Meso-level eco-efficiency indicators to assess technologies and their uptake in water use sectors

Collaborative project, Grant Agreement No: 282882

Deliverable 5.10

Finalised guidelines for the use of the EcoWater Toolbox

August 2014

DOCUMENT INFORMATION

Project	
Project acronym:	EcoWater
Project full title:	Meso-level eco-efficiency indicators to assess technologies and their uptake in water use sectors
Grant agreement no.:	282882
Funding scheme:	Collaborative Project
Project start date:	01/11/2011
Project duration:	38 months
Call topic:	ENV.2011.3.1.9-2: Development of eco-efficiency meso-level indicators for technology assessment
Project web-site:	http://environ.chemeng.ntua.gr/ecowater
Document	
Deliverable number:	5.10
Deliverable title:	Finalised guidelines for the use of the EcoWater Toolbox
Due date of deliverable:	30/04/2014
Actual submission date:	31/08/2014
Editor(s):	Michiel Blind
Author(s):	Michiel Blind
Reviewer(s):	George Arampatzis, Thanos Angelis-Dimakis
Work Package no.:	5
Work Package title:	Integration and Synthesis
Work Package Leader:	National Technical University of Athens
Dissemination level:	Public
Version:	1.0
Draft/Final:	Final
No of pages (including cover):	55
Keywords:	Toolbox, meso-level, eco-efficiency assessment

Abstract

Based on the developed methods and tools from EcoWater WP1, 'Framework and tools for meso-level eco-efficiency analysis and technology assessment', an integrated (suite of) on-line, web-based tools and resources has been built for the assessment and comparison of the eco-efficiency of innovative technologies. The purpose is amongst others to facilitate technology benchmarks in water systems. The suite of tools will thus provide a mechanism for developers of new technologies to demonstrate the effect of their technology on meso-level eco-efficiency and allow policy-makers to assess possible impacts of regulations.

Deliverable 5.10 provides the step-by step guidelines for the web-based toolbox which can be found on http://environ.chemeng.ntua.gr/ewtoolbox/. Each functionality for case study collaborators is presented via figures and explanations.

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1.1 General introduction

The overall aim of Work Package (WP) 5 is to integrate the developed analytical framework, indicators and Case Study results, into different outputs to ensure their application beyond the EcoWater Project, in terms of analysing the dynamics of water systems and sectors of water use. More specifically, WP5 is tasked amongst others with the development of a publicly available suite of tools and resources for meso-level eco-efficiency assessments in different systems, and technology benchmarking, providing access to an integrated environment for the undertaking of similar analyses. The main output from this WP will be an integrated, web-based toolbox, which will contain the resources and tools necessary for developing meso-scale eco-efficiency assessments of different technologies. In addition, the WP will produce consolidated, step-wise guidelines for future assessments, as well as policy recommendations, based on Case Study results and cross-case comparison (EcoWater Description of Work, 2011). Table 1 below provides information stated in the EcoWater Description of Work, with respect to the toolbox-task.

Table 1: The description of Task 5.3: Development of toolbox for meso-level eco-efficiency of systems/products (EcoWater Description of Work, 2011, Part A, p. 22)

Based on the developed methods and tools from WP1, an integrated (suite of) on-line, web-based tools and resources will be built for the assessment of the eco-efficiency of innovative technologies, to facilitate technology benchmarks in water systems. The indicator computational tools will be fed amongst others by an information database on eco-efficiency of technologies and materials, as developed through the WP 1.2 Technology Inventory. The suite of tools will thus provide a mechanism for developers of new technologies to demonstrate the effect of their technology on eco-efficiency and allow policy-makers to assess impacts of regulations. Where applicable, integration will be performed in such a way that potential extensions (post-EcoWater) to other systems and products are supported. The task will be based on a functional requirements analysis (all partners), followed by a technical design (Deltares, NTUA), preliminary integration of the tools developed within the framework of T1.3 (Deltares, NTUA), followed by testing by all participants. Two testing iterations and subsequent improvements of the toolbox will be carried out. Guidelines for use and future adaptation will also be developed. The development of the Toolbox will start in parallel to the activities of T1.3-2 and T1.3-3, with the definition of its functional design. Throughout the course of the Project, the Toolbox will be constantly fed with information, data and resources from T1.2 and from the Case Studies of WPs 2, 3 and 4, and will be tested and adapted according to feedback received (in addition to the two “formal” testing processes foreseen). The final version, including guidelines for use, will be released in M30.

This report concerns the Deliverable 5.10 Finalized guidelines for the use of the EcoWater Toolbox which can be found on http://environ.chemeng.ntua.gr/ewtoolbox/. Each functionality for case study collaborators is presented via figures and explanations.

1.2 Terms and conditions for using the web-based toolbox

The use of the EcoWater toolbox is ruled by the following terms and conditions, to which you must subscribe when creating a user account. At the time of authoring this manual these conditions are as written in the grey box below (Box 1: Terms and Conditions). In case of future changes, the conditions stated in the toolbox overrule the conditions in this document.

(1) Introduction
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You must not use this website in any way that causes, or may cause, damage to the website or impairment of the availability or accessibility of the website; or in any way which is unlawful, illegal, fraudulent or harmful, or in connection with any unlawful, illegal, fraudulent or harmful purpose or activity.
You must not use this website to copy, store, host, transmit, send, use, publish or distribute any material which consists of (or is linked to) any spyware, computer virus, Trojan horse, worm, keystroke logger, rootkit or other malicious computer software.
You must not conduct any systematic or automated data collection activities (including without limitation scraping, data mining, data extraction and data harvesting) on or in relation to our website without our express written consent.
You must not use this website to transmit or send unsolicited commercial communications.
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You may view, download for caching purposes only, and print pages or other content from the website for your own personal use, subject to the restrictions set out below and elsewhere in these terms and conditions.
You must not:
(a) republish material from this website (including republication on another website);
(b) sell, rent or sub-license material from the website;
(c) reproduce, duplicate, copy or otherwise exploit material on our website for a commercial purpose;

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In these terms and conditions, "your user content" means material (including without limitation text, images, audio material, video material and audio-visual material) that you submit to our website, for whatever purpose.
Your user content must not be illegal or unlawful, must not infringe any third party's legal rights, and must not be capable of giving rise to legal action whether against you or us or a third party (in each case under any applicable law).
You must not submit any user content to the website that is or has ever been the subject of any threatened or actual legal proceedings or other similar complaint.
We reserve the right to edit or remove any material submitted to our website, or stored on our servers, or hosted or published upon our website.

(5) Restricted access
Access to certain areas of our website is restricted. We reserve the right to restrict access to other areas of our website, at our discretion.
We provide you with a user name and a password to enable you to access restricted areas of our website or other content or services, you must ensure that that user name and password is kept confidential.

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(8) Variation
We may revise these terms and conditions from time-to-time. Revised terms and conditions will apply to the use of our website from the date of the publication of the revised terms and conditions on our website. Please check this page regularly to ensure you are familiar with the current version.

(9) Our details
The full name of our organization is:
Environmental & Energy Management Research Unit (EEMRU)
School of Chemical Engineering
National Technical University of Athens (NTUA)
You can contact us by email to: assim@chemeng.ntua.gr.

Box 1: Terms and Conditions

1.3 SEAT and EVAT

The web-based toolbox is connected to two stand-alone modelling tools: The “Systemic Environmental Analysis Tool” SEAT and the “Economic Value chain Analysis Tool” EVAT. Once logged in, both tools can be downloaded from the web-based toolbox in the section ‘Resources’ (http://environ.chemeng.ntua.gr/EWToolbox/Toolbox/Resources.aspx). Alternatively they can be downloaded from the project website:
(http://environ.chemeng.ntua.gr/ecoWater/Default.aspx?t=299)

1.3.1 SEAT

“SEAT is the core model building tool of the EcoWater project and supports the assessment of the environmental impacts of alternative technological configurations of a meso-level water use system. It provides the flows of the materials (water, resources, products, etc.) that can be used for estimating the environmental components of the eco-efficiency indicators.

SEAT allows the development of a model representation of the corresponding supply chain, its components, processes & interactions. The supply chain is the physical representation of

the various processes that are involved in producing goods (and services), starting with raw materials and ending with the delivered product. In the current concept, the water supply chain consists of various processes which modify the quality and/or the quantity of the water flow. It follows the actual flow of the water resource and can be described using physical quantities (i.e. kg, m3)."

(Source: Thanos Angelis-Dimakis, 2013. *Deliverable 1.5 Finalized Systemic Environmental Analysis Tool – SEAT*. EcoWater Project Deliverable, retrievable here: http://environ.chemeng.ntua.gr/ecoWater/Default.aspx?t=238)

It should be noted that both SEAT and EVAT store results in a single output file.

1.3.2 EVAT

"The Economic Value chain Analysis Tool (EVAT) is a tool which extends the information included in a SEAT model incorporating economic data. It supports the assessment of the economic performance of alternative technological configurations of a meso-level water use system and provides the monetary flows that can be used for estimating the economic performance of the system.

EVAT allows the development of a representation of the value chain, the various actors involved and their interactions. The actors are divided into directly and indirectly involved, and emphasis is placed on their role/function. Each directly involved actor is responsible for the operation, maintenance and investment decisions for at least one stage, whereas indirectly involved actors (e.g. river basin management authorities, government agencies etc.), intervene through the setting of rules/standards, the offer of incentives, etc. The value chain monitors the added value to the final product due to water use from stage to stage and can be described using monetary quantities (i.e. €).

(Source: Thanos Angelis-Dimakis, 2013. *Deliverable 1.6 Economic Value chain Analysis Tool – EVAT*. EcoWater Project Deliverable, retrievable here: http://environ.chemeng.ntua.gr/ecoWater/Default.aspx?t=238)

1.4 Reading guide

The main section of this user guide concerns chapter 2 which has 5 main sub-headers:

2.1 Getting started In this section the procedure to register and customize the user profile is explained.

2.2 The functions of the main tabs on the home screen

In this section the main resources of the toolbox are explained.

2.3 Step-by step: Developing and analyzing a case study

This section provides step by step guidance to develop a case study and assess results of individual 'technology scenarios'. Technology scenarios are sets of alternative technologies and processes which alter a system's eco-efficiency.

2.4 Step-by step: Adding and editing new technologies

Generic information about new technologies and processes can be stored for use in different case studies. Adding this information hence is independent of a case study.

2.5 Step-by step: Adding and editing new Indicators

Generic information about new environmental indicators and processes can be stored for use in different case studies. Adding this information hence is independent of a case study.

Chapter 3 “Collaborators, Administrators, Owner and Stakeholders” explain the different roles of the toolbox users, and the ways different individuals can add to a case study. Chapter 4 “Troubleshooting – ” provides a short list of issues which can help the user in case the problems. Some references are included in chapter 5 “Literature”.

2 User guide

2.1 Getting started

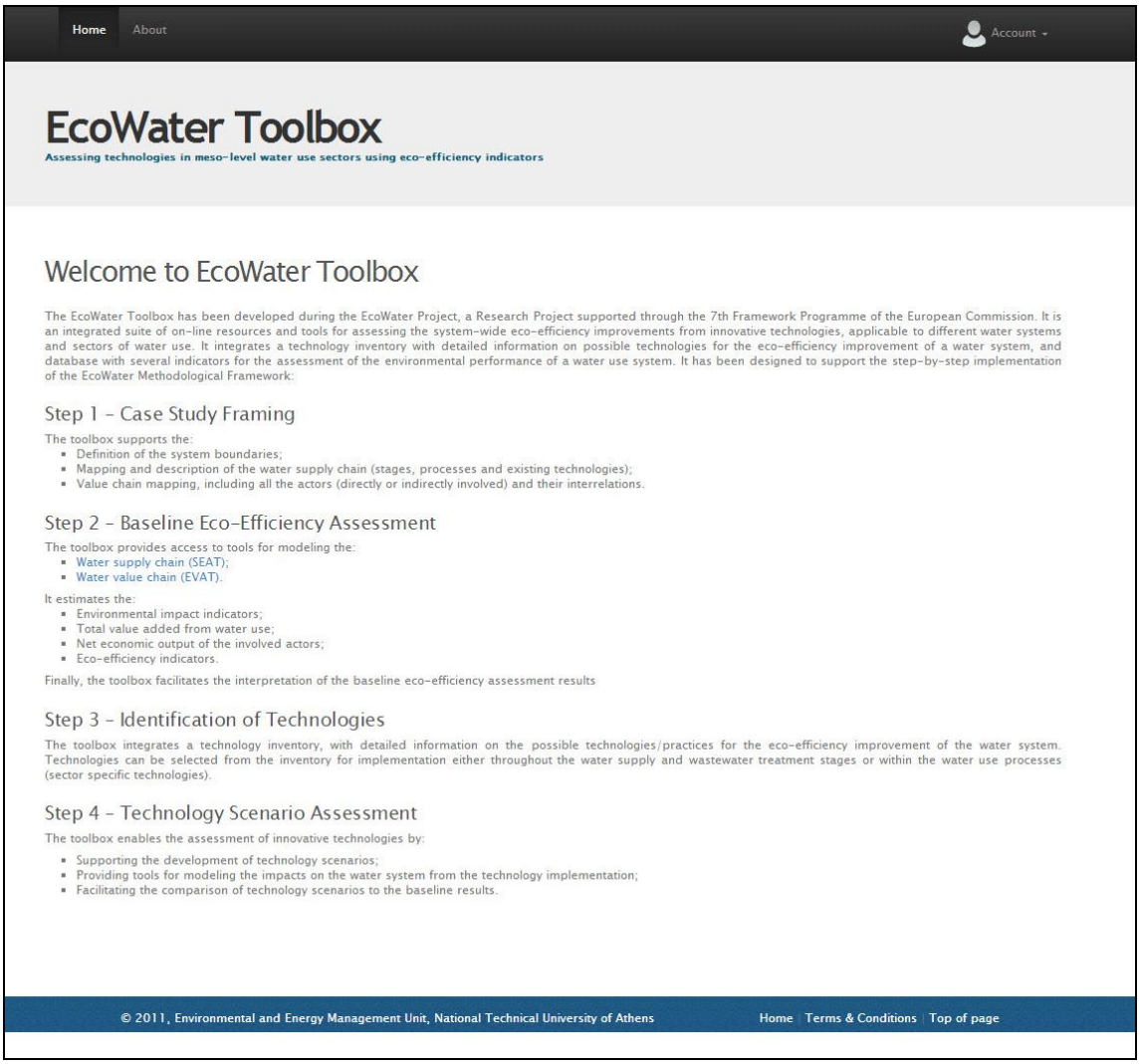


Figure 1: Opening screen of the EWT, not logged in.

2.1.1 About the toolbox

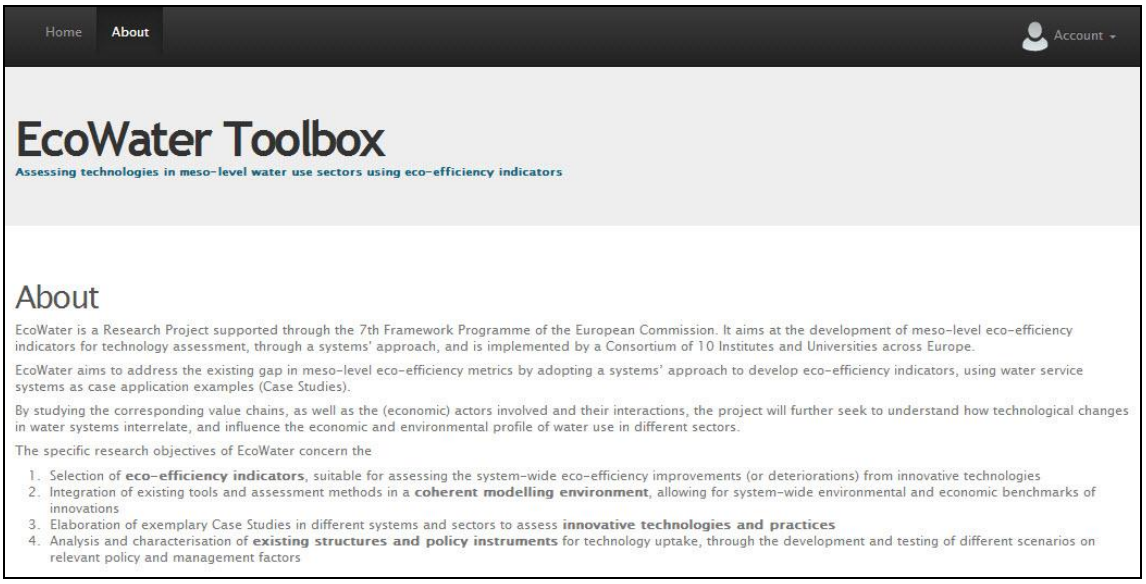


Figure 2: "About" the toolbox button

2.1.2 Creating a new account

In order to create an account, use the dropdown menu at the top right-hand corner, which has the options “Sign-In”, “Register for a new account” and “Can’t access your account” (Figure 3)

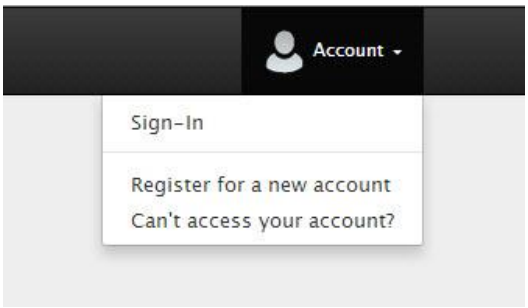


Figure 3: Registration / Account drop-down

Upon selecting “Register for a new account” Figure 4 will appear. After inserting your e-mail address, enter a password: Be aware that this password will be sent to you by mail as well, so you may want to choose a novel password.

