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Article

Eco-innovative Practices for Sustainable Consumption and Production: What are the Possible Benefits for Companies?

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Abstract: The paper aims to present some eco-innovative practices regarding Sustainable Consumption and Production (SCP). The study also focuses on potential benefits for the actors who implement these practices, mainly with reference to companies. After a literature review on the actual importance of SCP and on the effects of eco-innovation tools

and policies on companies, authors present the developed eco-innovation practices in three focus areas related to sustainable consumption and production. The aim of the study is to contribute to literature studies on SCP with the development of eco-innovative practices resulting by the integration of existing tools, by pointing out and valorizing their potentials and synergies. These practices have been pointing out in the framework of the international European project. Three focus areas are involved by the practices: sustainability of products and services, sustainability of production processes and sustainable management of industrial areas. Authors developed four eco innovative practices resulting from the integration of 15 existing tools. These practices offer many opportunities to many actors, mainly companies and public authorities, in order to achieve environmental and competitive benefits and implement eco-innovation principles with a cooperative and shared approach.

Keywords: eco-innovation practices; sustainable consumption and production; sustainability of products and services; sustainability of production processes; sustainable management of industrial areas

1. Introduction

Sustainable Consumption and Production (SCP) concerns "the use of services and related products, which respond to basic needs and bring a better quality of life while minimizing the use of natural resources and toxic materials as well as the emissions of waste and pollutants over the life cycle of the service or product so as not to jeopardize the needs of further generations" [1].

Since 1987, the importance of a rethinking of national and international policies towards sustainable development patterns was highlighted, through the indication of the Report of the World Commission on Environment and Development [2].

The field of SCP has become more and more important in recent years. The United Nations Conference on Sustainable Development (Rio+20) also promoted sustainable patterns of consumption and production. One of the outputs of the Conference, was the adoption of the 10-Year Framework of Programs on Sustainable Consumption and Production Patterns (10YFP). It refers to, among others, to the 2002 Johannesburg Plan of Implementation (JPOI) and builds on the 8 years work of the Marrakech Process, related to regional SCP strategies and initiatives and on some Sustainable Consumption and Production best practices [3].

The need to change our models for production processes, by paying attention to their environmental sustainability, was also stressed by McDonough and Braungart. They explained how products can be produced by considering the regenerative capacity of nature. They considered the basic principles of industrial design and example of innovative products and strategies based on eco-effectiveness principle. Their idea is that it is possible to transform a system that generates also waste into one that can produce goods and services also creating environmental, economic and social value [4].

Our paper gives a contribution to the framework of eco-innovative practices aiming to foster Sustainable Consumption and Production. Some interesting practices that have been developed in the

framework of ECO-SCP-MED project are described in the following sections of this paper, as also some potential benefits that could arise for companies adopting them. In this way, the paper gives a contribution to the framework of Sustainable Consumption and Production, with some interesting eco-innovative policies in this field.

To this purpose, the paper presents a brief literature review on the importance of Sustainable Consumption and Production and on eco-innovative practices, also considering the effects they produce on companies implement them.

Then, a brief introduction on the ECO-SCP-MED project through which some practices have been developed, is included. A section of the paper includes the method of the research.

Eco-innovative practices deal with some areas of Sustainable Consumption and Production topic: sustainability of products and services, sustainability of production processes, sustainable management of industrial areas. They will be described in this paper in the results section, by including also potential benefits—under economic and environmental point of view that companies that implement them can obtain.

Finally, a discussion paragraph and conclusions on the study will be provided at the end of the paper.

2. The Importance of Sustainable Consumption and Production and the Effects on Company Performances

Jackson with his book want communicate that today the economy is unsustainable [5]. Our growth is driven by consumption and this cannot be sustainable. For this reason, new sustainable model of consumption (and production) are now needed.

SCP is a concept that is receiving even more attention by the economy. The actual intense changes in production techniques and in consumption patterns are fundamental to the achievement of environmental improvements.

The term, Sustainable Consumption and Production, was developed at the Rio Summit of the United Nations Conference on Environment and Development in 1992. Agenda 21, a policy document of the summit, also included a section related to changing consumption patterns and the objective to pursue more sustainable consumption and production [6].

The attention improvement on this theme has been also restated by Barber [7]. In his paper he said that “the movement to achieve sustainable production and consumption is one of the most important yet little known social movements of the new century” [7] (pp. 499).

Sustainable consumption has been defined by OECD—The Organization for Economic Co-operation and Development [8] as ‘‘the consumption of goods and services that meet basic needs and quality of life without jeopardizing the needs of future generations” [8] (p. 2). Sustainable Consumption initiatives deal with raising awareness and changing consumption behavior, values, and motivations (e.g., such education for sustainability, right-to-know, consumer awareness campaigns) [7].

The Lowell Center for Sustainable Production (LCSP), University of Massachusetts Lowell, defined sustainable production as “the creation of goods and services using processes and systems that are non-polluting; conserving of energy and natural resources, economically viable; safe and healthful for employees, communities and consumers; and socially and creatively rewarding for all working

people" [9]. In other words, sustainable production considers environmental, social and economic dimensions of firm's activities [10].

Initiatives for Sustainable Consumption and Production aim to change particular production processes or products. They include, for example, cleaner production and industrial ecology methods, life cycle analysis and Integrated Product Policy, Extended Producer Responsibility.

Cleaner production could be achieved through a pollution prevention approach, for example. Pollution prevention can be defined as "source reduction or practices that reduce or eliminate the creation of pollutants by increased efficiency in the use of raw materials, energy, water or other resources, or protection of natural resources by conservation. Source reduction means any practice reducing any hazardous substance or pollutant prior to recycling, treatment, or disposal; including equipment or technology modifications, process modifications, reformulation or redesign of products, substitution of raw materials and improving in housekeeping, maintenance, training or inventory control" [11] (para. 13102).

Industrial ecology aims to reduce inefficient materials and energy use by the use of local by-products and energy flows [12], contributing to achieve a more Sustainable Consumption and Production.

Life cycle analysis is a method for evaluating and quantifying the environmental impacts of a product during all its "life", that means, from the extraction of resources to production, use, and end-of life treatment [13].

Integrated Product Policy aims to minimize life cycle environmental impacts of products from the mining of raw materials to production, distribution use and waste management [European Commission, 2001, 2003]. The focus in these kind of policies are tools oriented to the whole life cycle of products [14].

Extended Producer Responsibility is a strategy that deals with the responsibility of the producer for the impacts of their products in the final stage of its life cycle, after consumption phase. This approach shifts responsibility for recycling and waste disposal from local government and taxpayers to private industry [15]. In a report of Swedish Ministry of the Environment of 1990, the Extended Producer Responsibility was defined as an environmental protection strategy aiming to achieve a lower total environmental impact of a product, by making the manufacturer of the product responsible for the entire life-cycle of the product, as also for its recycling and final disposal [16].

Sustainable Consumption and Production initiatives can be considered a base for eco-innovation practices that paid attention to the environment impacts arising from these activities.

Discussions concerning consumption, production and sustainability are prone to a confusion in terminology between consumption of goods and services (demand and volume) and consumption of resources (environmental impact).

In addition, at the European level, SCP is becoming even more important in recent years. One of the scopes of the European Union is to realize an integration among environmental sustainability and economic growth.

A key action in this field as promoted at European level, is the Sustainable Consumption and Production and Sustainable Industrial Policy (SCP/SIM) Action Plan, referred to the year 2008. The plan includes many interesting proposals in the topic of SCP. They address the environmental performance of products as also foster the demand for environmental-friendly products and production technologies. Another European document contains the SCP/SIM Action Plan: it is the

Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions (COM)2008 397 final [17]. This document provides some measures to achieve a sustainable consumption and production that will determine a higher level of competitiveness of the European economy. The Action Plan has also the objective to reinforce the information towards consumers on eco-friendly products.

Other key European policies have as their main purpose to foster better consumption and higher level of products quality. They include, for example, the Energy Labelling Directive (2010/30/EU), the Energy Star Regulation (EU Regulation n. 174/2013) and the Ecolabel Regulation (EC Regulation n. 66/2010), or the Ecodesign Directive (2009/125/EC) (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.). These policies are mainly oriented to a life-cycle approach of products, as to define also specific requirements for energy-using products.

