GRECO INITIATIVE
GREEN COMPETITIVENESS

Regional Activity Centre
for Cleaner Production

GREEN COMPETITIVENESS IN THE MEDITERRANEAN

Finding business opportunities through Cleaner Production

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EXECUTIVE SUMMARY

1. Green competitiveness is about using an environmental focus to reshape the way to do business. The issue is moving towards the concept of "opportunity". It is one of reinforcing companies' capacity to learn, develop, absorb and apply "new" knowledge.

2. The potential of Cleaner Production (CP) in the Mediterranean can be reinterpreted at the light of such "Rio (+)" types of approaches through which the real challenge consists in shifting from considering the environment a "pulling factor" (an "environmental demand on the economy"), to that of considering the economy a "pushing factor" (an "economic contribution for the environment"). CP is then understood as the introduction of a set of techniques and management processes that support both environmental and financial benefits for companies, with consequences at the micro-, meso- and macro- levels. It thus contributes to the goal of sustainability.

3. Institutional arrangements and regulations for CP promotion in the Mediterranean are still weak in terms of their capacity to promote future green competitiveness strategies: a) still favoring end-of-pipe actions instead of preventive ones; b) not much attention being paid to present experiences by certain companies of profitable high returns, short paybacks and small investments in CP; and c) marked absence of economic instruments launched to that end, such as corrective techniques of a pro-green competitiveness type.

4. It is also the case of certain activities undertaken by National Cleaner Production Centers or equivalent institutions in the Mediterranean through, among others, EU-LIFE funded projects, the setting up of the Environmental Technologies Action Plan (ETAP), as well as through other activities with the EU beyond the traditional support to the Integrated Pollution Prevention and Control Directive (IPPC) or similar environmental compliance measures. Although more of a green competitiveness type, they remain limited to sparse technical and financial support to CP developments and their implementation, the slight promotion of CP transfer of technology and techniques, and new initiatives in the fields of information, capacity building and awareness.

5. There is an urgent need to consider the reinforcement of a Mediterranean entrepreneurship by using green competitiveness. The issue is one of wiring up the innovation framework to create favorable conditions for companies to engage in voluntary/profitable/competitive eco-innovation activities in their production processes.

6. The present report seeks to draw lessons from a set of very successful CP real cases produced by CP/RAC through the MedClean files, since the Center was set up,. One hundred and seventy-six different CP actions were identified and analyzed, and the results were integrated in a MedClean Integrated Database (MCID). They represent investments made in 100 Mediterranean companies that generated altogether total annual savings of 14,133,452 euros.-, and cumulated net benefits, after five years, of 56,866,505 euros.-

7. Today, some of the most serious pollution challenges of the Mediterranean region are abusive uses of water, energy, as well as chemical inputs into production processes. Most Mediterranean companies

examined have been particularly successful in addressing them effectively by means of the use of CP approaches. Cleaner Production includes both reduction at source and recycling at source, and techniques of both types are found among the analyzed Mediterranean preventive experiences.

8. Even though both reduction at source and recycling at source are considered of a preventive nature, the cases analyzed show that recycling usually implies higher costs because of the use of more expensive CP solutions carrying lower return on investment (ROI).

9. The analysis also identifies a majority of CP cases in which companies generate, through small investments, important benefits in both environmental and financial terms. Nearly all CP techniques generated substantial economic savings to Mediterranean companies with relatively short payback periods, substantial profitability and ROI. As an illustration, many techniques implied payback periods shorter than 1 month, some of them virtually requiring no investment. Moreover, 50% of the 176 CP actions made by companies recorded less than 6 months payback periods. A Spanish company got annual savings the first year 25 times higher than its 41,312 euros.- initial investment.

10. The interrelation between CP investments, environmental benefits and payback was found to depend on the nature of the CP alternative introduced, as well as on the type of product and sub sector concerned. In prospective terms, the most promising techniques could thus be tailored to these findings.

