User guide for edTOOL®

ecodesign tool

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sostenipra

ECO-SCP-MED Project

ECO-SCP-MED (**Integrating Experiences and Recommendations in Eco-innovation for Sustainable Production and Consumption in the Mediterranean Area**) project aims at ensuring sustainability across the supply chain of the main products and services in the MED area.

Its cornerstone is raising knowledge on SCP (Sustainable Consumption and Production) and fostering eco-innovation and competitiveness through transnational cooperation and especially through the capitalization of main achievements, activities and cooperation practices already developed in the Mediterranean space.

Funded by Europe / ERDF, the project is divided into four main areas:

Sustainability of production processes
Sustainability of products and services
Sustainable Consumption Patterns and Behaviour
Sustainable Management in Industrial Areas

edTOOL and its User Guide is part of the work done within the "Sustainability of Products and Services" area, which has been coordinated by Universitat Autònoma de Barcelona (UAB) and participated by the following partners: Province of Bologna, ENEA, CRO-CPC, IAT and SSSUP.

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Table of contents

1) Introduction

edTOOL is a web-based tool assisting the ecodesign process of products and services, developed within the ECO-SCP-MED Project (Integrating Experiences and Recommendations in Eco-innovation for Sustainable Production and Consumption in the Mediterranean Area).

edTOOL **aims to improve the sustainability of products and services by implementing ecodesign in companies in a step-by-step intuitive way.**

The tool has the following characteristics:

- Useful to guide companies through the process of ecodesign implementation.
- Flexible and intuitive.
- Propositive, with recommendations for the environmental improvement.
- Practical, with real examples from the partners' experience.

What is the intended audience of edTOOL?

The main users of the toolkit will be the **companies aiming to ecodesign their products and/or services**. By using edTOOL, they will be able to environmentally assess their current products/services and define environmental improvement strategies. edTOOL has been developed in order to make it easier for companies to introduce ecodesign concepts into their products and services.

By means of edTOOL, companies with different levels of environmental maturity will be able to follow the step-by-step methodology and incorporate environmental improvements into their products and services. The environmental performance level of the ecodesigned product/service will depend on the possibilities and interests of the companies, but they will all be encouraged to integrate environmental aspects into their products/services.

In addition, the toolkit can also be used by the **public administration** as a means of proof of the implementation of ecodesign into products and services. Thus, it may be considered in green public procurement processes. Similarly, **policy makers** may use the toolkit to foster the implementation of ecodesign and make it mainstream.

Finally, all those actors interested in ecodesign and environmental improvement may use the toolkit in order to learn the methodology and apply it to any case study.

Why this user guide?

edTOOL is a web-based tool that includes brief instructions in each step of the process in order to guide the users through the methodology. However, users are encouraged to read the User Guide in order to obtain more detailed descriptions and clarifications.

In addition, three practical case studies are presented within the guide: a Knife, a Wooden Packaging for wine bottles and a Jacket (Figure 1). These three projects are the result of a research project promoted by ENISA (Spanish National Innovation Company) addressed to ecodesign and innovation in products.

The Knife case study will be used throughout this User Guide in order to illustrate the functioning of edTOOL, whereas the two other case studies will be presented in Section 5 (Annex B - Case Studies).

Figure 1. Case studies included in the User Guide.

ENISA
Diego Crescente
Alberto Moratiel
Carmen Cuesta
Begoña Cristeto
Isabel Moneu
Alberto Moratiel
Adela Gimeno
Mireia Solà

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FINSA
Francisco Javier Silva
Diana Barreiro

ECOALF
Javier Goyeneche
Antía de Ron
Carolina Blázquez
Intza Eizmendi
Sonia Martínez

Figure 2. Organizations and members participating in the ENISA project.

2) Basic concepts of edTOOL

What is ecodesign?

Ecodesign is an approach to the design of products and services with special consideration for their environmental impacts during the whole lifecycle. It can be defined as the design that considers the environmental aspects and/or impacts associated with products, processes or systems, throughout the whole life cycle, together with other traditional aspects, such us costs, quality, safety, ergonomics, etc. (Figure 3). Thus, the environment is another criterion, which is considered in order to prevent environmental impacts.

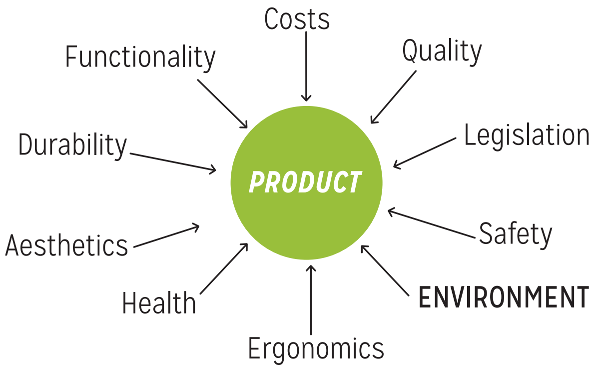


Figure 3. Criteria considered along ecodesign.

edTOOL overview and previous considerations

edTOOL is a web-based tool that can be used in any **computer with Internet access** with no specific technical requirements. The tool can be used for the **ecodesign of products and services**, although its implementation is more straightforward for the case of product ecodesign. In order to aid in the process of service ecodesign, specific recommendations will be provided.

For the implementation of the ecodesign methodology suggested by edTOOL, an **ecodesign team leaded by a Project Coordinator** will need to be created (more details on this will come later). The time devoted to implement the steps suggested by edTOOL will depend on every specific project (e.g. depending on the type of product or service to be ecodesigned, the available information and knowledge, the previous experiences on ecodesign, the level of detail of the project, etc.). However, as a merely **orientative reference time**, the whole process (from the initial definition of objectives up to an Action Plan with concrete actions) may be implemented within a period of time ranging from 1 to 5 months. Along the User Guide, guidelines on how to implement specific steps of edTOOL within the company (number of meetings, time consumed, etc.) will be given.

edTOOL considers two types of users for each project: an ecodesign **Project Coordinator** and a series of ecodesign **Team Members**. They will work together along the process, although the Project **Coordinator** will be the one in charge of using the web-based tool on behalf of the whole ecodesign team. The Project **Coordinator** will manage the tool, will move through the methodology, and will decide the speed in which the process is done. The **Team Members** will be invited by the **Coordinator** and will have access to all the information introduced in the tool, but limited edition permits.

To Start an Ecodesign Project, the Coordinator will create a project and then will go through 4 main steps (Figure 4.).

The first step is the **Initial Definition**, which includes creating the team, describing the project, setting objectives, describing legal requisites and market study (if necessary) and preparing the environmental assessment module.

The second step will consist of the **Environmental Assessment,** which will be carried out individually by every member of the ecodesign team (who will be invited by the Coordinator) and will provide information on the critical environmental hotspots.

The third step will be the **Ecodesign Strategy Selection**, along which the Coordinator will prioritize and refine ecostrategies in order to improve the environmental performance of the product/ service.

And finally the **Summary report** which will present the results for the whole process.

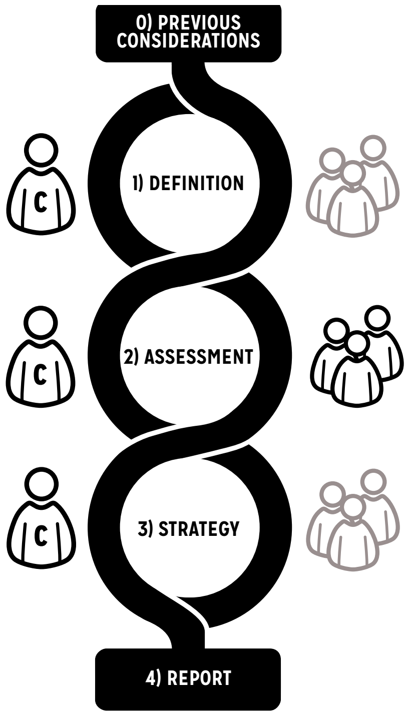


Figure 4. Overview of edTOOL process and team roles.

Figure 5. Team configuration and tasks. The composition of the team will be explained later.

3) How to use edTOOL?

Accessing edTool

edTOOL is web-based tool available for free from http://edTOOL.sostenipra.cat. On this frontpage, the Coordinator will be able to register to the tool by clicking on the 'Login' button (Figure 6). This step will need to be done only once (Figure 7). The system will identify each user of the tool by their e-mail address.

Figure 6. Frontpage of edTOOL (edTOOL.sostenipra.cat)

Figure 7. Registration process.

edTool homepage

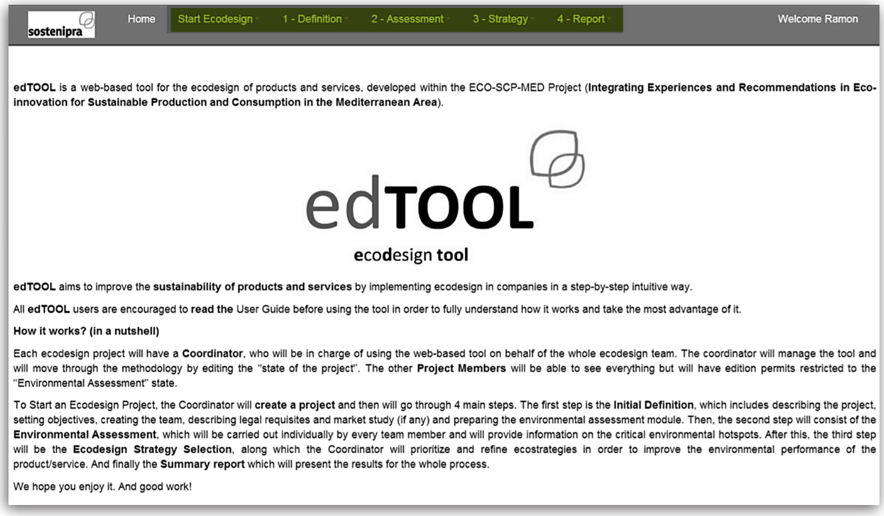


Figure 8. edTOOL homepage.

Once the user is registered, it is directed to the edTOOL Homepage (Figure 8). In this page, a brief description of the tool is presented. On the top of the screen there is a header-menu (green shadowed) that presents the several parts of the methodology, which will be described one by one along the User Guide. This header-menu will always be present throughout the web-tool.

Start ecodesign

To start an ecodesign project, the **Coordinator** will need to go to ‘Start Ecodesign’ and click on ‘New Ecodesign Project’. In this first step, the **Coordinator** will be able to introduce a name for the new project (Figure 9).

Figure 9. Creation of a new ecodesign project project.

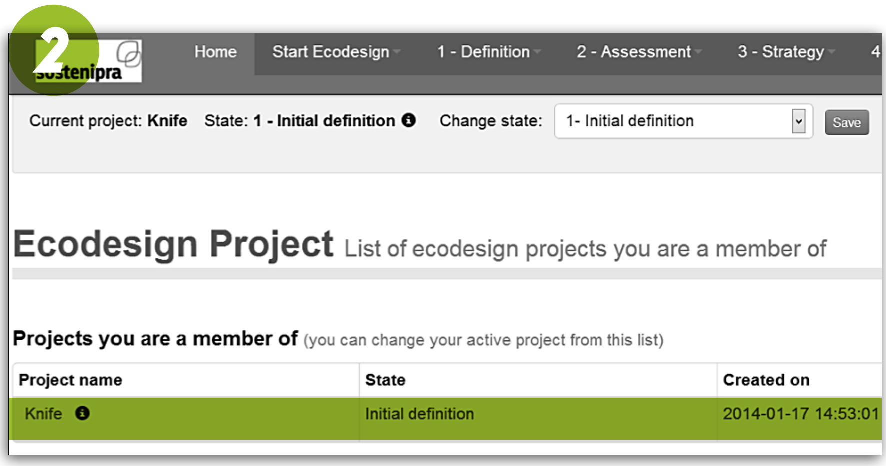


Figure 10. List of ecodesign projects that are managed by the Coordinator.

Once it is introduced, it will appear on a project list that is managed by the Project **Coordinator** (Figure 10). If this is the only project that has been created by the **Coordinator**, it will automatically be considered as the ‘Active’ project.

In case that there are other projects, the **Coordinator** will be able to select the ‘Active’ one from the ‘Start Ecodesign’ menu, by clicking on ‘Select Ecodesign Project’ (Figure 11).

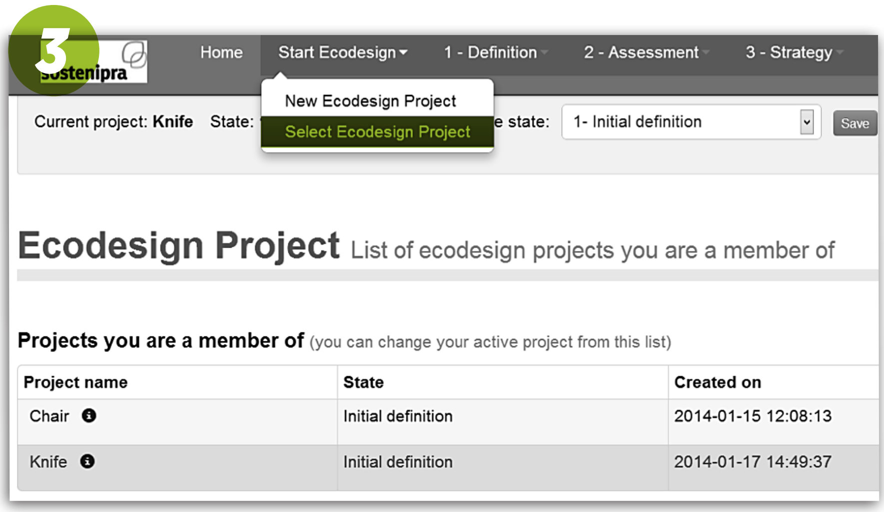


Figure 11. List of ecodesign projects that are coordinated by the Coordinator (several projects available).

Note that once the Coordinator clicks on 'Start Ecodesign', a new menu appears below the header-menu. This new menu, named as 'State menu' from now on (Figure 12), includes information regarding:

Current project: the name of the active project appears here

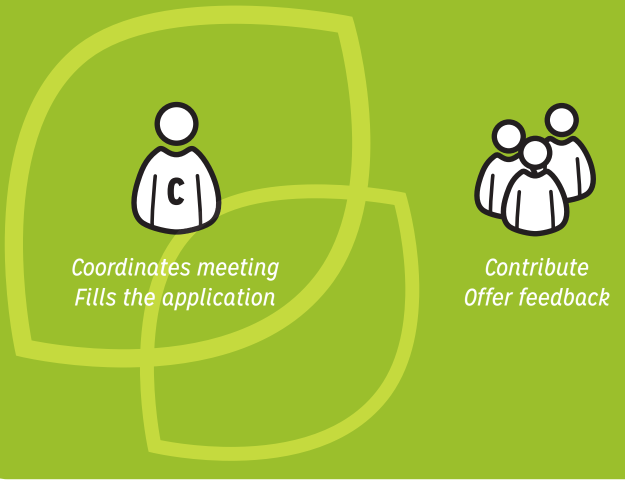
State: edTOOL is based on four different states that are controlled by the Coordinator, namely: *(1) Initial Definition, (2) Environmental Assessment, (3) Strategy Selecction and (4) Summary Report.*

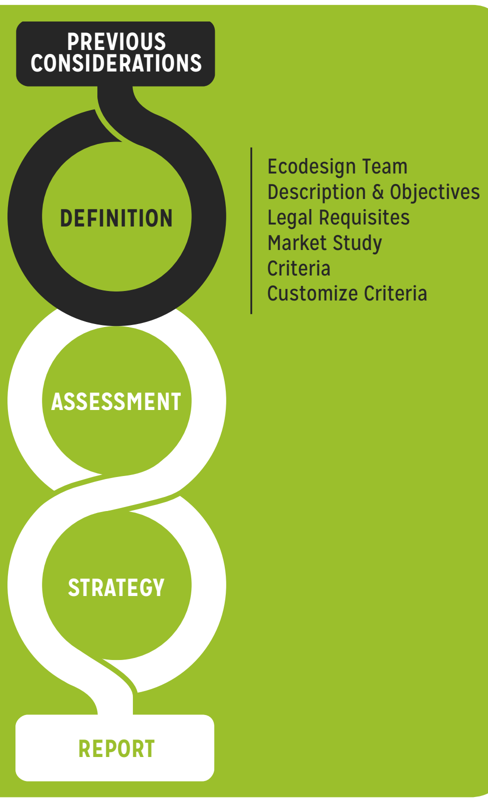
Change State pull-down menu: it allows the Coordinator to change the state of the project (more details about this will come later).

Figure 12. edTOOL state menu, from which the Coordinator controls the State of the project.

4) Step 1: Definition

This step will be useful for the **Coordinator** to define the team, the product/service to be assessed, the legal requisites affecting the product/service, the market environment and the environmental assessment criteria to be tused in next step.





The Initial Definition step is the first step of the methodology and allows the Coordinator to (Figure 13):

- Manage the ecodesign team (add and remove team members.
- Describe the ecodesign project and establish objectives.
- Create and modify legal requisites affecting the product/service.
- Create and modify market studies.
- Customize the environmental assessment criteria to be used later, in State 2, for the environmental assessment of the reference product/service

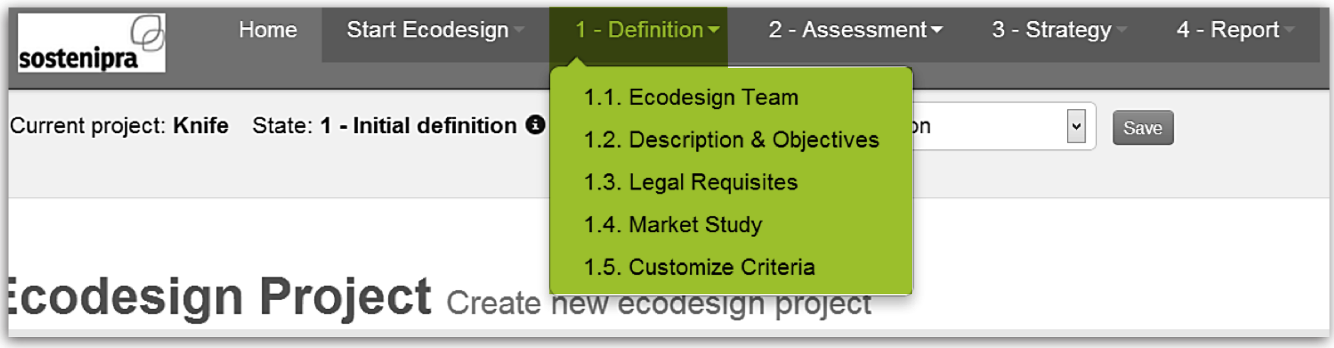


Figure 13. Sections included in Step 1 - Definition.

