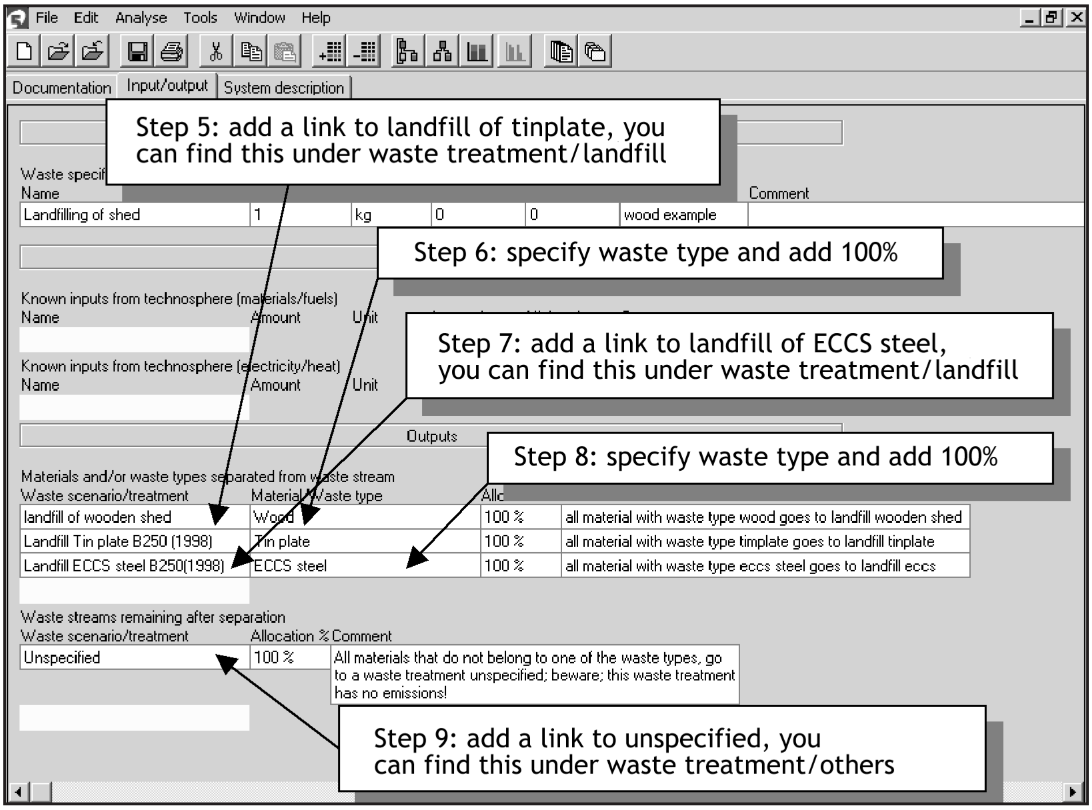

Figure 21
Entering the other outputs of the waste scenario

You can now enter the documentation of the process, as described earlier.

What has been realised now?
All wood that enters this record is send to the landfill of wooden shed treatment. All metals with the waste type ECCS steel, is send to the landfill of ECCS steel waste treatment and all metals with the waste type tin plate, is sent to the landfill for tinned steel. All other materials are sent to the waste treatment "Unspecified".

4.4.2 Waste scenario for the woodstove

Please repeat the previous actions and create a record as below. For the steel, we use already predefined records. Here we have used the 1995 version. Buwal also provided a 2000 version. Of course, these waste treatments are not really representative for an open fire, but as the amount of steel is low, for the time being, this is acceptable

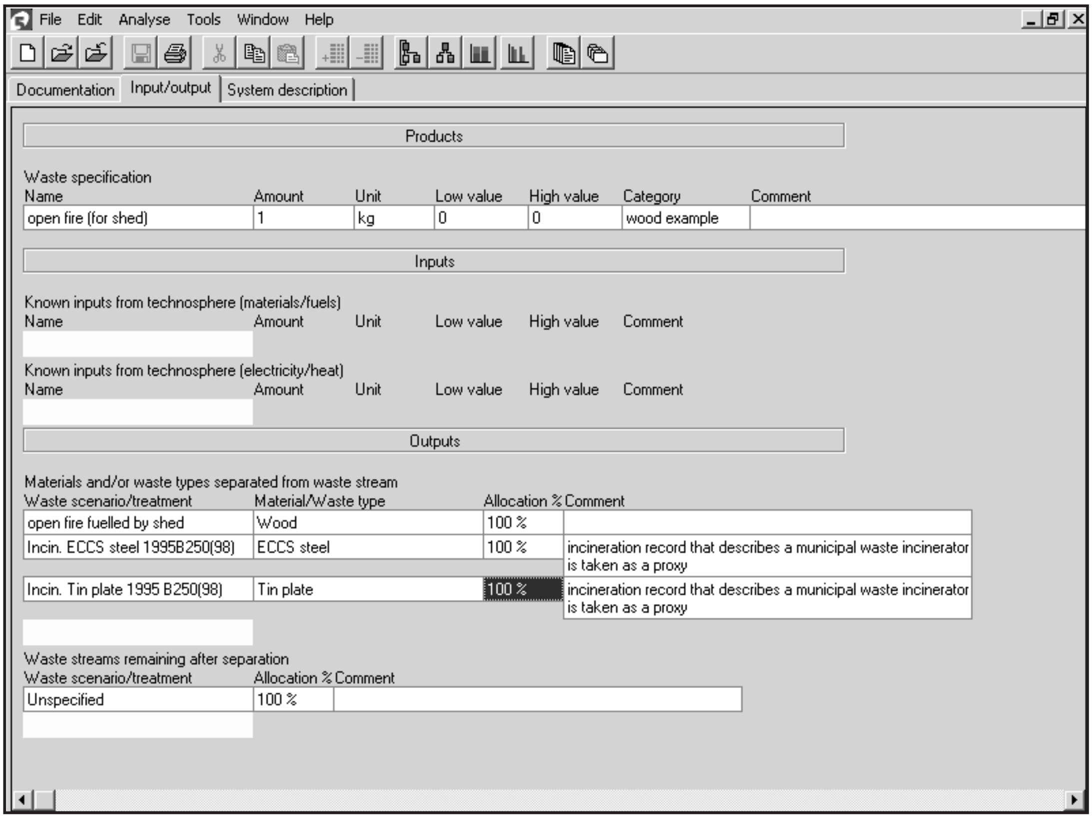

Figure 22
the waste scenario for the woodstove

You can now enter the documentation of the process, as described earlier.

4.4.3 Waste scenario for splitting waste stream

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

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

This waste scenario is relatively easy to make, just follow the steps in the figure below.

