

SPIonWeb

Advanced **S**ustainable **P**rocess **I**ndex
calculation software

Step-by-step Guide

1 Introduction

SPlonWeb is free software calculating the ecological pressure of a technical process along the whole life cycle, including raw materials as well as all emissions and wastes. It rates the ecological impact with the Ecological Footprint according to the Sustainable Process Index (SPI) method as well as regarding to carbon dioxide emission and Global Warming Potential (GWP).

This quick reference guide is intended to give a quick overview for handling and features of SPlonWeb. For a more detailed description and background information the reader is kindly referred to the manual. This quick reference guide should help you to have an easy start with SPlonWeb. The use of the software is explained using a simple example.

2 Step-by-step introduction

SPlonWeb may be started following the link spionweb.tugraz.at, leading to a homepage which contains some methodological background information, references, links and contact information and of course the SPlonWeb calculator. To start calculating the ecological impact of processes you have to create an account by signing up with a valid email address. This is necessary because every user has its own project database containing previously generated processes, which are stored on the server for easy access and management. After a successful sign up procedure and logging in, a navigation bar is shown on the top, which grants access to all important option within SPlonWeb (Figure 1).

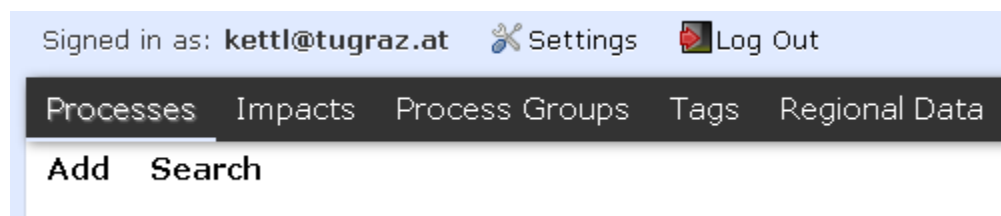


Figure 1: Personal environment

This guide focuses on the red highlighted *Processes* option, which is used to show an overview of user defined processes for this account and create new processes.

2.1 Process description

According to Figure 2 a click on *Add* will start the procedure to calculate the ecological impact of processes and lead you to Figure 3, defining general process information.

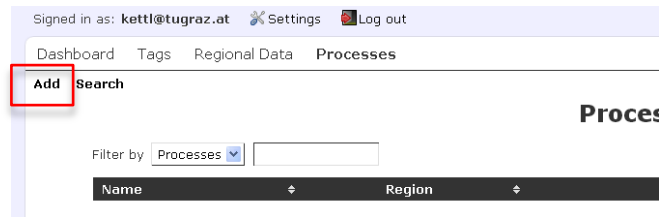


Figure 2: Adding Processes

Search allows browsing your previously defined user processes or core processes which are provided already by SPIONWeb.

Figure 3: Process description

The following items may be defined to create a new process (bold letters indicate required fields):

- **Name:** The process name which is unique for this process. (Try to use a nomenclature for yourself, which is helpful to keep an overview)
- **Description:** Here you can place some relevant information for this specific process
- **Reference:** Data sources should be mentioned here
- **Regional Data:** For every process a different location can be chosen, which influences the calculation of the SPI value. The dropdown box gives you a list of predefined locations. This list can be extended through the tab *Regional Data* on the navigation bar

A click on *Save* will complete the general process information part and guides directly to the Inventory definition. Figure 4 shows the inventory definition for processes in the *Process Details* sheet.

First define at least one tag (red box). This makes categorization of processes easier (e.g. transportation, energy production, agriculture). Users are also able to create their own tags which can be accessed through the navigation bar on the top.