The European Commission aims to realize a connection between all these policies in the field of Sustainable Consumption and Production that are included in the Action Plan. Some of these measures are briefly described below.

The Ecodesign Directive. This is a key policy tool promoting Sustainable Consumption and Production. The core of the Directive consists in rules for setting ecodesign requirements regarding energy-using products. The scope is to ensure a free movement of products in the internal market. This policy does not include binding rules for specific products, but it enables the Commission to enact implementing measures on specific products and their environmental aspects considering impact assessment and stakeholders' consultation [18].

The Labelling of Products: labelling categories will be defined considering the outcome of the procedure of the Ecodesign Directive (Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions on the Sustainable Consumption and Production and Sustainable Industrial Policy Action Plan. COM/2008/0397 final, page 5).

The labelling provides information on use phase energy consumption and savings and on other significant environmental parameters of the product.

There are also Incentives. The Treaty and State Aid rules gives incentives for development and acquiring of energy and environmental performing products and "greening" their procurement practice to foster their uptake.

The European Environment Agency [19] has published a first indicator-based report on the progress towards Sustainable Consumption and Production in Europe. The report focuses on indicators to address 35 policy questions in this field. Results of the report showed that the levels of environmental impacts and the resource use caused by European consumption and production are unbearable.

The promotion of Sustainable Consumption and Production initiatives is crucial due to the fact that environmental pollution arising by industrial activities has been emphasized by many data and studies. A European study estimates the environmental impact from SMEs in Europe, referring on data from Eurostat [20]. The study, considered some case studies from 13 countries and an online survey covering EU 27 countries. Results show that SMEs are responsible for more than 60% of industrial

pollution in Europe. Among the industrial activities with the higher impact on environment are: manufacturing of chemicals, basic metals, rubber and plastic, food, mining and quarrying, pulp, paper, coke, energy production, air and water transport, construction [21].

The importance of environmental practices and initiatives for companies and organization is even more growing [22].

Some initiatives of Sustainable Consumption and Production coming also from non-governmental organizations (NGOs). The paper of Kong *et al.* presented some interesting experiences. For example, one national network of waste reduction persons NGO promoted a campaign in US involving also Coca-Cola and Pepsi on waste reduction. Another environmental organization, the Alliance for Environmental Innovation, has worked to find solutions with some companies to integrated environmental decision making in new product development. NGOs are involved in forming extensive networks with stakeholders in order to promote sustainable consumption and production initiatives [23].

Some studies in literature deal with how achieve more sustainable consumption. Bocken and Allwood [24] in their studies interviewed some consumer goods manufactures in order to understand how they can minimize their carbon emissions through the involvement of stakeholders. Results showed many actions that could help to minimize their operations' emissions. Some identified strategies regarded, for example, the use of marketing techniques for environmental benefits, consisting in convince consumers of the benefits of eco-friendly products. Another strategy could be the creation of choice architectures to support low carbon behavior and purchases. This could be achieved through the selection of low carbon products and sell them for example [24].

There are many studies that deal with the effects of eco-innovative practices and environmental policies on the competitive and environmental performance of companies adopting them. For example, Porter and Van der Linde [25] state that properly designed environmental regulations can encourage technological development, promote firms' environmental activities, and enhance environmental performance. The study of Testa *et al.* [26] focused on the Integrated Pollution Prevention and Control Directive, a European eco-innovative policy that now has been enacted by the Emission Industrial Directive. The study investigates the effects of this regulation on 68 companies performance belonging to different industrial sectors and located in different European regions (Andalusia, Valencia, Tuscany, Piedmont, Sicily, West Macedonia). The paper found that the design of Integrate Pollution Prevention and Control policy provides positive effects by increasing facility environmental investments and, as a consequence, it determine benefits on facility performances, both at environmental and competitive level.

The EVER study [27] on the revision of the EMAS and the EU Ecolabelling scheme found that one of the main barriers for companies to adopt an environmental management system based on EMAS is the lack of competitive advantage and recognition by public institutions. Considering this, it is important think that improving environmental performance of companies, is possible only if they are able to obtain a competitive advantage on the market that can offset the higher production costs in the short term [21].

The study of Barber [7] leverages upon the North American Sustainable Consumption and Production Database, a project referred to the year 2003. The database identified 194 practices in the field of Sustainable Consumption and Production, differentiating them according to organization sector, country, organization type, focus areas, tools and approaches.

AEA *et al.* [21] affirmed that properly designed environmental policy that are able to provide incentives for innovation and for a better competitive performance, are not widespread at all in the EU. For this reason, it is clear that the adoption and implementation of policies based on Sustainable Consumption and Production is crucial to promote a more sustainable economy and a reduction of environmental burden. It is very important that companies implement eco-innovation practices in this field to promote a sustainable production processes and eco-friendly products and services.

3. Brief Introduction on the ECO SCP MED Project and on Three Focus Areas: Sustainability of Products/Services, Sustainability of Production Processes, Sustainable Management of Industrial Areas.

Currently in the Mediterranean area, France, Italy, Spain and Greece account for approximately 90% of generation of toxic waste. It is clear that this intensive resource consumption and production pattern cannot be maintained and for this reason partners from 6 Mediterranean countries are working towards improving and ensuring sustainability across the supply chain of the main products and services in the fostering eco-innovation, integrating experiences and recommendations in the framework of the the ECO-SCP-MED project (project co-financed by the ERDF—European Regional Development Fund—through the MED program). Rennings [28] defines eco-innovation as the process of developing new ideas, behavior, products and processes that contribute to a reduction in environmental burdens or to ecologically specified sustainability targets. According to this author, the project "Innovation impacts of environmental policy instruments" has introduced the term environmental innovation as "all measures of relevant actors which: develop new ideas, behavior, products and processes, apply or introduce them and which contribute to a reduction of environmental burdens or to ecologically specified sustainability targets" [28] (p. 322).

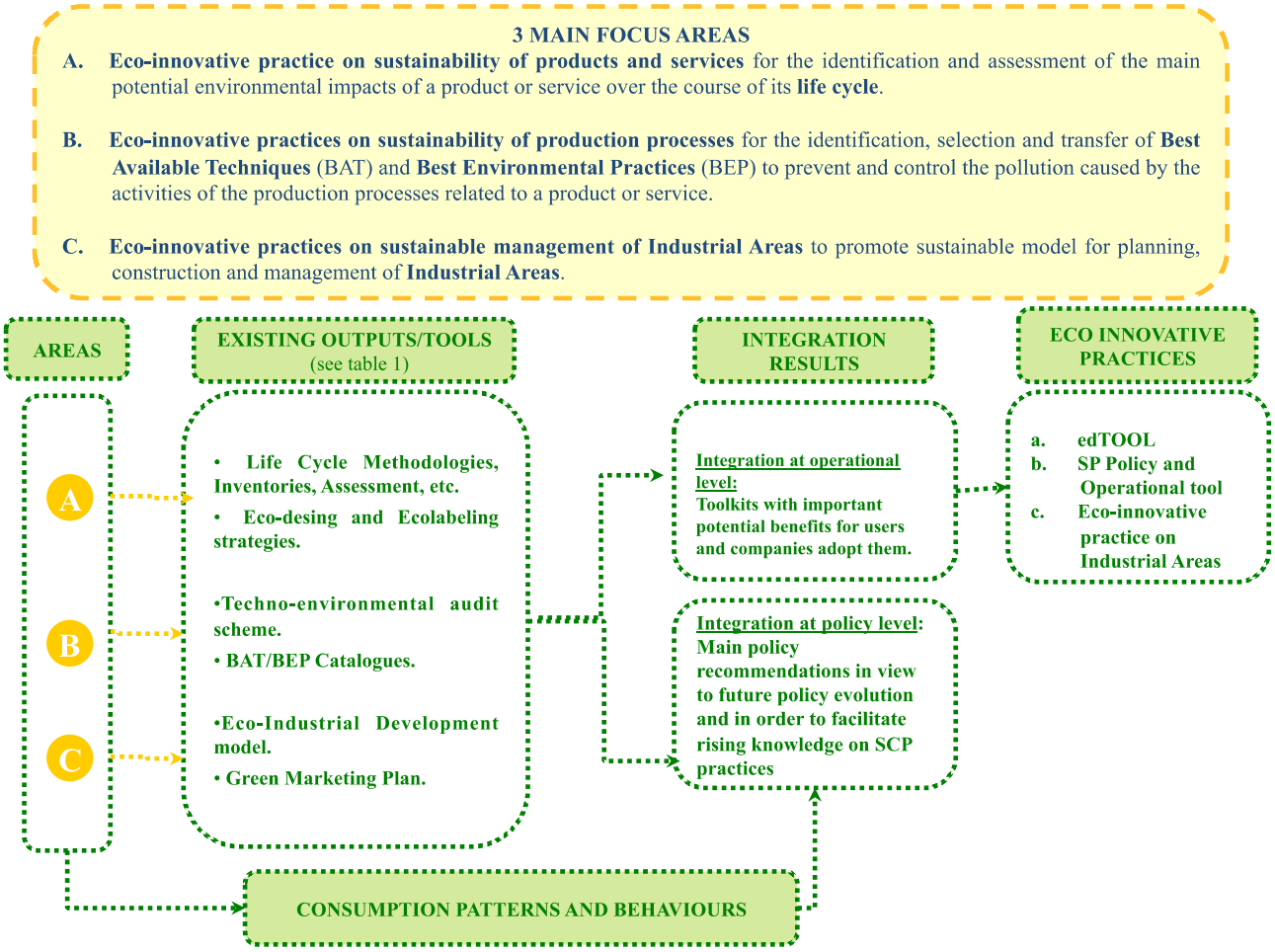
Starting from the exploitation of previous experiences, partners will focus in four main areas in relation with support to eco innovation: sustainability of products and services, sustainability of the production process, sustainable management of industrial areas and sustainable consumption patterns and behavior. The first three mentioned focus areas are strictly connected with the fourth focus area of the ECO-SCP-MED project: the sustainable consumption focus area. This area could be considered as an horizontal one and it allows to focus to specific topics if crossed with the other three areas of the project (Figure 1).