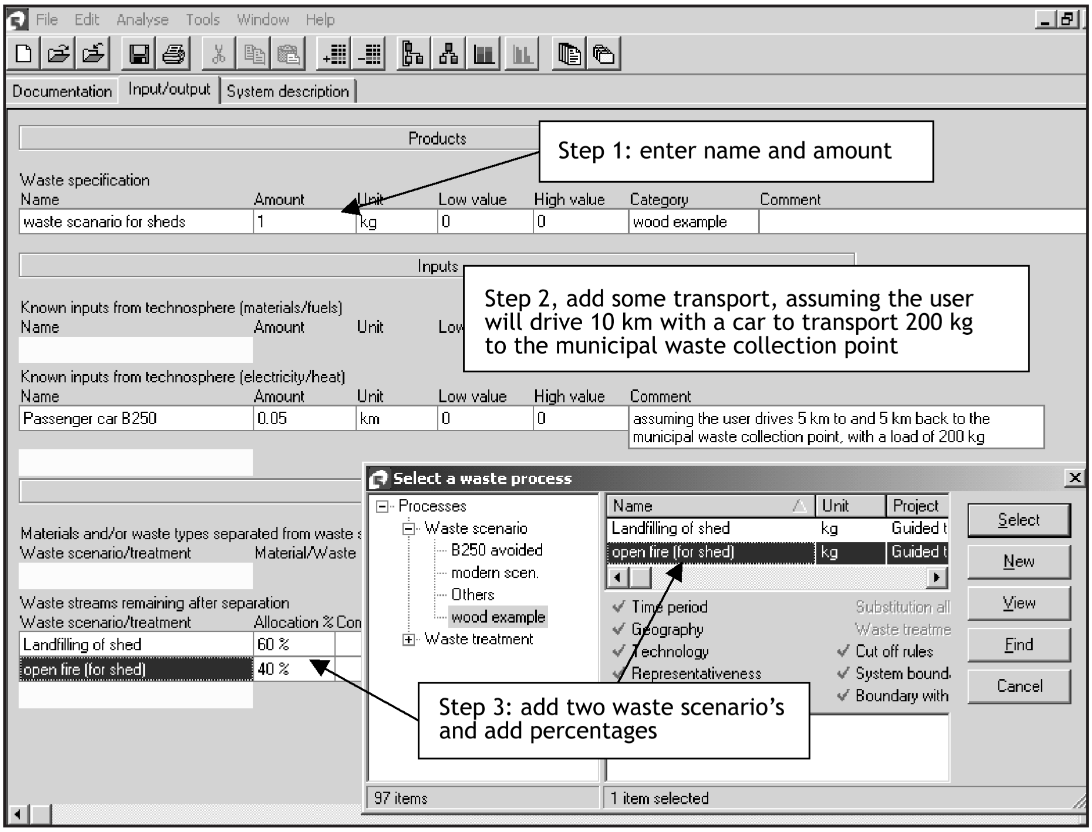

Figure 23
entering the waste scenario that splits the waste over landfill and open fire places

In step 2 we add the transport between the home and the municipal waste collection point. The mass specified in the top line refers to the inputs from technosphere, such as in this case the car.

Please note that in step 3 of this scenario, we do not specify any waste types. We just added percentages to specify how the waste is divided over the different treatments.

You can now enter the documentation of the process, as described earlier.

You cannot get an overview of the waste scenario with a tree. SimaPro does not know yet which materials will be in the waste stream. We first have to define the life cycle and the input to the waste stream. After we defined the life cycle, we can see the structure.

5 The product life cycle

Now we have seen how process trees are built up in SimaPro. We created a process that describes the impacts of making planks. On the other hand, we prepared waste treatments and scenarios.
The next step is to describe the product and its life cycle. SimaPro uses a different type of record to describe products and lifecycles, the so-called product stages. The product stages do not contain environmental information, but the refer to processes like the one we defined. In this tutorial tour we will use 2 out of the 5 available product stages:

- The assembly is used to describe the shed
- The life cycle describes the use and links to the waste scenario.

The three other product stages are not explained here; they are useful if you want to define relatively complex disassembly and reuse scenarios

5.1 The assembly product stage

The following steps show how to enter the following data:

- The shed is made of 200 kg planks
- About 2 kg of steel parts are used for nails etc.
- The consumer picks up the wood with his or her private car, and drives on average 5 km to and 5 from the shop; we disregard the possibility that other things are purchased on the same trip, which would require some form of allocation.

All 11 steps needed to create the assembly are specified in the following figures.

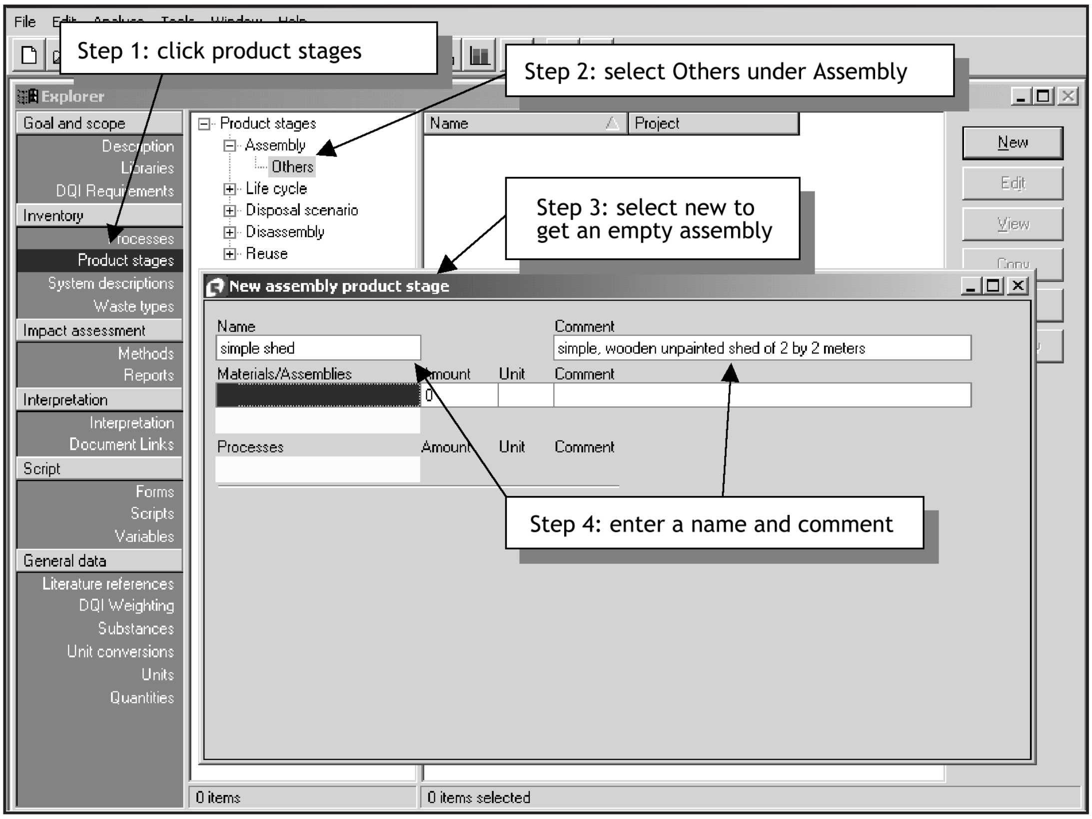

Figure 24
Creating an Assembly and defining the name

In the next figure, we will link the assembly to the plank process. Please note that in step 5, where you click in the white square under materials/subassemblies, you get the choice between entering materials and sub assemblies. This shows that you can also create subassemblies, which is very useful for more complex designs. For instance, we could create a separate sub assembly for a window or for a door, a floor, or if you want for a table (all with different specifications).