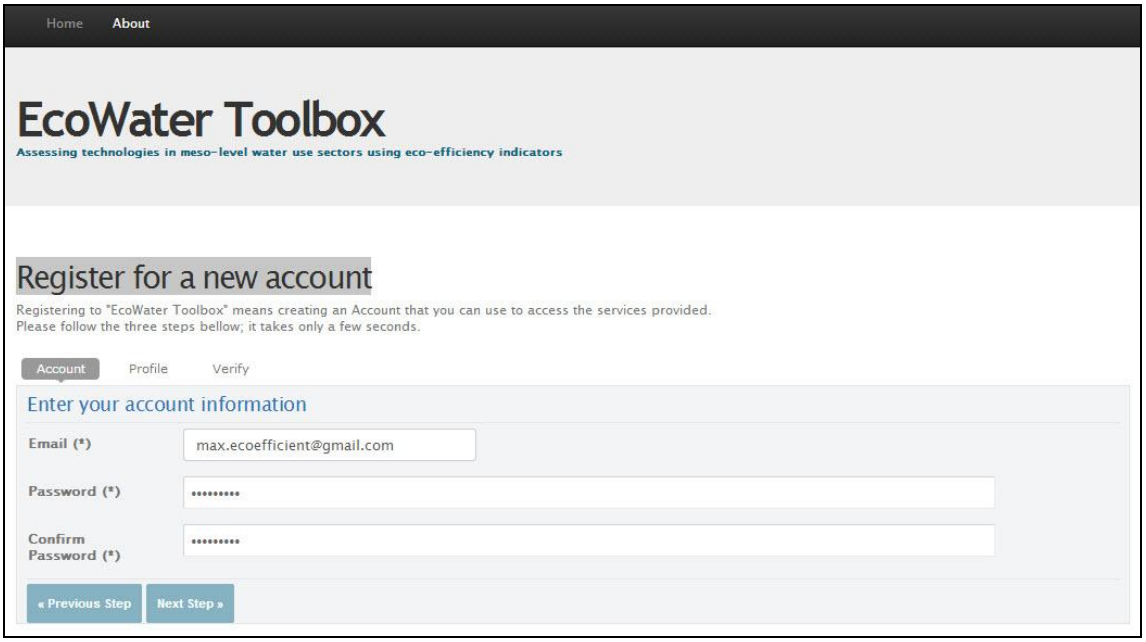


Figure 4: "Register for a new account" screen.

Pressing "Next step" will lead to a screen requiring some additional profile information (Figure 5).

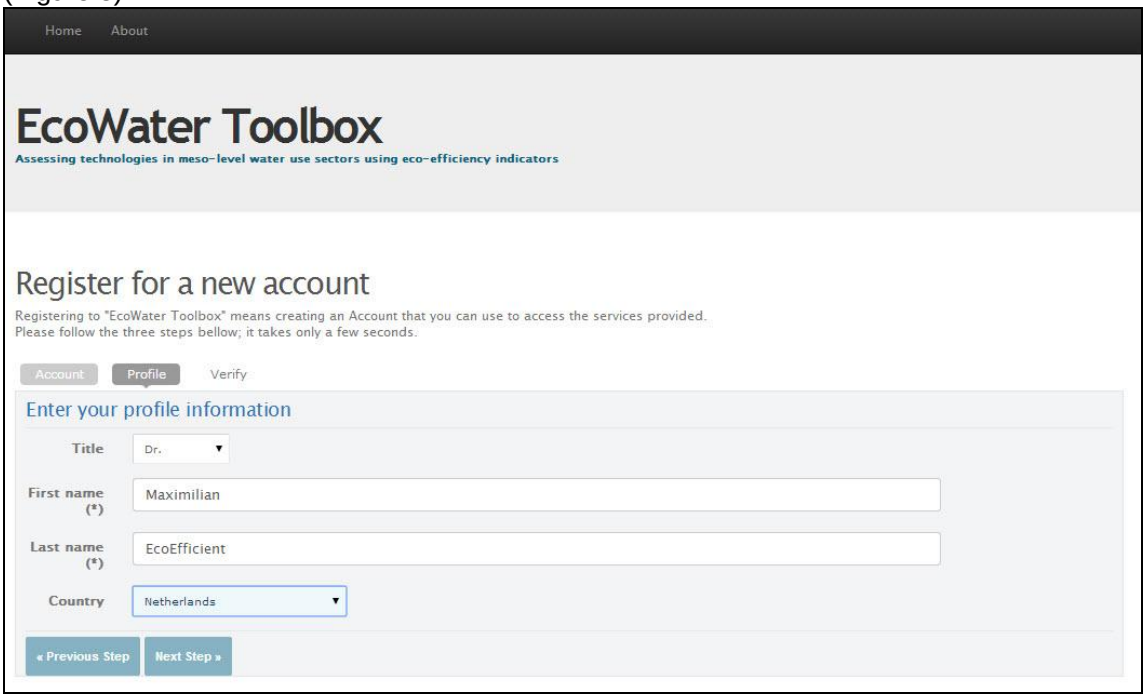


Figure 5: Entering profile information.

Pressing “Next step” will lead you to Figure 6, which prompts you to accept the “terms and conditions” (see Box 1, page12), and inserting a verification code. Pressing “Finish” will lead to Figure 7.

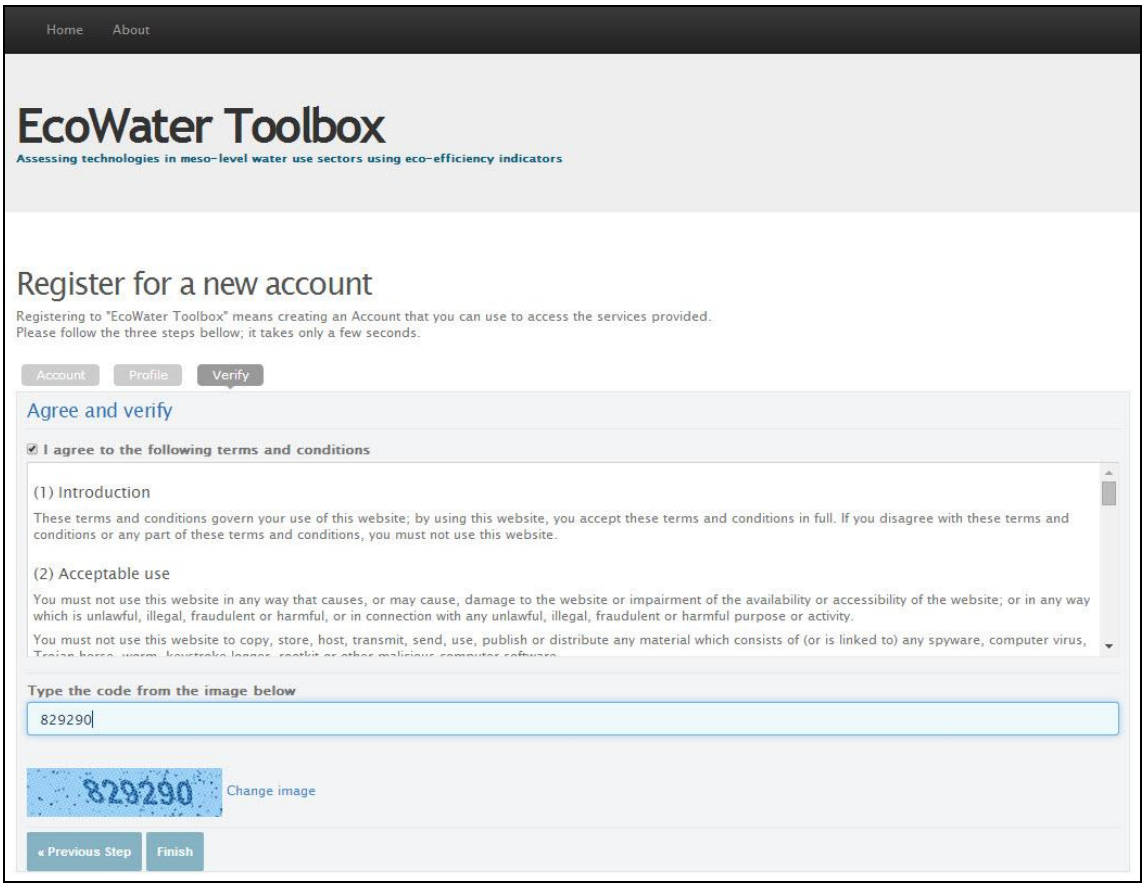


Figure 6: Verifying your account.

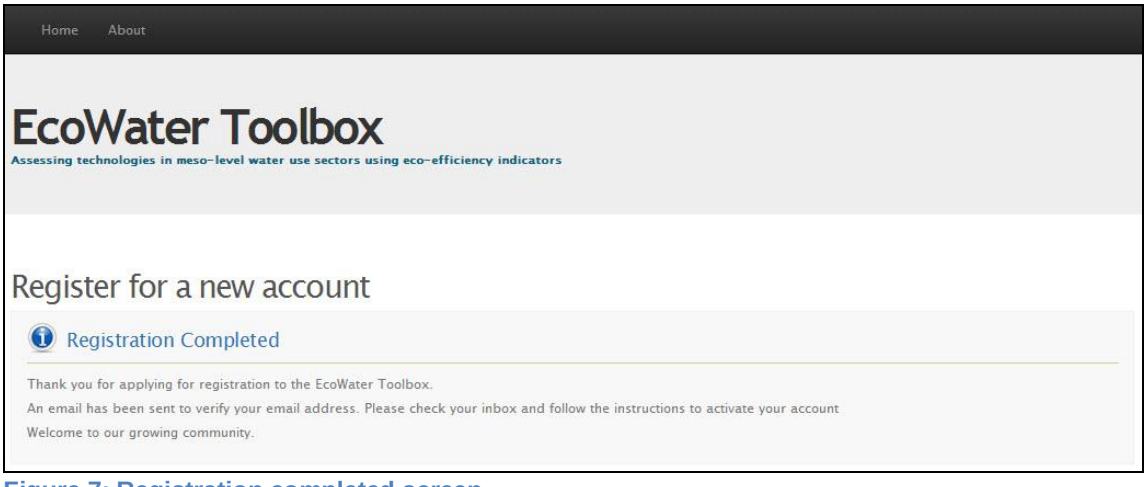


Figure 7: Registration completed screen.

You will now need to the mailbox used when registering. An e-mail should arrive as depicted in Figure 8. The red circle in this figure hides the password of “Max EcoEfficient”: in your case it should show the password you selected for future reference. Following the instruc-

tions in the email should finalize your registration, via Figure 9 to the confirmation of successful registration (Figure 10).

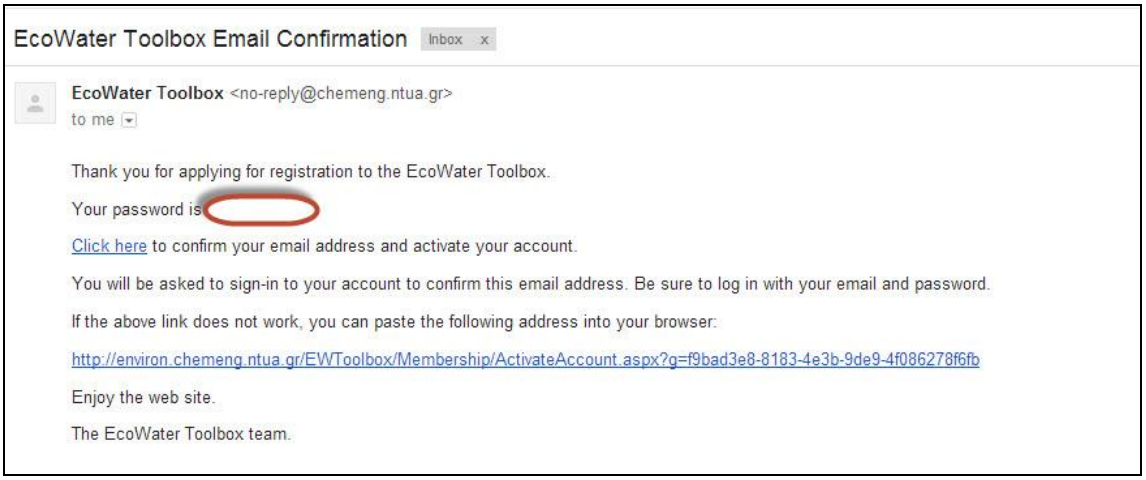


Figure 8: Verification e-mail.

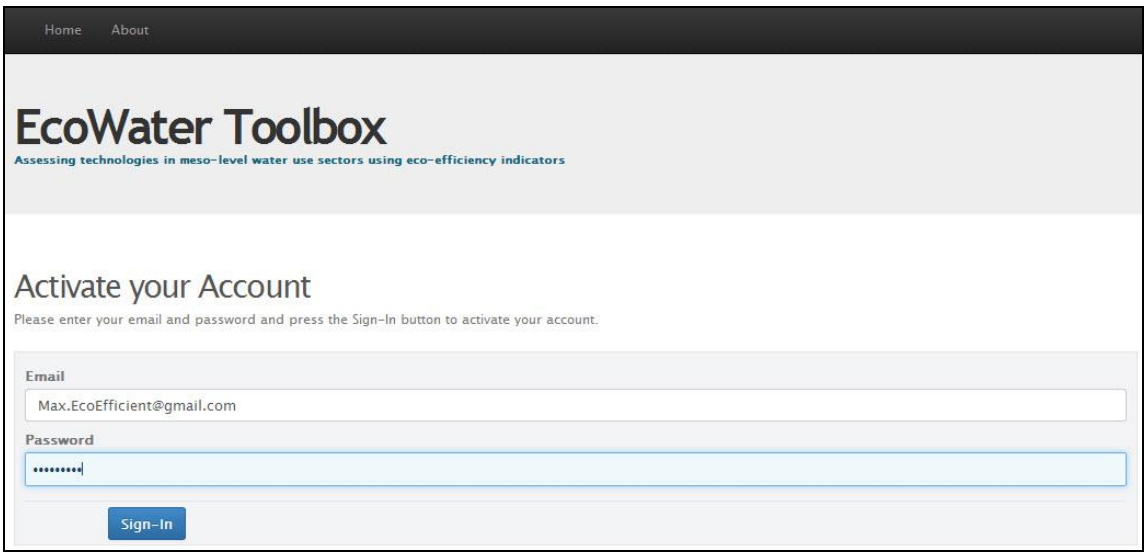


Figure 9: Final activation step.

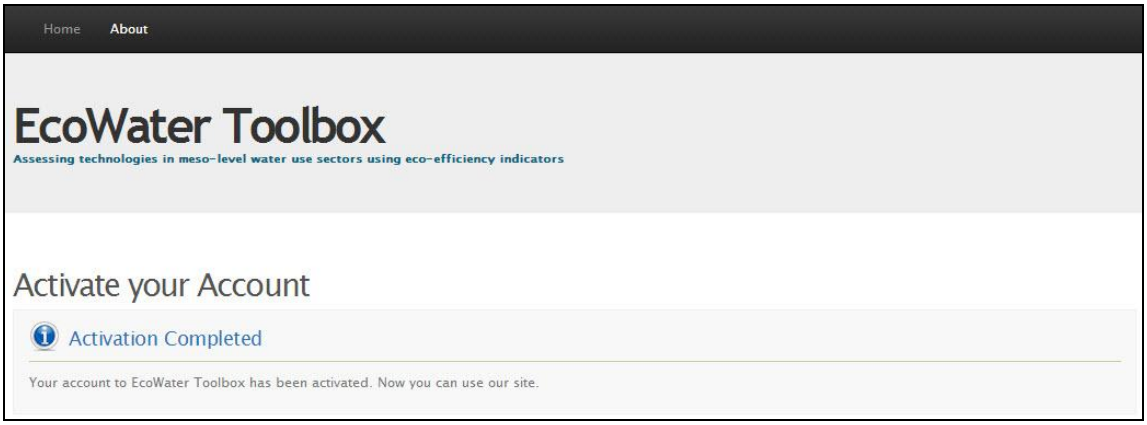


Figure 10: Final activation step: Confirmation screen.

2.1.1 Editing your profile, profile information

In the upper right corner, you can use the drop down menu to select editing your profile (Figure 11).

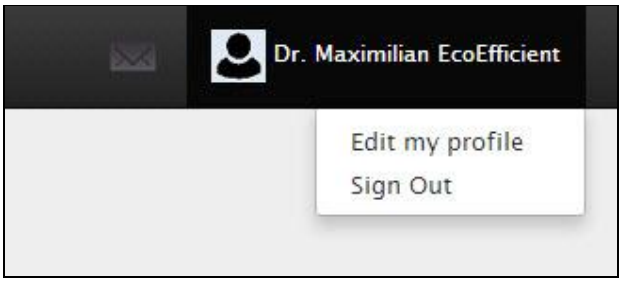
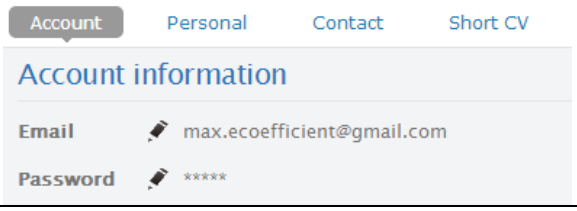
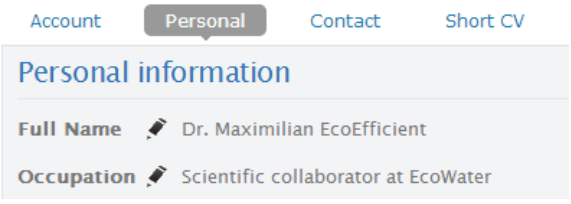
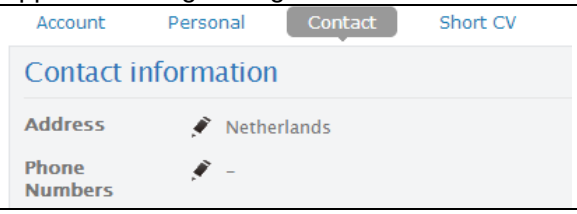
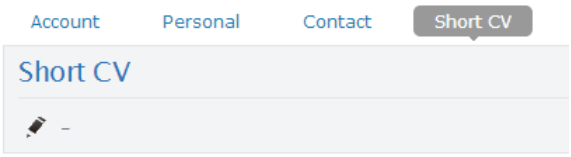


Figure 11: Profile dropdown menu.

Figure 12: Profile information tabs.

A new screen appears (Figure 12), providing (editable) information. Any field with the pencil icon ( ) can be edited.

Tab	Options
Account	
Personal	 Figure 13 shows that when using the pencil-button ( ), a pop-up will appear allowing editing information.
Contact	

Short CV	
Avatar	Figure 14 shows the screen to upload a picture which can serve as a personal avatar. When logged in, this avatar will be visible in the right hand corner, as is emphasized by the circle and arrow.
My access rights	Figure 15 shows the access rights associated with the account. Access rights are discussed in chapter 3.