ECO-SCP-MED targets both policy and operational levels.

At policy level, in order to achieve its objectives, ECO-SCP-MED integrates relevant outputs and mutualizes experiences and tools in view to future policy evolution and in order to facilitate rising knowledge of SCP practices, and foster awareness rising around eco-innovation. Activities target regional, national and transnational SCP practices at policy level as well as the supply and demand side of SCP.

At operational level, the project aims at enhancing the capacity of the companies in the decision making for the improvement of the products sustainability, production process, sustainable consumption patterns and management of industrial areas based in a way that allows cost savings through the prevention and consumption.

Figure 1. The focus areas of the project.



10 research institutions analyzed 20 outputs obtained in previous projects. To develop eco-innovative practices, partners organized themselves in three working groups, one for each focus area: sustainability of products and services, sustainability of production processes, sustainable management of industrial areas. The area of sustainable consumption patterns and behavior was considered strictly linked with all three areas and cross-sectional with them, and for this reason a specific working group for this area was not set. Moreover outputs were also sorted in the same focus areas. Outputs, mainly, give as a result guidelines or databases which define best practices. Some of the developed outputs could be interrelated because they tackle similar topics. Finally, there is also the need to increase cost/benefit analysis to evidence economical advantages of the outputs.

4. Method

To realize eco-innovative practices, partners integrated previous project outputs.

A practice was the result of the integration between at least two outputs.

The main features of each output were considered, also as possibilities for integration, and found synergies with other outputs. The key determinant to decide whether to include in the practice one output and not another is the added value that potential users of the practice can obtain using the selected outputs together. The added value to apply the eco-innovative practice has been identified

according to: synergies among different outputs in the pursuing of a specific objective (e.g., sustainable planning of industrial areas, environmental monitoring of processes, identification of Best Available Techniques (BAT) of industrial processes); or according to the fact that the outputs have the same target users (e.g., policy makers, industrial companies, services *etc.*); or taking into account that the outputs are related to the same activity (e.g., communication, planning, management).

Each practice aims to highlight the connections among the different existing outputs, by making possible the reinforcement and empowerment of tools already developed, by taking advantage of their synergies.

New practices have been not developed.

The following table includes the list of outputs from previous projects, starting from which partners developed the practices. Outputs were integrated for the practices development are in bold in the Table 1.

Table 1. Considered outputs for eco-innovative practices development.

No.	Outputs	Area: Products and Services	Area: Management of Industrial Areas	Area: Production Processes
1	International Benchmark in industrial areas		X	
2	Establishment of the Regional IPPC Centers			X
3	Regional Network for CSR Competence			
4	Database of Best Practices developed in Industrial MED Areas		X	
5	Guide for the construction of eco-efficient industrial buildings		X	
6	MEID procedural model		X	
7	Catalogue of BAT (Best Available Technologies) and BEP (Best Environmental Practices) in Mediterranean Agro-food Sector			X
8	MED-IPPC-NET Guidelines on the Best Practices on IPPC Permitting and Following-up Procedure			X
9	Ecodesign Pilot Project	X		
10	LCADB (Life Cycle Inventories—Regional Database for Southwest Europe)	X		
11	CO_2ZW ®		X	
12	Innovative service guidelines	X	X	
13	Interregional Analysis for the implementation of the IPPC Directive			X
14	Process and Best Available Techniques Databases			X
15	Interregional Characterization Mediterranean Agrofood Subsectors			X

Table 1. *Cont.*

No.	Outputs	Area: Products and Services	Area: Management of Industrial Areas	Area: Production Processes
16	Methodology for techno environmental assessment for SMES			X
17	Demonstration of a Sustainable and Effective 2nd Generation Biofuels Application in an Urban Environment.doc			X
18	Establishing Public-Private Partnerships (PPPs) for WCO collection	X		
19	Policy Measures for Promoting Waste Cooking Oil Collection	X		
20	Mediterranean region and the development of renewable energy sources	X		X

To realize the outputs integration a common approach was followed. To this purpose, partners realized a Guideline document on how develop the integration of outputs.

The document included indications for Working Groups to develop the Sustainable Consumption and Production practices. The Guidelines aimed to propose and share a unique schema on how to set the practices.

Then, an International Workshop attended by thirteen external experts in the field of SCP was organized in Pisa (Italy) to validate a first version of eco-innovative developed practices. The workshop included:

(a) an open discussion section;

(b) a validation of the practices.

The open discussion section aimed to collect comments and suggestions from the experts to improve the practices. After the presentation of the eco-innovative practices by partners, external experts given us their opinions on them, also stating their doubts on some aspects.

The validation of tools focused on environmental efficiency through workshops method was also supported by the literature [29].

The validation of eco-innovative practices was achieved through a scoring system based on the evaluation of different aspects related to eco-innovative practices. Each experts evaluated many aspects concerning the each practice, such as:

- assessment and validation;
- further development;
- application;
- dissemination

Each of the above-mentioned aspects was composed by many items: experts evaluated all items of all four considered aspects.

The scoring system through which experts evaluated each aspect of the practices is the following (Table 2).

Table 2. The scoring system for the practices evaluation.

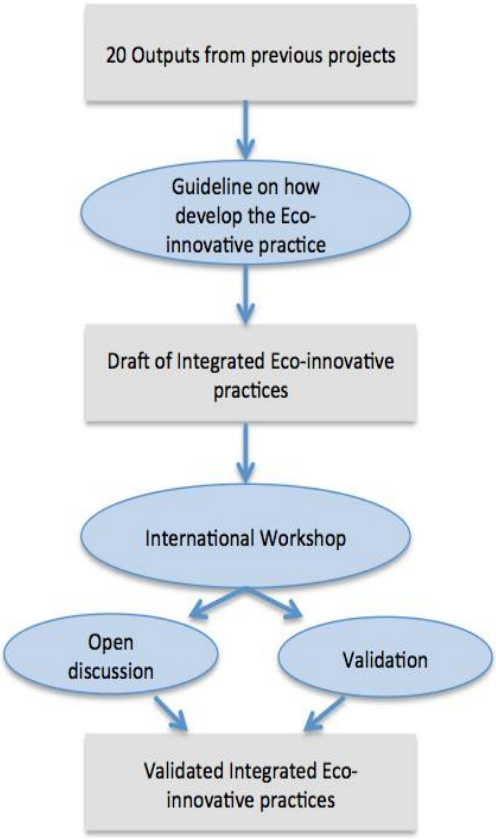
Judgment	Score
Strongly negative/Poor/Not important	1
Negative/Below average/	2
Average/Average/average importance	3
Positive/Good/Important	4
Strongly Positive/Excellent/Very important	5

According to partners' shared approach, practices were considered validated by the external experts if the first section of questions (assessment and validation) obtained an average value > 3. This value was calculated through the arithmetic mean of the weighted averages obtained for each singles items.