Start ecodesign

edTOOL is thought to be used by a team of people with different backgrounds and roles. Thus, it is suggested to form teams of at least 5 people, including directors, engineers, marketing and sales, accounting and logistics personnel. In general, the more people representing the whole value chain, the better. From the '1.1 – *Ecodesign Team*' button, the coordinator will be able to introduce the participating in the ecodesign project either staff from the company or external assessors (Figure 14).

To use edTOOL, the team should:

- Have consistent knowledge on the product/service to be ecodesigned and its life cycle. For this reason it is important that the team includes people with different backgrounds, including those experts in charge of the design of the product/service.
- Have a general knowledge on environmental issues

From this section, the **Coordinator** will be able to add members, indicating the information fields shown in Figure 15.

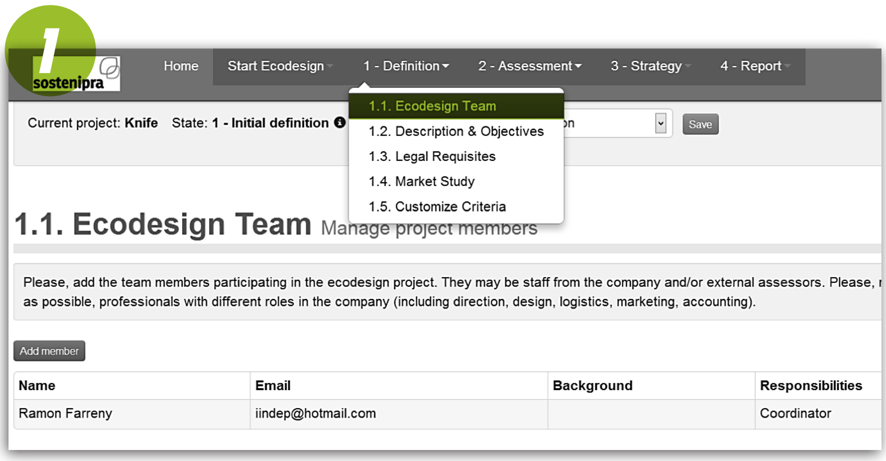


Figure 14 . Ecodesign team page.

Please, note that the e-mail address is used as the main identifier of each edTOOL user.

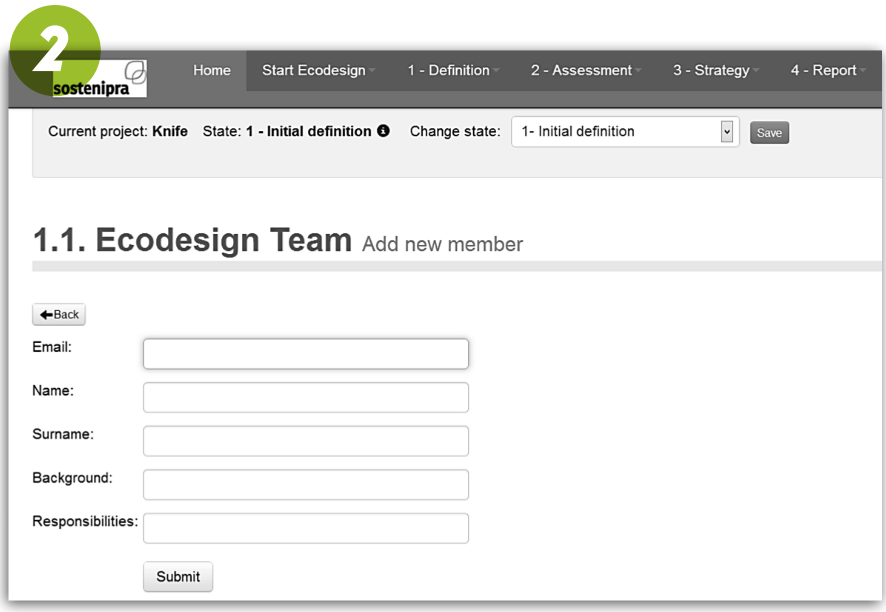
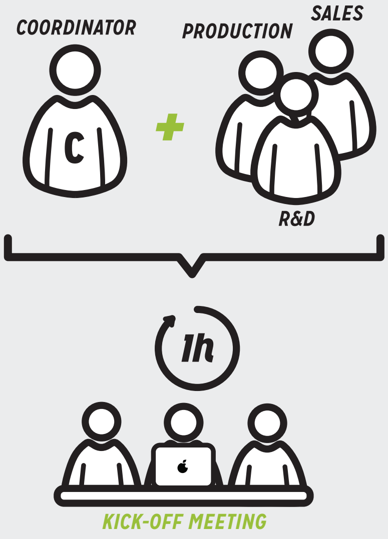


Figure 15 . Addition of new memers to the ecodesign team.

What should we do in our company?

It would be advisable to hold a kick-off meeting in order to present the ecodesign project (including description and objectives) and to introduce all the team members. In addition, this could be useful for the coordinator in order to find support for the development of steps 1.3 and 1.4 of the methodology (Legal requisites and market study) (more details next). This presentation session could be done in 1 hour. An alternative way would be to substitute this meeting by creating a mailing list and sharing the information by this means.



Description & Objectives

The **Coordinator** will describe the product/ service to be ecodesigned and will indicate what are the general objectives pursued with this project (Figure 16). In addition, it will be able to add the logo of the company and an image related to the product/service.

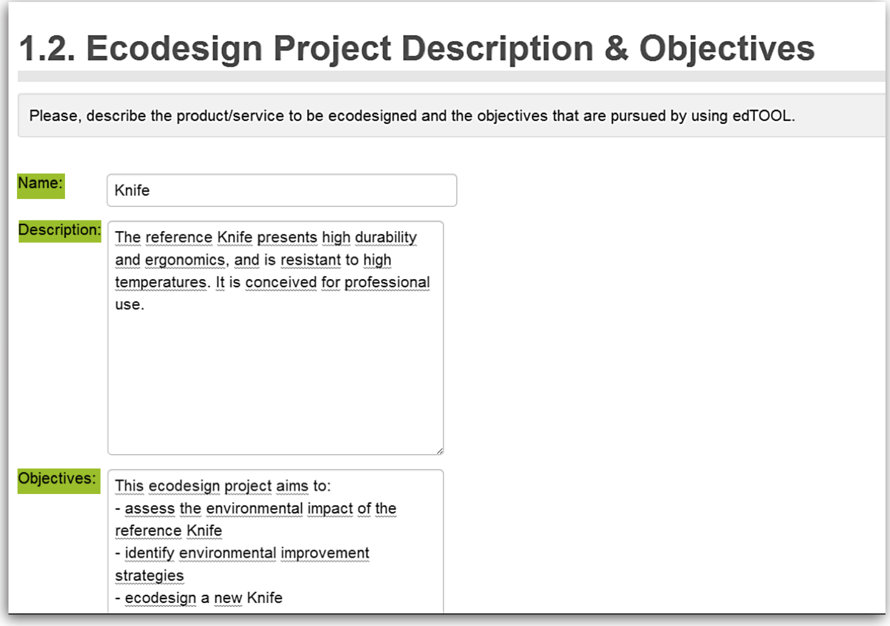


Figure 16. Ecodesign project description and objectives.

ARCOS

Image of the knife to be ecodesigned and logo of the company.

Make sure that the images have a maximum size of 300x300 pixels (no restrictions for image resolution).

Legal requisites

This is an **optional** Step. In this Step, the **Coordinator** will be able to describe the most important legislation and regulations affecting the product/service, which will need to be considered when thinking of potential strategies and new ecodesigned concepts (Figure 17).

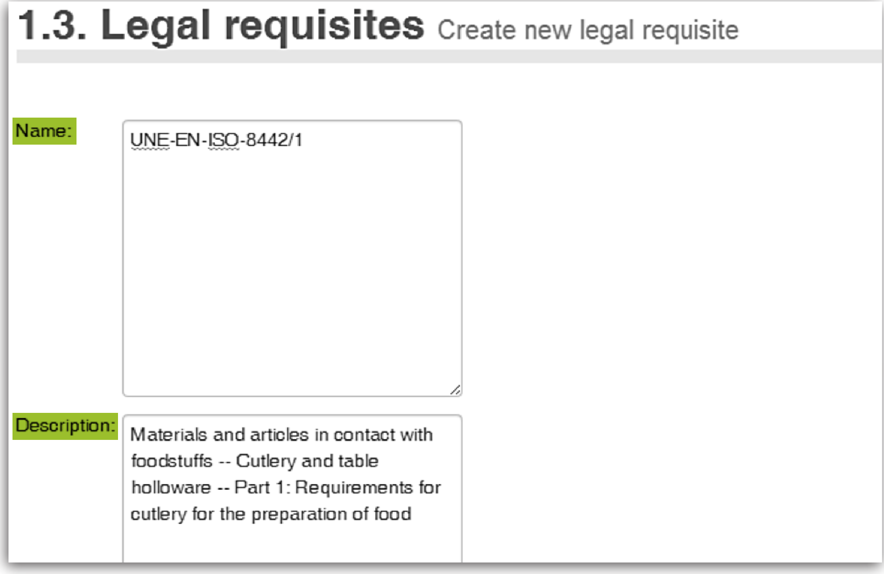


Figure 17. Legal requisites.

Market study

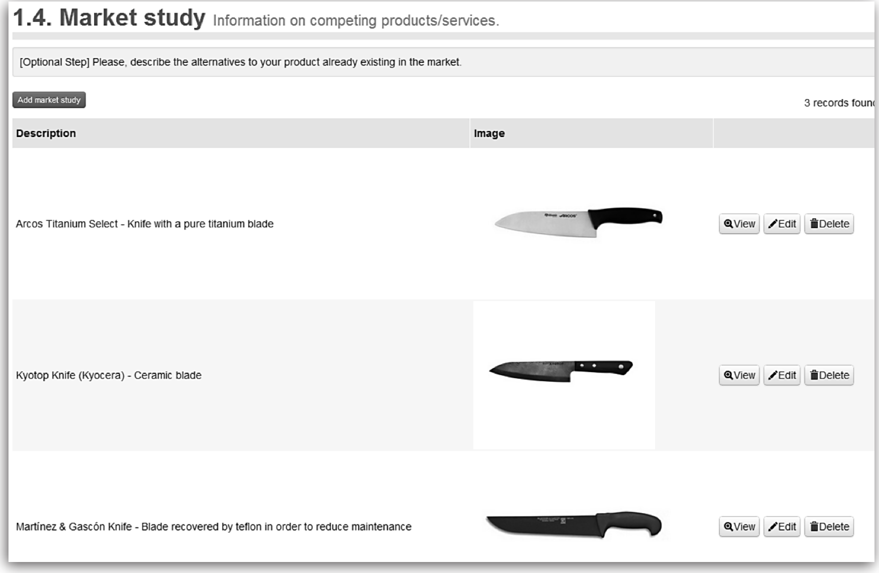


Figure 18. Market study.

This is an **optional** Step. In this Step, the **Coordinator** can introduce a description and image of the related products/ service existing in the market, result of a Market Study (Figure 18).

Customize criteria

This Step consists of a preparation for the Environmental Assessment that will be performed by means of a **Qualitative Assessment of Life Cycle Criteria**. This is a qualitative environmental assessment tool based on the study of life cycle stages. In brief, this tool places in a spider web diagram the various life cycle stages and shows a score which is representative of the degree of environmental performance of each stage against several criteria that characterize them.

This environmental assessment starts with a definition of the life cycle stages of the analysed product or service. Here edTOOL presents a table which includes the most common life cycle stages for any product/service, as seen in Figure 19.

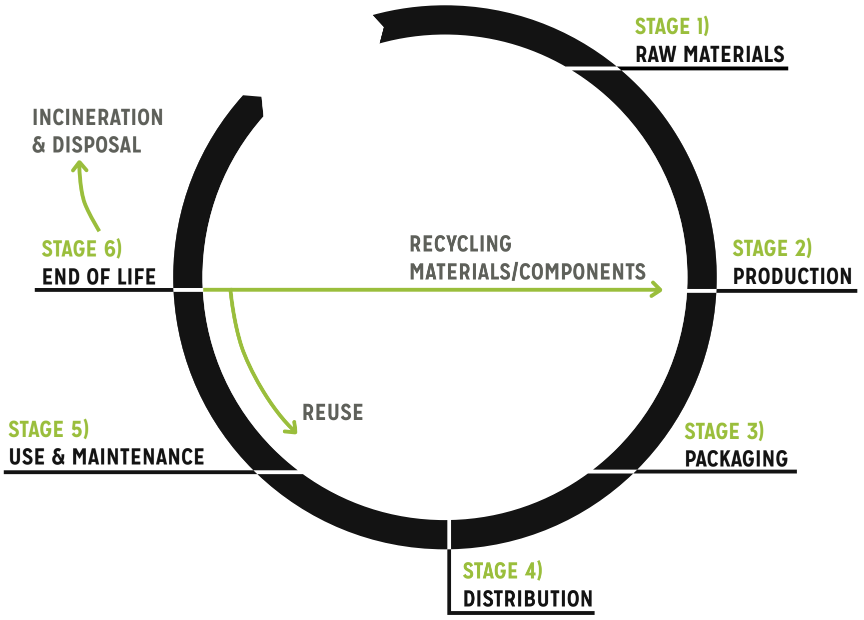


Figure 19. Life cycle stages of a typical product.

Then, after the definition of life cycle stages, it is time to select relevant life cycle criteria that will be later assessed in environmental terms (in the following steps). For each life cycle stage, a selection of default life cycle criteria is presented, which will be used in order to perform an environmental assessment of the reference product/service (Figure 20). The criteria included in the table should be adapted to each project.

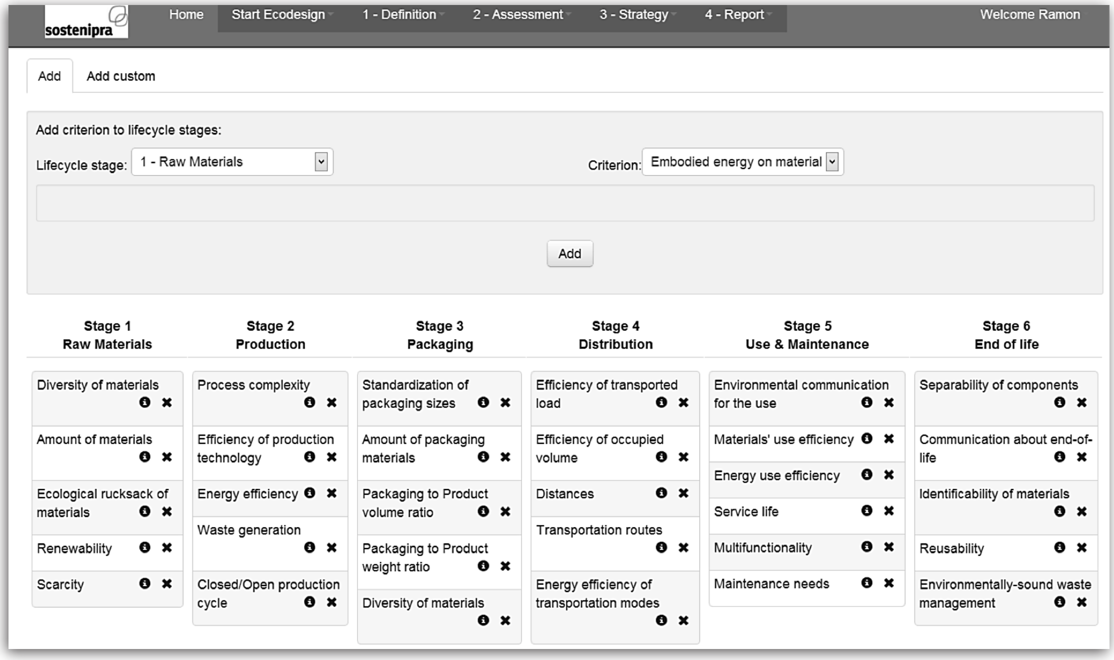


Figure 20. Customization of life cycle criteria.

The **Coordinator** will be in charge to customize the life cycle criteria on behalf of the whole ecodesign team. Thus, he/she will be able to remove some of the default life cycle criteria or add new ones. Additional life cycle criteria can be added from a predefined list with other criteria, available under the Add label (Figure 21), our new customized criteria can be created under the Add custom label (Figure 22). Note that the newly created criteria will be available only for that project, and will not be visible for other projects.

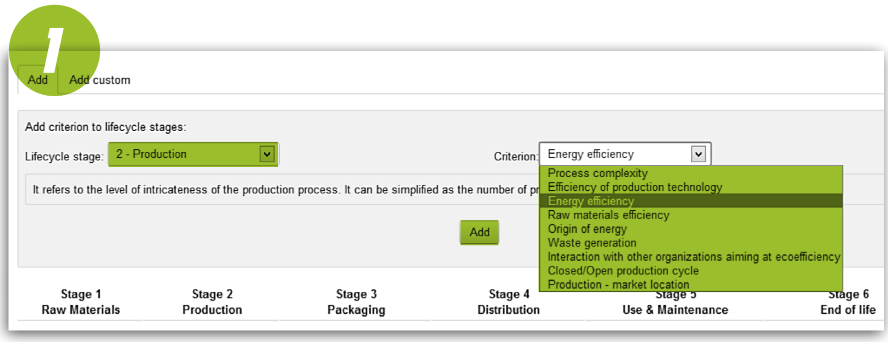


Figure 21. Addition of pre-defined life cycle criteria.

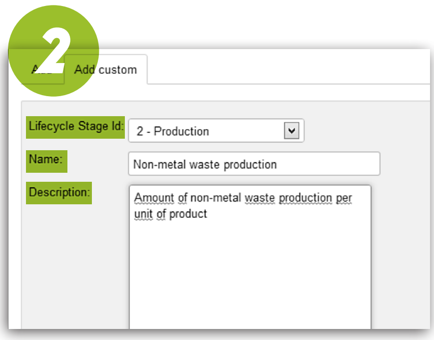


Figure 22. Addition of customized life cycle criteria.