In the next step (green box) one primary product/service must be defined which is provided by the process. **All product names must be unique to the process in order to avoid compromising existing processes!!**

An appropriate reference unit has to be chosen (e.g. kg, km, m³). **Please be aware that every input to the inventory of this process has to be related to 1 unit of the primary product.** It is also possible to add more products, thinking of side or waste streams. **Again all secondary product names must be unique to the process! Please be aware that every secondary product of this process has to be related to 1 unit of the primary product.**

Back Copy Delete Results

Process Details USEM

Process Data

SPI Index: 0.000

Name:

Description:

Reference:

Restricted?:

Last Update: 12/18/2012 12:02

Tags:

Regional Data

Region:

Water

Yw: [mm/a]

r:

Rw: 294.900 [kg/m².a]

Soil

Ys: [kg/m².a]

I:

Rs: 0.420 [kg/m².a]

Footprint SPI Categories

Zoom

Outputs

+ New Product

Products

Name	Main product?	Unit	Inventory	α_{tot} [m ² .a/Unit]	α_{part} [m ² .a/Unit]	K
<input type="text"/>	<input type="checkbox"/>	<input type="text" value="kg"/>	<input type="text" value="1.0"/>			

Included in 0 other processes.

Footprint Inputs

Zoom

Inputs

+ Add Sub-Process + Add Sub-Process (Advanced Search) + Add Impact + Add Impact (Advanced Search)

Sub-Processes

Name	Unit	Inventory	V_{spec} [m ² .a/q]	α_{part} [m ² .a/Unit]	Share
<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>

Impacts

Name	Unit	Inventory	V_{spec} [m ² .a/q]	α_{part} [m ² .a/Unit]	Share
<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>

Figure 4: Process definition

If more than one product has been defined (Figure 5) the option *Allocation type* pops up. There are three different allocation methods:

Process Data

SPI Index: 0.000
 Name: Process 1
 Description: Test process for the quick reference guide
 Reference: Literature Source #1
 Allocation Type: primary
 Restricted?:
 Last Update: 12/12/2012 12:53
 Tags: Add
 Test processes

Regional Data

Region: Europe
 Water: Yw: 983.000 [mm/a]
 r: 0.300
 Rw: 294.900 [kg/m².a]
 Soil: Ys: 0.750 [kg/m².a]
 l: 0.560
 Rs: 0.420 [kg/m².a]

Footprint SPI Categories Zoom

Footprint Inputs Zoom

Outputs
 + New Product

Products

Name	Main product?	Unit	Inventory	a_{tot} [m ² .a/Unit]	a_{part} [m ² .a/Unit]	K	Delete
Test product 1	<input checked="" type="radio"/>	kg	1.0	0.0	0.0	1.000	<input checked="" type="checkbox"/>
Test product 2	<input type="radio"/>	kg	0.500	0.0	0.0	0.0	<input checked="" type="checkbox"/>

Included in 0 other processes.

Figure 5: Allocation methods

- **Primary:** Regardless how much products are defined, the whole footprint will be assigned to the primary product
- **Output:** the ecological pressure will be shared between the products according to the ratio of output of all products (Green box, Figure 5),. (Be aware that this allocation method is only available if all products are within the same group of units e.g. g, kg, t or cm³, dm³, m³ or KJ, kWh)
- **Price:** For every product a *price per unit* [\$/unit, €/unit,...] has to be defined. The ecological pressure is then shared according to the profit which can be gained for each.

2.2 Process inventory definition

After defining the products of the process inputs and emissions can be added step by step. There are two major inventory types: *Sub-Processes*, which are already existing processes providing input to the process. This **allows linking processes to process chains and creating the life cycle**. *Impacts* are emissions into the compartments air, water and soil.

Through *Add Sub-Process* or *Add Impact* both inventory types can be added to the process. Dynamically the SPI value will be calculated whenever an inventory constituent is added. Both options are adequate if the user is already familiar with the process names. For newbies the *Add Sub-Process (Advanced Search)* or *Add Sub-Process (Advanced Search)* option may be more useful, because of extended search functions along multiple criteria (e.g. previously mentioned tags).