The final step to develop eco-innovative practices was to consider all comments and suggestions of the external experts in order to improve these tools and define them.

The Figure 2 gives a synthesis about the methodological approach of the research.

Figure 2. Methodological approach of the research.



The following paragraphs include a description of the eco-innovative practices developed in the field of SCP, with a clear indication of benefits for competitive and environmental performance of main users, mainly companies, implementing them.

5. Results

According to the defined method, working groups developed four eco innovative practices: one related to sustainability of products and services, two in the area of sustainable production processes, and one in the field of the sustainable management of industrial areas. The eco-innovative practices resulted by the integration of 15 outputs out of 20 (Table 3).

All the practices obtained the validation from the experts.

Table 3. Tools and outputs integrated and related eco-innovative practices.

Research Group (Acronyms)	Output/tools capitalised	Eco-innovative practices
(A) Eco-innovative practice on sustainability of products and services:		
UAB	Ecodesign Pilot Project LCADB (Life Cycle Inventories—Regional Database for Southwest Europe)	edTOOL
Province of Bologna	Innovative service guidelines	
B) Eco-innovative practices on sustainability of production processes:		
SSSUP	Interregional Analysis for the implementation of the IPPC Directive.	SP Policy tool
IAT	MED-IPPC-NET Guidelines on the Best Practices on IPPC Permitting and Following-up Procedure.	
Province of Bologna	Establishment of the Regional IPPC Centers.	
ZRS Bistra PTUJ	Interregional Characterization Mediterranean Agro-food Subsectors. Methodology for techno environmental assessment for SMES.	SP Operational tool
IAT	Catalogue of BAT (Best Available Technologies) and BEP (Best Environmental Practices) in Mediterranean Agro-food Sector.	
SSSUP	Process and Best Available Techniques Databases.	
C) Eco-innovative practices on sustainable management of Industrial Areas:		
CCI - Nice Côte d'Azur	International Benchmark in industrial areas Database of Best Practices developed in Industrial MED Areas	
ENEA	Guide for the construction of eco-efficient industrial buildings MEID procedural model	
UAB	CO_2ZW ®	
Province of Bologna	Innovative service guidelines	

Below the practices will be described in the detail.

5.1. Eco-innovative Practice on Sustainability of Products and Services

The eco-innovation practice on sustainability of products and services aims to develop a web tool called "edTOOL" (Ecodesign Tool), which intent to guide companies and public administration throughout ecodesign processes of products and services. This practice integrates three of the twenty outputs (tools) presented in the ECO-SCP-MED project: the Ecodesign Pilot project [30] funded by the Spanish Government; the LCADB resulting from the ECOTECH SUODE call [31]; and the Innovative Service Guidelines output provided by Province of Bologna which was developed in the Ecomarck Project [32].

In most cases, companies do not know how to approach ecodesign, and may consider it something difficult to implement when a life cycle assessment approach has to be carried out. Thus, there is a lack of methodologies and tools aiding companies to ecodesign their products and services. In addition, many of the environmental assessment tools used are too costly (not only in economic terms but also in time) for most companies, which prevents their use. The result is that there are many difficulties in environmentally assessing products and services, and implementing ecodesign.

edTOOL is a web tool (available at [33]) that helps companies to characterize the environmental aspects of products and services by using, mainly, qualitative analysis and also quantitative data if LCA results are available. The practice also proposes flexible and intuitive environmental improvement strategies for the product or service of study and guides the company to assess the economic, technological and social feasibility of these strategies. The proposed environmental improvement strategies are the result of several innovative projects done during the last years [34–43] and the experience obtained during the ENISA—Empresa Nacional de Innovación Ecodesign Pilot Project [30]. One of the ecodesigned products was a knife produced by Arcos [44] and is used to illustrate this methodology.

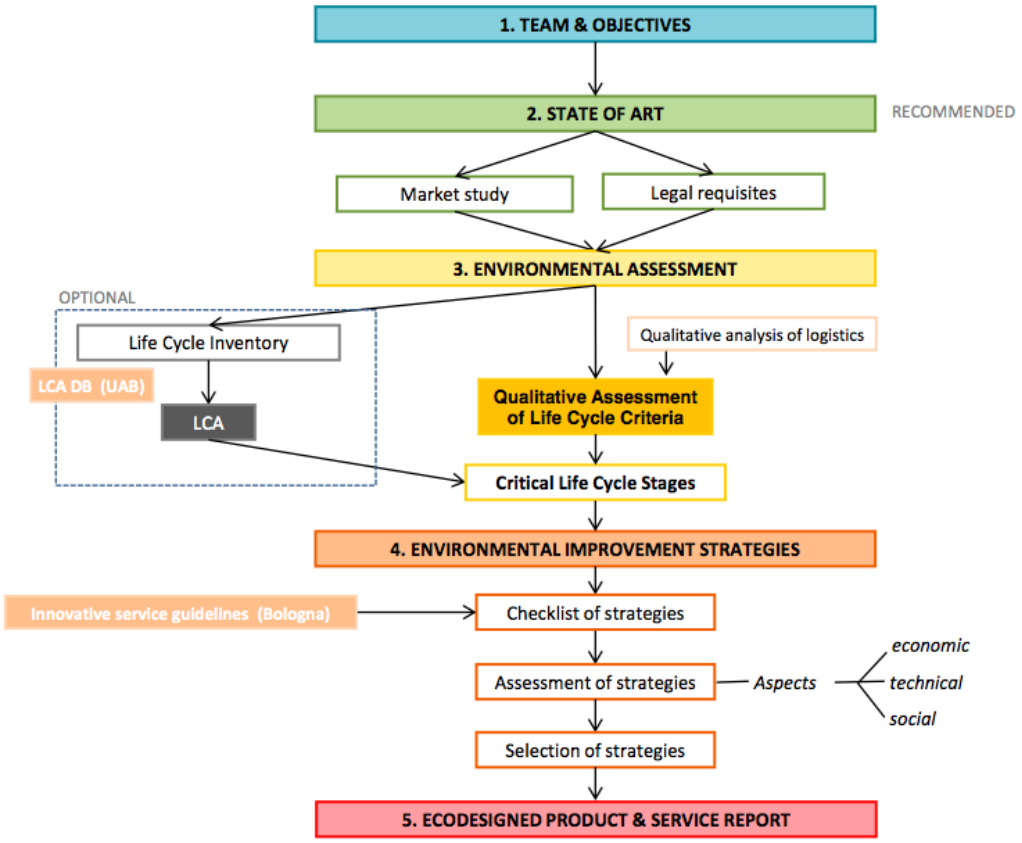
Figure 3 shows the methodology of edTOOL. It considers two types of users for each project: an ecodesign Project Coordinator and a series of ecodesign Team Members. They will work together along the process, although the Project Coordinator will be the one in charge of using the web-based tool on behalf 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. To start an Ecodesign Project, the Coordinator will create a project and then will go through five main steps, as it is shown in Figure 3:

(a) The first step is the Initial Definition, which includes creating the team, describing the project, and setting objectives. 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 the following step. This presentation session could be done in one hour. An alternative way would be to substitute this meeting by creating a mailing list and sharing the information by this means.

(b) The second step (state of art in Figure 3) consists on describing legal requisites and market study (if necessary) and preparing the environmental assessment module.

(c) The third step will consist of the Environmental Assessment (Figure 3), which will be carried out individually by every member of the ecodesign team and will provide information on the critical environmental hotspots. It includes a Qualitative Assessment of Life Cycle Criteria. This is a qualitative environmental assessment based on the study of life cycle stages. In brief, this practice places in a spider web diagram (Figure 4) 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. The methodology gets inspiration from the Ecodesign Strategy Wheel. This environmental assessment starts with a definition of the life cycle stages of the analyzed product or service. The edTOOL presents a table which includes the most common life cycle stages for any product/service. 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. The criteria included in the table should be adapted to each project. The Coordinator will be in charge to customize the life cycle criteria on behalf of the whole ecodesign team. Additional life cycle criteria can be added from a predefined list with other criteria. The process of criteria customization should be done in a workshop session (about 2 hours) with the whole ecodesign team. 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).