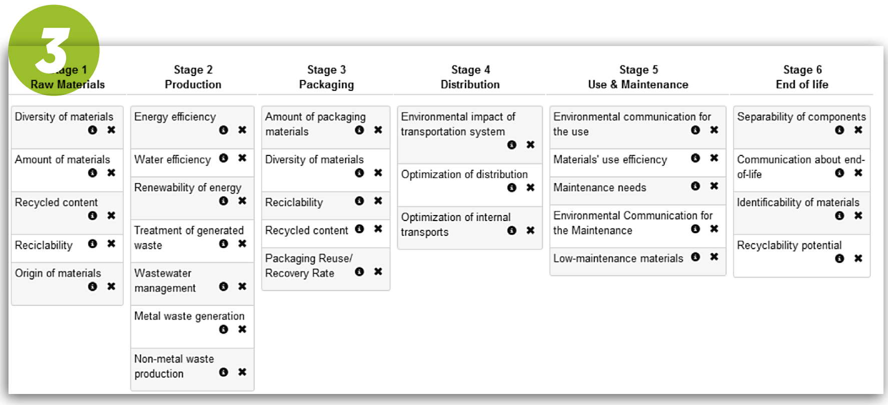
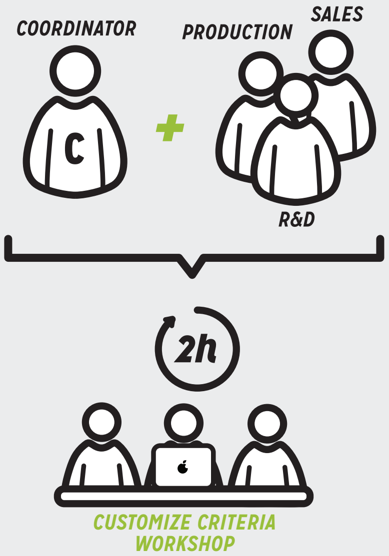


Figure 23. Selection of life cycle criteria, after the customization process.

For the team guidance, note that Annex C includes a list of potential life cycle criteria and a brief description of each of them.

What should we do in our company?

The process of criteria customization should be done in a **workshop session (about 2 hours) with the whole ecodesign team (coordinator + team members)**. The Project **Coordinator** should have prepared himself for this workshop by looking at all the potential life cycle criteria available in edTOOL. During the workshop, the Coordinator will be able to participate in the discussion like any other member but, at the same time, he/she will have the role of facilitator/moderator. The aim of the workshop will be to reach an agreement on **what are the most relevant life cycle criteria** for the product/service under study. This implicitly means that all **team members** will understand the meaning of each life cycle criteria (since it is expected that later each of the members will individually assess each criteria). During or after the workshop, the **Coordinator** will customize the criteria in the edTOOL **webpage**.



Special case #1

Product vs Service ecodesign

edTOOL can be used for the ecodesign of products and services. However, applying ecodesign to products is more straightforward, since in general it is easier to think about the life cycle stages of a product than of a service.

edTOOL suggest a set of typical life cycle stages (*raw materials › production › packaging › distribution › user maintenance › end of life*) that can not be edited (and that fit with most products). In the case of a service, one may face difficulties in understanding and identifying the life cycle stages (for example, in the case of a dry cleaner's service, what could be considered as packaging or distribution?). However, one has to keep in mind that all services are supported to a certain extent on a material base (e.g. infrastructure, consumables, etc.), which can incorporate ecodesign criteria. Therefore, one should think of this material base and think of the related life cycle stages.

In the case of a dry cleaner's service, the approach could be as follows (orientative description):

1. **Raw materials**: it may include the materials to obtain the washing machines and other consumables (e.g. infrastructure materials).
2. **Production**: it may include the production processes to obtain the washing machines and other consumables (e.g. infrastructure construction).
3. **Packaging**: it may include the bags used to protect the clean and ironed clothes.
4. **Distribution**: it may include, if existing, the service for transporting the clean clothes to the client's place.
5. **Use & Maintenance**: it may include those aspects related to the operation of the laundry (energy consumption, waste waster generated, maintenance tasks, etc.).
6. **End of life**: it may include those aspects related to the management of old washing machines, etc. (e.g. infrastructure end of life).

Special case #2

What if I have less life cycle stages? The case of a wooden box

As mentioned earlier, edTOOL suggests a set of typical life cycle stages (*raw materials › production › packaging › distribution › user maintenance › end of life*).

However, it may happen that some of these life cycle stages are not useful for the ecodesign of a given product or service. For example, in the case of a wooden box for containing wine bottles, the 'use and maintenance' stage would not be of interest, since there may not be environmental aspects related to this stage. If this is the case, edTOOL provides a solution which consists on deleting all life cycle criteria related to such life cycle stage within the Customize criteria step. Then, nobody would be able to assess that life cycle stage and it would not be represented in the environmental assessment results (spider diagram).

See more details on this by looking at the **Wooden Box Case Study** (Annex B).

Once the Coordinator has finished the life cycle criteria customization (Figure 23), he/she will be able to change the state of the project to 2 – *Environmental Assessment* (Figure 24) from the State Menu. By doing so, all team members will be able to proceed with the environmental assessment of each of the life cycle criteria selected.

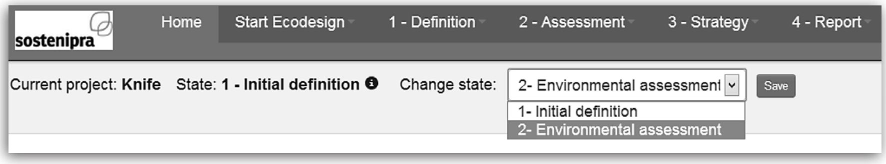
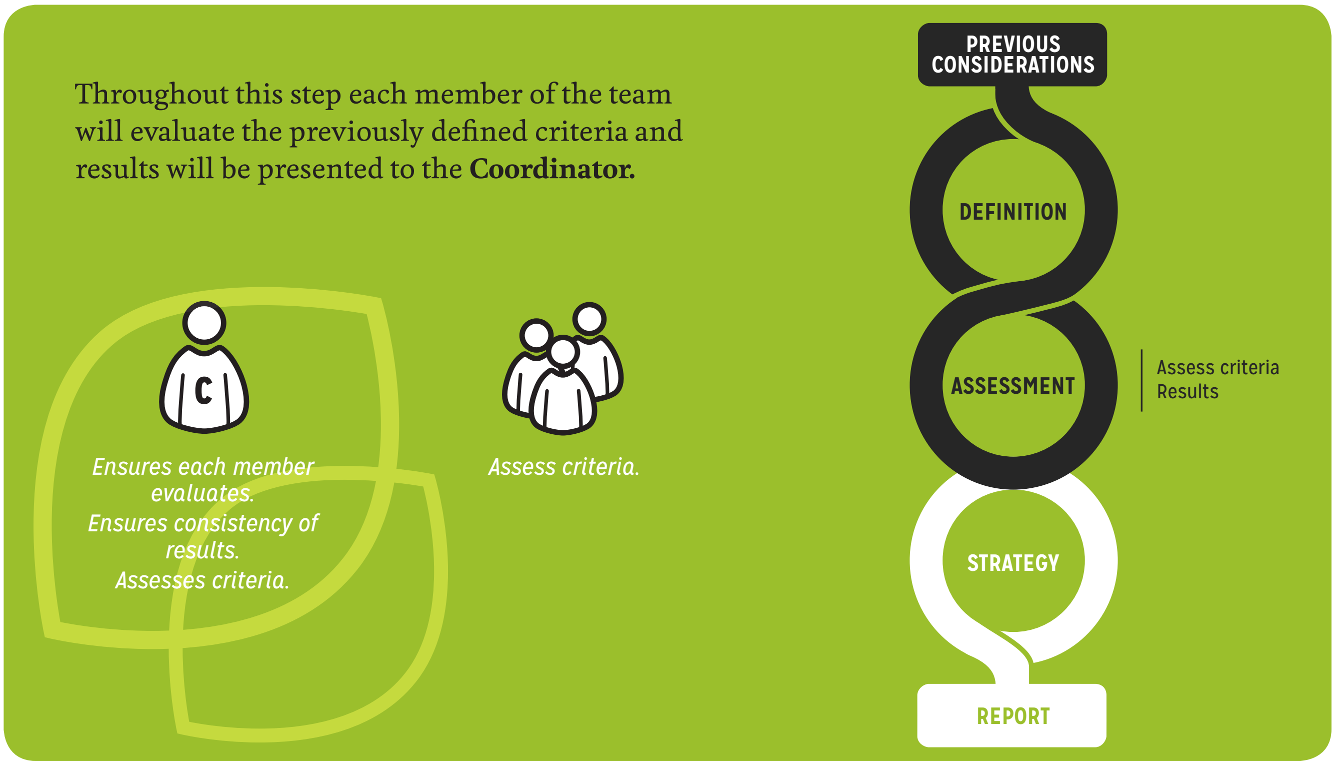


Figure 24 . Change State process (from 1- Initial Definition to 2 – Environmental Assessment)

5) Step 2: Environmental assessment



The Environmental Assessment state is the second step of the methodology (Figure 25). In this step, the **Coordinator** and all **Team Members** can make an assessment of the life cycle criteria previously defined.

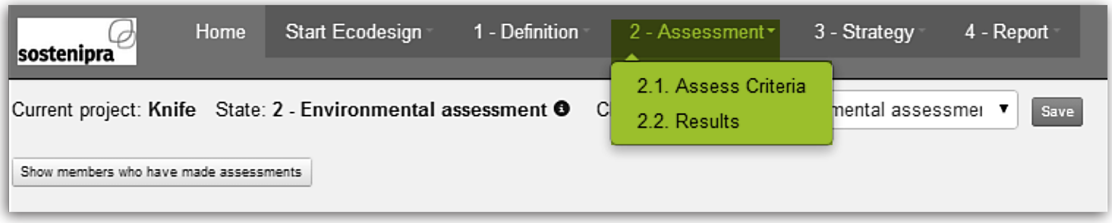


Figure 25. Sections included in Step 2 - Assessment.

Assess criteria

Once the criteria for the Qualitative Assessment of Life Cycle Criteria are agreed, each ecodesign team member can access to step 2.1 and assess the criteria. To do so, they will use the scale from 1 to 5 (being 5 the best score and 1 the worse) (Figure 26). This assessment should be made based on an informed knowledge and avoiding subjectivity as much as possible. In case that information is not available or the user is unsure about what score should be given to a particular criteria, he/she shall write a ‘0’.

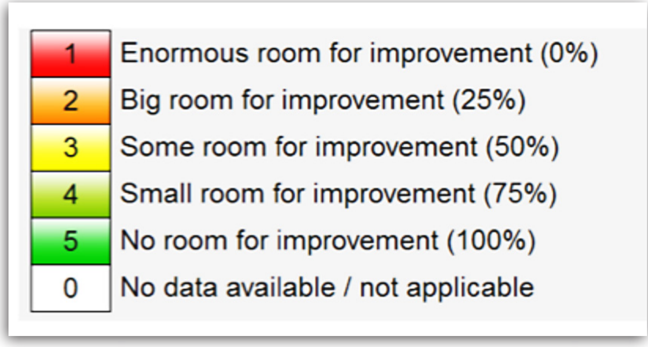


Figure 26. Scale used for the assessment of life cycle criteria.

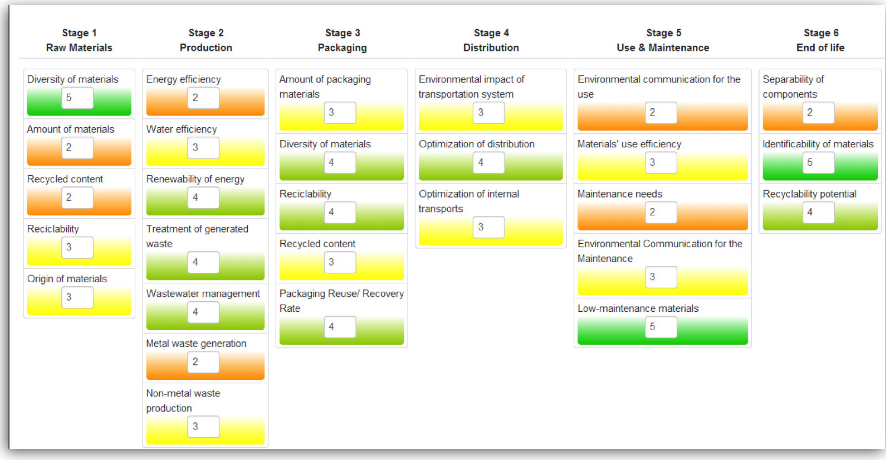


Figure 27. Environmental Assessment of Life Cycle Criteria.

After writing down all criteria (Figure 27), please click on the ‘Save’ button. Note that empty cells are not allowed (they should have either a score between 1 and 5 or a 0).

Once all the ecodesign **team members** (**Coordinator** included) have assessed the life cycle criteria, the project will be ready to move to the next phase. The Coordinator will be able to check if the members of the team have made the assessment by clicking on the ‘Show members who have made assessments’ button (Figure 28).

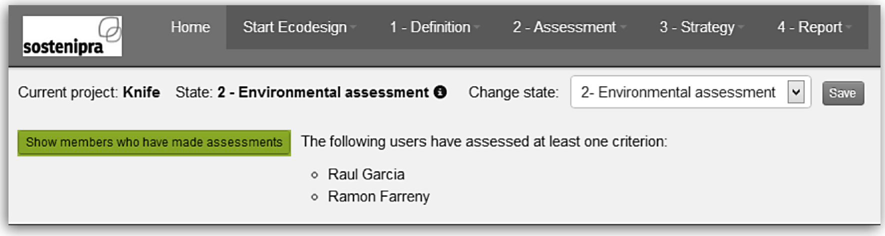


Figure 28. Review of members that have already assessed the life cycle criteria.

What should we do in our company?

The process of **life cycle criteria assessment is made individually** by each ecodesign team member (including the **coordinator**). It is strongly suggested that this assessment is not made later than one week after the 'Customize criteria' workshop (ideally, it could be made just after that workshop). However, since this is an individual activity, the **Coordinator** may decide how much time is left for doing the assessment. It is recommended that the **Coordinator** reminds the **team members** to do the assessment within the expected deadline. On the other hand, it is also important that **each individual does the assessment all in once**, in order to maintain the same 'individual assessment scale' when giving scores to all life cycle criteria. This individual **assessment in one go should not take more than one hour**.

Results

The results of the environmental assessment are made available to the **Coordinator** and the rest of the team only once the **Coordinator** changes the state to '*3-Strategy Selection*' (Figure 29). Just after changing the state, the Results will be made available for consultation.

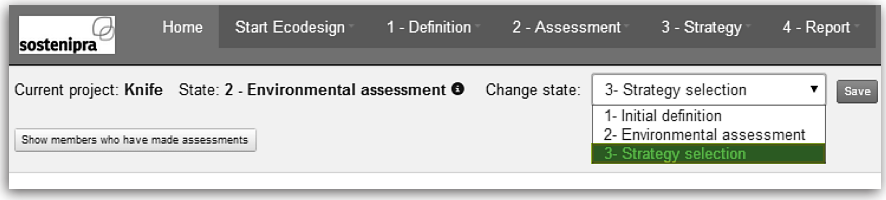


Figure 29. Change State process (from 2- Environmental Assessment to 3- Strategy Selection).

The results of the environmental assessment for the product/ service are presented in a summary table. This table shows the average score for each life cycle criteria and life cycle stage (Figure 30).

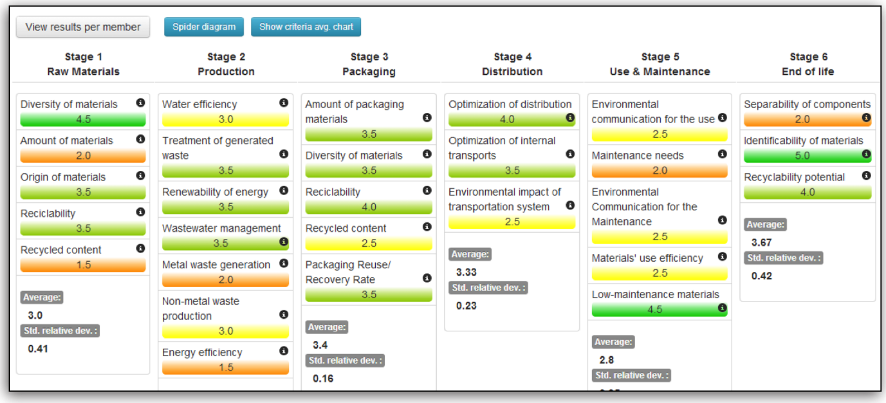


Figure 30. Average results of the environmental assessment.

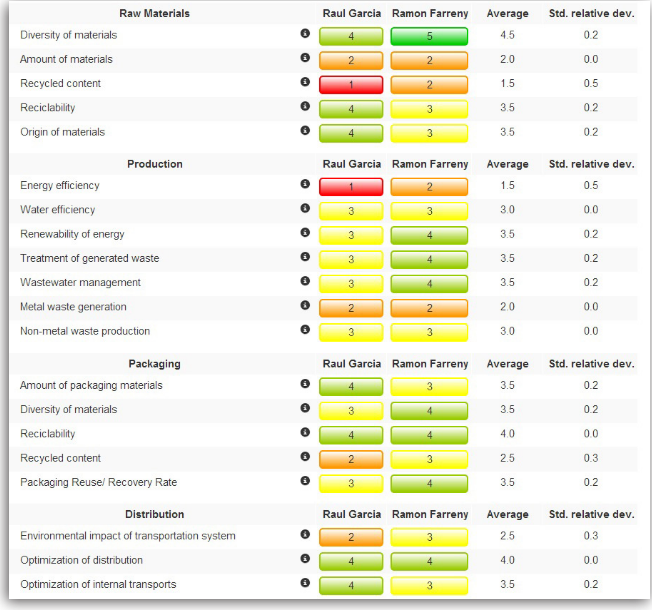
In addition, individual results from each member can be checked by clicking on the 'View results per member' button (Figure 31).

Figure 31. Result visualization alternatives.

There, the is able to assess if the scores are relatively similar among the team or if there is a big heterogeneity (Figure 32) .

A useful indicator of this heterogeneity is the standard relative deviation of the answers for each life cycle criteria, which is provide when viewing results per member. If necessary, the Coordinator could ask the team to revise their scores. To do so, the state of the project should be moved back to *2- Environmental Assessment.*

Besides, two graphic representations of the results are available: the 'spider diagram' (Figure 33) and the 'criteria averages chart' (Figure 34).