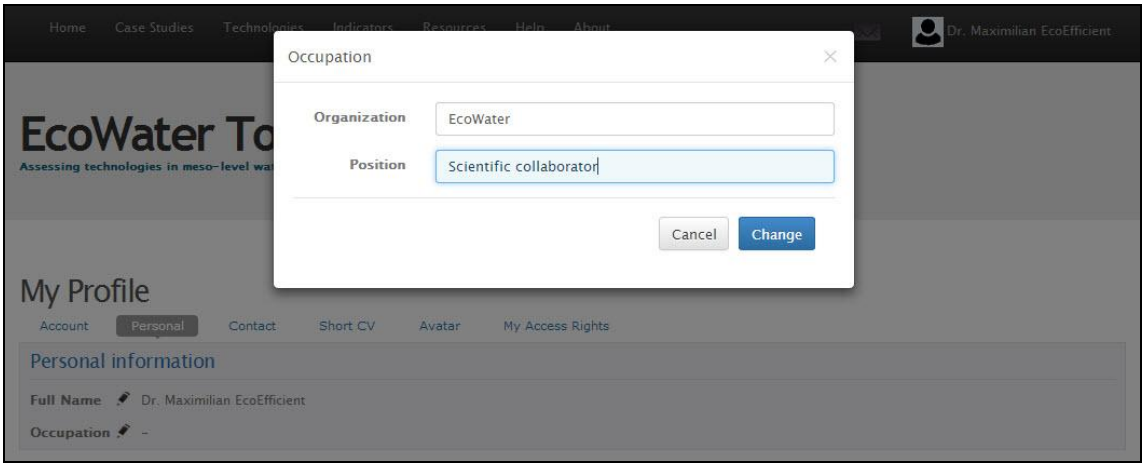


Figure 13: Editing personal information.

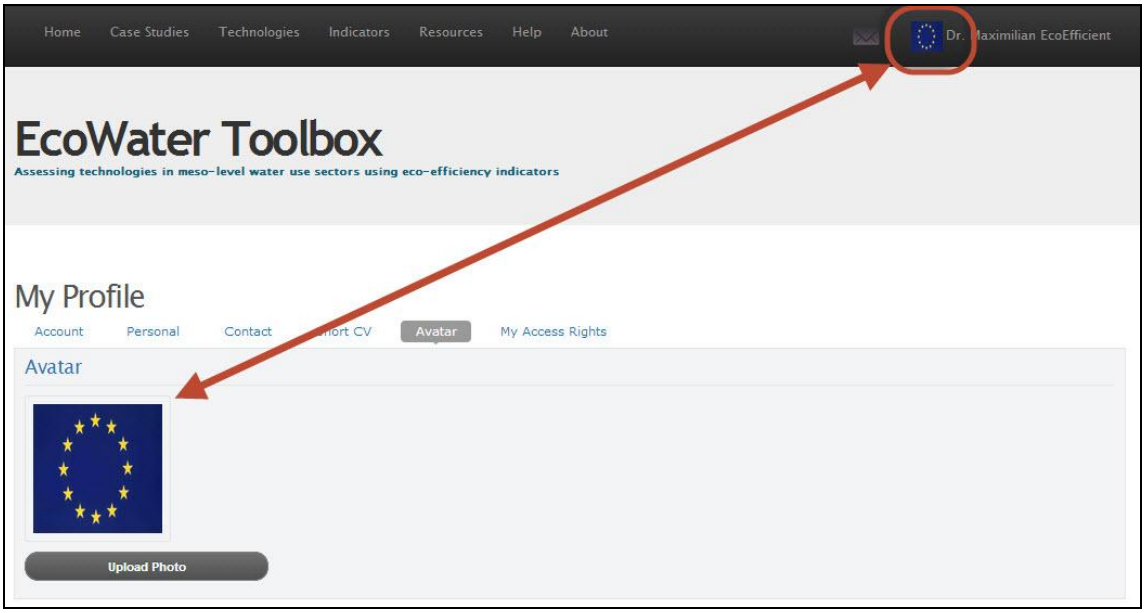


Figure 14: Uploading an avatar

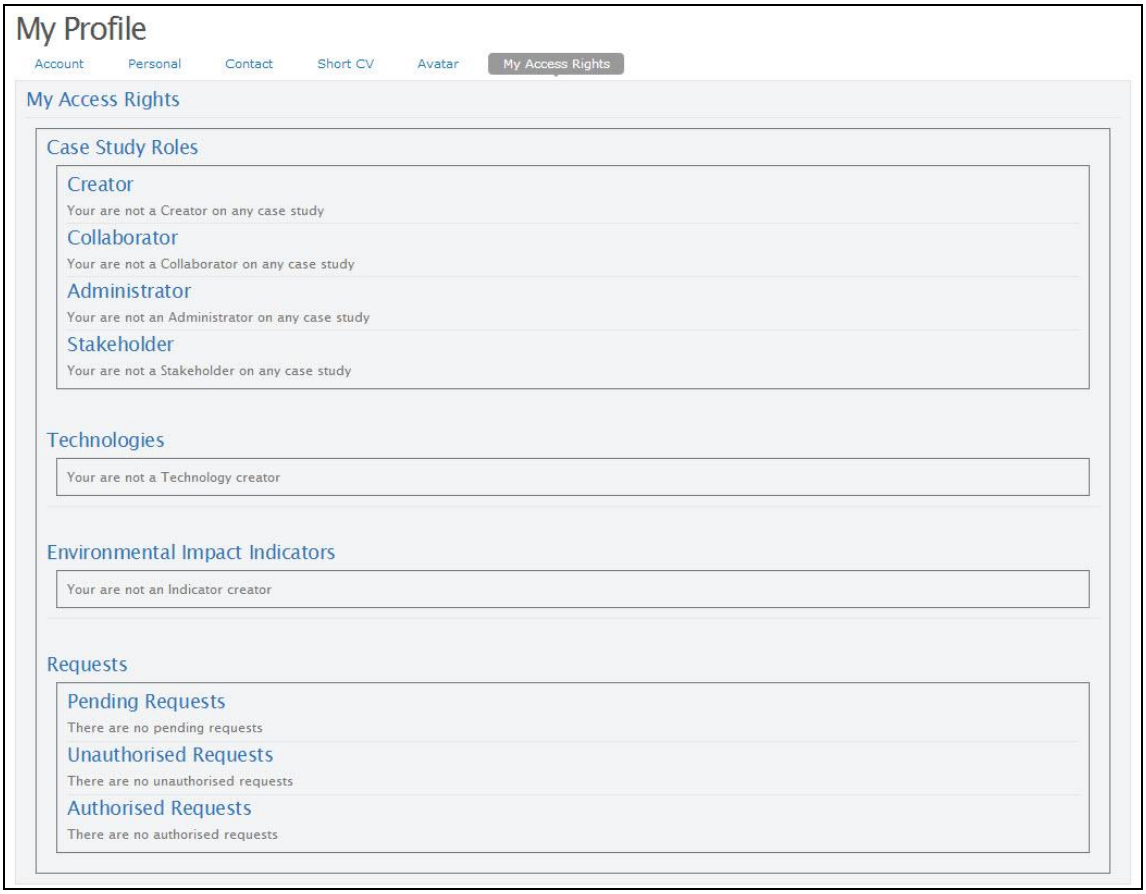


Figure 15: Access right overview.

2.1.2 Signing in

The process of signing in is visualized in Figure 16: Using the top right hand drop down menu will result in a pop-up shown in the lower part of the figure. Checking “Keep me signed in” will keep you signed in depending on the security setting of your computer.

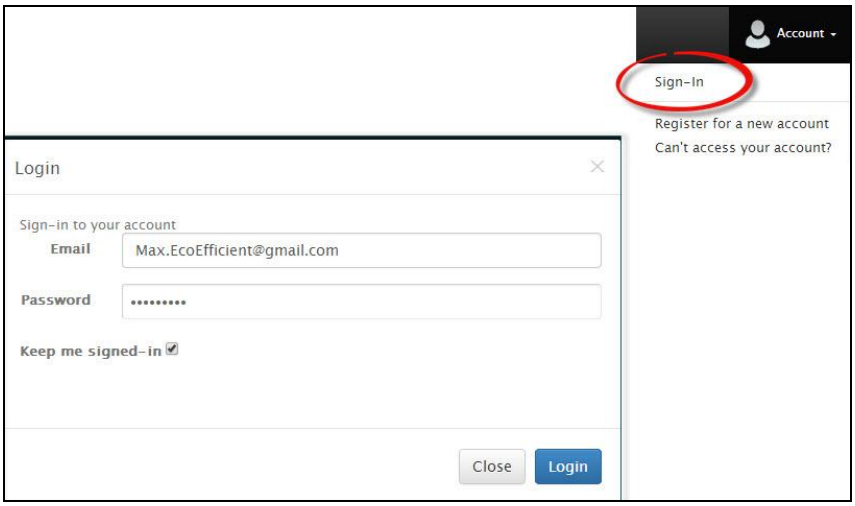


Figure 16: Sign in to the toolbox.

2.1.3 Retrieving sign-in information (password)

The process of retrieving your password is visualized in Figure 17: Using the top right hand drop down menu will result in a new window shown in the lower part of the figure. Your password will be send to you by email.

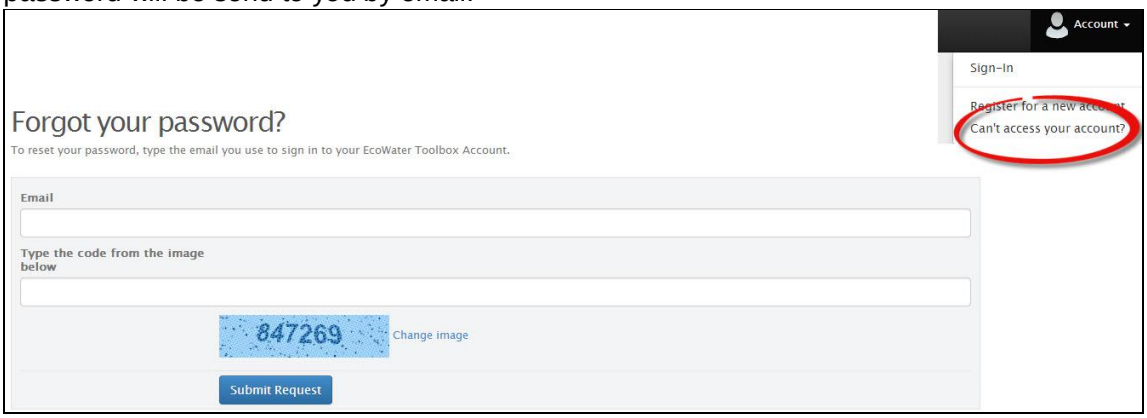


Figure 17: Retrieving your password.

2.1.4 Deleting an account

To delete an account contact the administrator.

2.2 The functions of the main tabs on the home screen

Once logged in a number of tabs are available.

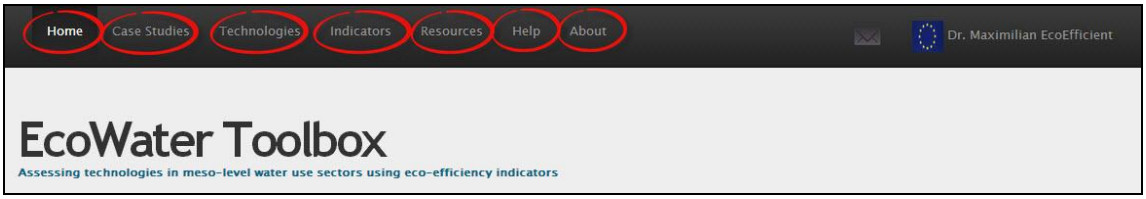


Figure 18: Available tabs once signed in to the toolbox. The red circles emphasize the tabs and are not visible on screen.

Tab	Explanation
'Home'	Selecting this tab will get you back to the home. The information is identical to the information when not signed in, depicted in Figure 1.
'Case studies'	Most of the intelligence to develop a case study is available behind this tab. It is explained in chapter 2.3.
'Technologies'	A technology can only be used in a case study after generic technology information is added to the toolbox. This information is available when you select this tab. It is discussed in chapter 2.4.
'Indicators'	An eco-efficiency indicator can only be used if it is defined a priori. How to add an indicator is explained in chapter 2.5.
'Resources'	Selecting 'Resources' will provide easy access to the following: • Tools • Demo Case Study Files • Projects • Documents • Other Initiatives

‘Help’	The section ‘Help’ contains this help document, several video-tutorials and download.
‘About’	The section ‘About’ provides information on the project and the toolbox.

2.3 Step-by step: Developing and analyzing a case study

2.3.1 The overall case-study process

The development of the EcoWater Case Studies has been divided into seventeen distinct steps, grouped into four Phases (Figure 19). **Table 2** provides information on indicative functionalities that may be supported for each step. It should be highlighted that all these functionalities will be available only for the Case Study Collaborators.

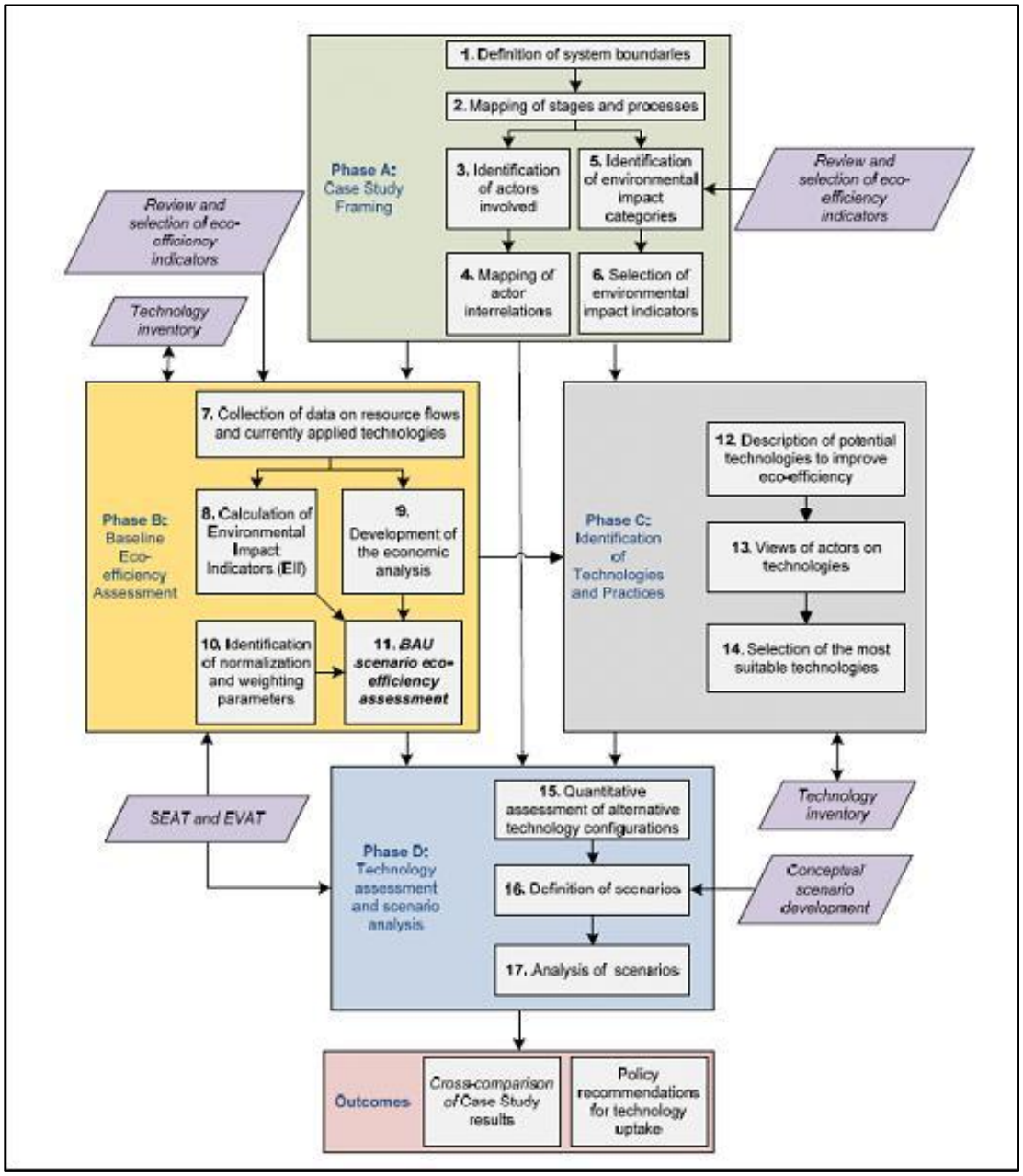


Figure 19: Phases and steps in the Case Study development (Kourentzis, 2012)

Table 2: Preliminary list of functionalities that will be supported for each step of the Case Study development

Step	Toolbox	SEAT/EVAT*
1. Definition of System Boundaries	• 'Narrative for case study' **	
2. Mapping of stages and processes	• Ditto	SEAT
3. Definition of actors involved	• Ditto	EVAT
4. Mapping of Actor Interrelations	• Ditto	EVAT
5. Identification of environmental impact indicators	• Ditto • Defining new generic indicators	
6. Selection of environmental impact parameters	• Toolbox	
7. Collection of data on resource flows and currently applied technologies	• 'Narrative for case study'	SEAT
8. Calculation of Environmental Impact Indicators	• Toolbox	(SEAT***)
9. Development of the economic analysis	• 'Narrative for case study'	EVAT
10. Identification of normalisation and weighting parameters	• Toolbox	
11. Business as usual scenario eco-efficiency-assessment	• Toolbox	SEAT/EVAT
12. Description of the potential technologies to improve eco-efficiency	• 'Narrative for case study'	
13. Assessment of views of actors on technologies	• Ditto	
14. Selection of the most suitable technologies	• Ditto • Defining new technologies	
15. Quantitative assessment of alternative technology configurations	• 'Narrative for case study' • Toolbox	SEAT/EVAT****
16. Definition of scenario's	• Ditto	SEAT/EVAT
17. Analysis of scenario's	• Ditto	SEAT/EVAT

*: SEAT and/or EVAT are the tools to be used.

**: 'Narrative for case study' implies that the toolbox holds the functionality to store a narrative on this step, either by direct entry in the case study description, or by attaching relevant documents in the toolbox.

***: The flows of resources/pollutants are computed in SEAT, the computation of indicators based on these flows is carried out in the web-based toolbox.

****: The computation of the flows and economic aspects is carried out in SEAT and EVAT. The comparison is done in the toolbox.

2.3.2 Creating a new case study

When selecting the tab 'Case studies' existing case studies will be visible. A table of contents on the case studies is available on the left hand side of the screen, and a button to request to create a new case study is visible on the right hand side (Figure 20). The table of contents does not appear if your screen is not wide enough. Clicking the request will automatically send an email to the administrator, and the administrator will provide the access rights to develop a new case study (Figure 21). Using the 'X', marked in the right lover corner will close this notification. As granting access is not automatic, granting access may take some time.

