

SimaPro Flow tutorial

Title: SimaPro Flow tutorial

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1 Introduction

1.1 Goal of the tutorial

The aim of the tutorial is to guide you through creating your first model with the SimaPro online platform by taking you through a simplified example. The tutorial is connected to the steps of a life cycle analysis (LCA), however, does not attempt to explain all the theory behind LCA and all its methodological issues.



The basic theory and main concepts behind LCA are described in the manual [Introduction to LCA with SimaPro](#). That manual as well as a lot of other interesting articles can be accessed through the [SimaPro Help Center](#). Each chapter in this tutorial starts with a table that summarizes the learning objectives of the lesson, recommended reading materials and estimate time.

Following the examples in the tutorial

You need to have login credentials for the SimaPro online platform. This should be sufficient to do all exercises in this tutorial. There is no installation involved. You can access the platform here: <https://apps.simapro.com/>

SimaPro 9.0

Please note, that this tutorial has been developed using the SimaPro online platform during spring 2020. Since then, updates to the platform have been made. Therefore, if you are trying out this tutorial after a release, your screens may differ from what is presented here.

1.2 Tutorial structure

We have prepared an example that will allow you to become acquainted with the SimaPro Online Platform.

Lesson 1: Basic workflow of the SimaPro online platform. You will become familiar with the three modules, the general workflow and some basic concepts of the platform.

Lesson 2: Learn about the main concepts of an LCA in SimaPro, such as libraries, projects, the goal and scope, functional unit and reference flow.

Lesson 3: Build a process network in canvas, add library processes, learn about the principles of allocation and how to use parameters.

Lesson 4: Learn about the concepts of an LCA calculation and how to interpret the results.

1.3 SimaPro training

With this tutorial, you will learn how to use the basics of the SimaPro online platform by yourself. If you want to develop more advanced skills, PRÉ and its global partners provide dedicated

SimaPro trainings. Please check <http://www.pre-sustainability.com/training> for more information. Some trainings require you to first perform some of the lessons in this tutorial, to ensure that everyone attending the course understands the basics. This also allows for more time to be spent on more advanced subjects.

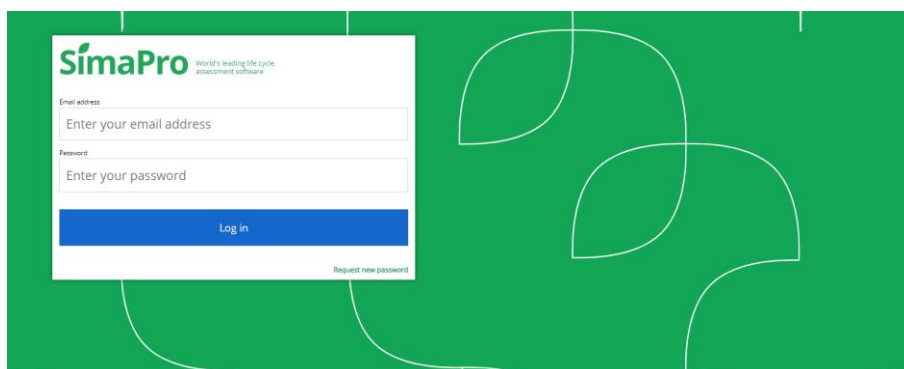
2 Lesson 1: Get familiar with SimaPro online platform

Overview	
What you will learn	Basic workflow of the SimaPro online platform and become familiar with the three modules and some basic concepts of the platform.
Required entry level	Basic understanding of what LCA is. This is intended to be your first experience with the SimaPro Platform.
Recommended reading	Introduction to LCA with SimaPro: Chapter 1
Approximate time needed	10 mins

2.1 Tutorial example – Introduction

In this tutorial you will learn how to set up an LCA model in SimaPro Flow. This will be done by following the practical example of a road bike produced in China. As you might know, the frame, saddle, handlebars, breaks, groupset (which means breaks, gears and other moving parts) and wheels are essential to a bike, and will therefore be part of the cradle-to-gate model. Furthermore, the manufacturing and transport of the frame will be taken into account. However, first we need to get familiar with the SimaPro platform and in particular with Flow.

2.2 Log in to the online platform



To get started, you can follow these steps:

1. Go to <https://apps.simapro.com/> and login with your credentials. If you do not have a username yet, [contact support](#).

2. Once you have logged in, you can see the three modules available on the platform.

The platform modules

Flow

Flow is the module in which all the LCA modelling is done, as well as calculations and in-depth analysis. We recommend starting with Flow as you often need an LCA model to be able to link the two other modules.

Collect

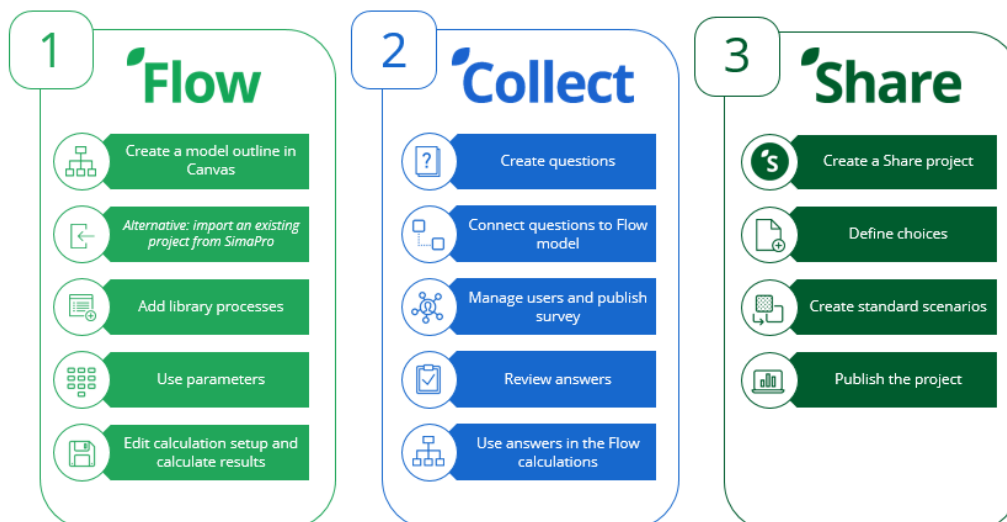
Collect is a data collection tool which is set up as a survey. Your information suppliers can enter the data in a Collect survey. If the survey is linked to your Flow model the information is directly fed into the model that you have made.

Share

Share is a scenario analysis/comparison tool, which can make it easier for non-LCA-experts to get insights in how different variables influence the environmental impact of their products or organizations.

If you want more information on the specific features within each of these modules, then have a look at the [Getting started guides](#).

2.3 General workflow



Above you can see the general workflow, which in reality is iterative, therefore, you might have to go back and forth between these steps to finalize the project. Your project might also be different

and you might be able to skip certain steps. However, for this tutorial we will follow the steps in Flow.

2.4 Users on the platform

The online platform is divided into companies which are accessible to selected users. It can be seen as a database in which your data is stored. Within each company there can be many libraries and projects. Libraries and projects will be elaborated on in the next lesson.

There are two types of users; the expert user and the business user. Expert users have editing rights and can create and share different projects. The projects in each company are visible to all the expert users who have access to that company. Experts can see the results of a survey as well as the scenarios from other users in Share. Business users, or respondents, on the other hand, have less rights and can only view the Share projects or Collect surveys that they have been invited to by an expert user. Business users do not have access to Flow. See the overview in the table below.

	Expert user	Business user
Flow	Can view, create and edit all Flow models.	No access.
Collect	Can view, create, edit and send all open Collect surveys.	Can view and answer Collect surveys they have been invited to.
Share	Can view, create, edit and send all open Share projects.	Can view and use Share projects they have been invited to. Can view scenarios they created and those created by the expert users.