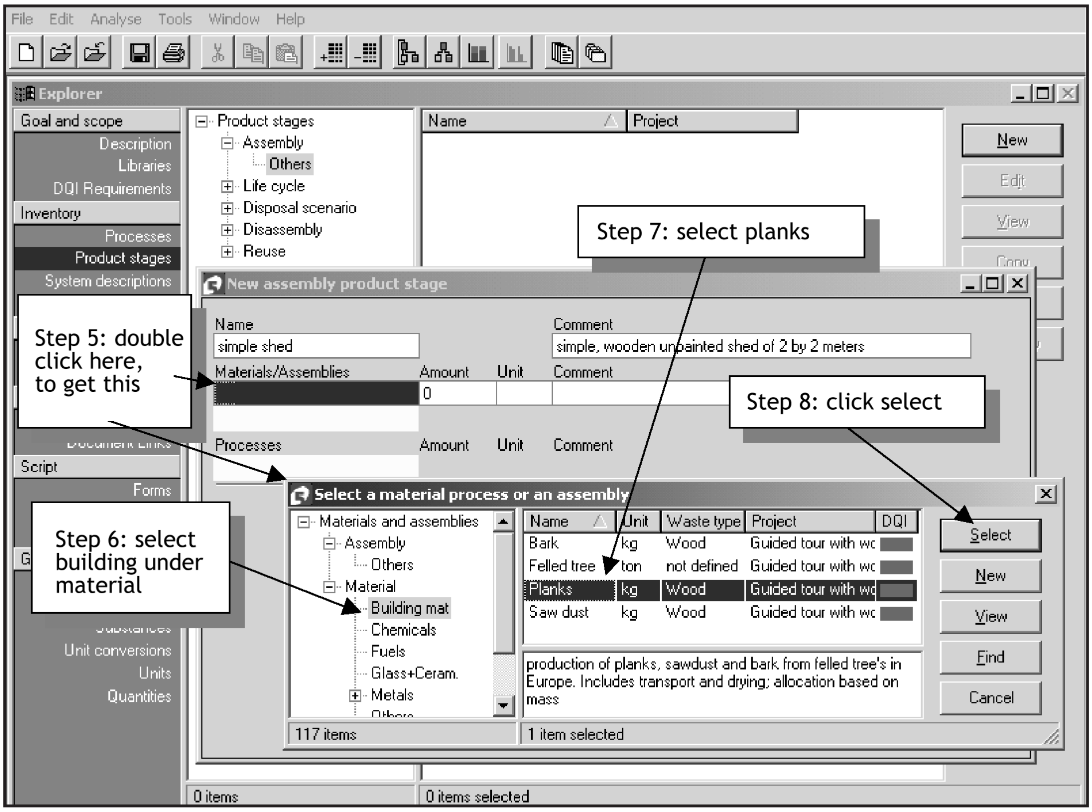

Figure 25
Entering the link to the planks

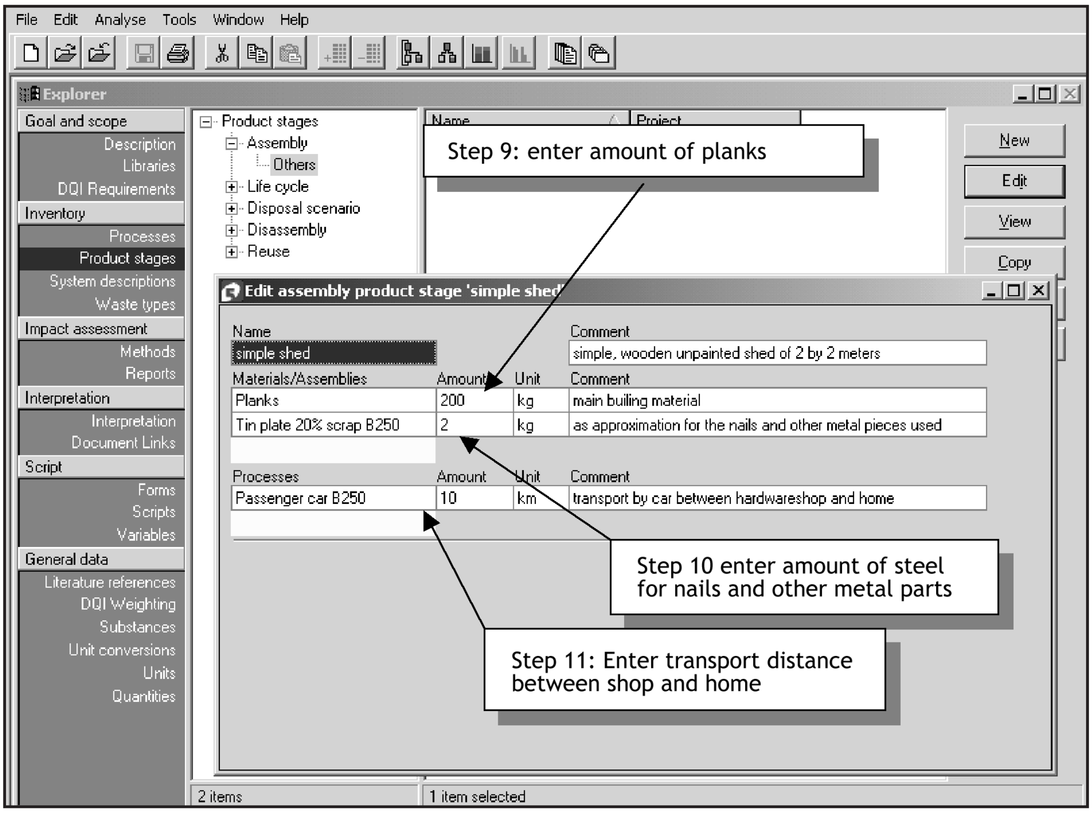

Figure 26
Finalizing the assembly

You cannot set data quality specifications in an assembly. So, after step 11 you can save and close the assembly.

Inspecting the network

To get an overview of what you just have been modelling, we suggest you press the button to present the network. SimaPro will give you a warning that not all processes are shown. It calculates a cut-of level in such a way that only the 12 most important processes are made visible. The processes that contribute less than that level are not shown (although their contribution counts in the result of course). You can still see the planks, but the felling of the tree and the chain saw are not visible. If you adjust the cut-of, you can make these visible too.