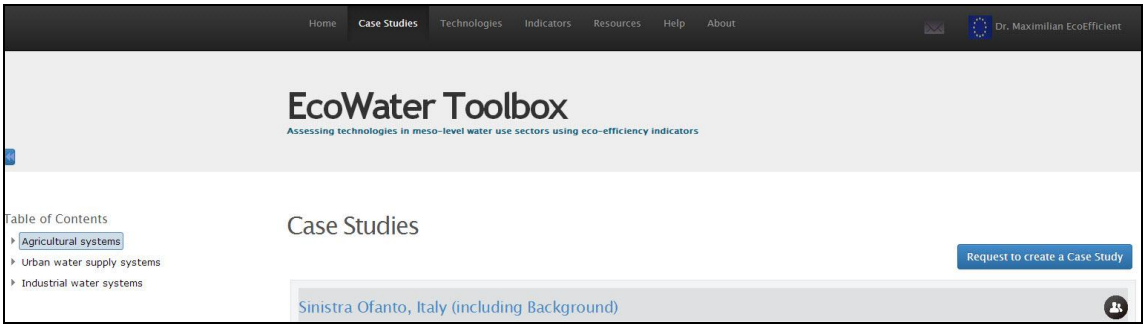


Figure 20: Case studies opening screen, showing the table of contents and the button to request a new case study.

Figure 21: Response on requesting a new case study'.

Figure 22: Notification sample after access has been granted.

Figure 23 shows the position of the 'Create New Case Study' button. Selecting 'Create New Case Study' will result in a pop-up which allows inserting basic information about the case study. This result is depicted in Figure 24.

Figure 23: Create New Case Study.

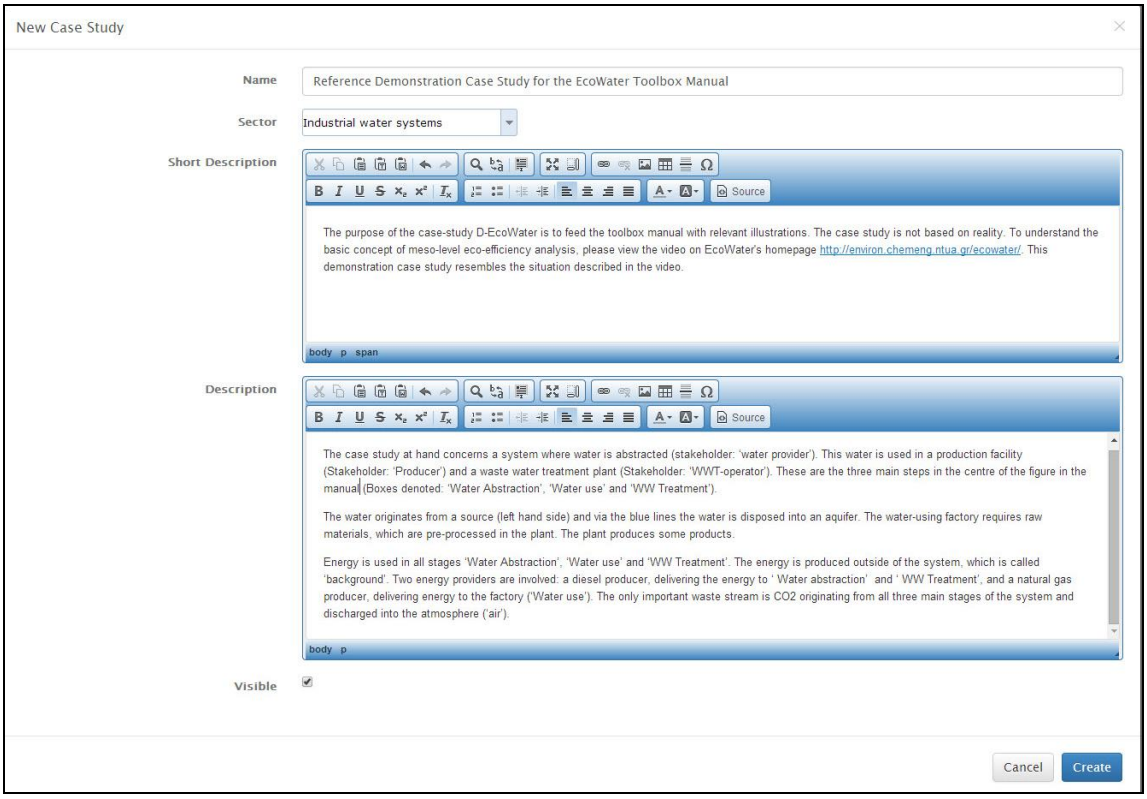


Figure 24: Entering basic information about a new case study.

As fields may be hard to read, this is the content of the demonstration case study:

Name: Reference Demonstration Case Study for the EcoWater Toolbox Manual.

Sector: Industrial water systems.

Short descript.: The purpose of the case-study D-EcoWater is to feed the toolbox manual with relevant illustrations. The case study is not based on reality. To understand the basic concept of meso-level eco-efficiency analysis, please view the video on EcoWater's homepage http://environ.chemeng.ntua.gr/ecowater/. This demonstration case study resembles the situation described in the video.

Description: The case study at hand concerns a system where water is abstracted (stakeholder: 'water provider'). This water is used in a production facility (Stakeholder: 'Producer') and a waste water treatment plant (Stakeholder: 'WWT-operator'). These are the three main steps in the centre of the figure in the manual (Boxes denoted: 'Water Abstraction', 'Water use' and 'WW Treatment').

The water originates from a source (left hand side) and via the blue lines the water is disposed into an aquifer. The water-using factory requires raw materials, which are pre-processed in the plant. The plant produces some products.

Energy is used in all stages 'Water Abstraction', 'Water use' and 'WW Treatment'. The energy is produced outside of the system, which is called 'background'. Two energy providers are involved: a diesel producer, delivering the energy to 'Water abstraction' and 'WW Treatment', and a natural gas producer, delivering energy to the factory ('Water use'). The only important waste stream is CO_2 originating from all three main stages of the system and discharged into the atmosphere ('air').

Visible: If unchecked, the basic information of the case study is only visible to yourself and co-workers you select.

The figure in the manual referred to is Figure 25.
As you can the input text can be formatted. However, uploading pictures is not possible, due to limitations in the freeware licence used for this functionality.

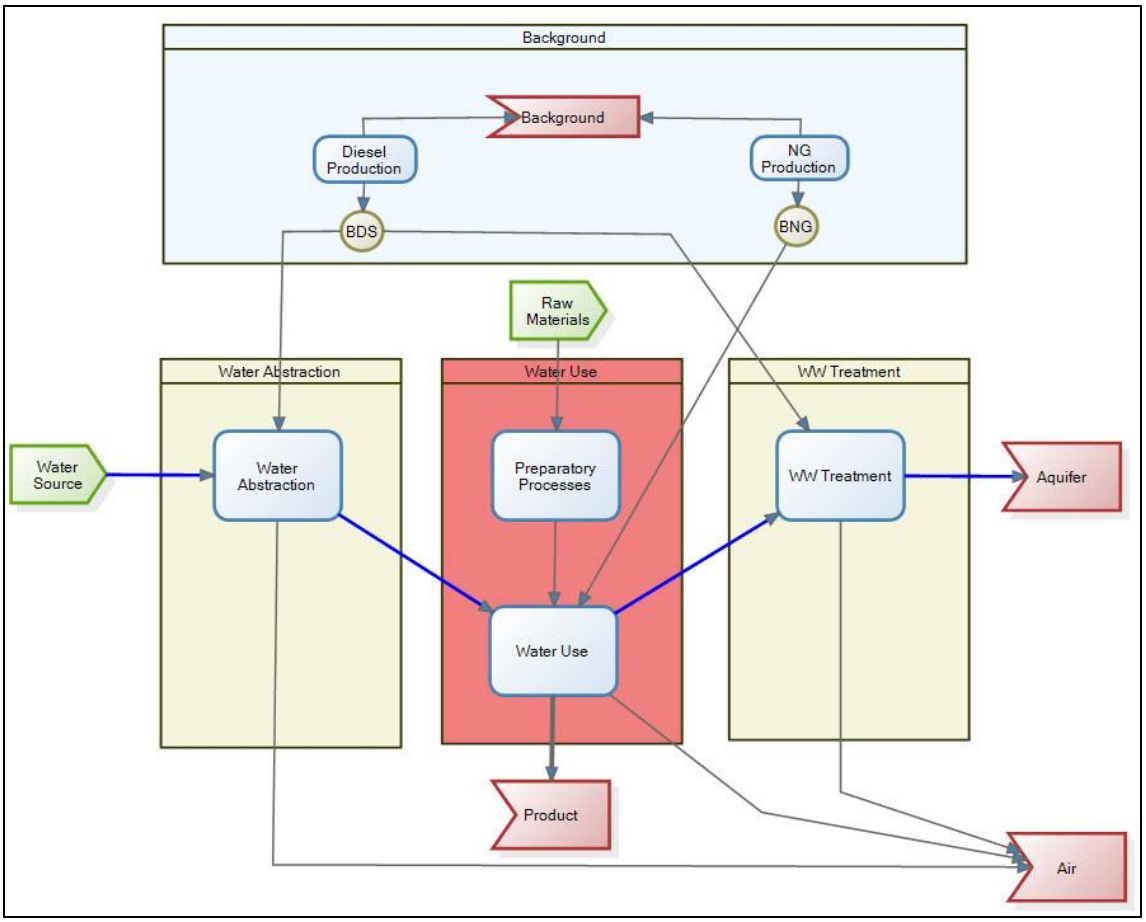


Figure 25: Schematisation of the demonstration case study 'DEWOT'.

After clicking ‘Create’ the case study will be among the other case studies, looking like Figure 26.

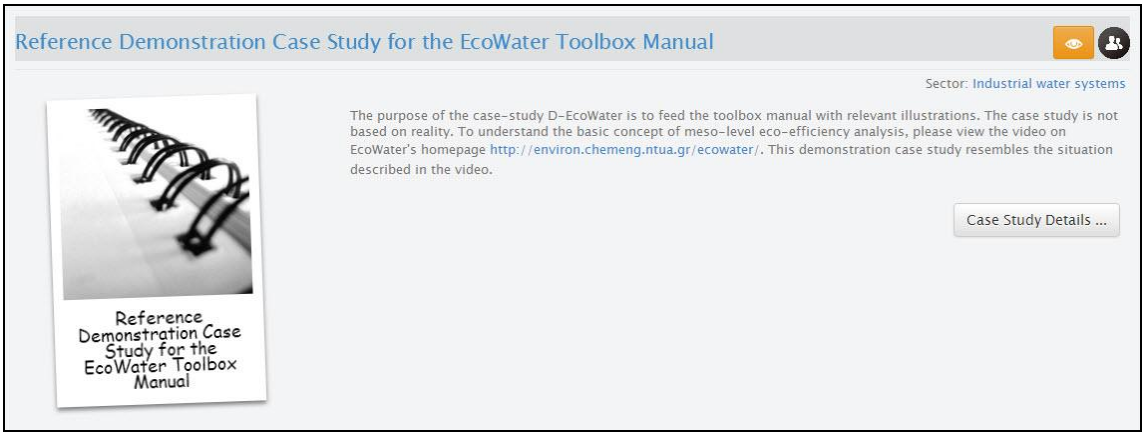


Figure 26: Case study immediately after creation.

The icon in the upper right corner of Figure 26 ( ) will provide insight in users and collaborators of the case study. This is discussed in chapter 3.

The creator of the case study can change the visibility of the case study using (hide) and, if hidden (unhide).

2.3.3 Adding and editing details of the case study

Selecting “Case Study Details” will result in Figure 27.

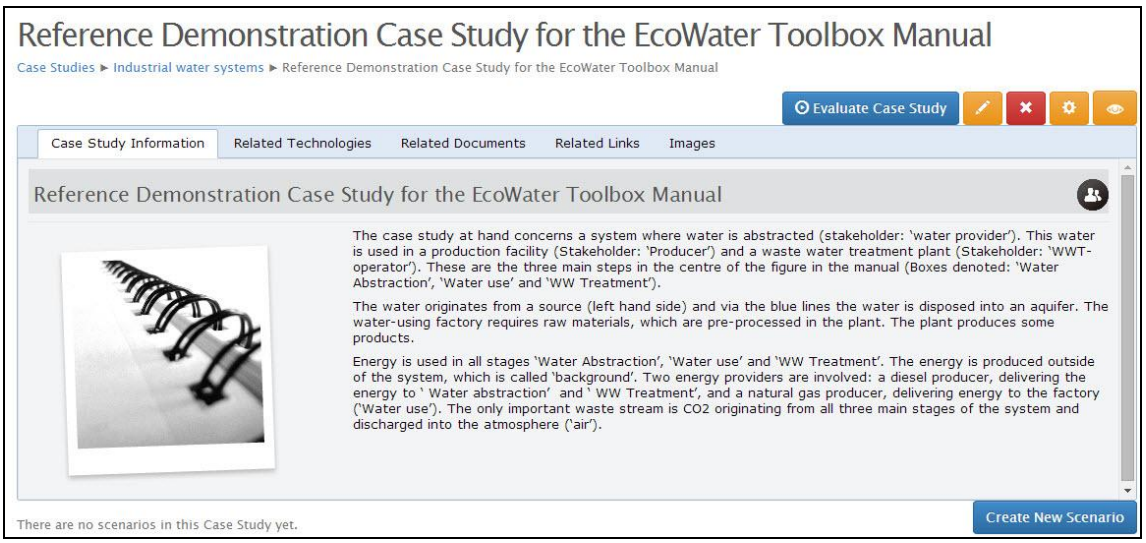


Figure 27: Case study details screen.

The following table presents the main options of this screen:

Item	Description
Case study information	This tab provides the extended case study description provided when creating the case study (or after further editing). It also alllows you to add one picture which serves as case study logo, replacing the default ‘folder’ picture. Look out: case study images other than the logo are stored under the tab ‘Images’.
Related Technologies	The related technologies field will list those relevant technologies which are used in the different scenario’s,

	including in the 'Business as usual' scenario. You can add related technolgies, see for more information below.
Related documents	Here you will find background information to the case study. You can add documents using .
Related links	Here you will links to other sources of information to the case study. You can add links using .
Images	Here you will find the possibility to add case study pictures. The first picture will become the logo picture of the case study.
Evaluate Case Study	The evaluate case button will only function after a scenario has been defined.
	Edit case study function.
	Delete case study function
	Administer case study function, mainly providing access rights to collaborators (see chapter 3)
	Hide/unhide function
	View the access rights
Create New Scenario	You can use this button to create new scenarios. (see chapter 2.3.4 and following)

Adding related technologies

Selecting the tab 'related technologies' will on first use reveal Figure 28. Using will allow you to add a technology to your case study from a larger list (Figure 29) leading to a case study technology list as shown in (Figure 30). The technoliges are copied and stored with the case study, which allows to edit the basic information to match the case study specificities. Clicking on the name of the technology will allow you to make changes, but also to delete the technology from the case study (Figure 31). The View details on Technology Inventory... button present detailed information on the technology as stored in the inventory. (Figure 32)

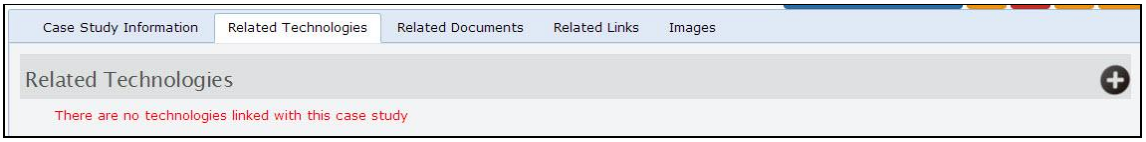


Figure 28: First time use of 'related technologies' tab.

Figure 29: Selecting a related technology

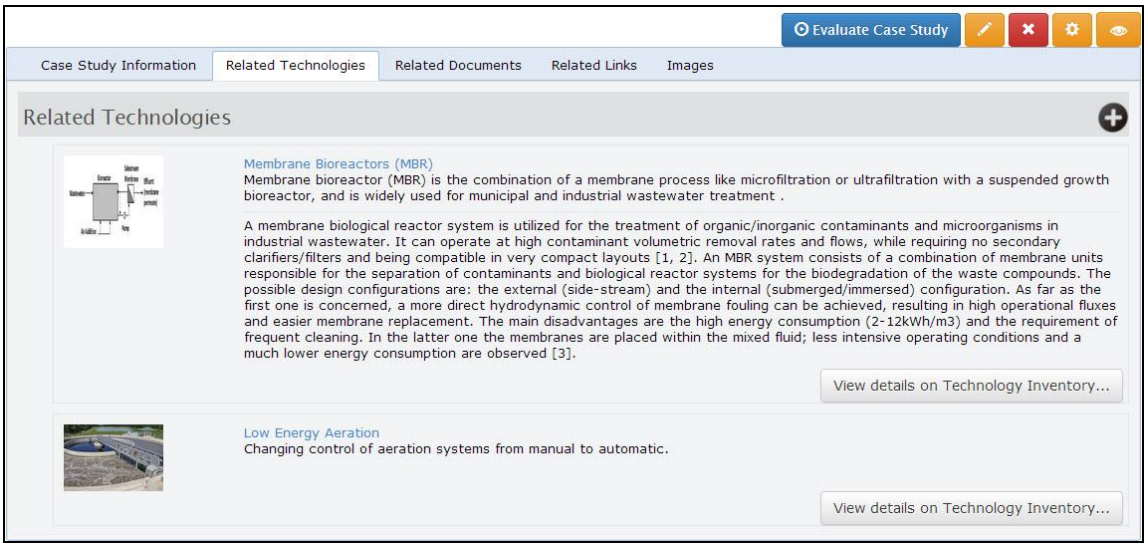


Figure 30: Technology list related to the case study..