11. Among CP types of alternatives introduced by Mediterranean companies, those found recording relatively higher levels of profitability were: i) Good housekeeping and organizational measures; ii) use of alternative production inputs, gas and heat recovery and recycling systems –with annual savings of 1,581,964 euros the first year, out of 219,081 euros of initial investment-; and iii) energy saving measures and organic material recovery and recycling systems. Those recording substantial but relatively lower levels of profitability were: i) Use of alternative processes –2,768,.431 euros of annual savings on aggregate from initial investments of 1,990,422 euros–; ii) use of alternative components and machinery; iii) inorganic material recovery and recycling systems; iv) water recovery systems and wastewater segregation; v) energy savings through boiler efficiency; vi) material and water circuit recovery and recycling systems; and vii) use of alternative designs and other water saving technologies. However, this does not imply that companies have to disregard "lower levels of profitability" actions at all.

12. In environmental terms, some interesting lessons could also be drawn. The reduction of water consumption was mainly achieved through the introduction of good housekeeping and organizational measures technologies in one third of the cases. Correspondingly, achieving the reduction of chemical consumption inputs was also found to be due, in one third of the cases, to the introduction of the use of alternative inputs and processes. Regarding the reduction in energy inputs consumption, technological alternatives were again responsible for 42% of the reduction in energy consumption. In the case of the reduction and/or recycling of wastewater, the use of alternative processes contributed to 41% of this environmental benefit.

13. From the cases analyzed, green competitiveness patterns seem also to depend on the nature of the product lines and sub sectors in which companies develop their productive activity. Largest profitability was recorded by companies introducing CP in production processes from the electrical machinery, food products, transport equipment, chemicals and textile sectors, respectively. Independently of the companies' financial profitability records, highest CP investments were recorded in companies active in the manufactures of basic metals, the chemicals and electrical machinery sectors. Finally, and in terms of diversified environmental benefits reached from the introduction of CP, companies from the food products, electrical machinery and basic metals manufactures achieved the most impressive results.

14. Among the cases analyzed, those from Spain, Croatia, and Turkey recorded the largest CP investments (5,132,884 euros.-; 1,644,878 euros.-; and 3,302,005 euros.- respectively). Largest profitability from the introduction of green competitiveness was particularly noteworthy in companies from Bosnia & Herzegovina, Egypt, Israel and Tunisia, (with second year returns on investment –ROI- of 409,6%; 435,2%; 269,1%; and 549,3%, respectively).

15. Regarding future trends, a prospective structural analysis, performed on the basis of the MCID database (with the limitations that have to be born in mind), showed that critical paths scenarios for the next 10-15 years would focus on introducing CP technologies making full use of "alternative processes" and of "alternative components and technologies". In the first case this type of CP technological actions is expected to continue increasing, with a 39% ROI already in the first year. "Good housekeeping and organizational measures" follow in importance as a key "link variable" with 622% of ROI for the first year of investment. Other techniques identified with important link characteristics were found to be "Gas and heat recovery and recycling systems technologies", "inorganic material recovery and recycling systems technologies" and the use of "alternative production input technologies".

16. Eighty-seven out of one hundred and seventy-six CP techniques represented investments with less than 6 months payback period (50% of all techniques recorded). These have a large potential of replication, and are logically expected to grow significantly more than other relatively less profitable ones in the coming decades.

17. In conclusion, CP entrepreneurship constitutes the most feasible policy approach recommended by the present report, and presupposes widespread environmentally proactive companies, specific commitments on CP strategies among the public and private sectors, and concrete tools and mechanisms launched with the purpose of meeting this challenge.

18. Such a green competitiveness win-win strategy and opportunity for Mediterranean companies will only be possible if complemented by specific policy making in Mediterranean countries. The main recommendation made in the final chapter encourages private and public sector Mediterranean partners to launch "GRECO" (Green Competitiveness for the Mediterranean). GRECO is a Mediterranean initiative intended to boost green competitiveness in the Region and enhance the visibility of the enormous financial opportunity the environment offers to those introducing it in their practices.