Figure 6 shows a simple example of a Process 1 with two test products as output and two sub-processes as input. Additionally one emission into every compartment has been defined. **(Remember: Every value along the column *Inventory* is related to 1 kg of Test product 1).**

Area A shows two sub-processes which are inputs to produce Test product 1 and 2. y_{spec} shows the SPI footprint for 1 unit of the sub-process (e.g. 1 kWh of Net electricity, EU-27, medium voltage has a SPI value of 260.4 m²). a_{part} gives the result of the multiplication of inventory and y_{spec} . Additionally the actual contribution to the whole SPI value is shown in percent. The sign on the very left side (CORE or USER) indicates if the sub-process is a core process given by the program or a user defined process.

Area B shows three different emissions (*impacts*) caused by the process. The color on the left hand side indicates the compartment in which the emission is going to. Having a close look at Figure 6, reveals that some impacts are ignored for the calculation (grey) of the dissipation area. The reason is the evaluation method of the key emission area explained in more detail in the manual.

Area C gives instant information about the 7 SPI categories along the whole life cycle chain (left) and the share of contribution to the SPI value between sub-processes and impacts.

Area D shows the absolute footprint depending on the allocation method chosen above. a_{tot} gives the ecological footprint per unit for each product, whereas a_{part} gives the footprint for the given amount of each product within the process.

Area E provides information if this process is included already as sub-process to another one. A click shows the linkage information and gives the possibility to follow the chain of life cycle towards the next higher level. Clicking on sub-processes, the life cycle chain can be followed towards the opposite direction.

Area F shows some action options. *Back* will bring the processes page, where all user defined processes are listed. *Copy* allows copying the whole process, which can be useful if many similar processes have to be added. Please note that **during the copy action, tags, process name and products have to be adjusted to avoid multiple entries to the database.** *Delete* removes the given process from the database under the condition that it is not part of any other life cycle chain. If there are any links to other processes, these links have to be removed to be able to delete processes. *Results* opens up a new page which gives detailed information about the process.

Area G provides information about the linkage of this specific process to other processes. Showing a process within a process chain is like zooming into one chain link. Sub-Processes giving backward linking information, whereas forward linking information can be seen from **Area G**.

Back Copy Delete Results
F

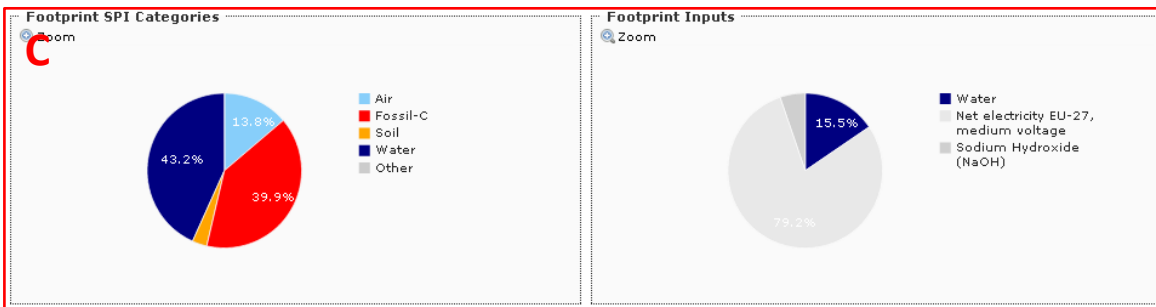
Process Details USM

Process Data

SPI Index: 0.103
 Name: Process 1
 Description: Test process for the quick reference guide
 Reference: Literature Source #1
 Allocation Type: primary
 Restricted?:
 Last Update: 12/18/2012 12:25
 Tags: Add
 Test processes

Regional Data

Region: Europe
 Water: y_w : 983.000 [mm/a]
 r_i : 0.300
 R_w : 294.900 [kg/m².a]
 Soil: y_s : 0.750 [kg/m².a]
 l : 0.560
 R_s : 0.420 [kg/m².a]



Outputs

New Product

Products

Name	Main product?	Unit	Inventory	a_{tot} [m ² .a/Unit]	a_{part} [m ² .a/Unit]	K	
Test product 1	<input checked="" type="radio"/>	kg	1.0	3448.795	3448.795	1.000	Delete
Test product 2	<input type="radio"/>	kg	0.500	0.0	0.0	0.0	Delete

Included in 0 other processes.