Raw Materials	Raul Garcia	Ramon Farreny	Average	Std. relative dev.
Diversity of materials	4	5	4.5	0.2
Amount of materials	2	2	2.0	0.0
Recycled content	1	2	1.5	0.5
Reciclability	4	3	3.5	0.2
Origin of materials	4	3	3.5	0.2
Production	**Raul Garcia**	**Ramon Farreny**	**Average**	**Std. relative dev.**
Energy efficiency	1	2	1.5	0.5
Water efficiency	3	3	3.0	0.0
Renewability of energy	3	4	3.5	0.2
Treatment of generated waste	3	4	3.5	0.2
Wastewater management	3	4	3.5	0.2
Metal waste generation	2	2	2.0	0.0
Non-metal waste production	3	3	3.0	0.0
Packaging	**Raul Garcia**	**Ramon Farreny**	**Average**	**Std. relative dev.**
Amount of packaging materials	4	3	3.5	0.2
Diversity of materials	3	4	3.5	0.2
Reciclability	4	4	4.0	0.0
Recycled content	2	3	2.5	0.3
Packaging Reuse/ Recovery Rate	3	4	3.5	0.2
Distribution	**Raul Garcia**	**Ramon Farreny**	**Average**	**Std. relative dev.**
Environmental impact of transportation system	2	3	2.5	0.3
Optimization of distribution	4	4	4.0	0.0
Optimization of internal transports	4	3	3.5	0.2

Figure 32. Results of the environmental assessment per member.

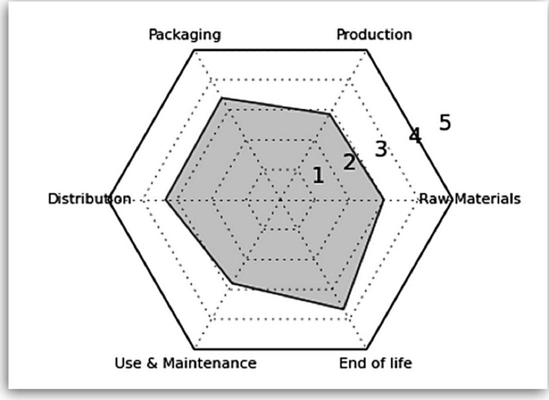


Figure 33. Spider diagram.

The spider diagram is useful to see which are the life cycle stages with the lowest environmental performance. In the example one can see that '*Use & Maintenance*' and '*Production*' present the lowest scores. On the contrary, the '*End of life*' stage presents the highest score.

On the other hand, the 'criteria averages chart' shows the average score of each life cycle criteria, sorted in an ascendant order. This means that this chart will highlight the criteria with lowest score on the left side and the ones with the highest score on the right one. In addition, the bar colour corresponds to the life cycle stage.

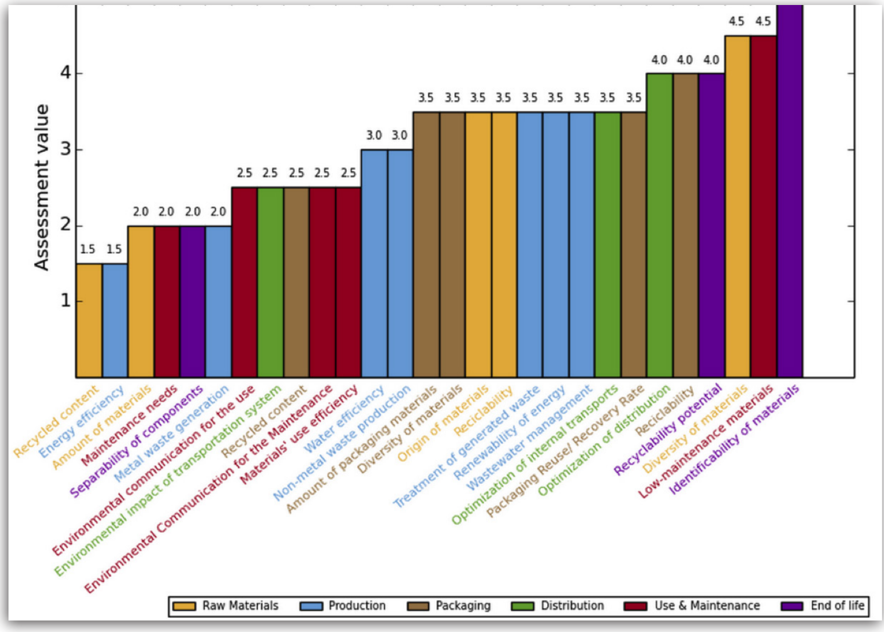


Figure 34. criteria averages chart.

What should we do in our company?

A workshop with the whole ecodesign team should be made once the results are available. The time between the previous workshop (*step 1.5*) and this one should not exceed 10 days, in order to keep all the ideas and criteria in mind. This workshop will be useful for presenting the results and discussing them (it could take 1 hour).

In addition, this workshop could be extended to a whole-morning session in order to go through the following steps of the methodology (selection and prioritization of ecodesign strategies, see '*Ecodesign strategies workshop*' later).

Special case #3

What if we have other environmental impact assessement studies (e.g. LCA) ?

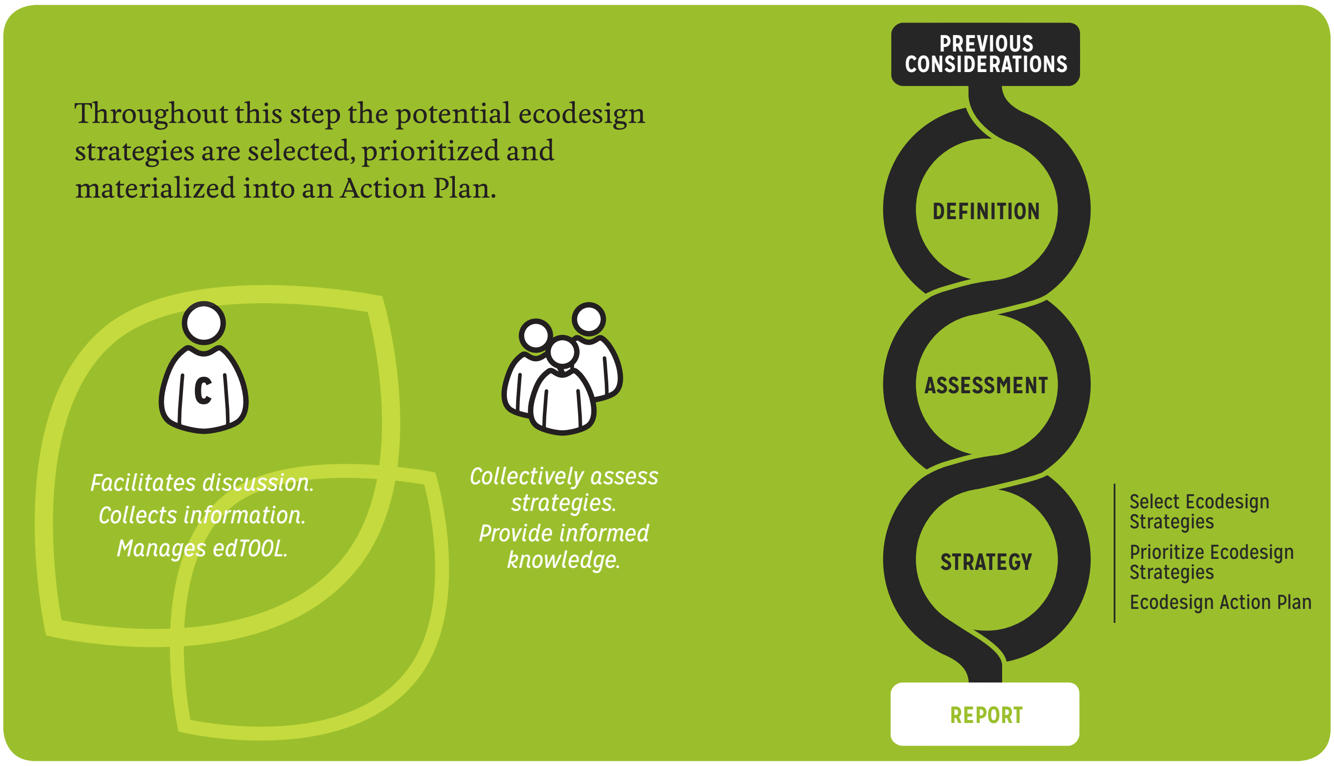
The Qualitative Assessment of Life Cycle Criteria is an easy and quick way to perform an environmental assessment. The main pros for this tool are that it introduces the life cycle concept, the diagram is easy to read for unfamiliar professionals and facilitates the communication of improvements. In contrast, it is a quite subjective tool whose results depend on the capacity and experience of the team. Additionally, it does not show the importance of each life cycle stage, as they are equally weighted. For this reason, it may be advisable to use other environmental assessment tools for a more rigorous assessment, such a Life Cycle Assessment (LCA).

LCA is a process to evaluate the environmental burdens associated with a product, process, or activity by identifying and quantifying energy and materials used and wastes released to the environment; to assess the impact of those energy and materials used and releases to the environment; and to identify and evaluate opportunities to affect environmental improvements. The assessment includes the entire life cycle of the product, process or activity, encompassing, extracting and processing raw materials; manufacturing, transportation and distribution; use, re-use, maintenance; recycling, and final disposal.

In case that a LCA study is available for the product/service under study, the **Coordinator** is encouraged to compare its results with the ones obtained with edTOOL. In case that there is a divergence between methodologies in the life cycle stages accumulating more impact, the **Coordinator** should take it into account it and make some amendments to the list of potential ecodesign strategies suggested in *Step 3.1*. As it will be seen next, edTOOL presents a list of strategies referring to the 2 most impacting life cycle stages based on the Qualitative Assessment of Life Cycle Criteria. In particular, the Coordinator will need to manually include the set of strategies related to the life cycle stages that have not been considered more impacting according to edTOOL but have appeared to have a substantial impact based on the alternative impact assessment study.

See more details on this by looking at the Jacket Case Study (Annex B).

6) Step 3: Strategy



The Strategy Assessment state is the third step of the methodology. Within this state, edTOOL suggests a series of ecodesign strategies that shall be selected and prioritized by the whole ecodesign team, and then an Action Plan shall be defined (Figure 35).

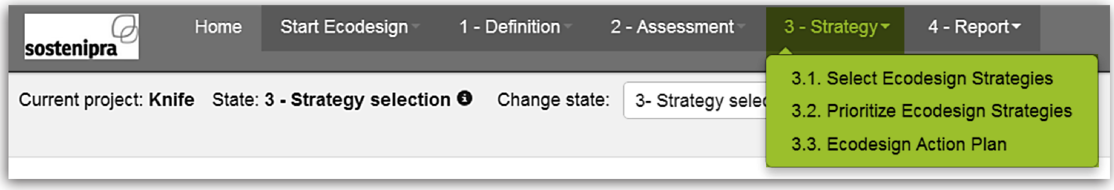


Figure 35. Sections included in Step 3 - Strategy.

Select ecodesign strategies

edTOOL includes a database of generic environmental improvement strategies that could be applied to ecodesign products and services, which are grouped according to what life cycle stage they correspond to. Taking this into account, edTOOL suggests a set of environmental improvement strategies focused on the **two life cycle stages with worse environmental performance** (according to the results of the environmental assessment).

Then, the **Coordinator** will need to navigate through the set of suggested strategies with the collaboration of the whole team and check if the strategies:

- Are **appropriate** for the assessed product/service, meaning that it does make sense to implement such strategy in the product/service under study.

- Have already been **completed** for the product/service under study, meaning that such strategies have already been applied.

Only those strategies that are marked as Appropriate and that are not marked as Completed will be considered for further evaluation.

In addition, the **Coordinator** will be able to add other predefined strategies offered by edTOOL that correspond to the other life cycle stages. To do so, the **Coordinator** shall click on the '*Add Strategy label*' and look for those strategies that could be of interest (Figure 36). For example, in the *Knife Case Study* shown in this Guide, some strategies for the '*Raw materials*' stage are included, since it was the third life cycle stage with worse environmental performance.

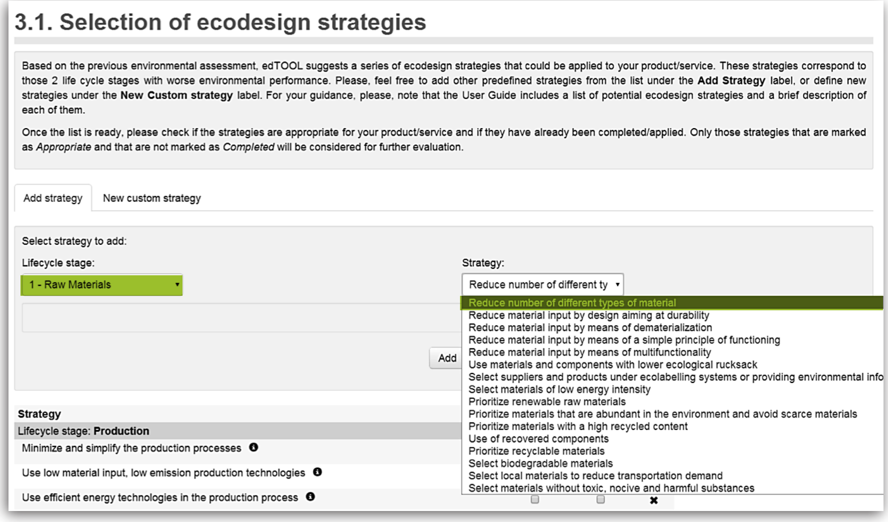


Figure 36 . Addition of strategies to the list of potential environmental improvement strategies.

Furthermore, the **Coordinator** can define new strategies under the '*New Custom strategy*' label for any of the life cycle stages.

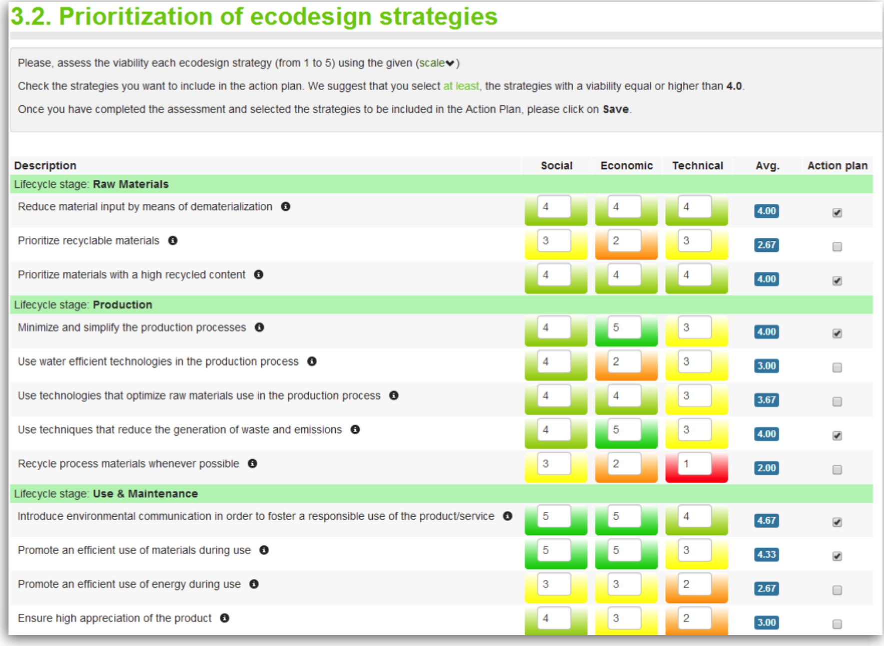
Prioritize ecodesign strategies

Then, the **Coordinator** can move to the header menu and select '*3.2 – Prioritize ecodesign strategies*' in order to apply the previous filter based on appropriateness and completeness of strategies. This will reduce the list of environmental improvement strategies to a more manageable set, which will be assessed in social, economic and technical terms within this step.

This assessment will consider a viability scale from 1 to 5, being 1 the worst score and 5 the best (Figure 37). Carrying out this assessment means that the whole team discusses the social, economic and technical implications of implementing each of the strategies, and gives a score to each of these parameters.

After assessing these three '*viability parameters*', the average score is given on the column with blue cells.

Then, it is time that the team decides which strategies will be considered for the Action Plan, which will be translated in specific actions to be undertaken. It is suggested that, at least, those strategies with an average viability higher than 4 are included in the Action Plan (Figure 37).


3.2. Prioritization of ecodesign strategies

Please, assess the viability each ecodesign strategy (from 1 to 5) using the given (scale)

Check the strategies you want to include in the action plan. We suggest that you select at least, the strategies with a viability equal or higher than **4.0**.

Once you have completed the assessment and selected the strategies to be included in the Action Plan, please click on **Save**.

Description	Social	Economic	Technical	Avg.	Action plan
Lifecycle stage: **Raw Materials**					
Reduce material input by means of dematerialization	4	4	4	4.00	☑
Prioritize recyclable materials	3	2	3	2.67	☐
Prioritize materials with a high recycled content	4	4	4	4.00	☑
Lifecycle stage: **Production**					
Minimize and simplify the production processes	4	5	3	4.00	☑
Use water efficient technologies in the production process	4	2	3	3.00	☐
Use technologies that optimize raw materials use in the production process	4	4	3	3.67	☐
Use techniques that reduce the generation of waste and emissions	4	5	3	4.00	☑
Recycle process materials whenever possible	3	2	1	2.00	☐
Lifecycle stage: **Use & Maintenance**					
Introduce environmental communication in order to foster a responsible use of the product/service	5	5	4	4.67	☑
Promote an efficient use of materials during use	5	5	3	4.33	☑
Promote an efficient use of energy during use	3	3	2	2.67	☐
Ensure high appreciation of the product	4	3	2	3.00	☐

Figure 37. Assessment of the viability of potential strategies and selection of those to be included in the Action Plan

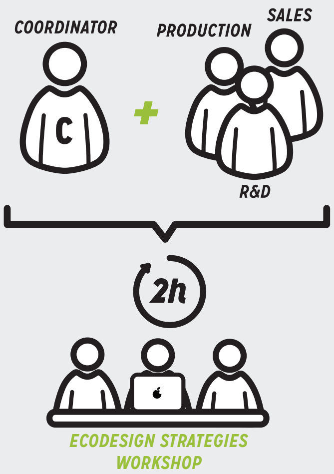
Only once the strategies are assessed and those to be included in the Action Plan are selected, the **Coordinator** will click on the 'Save' button. This will move to the next step, which is the Ecodesign Action Plan. Arriving at this point of the methodology is, in itself, an achievement, since it means that the team has obtained a list of ecodesign strategies that should be implemented.

What should we do in our company?