In the figure below, the line thickness is set to express the environmental load of the flow, in this case also expressed as eco-indicator score. You can toggle this function on or off, using the indicated button.

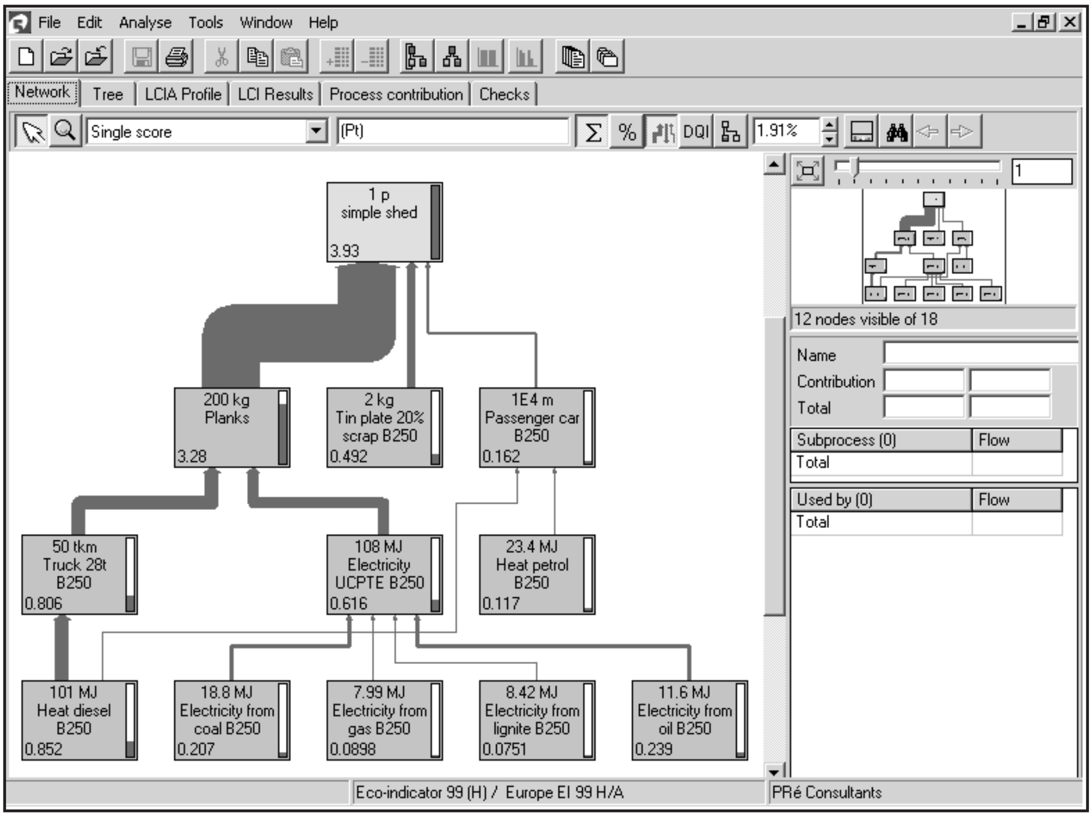

Figure 27
Inspecting the result of your modelling. Note that not all processes are shown

5.2 The product life cycle

The product life cycle is created in the same way as an assembly. Only three steps are needed:

Step 1: open a new life cycle and add a name

Step 2: make a link to the assembly. A life cycle can only contain one assembly

Step 3: make a link to the waste scenario. A life cycle can only contain one waste scenario, or one disposal scenario.

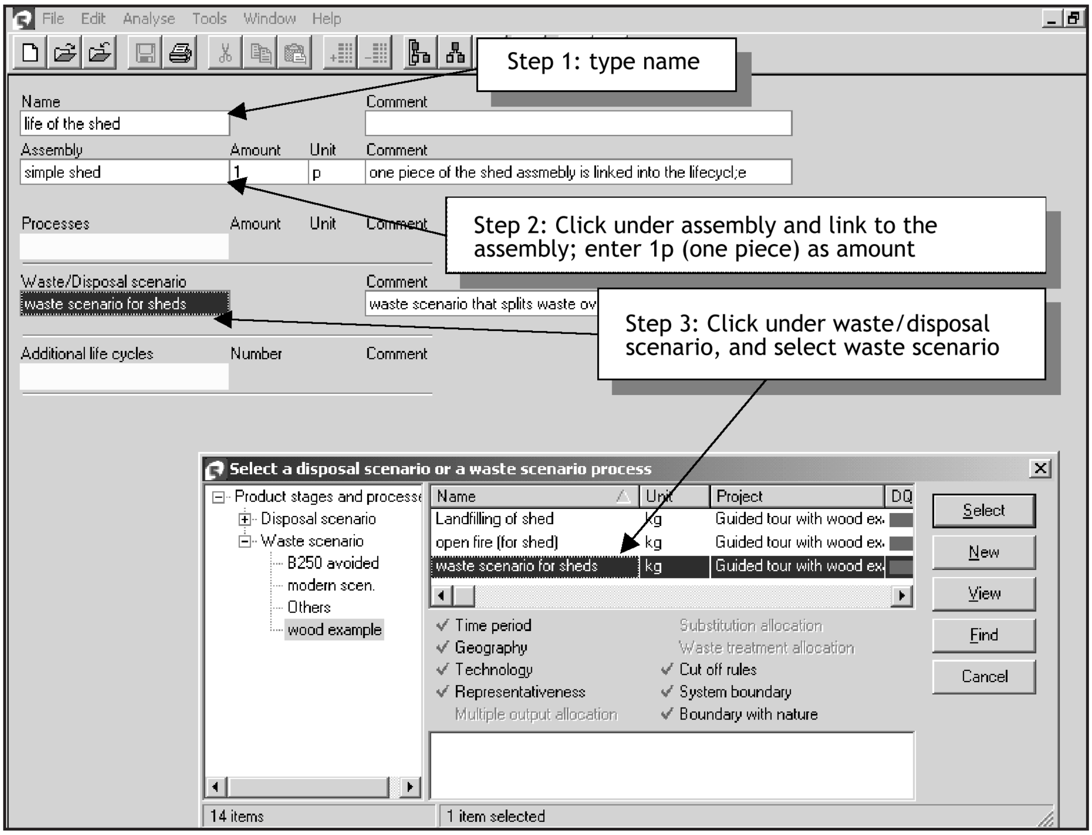

Figure 28
Life cycle of the shed; here the assembly is linked to the end of life

Inspecting the process structure

Now we can get a complete overview over the life cycle, and we can see the end of life scenario, by pressing the tree or network button. Again not all processes are shown, but we can clearly see the assembly (blue and the life cycle (yellow) and the disposal part.