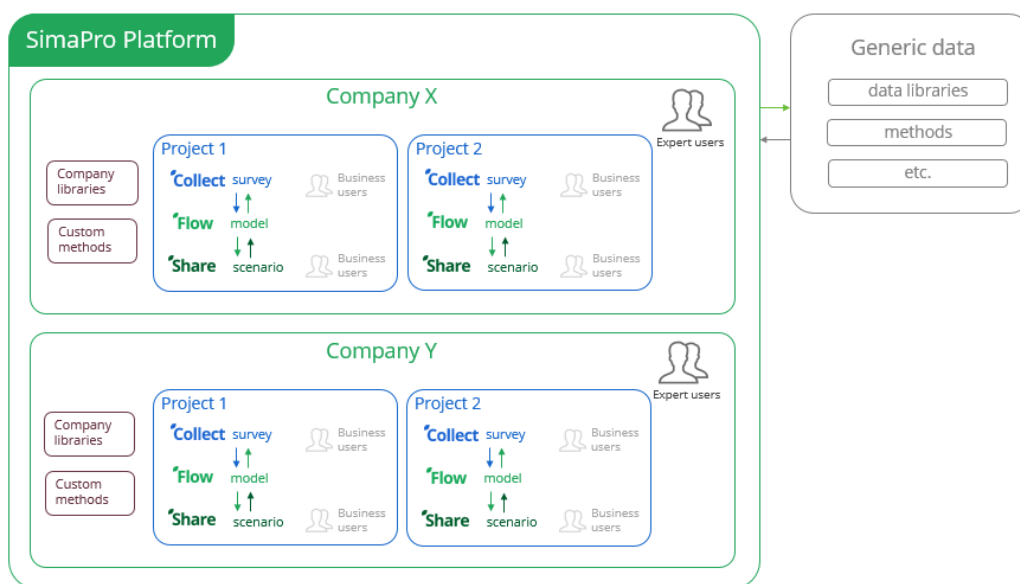
3 Lesson 2: Concepts of SimaPro and LCAs

Overview

What you will learn	Learn about the main concepts of an LCA in SimaPro, such as libraries, projects, the goal and scope, functional unit and reference flow.
Required entry level	Lesson 1 should be completed and understood
Recommended reading	Introduction to LCA with SimaPro: Chapter 2 and Chapter 3
Approximate time needed	15 min

3.1 Building blocks of SimaPro

A SimaPro database, also called company, consists of projects, libraries and work with general data.



General data: Consist of substances, units, and literature references. The substances contains a list of all the raw materials, waste flows, emissions, etc. that can be used in different processes in the libraries and projects.

Projects: Your Flow model is a central point for your projects. The name of your Flow model is the name of the project. It is also where all the data such as the input data created with your own materials/processes (if you have detailed data) and/or links to the materials/processes already predefined in the background databases (i.e. ecoinvent) are stored.

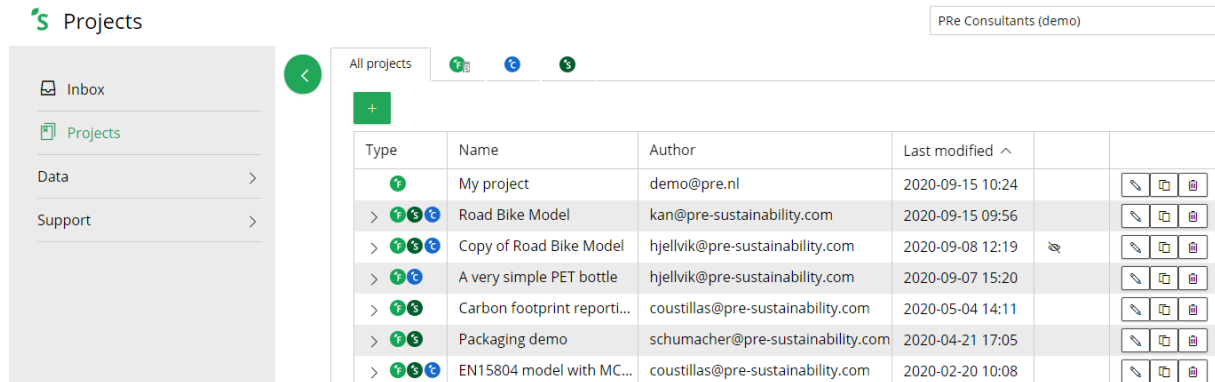
A project can only have one Flow model, however it can contain several Share and Collect parts.

Libraries: Life cycle inventory (LCI) databases are stored as libraries. The SimaPro online platform includes LCI databases, such as the renowned ecoinvent v3 database and EF databases. LCI

databases contain information about the inputs, outputs and emission of industrial, agricultural, transport, household processes, and more. These processes can be used as background data for your LCA model.

3.2 Projects

Your work will be saved in a project. When you log in to the SimaPro online platform, you will see a project overview similar to this:



Each project contains one model with all the links to library processes, Share and Collect. In the next lesson, you will learn how to use a project to model an LCA. *Note!* You can see if the Flow model is connected with Collect and/or Share by the icon that appears at the left of the project name, as shown here: > Road Bike Model

Two types of projects

After creating a Flow model you might notice that there are two types of projects, 'Library Project' (seen in the image above) and 'Modelling Project' (not seen in the image above). The general library projects such as ecoinvent 3.6 Cut-off etc., are standard there and cannot be edited. However, you as an expert user can create your own library project, also called company library, that can be reused in many projects. This is a good way of separating the general data from project specific data. Find out how to do it [here](#).

3.2.1 Project details

Once you start a project, by clicking on the green + and *Flow model*, the first step of a life cycle analysis (LCA) of any system is to define the goal and scope. These details you can add in the *Project details* in the left-side menu and edit them by clicking *Edit details*. You will see a window similar to the image below:

The screenshot shows the 'Project' details form in SimaPro Flow. The form is titled 'Project' and has a sidebar with 'Inbox', 'Projects', 'Data', and 'Support'. The main form has tabs for 'Details', 'Libraries', and 'Privacy and Ownership'. The 'Details' tab is active, showing fields for 'Project name' (New Flow model), 'Comment' (empty text area), 'Author' (Synnøve), 'Publisher' (Hjellvik inc.), 'Version' (1), and 'Is a library' (checkbox). A 'Save details' button is at the bottom.

You can enter the name, comment, author (default is the creator of the project), publisher (default is the company name), version number and select if it is a library or not. The goal and scope of your project can be added in the *Comment* field. When you are done, click *Save details*. You do not need to fill all fields to complete this tutorial.

The following description of the goal and the scope of an LCA is just to inform you on the standard procedures in life cycle assessment.

Goal: Define the main goal of your LCA study. According to the ISO 14040 LCA standard, the description of the goal of an LCA study should contain the following elements:

- the intended application of the LCA.
- the reason for carrying out the study.
- the intended audience.
- whether the results are intended to be used to support comparative assertions intended to be disclosed to the public.

The goal of the road bike model for this exercise is to analyze the environmental impacts of the production of an aluminium framed bike.

Scope: According to the ISO 14040 LCA standard the scope of an LCA study should contain the following elements:

- The product system to be studied.
- The functions of the product system(s).
- The functional unit and respective reference flow(s).
- The system boundaries.
- Allocation procedures.
- Impact categories selected and life cycle impact assessment method.
- Data requirements.
- Assumptions.

- Limitations.
- Initial data quality requirements.
- Type of critical review, if any.
- Type and format of the report required for the study.

The scope of the road bike model is limited to the transport and production of the bike and the ReCiPe 2016 Endpoint (H) will be used to evaluate the results.

Functional unit: When comparing two or more products it is essential that they have the same function. A measure of this function is defined as functional unit (FU). The functional unit consists of quantitative and qualitative elements defining the “what,” “how much,” “how long” and “how well”.

Functional unit example

If you are comparing the environmental impacts of two different hand drying systems (for example, paper towels and electric hand dryers), then the function is drying hands. The functional unit can be defined in the following way:

What	Dry hands
How much	1 pair of hands
How long	Right after drying
How well	Less than 0.1 gram of water remaining per hand

The functional unit in this case would be: 1 pair of dry hands right after drying with less than 0.1 gram of water remaining per hand.

However, if you do this analysis for a hospital, one of their requirements might be that it does not disperse virus and bacteria. Then the *what* becomes dry hands by dispersing the least amount of virus and bacteria. Then, suddenly, the electric hand dryer is not fulfilling the requirements any more.