Inputs

Add Sub-Process Add Sub-Process (Advanced Search) Add Impact Add Impact (Advanced Search)

Sub-Processes

Name	Unit	Inventory	y_{spec} [m ² .a/a]	a_{part} [m ² .a/Unit]	Share	
Net electricity EU-27, medium voltage	kWh	10.00000	260.390	2603.900	75.5%	Delete
Sodium Hydroxide (NaOH)	kg	2.000000	86.662	173.324	5.0%	Delete

Impacts

Name	Unit	Inventory	y_{spec} [m ² .a/a]	a_{part} [m ² .a/Unit]	Share	
CO ₂	kg	2.000000	222.000	444.000	12.9%	Delete
Hg (water)	mg	150.0000		508.647	14.7%	Delete
Zn (soil)	mg	65.00000		0.516	0.0%	Delete

Figure 6: Inventory definition

2.3 Process results

Every process can be viewed in detail through a click on *Results* at **Area F** in Figure 6.

2.3.1 Process Graph

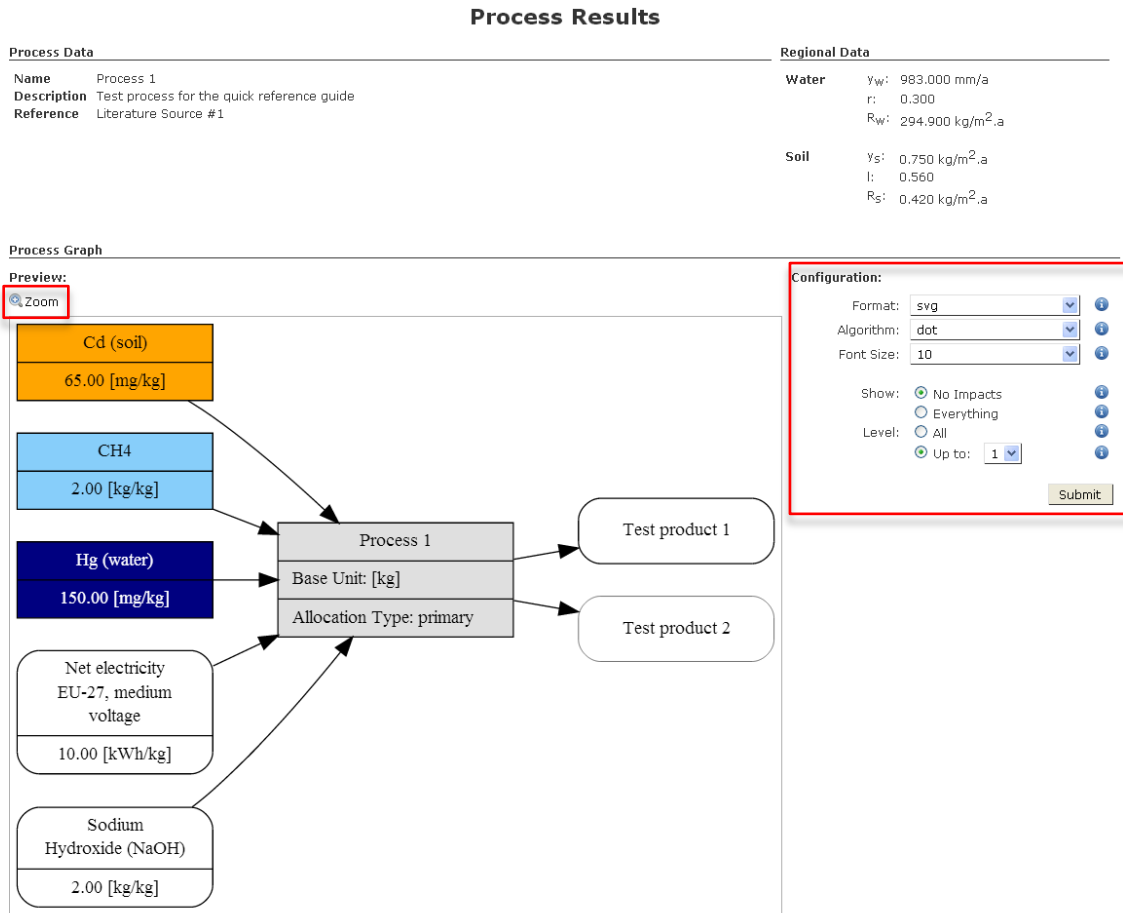


Figure 7: Process Results - Process Graph

A process graph is generated automatically, depending on the process structure. This may however take some calculation time.

Zoom always opens up a separate window, where the graph can be viewed as stand-alone graphics. Through the configuration box on the right part of the screen, adjustments can be made to trigger changes in the way the graph is generated.

Format allows choosing between SVG (Scalable Vector Graphics), PNG (Portable Network Graphics) and JPEG (Joint Photographic Experts Group). If a manipulation of the process graph in a 3rd party program is needed, SVG is the recommended format. If many sub-processes are involved the amount of boxes increases and makes it difficult to draw an automated graph.

Algorithm offers 3 different methods (dot, circo and neato) to draw a process graph. Depending on the process structure the best drawing algorithm can be one of these.

Font size allows adjusting the size of the text labeling the processes within the process graph.

Show offers two different options. By default, impacts are only displayed for this actual process (within the process graph). If *Show - Everything* is selected, for every sub-process impacts will be included. This leads quite often to excessive huge graphs.

Level allows adjusting the depth of the graph. Level 1 represents the actual process. Sub-processes to this process are Level 2 and sub-processes to level 2 processes are Level 3 and so on.

2.3.2 Hot-Spot Graph

The second part of the results is focused on visualization of the 7 SPI categories. Level 1 and 2 is shown in the diagram, to get a picture about the relation between sub-processes contributing to the final footprint of the Level 1 process.