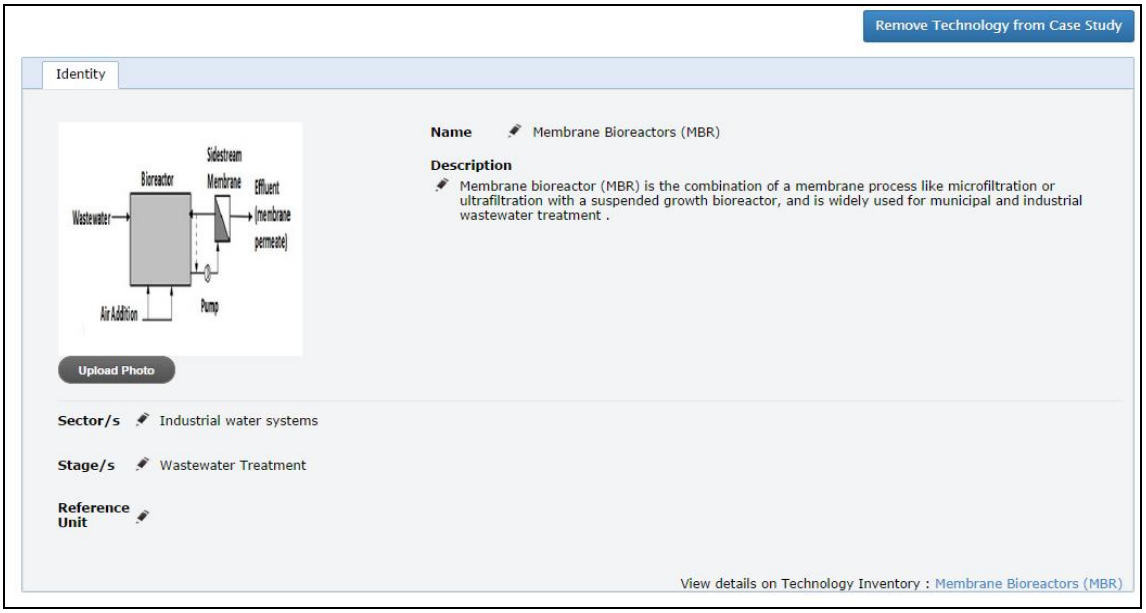


Figure 31: Editing a Case Study Technology.

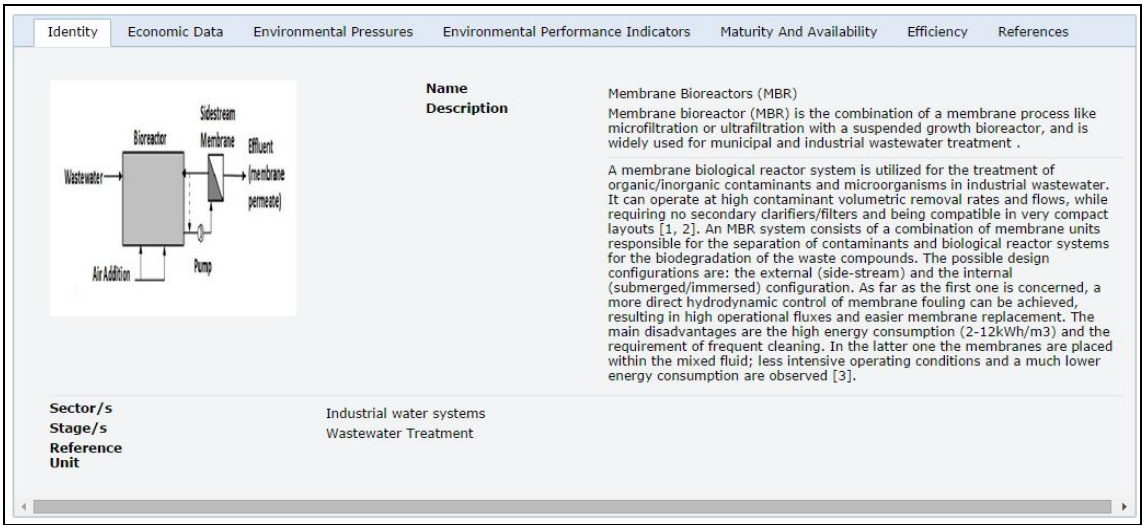


Figure 32: Details on a selected technology.

2.3.4 Developing (the business as usual) scenario's

Typically, the business as usual scenario is the first scenario developed. It serves as reference for other scenarios.

Developing a scenario is only possible if a solvable SEAT and EVAT files are available.

To develop a scenario press Create New Scenario in the edit case study field. A screen will pop-up as is shown in Figure 33. In this particular case the text entered in the scenario description is identical to the case study information, as the scenario is the business as usual scenario. Ordinarily, the BAU description would contain different narrative information.

The screen also requests uploading a SEAT model file. Once finished, the overall case study information will look similar to Figure 34. The icons in the upper section have previously been described. New icons relate to the scenario:

Item	Description
	Edit scenario function.
	Delete scenario function
/	Hide/unhide scenario from public view function

When sececting the edit function, you can change the description, the uploaded SEAT/EVAT model file, add/edit related documents and links, as is shown in Figure 35.

When looking at the scenario details (Scenario Details ...), more information is available as a result of the uploading of the SEAT/EVAT model file. As shown in Figure 36, tabs exist on " Environmental Analysis, Economic Analysis, Model Preview and Images. Environmental Analysis and Economic Analysis tabs show the numerical values imported from the SEAT/EVAT model file (Figure 36 and Figure 37). The data cannot be edited, but can be printed and exported. At this point, several columns in the environmental analysis section are not populated, this will happen later in the process.

In both Figure 36 and Figure 37 the number of fractional digits can be changed using the button (Figure 38).

At last the Model Preview tab shows the schematisation of the SEAT and EVAT files. Figure 39 visualizes the EVAT model. The essential difference to the SEAT visualisation is that the actors are mentioned in the headers of the water use chain. It is possible to use different colours for different stakeholders in EVAT. This would be visible in the visualisation of the model.

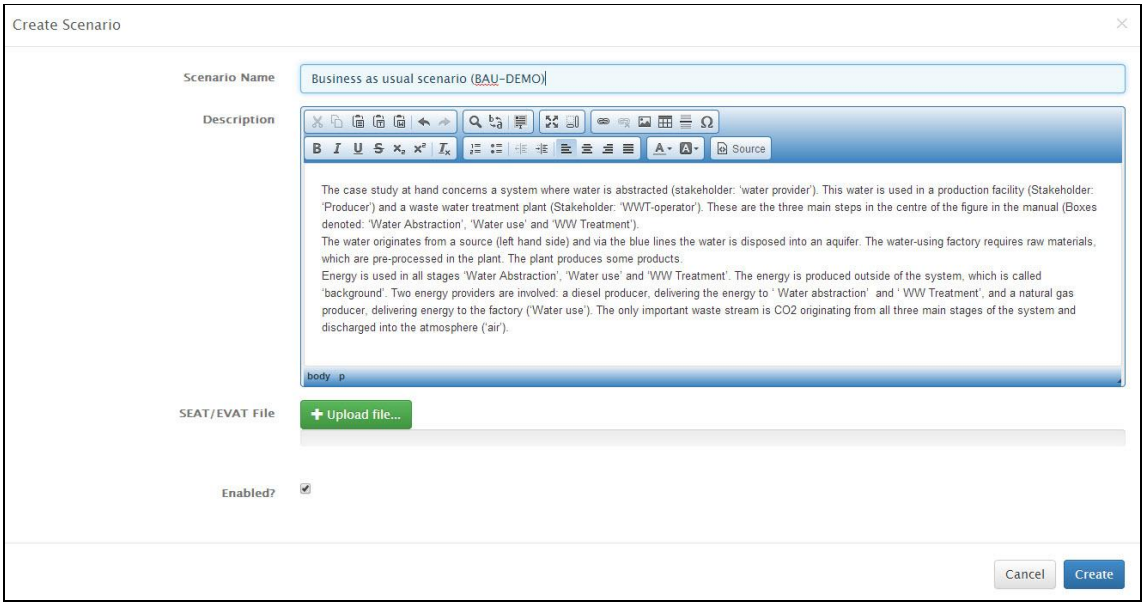


Figure 33: Opening screen to create a new scenario.

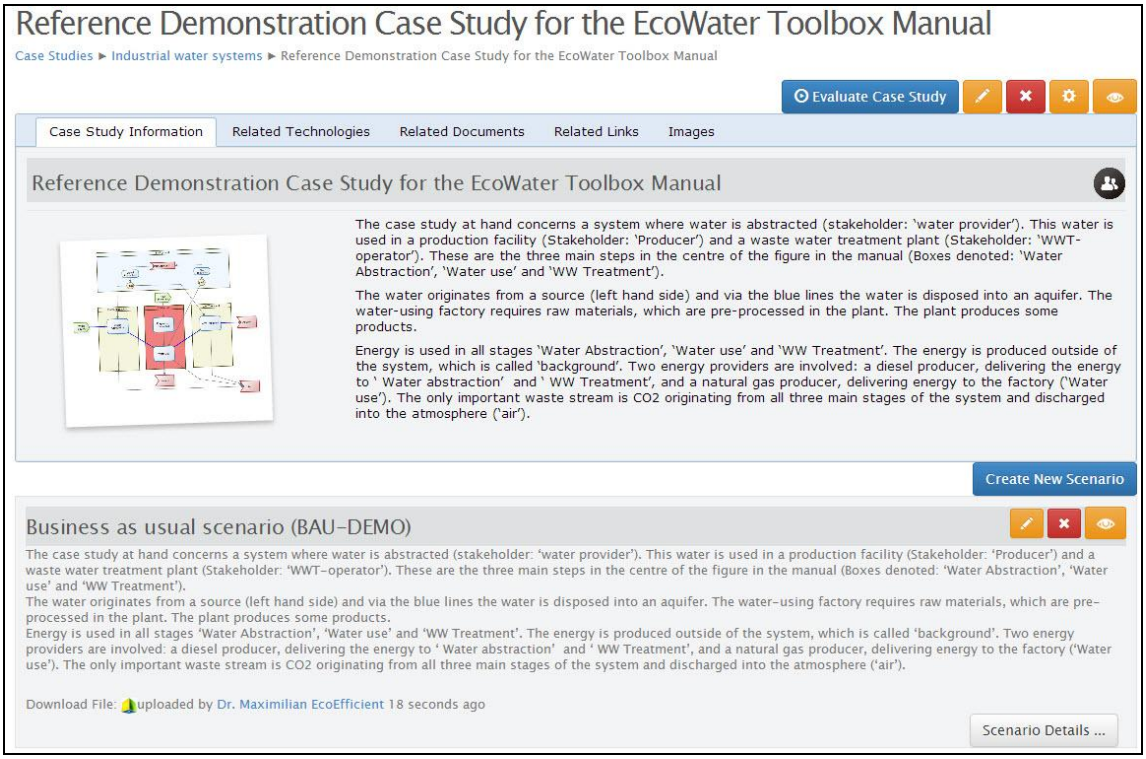


Figure 34: Case study overview, showing the general information (top) and the (BAU) first scenario.

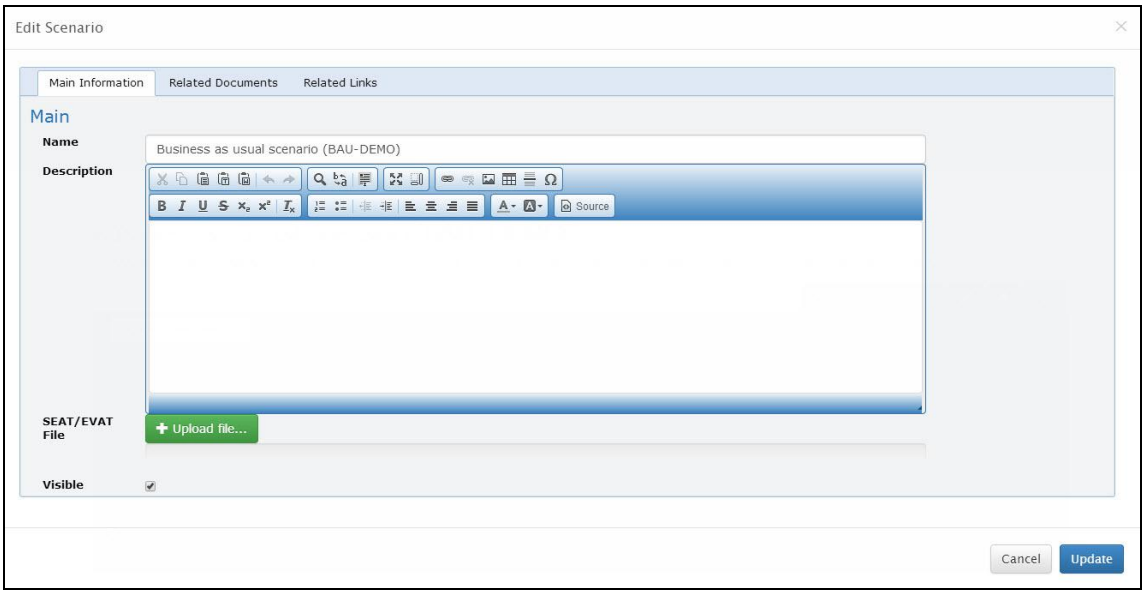


Figure 35: Editing scenario details.

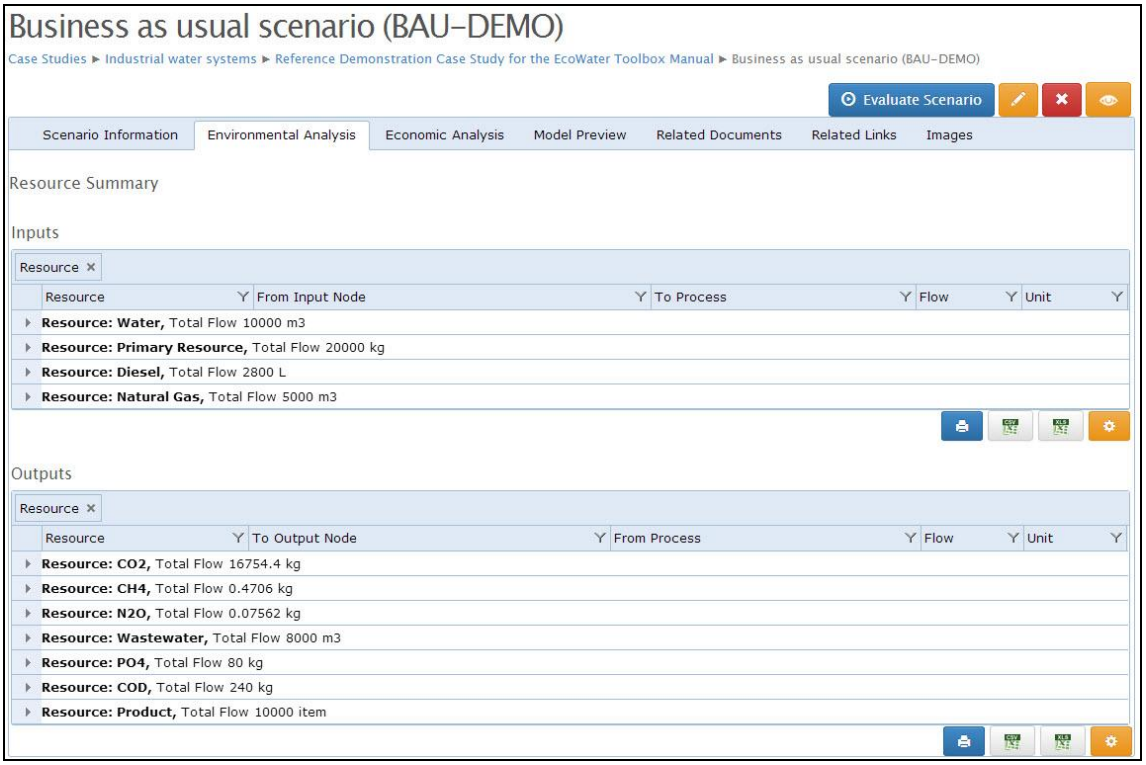


Figure 36: Scenario details - Environmental analysis (numerical data not editable).

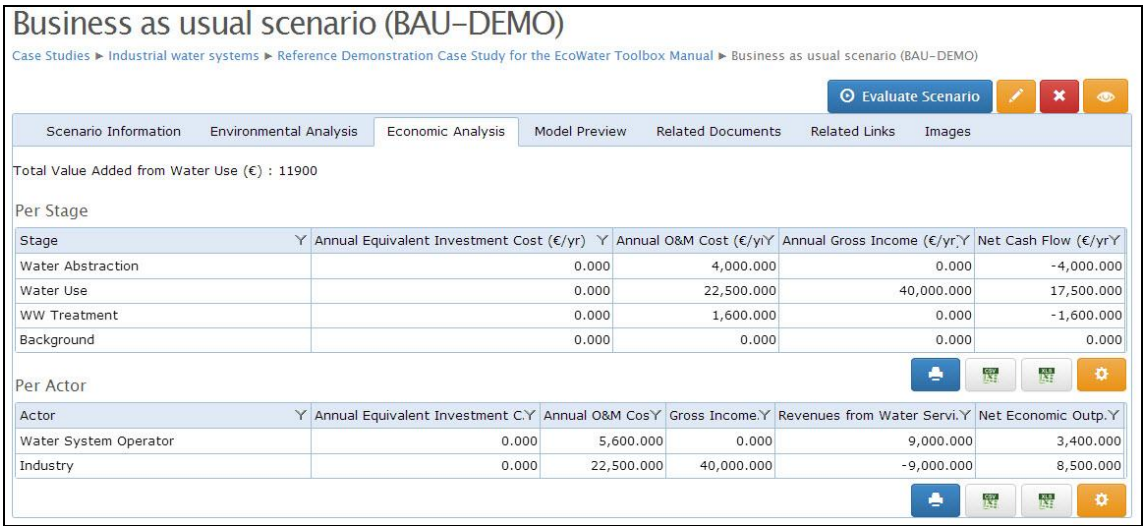


Figure 37: Scenario details - Economic Analysis (numerical data not editable).

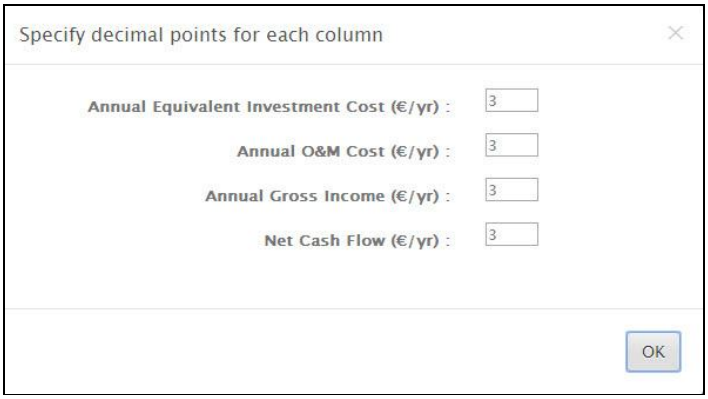


Figure 38: Specifying decimal points.