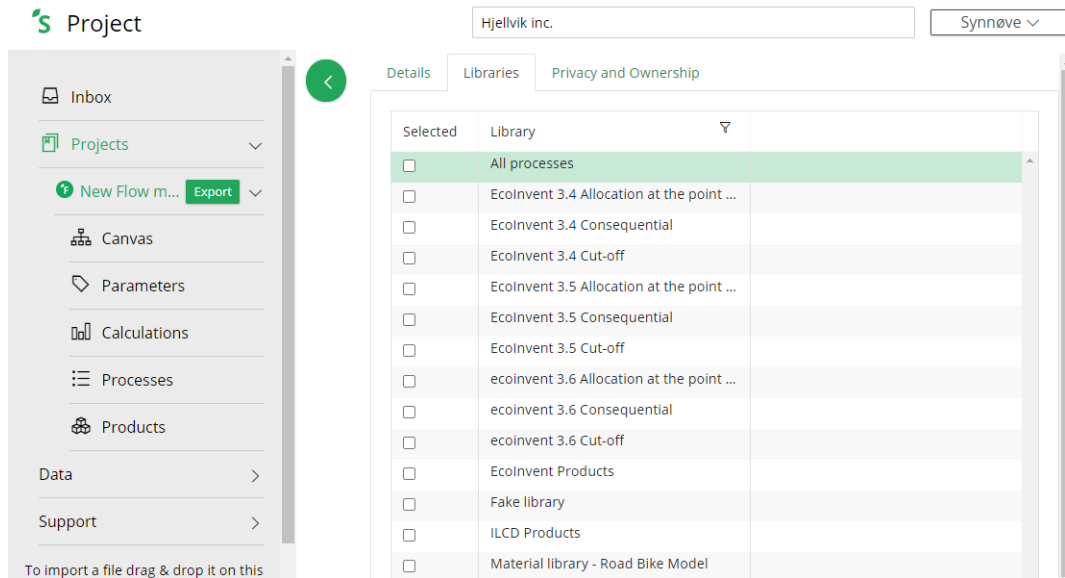
Reference flows: The reference flows of the system you model are the systems which are required to fulfil the functional unit of your system.

Reference flows example

If you are calculating the environmental impact of paper towels, with the functional unit being one pair of dry hands with less than 0.1 gram of water remaining after drying. In this case, the appropriate reference flows would be two 50% recycled paper towels of 5 grams each and corresponding plastic packaging systems involved, dispenser, waste bin and bin liner used. Without these systems, it would be impossible to fulfil the functional unit.

The reference flow of our exercises is: One frame, two wheels, one groupset (moving parts of the bike), a set of brakes, one saddle, one handlebar, since these are the materials required to satisfy the functional unit of a bike.

3.3 Libraries



After saving in the project details, click on the *Libraries* tab, then you will see something similar to the image above. These libraries contain the inventory databases for the materials and processes which you can select for your model. The LCI libraries are constructed in the manner explained in the next sub-chapter. Find out which libraries are already available on the SimaPro online platform [here](#).

ecoinvent 3

The ecoinvent LCI database developed by the Ecoinvent center is the most complete and well-documented LCI database that is currently available. It consists of more than 15,000 datasets on energy supply, agriculture, transport, biofuels and biomaterials, bulk and specialty chemicals, construction materials, packaging materials, basic and precious metals, metals processing, ICT and electronics, dairy, wood, and waste treatment. Read more about the ecoinvent methodology at [Ecoinvent Overview and Methodology](#).

The following ecoinvent databases are included in SimaPro: allocation at point of substitution (APOS), allocation cut-off by classification, and consequential.

System and unit are not on the online platform

Users who have used SimaPro 9 (desktop), are familiar with the terms ecoinvent unit and system processes. This refers to if the data is pre-calculated or not and if the calculation will show details or not. On the SimaPro online platform, you will always see the 'unit' version of a process when you check the list of inputs and outputs, and will by default use its 'system' version when calculating, unless specifically requiring a detailed calculation.

Therefore, there is no need for the distinction between unit and system process libraries.

3.3.1 Library design

If you take any system or model, there will be five main life cycle stages associated with it as shown in Figure 2.2.

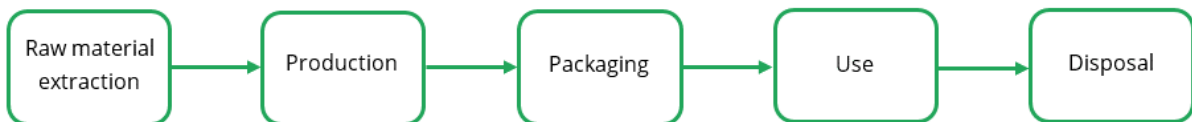


Figure 2.2. Overall life cycle stages of products

During these life cycle stages, other processes are also involved like the transportation and energy/industrial based processes which cause emissions and related social and economic impacts during these stages. The LCI libraries are built by encompassing these product life cycle stages, processes, emissions and impacts. Figure 2.3 gives an overview of how these SimaPro inventory databases are built.

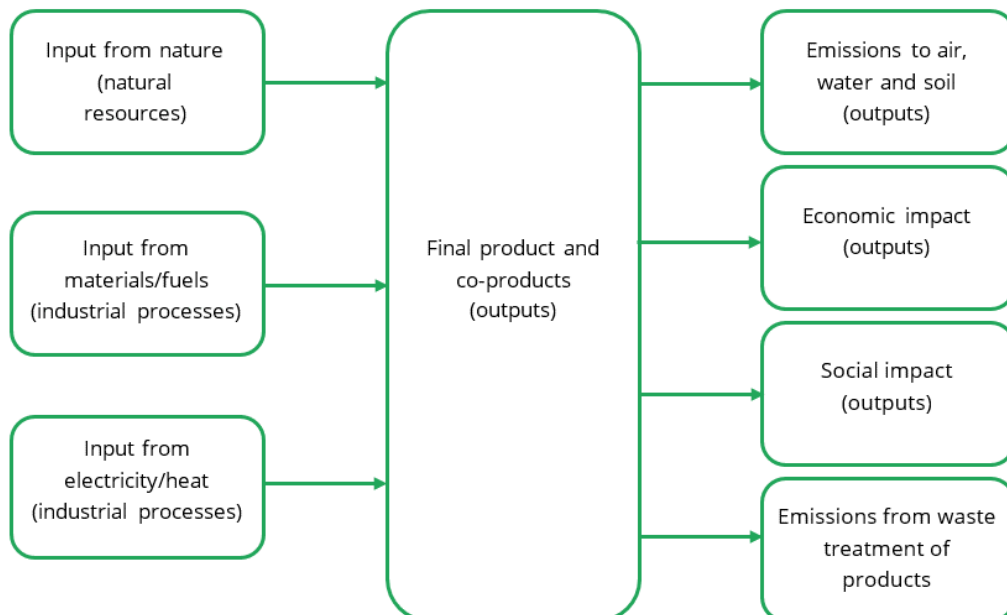


Figure 2.3. SimaPro inventory databases

4 Lesson 3: Start modeling

Overview	
What you will learn	Build a process network in canvas, add library processes, about the principles of allocation and how to use parameters.
Required entry level	Lesson 1 and 2 should be completed and understood
Recommended reading	Introduction to LCA with SimaPro: Chapters 2 and Chapter 3
Approximate time needed	1.5 hours


In this lesson you will go through the main features of Flow and learn how you can apply them to the road bike example. To start, you will set up the project and create a simple outline of the model in the Canvas. Thereafter, you will add library processes and touch upon the use of parameters. You will practice with creating processes and, in the next lesson, do a calculation.

While modeling, you will encounter some methodological issues. However, these will not be thoroughly analyzed here. Please refer to the [Introduction to LCA with SimaPro](#) manual for further information. Also, please note the data we have used for this LCA is not the most representative and the model is by no means complete. The purpose here is to learn about SimaPro Flow and not to provide you with accurate data.