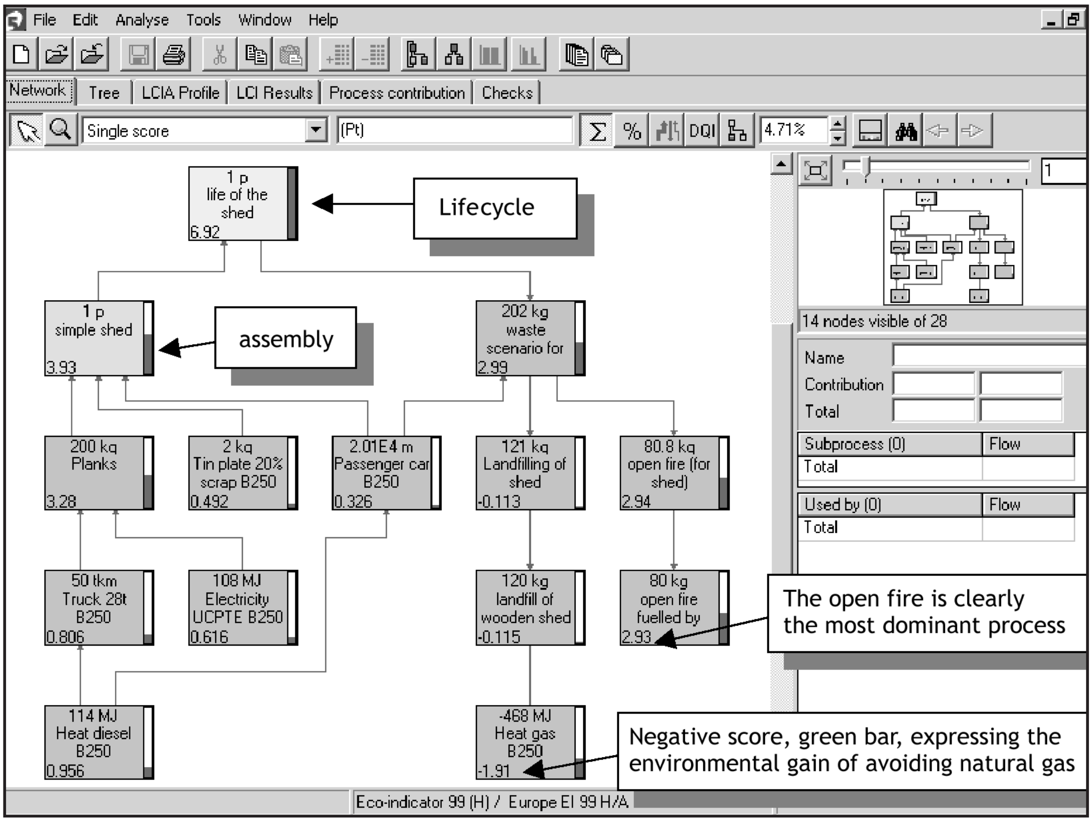

Figure 29
Inspecting the results of your modelling; the life cycle overview

6 Analysing some of the results

6.1 Inventory (LCI) results

So far, we have analysed the tree as an intermediate check of our work. Now we will discuss a few of the other outputs. We only show a few of the many possibilities and we suggest you experiment yourself. If in doubt about the meaning of a screen, press F1 to get online help
To get the inventory results, select the life cycle product stage and click the analyse button , and click the LCI results tab

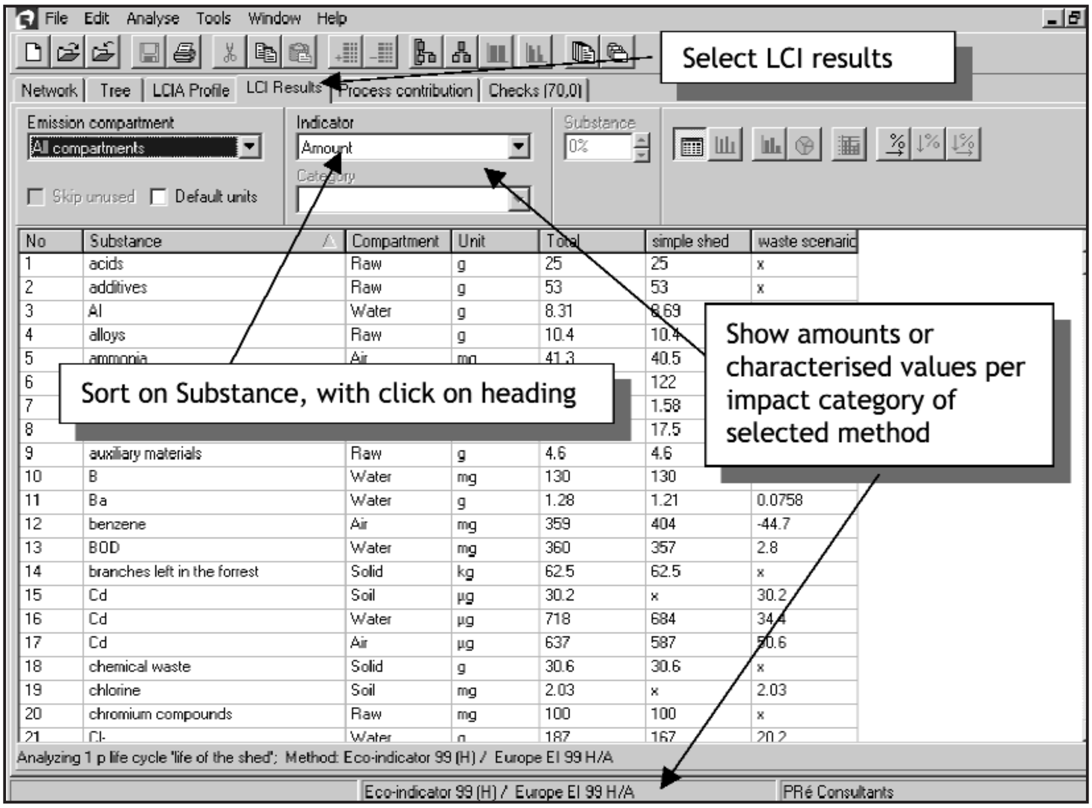

Figure 30
Inventory (LCI) result screen

The LCI screen has many different features: In fact you can also use it to show characterized results.

6.2 LCIA results

Apart from using the tree, we can use the LCIA results button , while you have selected the life cycle of the shed, to get a graph as below.

In this graph, we see the characterization result, and a specification of the production of the simple shed (in blue) and the waste scenario of the shed (in yellow). It shows that the production is dominating in some impact category, while the end of life is dominating others. It also shows that there is no data on land-use, which is of course strange, as forests do need land. For simplicity, we left this out, but obviously the damage to land use should have been entered in the "felling a tree" example.

You can also view your results using another method. To change to a new method, follow the three steps in the screen below. We suggest you try different methods, and see if these would lead to different conclusions. The SimaPro database manuals give you an overview of the characteristics of the methods.