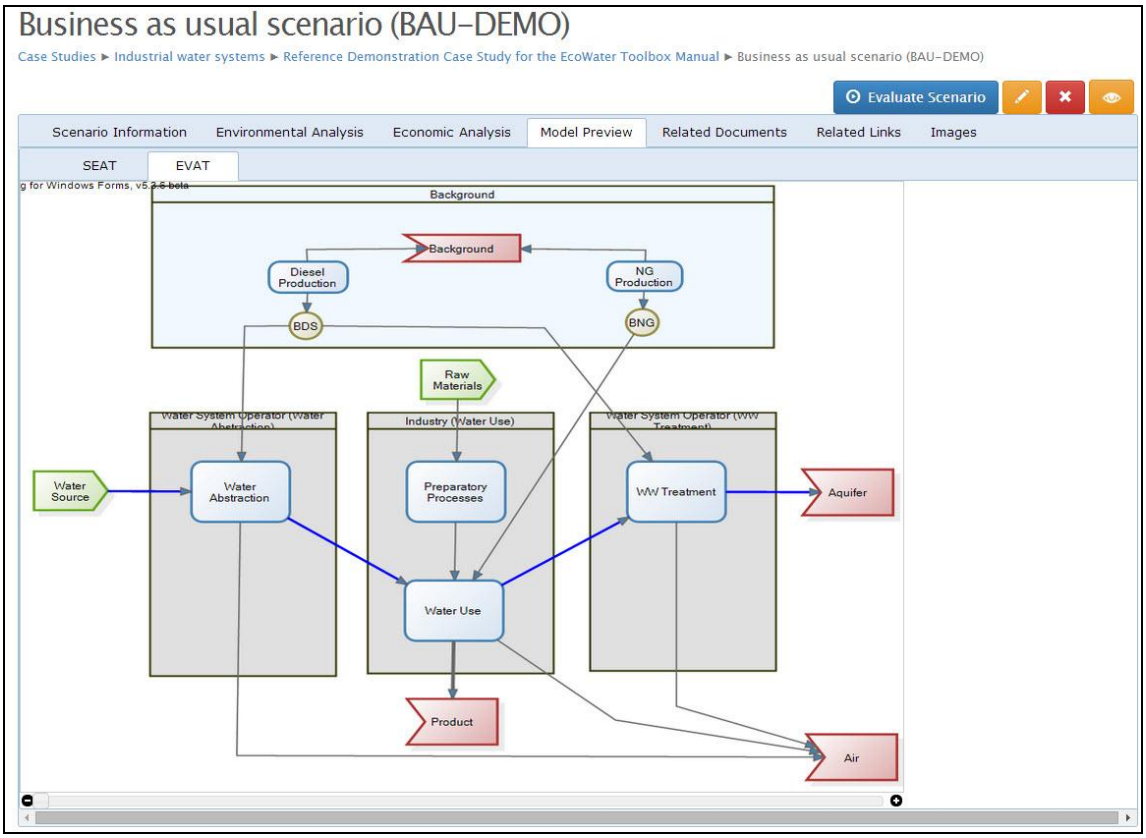


Figure 39: Visualisation of the EVAT model within the scenario section.

2.3.5 Evaluating (the business as usual) scenario's

When pressing 

Figure 40 will appear. As shown, the first step concerns the selection of the indicators, the second step the association of the model with the indicators, and as last step a review of results.

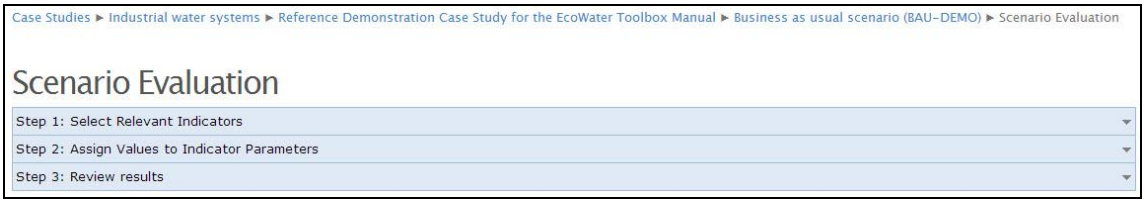


Figure 40: The steps of scenario evaluation.

2.3.5.1 Scenario evaluation: Step 1 – select indicators

Using the 'down-arrow' on the right hand side allows expanding the steps. In Figure 41 you see that two indicators are selected to be included in the analysis: 'Climate Change' and 'Freshwater Resource Depletion'. The majority of pre-defined indicators are international defined midpoint indicators originating from Life Cycle Assessment studies. However you can define your own indicators (chapter 2.5).

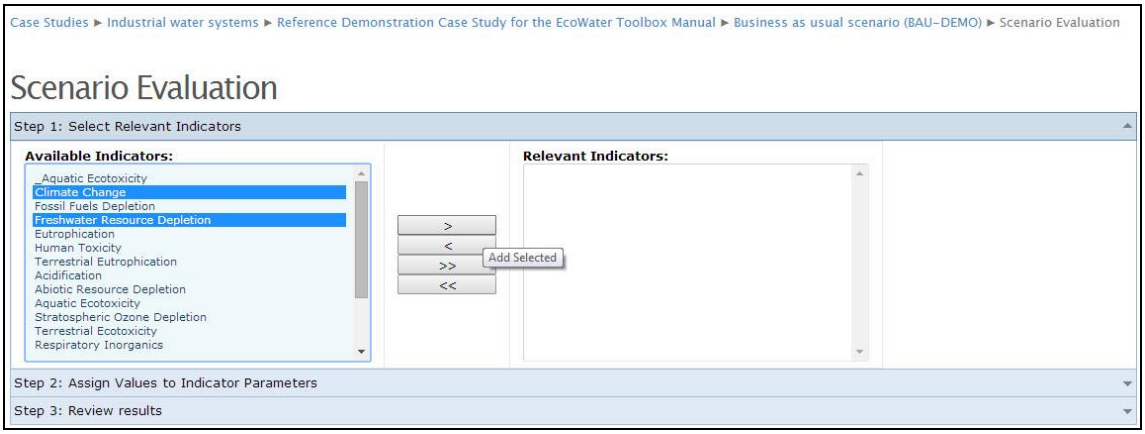


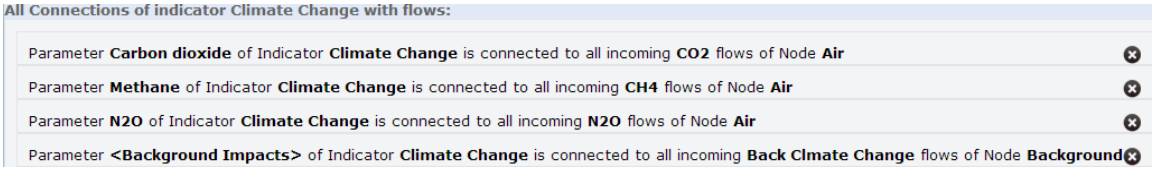
Figure 41: Expanded ' Select Relevant Indicator tab'.

2.3.5.2 Scenario evaluation: Step 2 – assign values to indicators parameters

The step 'Assign values to indicator parameters' consists of several sub-steps. In step 1, the indicator is selected (Figure 42). On the right hand side you can scroll through the indicator background info. For the indicator 'Climate Change' the full information is included in 'Box 2: Details on the Climate Change indicator.' The essential part is highlighted: it provides insight in the parameters which should be combined when calculating the indicator. Figure 43 shows the selection of Carbon Dioxide (Step B of assigning values). In step 2, depicted in Figure 44, all the CO2 flows leading into the air are combined.

Climate Change Indicator
In case of Climate Change, the SEAT model includes flows Carbon Dioxide, Methane and Nitrous Oxygen. The model however also allows assessing the environmental pressures in the background, this case the CO2 flow resulting from Diesel and Natural gas production. Including this in the evaluation is done by defining:
Parameter <Background Impacts> of Indicator Climate Change is connected to all incoming Back Climate Change flows of Node Background

For the Climate Change Indicator, step 2 concerns 4 assignments of model parameters to the indicator:



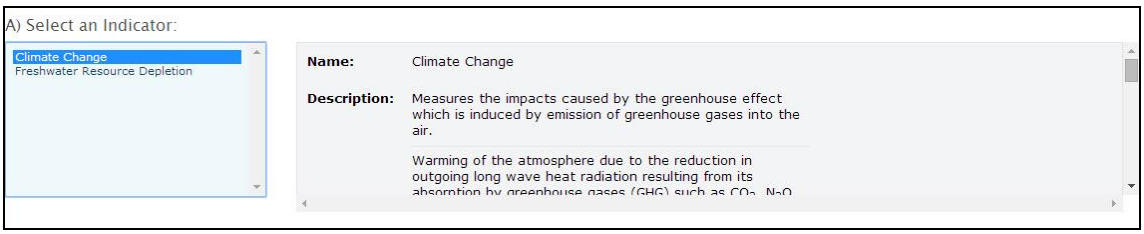


Figure 42: Select an indicator to assign values to.

Name: Climate Change

Description:
Measures the impacts caused by the greenhouse effect which is induced by emission of greenhouse gases into the air.

Warming of the atmosphere due to the reduction in outgoing long wave heat radiation resulting from its absorption by greenhouse gases (GHG) such as CO_2, N_2O, CH_4 and volatile organic compounds (VOCs) (JRC, glossary of terms

Symbol: GWP100

Formula: CO2 + 25 * CH4 + 298 * N2O + 14800 * HFC23 + 1430 * HFC134a + 22800 * SF6 +7390*CF4+8.7*CH2Cl2

Unit: tCO2eq

Type: Output

Source:
JRC (2010), ILCD Handbook: General Guide for Life Cycle Assessment – Detailed Guidance, First Edition, European Union.

IPPC (2007) Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, 2007. 2007. Retrieved 2012-05-24.

Guinée, J.B. (Ed.), Gorrée, M., Heijungs, R., Huppes, G., Kleijn, R., de Koning, A., Van Oers, L., Wegener Sleeswijk, A., Suh, S.,. Udo de Haes, H.A, De Bruijn, J.A., Van Duin R., Huijbregts, M.A.J. (2002). Handbook on Life Cycle Assessment: Operational Guide to the ISO Standards. Series: Eco-efficiency in industry and science. Kluwer Academic Publishers. Dordrecht (Hardbound, ISBN 1-4020-0228-9; Paperback, ISBN 1-4020-0557-1).

Box 2: Details on the Climate Change indicator.

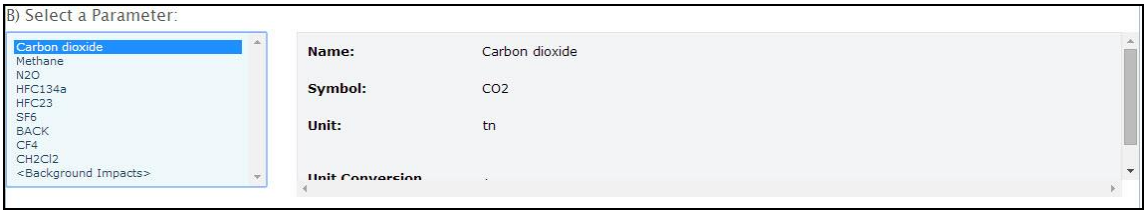


Figure 43: Selecting a parameter associated to an indicator.

Figure 44: Selecting all flows of CO2 to the air.

Step 1 (selecting mid-point indicators) and step 2 (assigning parameters) need to be repeated until all parameters related to the indicators are properly assigned. The next sections elaborate on the assignments in this case study.

Freshwater Resource Depletion

Freshwater Resource Depletion is calculated as the product of "Water Withdrawal to Availability ratio" multiplied by the "Water Abstracted" for each basin and for each "water" involved. Here we have one basin and only freshwater. If one of the two parameters is not assigned a value then it is automatically set to 0, and the result of the product is zero, regardless the value of the other.

The "Freshwater Abstracted" is linked to an actual flow of the system (as the majority of the parameters). The selected method for specifying the parameter value is "Use Resource Flow" (which the default). However, the Water Withdrawal to Availability ratio is not linked to an actual flow of the system, but is a constant region/system-dependent value. So, in order to specify its value you should use the method "Use a constant value".

The overall assignments regarding freshwater resource depletion is:

Parameter **Surface Water Abstracted** of Indicator **Freshwater Resource Depletion** is connected to all outgoing **Water** flows of Node **Water Source**

Parameter **Water Withdrawal to Availability** of Indicator **Freshwater Resource Depletion** is connected to a Constant (Value 0.5)

The Freshwater Resource Depletion in the background can in no case be determined, as the information required is system dependent, something typically unknown for background processes.

Eutrophication

Aquatic eutrophication potential is defined as a combination of all nutrients. The following links are relevant in this

Parameter **Total P Released** of Indicator **Eutrophication** is connected to all incoming **PO4** flows of Node **Aquifer**

Parameter **Chemical oxygen demand** of Indicator **Eutrophication** is connected to all incoming **COD** flows of Node **Aquifer**

Parameter **<Background Impacts>** of Indicator **Eutrophication** is connected to all incoming **Back Eutrophication** flows of Node **Background**

Human toxicity, Aquatic Eco-toxicity, Acidification

In the case study at hand, these midpoint indicators are not considered important in the foreground system. However, these are important in the background. Hence, these three indicators should be included in "Step 1: Select Relevant Indicators", too, and values should be assigned in "Step 2: Assign Values to Indicator Parameters" as follows:

Parameter **<Background Impacts>** of Indicator **Human Toxicity** is connected to all incoming **Back Human Toxicity** flows of Node **Background**

Parameter **<Background Impacts>** of Indicator **Aquatic Ecotoxicity** is connected to all incoming **Back Aquatic Ecotoxicity** flows of Node **Background**

Parameter **<Background Impacts>** of Indicator **Acidification** is connected to all incoming **Back Acidification** flows of Node **Background**

2.3.5.3 Scenario evaluation: Step 3 – Evaluate results

Figure 45 provides an overall view of the eco-efficiency per indicator. The results should be read as follows: The system 'earns' 0.66€ per ton CO_2-equivalent, in the period covered in the SEAT model, which typically concerns a year.

Figure 46 provides the absolute total, foreground and background values of the indicators. For example: Of about 18.100 ton CO_2-equivalent 16.800 ton is emitted in the foreground, and 1.300 is emitted in the background. As anticipated, there is no value for the Fresh Water Resource Depletion in the background, nor values for Human toxicity, Aquatic Eco-toxicity, Acidification in the foreground.

The distribution of these Environmental Impact indicators over the stages of the system is visualized in Figure 47. As you can see, the Fresh Water Resource Depletion is fully associated with 'water abstraction' and Eutrophication with waste water treatment.

For each environmental impact indicator, Figure 48 shows distribution between background and foreground fractions of the impact.

Figure 49 provides insight in the costs per actor. In this simple example, you can see that the revenues from water services are positive for the Water System Operator, and likewise negative for the industry. Still, industry has the highest overall revenue.

(a) Eco-Efficiency Assessment

Indicator	Value (€/Unit)
Climate Change (tCO2eq)	0.66
Freshwater Resource Depletion (m3)	2.38
Eutrophication (kgPO4eq)	32.58
Human Toxicity (kg1,4-DBeq)	82.53
Acidification (kgSO2eq)	852.45
Aquatic Ecotoxicity (kg1,4-DBeq)	1,080.68

Figure 45: BAU results: Eco-Efficiency Assessment.

(b) Environmental Performance Assessment

Indicator	Value (Unit)	Foreground Value(Unit)	Background Value(Unit)
Climate Change (tCO2eq)	18,075.85	16,788.70	1,287.15
Freshwater Resource Depletion (m3)	5,000.00	5,000.00	0
Eutrophication (kgPO4eq)	365.27	250.08	115.19
Human Toxicity (kg1,4-DBeq)	144.20	0	144.20
Acidification (kgSO2eq)	13.96	0	13.96
Aquatic Ecotoxicity (kg1,4-DBeq)	11.01	0	11.01

Figure 46: BAU results: Environmental Performance Assessment.

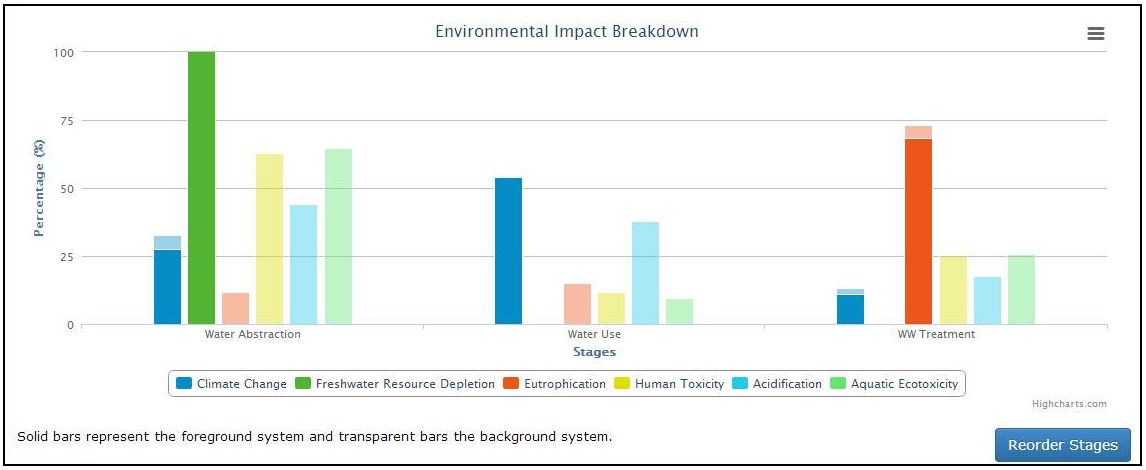


Figure 47: Environmental Impact Breakdown.