To summarize the parts that were discussed about the exercise example in the last lectures, the goal of the road bike model for this exercise is to analyze the environmental impacts of the production of an aluminium framed bike and transport to our store in Rotterdam. The scope of the road bike model is limited to the production and transport of the bike, and the ReCiPe 2016 Endpoint (H) will be used to evaluate the results. The reference flows of our exercise is one frame, two wheels, one groupset (moving parts of the bike), a set of brakes, one saddle, one handlebar. We will be using ecoinvent 3.6 Cut-off for background data.

4.1 Set up a Flow project

Before starting to build the model you need to set up a project:

1. Click on the green +.
2. Select *Flow model*.
3. Change the details of your project, for this exercise it is only necessary to fill in a name, such as "Road Bike model". However, in the earlier lesson we discussed the goal and scope and functional units and reference flows which can be added here.
4. Click *Save details*.
5. Go to the *Libraries tab* and filter on name by clicking on the  next to *Name*, and find 'ecoinvent 3.6 Cut-off'.
6. Tick the box next to: ecoinvent 3.6 Cut-off

4.2 Start on the canvas

As you might have drawn a model on paper, you can create the processes or nodes on the canvas, to create a preliminary structure. To start building the processes of your road bike model on canvas:

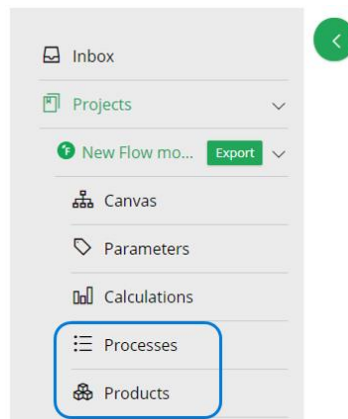
1. Click on *Canvas* in the left-side menu. The canvas should be blank when you enter it.
2. *Double-click* anywhere on the Canvas to create a new node.
3. *Rename* the node to: My Road Bike. This node is actually now a new process in your project – with a reference product bearing the same name. In this tutorial it will act as the bike assembly or lifecycle.

Process vs product

It is important to understand that every producing process is producing one or more products, and each product has one or more producing processes.

In SimaPro desktop, the differentiation between a product and a producing process is small. Usually, the name of the product is stated in the inputs and outputs, and the process name is (meant to be) stated in the documentation tab.

In the SimaPro platform, there is a distinction made between a product and a producing process. This is due to requirements of different data formats, such as ILCD and Ecospol. The distinction is not reflected in the Canvas, but is shown in the sections of the side menu.

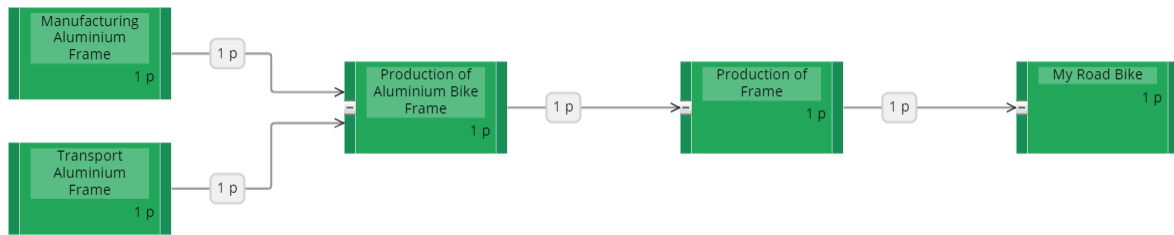


Note! Whenever you create a producing process on the canvas, a product with the same name is created. It is not very important to edit these products, but just know that they are there and that there is a difference between a process and a product.

4. To create a sub-process connected to the new node, *double-click* on the node you already created to make a new sub-process.
5. *Rename* the sub-process to: Production of Frame.
6. Add another sub-process under Production of Frame and call it: Production of Aluminium Bike Frame.

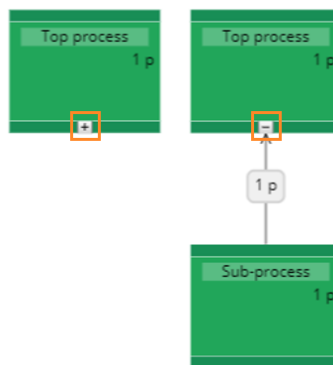
7. Add two sub-processes under Production of Aluminium Bike Frame and call them: Manufacturing Aluminium Frame, and; Transport Aluminium Frame.

This is how you model should look like:

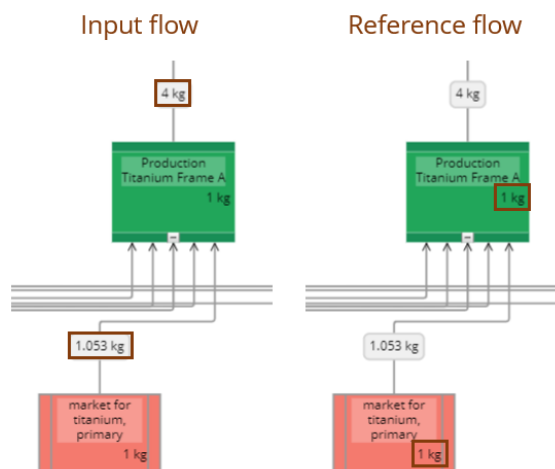


Handy canvas tips

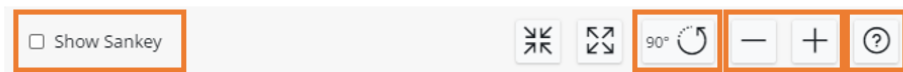
- **Expand and Collapse sub-processes** - When a processes has sub-processes, there will be an option to hide or display these sub-processes. You can do this clicking on the plus sign (+) /minus sign (-) at the bottom of the process box.



- **Descriptive numbers** - Each node and its links display the process name and two numbers. These numbers represent the reference flow (amount and unit), which can be seen inside the node, and the input flow, which can be seen in the arrow of the reference. The input flow can be edited in the canvas, try clicking on the label on the arrow and fill in any number or available unit.



- **The top bar** - On the top of the canvas, there are several useful buttons. You can find:



1.

2.

3.

4.

1. **Show Sankey:** This option allows you to see the calculation network of your model. Keep in mind that this function is only available after you have selected a default calculation set up (see section 5.2)
2. **Turn entire canvas 90 degrees:** This will be remembered for the specific projects, so next time you come back it has the same layout as before.
3. **Zoom in and out:** You can also zoom in and out more smoothly by holding CTRL and using the mouse wheel.
4. The question mark will give you some tips for using the Canvas.

The next step after creating the outline of your bike model is to go to the process list to add library processes. Library processes can only be added from the process list, but it is important to note that they will be shown on the Canvas with pink process nodes.

4.3 Edit processes and products

In this exercise, we will *add library processes* to the already created processes. As a start, we want to add tap water to the manufacturing and a container ship to the transport.

To do that:

1. Go to the process page by clicking on *Processes* in the left-side menu.
2. On the process page, *double-click* on Manufacturing Aluminium Frame which you created on the canvas.
3. The *Edit process* screen opens up, similar to the image below:

Edit process Manufacturing Aluminium Frame
✕

Name

Geography

Tags

Comment

Outputs
Inputs
Substances
+ Collect data

Outputs

+ Add output

Product Name	Amount	Unit	Allocation Percentage	Comment	
Manufacturing Alu...	1	p	100		✎ ✕

1
46 items per page
1 - 1 of 1 items
↻

Save
Cancel

- Here you can adjust the name of the process, the geography, apply tags or add comments.

Using tags

Each process can be give custom tags. These tags can make it easier to:

- Search for processes in process lists.
- Search and filter in the material lists, which are used for Collect.
- For business users, filter in the Collect grid questions as it appears in the material family.
- Adding to dynamic analysis groups.

- Change the geography of Manufacturing Aluminium Frame to China, so the documentation is correct.
- Then, in the *Outputs* tab you can see that the process has a product of 1p (part) output of Manufacturing Aluminum Frame. To indicate that it is not a process, but actually a product, you should change the name to: Aluminium Frame. If you edit this in the process form, you actually create a new product. This is not what we want. Therefore, save and:
- Go to the *Product* page.
- Find the *Manufacturing Aluminium Frame*, and double-click on it.
- Edit the name to become Aluminium Frame, and save.
- Then go back to the Manufacturing Aluminium Frame process in the process list. Furthermore, the Manufacturing Aluminium Frame has only one output product and therefore 100% of the impact of the manufacturing is allocated to this output product.