The selection and prioritization of strategies should be done in a **workshop session with the whole ecodesign team (coordinator + team members)**. This workshop session could be integrated with the '*Environmental Assessment Results workshop*' (total time: one morning/ afternoon).

For this workshop, it is of great importance that the Project **Coordinator** has prepared himself by looking at all the potential ecodesign strategies available in edTOOL (see Annex C), which will be useful during the discussion and while managing the web-based edTOOL.

During the workshop, the **Coordinator** will be able to participate in the discussion like any other member but, at the same time, he/she will have the role of facilitator/moderator and will introduce changes to edTOOL on behalf of the whole team. During discussion, argumented opinions will be encouraged. The aim of the workshop will be (**1**) to make a selection of ecodesign strategies and (**2**) to prioritize the selected ones and eventually decide those that will be object of further work in the Action Plan.



Ecodesign Action Plan

The Ecodesign Action Plan is the last step before obtaining a report with the results. The development of an Ecodesign Action Plan may require substantial amount of time and efforts, since it consists of materializing the ecodesign strategies into specific and concrete actions. For this reason, the Ecodesign Action Plan may be considered as a ‘Plus’ step, meaning with this that it is expected that some organizations will skip the Action Plan while others –those with higher commitment or more available resources - will develop it.

In this step, the team will define concrete actions to be carried out in order to implement the selected ecodesign strategies, establish responsibilities and deadlines. Therefore, for each strategy, the **Coordinator** will be able to introduce one or more actions (Figure 38). It is possible that two different strategies can be implemented simultaneously by one action or, on the contrary, that one strategy results in several actions.

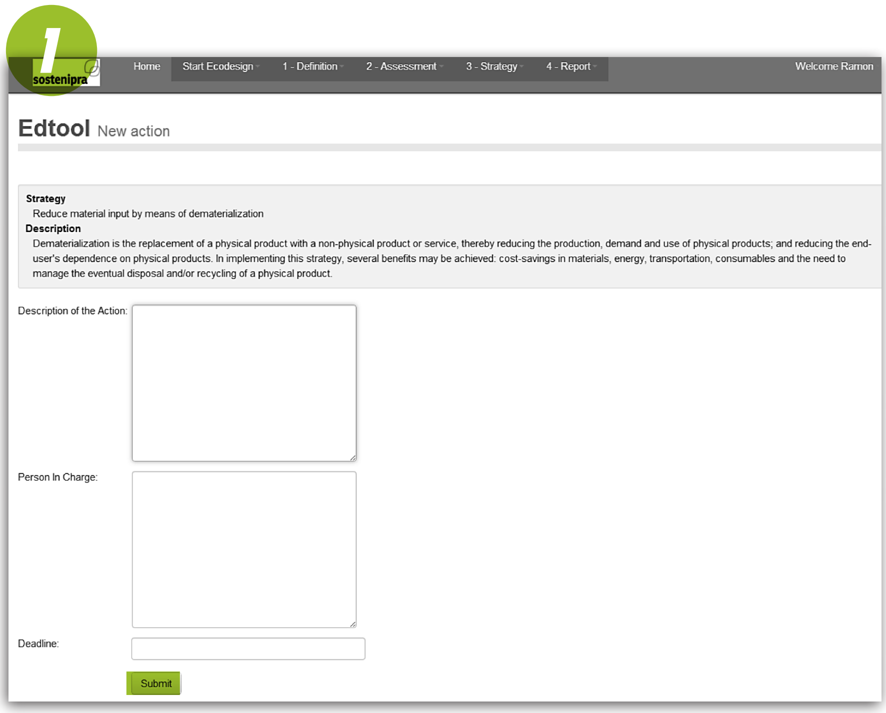


Figure 38. Description of actions within the Action Plan.

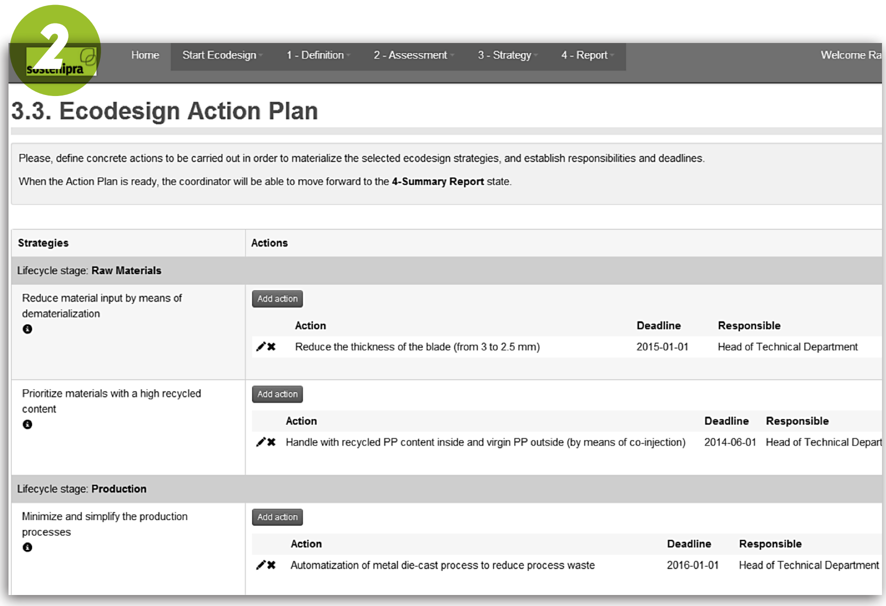


Figure 39. Action plan.

As a result of this, an Action Plan for the ecodesign of the product/service is obtained (Figure 39).

This Action Plan is the main result of the ecodesign process, since it includes the Actions to be implemented in order to increase the environmental performance of the product/service. In addition, it shows the person in charge of applying the actions and a deadline.

Once the Action Plan is completed the Coordinator will be able to move to the last Step of the Project, by changing the State to '4 – *Report*' (Figure 40).

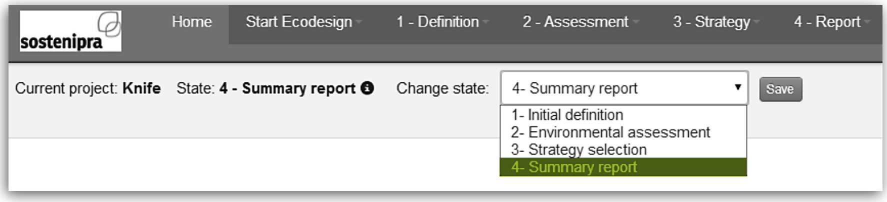


Figure 40. Change State process (from 3- Strategy Selection to 4 – Summary Report).

7) Step 4: Report

The Report is the final step of the methodology, in which the Coordinator will be able to obtain a predefined summary report or create a customized one (Figure 41).

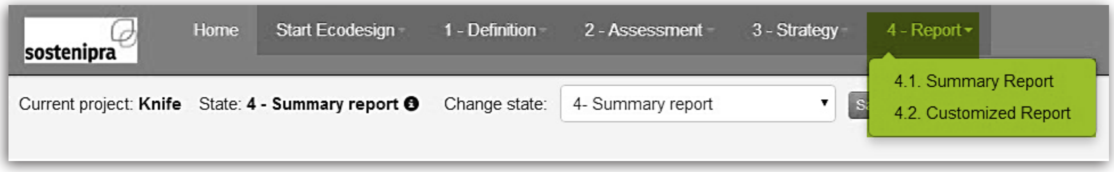


Figure 41. Sections included in Step 4 - Report.

edTOOL provides two types of Report, the so-called '*Summary Report*' that is composed of a pre-determined set of parts of the methodology, and a Customized Report, whose content can be tailored to each project.

Summary report

The contents of the Summary report are pre-established in order to provide a common means of reporting the results of the implementation of edTOOL, which includes the most relevant steps and information (Figure 43): Ecodesign Team, Description & Objectives, Environmental Assessment, Spider diagram and Action Plan.

This Report could be used to summarize the ecodesign project. The report can be printed or converted into a .pdf file by clicking on the 'Print Report' button.

edTOOL ecodesign tool

Knife

Ecodesign Team

Name	Email	Background	Responsibilities
Ramon Farreny	iindep@hotmail.com	CEO	Coordinator
Raul Garcia	raul@ineditinnova.com	Industrial Designer	Conceptual design
Esther Sanye	esther.sanye@uab.cat	Environmental Sciences	Environmental Assessment

Report print date: **2014-02-04**

Company logo	Product image

ARCOS

Description & Objectives

Description	The reference Knife presents high durability and ergonomics, and is resistant to high temperatures. It is conceived for professional use.
Objectives	This ecodesign project aims to: - assess the environmental impact of the reference Knife - identify environmental improvement strategies - ecodesign a new Knife

Lifecycle Assessment

Stage 1 Raw Materials
- Diversity of materials 4.5
- Amount of materials 2.0
- Origin of materials 3.5
- Reciclability 3.5
- Recycled content 1.5
- Average: 3.0
- Std. relative dev.: 0.41

Stage 2 Production
- Water efficiency 3.0
- Treatment of generated waste 3.5
- Renewability of energy 3.5
- Wastewater management 3.5
- Metal waste generation 2.0
- Non-metal waste production 3.0
- Energy efficiency 1.5
- Average: 2.86
- Std. relative dev.: 0.28

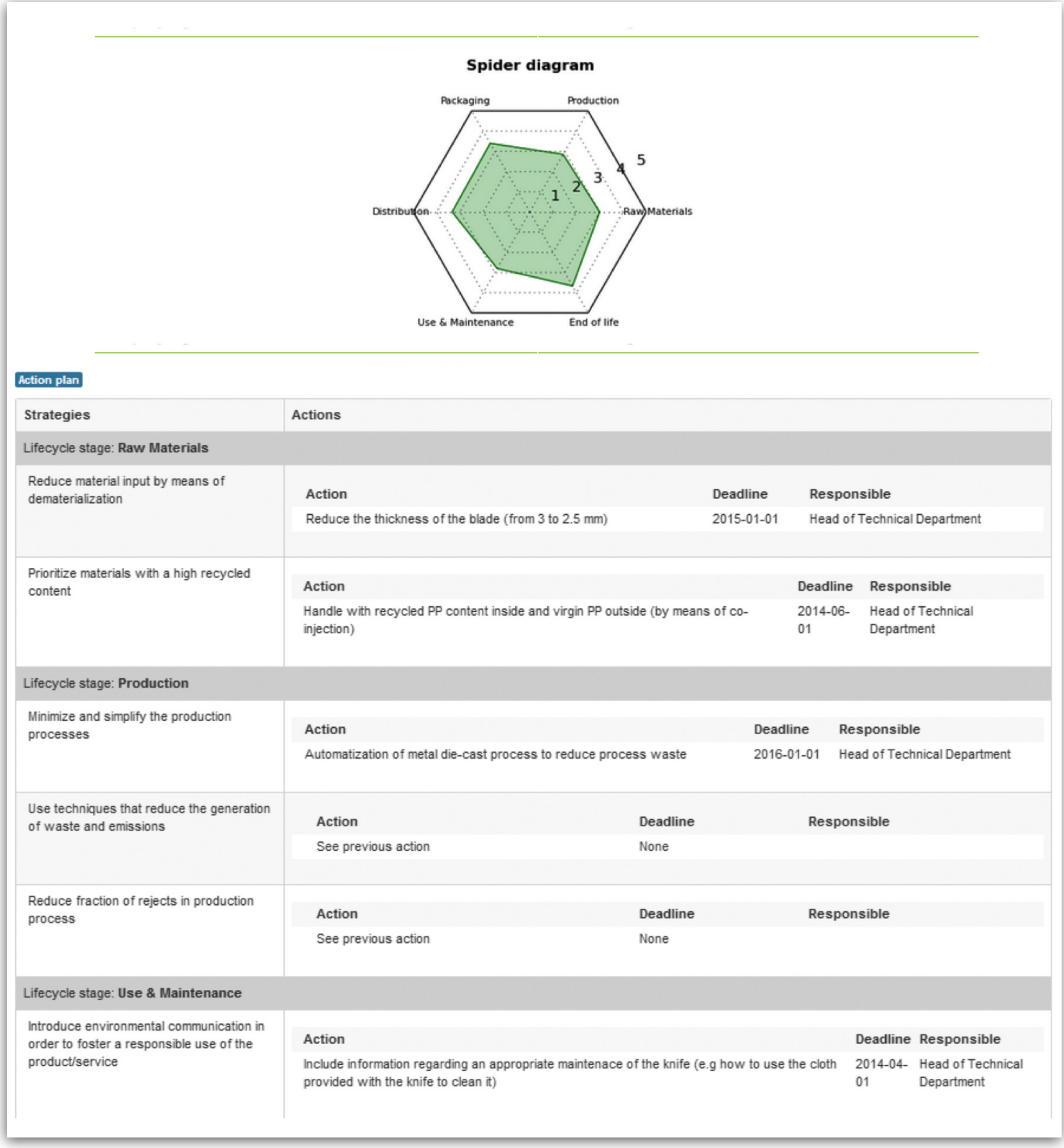
Stage 3 Packaging
- Amount of packaging materials 3.5
- Diversity of materials 3.5
- Reciclability 4.0
- Recycled content 2.5
- Packaging Reuse/ Recovery Rate 3.5
- Average: 3.4
- Std. relative dev.: 0.16

Stage 4 Distribution
- Optimization of distribution 4.0
- Optimization of internal transports 3.5
- Environmental impact of transportation system 2.5
- Average: 3.33
- Std. relative dev.: 0.23

Stage 5 Use & Maintenance
- Environmental communication for the use 2.5
- Maintenance needs 2.0
- Environmental Communication for the Maintenance 2.5
- Materials' use efficiency 2.5
- Low-maintenance materials 4.5
- Average: 2.8
- Std. relative dev.: 0.35

Stage 6 End of life
- Separability of components 2.0
- Identificability of materials 5.0
- Recyclability potential 4.0
- Average: 3.67
- Std. relative dev.: 0.42

Figure 42. Overview of the Summary Report.



Strategies	Actions		
Lifecycle stage: Raw Materials			
Reduce material input by means of dematerialization	**Action**: Reduce the thickness of the blade (from 3 to 2.5 mm)	**Deadline**: 2015-01-01	**Responsible**: Head of Technical Department
Prioritize materials with a high recycled content	**Action**: Handle with recycled PP content inside and virgin PP outside (by means of co-injection)	**Deadline**: 2014-06-01	**Responsible**: Head of Technical Department
Lifecycle stage: Production			
Minimize and simplify the production processes	**Action**: Automatization of metal die-cast process to reduce process waste	**Deadline**: 2016-01-01	**Responsible**: Head of Technical Department
Use techniques that reduce the generation of waste and emissions	**Action**: See previous action	**Deadline**: None	**Responsible**:
Reduce fraction of rejects in production process	**Action**: See previous action	**Deadline**: None	**Responsible**:
Lifecycle stage: Use & Maintenance			
Introduce environmental communication in order to foster a responsible use of the product/service	**Action**: Include information regarding an appropriate maintenace of the knife (e.g how to use the cloth provided with the knife to clean it)	**Deadline**: 2014-04-01	**Responsible**: Head of Technical Department

Figure 42. Overview of the Summary Report.

Customized report

This step, available under the header-menu 4-Report, allows the **Coordinator** to choose what information will be included in the Report (Figure 43).

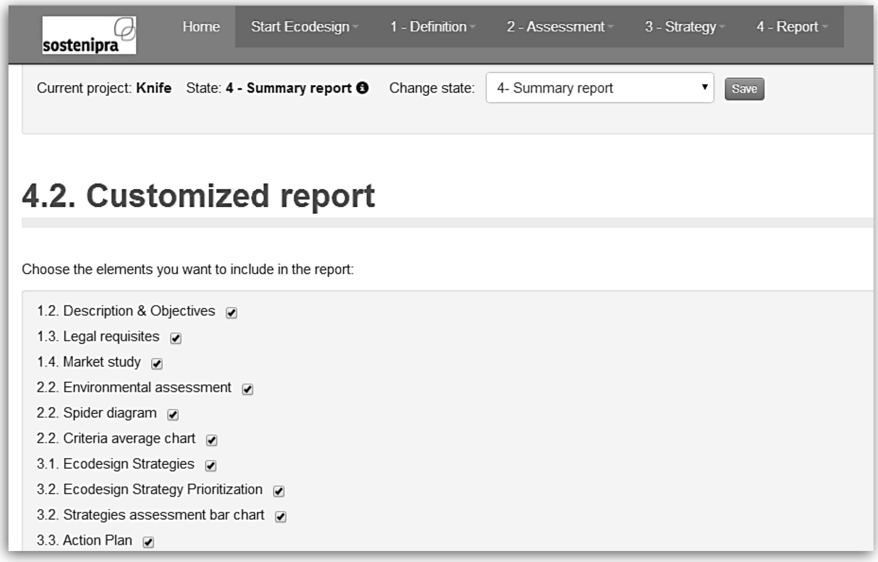
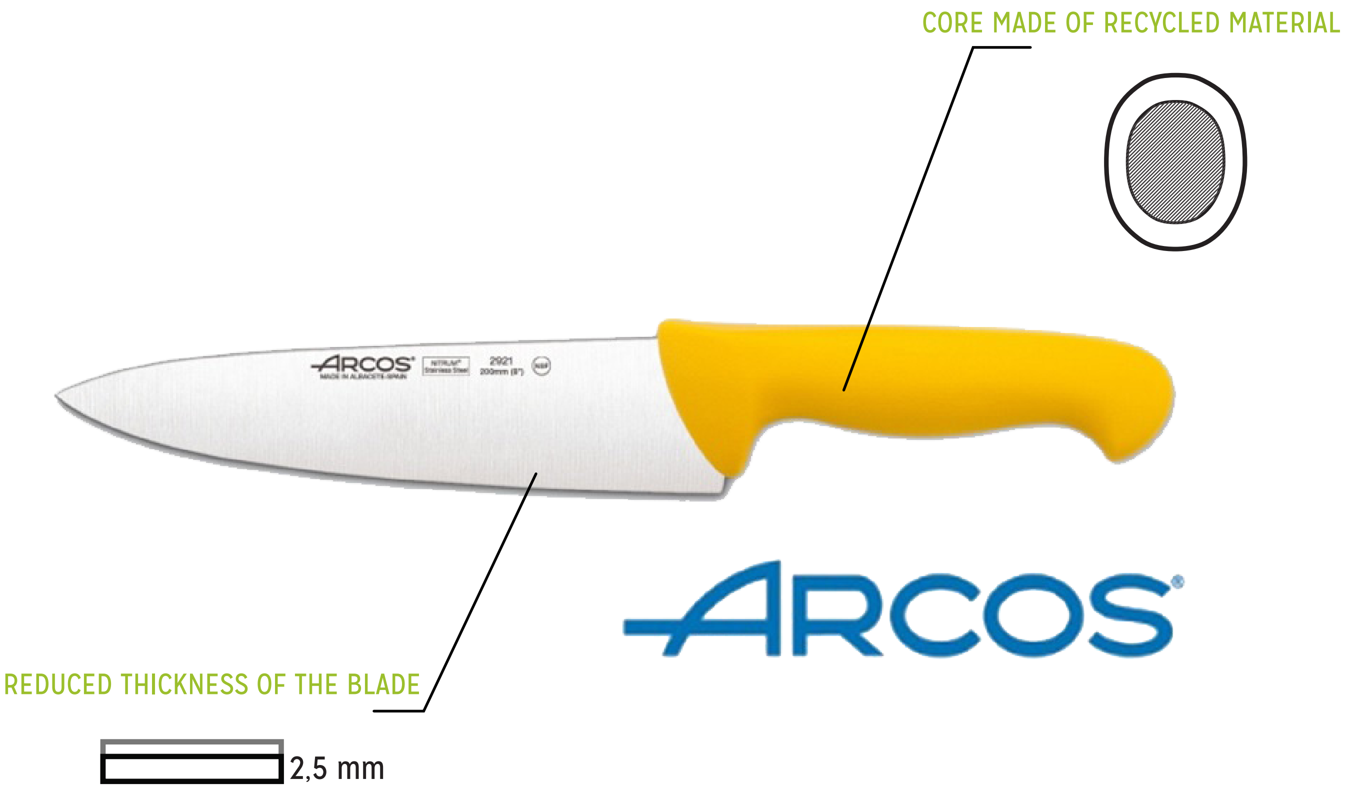


Figure 43. Custom report element selection.