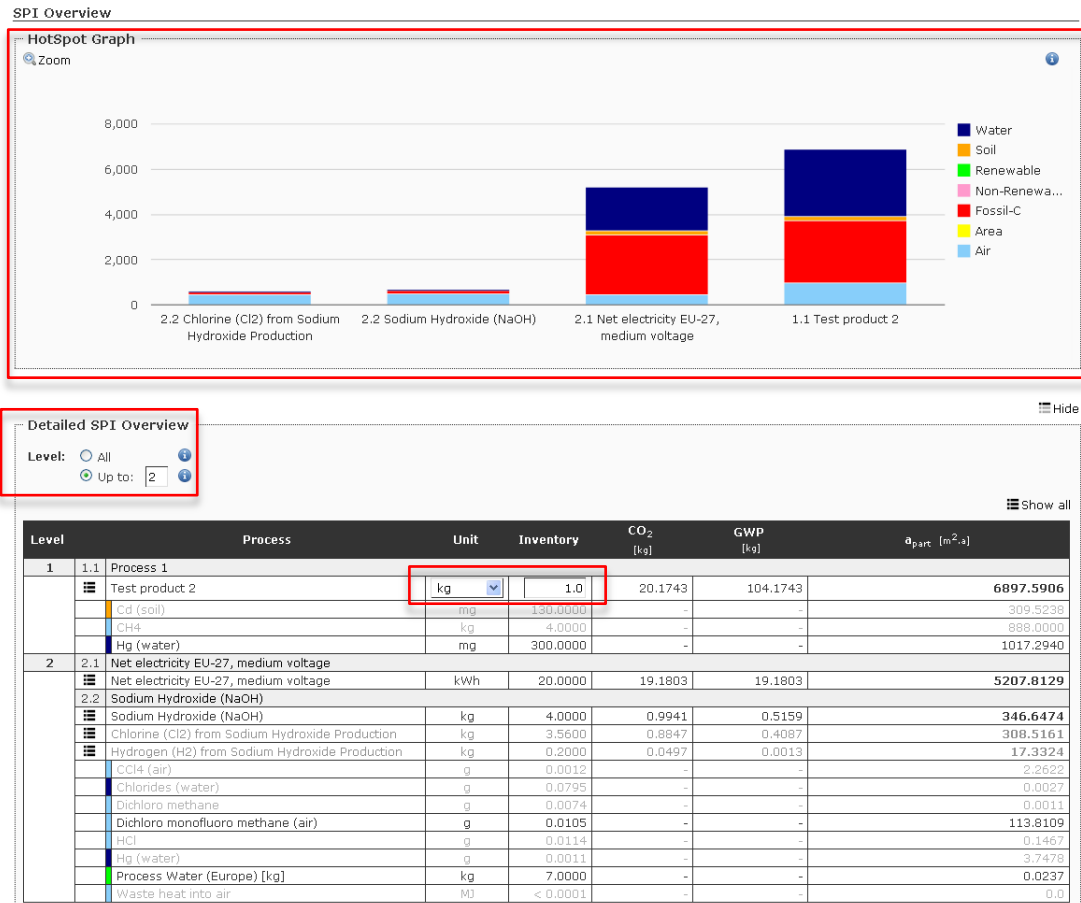


Figure 8: Hot-Spot Graph

Detailed SPI Overview shows table consisting sub-processes and impacts, including their share of footprint to the final product. Additionally CO₂ emissions and GWP (Global Warming Potential) are calculated on a life cycle base. Similar to the process graph, Level can be used to choose the amount of displayed sub-processes within the table.

The amount of the main product and its unit may be chosen by the user, resulting in the recalculation of the ecological pressures. This option allows adjusting to real production values if a particular plant shall be evaluated. Material and energy balances are then related to the given amount of the product.

2.3.3 Impacts overview

Whereas impacts of level 2 processes can be seen at the hot spot graph, life cycle impact information is part of the Impacts Overview section. A diagram shows the SPI share between all 7 SPI categories for the whole life cycle of the viewed process. A table shows with every specific impact along the life cycle and its inventory and GWP amount. By default the second part is hidden because of the typically long list.