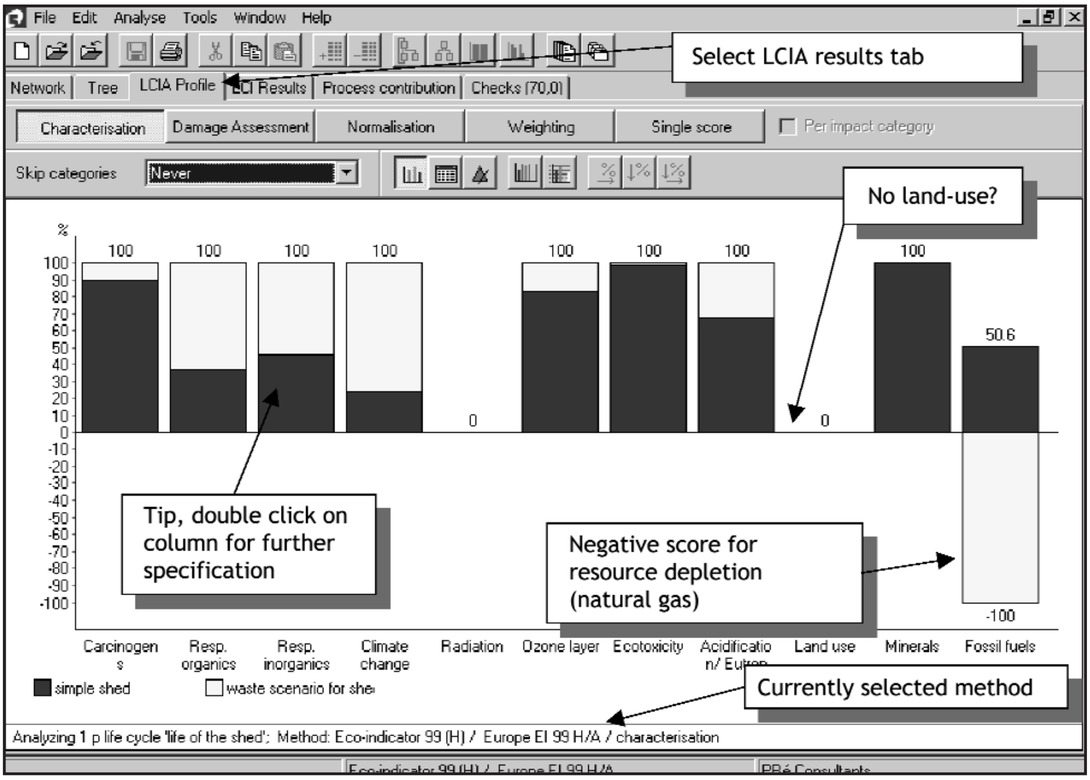

Figure 31
Results of the characterisation step; all impact scores are displayed on a 100% scale; the colours indicate the contribution of production and waste

If you want to change a method, always copy the method to your project first, and make the changes in the copied version. This will keep your libraries clean.

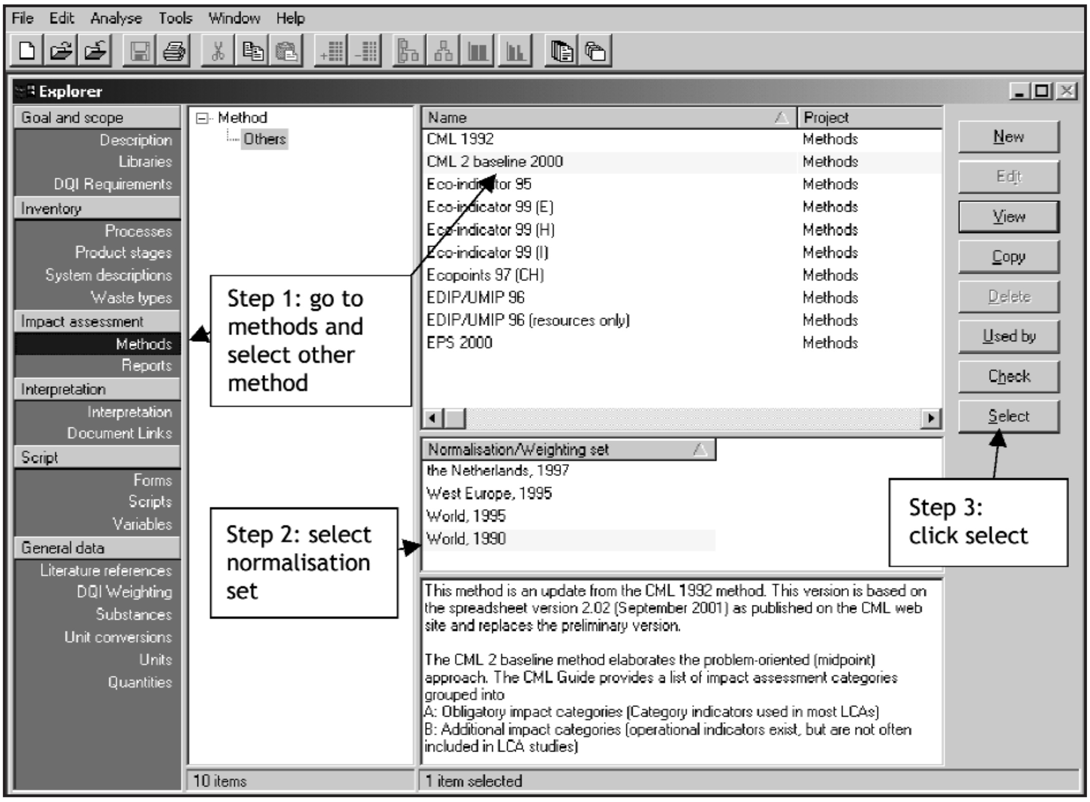

Figure 32
Selecting an alternative impact assessment method

6.3 Inspecting the complete network

We can get a complete view, by lowering the cut-of to zero while you have figure 29 on the screen. You can produce a figure as below by setting the desired zoom level (parts of the tree may be outside the screen) and use the copy command under Edit, or the Export command under File. The BMP format works best with most softwarepackages.

We are now able to analyse all processes, from cutting the tree to the disposal processes. The small thermometers give the contribution to the environmental load. The line thickness also indicates the total environmental load flowing between processes. Red means an environmental load, green means a negative environmental load, or in fact an environmental benefit. In this case the environmental load for the collection and application of the methane from this modern landfill is an environmental benefit.