Annex A: New ecodesigned knife by ARCOS

The practical implementation of the Action Plan for the Knife Case Study results in the product presented in Figure . One can see the use of recycled material in the handle core as well as the new blade of the knife, which has reduced the thickness from 3.0 to 2.5 mm and is produced in a new automated process that reduces waste generation.



Annex B: Case Studies

Jacket Case Study

The Case Study Jacket is a waterproof jacket made of 100% recycled nylon obtained from used fishing nets, from the company ECOALF (Figure 44).

The results of the **Qualitative Assessment of Life Cycle Criteria** of the Jacket Case Study Jacket are shown in Figures 45 and 46. In this figure one can see the life cycle criteria used for the jacket (some are the default ones, others were defined by the case study **team members**). This environmental assessment shows that the two life cycle stages with worst environmental performance are the 'end of life' and '*production*' (closely followed by '*packaging*'). On the contrary, the life cycle stage with the best environmental performance would be the '*Use & Maintenance*' and, secondly, the '*Raw Materials*'.

Figure 44 . Jacket to be ecodesigned.

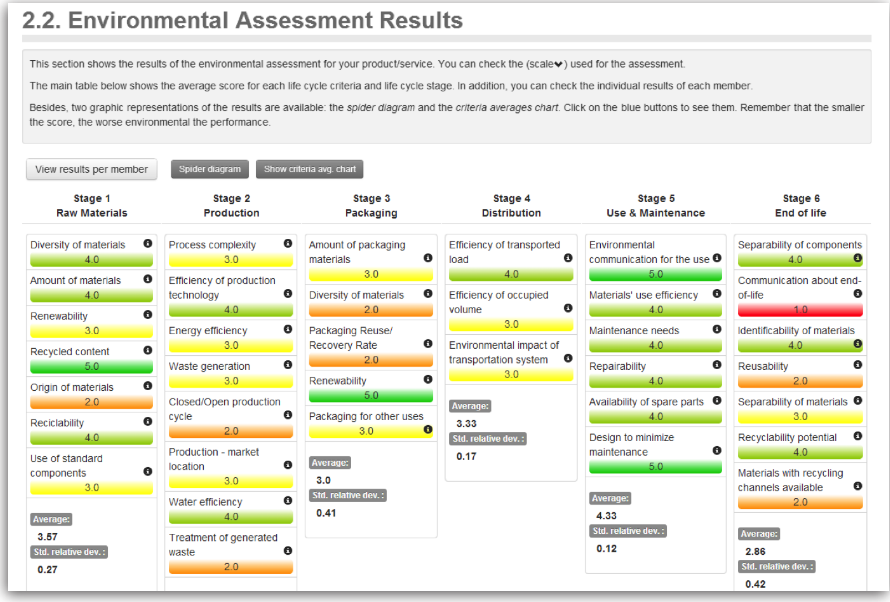


Figure 45 . Environmental Assessment of the case study jacket (average results).

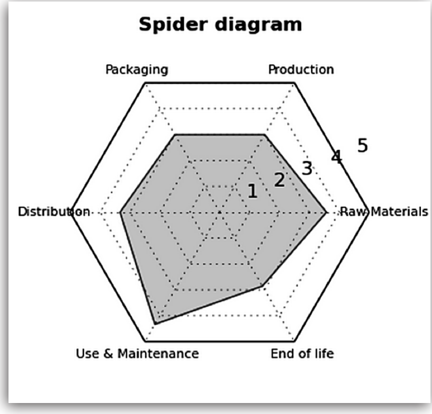


Figure 46. Environmental Assessment of the case study jacket (spider diagram).

However, a **Life Cycle Assessment (LCA)** was performed in order to have an alternative means of assessing the environmental performance of the product. In this case, the LCA showed contrasting results compared to the **Qualitative Assessment of Life Cycle Criteria**

According to LCA, the most impacting life cycle stage is the *Use & Maintenance*, mainly due to energy consumption for washing, drying and ironing the jacket (Figure 47). This is an issue that was forgotten when doing the Environmental Assessment on the first time (remember that ecodesign is about reducing the environmental impact throughout the whole life cycle of products and services!). Similarly, the second most impacting stage was the raw materials one (due to the recycling process of the fishing nets).

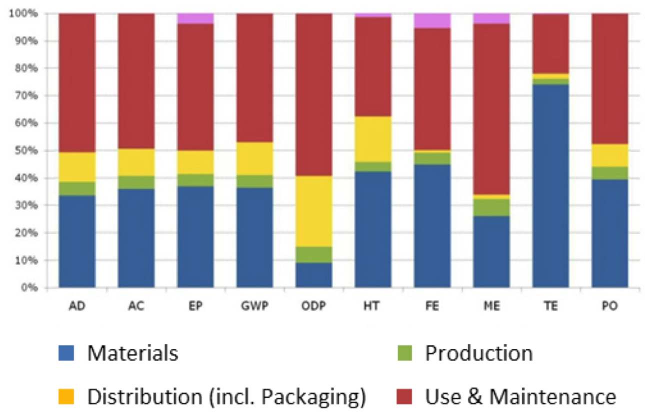
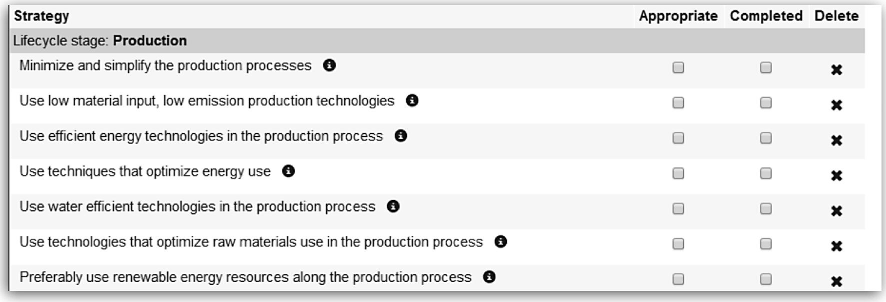


Figure 47. Environmental Assessment of the case study jacket LCA. Each bar represents an impact category (e.g. GWP stands for Global Warming Potential; ODP stands for Ozone Depletion Potential, etc.). Results vary from impact category to impact category, but in general, the red and blue colours are predominant (meaning that they contribute to most of the environmental impact of the respective impact category).

Based on the Qualitative Assessment of Life Cycle Criteria, edTOOL suggests a set of ecodesign strategies for those two life cycle stages with worse environmental performance (in this case study, these would be production and end of life). However, the team knew that the life cycle stages of greatest concern should be the '*Raw materials*' and the '*Use & Maintenance*' (according to LCA results).



Strategy	Appropriate	Completed	Delete
Lifecycle stage: **Production**			
Minimize and simplify the production processes			✖
Use low material input, low emission production technologies			✖
Use efficient energy technologies in the production process			✖
Use techniques that optimize energy use			✖
Use water efficient technologies in the production process			✖
Use technologies that optimize raw materials use in the production process			✖
Preferably use renewable energy resources along the production process			✖

Figure 48. The Coordinator can delete the strategies related to the life cycle stages that have appeared to not be among the most environmentally impacting ones

This situation can be solved in edTOOL by making amendments to the list of potential ecodesign strategies suggested in *Step 3.1* (Figures 48 and 49).

Thus, the Coordinator has the possibility to include (one by one) the different ecodesign strategies that are related to the most impacting life cycle stages according to LCA. Optionally, the Coordinator could decide to keep the strategies suggested by edTOOL. Actually, any company could choose to study all the ecodesign strategies offered by the tool, but for obvious reasons of time and resources, one normally focuses on the ones related to the most impacting life cycle stages.

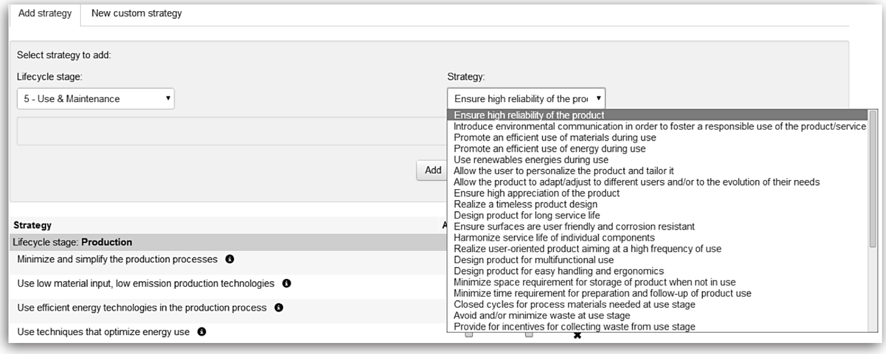


Figure 49. The Coordinator can add (one by one) the strategies related to the life cycle stages that have appeared to be among the most environmentally impacting ones

After doing these amendments, the team can go on with the selection and prioritization of ecodesign strategies, as described in the User Guide.

In this case study, the strategies that were prioritized and included in the Action Plan were:

1. Reduce the need of drying and ironing
2. Communication about use and environment
3. Extend the usability options of the jacket

The implementation of these strategies result in a waterproof jacket with hood (100% recycled fishing nets), which has the distinction of being multifunctional and its main parts can be removed (sleeves, skirt) for greater versatility in relation to weather conditions or the user's wishes, and that is complemented by a removable internal waist coat (100% recycled cotton). It incorporates labelling with recommendations of use (Figure 50).

ECOALF

Figure 50 . Prototype of the ecodesigned jacket

Wooden box Case Study

The Case Study Wooden box is a box for three bottles of wine (350 x 260 x 103 mm) and made of pinewood, Medium-Density Fibreboard (MDF) for the top and back covers and a jute handle, from the company FINSA (Figure 51).

Figure 51. Wooden box to be ecodesigned

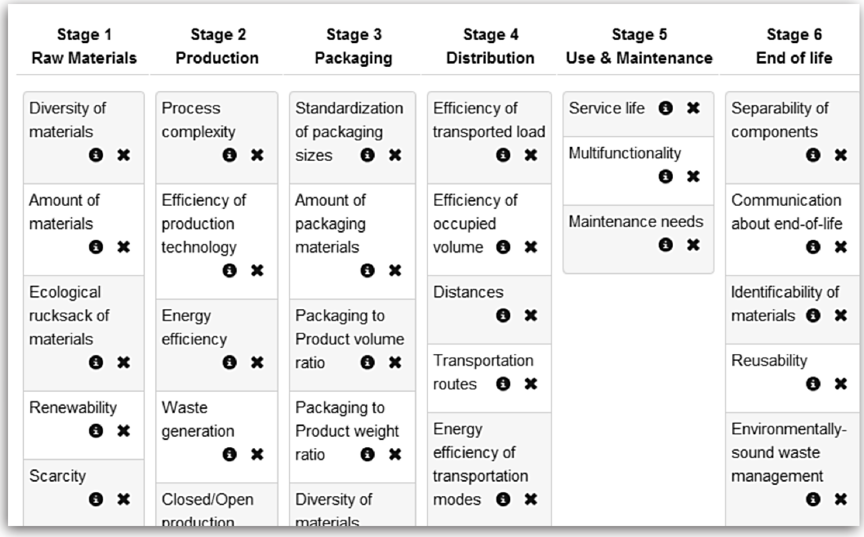


Figure 52. Elimination of life cycle criteria to reduce the number of life cycle stages

In step 1.5, edTOOL suggests a set of life cycle stages for the **Qualitative Assessment of Life Cycle Criteria**. In this case, it did not make sense to assess the '*Use and Maintenance*' stage for a wooden box. To face this sort of situation, the **Coordinator** can remove the life cycle criteria for that given life cycle stage (Figure 52). By doing this, the total number of life cycle stages will be reduced.

Once the customization of life cycle criteria is done, the **team members** can proceed with the project as usual and make their assessments (Figure 53). In this case, since there will be a total of 5 life cycle stages, the spider diagram will have 5 axis (pentagon) instead of 6 (hexagon) (Figure 54).

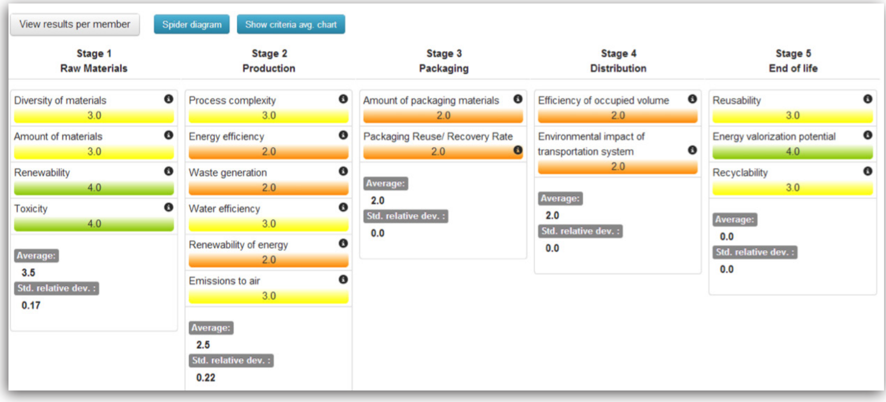


Figure 53. Environmental Assessment of the case study wooden box (average results)

After the environmental assessment, the strategies that were prioritized and included in the Action Plan in this case study were:

- Increase multifuncionality
- Increase durability
- Use local materials

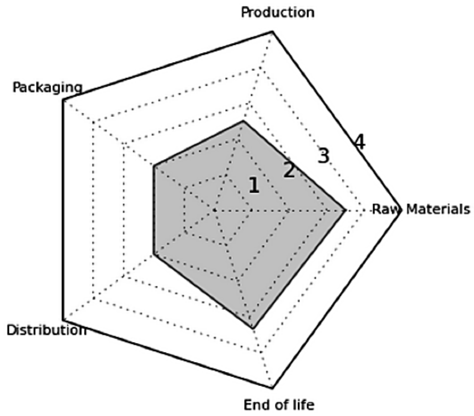


Figure 54. Environmental Assessment of the case study wooden box (spider diagram)

The implementation of these strategies resulted in a wooden box aiming to have a longer multifunctional life. For this, it included orientative graphics on the reverse of the cover in order to encourage future uses (e.g. nest box, tool box). In addition, it substituted the original jute handle (from Asia) by a hemp handle made of local materials (Figure 55).