19. GRECO could be viewed as a major innovation-oriented policy renewal for green competitiveness. Its components include the following: i) a technical assistance program on Green Competitiveness could be devised; ii) special attention should also be devoted to the development of the most appropriate financial tools and mechanisms to support the progressive introduction, by companies, of the most effective CP alternatives identified; iii) in order to ensure maximum efficiency in the generation, diffusion and appropriation of these successful alternatives, the creation of a "Digital CP Information Platform" (DCPIP) for companies, using most advanced web tools, would also be considered; finally iv) GRECO could launch a yearly publication in the form of a "GRECO Annual Report" integrating all information, strategies and benchmarks regarding Mediterranean companies' green competitiveness. Above all, GRECO should ultimately reinforce companies' incentives for a widespread and successful profit-driven introduction of CP technologies in the coming decades.

INTRODUCTION

Our environmental past remains a sad story of inefficient economic resource allocation. There has been too much investment and consumption, and for too long, of industrial "unsustainable" products and processes, at too low prices, and generating substantial environmental costs; and too little of "sustainable" ones, at too high prices, and generating large environmental benefits.

Our environmental future is inextricably linked to developments of a knowledge economy in which other factors of production, human (knowledge/innovation) and natural capital, are becoming the main competitive drivers. The still overwhelming predominance of an international environmental agenda focusing mainly on the "cost" side of environmental threats, while under-valuing the compensatory potential of the positive "benefit" side of natural and human (knowledge-innovation) capital, does not help much.

Companies are increasingly pressed for compliance with environmental legislation and the introduction of environmental techniques in their production processes, and tend to interpret these pressures just as costs threatening competitiveness. This perception hides the formidable and unexploited potential of sustainable production models based on competitiveness.

In this framework, Cleaner Production becomes an efficient tool for industrial modernization by introducing techniques and practices that prevent the generation of pollution. Preventive tools, acting at the source of environmental costs and inducing a better allocation of resources, are more efficient, both in economic and environmental terms, than corrective techniques (end-of-pipe ones) which generate additional environmental costs that have to be internalised. "Green competitiveness" emerges as the key resultant of synergies reached between economic and environmental efficiency vectors.

The present report seeks to preliminarily assess, on the basis of the analysis of 100 case studies from Mediterranean companies having implemented successful Cleaner Production experiences, in specific techniques, the extent to which a new Mediterranean strategy focused on companies, and built on the concept of "green competitiveness", can be an appropriate answer to help attaining sustainable production. That strategy would focus in dealing with simultaneous environmental and economic benefits, as an efficient way to address pressing companies to compete and respond to environmental constraints.

Chapter I of the present Report starts bringing clarification on the micro and macro dimensions of Cleaner Production and in today's global competitive economy, particularly on how public and private actors, in the framework of their efforts to comply with environmental legal and policy prescriptions, are starting to move in this direction.

Chapter II looks at the successful case studies available[1] from 100 Mediterranean companies that have implemented Cleaner Production alternatives in recent years. The chapter focuses on analyzing the technical, economic and environmental data related to the implementation of Cleaner Production on the basis of the previously elaborated MedClean Files Integrated Database (MCID)[2].

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1 Mainly from the Med Clean Files Integrated Database (MCID) of CP/RAC

2 The MedClean Files Integrated Database (MCID) of CP/RAC contains now integrated and fully harmonized information on investments, savings and pay-back periods recorded by 100 Mediterranean companies implementing CP solutions. The Database includes companies, products, sectors, processes and environmental impacts taking place in a simultaneous environmental and economic efficiency framework. MCID allows the identifying the most successful techniques and practices, economic efficiency levels and types of environmental benefits.

Chapter III focuses on the future: a more clear understanding of the structural characteristics of Cleaner Production in the Mediterranean. This makes for a preliminary test of the identification and categorization, through appropriate prospective tools, of those CP actions which could prove to be most efficient and critical in the medium and long-term according to the 100 case studies analysed. On the basis of these findings, the chapter suggests possible "Cleaner Production Mediterranean critical paths" (main causal paths/interconnections among leading "influence", "link" and "dependent" variables), identifying paths to more efficient market and policy measures in this field.