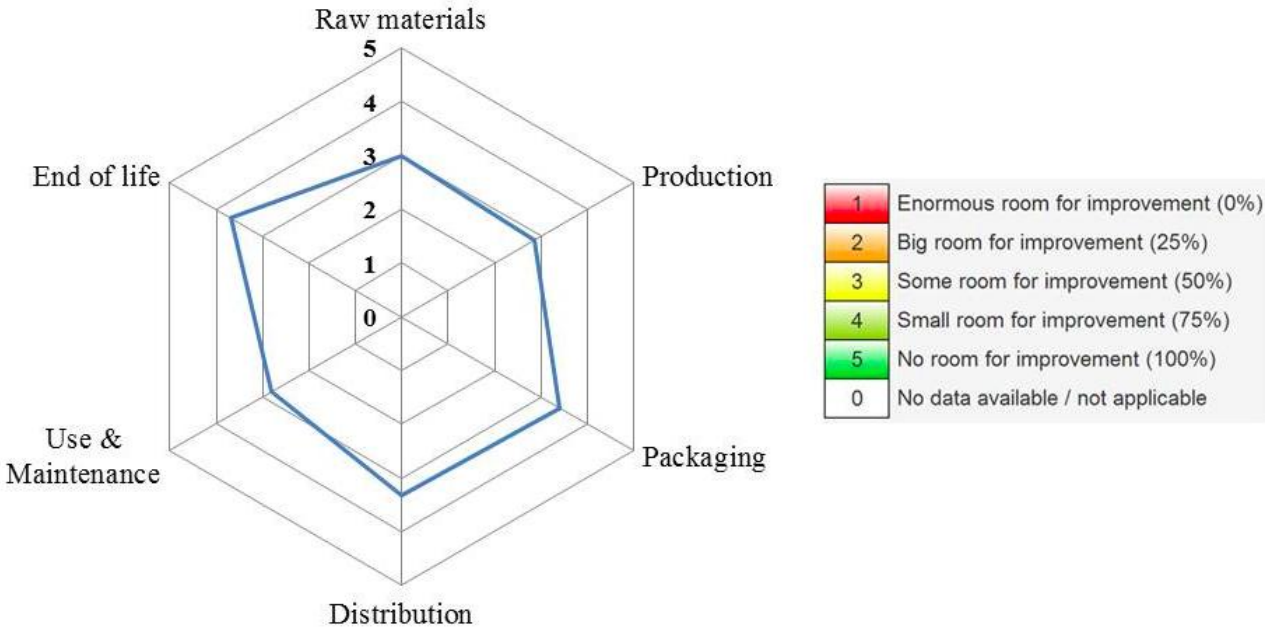
Figure 3. Methodology scheme of the edTOOL.



Once the criteria for the Qualitative Assessment of Life Cycle Criteria are agreed upon, each ecodesign team member can assess the criteria. To do so, they will use the scale from 1 to 5 (5 being the best score and 1 the worst) (Figure 4). This assessment should be made based on an informed knowledge and avoiding subjectivity as much as possible. In case 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'. Each individual does the assessment all at once in order to maintain the same 'individual assessment scale' when giving scores to all life cycle criteria. This individual assessment in one goes should not take more than one hour.

Once all the ecodesign team members have assessed the life cycle criteria, the project will be ready to move to the next phase. 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. Besides, a graphic representation of the results is presented by means of a 'spider diagram' (Figure 4).

Figure 4. Results of the environmental assessment for a specific case study, including the spider diagram with its assessment criteria.



The spider diagram is useful to see which life cycle stages have the lowest environmental performances. In the example, one can see that 'Use & Maintenance', 'Raw Material' and 'Production' present the lowest scores. In contrast, 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 color corresponds to the life cycle stage.

The Qualitative Assessment of Life Cycle Criteria is an easy and quick way to perform an environmental assessment. The main purpose 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 as Life Cycle Assessment (LCA). In case that a LCA study was available for the product/service under study, LCA results should be compared 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 the next step.

(d) The fourth 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.

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. 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 (Figure 5). In addition, the Coordinator will be able to add other predefined strategies offered by edTOOL that correspond to the other life cycle stages. For instance, in the Knife example, some strategies for the 'Raw materials' stage are included, since it was the third life cycle stage with worse environmental performance.

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

The development of an Ecodesign Action Plan consists of transforming 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. 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 6). It is possible that two different strategies can be implemented simultaneously by one action or, in contrast, that one strategy results in several actions. As a result of this, an Action Plan for the ecodesign of the product/service is obtained (Table 4). 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.

(e) And finally the Summary report which will present the results for the whole process. At the end of use, a Summary report is automatically generated which includes all the information and results related to the ecodesign process. There are 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.

Figure 5. List of potential ecodesign strategies, which are presented based on the critical life cycle stages previously identified.

Strategy	Appropriate	Completed
Lifecycle stage: **Raw Materials**		
Reduce material input by means of dematerialization	✓	
Prioritize materials with a high recycled content	✓	
Prioritize recyclable materials	✓	
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	✓	✓
Preferably use regionally available energy resources	✓	✓

Figure 6. Assessment of the viability of potential strategies and selection of those to be included in the Action Plan.

Description	Social	Economic	Technical	Avg.	Action plan
Lifecycle stage: **Raw Materials**					
Reduce material input by means of dematerialization	4	4	4	4.0	✓
Prioritize materials with a high recycled content	3	2	3	2.7	
Prioritize recyclable materials	4	4	4	4.0	✓
Lifecycle stage: **Production**					
Minimize and simplify the production processes	4	5	3	4.0	✓
Use water efficient technologies in the production process	4	2	3	3.0	
Use technologies that optimize raw materials use in the production process	4	4	3	3.7	
Use techniques that reduce the generation of waste and emissions	4	5	3	4.0	✓
Recycle process materials whenever possible	3	2	1	2.0	

Table 4. Action plan.

Strategy	Action	Deadline	Responsible
Reduce material input by means of dematerialization	Reduce thickness of the blade (from 3 to 2.5 mm)	2015-01-01	Head of Technical Department
Prioritize recyclable materials	Handle with recycled PP content inside and virgin PP outside (by means of co-injection)	2014-09-01	Head of Technical Department
Minimize and simplify the production processes	Automatization of metal die-cast process to reduce process waste	2016-01-01	Head of Technical Department
Use technique that reduce the generation of waste and emissions	Automatization of metal die-cast process to reduce process waste	2016-01-01	Head of Technical Department

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:

- Ecodesign Team
- Description and Objectives
- Environmental Assessment
- Spider diagram
- Action Plan

This Report could be used to summarize the ecodesign project.

The knife example produced by Arcos [44] was improved by reducing by 16.7% the material used for the blade; reducing by 10% waste metal from production; and using a 70% of recycled PP for the interior of the knife handle (Figure 7). In addition, packaging and transportation were environmentally improved during the ecodesign process [45]. This company, after ENISA project, has informed verbally to the collaborators about its economic benefits after applying different ecodesign strategies which are now applying to other of their products.

Figure 7. Recycled PP content of the ecodesigned knife produced by Arcos within ENISA Ecodesign Pilot Project (ENISA, 2012)**.**

The most relevant aspect of the edTOOL is its simple and effective methodology. The use of the software allows technicians to obtain an ecodesigned action plan with a reasonable effort. However, a trained expert with knowledge about environmental analysis and ecodesign is required to guide a team of people from the company throughout the use of the software.

This practice has been developed in order to operationalize the ecodesign process and make it easier for companies to introduce ecodesign into their products and services. The tool allows companies to give an added value to their products and services by being more ecoefficient.

Many companies are interested in the environmental improvement of their products and services, but do not know where to start. By means of this eco-innovative practice, a practical and intuitive means is provided, so companies can learn how to ecodesign and implement it in their products and services. 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 or service will depend on the possibilities and interests of the companies. The tool can be used as the first step towards the environmental improvement of products and services, encouraging companies to integrate ecodesign into their activities.

Many ecodesign strategies proposed when using the edTOOL intent to increase ecoefficiency which is directly related with economic benefits.

In addition, this practice promotes team-working and communication within the company, which has proved to be a very valuable asset for any company willing to innovate and success. Thus, it is important because it can contribute to streamline ecodesign and also to change the attitude of companies towards environmental issues.