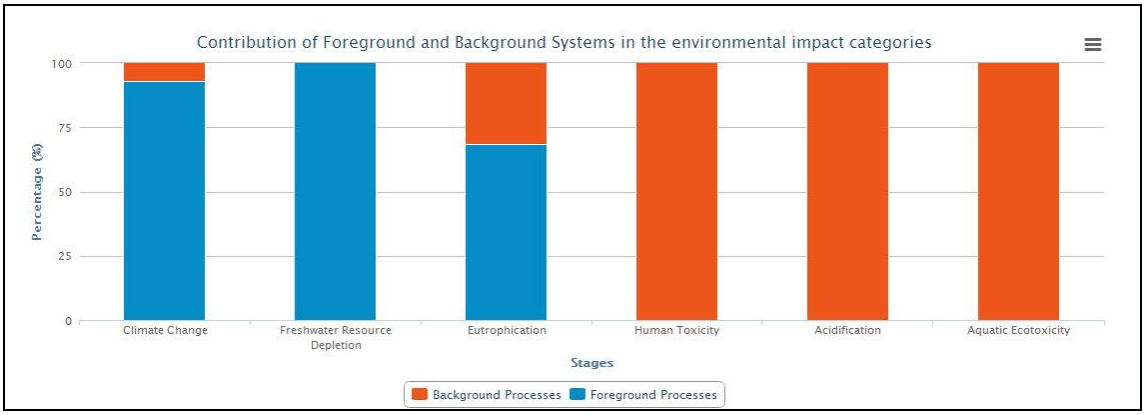


Figure 48: Contribution of Foreground and Background Systems in the environmental impact categories.

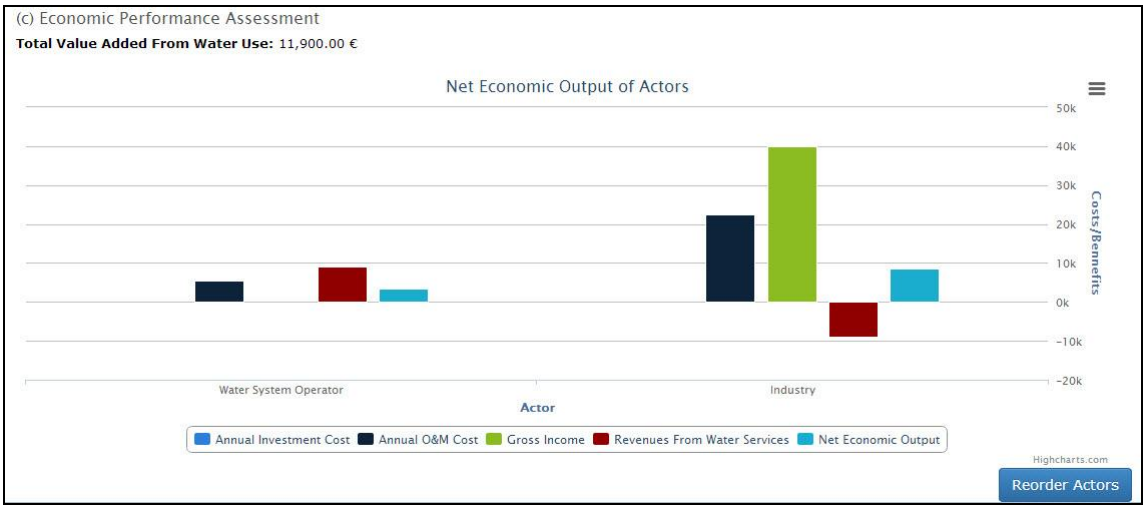


Figure 49: Net Economic Output of Actors.

2.3.6 Comparing multiple scenario's.

For the purpose of this manual a second scenario has been developed using SEAT/EVAT. In this scenario, a more energy efficient pump has been installed in the water abstraction stage.

When developing a new scenario, it is not necessary to re-create the links to indicators: these links are consistent throughout a case study.

The numerical results of this scenario are presented in Figure 50. Figure 51 provides the numerical results of both scenarios. There are clear differences all originating from using less energy to pump water, both in the foreground and in the background.

The net economic output per actor is graphically represented in Figure 52. It is evident that the water system operator increases his net revenue, mainly because of lower energy costs. Figure 53 shows that the eco-efficiency with respect to all indicators improves, meaning that installing the pump has a higher economic output/environmental impact ratio.
Figure 54 presents a type of diagram allowing positioning of a scenario in different quadrants with respect to economic output and environmental impact. Everything above the diagonal line is more eco-efficient compared to the business as usual situation. Only the right top quadrant implies both absolute economic and environmental gains.

Figure 55 shows the eco-efficiency per actor, which is selected on the top left of the figure. Such analysis can show that a technology has positive eco-efficiency effect for one actor, but negative for another.

(a) Eco-Efficiency Assessment

Indicator	Value (€/Unit)
Climate Change (tCO2eq)	0.85
Freshwater Resource Depletion (m3)	2.56
Eutrophication (kgPO4eq)	37.27
Human Toxicity (kg1,4-DBeq)	129.72
Acidification (kgSO2eq)	1,178.22
Aquatic Ecotoxicity (kg1,4-DBeq)	1,718.32

(b) Environmental Performance Assessment

Indicator	Value (Unit)	Foreground Value(Unit)	Background Value(Unit)
Climate Change (tCO2eq)	15,110.09	14,282.07	828.02
Freshwater Resource Depletion (m3)	5,000.00	5,000.00	0
Eutrophication (kgPO4eq)	343.64	250.08	93.56
Human Toxicity (kg1,4-DBeq)	98.74	0	98.74
Acidification (kgSO2eq)	10.87	0	10.87
Aquatic Ecotoxicity (kg1,4-DBeq)	7.45	0	7.45

Figure 50: Numerical results of the scenario including a more efficient pump.

Ecoefficiency Indicators

Indicator	Business as usual scenario (BAU-DEMO)	Energy Efficient Water Pump
Climate Change (€/tCO2eq)	0.658	0.848
Freshwater Resource Depletion (€/m3)	2.380	2.562
Eutrophication (€/kgPO4eq)	32.579	37.273
Human Toxicity (€/kg1,4-DBeq)	82.526	129.717
Acidification (€/kgSO2eq)	852.450	1,178.221
Aquatic Ecotoxicity (€/kg1,4-DBeq)	1,080.677	1,718.321

Environmental Performance

Indicator	Business as usual scenario (BAU-DEMO)	Energy Efficient Water Pump
Climate Change (€/tCO2eq)	18,075.846	15,110.094
Freshwater Resource Depletion (€/m3)	5,000.000	5,000.000
Eutrophication (€/kgPO4eq)	365.271	343.636
Human Toxicity (€/kg1,4-DBeq)	144.197	98.740
Acidification (€/kgSO2eq)	13.960	10.871
Aquatic Ecotoxicity (€/kg1,4-DBeq)	11.012	7.454

Economic Performance

Actor	Business as usual scenario (BAU-DEMO)	Energy Efficient Water Pump
TVA	11,900.000	12,808.227
Water System Operator	3,400.000	4,308.227
Industry	8,500.000	8,500.000

Figure 51: Numerical results of both scenario's.

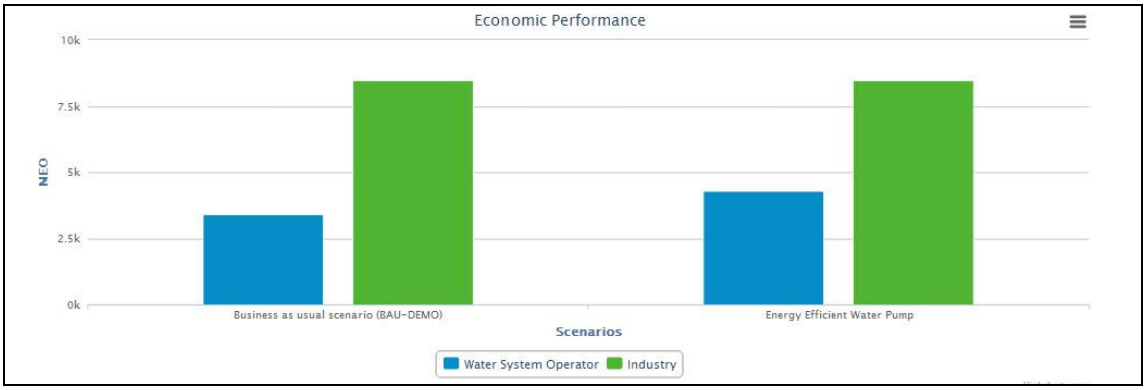


Figure 52: Comparison of the net economic output of the system per actor.

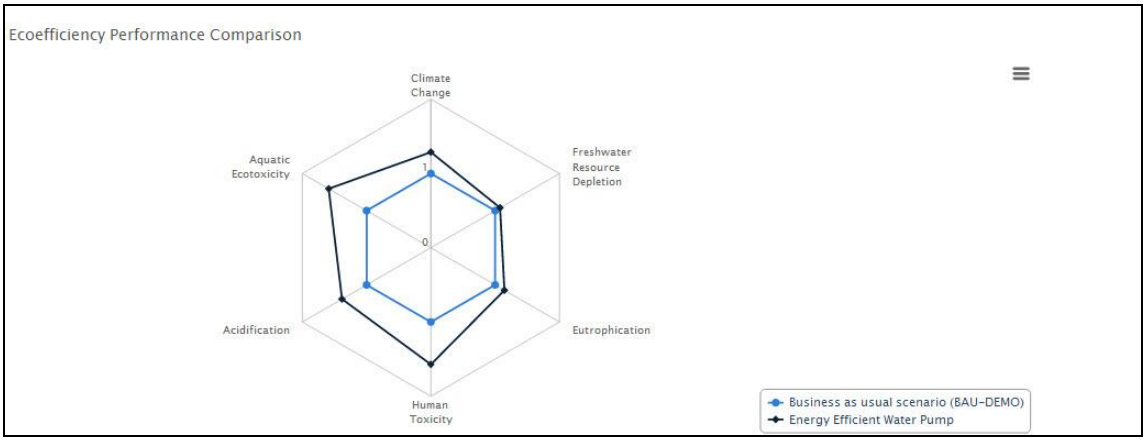


Figure 53: Comparison of the eco-efficiency performance.

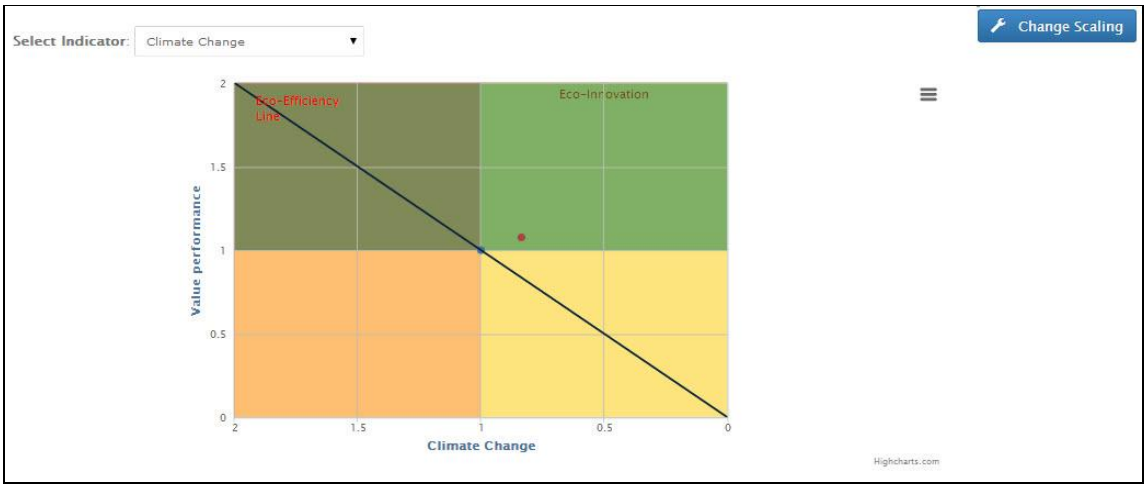


Figure 54: Direction of innovation for specific indicators.

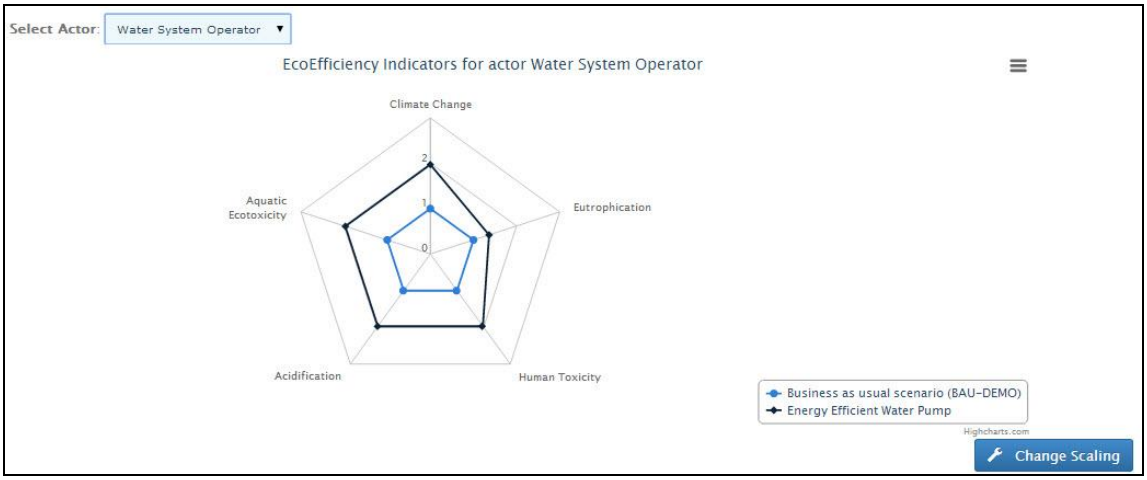


Figure 55: Eco-efficiency effect of an individual actor.

2.4 Step-by step: Adding and editing new technologies

Figure 56 depicts the opening or overview screen of technologies. Novel processes or methods can also be included. The picture reveals a 'Request adding a Technology' button. Using the button will send an e-mail to the administrator who will grant access. The notification for sending the message is shown in Figure 57. Using the 'X', marked in the right lower corner will close this notification. As granting access is not automatic, granting access may take some time.

After access has been granted the user can press Create Technology button, which will launch a pop-up for basic information of the tehcnology (Figure 58). After the new technology with basic information is created, much more information can be included, using the different tabs of the tool (Figure 59). Table 3 lists the different types of data that can be associated with a technology.

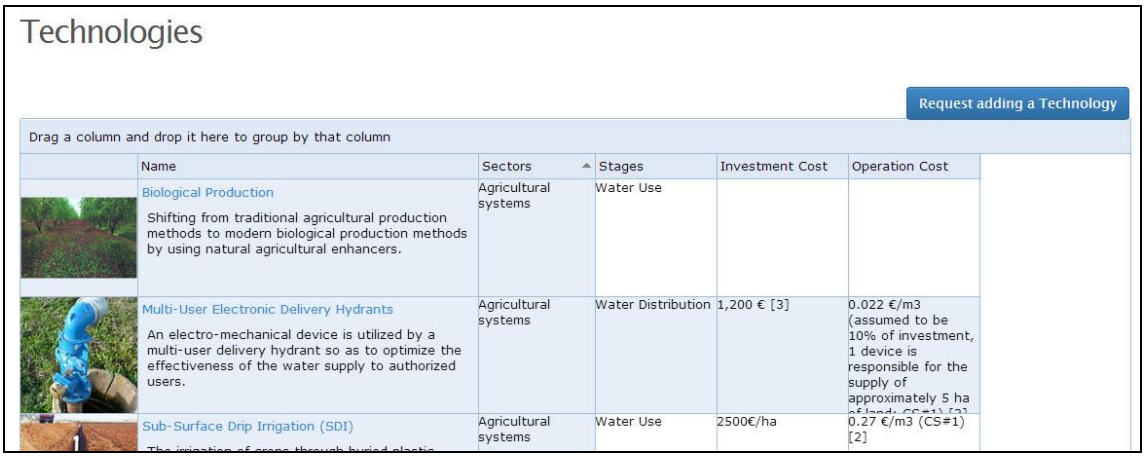


Figure 56: Technology overview screen with request new technology button.

Figure 57: Notification that your Technology request is sent to the administrator.

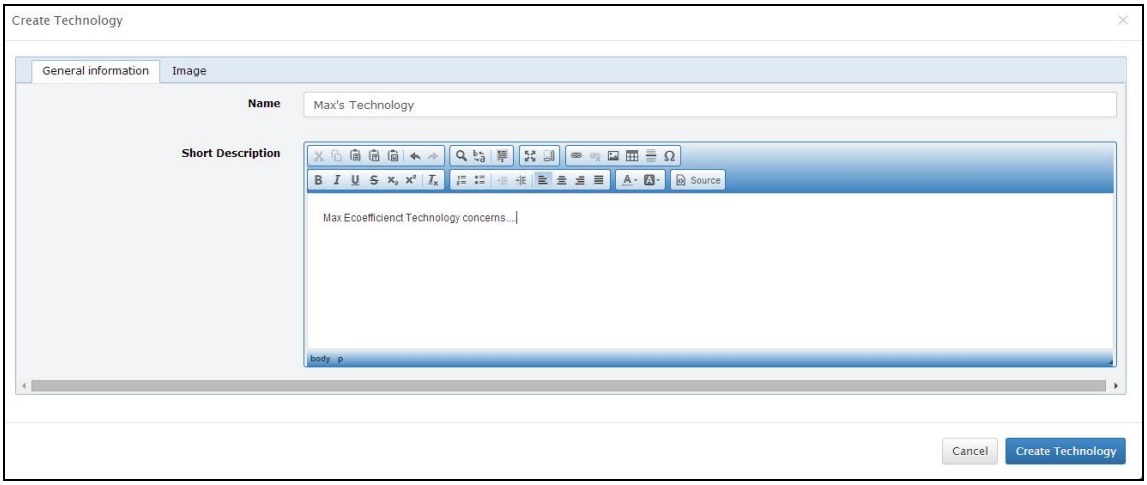


Figure 58: Technology creation pop-up screen.