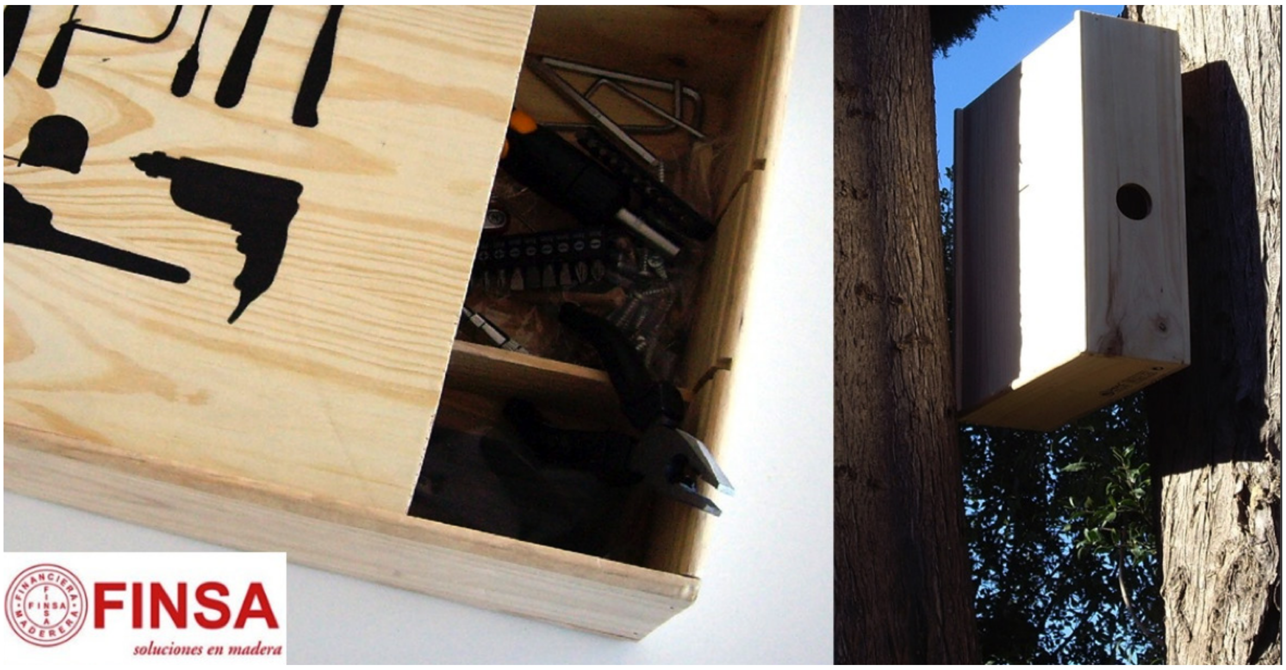


Figure 55. Prototype of the ecodesigned wooden box

Annex C: Life cycle criteria and strategies

List of life cycle criteria

Materials	Diversity of materials	*It can be represented by the number of different typologies of materials involved in the product. In general, less is better.*
	Amount of materials	*It can be represented by the weight of the materials involved in the product. The less material has to be used in a product, the less resources will be consumed in the production process.*
	Ecological rucksack of materials	*An Ecological Rucksack is the total quantity of materials moved from nature to create a product or service, minus the actual weight of the product. That is, ecological rucksacks look at hidden material flows. Ecological rucksacks take a life cycle approach and signify the environmental strain or resource efficiency of the product or service.*
	Embodied energy on materials	*Embodied Energy is the sum of all the energy required to produce any goods or services, considered as if that energy was incorporated or 'embodied' in the product itself.*
	Renewability	*A renewable resource is a natural resource which can replenish with the passage of time, either through biological reproduction or other naturally recurring processes.*
	Durability	*Durability is aimed at extending the lifetime of products thanks to the inherent material properties.*
	Scarcity	*It refers to the lack or the limited existence of resources that are fundamental for the product or service provided. The more scarce, the worse.*
	Recycled content	*The proportion, by mass, of recycled material in a product or packaging. Only pre-consumer and post-consumer materials shall be considered as recycled content.*
	Recovered components	*Recovered materials are products, components or parts of a production or waste stream captured or separated for reuse (without processing, which would be recycling)*
	Reciclability	*Reciclability refers to the ability of a material to be captured and separated from a waste stream for being recycled*
	Biodegradability	*Biodegradability refers to the capability of being decomposed by biological agents, especially bacteria.*
	Origin of materials	*The origin of materials refers to the geographical location from which they are obtained. Local materials are desirable due to shorter distances*
	Toxicity	*Toxicity refers to the degree to which a substance can damage an organism*
Production	Process complexity	*It refers to the level of intricateness of the production process. It can be simplified as the number of production processes (the less, the better).*
	Efficiency of production technology	*It refers to the capability of the production technology to produce the desired results without wasting inputs (materials, time or energy)*

	Energy efficiency	*The energy efficiency refers to the percentage of total energy input to a machine or equipment that is consumed in useful work and not wasted as useless heat.*
	Water efficiency	*It refers to the capability of the production technology to produce the desired results without wasting water*
	Raw materials efficiency	*It refers to the capability of the production technology to produce the desired results without wasting materials.*
	Renewability of energy	*A renewable resource is a natural resource which can replenish with the passage of time, either through biological reproduction or other naturally recurring processes.*
	Origin of energy	*The origin of energy refers to the geographical location from which it is obtained. Local energy is desirable.*
	Waste generation	*It refers to the quantity of materials or products that enter a waste stream before composting, incinerating, landfilling or recycling.*
	Treatment of generated waste	*Generated waste can be treated by means of different ways. In general, the waste treatment hierarchy in order of their environmental performance is as follows: preparing for re-use; recycling (material recovery); other recovery, e.g. energy recovery; and disposal*
	Interaction with other organizations aiming at ecoefficiency	*Interactions among organizations may bring opportunities to increase efficiencies and reduce costs (e.g. sharing common services, reusing waste flows...)*
	Closed/Open production cycle	*Open loop systems are of linear nature, in which resource and capital investments move through the system to become waste, whereas closed loop systems are those where wastes can become inputs for new processes.*
	Production - market location	*It refers to the geographical distance between the production place and the market for the given product/service. Generally, the shorter distance, the better.*
Packaging	Standardization of packaging sizes	*It refers to the use of packaging whose size complies with existing standards regarding the size. These standards have the aim to help the industry (incl. packaging, producers, transportation) by making mutually consistent decisions on the size of the elements (packaging), so all parties can realize mutual gains.*
	Amount of packaging materials	*It refers to the quantity of materials that are used in the packaging*
	Packaging to Product volume ratio	*Ratio between the volume of the packaging and the volume of the product. The smaller, the better.*
	Packaging to Product weight ratio	*Ratio between the weight of the packaging and the weight of the product. The smaller, the better.*
	Diversity of materials	*It can be represented by the number of different typologies of materials involved in the packaging. In general, less is better.*
	Renewability	*A renewable resource is a natural resource which can replenish with the passage of time, either through biological reproduction or other naturally recurring processes. Packaging can be made of renewable materials.*
	Reciclability	*Reciclability refers to the ability of a material to be captured and separated from a waste stream for being recycled.*

	Recycled content	*The proportion, by mass, of recycled material in a product or packaging. Only pre-consumer and post-consumer materials shall be considered as recycled content.*
	Packaging Reuse/ Recovery Rate	*It refers to the percentage of packaging that can be effectively recovered and reused.*
	Waste from packaging	*It refers to the quantity of materials from the packaging that enter a waste stream.*
	Freight transport damage	*It refers to the damage suffered by the products during their transport, partly due to the packaging used.*
	Labelling	*It refers to the labelling in place, which could identify the materials used in the packaging and, thus, provide an indication on the best waste management option for them.*
Distribution	Environmental sustainability of logistics	*It refers to the overall environmental performance of the logistics in place, understood as the management of the flow of resources between the point of origin and the point of consumption in order to meet some requirements*
	Efficiency of transported load	*It refers to the optimization of the ratio between the transported load and the loading capacity of the transportation mode.*
	Efficiency of occupied volume	*It refers to the optimization of the ratio between the transported volume and the volumetric capacity of the transportation mode.*
	Distances	*The distance between the location of production and the market contributes to the environmental impact. The shorter distances, the better.*
	Transportation routes	*The transport of goods from one place to another may be done following different routes (they may be quite straightforward or on the contrary redundant). Therefore, this aspects takes into account the level of optimization of the transportation route, looking for overall shorter distances between delivery points through the route.*
	Ecofriendly driving	*It refers to the practice of driving in such a way as to minimize fuel consumption and the emission of carbon dioxide*
	Energy efficiency of transportation modes	*The energy efficiency refers to the percentage of total energy input to a machine or equipment that is consumed in useful work and not wasted as useless heat.*
	Environmental impact of transportation system	*It refers to the overall environmental impact of the transportation system used, thanks to which the several transportation modes could be prioritized. For example, transporting 1 ton by ship is environmentally preferrable than by train, and by turn, the train is preferrable than the truck.*
	Technology of the vehicle	*The technology of the vehicle conditions not only the performance of the vehicle but also its environmental impact. Some vehicles, such as cars, are classified according to their technologies (EURO 4, EURO 5, etc...).*
	Emissions of vehicles	*It refers to the exhaust gases from the vehicles. Their amount and composition depends on the vehicle technology (motor, filters, etc.), the fuel and the driving habits.*
	Renewability of fuels	*A renewable resource is a natural resource which can replenish with the passage of time, either through biological reproduction or other naturally recurring processes.*

Use & Maintenance	Reliability	*It refers to the trustworthiness to do what the product/service is expected or designed to do*
	Environmental communication for the use	*It refers to the (un)existence of environmental communication aspects aiming to promote an environmentally-friendly use by the user.*
	Materials' use efficiency	*It refers to the capability of the product or service to use materials wisely and without generating waste*
	Energy use efficiency	*It refers to the capability of the product or service to use energy wisely and without generating waste*
	Energy use renewability	*A renewable resource is a natural resource which can replenish with the passage of time, either through biological reproduction or other naturally recurring processes.*
	Potential to customize the product	*User customization allows for the customer to create a personalized variation of the initial design, which may create an attachment between the product and the user.*
	Adaptability to user needs	*An adaptable 'product' can be utilized under varying service requirements and, thus, prevents premature product replacement.*
	Appreciation of the product	*It refers to the level in which the user estimates the qualities of the product and services and gives them their proper value. In other words, it is about recognizing the quality, value or significance of the product/service.*
	Atemporality of design	*Atemporality refers to a design which is not limited or affected by time, which may extend the useful life of the product.*
	Service life	*The service life of a product is defined by the durability and the environment and use conditions. The longer service life, the better.*
	Frequency of use	*Measure of the frequency of use, related to the utilisation of the potential offered by products (it is desirable to take advantage of the use potential and not missuse them)*
	Multifunctionality	*Capacity to perform different functions, intrinsecally-related to the design*
	Handling of the product / Ergonomics	*Product ergonomics refer to the design factors intented to maximize productivity (results) by minimizing operator fatigue and discomfort*
	Storage potential	*It refers to the ability to be stored, thus minimizing the occupied volume/area and freeing up space.*
	Requirements previous to / during use	*It refers to the preparatory and follow-up work needed to be able to use the product.*
	Need of process materials	*Process materials during the use stage are those materials necessary for the functioning of the product/service.*
	Waste generation during use	*It refers to those materials entering the waste stream, deriving from the use of the product/service.*
	Reusability	*Capacity to use again a product for the same function*
	Maintenance needs	*Maintenance involves fixing any sort of mechanical, plumbing or electrical device should it become out of order or broken; it also includes performing routine actions which keep the device working in order or prevent trouble fromarising.*
	Upgrading possibilities	*Upgrading is the proces of replacing a product with a newer version of the same product, in order to bring the system up to date. The replacement of some parts of a product/service may upgrade it and improve its characteristics.*
	Repairability	*Ability of a damaged or failed equipment, machine or system to be restored to acceptable operating condition within a specified period (repair time).*
	Availability of spare parts	*Spare parts, also known as service/repair/replacement parts, are an interchangeable part that is kept in an inventory and used for the repair or replacement of failed units.*

End-of-life management	Separability of components	*Ability to separate the components, in order to manage each of them in an adequate manner.*
	Separability of materials	*Ability to separate the materials, in order to manage each of them in an adequate manner.*
	Communication about end-of-life	*It refers to the (un)existence of information regarding the end-of-life management of the product/service or its parts.*
	Identificability of materials	*Information regarding the type of material, which is useful for an adequate waste management.*
	Reusability	*Capacity to use again a product for a different function*
	Environmentally-sound waste management	*A given waste stream may be treated by means of different waste management systems and technologies, which probably have different environmental performance. An environmentally-sound management prioritizes material recovery and, secondly, energy recovery (and ultimately landfilling).*
	Energy valorization potential	*Potential to recover energy from waste (the greater, the better).*

List of environmental improvement strategies

Materials	Reduce number of different types of material	*In general, a reduced number of different types of materials is desirable, since it simplifies all life cycle stages (e.g. procurement of materials, production processes, management of wastes, etc.). However, this strategy may be difficult to achieve for reasons of function, strength, etc.*
	Reduce material input by design aiming at durability	*This strategy aims to reduce the use of materials to the minimum, always considering the requirements of the product (strenght, durability, service life, etc.).*
	Reduce material input by means of dematerialization	*Dematerialization is the replacement of a physical product with a non-physical product or service, thereby reducing the production, demand and use of physical products; and reducing the end-user's dependence on physical products. In implementing this strategy, several benefits may be achieved: cost-savings in materials, energy, transportation, consumables and the need to manage the eventual disposal and/or recycling of a physical product.*
	Reduce material input by means of a simple principle of functioning	*The reduction of non structural parts and of connecting parts allows to reduce the consumption of resources, as well as to a reduction of assembly and disassembly times.*
	Reduce material input by means of multifunctionality	*The combination of functions into one product reduces the consumption of material per function. Therefore, the consumed resources are used to provide several functions, for which reason the generated impacts could be partially allocated to each of the functions).*
	Use materials and components with lower ecological rucksack	*The consumption of resources for the supply of raw materials and the manufacture of external parts and components has an ecological rucksack, that is aggregated into the product's rucksack. Consequently, efforts should concentrate on minimizing the ecological rucksacks accompanying materials and other external parts and components. This may be realized by clearly defined requirements for the selection of suppliers, for which different assessment methods exist. In most cases indicators will be calculated from life cycle analysis data (LCA), which can be used as a basis for the assessment of the environmental impact of materials. Of course, each of the methods used yields results only within its own bounds. Therefore, knowing these limits and the potential environmental impact not detected by a given method is essential for application in practice.*
	Select suppliers and products under ecolabelling systems or providing environmental information	*Certified and ecolabelled materials are preferrable*
	Select materials of low energy intensity	*Materials with low energy intensity or low embodied energy are preferrable, since they reduce the cumulative energy demand of the offered product/service.*
	Prioritize renewable raw materials	*Renewable raw materials are not of fossil origin but are made, in most cases, from plants. Their use presents benefits, since other limited resources are not used and, in addition, it provides for adequate disposal.*
	Prioritize materials that are abundant in the environment and avoid scarce materials	*The use of materials that are abundant provides for greater opportunities to obtain them and avoids the depletion of other resources that are scarcer.*

	Prioritize materials with a high recycled content	*The prioritization of materials with high recycled content promotes a circular economy in which materials are recycled and converted into new products.*
	Use of recovered components	*Using recovered components avoid the need to produce new components and, thus, all associated impacts. This may result in an environmental benefit but also an economic one.*
	Prioritize recyclable materials	*A requisite for achieving a circular economy with closed material cycles is to use only materials that are really recyclable and that ensure, at the same time, that its characteristics are also present in the secondary material to a sufficient degree. This implies that not only the characteristics of the material are adequate for recycling, but also that there exist the necessary infrastructure to recover and recycle materials.*
	Select biodegradable materials	*When selecting biodgradable materials, it is important not to forget the product use expectatives and, therefore, select materials that satisfy the technical and durability requirements for the product.*
	Select local materials to reduce transportation demand	*Using regionally available raw materials reduces the requirement for transportation and thus environmental damage caused by increasing traffic. Thus, one has to take into account the environmental impact through emissions such as CO2, NOx, dust, and noise. The necessary input for transportation depends on factors such as mass and volume of the cargo, hauling distance, choice of the means of transportation, and number of hauling operations required.*
	Select materials without toxic, nocive and harmful substances	*Toxic, nocive and/or harmful substances substances (e.g. heavy metals, dioxines, etc.) may have serious effects on the environment and health even if used in small quantities and should be avoided where possible during the whole life cycle.*
Production	Minimize and simplify the production processes	*A simplification of the production process may result in (1) a reduction of materials and energy use, (2) reduction of wastes and (3) reduction of processing time. Obviously, this strategy should be studied in detail for each production process, in order to assess the different alternatives.*
	Use low material input, low emission production technologies	*Efficient use of materials, process and auxiliary materials by applying adequate technologies (best practice) reduces the overall consumption of raw materials. This, in turn, reduces damage to the environment through waste, on the one hand, and reduces the quantity of raw materials extracted from the environment, on the other. Low emission production technologies reduce the need for downstream purification and filter plants.*
	Use efficient energy technologies in the production process	*The type of production technology may have a decisive influence on the energy consumption in the manufacture of a product. Selecting adapted production technologies contributes to the minimization of energy demand. The objective is to analyze the energy consumption of the individual stages of production and, on the basis of this knowledge, to make manufacture of the product as effective as possible.*
	Use techniques that optimize energy use	*In addition to using energy efficient technologies an optimized process design also contributes to a reduction of energy consumption, which, in turn, reduces the environmental impact caused by the generation of energy provided for the production process. Savings can be realized through constant monitoring and optimization of the process parameters (e.g. temperature, quantity of auxiliary material used, etc.).*
	Use water efficient technologies in the production process	*The type of production technology may have a decisive influence on the water consumption in the manufacture of a product. Selecting adapted production technologies contributes to the minimization of water demand.*

Use technologies that optimize raw materials use in the production process	*The type of production technology may have a decisive influence on the raw material consumption in the manufacture of a product. Selecting adapted production technologies contributes to the minimization of raw materials demand.*
Preferably use renewable energy resources along the production process	*The use of renewable energy resources such as solar energy, biomass, hydroelectric power, wind energy, and geothermal energy can be done by means of renewable technologies and/or contracting renewable electricity suppliers. However, in this context one has to keep in mind that these natural resources must not be over-used as they are renewable only within the scope of their natural regenerative ability. Therefore, the issue of energy efficiency is an important factor in the context of renewables. Similarly, the environmental impact caused by the utilization of renewable energy sources must not be neglected.*
Preferably use regionally available energy resources	*The utilization of renewable energy sources is closely related to the utilization of regionally available energy resources. Thus, the use of regionally available biomass reduces hauling distances and, as a consequence, the consumption of fossil energy sources for the transportation of biomass.*
Use techniques that reduce the generation of waste and emissions	*The goal of each production process consists in the transformation of raw materials into products. Thus, process waste may be considered an indicator for inefficient use of materials. Apart from the environmental impact caused by the disposal of waste the consumption of raw materials extracted from the environment has to be taken into account.*
Reduce fraction of rejects in production process	*Rejects could be defined as product without any direct benefit attributable to the input of resources used up in the manufacture of the product; this means that resource efficiency is absolutely zero. Thus, minimizing the reject rate is an important goal if only with a view to cost reduction, and it is also a key factor in quality management and quality assurance.*
Recycle process materials whenever possible	*Consumption of materials may be reduced through their recycling. In some sectors, the recycling of some materials is already considered best practice (e.g. recycling of water in closed cycles, in combination with heat recovery). These strategies may not only reduce environmental impacts but also costs.*
Search for sinergies and symbioses with neighbouring companies and organizations	*Sinergies and symbioses with other organizations is a pillar of industrial ecology, which is a discipline that conceptualises industry as a man-made ecosystem that operates in a similar way to natural ecosystems, where the waste or by product of one process is used as an input into another process. Industrial ecology interacts with natural ecosystems and attempts to move from a linear to cyclical or closed loop system.*
Close material cycles in the production process	*Recycling waste materials and returning them into the production process reduces consumption of primary raw materials as well as the cost of waste disposal, promoting a closed material cycle. In addition, transportation needs are reduce (compared to external recycling or disposal). One of the prerequisites consists in the use of recyclable materials and in collecting and sorting of process waste.*
Recycle and reuse waste for new products/materials	*In many cases it will not be possible to avoid process waste altogether or to return these materials in the production process. It should be considered to re-use/recycle them for the manufacture of new products.*
Use parts of identical design for different products	*Using parts of identical design for different products reduces the number of different parts in production, which simplifies assembly and facilitates the supply of spare parts as well as refurbishing and re-use of structural parts and components.*