The edTOOL 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 tool to foster the implementation of ecodesign and to make it mainstream

5.2. Eco-innovative Practices on Sustainability of Production Processes

The need to manage the several environmental aspects associated to the activities of the production process in an integrated way is one of the main challenges to face in the environmental management of companies. To stimulate this approach the European Commission adopted in 1996 the Directive on Industrial Pollution Prevention and Control (IPPC) [46]. This Directive was codified (the codified act includes all the previous amendments to Directive 96/61/EC and introduces some linguistic changes and adaptations (e.g., updating the number of legislation referred to the text). The substance of Directive 96/61/EC has not been change) in 2008 [47] and it has been recently recast along with the Directive on Industrial Emission (IED) [48].

The application of this scheme has thus practical and important consequences for the affected facilities, as all licenses are now brought together under a unique administrative concept: the IPPC permit, which aims at establishing the measures to avoid or, at least, reduce emissions to the atmosphere, water and soil. Testa *et al.* [26] show that IPPC regulations positively affect the environmental performance of facilities. However, this depends on how the regulation is designed and implemented by the Member States.

Daddi *et al.* [49] show how the method of IPPC regulations implementation can be strategic for companies. IPPC approach aims to stimulate the introduction of eco-innovation in the production processes through the role of Best Available Techniques (BAT). The BAT are the reference techniques that the Competent Authorities must use to establish Emission Limit Values (ELV) in the IPPC permits. According to this approach the companies in the scope of the IPPC regulations are stimulated to innovate their production processes, pursuing the level of emissions achievable through these techniques.

The Sustainability of the production process (hereafter SP) practice has been developed to facilitate the policy makers and enterprises to improve the implementation of the requirements established in the IPPC regulations and other environmental policies and schemes. The eco-innovative practice is made up by two different ones, one at policy and the other one at operational level.

The SP Policy practice is a key, necessary and innovative instrument that can support policy makers and regional authorities in the implementation of the legal requirements of the IPPC regulations. Some assessment reports published by the European Commission [50–52] or technical reports published by European projects as MED-IPPC-NET project (MED-IPPC-NET project has been co-funded by MED Programme involving 7 European Regions: Valencia, Andalusia, Tuscany, Piedmont, Sicily, West Macedonia & Slovenia) demonstrated disparities in the implementation of the IPPC regulations by several European Regions. The particularities of the Mediterranean industrial sector and its insufficient level of implementation of these requirements in comparison to other European regions strengthened the need of developing such SP Policy practice in the Mediterranean context [53]. The SP Policy practice consists on the following tools:

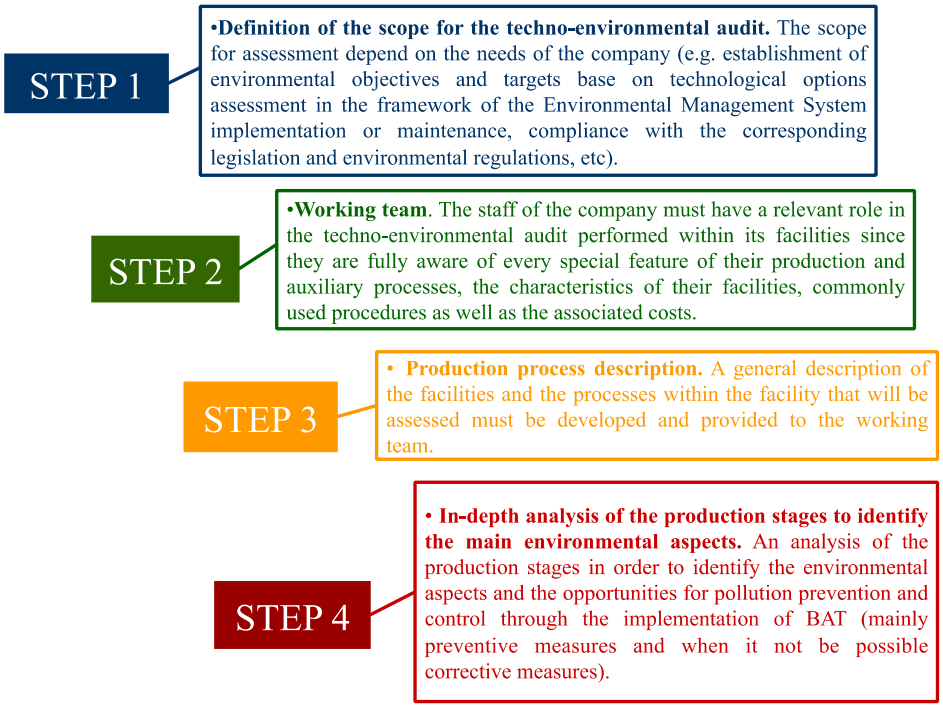
- Guidelines on best practices on IPPC permitting and following-up procedures which contains, per each one of the best practices identified, the legislative references and requirements, description of the best practice, deployment and results.
- Permit template which is divided into three different sections (with their correspondent subsections): General Information, environmental conditions and technical annexes.
- Applicant guidelines which provides guidance to the owner of the facility on the content of a permit issued according to the IPPC Directive. The list of the content is in concordance with the template permit and with the public officer guidelines.
- Public officer guidelines which provides guidance to the Competent Authority on the content of the permit issued according to the IPPC Directive. The list of the content is in concordance with the template of the permit and with the applicant guidelines.
- Software application which was delivered to help users to apply the SP Policy practice.

The SP Operational practice has been developed for supporting companies, mainly SMEs, to identify BAT in order to improve their environmental performance. SP Operation practice is a useful tool that supports companies to comply with the requirements introduced by the IPPC regulations, providing companies with a guide to analyze their production process and to identify the applicable and environmentally-friendly technologies and practices aiming to comply with Best Available Techniques Associated Emission Levels (BATAELs). In addition, the company also benefits from a series of advantages that difficult to measure but which are just as important. These are the so-called intangible benefits, such as the enhanced corporate image of the company, which is something that improves the communication policy and the relationship with public authorities, suppliers, clients and

neighbors, minimize the risk of accidents and afford greater adaptability concerning changes in regulations and legal requirements, all of which will increase the competitiveness compared to the rest of the sector. BATAELs are defined in article 3 of the IED as "the range of emission levels obtained under normal operating conditions using a BAT or a combination of BAT, as described in BAT conclusions, expressed as an average over a given period of time, under specified reference conditions". According to the article 15 of the IED, "the Competent Authorities shall set ELVs that ensure that, under normal operating conditions, emissions do not exceed the BATAELs as laid down in the decisions on BAT conclusions in the Best Available Techniques Reference Document (BREF)" [48]. BREF are the results of the information exchange process that takes place in the European Integrated Pollution Prevention and Control Bureau (European IPPC Bureau, EIPPCB), which is an action of the Sustainable Production and Consumption Unit of the Institute for Prospective Technological Studies (IPTS) [47]. The Institute for Prospective Technological Studies (IPTS) is one of the seven scientific institutes of the European Commission ś Joint Research Centre (JRC). BAT conclusions are presented in the form of "a document containing the parts of a BREF laying down the conclusions on the BAT, their description, information to assess their applicability, the BATAELs, associated monitoring, associated consumption levels and, where appropriate, relevant site remediation measures" (article 3 (12), European Parliament, 2010) [48]. BATAELs will determine the rank in which ELV will be located for each significant emission and facility. ELV means "the mass, expressed in term of certain specific parameters, concentration and/or level of a emission, which may not exceeded during one or more periods of time".

The SP Operational practice is oriented to support the implementation of BAT establishing several steps to guide the users towards the identification of the BAT applicable in the production processes. A brief summary description of the steps defined are shown in the Figure 8.

Figure 8. Several steps to guide the SP Operational practice users towards the identification of the BAT applicable in the production processes.



The analysis will include the following issues:

- Consumptions–side analysis:

− Raw materials used: description of the kind of raw materials used;

− Water use: description of the types of water (e.g. process water, cooling water, wash water, *etc*.), sources of water (e.g., tap water, ground water, recuperation/recycling streams, *etc*.) and amount used per type and source;

− Energy use and related emissions: description of what kind of energy flows exist (e.g., fossil fuels, renewal energy, *etc*.), where are they used and how much is used (e.g., kWh, ton per kg product produced, *etc*.).