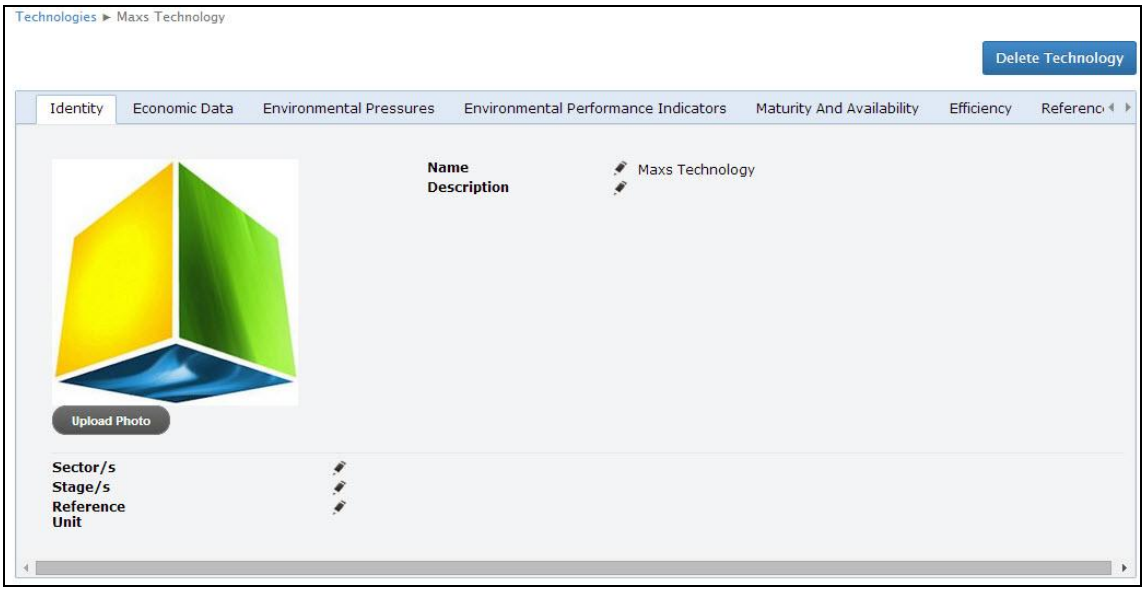


Figure 59: Editing and adding information on technology tabulated screen.

Table 3: Technology characteristics fields.

Section/Item	Type of field	Description
Identity		
• Name	Text field	Self-explanatory (s.e.)
• Description	Text field	(s.e.)
• Sector/s	Text field	(s.e.)
• Stage/s	Text field	Stages in a water value chain
• Reference Unit	Text field	It reference unit referring to the size or capacity of each technology for which the economic and environmental data are estimated. (i.e. Pump: 10kW)
Economic Data		
• Technology lifetime (number of years)	Numeric	(s.e.)
• Investment Cost (Euro)	Numeric	(s.e.)
• Operation Cost (Euro/year)	Numeric	(s.e.)
Environmental Pressures		
• Air Quality	Text field	Narrative description of the technology pressure
• Soil Quality	Text field	dito
• Water Quality	Text field	dito
• Water Use	Text field	dito
• Resource Use	Text field	dito
• Solid Waste	Text field	dito
• Indirect Impacts	Text field	dito
Environmental Performance indicators		
a. Resource Depletion Potential		
i. Water Consumption (m3)	Numeric	Value per reference unit

ii. Energy Consumption (kWh)	Numeric	dito
iii. Type of energy consumed (thermal/electrical/fuel)	Numeric	dito
iv. Resource consumption (kg)	Numeric	dito
v. Type of Resource consumption (i.e. solvents, fertilizers)	Numeric	dito
b. Global Warming Potential (KgCO2,eq)	Numeric	dito
c. Eutrophication potential (KgPo4-3,eq)	Numeric	dito
d. Ecotoxicity Potential (CTUe)	Numeric	dito
e. Human Toxicity Potential (CTUh)	Numeric	dito
f. Acidification Potential (KgSO2-,eq)	Numeric	dito
g. Ozone Depletion Potential (KgC2H2,eq)	Numeric	dito
h. Photochemical Ozone Creation Potential (KgC2H2,eq)	Numeric	dito
i. Respiratory Effects (Kg PM10,eq)	Numeric	dito
j. Land Use (ha)	Numeric	dito
k. Ionizing Radiation (Kbq U235air,eq)	Numeric	dito
Maturity and Availability		
• Technical maturity	Selection field	Value between one star and five star maturity
• Commercial maturity	Selection field	Value between one star and five star maturity
• Reliability	Text field	Narrative
• Applications/Innovative Character	Text field	Narrative
Efficiency		
• Water saving	Text field	Narrative
• Energy Efficiency	Text field	Narrative
• Physical Efficiency	Text field	Narrative
• Environmental Impact	Text field	Narrative
References		
	Text field	Field for publications etc

2.5 Step-by step: Adding and editing new Indicators

Figure 60 depicts the opening or overview screen of Environmental Impact Indicators. The picture reveals a ‘Request adding an Indicator’ button. Using the button will sent an e-mail to the administrator who will grant access. The notification for sending the message is shown in Figure 61. Using the ‘X’, marked in the right lover corner will close this notification. As granting access is not automatic, granting access may take some time.

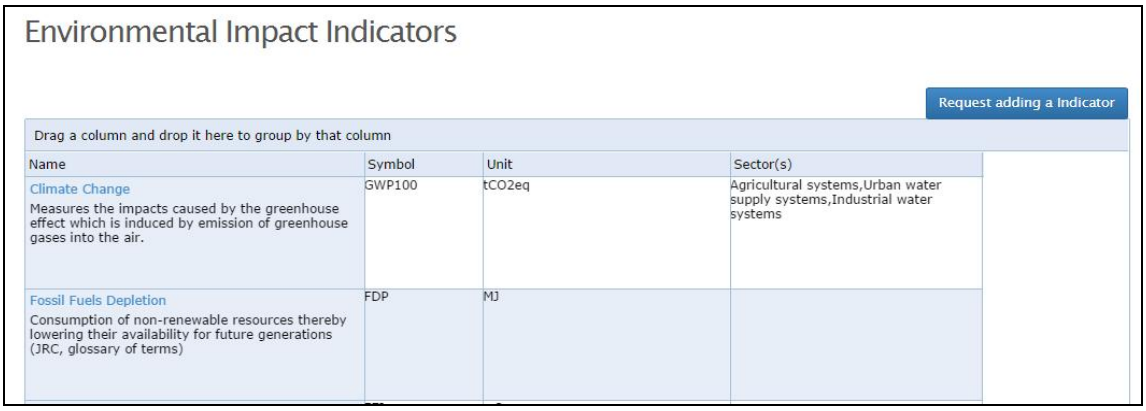


Figure 60: Environmental Impact Indicator overview screen with request new Indicator button.

Figure 61: Notification that your Indicator request is sent to the administrator. The window can be closed using the 'x' in the right hand corner.

Once the request is granted, a '  ' button wil become available. Pressing this button wil start an indicator definition process. The first step is shown in Figure 62. Once this information is completed and the '  ' button is pressed Figure 63 will appear. The fields with the pencil icon () can be edited. The evaluation rule section, and in particular the 'weighted sum of parameters' is the important part of the indicator definition. Checking the weighted sum button will reveal Figure 65. Using 'add parameter' a parameter can be added to a formula, as is shown in Figure 66. Repeating this process may result in a table of weighted parameters as is shown in Figure 67.
In case the user wants to use a fixed value he can use the 'formula' checkbox, and fill in a simple formula or fixed value (Figure 68).

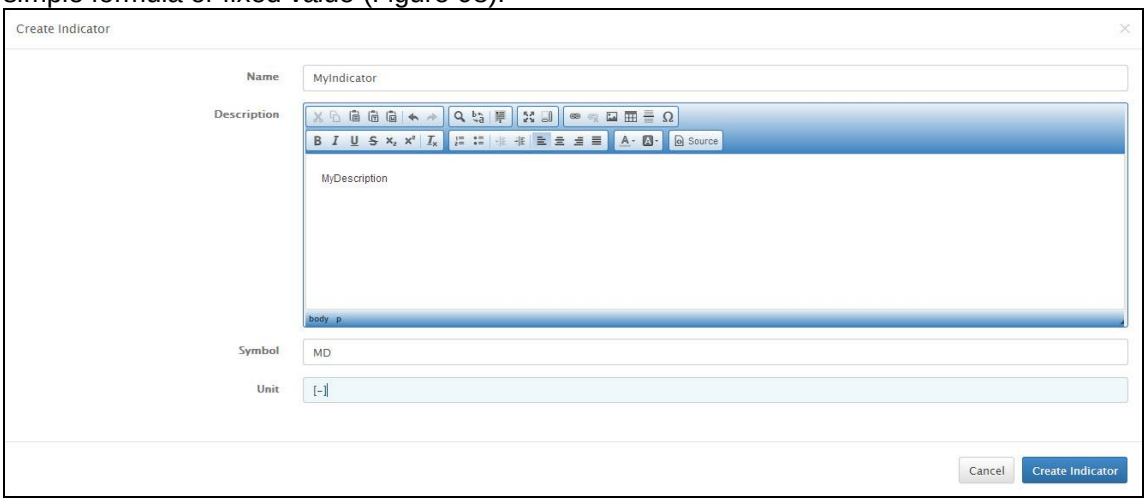


Figure 62: Indicator description pop-up screen.

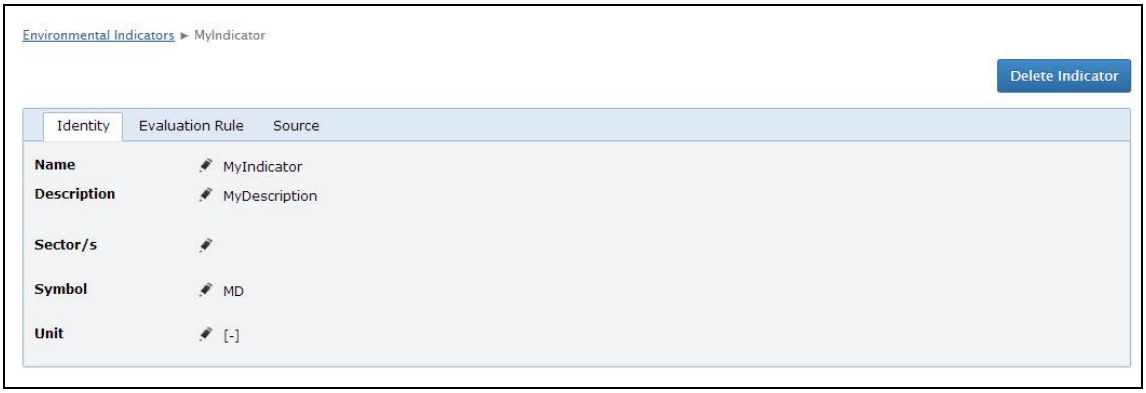


Figure 63: Editing and adding information concerning an indicator (A).

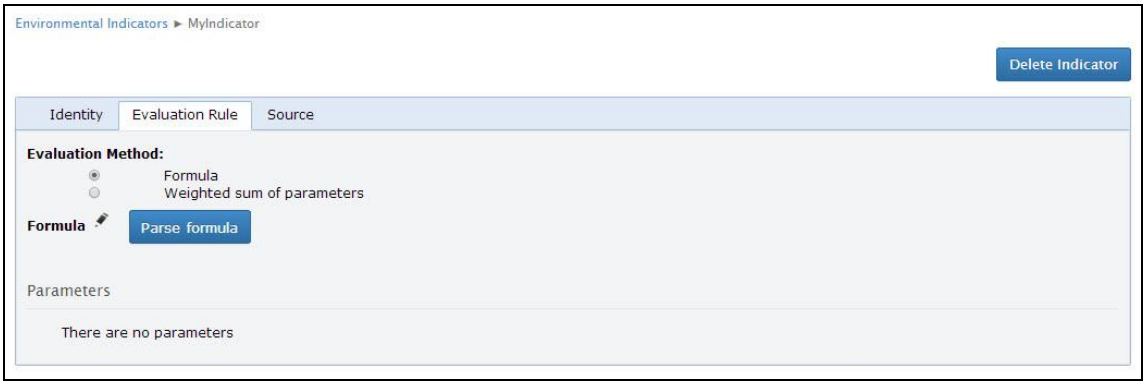


Figure 64: Editing and adding information concerning an indicator (B).

Figure 65: Weighted sum of parameters evaluation rule – opening screen.

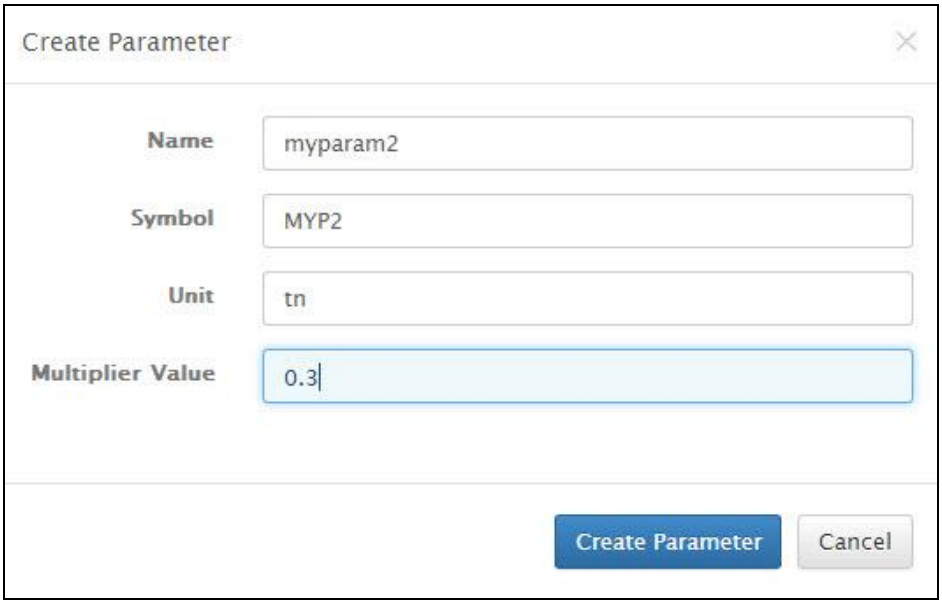


Figure 66: Weighted sum of parameters evaluation rule – parameter definition.

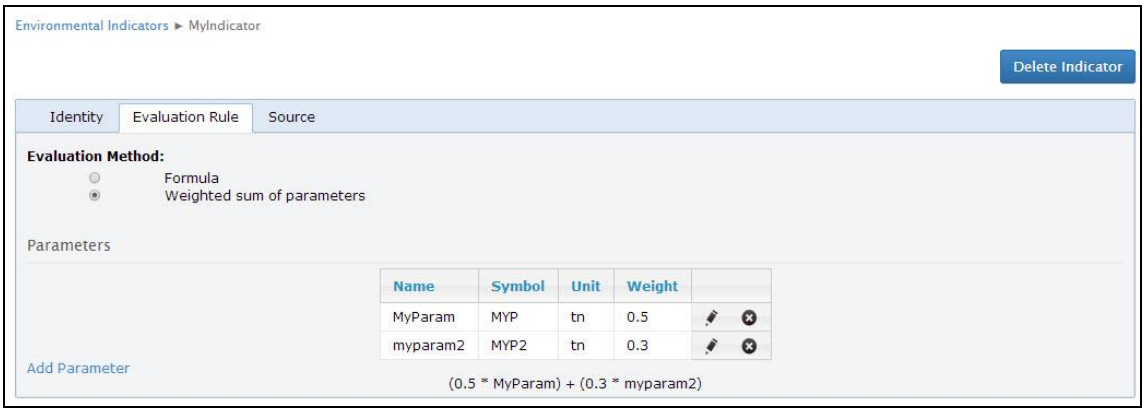


Figure 67: Weighted sum of parameters evaluation rule – overview of formula.

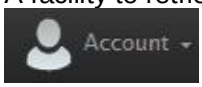
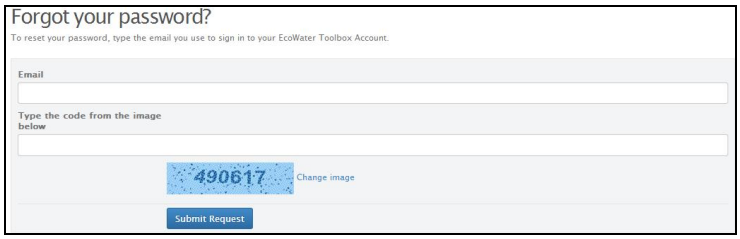
Figure 68: Editing and adding information concerning a fixed formula indicator.

3 Collaborators, Administrators, Owner and Stakeholders

Collaborators, administrators, owner and stakeholders are three types of persons working on a case study (see Figure 69). A case study has one creator/owner. This owner is also administrator, who on request can give administrator rights to other registered users. These administrators can give access to other registered users to collaborate on the case study. All administrators can also delete a case study. We recommend not giving administrator rights to inexperienced users, but letting these users be collaborators or stakeholders. They have the same access rights to view and edit case studies.
As one can see from the figure, giving access rights is user driven, which implies that a case study must be visible, see at the end of 2.3.2 Creating a new case study.

Figure 69: Case study users.

4 Troubleshooting – Frequently asked questions

Issue	Solution
Can't log in	A facility to retrieve a lost password is incorporated in the  scrol down menu. 
Accidently deleted a case study	Currently there is no repair mechanism implemented.
Ruined a case study – would like to revert to a previous version	The user can revert to the previous scenario using the 'Scenario Information' screen.
Can't see a case study	The case study administrator must make the case study visible, or include the user as case study collaborator.
Can't access case study	The case study administrator must include the user as case study collaborator.
SEAT file will not load	Most likely the model was not able to solve. Return to SEAT.
SEAT file loaded there are no results.	A model may solve but have no flows. Return to SEAT.
Can't change the case study logo	The image can be changed in the edit section ( )of case study details. The case study picture cannot be altered by adding pictures to the tab 'Images'. The latter only concerns pictures relating to the case study.

5 Literature

Angelis-Dimakis, Thanos. 2013. *Deliverable 1.5 Finalized Systemic Environmental Analysis Tool – SEAT*. EcoWater Project Deliverable, retrievable here: http://environ.chemeng.ntua.gr/ecoWater/Default.aspx?t=238

Angelis-Dimakis, Thanos. 2013. *Deliverable 1.6 Economic Value chain Analysis Tool – EVAT*. EcoWater Project Deliverable, retrievable here: http://environ.chemeng.ntua.gr/ecoWater/Default.aspx?t=238

EcoWater Description of Work, 2011, EcoWater Project, Meso-level eco-efficiency indicators to assess technologies and their uptake in water use sectors, 7th Framework Programme, Grant Agreement No: 282882 (restricted access).

Kourentzis, V., 2012, Roadmap for Case Study Development, Deliverable 1.8 of the EcoWater Project, Meso-level eco-efficiency indicators to assess technologies and their uptake in water use sectors, 7th Framework Programme, Grant Agreement No: 282882 (restricted access, available on demand).

Van Vliet, L., Levidow, L., Alongi Skenhall, S. and Blind, M., 2012, Review and selection of eco-efficiency indicators to be used in the EcoWater Case Studies, Deliverable 1.1 of the EcoWater Project, Meso-level eco-efficiency indicators to assess technologies and their uptake in water use sectors, 7th Framework Programme, Grant Agreement No: 282882.