Allocation

Allocation is used when a process produces more than one output product i.e., co-products. In that case, you have to allocate the environmental impacts of the process across the main product and co-products produced. For example, in a sawmill, the logs are converted into planks, sawdust and bark. Thus, you have to allocate the environmental impact of the sawmill process across the planks, sawdust and bark.

There are many ways of allocating impact, such as: mass, economic, area and volume allocation. The most commonly used are mass and economic allocation.

With **mass allocation**, you will allocate the impacts of the process according to the mass (weight) of the product and co-products produced. This means that the more the product weighs, the higher the allocation percentage. For the above sawmill example, you have to allocate the environmental impacts according to the mass of the planks, sawdust and bark produced. For instance, if the mass of planks is 60% of the total weight of these three products, sawdust is 30% and the bark is 10%, then the environmental impacts are allocated accordingly. This means that 60% of environmental impact is allocated to the planks, 30% to the sawdust and 10% to the bark.

For the **economic allocation**, you will allocate the environmental impacts according to the revenue generated by the main product and the co-products. This means that the higher the product revenue

is, the higher allocation percentage. For the above sawmill example, you have to allocate the environmental impacts based on the revenue generated by the planks, sawdust and bark. For instance, if the sawdust generates 10% of the revenue, planks generate 80% and bark generate 10%, then allocate the environmental impacts accordingly. This means that 10% of environmental impact is allocated to the sawdust, 80% to the planks and 10% to the bark. This would then give a different outcome than the mass allocation.

11. Then go to the *Inputs tab*.
12. Click on + *Add input*. Start typing the product name 'Tap water', select it when you can see it.
13. Set the amount to 1.5, and make sure the unit is in kg.
14. The producing process should be: market for tap water.
15. Set the Geography to Rest-of-World.
16. Click *Save* for the input window, as well as for the process window.

You have now added 1.5 kg of average tap water from the market everywhere except the EU with a cut-off approach fromecoinvent 3.6 to your own process Manufacturing Aluminium Frame. If you want to see which library the process is from then you can open the producing process dropdown. The process window should look similar to the picture below.

Edit process Manufacturing Aluminium Frame ✕

Name Comment

Geography

Tags

Inputs

Product Name	Amount	Unit	Process	Comment	
tap water	1.5	kg	market for tap... RoW		✎ ✖

1

items per page

1 - 1 of 1 items

Then, we want to add a container ship to the Transport Aluminium Frame.

17. In the process list, find Transport Aluminium Frame.



Filtering tip!

You can try using the filtering to find this process. In the processes page these filtering options are available:

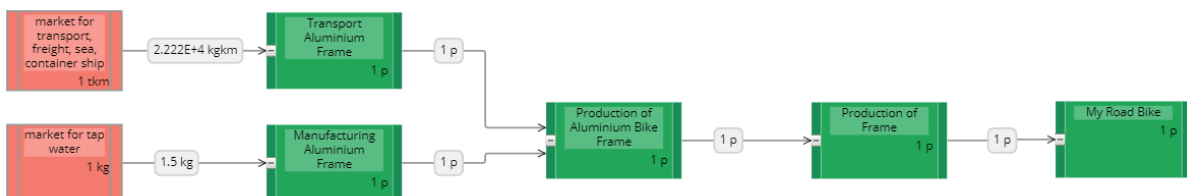
Name	▼	Comment	▼	Tags	▼	Geography
------	---	---------	---	------	---	-----------

To filter for any of these options:

- Click on the funnel for the category you want to filter on.
- Write a part of the name, and click *Filter*.

- When you have found the process, *double-click* on it and check that the geography is Global.
- Then click on the *Inputs* tab.
- Click on *+Add input*.
- Start typing: transport, freight, sea, container ship, and select it when you see it.
- To set the amount for this input, we would like to add a parameter called `Frame_weight`, which represents the weight of the aluminum frame in kg. We also assume that the distance from Shanghai to Rotterdam is 22 222 km. Therefore, fill in `Frame_weight*22222` in the amount field. By doing this, the `Frame_weight` is automatically created as a project parameter with value 1. We will change the parameter in the next exercise.
- Make sure the unit is kgkm, the producing process is: market for transport, freight, sea, container ship and the geography is Global. You can also add a comment of: Distance shipping route from Shanghai to Rotterdam: 22 222 km, for documentation.
- Click *Save* for the input, as well as for the process.
- Go back to the Canvas.

After adding these library processes your model should look like the figure below. Note that the library processes used are shown in pink nodes, so it is easy to distinguish them from project processes.



4.4 Edit parameters

Before going further, we need to change the parameter which was created for the weight of the aluminium frame. The frame weighs 1.5 kg.

As was explained in last lesson, the parameter will be used for calculating the transport, however as you will see next lesson, also for the manufacturing.

To change the parameter:

1. Go to the *Parameters* page from the left-side menu.
2. Click in the *Expression* field of *Frame_weight*
3. Fill in: 1.5, and click away.

Also add the unit in the comment field, so this is always clear when using the parameter. To do this:

1. Double-click on the *Comment* field
2. Fill in: [kg], and click away.

4.5 Continue adding processes

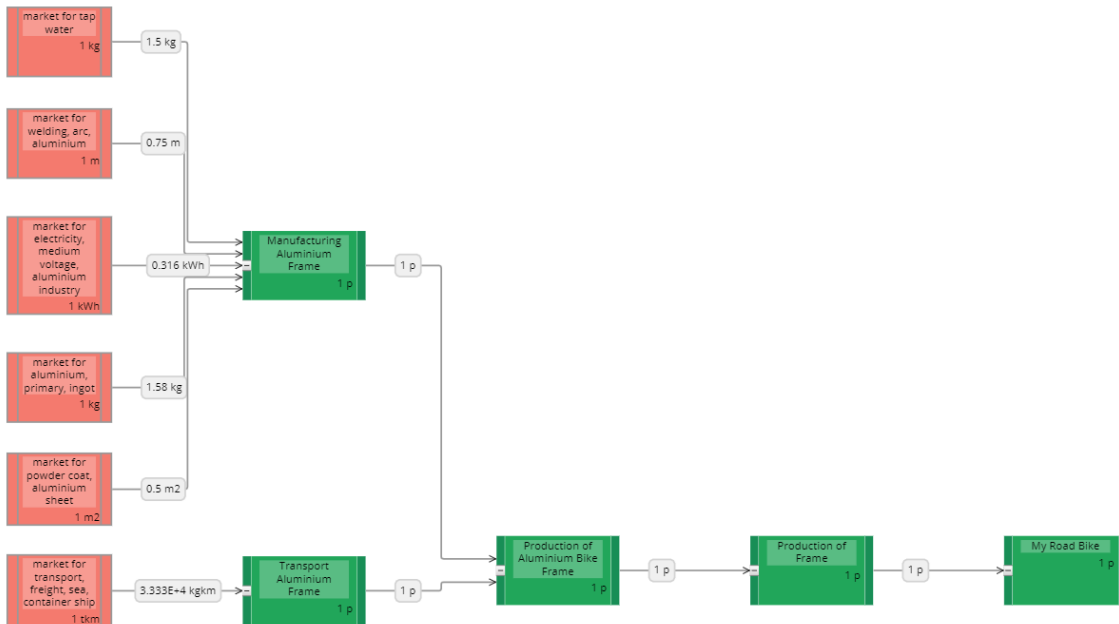
Next, more library processes should be added to the Manufacturing Aluminium Frame.

The aluminium process has a 5% production loss, which means we have to add 5.27% more aluminium to the input to get the intended output. This is computed by entering the output intended 5% losses, see table below.