Finally, Chapter IV presents the final recommendations of the report around the preliminary components of the GRECO Initiative, designed to boost green competitiveness in the Mediterranean Region and enhance the visibility of the profitable financial opportunities that the environment offers to those companies introducing it in their industrial practices and processes.

CHAPTER I

GREEN COMPETITIVENESS AS AN ENGINE FOR BUSINESS AND SUSTAINABLE DEVELOPMENT IN THE MEDITERRANEAN

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II.1 – CLEANER PRODUCTION STRATEGIES: AN OPPORTUNITY FOR SUSTAINABLE DEVELOPMENT THROUGH INDUSTRIAL EFFICIENCY, PROFITABILITY AND COMPETITIVENESS

Reconsidering concepts: Cleaner Production

UNEP defines Cleaner Production as "the continuous application of an integrated preventive environmental strategy to processes, products, and services to increase overall efficiency, and reduce risks to humans and the environment. Cleaner Production can be applied to the processes used in any industry, to products themselves and to various services provided in society." When applied to production processes, "Cleaner Production results from one or a combination of conserving raw materials, water and energy; eliminating toxic and dangerous raw materials; and reducing the quantity and toxicity of all emissions and wastes at source during the production process.[3]"

The current trends for meeting sustainable development in the Mediterranean Region are moving increasingly towards an integrated approach combining environmental, economic and social concerns. Companies, among them, Mediterranean, are been observed as the leading role players on the "red carpet" towards sustainable development, on which only those that really bet on integrating the triple bottom line will win the race of competitiveness.

Companies are the engine of our economy and a clear example where integrating the three variable above is crucial. And Cleaner Production is there, therefore, to help them, with simple but very efficient proposals, to improve their behaviour promoting a new paradigm of environmental profitability: that is what we call Green Competitiveness.

Intuitively speaking, Cleaner Production can be seen as the implementation of a group of techniques, technologies and management processes and practices that prevent negative impact on the environment while generating economic value.

It is a win-win strategy resulting from the adoption of methods of production that improve productivity while reducing natural resources consumption, and, consequently, increasing benefits: reducing costs, increasing profits, improving quality of products, transforming products and discovering new goods and services, and, indirectly, reducing legal non-compliance risks.

Micro dimensions of Cleaner Production

Pollutant firms are synonym of inefficiency, but to become an efficient company is usually seen as a very difficult task. The key is to consider environmental criteria as an intrinsic element that fosters dynamism in the firm, instead than as an external factor that restricts it. Cleaner Production helps creating the bridge linking environmental, technical and economic strengths.

In detecting the economic value emerging from using environmentally friendly techniques in a firm, two basic types of actions can be distinguished: **Reduction at source** techniques used to prevent pollution and to reduce consumption of raw materials, water and energy ; **Recycling at source** techniques used to recover the value from different environmental aspects, such as wastewater or waste.

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3 http://www.uneptie.org/pc/cp/understanding_cp/home.htm#definition

These illustrate how Cleaner Production implementation reduces costs, so, the margin between price and cost of the product widens, and consequently, it makes benefits grow. Cost reduction can be due to:
- Less raw material required,
- Less space for raw material storage,
- Less waste at the end of the process,
- Less space for waste storage,

Other non-economic benefits can increase as well, due to Cleaner Production implementation:
- Reorganizing processes can change relationships among factors of production, making them more productive, and therefore giving the company the opportunity to expand its capacity;
- Innovating in product design or processes can be positive in two ways: i) changing the components of the product, making it cheaper, or improving its quality, and consequently letting the company expand sales or increase prices; and ii) by introducing important changes at product levels and finding new products (and thus gaining access to new more profitable markets).

Additionally, some indirect consequences of the whole process are, among others: a) improvement of skills, thanks to specific training from the acquisition of new technologies or the adoption of new practices; b) decrease of environmental costs in the community, c) reduced pressure from stakeholders, and d) improving reputation.

Macro dimensions of Cleaner Production

Integrating the new green competitiveness concept in the sustainable development circuit can put in motion economic, environmental and social changes. Investments in innovation (technologies and knowledge) encourage changes in quality in any sector. In turn, better quality in an industrial sector changes dynamics and productivity with three main consequences for the rest of the economic circuit. It increases GDP, surplus and export opportunities, and helps building knowledge and skills of people working in all sectors of the economy.