- Emissions-side analysis:

− Waste generation: description of what kind of waste fractions are produced (and where), the amount of waste (per fraction);

− Waste water emissions: description of where do waste water streams arise, and what type of pollutants can be found in the waste water;

− Air emissions/dust/odor: description of the sources of air emissions, type of pollutants found in the air emissions and the amounts;

− Soil and groundwater contamination: description of which process steps can contaminate the soil (e.g., spillages and leaks);

—Noise generation: description of which process steps emit.

Step 5. Final report. Summarize the opportunities for pollution prevention and control coming from BAT implementation. The following information should be included:

− Achieved environmental benefits: emission reduction percentages, total amount of emissions prevented;

− Environmental performance and operational data;

− Cross-media effects;

− Considerations relevant to applicability (e.g., why and when is the technique applicable/non applicable);

− Economics: Information on the costs of techniques (e.g., capital/investment, operating and maintenance including details on how these costs have been calculated/estimated) and any possible savings following from their application (e.g., reduced raw material or energy consumption, waste charges, reduced payback time compared to other techniques), revenues or other benefits (including details on how these have been calculated/estimated);

− Driving force for implementation.

5.3. Eco-Innovative Practices on Sustainable Management of Industrial Areas

Sustainable management of Industrial Areas (IAs) is one of the key elements to foster eco-innovation in the Mediterranean region. The aim of the Working Group in this area is to outline a new approach heading for modern IA management, encouraging SCP policy application. IA management is becoming in fact a complex duty which comprises several tasks and requires a remarkable expertise in several fields, as shown in Figure 9. The fields related to environment and sustainability, as well as marketing and promotion of the image of the Area, are innovative and challenging, requiring a strong involvement of both Local Authorities and settled enterprises, especially SMEs, along with the IA Managing Company. One of the keys of the success of IA is in fact the creation of cooperative networks among enterprises and stakeholders, which could allow for identification of environmental, economic and social synergies, overcoming the problem of the small dimensions of SMEs, main obstacle to their environmental and innovation investments [54–56]. Gibbs emphasizes the importance of networking and collaboration among the co-located firms as a key factor for long-term eco-industrial development, stating that "it is this networking activity that will potentially encourage materials interchange in the long-term and distinguish eco-industrial development from other, more superficial initiatives for the greening of industry" [56] (p. 1148).

Figure 9. Tasks for IAs management (Source: EU MITKE Project).

To support the evolution towards an innovative IA management system, a set of outputs developed in several project has been collected by a multidisciplinary working group coordinated by the Italian National agency for new technologies, Energy and sustainable economic development (ENEA). To make this integration more operational and suitable for IA managers, the outputs have been integrated and developed in an eco-innovative practice called "Sustainable Management of Industrial Areas" composed of six tools.

The six tools integrated are the following:

- Mediterranean Eco Industrial Development (MEID) model, made-up of a series of necessary steps to be followed in order to implement a sustainable management of Mediterranean IAs. The Model procedure systematizes several project experiences which have been realized at a European and local level, taking into consideration the specificities of the MED area. Since IAs of the Mediterranean have different levels of management and, most of all, have heterogeneous management, three different paths have been detected and should be followed according to the starting point of each IA [57]:

- Path 1—Planning and design of a new Industrial Area;
- Path 2—Towards MEID Model in non-structured Industrial Areas;
- Path 3—MEID Model in structured Industrial Area.

The essential elements which have to be present and implemented at the end of the Path 3 are shown in Figure 10.

The framework created by the MEID model is essential to guarantee cohesion among companies and to provide a unique interface with Local Authorities and stakeholders, supporting the settled SMEs to improve their resource efficiency and competitiveness. In particular, the MEID model approach has contributed to identifying and exploiting synergies at the IA level, promoting a shared industrial development policy, common infrastructures and innovative services. Figure 11 shows the key concept and elements of a sustainable IA according to MEID approach [58]. Besides, the management framework given by MEID model has shown the necessary system perspective of the structured practice.

Figure 10. The Mediterranean Eco Industrial Development (MEID) model.

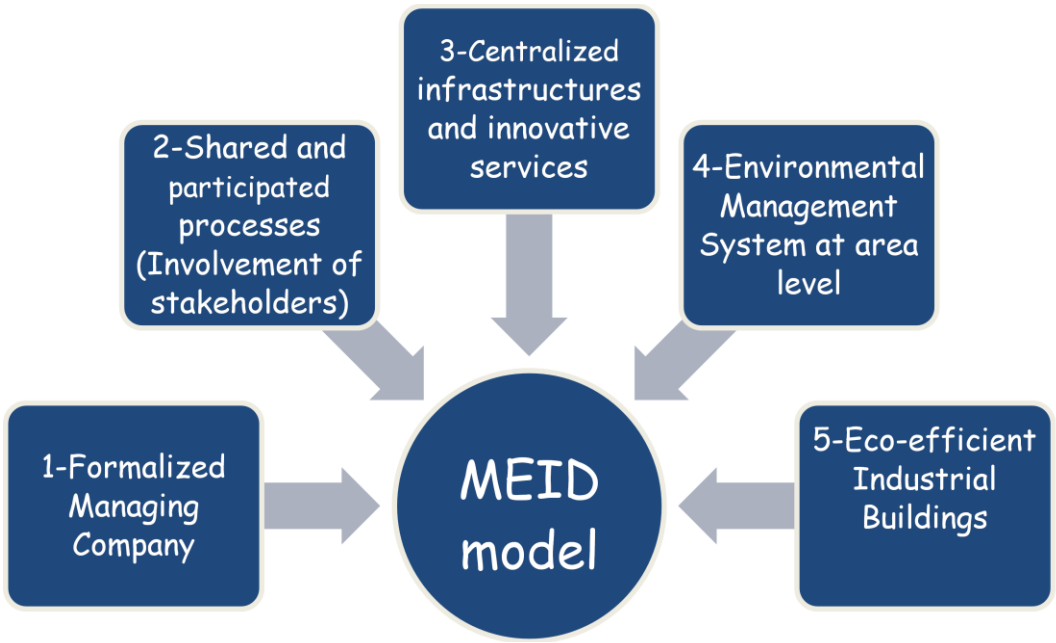


Figure 11. Key concepts and elements of a sustainable IAs.

- a check-list with a scoring system to (self) evaluate the status of an IA with regard to its most relevant aspects. The checklist is based on 13 yes/no questions divided in five main areas, considered the most relevant for IA management: management, infrastructures and centralized services, energy/environmental quality of industrial buildings, animation/participation, green marketing/external communication. According to the answer, at each question is given a score which depends by the relative importance of the related area. The scores are then summed up to have a unique score of the IA. The weighting system is based on a qualitative expert judgment and has been built on the experience gathered in several European projects as MEID, Ecomark and SIAM - Sustainable Industrial Area Model [59]. To increase its usability, the tool has been developed on excel program;
- a web database of best practices which can be adopted in MED IAs for improving their environmental, social and economic profile. It includes environmental, social and economic solutions referred to centralized established infrastructures as well as innovative services in IAs of the Mediterranean Region. To develop this tool, the database of MEID project, almost 150 examples of best practices related to about 50 IAs of MEID partner countries, has been integrated with the content of Ecomark project, about 30 added IAs;
- a guide to support the different agents involved in the process of design, construction and maintenance of Eco-efficient Sustainable Industrial Buildings to evaluate and improve their environmental and energy performances. It consists in 88 good practices related to the entire

building lifecycle. Each measure is scored and weighted according to the relative importance of the area of action (e.g.: material, energy, waste, ecosystem, *etc*.) The weighting system allows to reach a unique score for the entire building;

- software for calculating the carbon footprint of waste management in IAs. It is an adaptation of CO2ZW® software by Zero Waste project [60], an excel based software created for municipality waste, to IAs context. It allows to calculate the greenhouse gas emissions (in carbon dioxide equivalents) from the management of the waste fraction of IAs assimilated to urban waste. The output can be used as a guide for driving local government policy in the context of waste sector operations;
- a check-list to present to IA managers, Local Authorities, general stakeholders (Development Agencies, businesses promoters) the steps and the phases for carrying out an innovative sustainable logistics service which includes the planning, organization, management, execution and control of freight transport operations also by integrating information, transport, inventory, warehousing, materials handling, packaging and even security activities. It is based on the Ecomark project activities, in particular on two operative tools: software for routes and one for loads optimization.