The electricity is a similar matter. The input for the process is 105.27% of the *Frame_weight*, since there will be a 5% loss during the manufacturing. The assumed kWh/kg for these activities is 0.2 kWh/kg. Thus, the calculation becomes $1.0527 * \text{Frame_weight} * 0.2$. Go back to the process list and add the following inputs to the Manufacturing Aluminium Frame:

Product	Amount	Unit	Producing process	Geography	Comment
aluminium, primary, ingot	$\text{Frame_weight} * 1.0527$	kg	market for aluminium, primary, ingot	IAI Area, EU27 & EFTA	Estimated 5% production loss
powder coat, aluminium sheet	0.5	m2	market for powder coat, aluminium sheet	Global	
electricity, medium voltage, aluminium industry	$1.0527 * \text{Frame_weight} * 0.2$	kWh	market for electricity, medium voltage, aluminium industry	China	Energy use for bending, hydroforming, furnace, quench tank, and screwing the frame.
welding, arc, aluminium	0.75	m	market for welding, arc, aluminium	Global	

After adding these library processes your model should look like this on the canvas:



To practice, model the remaining bike parts: the handlebar, groupset (chain, cassette, crankset, derailleurs, shifters and other moving parts of the bike), a pair of brakes and wheels. Create these five processes under *My Road Bike*. You can choose to start from the canvas or directly from the process list:

Parts	Weight (grams per piece)	Quantity
Groupset (Chain, cassette, crankset, derailleurs, shifters and other moving parts of the bike)	1676	1
Handlebar	350	1
Saddle	280	1
Set of brakes	679	1
Wheel	1400	2

Remember to multiply the weight of the wheel by 2 as there are two wheels needed.

Product 1: Groupset,

Amount: 1, **Quantity:** Amount, **Unit:** p, **Producing process:** Production of Groupset,

Geography: Global

Input Product	Amount	Unit	Producing process	Geography	Comment
aluminium, wrought alloy	378	g	market for aluminium, wrought alloy	Global	Crankset

Continues on the next page

aluminium, wrought alloy	225	g	market for aluminium, wrought alloy	Global	Derailleur (back)
aluminium, wrought alloy	95	g	market for aluminium, wrought alloy	Global	Derailleur (front)
aluminium, wrought alloy	47	g	market for aluminium, wrought alloy	Global	Bottom bracket
glass fibre reinforced plastic, polyamide, injection moulded	30	g	market for glass fibre reinforced plastic, polyamide, injection moulded	Global	Bottom bracket
aluminium, wrought alloy	160	g	market for aluminium, wrought alloy	Global	Shifters
glass fibre reinforced plastic, polyamide, injection moulded	40	g	market for glass fibre reinforced plastic, polyamide, injection moulded	Global	Shifters
Steel, chromium steel 18/8	50	g	market for steel, chromium steel 18/8	Global	Shifters
Steel, chromium steel 18/8	100	g	market for steel, chromium steel 18/8	Global	Cable for shifters
Wire drawing, steel	$(100/(100-9.09))*100$	g	market for wire drawing, steel	Global	For shaping the shifter cables, 9.09% losses assumed during processing.
Iron-nickel-chromium alloy	294	g	market for iron-nickel-chromium alloy	Global	Cassette
Steel, chromium steel 18/8	257	g	market for steel, chromium steel 18/8	Global	Chain

Product 2: Handlebar

Amount: 1, **Quantity:** Amount, **Unit:** p, **Producing process:** Production of Handlebar, **Geography:** Global

Input Product	Amount	Unit	Producing process	Geography	Comment
aluminium, wrought alloy	300	g	market for aluminium, wrought alloy	Global	Handlebar material
polyurethane, flexible foam	50	g	market for polyurethane, flexible foam	Rest-of-World	Handlebar tape
section bar extrusion, aluminium	$(300/(100-6.25))*100$	g	market for section bar extrusion, aluminium	Global	Aluminium processing, 6.25% losses assumed

Product 3: Saddle

Amount: 1, **Quantity:** Amount, **Unit:** p, **Producing process:** Production of Saddle, **Geography:** Global

Input Product	Amount	Unit	Producing process	Geography	Comment
injection molding	100	g	market for injection moulding	Global	
ethylene vinyl acetate copolymer	30	g	market for ethylene vinyl acetate copolymer	Rest-of-World	
polyurethane, flexible foam	50	g	market for polyurethane, flexible foam	Rest-of-World	
aluminium, wrought alloy	100	g	market for aluminium, wrought alloy	Global	

Product 4: Set of breaks,

Amount: 1, **Quantity:** Amount, **Unit:** p, **Producing process:** Production of Set of breaks, **Geography:** Global

Input Product	Amount	Unit	Producing process	Geography	Comment
aluminium, wrought alloy	379	g	market for aluminium, wrought alloy	Global	Brake mounts
synthetic rubber	200	g	market for synthetic rubber	Global	Blocks (4 pieces)

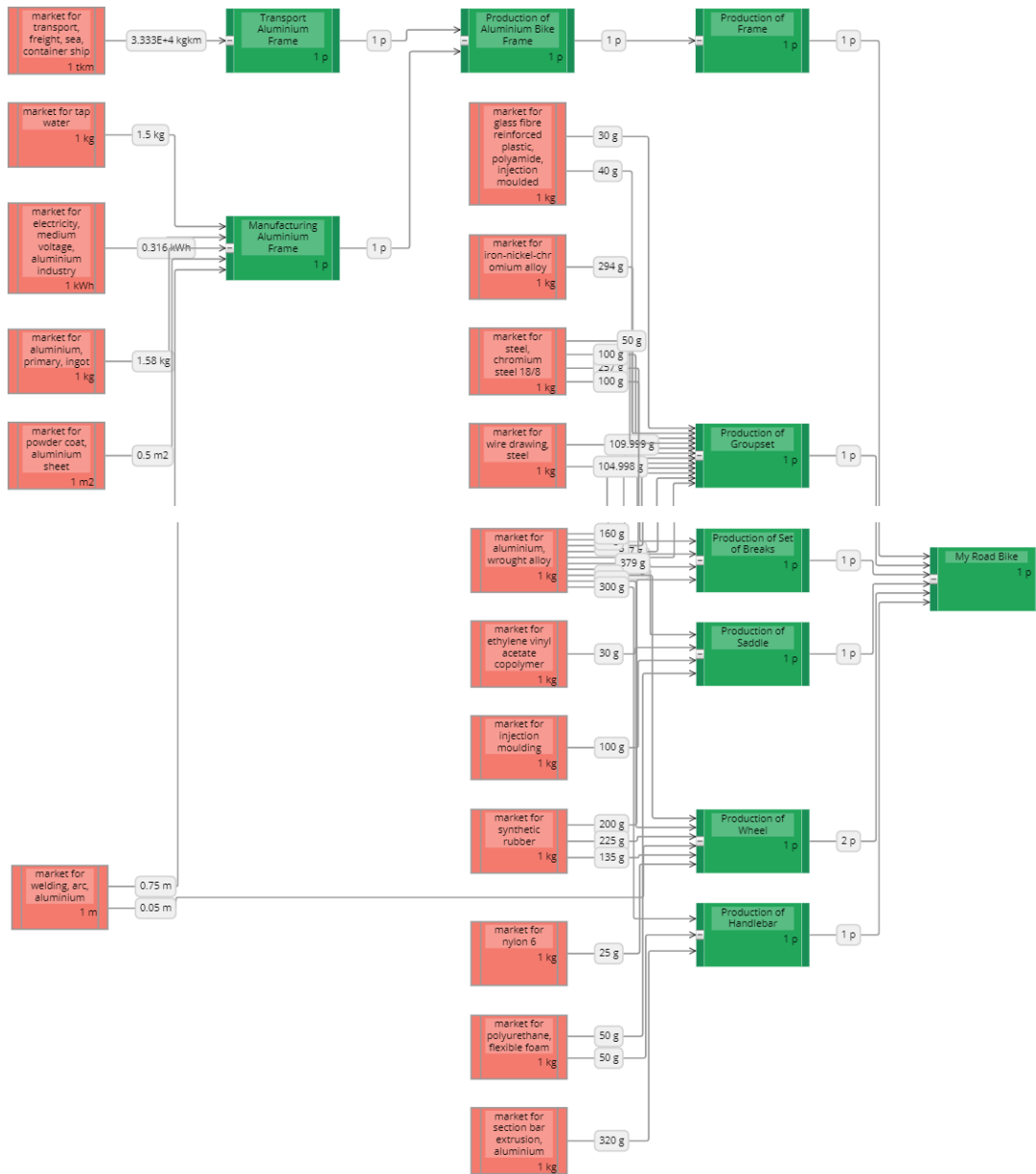
Continues on the next page

Steel, chromium steel 18/8	100	g	market for steel, chromium steel 18/8	Global	Brake cables
wire drawing, steel	$(100/(100-4.76))*100$	g	market for wire drawing, steel	Global	For shaping brake cables, 4.76% losses assumed during steel processing