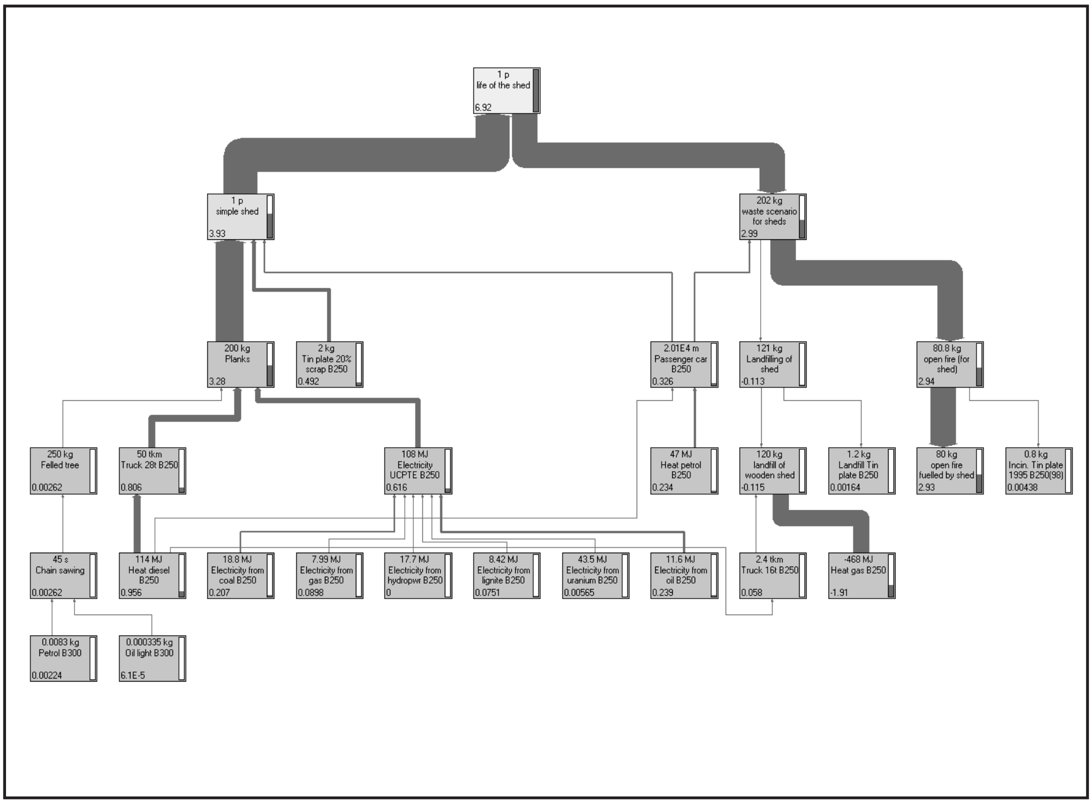

Figure 33
Overview of the complete life cycle presented as a network (all processes shown, cut-of= zero)

6.4 Sensitivity analysis

One may wonder if it is justified to take into account such environmental benefits, and in fact this is not so clear. Some people will argue that you should not allocate the benefit of collecting the methane to the landfill, but to the system that uses the landfill gas. In that case we may not subtract the benefit of the gas.

It is always very useful to make some kind of sensitivity analysis of the results, to investigate the impacts of such an assumption. The purpose is to identify important choices and analyse what would be the result if choices would have been made differently. In the figure below we have recalculated the tree, putting the figure for avoided natural gas in the waste treatment record for the landfill to zero (see paragraph 4.3). In the recalculated figure below, we see that there are no gains in the landfill anymore, and that the total environmental load specified in the life cycle box, is significantly higher. You can experiment with different assumptions and recalculate the results.

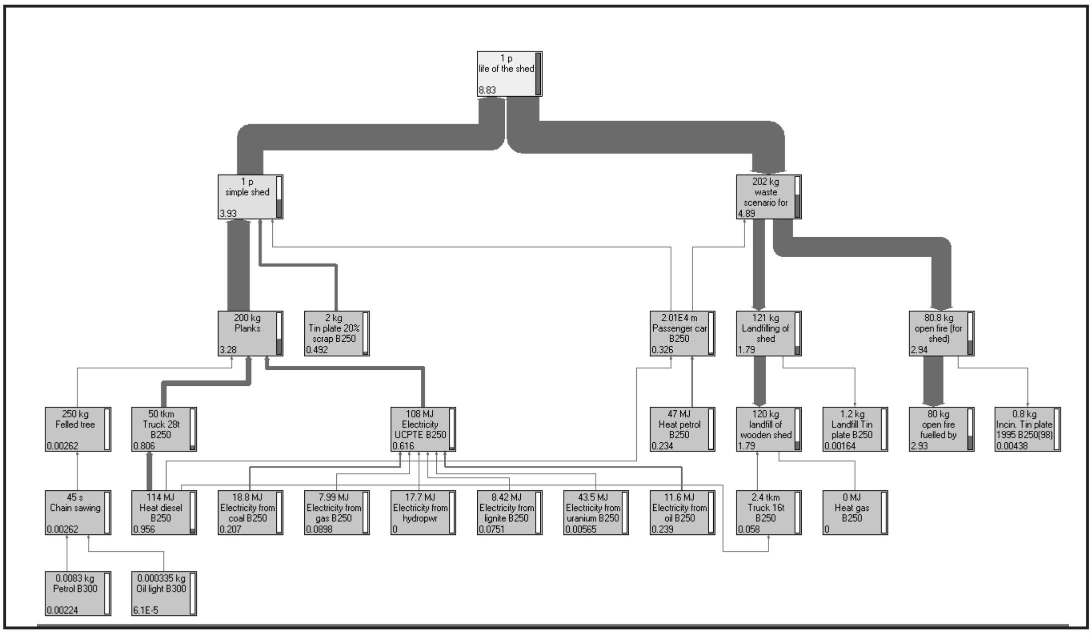

Figure 34
Complete overview over the life cycle, now without the assumption that natural gas will be avoided because methane is collected

6.5 Contribution analysis

Another way of getting an overview of the results is by using the function "contribution analysis". This feature will help you to get an overview of processes that contribute most to the impact of your life cycle.
To make a contribution analysis select your life cycle and click the analyse button , or if you are presently in the inventory screen, simply click on the contribution analysis tab.

- Step 1: Select the tab Process contribution
- Step 2: Click the show chart button
- Step 3: Adjust the cut-off to decrease the amount of processes that is shown in your chart.

In the figure below you can see that the burning of the shed in open fire places contributes most to the total impact of the life cycle, followed by the production of planks (processes in the sawmill). Avoiding energy production with natural gas gives a relative large environmental benefit.