The practice can be used by IAs managers, Local Authorities, SMEs, service providers and all the general involved stakeholders (Figure 12), giving theme some benefits. It gives to all the actors interested in improving the efficiency and sustainability of IAs the opportunity to have a single access point to information and tools. Besides, it valorizes and aggregates some related outputs and make them more operational and suitable, increasing therefore their implementation in Mediterranean IAs

Figure 12. Users of the practice "Sustainable Management of Industrial Areas".

In particular, Local Authorities can gather suggestions on the policies to set up for reaching a low-carbon economy, an efficient management of IAs and sustainable productive activities. Besides, they can act as facilitators for the development of sustainable IAs by adopting administrative and regulation relief, along with financial incentives. By a careful examination of needs and a consequently accurate IA policy, IAs can seriously consider the transition to sustainable ones, with benefits for all. SMEs can understand the benefit in settling in well-managed IAs, in sharing services and infrastructures and in gathering indications on how to improve the efficiency of their industrial buildings. Service providers (e.g., energy, waste, water management companies) and general stakeholders (e.g., Development Agencies and Businesses Promoters) can understand how to give

more value to their services. Nevertheless, the main users will be IA managers interested in improving the performance of their IA. With the adoption of the practice, they will be able to understand and to evaluate the initial status of the IA, to develop specific operational paths to improve its performance, to access an extensive database of operational good practices and to know how to contact the related organizations, to understand how to minimize the greenhouse gas emissions from the IA waste management and to solve problems such as industrial building efficiency and logistic.

In conclusion, the practice could allow to solve several problems encountered by IA managers and SMEs which want to improve their resource efficiency and market attractiveness and competitiveness, in particular the lacks of:

- a system perspective in managing environmental issues;
- a single source of information, examples of good practices, case studies on sustainable IAs;
- an internationally accepted model in managing IAs to which to refer and to propose to Local Authorities;
- tools for scoring IAs and measure the progress towards resource efficiency and sustainability.

6. Discussion

For product and services the project provides an ecodesign web-based tool with the following characteristics: a useful to guide companies through the process of ecodesign implementation; flexible and intuitive; propositive, with recommendations for the environmental improvement; practical, with examples done in the past from the partners' experience. The so called edTool is complemented with the SP Policy practice that supports policy makers and regional authorities in the implementation of the legal requirements of the IPPC regulations.

Regarding the eco-practice on sustainability of production processes, the SP Operational practice has been conceived to be used by experts who are familiar with the industrial activities and processes to be analyzed. They must also be familiar with the environmental aspects and techniques that are being put forward for its prevention and control at the source. The ultimate goal of the SP Operational practice is to put forward a range of alternatives to deal with a series of malfunctions that are often the results of routine practices or activities and for providing the companies with sufficient data to orientate its policy towards cleaner production practices that are technically and economically viable. Solutions and proposals often come out of other solutions that are applied in sectors that in theory quite separate from the facility that are being diagnosed.

At European level, Mediterranean region included, a widespread problem in adopting SCP practices is the lack of significant support systems for enterprises, mainly for SMEs, and for IAs. There is a general lack of financial and economic incentives, together with an overall lack of administrative simplification strategies and regulation relief [61]. There is also a common lack of integration among different environmental and research policies in business activities, along with a general lack of knowledge of how to spread SCP approach among enterprises and Local Authorities. All these settings represent a strong barrier for IAs managers and enterprises of MED regions to undertake the path towards sustainability. To overcome those obstacles and to support SCP policy, European projects

should favor the integration among research, business, innovation and environmental performances of enterprises and IAs, as ECO SCP MED project.

Within this framework, main aim of the practice on Sustainable Management of IAs is to encourage the application of SCP concepts in Mediterranean IAs. In particular, it fosters a proper management of IAs and helps in overcoming the problem of the small dimensions of Mediterranean SMEs, the real giants of the European economy [61], contributing to create a cooperative climate which helps the identification of synergies at Area level. Innovative IAs, in fact, have been confirmed as the most favorable contest to implement and test the principles and tools of Industrial Ecology due to the possibility not only of sharing infrastructures and services for increasing the production and minimizing costs, but also [54,55]:

- reducing the industrial settlements dispersion in the territory;
- sustaining industrial development by means of optimized transport networks for goods and people and also for local resources handling;
- reducing environmental impacts caused by the industries concentration;
- aggregating the demand and transfer of technological innovation related to environmental, energy and water resources.

This cooperative approach can therefore help enterprises to face the increasing challenges of the European legislation, exploiting the opportunities of Green Economy that, in the recent years of economic crisis, stood out as the only sector that can achieve high growth rate when most of the others have negative trends [60]. Moreover, a common understanding of the enterprises needs and the development of cooperation attitudes push for the creation of networks which increase the SMEs possibilities to compete on international markets.

7. Conclusions

Eco innovative practices we developed could help many actors, mainly companies and public authorities, to achieve environmental and competitive benefits and implement eco-innovation principles, also with a cooperative and shared approach.

The added value of our paper and of the eco-innovative practices with respect to other existing tools and practices, is, first of all, due to the integration that is behind each practice. A practice is the result of the mixing and the synergies among more than one output focused on SCP. The integration of more outputs in a single practice, makes possible higher potentials from the practice application with respect to single outputs ones. In other words, the integration we carried out, provides and results in a strengthening of the single potential of each tool. Rather than focusing on single solutions, this paper identified new opportunities to promote sustainable consumption and production by valorize synergies of tools applied together.

With this study, we also offered a concrete possibility to valorize existing outputs on SCP. Indeed, some literature studies also highlight the fact that many references indicated a more interested in developing new tool on eco-design than on studying the use of existing ones and to evaluate them for their improvement [62].

The benefits that could arise from one single output, could be increased with the practice, since it is the result of mixing tools that can create more benefits and synergies out of their single potential. A company that implements a practice resulting from more than one single tool could obtain more benefits and positive effects in the same moment and with the same action.

Under this aspect, our research differs from other studies on eco-design tools and eco-innovative practices. Some of these studies consider tools individually and are not focus on the potential of their synergies. For this purpose, the paper of van Hemel and Cramer [63] deals with many eco-design strategies for companies. In addition, the Ten Golden Rules [64] is an eco-design tool composed by generalized set of guidelines resulted by a synthesis of other environmental design guidelines.

Moreover, our paper includes, at the same time, operational and policy practices about SCP in one single study. The research provides SCP option practices both for public stakeholders, as guidelines, best practices or databases, and also for private companies, as practical solutions (the eco-design tool).

Author Contributions

All authors contributed in the same way to the study development. Indeed, the authors are part of the membership of the European project ECO SCP MED.

List of acronyms:

- BAT: Best Available Techniques
- BAT-AEL: Emission Level Associated with the Best Available Techniques
- BREF: Best Available Technique Reference Document
- CO2ZW: The Carbon Footprint Tool for Waste management in Europe
- ECO-SCP-MED: Integrating Experiences and Recommendations in Eco-Innovation for Sustainable Production and Consumption in the Mediterranean Area
- EdTOOL: Eco-design Tool
- EIPPCB: European Integrated Pollution Prevention and Control Bureau.
- ELV: Emission Limit Values
- EMAS: Eco-Management and Audit Scheme
- ENISA: Empresa Nacional de Innovación
- ERDF: European Regional Development Fund
- IA: Industrial Area
- IED: Industrial Emissions Directive
- IPPC: Integrated Pollution Prevention and Control
- IPTS: Institute for Prospective Technological Studies
- JPOI: Johannesburg Plan of Implementation
- LCA: Life Cycle Analysis
- MED IPPC NET: Network for strengthening and improving the implementation of the IPPC European Directives regarding the Integrated Pollution Prevention and Control in the Mediterranean
- MEID: Mediterranean Eco Industrial Development
- OECD: The Organization for Economic Co-operation and Development
- SCP: Sustainable Consumption and Production

- SCP/SIM: Sustainable Consumption and Production and Sustainable Industrial Policy
- SIAM: Sustainable Industrial Area Model
- SME: Small and Medium Enterprises
- SP: sustainability of production processes

Conflicts of Interest

The authors declare no conflict of interest.

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