	Locate the production plant as close as possible to the market	*Local economies are those that concentrate in a given area most life cycle stages of a product (e.g. raw material extraction, production, distribution, use, end-of-life management). This approach presents a major benefit in terms or reduced transportation distances. Since the market for a product can not located in a given place at our desire, we can try to locate the production plant as close as possible to the market.*
Packaging	Dimension the packaging according to standard transportation measures	*The use of packaging dimensioned to logistics and retailers optimizes the room in trucks and warehouses better than non standard packaging.*
	Reduce the packaging to the minimum	*Reducing the material input in packaging can be done by optimization of packaging or by appropriate product design (e.g. casings that endure transportation without or with only a minimum of packaging)*
	Optimize the relationship between the volume of the packaging and the product	*The complete system of primary, secondary, and transport packaging must be considered so reductions to one component are not overcompensated for by an increase in another component. Reductions in material should never compromise the primary function of product protection.*
	Optimize the relationship between the weight of the packaging and the product	*The complete system of primary, secondary, and transport packaging must be considered so reductions to one component are not overcompensated for by an increase in another component. Reductions in material should never compromise the primary function of product protection.*
	Use monomaterial packaging	*A packaging made of only one material enables easy handling for proper waste management. In contrast, when packaging is made of different materials, these need to be separated and managed in different ways.*
	Use renewable raw materials for packaging	*The use of renewable raw materials (e.g. non fossil materials) is preferrable since it does not contribute to the depletion of resources and, in addition, it constitutes an adequate solution for the disposal of packaging material.*
	Use recyclable materials in the packaging	*Using recyclable materials reduces the consumption of virgin materials, and it allows to recirculate waste materials into the economy. Materials for which there are already well established recycling channels facilitate recycling of packaging materials.*
	Use recycled materials in the packaging	*The prioritization of materials with high recycled content promotes a circular economy in which materials are recycled and converted into new products.*
	Use a reusable / returnable packaging	*Packaging designed for multiple use reduces the overall environmental impact of packaging. In this sense, returnable packaging is particularly advantageous when deposit and return schemes are in place (which facilitate the return of packaging and its reuse).*
	Reduce amount of waste from packaging	*The consumption of resources can be considerably reduced by a minimization of waste. Returnable packaging should be considered, in particular if returning packaging material to the supplier does not require additional transportation.*
	Prevent shipping damage	*The product can be prepared (e.g. fastening certain parts) to reduce the risk of damage and avoid freigh transport damages.*

	Label packaging materials (including instructions for disposal)	*A clear labeling of packaging material is necessary to foster its recycling. Packaging usually has only a very short life cycle; therefore labeling is particularly important in order to ensure appropriate recycling (value added) or environmentally acceptable disposal.*
Distribution	Implement a logistics broker system at the industrial park level	*A sustainable logistics management would introduce operational improvements that can produce profits: re-evaluating a company's supply chain from purchasing and planning, and managing the use of materials to shipping and distributing finished products. The Logistics Broker service answers to the need of improving the sustainability and efficiency of logistics processes. The service consists in interjecting a logistics broker between the companies and the carriers. Using modern ICT-Tools (software) the broker supports the customers and the carriers in their daily transport planning. Firms often do the planning of transports internally rarely using specific optimizing systems. They manage the whole amount of data management on their own. The interposition of a broker, between these two stakeholders introduces essential changes in the proceeding of the transport planning. The broker takes over the entire transport planning acting as a mediator between customers and carriers and reducing their effort to find the best and cheapest transport solutions*
	Optimize the load transported in the vehicle	*An optimization of the load transported in the vehicle means that the transported load is as close as possible to the maximum allowed load (always bearing in mind the volumetric limitations). This optimization allows to reduce the consumption of fuel and emissions per ton of load.*
	Optimize the volume occupied in the vehicle	*An optimization of the volume transported in the vehicle means that the transported volume is as close as possible to the volumentric capacity of the vehicle (always bearing in mind the load limitations). This optimization allows to reduce the consumption of fuel and emissions per volume of transported good.*
	Use stackable product packaging	*Stackable product packaging reduces the volume of the cargo to be transported. This measure helps to minimize the overall input required for transportation of the product.*
	Reduce distribution distances	*A reduction of distribution distances is possible by means of an adequate planning of the transportation routes and an optimization of loads in vehicles*
	Optimize transportation routes and minimize hauling operations	*Transportation routes may be optimized by an adequate planification of the points to be covered, including aspects not only about distances but also considering the hauling operations to be done in each point.*
	Foster ecofriendly driving patterns	*There are several tips for an eco-friendly driving, such as (1) keeping tires properly inflated, (2) using the recommended grade of motor oil, (3) checking and replacing aire filters regularly, (4) not speeding, (5) avoid agressiv driving, (6) taking advantage of cruise control, (7) using overdrive gears to lower engine speed, save gase and reduce engine wear and (8) avoiding peak rush hours if possible.*
	Choose environmentally acceptable means of transportation for distribution of product	*The choice of appropriate means of transportation reduces the environmental impact caused by the distribution of the product. Among the locally available systems choose the one that is environmentally most acceptable. Switching from transportation by truck to railroad or ship can drastically reduce damage to the environment.*

	Use vehicles with the most efficient technology available (less energy consumption)	*Environmentally friendly vehicles produce less harmful impacts to the environment than comparable conventional vehicles (e.g. internal combustion engine vehicles running on gasoline or diesel). Within each technology of vehicle, there may be different levels of efficiency, with effects on energy consumption and vehicle emissions.*
	Use vehicles with less emissions	*A low-emission vehicle is a motor vehicle that emits relatively low levels of motor vehicle emissions. In general, the less energy consumption of the vehicle, the less emmissions (this is particularly true for combustion engine vehicles running on fossil fuels).*
	Use fuels from renewable origin	*The use of fuels from renewable origin (i.e. bioethanol, biomethanol, biodiesel and biogas, derived from sources such as palm oil, oilseed rape, cereals, sugar cane, sugar beet, and reprocessed vegetable oil) constitutes an alternative to the use of fossil fuels, that are scarce and more polluting.*
Use & Maintenance	Ensure high reliability of the product	*The concept of reliability refers to the probability of the product fulfilling its functions under given service conditions for a predetermined period of time without becoming defective.*
	Introduce environmental communication in order to foster a responsible use of the product/service	*The planned and strategic use of environmental communication to support a responsible use of the product and service is an important strategy, particularly for those products that have a relevant environmental impact during the use stage. As an example, an important part of the impact of textiles is during the use stage (washing, drying, ironing), therefore it is of interest to provide instructions to the user on how to maintain the textiles in an environmentally-friendly manner. For this, information can be provided in the label of the piece of textile.*
	Promote an efficient use of materials during use	*The design of products and services can be done in such a way that allows to use the fewest resources during use , without having a negative impact on their functionality or appearance. This can be achieved by introducing more efficient devices and technologies and by a smart design contributing to reduce the demand of such materials.*
	Promote an efficient use of energy during use	*The design of products and services can be done in such a way that allows to use the fewest energy during use , without having a negative impact on their functionality or appearance. This can be achieved by introducing more efficient devices and technologies and by a smart design contributing to reduce the demand of energy.*
	Use renewables energies during use	*The use of renewable energy resources such as solar energy, biomass, hydroelectric power, wind energy, and geothermal energy can be done by means of renewable technologies and/or contracting renewable electricity suppliers. However, in this context one has to keep in mind that these natural resources must not be over-used as they are renewable only within the scope of their natural regenerative ability. Therefore, the issue of energy efficiency is an important factor in the context of renewables. Similarly, the environmental impact caused by the utilization of renewable energy sources must not be neglected.*
	Allow the user to personalize the product and tailor it	*User customization allows for the customer to create a personalized variation of the initial design, which may create an attachment between the product and the user.*

	Use vehicles with the most efficient technology available (less energy consumption)	*Environmentally friendly vehicles produce less harmful impacts to the environment than comparable conventional vehicles (e.g. internal combustion engine vehicles running on gasoline or diesel). Within each technology of vehicle, there may be different levels of efficiency, with effects on energy consumption and vehicle emissions.*
	Use vehicles with less emissions	*A low-emission vehicle is a motor vehicle that emits relatively low levels of motor vehicle emissions. In general, the less energy consumption of the vehicle, the less emmissions (this is particularly true for combustion engine vehicles running on fossil fuels).*
	Use fuels from renewable origin	*The use of fuels from renewable origin (i.e. bioethanol, biomethanol, biodiesel and biogas, derived from sources such as palm oil, oilseed rape, cereals, sugar cane, sugar beet, and reprocessed vegetable oil) constitutes an alternative to the use of fossil fuels, that are scarce and more polluting.*
Use & Maintenance	Ensure high reliability of the product	*The concept of reliability refers to the probability of the product fulfilling its functions under given service conditions for a predetermined period of time without becoming defective.*
	Introduce environmental communication in order to foster a responsible use of the product/service	*The planned and strategic use of environmental communication to support a responsible use of the product and service is an important strategy, particularly for those products that have a relevant environmental impact during the use stage. As an example, an important part of the impact of textiles is during the use stage (washing, drying, ironing), therefore it is of interest to provide instructions to the user on how to maintain the textiles in an environmentally-friendly manner. For this, information can be provided in the label of the piece of textile.*
	Promote an efficient use of materials during use	*The design of products and services can be done in such a way that allows to use the fewest resources during use , without having a negative impact on their functionality or appearance. This can be achieved by introducing more efficient devices and technologies and by a smart design contributing to reduce the demand of such materials.*
	Promote an efficient use of energy during use	*The design of products and services can be done in such a way that allows to use the fewest energy during use , without having a negative impact on their functionality or appearance. This can be achieved by introducing more efficient devices and technologies and by a smart design contributing to reduce the demand of energy.*
	Use renewables energies during use	*The use of renewable energy resources such as solar energy, biomass, hydroelectric power, wind energy, and geothermal energy can be done by means of renewable technologies and/or contracting renewable electricity suppliers. However, in this context one has to keep in mind that these natural resources must not be over-used as they are renewable only within the scope of their natural regenerative ability. Therefore, the issue of energy efficiency is an important factor in the context of renewables. Similarly, the environmental impact caused by the utilization of renewable energy sources must not be neglected.*
	Allow the user to personalize the product and tailor it	*User customization allows for the customer to create a personalized variation of the initial design, which may create an attachment between the product and the user.*

Allow the product to adapt/ adjust to different users and/ or to the evolution of their needs	*Products are produced for different users and conditions of use. For this reason, the adaptability of the product constitutes an relevant attribute. This adaptability fosters a longer service life of the product.*
Ensure high appreciation of the product	*A high appreciation of the product on the part of the user is an important prerequisite for long use. Products that work well and that are appreciated will rather be repaired than exchanged for new products.*
Realize a timeless product design	*A timeless product design is essential for achieving a reasonable lifetime of the product and avoid a premature transformation into waste because it has become old-fashioned. If it is not feasible to realize a timeless design for a certain range of products, another possible approach would be to make the external "shell" (characteristic look) of the product exchangeable so it can be adapted to prevailing fashions.*
Design product for long service life	*Long-lived products create maximum benefit for a long time with minimum input of raw materials and energy.*
Ensure surfaces are user friendly and corrosion resistant	*Surface design has a great influence on the service life of products. The external shell and surfaces of the product have to be incorporated in an overall concept aiming at durability. The surfaces should be resistant to impacts and scratches and tolerate traces of use. In addition, they should prevent corrosion.*
Harmonize service life of individual components	*Harmonizing the service life of individual components will prevent the product from becoming waste after a short time and being discarded on account of minor defects. All parts and components of the product should be about equally durable.*
Realize user-oriented product aiming at a high frequency of use	*Products that, once produced are not used afterwards, are not environmentally sound, even if manufacture was based on environmentally acceptable criteria; resources and energy have already been used up for manufacture and transportation. Product-service systems are oriented towards an efficient use of resources.*
Design product for multifunctional use	*The integration of several functions into one product may allow to reduce the consumption of resources involved in satisfying the functions. However, this may not be the cause of a premature obsolence of the product because one of the parts/functions has a shorter service life. In addition, functional quality should not be impaired because of multifunctionality.*
Design product for easy handling and ergonomics	*The overall environmental performance of a product depends on the actual use during its service life. Thus, simple handling of the product and an ergonomic interface man-product is essential in order to assure a proper use. For this purpose, the use of the product should be self-explanatory, and the product should clearly show its potential functions and the way it works.*
Minimize space requirement for storage of product when not in use	*Many products are needed and used on rare occasions or in special situation. When they are not in use, however, it is important that their space requirement for storing is as small as possible. Approaches to space saving consist in solutions using stackable or collapsible elements or collaborative consumption schemes.*

Minimize time requirement for preparation and follow-up of product use	*The time needed to be able to use the product (before, during and after use) is an important factor that may determine whether or not the product is actually used. This also includes the time and efforts needed to set-up the product, store it, etc. Another factor, in addition ot time, is the resources involved in such preparation and follow-up.*
Closed cycles for process materials needed at use stage	*Process materials should be used in closed cycles (prioritizing reuse to recycling).*
Avoid and/or minimize waste at use stage	*The prevention of waste at use stage is important for those products that are intensive in the consumption of resources (energy and materials) during use. In some cases, the impact of such waste may be one of the greatest environmental threats of the products.*
Provide for incentives for collecting waste from use stage	*Collecting waste from use stage is of interest in order to allow a re-use or recycling parts, components and materials, or if this not possible, to provide an adequate management of waste (in particular for hazardous waste). Some incentives (such a discount in the new product when offering the old one) have proved to be successful.*
Use standardized elements, parts, and components for easy reuse	*Reuse of components is preferable to recycling, which is easier when using standardized elements.*
Reduce maintenance needs to minimum	*Products that imply high levels of maintenance are prone to become waste after a very short time. On the contrary, those products that have reduced maintenance requirements will have longer service lifes (reducing the environmental impacts on the whole life cycle).*
Design product and components for easy cleaning	*Products that are difficult to clean are prone to become waste after a very short time. They will be replaced for bad looks, not for malfunction. In this context, surface design is of great importance. Surfaces should be easy to clean and inaccessible corners or edges should be avoided.*
Ensure maintenance with standard tools	*The use of standard tools for maintenance is preferred in order to make it easier and ensure that maintenance work can be done at any time.*
Design for possible upgrading	*Design for possible upgrading is particularly important in areas where technological progress is fast and the product would become outdated soon (e.g. computer industry). In general, only certain parts become outdated, thus, it is recommended to design the product in a modular way, so these parts can be upgraded.*
Concentrate wear on replaceable components of product	*If a certain degree of wear and tear is unavoidable it should be directed to those parts in the product that can easily be exchanged and replaced. This measure aims at prolonged product life through adequate maintenance and repair.*
Indicate servicing intervals for product	*An adequate maintenance according to prescribed servicing intervals contributes to prolonging product life considerably and avoid potential troubles.*

	Provide for instruction for repair on product	*Ease of repair is one prerequisite to ensure a long service life. For this purpose, if necessary, instructions providing information on the sequence of repairing would be helpful.*
	Ensure easy access to components for repair and replacement	*Easy access to components for repair and replacementE ensures a longer service life. In many cases, designers concentrate on simple assembly but forget how to disassembly and repair products.*
	Standardize components	*The use of standardized components and that of identical structural components for different variants of products allows to simplify the repairing process and fosters their reuse.*
	Ensure availability of spare parts	*Successful repair work presupposes that spare parts are readily available. Special parts that are difficult to procure make basically simple repair work impossible.*
	Preferably use refurbished components as spare parts	*Reuse of parts in a product either as spare parts needed for of repair work or as refurbished parts in the manufacture of new products is an important measure with a view to closing cycles and optimizing the efficiency of resources. The consumption of resources for refurbishing parts and components is usually much lower than is the case in the manufacture of new components. Structural parts designed for a long service life can survive two or three product life cycles and contribute to a reduction of the overall environmental impact of a product.*
End-of-life management	Design product structure for easy disassembly	*A clear and easily understandable structure ensures easy disassembly, which is important in in case of manufacturing defects and for repair work during use stage, and, particularly, for disassembly after end of life.*
	Ensure simple assembly/ disassembly by reduction of parts used	*Reducing the diversity of components makes assembly and disassembly simpler and minimizes work input, and it also improves reparability of the product at use stage.*
	Minimize time and paths for disassembly	*The disassembly process should require the minimum time and be as simple as possible, ensuring greater possibilities for the recovery of parts and components. Thus, the process for (dis)assembly should be minimized and connections should be easily detachable, avoiding a destructive disassembly which would impair the reuse of parts and components.*
	Ensure easily visible access to connections for disassembly	*Easy access to connecting parts is important for simple assembly and disassembly. Thus, connections can be detached only if they can be easily found and accessed*
	Make possible separation of materials for recycling and avoid inseparable composite materials	*Design should ensure easy separation of different materials, since the recycling of materials requires the use of uniform or at least recyclable materials. The potential for recycling is reduced when using composite materials or when gluing materials together for strength reasons.*
	Ensure simple extraction of harmful and valuable substances	*Harmful substances shoul be identifiable and be able to be extracted in order to avoid impairing recycling. In the case of valuable substances, which retain their high value only when treated separately, it should be possible to separate them. This requires an adequate labeling of components.*
	Take into account end-user's opportunities for disposal and provide for instructions	*The disposal of products should be simple and should not require means the average end-user does not have. For this, it is helpful to provide the user with information concerning adequate disposal and to encourage correct user behavior.*

Allow an easy identification of materials	*Materials should be easily identified by means of an adequate labeling system in order to allow for their recycling.*
Create new or use existing collection system	*Take back systems allow the producer to collect used products and components and disassemble them, refurbish and reuse parts, recycle materials, and dispose of waste in an environmentally-friendly manner. This system should be easy to understand for the end-user and provide incentives for him/her to participate in it. This product take back could be realized within the framework of existing or newly established collecting systems.*
Ensure high return rate	*High return rates are essential in order to make the take back system economically feasible. The highest the return rate, the greatest closing of the materials cycle and consequent benefit for the environment. Therefore, both the environment and the manufacturer benefit from high return rates (for which incentives are necessary).*
Waste sorting/separation whenever possible	*Sorting and separating waste is necessary for, both, in-house or external recycling and re-using of materials as well as for specific treatment of different types of waste.*
Dispose of unavoidable waste in an environmentally acceptable manner	*The unavoidable waste has to be disposed of in such a way as to ensure that the environmental impact is kept to a minimum.*
Allow the energy valorization of waste, once material valorization options are not possible	*The waste management hierarchy places material valorization as preferrable to energy valorization. This is because a product can be materially recycled several times (depending on the material) but it can only be energetically valorised once (which makes it to be considerd a finalist treatment option). However, if the product can not be recycled, an energy valorization will allow to obtain energy from it (which will avoid the obtention of energy from other sources).*

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