Product 5: Wheel**Amount: 1, Quantity:** Amount, **Unit:** p, **Producing process:** Production of Wheel,**Geography:** Global

Input Product	Amount	Unit	Producing process	Geography	Comment
synthetic rubber	225	g	market for synthetic rubber	Global	Outer tire
nylon 6	25	g	market for nylon 6	Rest-of-world	Rim tape
aluminium, wrought alloy	940	g	market for aluminium, wrought alloy	Global	Rim
welding, arc, aluminium	0.05	m	market for welding, arc, aluminium	Global	
aluminium, wrought alloy	75	g	market for aluminium, wrought alloy	Global	Spokes
synthetic rubber	135	g	market for synthetic rubber	Global	Inner tire

After adding these library processes your model should look like this in the canvas:



At this point, you have finished the model of the road bike with aluminium frame and you can continue to calculate the model you have built.

5 Lesson 4: Impact assessment

Overview

What you will learn	Learn about the concepts of an LCA calculation and how to interpret the results in Flow.
Required entry level	Lesson 1, 2 and 3 should be completed and understood
Recommended reading	Introduction to LCA with SimaPro: Chapter 4 and Chapter 5
Approximate time needed	45 min

5.1 Five steps of life cycle impact assessment

During the impact assessment step of an LCA study, all resources used and emissions during the life cycle of a product are translated to environmental impacts.

There are five different steps in a Life Cycle Impact Assessment (LCIA) process. The steps are:

- 1) *Characterization*: All substances are multiplied by a factor which reflects their relative contribution to the environmental impact, quantifying how much impact a product or service has in each impact category.
- 2) *Damage assessment*: This (optional) step is similar to the previous step, but now the contributions of different materials and processes are expressed according to the endpoint impact categories of the selected impact assessment method (i.e., in a more aggregated manner).
- 3) *Normalization*: In this (optional) step, the results are compared to a reference value, like the average environmental impact caused by one person in one year.
- 4) *Weighting*: This (optional) step multiplies the normalized indicators of each impact category with a weighting factor. Higher weighting factors can be attributed to more "important" impact categories. The weighted results all have the same unit and can be added up to give a single score.
- 5) *Single score*: In this step, the normalized and weighted results are aggregated into a single score, representing the overall environmental impact.

Some of the impact assessment methods in SimaPro do not have normalization/weighting sets. When you select any of these methods it is not possible for you to view the normalized/weighted/single score results.

You can view the different normalization/ weighting sets available for each method if you go into any project, click on the *LCIA* page in the left-side menu, click methods and then edit any of the methods available. When the *Edit methods* window opens, there is a *Normalization* tab and a

Weighting tab. Read more about the midpoint and endpoint methods in Chapter 4 of [Introduction to LCA with SimaPro](#).

5.2 Calculation

After building you model, you can calculate the impact of the entire model or a certain process, in this case the assembly *My Road Bike*. You can do this by:

1. Click on the *Calculations* tab in the left-side menu
2. Select the top process by clicking on the menu for *Top process*.
3. Double-click on *My Road Bike*. Then the product will automatically become *My Road Bike* which is the only product produced by the *My Road Bike* process.
4. Furthermore, make sure the amount is 1 and unit is p.
5. Next you need to select a method. For this calculation we use the *ReCiPe 2016 Endpoint (H)* with default normalization and weighting set.
6. Then, *Save default set up* and click *Calculate*.

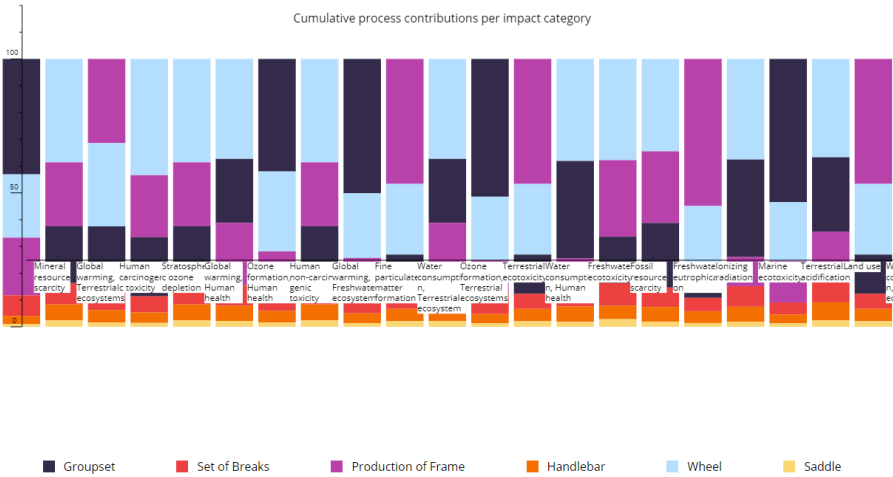
The *Calculation setup* can store one calculation set up that you made for your model in SimaPro Flow. It is often necessary to save a calculation set up to be able to use other functionalities for on the platform.

5.3 Interpret the results

After the calculation is done, you will see graphs and tables with the results. You as an expert or expert-to-be in LCA should understand how to interpret these results. Below is a short explanation of the most important results including characterization results, damage assessment, normalization results and single score. These different results each correspond to a tab on the calculation page.

5.3.1 Characterization

After the calculation is done the following window will open. It shows the *characterization* result for the production of 1 p Road Bike:



In this chart, you can see the amount of environmental impacts (characterized results) of the different parts and processes used for manufacturing and transporting the road bike with

respect to the various midpoint impact categories. It is displayed with a scale from 0-100 of each of the impact categories selected in the drop-down above the graph.

If you scroll down, you can see the different impact category values in a table:

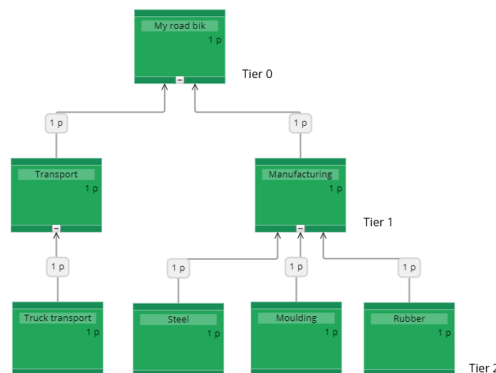
Cumulative process contributions

Impact Category	Unit	Tier	Product	Value
▼ Tier 0				
Mineral resource ...	USD2013	Tier 0	My Road bike	0.397
Global warming, T...	species.yr	Tier 0	My Road bike	2.113E-7
Human carcinoge...	DALY	Tier 0	My Road bike	5.789E-5
Stratospheric ozo...	DALY	Tier 0	My Road bike	1.57E-8
Global warming, ...	DALY	Tier 0	My Road bike	7.002E-5
Ozone formation, ...	DALY	Tier 0	My Road bike	1.819E-7

These show the cumulative process contributions, which means that if you move up a tier the emissions from processes below that process is attributed to the process in the above tier.

What are Tiers?