There are also social consequences beyond the economic circuit. Investment and innovation can change education and knowledge of a society (thus generating a society demanding stronger commitments on sustainability from companies). This, combined with the environmental positive outcomes from a better economic performance, changes attitudes towards the role of public and private sectors to commit to deliver welfare. This situation generates social cohesion.

Better understanding Cleaner Production

1. Cleaner Production is a bottom-up process. Firms engaged in sustainable production generate positive values to their sector at local and regional levels.
2. Cleaner Production can be implemented in most kinds of economic activities at different levels.
3. Green competitiveness involves a multistakeholder approach. CP is included in the national planning for environmental protection of most Mediterranean countries, although activities in this area too strongly rely on multilateral or bilateral support.
4. Environmental benefits are interconnected with economic benefits. Accurate use of natural resources, using adequate techniques improving efficiency and productivity, can reduce costs and generate profits.

Acting consequently

1. Technology is one of the proactive keys in green competitiveness. Eventhough a legal framework is important to regulate all activities, Cleaner Production promotion should be approached mainly through proactive actions. With this purpose in mind, governments, public and private associations and institutions have to make an effort to promote the introduction of CP strategies in companies. This means going beyond the enforcement and compliance with innovative voluntary tools.
2. Communication networks disseminate green competitiveness. To improve technologies and techniques in eco-management and to further spill-over effects, it is necessary to promote networking, aiming to share knowledge among Mediterranean countries and companies.
3. Green competitiveness constitutes a new paradigm to boost profits. The present report provides substantial evidence in this regard and stresses the consequent importance of private/entrepreneurial and public/institutional roles.
4. Mediterranean countries have a huge potential to introduce green competitiveness. CP/RAC reports demonstrate that the interest of international institutions and bilateral projects from EU countries to introduce CP is significant. Non-EU countries could benefit from future international support to help them adopting CP techniques and practices.

II.2 – PROGRESSIVE STEPS TO GREEN COMPETITIVENESS THROUGH ENVIRONMENTAL LEGAL AND POLICY ACTIONS ON CLEANER PRODUCTION IN MEDITERRANEAN COUNTRIES

In the mid-1990's, if was found that the need to improve environmental performance was the key driver of green innovation and competitiveness while creating the conditions for an emerging market for green technological innovation and applied techniques for clean industrial production.

Today, we assist at the proliferation of environmental regulations, economic instruments, voluntary instruments and awards, introduced throughout the Region, with the purpose of preventing, reducing or eliminating the environmental damages or costs generated by companies, and impinging on nature and society at large. Both public and private sector agents, and specially in the framework of Mediterranean SMEs, are still adopting a slightly ambiguous attitude vis-à-vis the new environment-competitiveness link.

As recently stated[4], reducing pollution or preventing it at source, usually coincides with more efficient industrial processes and better use of resources. Certain environmental legal and policy developments in the Mediterranean have the purpose of generating increases in efficiency that will pay off in terms of lower energy, waste and resource costs. Consequently, the main question is to address the extent to which both public and private sector agents are fully, and simultaneously, playing efficiently their respective roles in that direction.

I.2.1 – Promoting the implementation of Cleaner Production

CP/RAC Report[5] on the State of the Art of Sustainable Production in the Region constitutes a very useful tool for assessing progress made in Mediterranean countries in the implementation of environmental laws and regulations. From a deeper analysis of its findings, an additional judgment can be made on the extent to which initial steps are being taken or not in the right direction, at private and public sector levels, to start orienting and supporting companies seeking green competitiveness as a new way of responding, precisely, to the challenge of implementing CP. Certain conclusions can be drawn from the analysis.

What is today the level of awareness of both public and private actors in the Mediterranean, regarding the green competitiveness option? And its corollary: What type of actions and initiatives, starting already to be taken in these fields in the Mediterranean, could work in favor of the future promotion of this key alternative approach, and through which types of institutions?