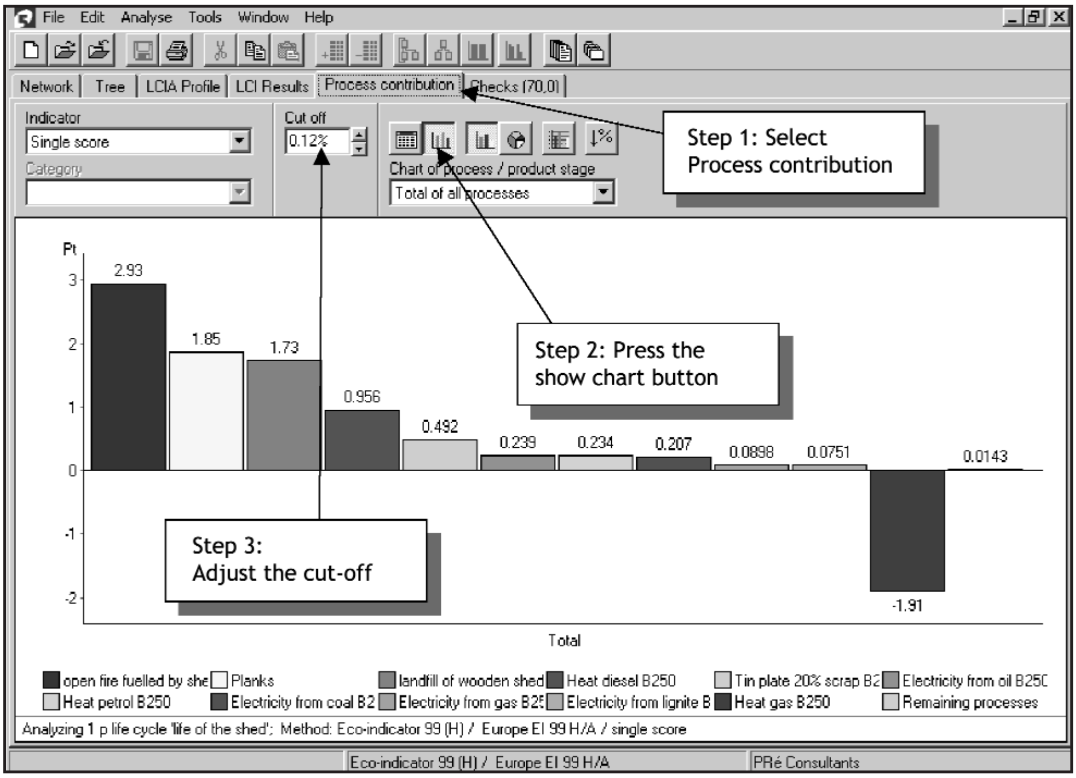

Figure 35:
Overview of the complete life cycle presented as a network (all processes shown, cut-of= zero)

6.6 Inspecting the details

Finally, we will show one of the most advanced features of the network representation, the "split screen". By pressing the appropriate button, you can open a new screen in which you can get all results of the process you select in the tree.
The content of that screen is determined by the process box you click on. In the figure below the waste treatment for the open fireplace is selected. You can now see the contents of that record (although you cannot edit, the LCI results, the TLCI results, the contribution analysis and the status of the data quality indicators for the screen).

In the figure, we present the LCI results as characterized results, in this case as total indicator score. However, you can also select other impact category indicators or present the LCI results in original form.

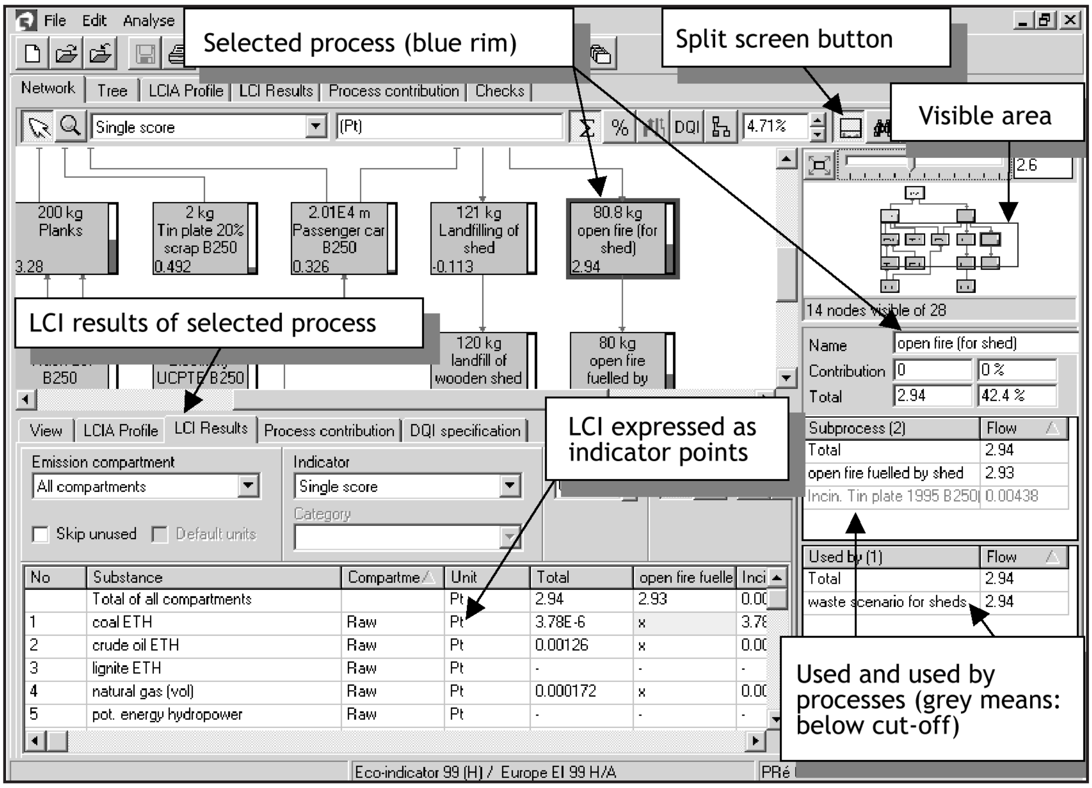

Figure 36
split screens

7 Final remarks

7.1 Interpretation

The real art of making an LCA lies in the interpretation of the results. In the interpretation section of the tutorial with wood example we have tried to provide an example of how you could write an interpretation. The text boxes refer to the issues mentioned in the ISO 14043 standard as obligatory points that need to be addressed. The key question is whether your LCA results are sufficiently reliable to base a conclusion on.

7.2 Further learning

As you will discover there are still many more features in SimaPro that have not yet been explained. For instance, we have not yet discussed the use of disposal scenarios disassemblies and reuse. The coffee machine demo has a ready made example on how to use these. Other issues we did not discuss were the maintenance of the general data section, the file import and export facilities. We suggest you use the reference manual or the help file to explore these features

In spite of these limitations, we believe that when you have followed this tutorial, you have the basics for making your own LCA in SimaPro. LCA is typically a skill you acquire in a learning by doing mode, so by experimenting and trying to improve. The basic references for this continued learning are in:

- The user manual
- The database manuals
- The help file (press F1 to get help)

Furthermore, PRé and some of its partners provide courses at regular intervals. Please, check the PRé website.

As was sometimes mentioned, there is not a single way to make an LCA. Much depends on your goal, ambition and data availability. In general, we advise to start with a simple LCA first, and make refinements later.

We wish you success creating your first LCA.

product ecology
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