Tiers are the levels of depth in the model as you can see in the image below:



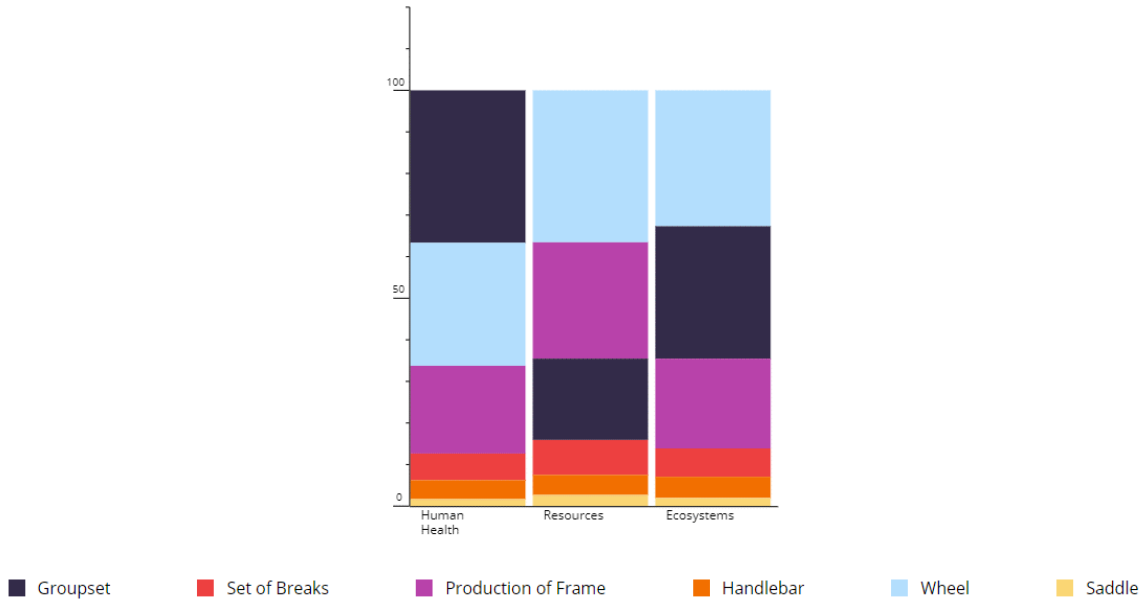
When we talk about cumulative process contribution it means that all the impact of the steel, rubber and molding processes from Tier 2 will be attributed to the manufacturing process in Tier 1.

In the table above, you can see the characterized results for the product from the first tier (Tier 0). In the calculation setup, you can set the Tier to be more than 1, in that way you can see deeper in the model. For example, if you set the amount of tier to be 3, you can see the characterized impact of all the products from three first tiers (Tier 0, Tier 1, Tier 2).

5.3.2 Damage assessment

When you click on the *Damage Assessment* tab, you will see the following figure:

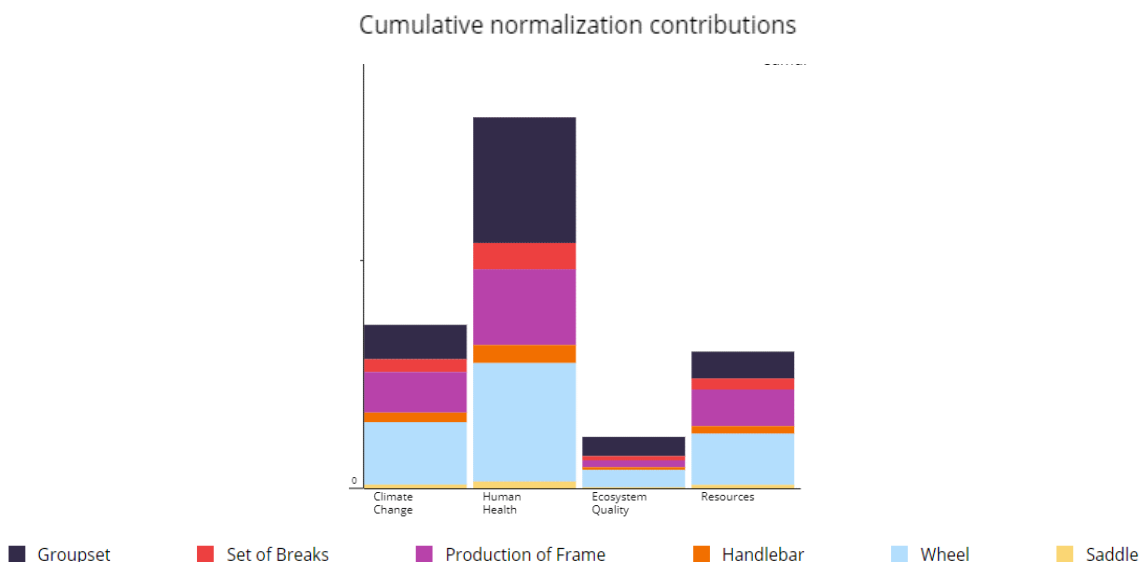
Cumulative process contributions per damage category



The damage assessment results are similar to the characterization results above but now the endpoint indicators (Damage to Human health, Ecosystems and Resources) of the ReCiPe impact assessment method are calculated. The difference is that the damage assessment results are presented in a more aggregated manner. You can read more about the midpoint and endpoint impact categories of the ReCiPe impact assessment method on our [website](#).

5.3.3 Normalization

The selected method does not have normalized results, however, you can try to *do a new calculation with the IMPACT 2002+* method to see the normalized results. Then when you click on the *Normalization* tab, you will see the following figure:



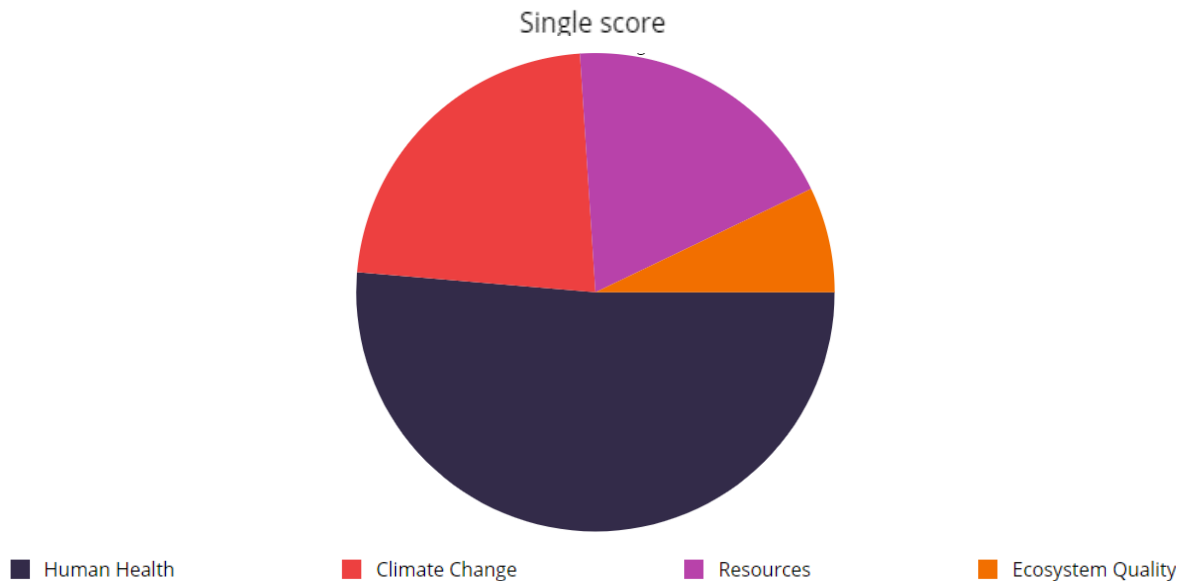
In this figure, you can see the normalized contribution of the different materials and processes to the impacts of aluminium frame production. These results express the relative contribution of the different materials and processes used for the aluminium frame to the average

environmental impact of one person in the world per year, since you chose the default Normalization/Weighting set which in this case is **World (2010) H/A**, while selecting the impact assessment method.

5.3.4 Single score

The selected method does not have single score, however, you can try to do a calculation with the IMPACT 2002+ method to see the single score results.

Then when you click on the *Single score* tab, you will see the following figure:



This graph shows the single score results for the production of aluminium frame. This method gives the environmental impacts of the different materials and processes used for the aluminium frame production in a single score.

For questions regarding the SimaPro software, you can visit our [website](#) or [contact PRé support](#) directly if you cannot find the answer in our SimaPro Help Center.

Congratulations, you have finished your first Flow model!