Detailed Impacts Overview

Hide

Show all

Impact	Input for	Unit	Inventory	GWP [kg]	α_{part} [m ² a]
CH4	Show	kg	4.0000	84.0000	0.0001
CCl4 (air)	Show	kg	< 0.0001	0.0068	9.0487
Dichloro methane	Show	kg	< 0.0001	0.0	0.0045
Dichloro monofluoro methane (air)	Show	kg	< 0.0001	0.0	455.2442
HCl	Show	kg	< 0.0001	0.0	0.5867
Waste heat into air	Show	TJ	< 0.0001	0.0	0.0
CO	Show	kg	< 0.0001	0.0	0.0005
NM VOC	Show	kg	< 0.0001	0.0	0.0006
NOx	Show	kg	< 0.0001	0.0057	0.1402
SOx as SO2	Show	kg	< 0.0001	0.0	0.0053
N2O	Show	kg	< 0.0001	0.0001	0.0074
Particles	Show	kg	< 0.0001	0.0	0.0002
NH3	Show	kg	< 0.0001	0.0	< 0.0001
Acetone	Show	kg	< 0.0001	0.0	< 0.0001
Alkanes (air)	Show	kg	< 0.0001	0.0	< 0.0001
Alkenes (air)	Show	kg	< 0.0001	0.0	< 0.0001
Butane	Show	kg	< 0.0001	0.0	< 0.0001
Cd (air)	Show	kg	< 0.0001	0.0	< 0.0001
Ethanol	Show	kg	< 0.0001	0.0	< 0.0001
HF	Show	kg	< 0.0001	0.0	< 0.0001

Figure 9: Impacts Overview

Clicking on *Show* gives more detailed information about the impacts and where they participate on the life cycle chain of production.