I.2.2 – First steps towards green competitiveness

Present institutional arrangements and regulations for adopting CP in the Mediterranean still suffer from four main weaknesses when gauging their capacity to fit into the green competitiveness strategy:
- They tend to favor "end-of-pipe" actions instead of more effective preventive ones (acting at source);
- In most cases, the only considered benefits for companies are those of complying with environmental regulations, with not much attention being paid to the high potential of profitable, high returns/short payback CP actions;
- There is a marked absence of economic instruments directed at facilitating the introduction of these profitable CP alternatives;

Nevertheless, certain important national initiatives and international programs are starting to

4 See Stavros Dimas (2005)

5 See UNEP/MAP/CP RAC (2006). The report analyses the development of measures promoting the reduction of environmental depletion associated with industrial and economic activities, focusing specially on those promoting the shift to production patterns which apply CP mechanisms.

simultaneously gear Mediterranean countries in new directions which could, in the medium term, offset the above-mentioned weaknesses. Many Mediterranean countries have already established National Cleaner Production Centers (NCPCs), while others are in the process of establishing them or have put in place similar bodies[6]. A rapid cross country observation confirms that many actions presently undertaken by these Centers, although sparse, could be considered an initial step in the direction of emerging green competitiveness initiatives in the Mediterranean (see Box 1).

Programs, projects and tools

In the same way, some of the programs, projects and tools, undertaken by Mediterranean countries, in the framework of moving towards sustainable production, could also have an important potential to contribute to future efforts to support a green competitiveness strategy for the Region. As the first and second parts of Graph I.2.B show (see Annex 1), Mediterranean countries, although with different intensity, are already benefiting from some of these programs, projects, and implementing tools. Information presented reveals an already existing potential in favor of Cleaner Production through green competitiveness, but there is still a long way to go:

Strengths

- It is encouraging to see that certain countries' Cleaner Production Centers, or similar bodies, as well as programs and projects, tend to privilege CP solutions in parallel to strictly legal environmental compliance ones.
- EU-LIFE funded projects, as well as other programs and projects tied to ETAP or to German and Spanish cooperation, are among those more clearly acting in certain Mediterranean countries, and very much in line with the future promotion of green competitiveness.
- Partnerships with the European Union, beyond more traditional support to IPPC or similar environmental compliance, could be crucial.

Weaknesses

- Tools such as economic instruments, which are mostly addressed at end-of-pipe pollution reduction techniques, are nearly inexistent to promote the competitiveness of firms.
- There needs to be more coordination, at national and Mediterranean levels, among countries exhibiting most activity in favor of CP implementation.
- In CP financing, except very useful actions observed in certain cases, the role of promoting soft loans to companies by commercial banks, is nearly inexistent.
- Grant scheme incentives for investing in industrial environmental protection, a very promising tool for green competitiveness, are also rare.
- Voluntary instruments of a green competitiveness type are barely developed in the Mediterranean.

6 As observed in Annex 1, Table I.2.A, this is the case in the following Mediterranean countries examined: Albania, Algeria, Bosnia & Herzegovina, Croatia, Cyprus, Egypt, France, Greece, Israel, Italy, Malta, Monaco, Montenegro, Morocco, Slovenia, Spain, Syrian Arab Republic, Tunisia and Turkey.

BOX 1 - PRESENT ACTIVITIES UNDERTAKEN IN NATIONAL CLEANER PRODUCTION CENTERS AND SIMILAR INSTITUTIONS RELATED TO GREEN COMPETITIVENESS IN MEDITERRANEAN COUNTRIES

Direct technical and financial support to CP development and implementation

- Promotion of a wide range o Cleaner Production techniques
- Support for the improvement of competitiveness in implementing CP
- Improvement of simultaneous environmental and economic benefits in industries
- Financial and technical support to enterprises
- Increase of investment opportunities
- Promotion of good housekeeping programs
- Improvement of environmental competitiveness of industries
- Promotion of markets on cleaner production
- Rationalisation of water consumption in industrial sectors

Promotion of technology transfer

- Support of transfer and implementation of CP technologies to SMEs
- Support of transfer of best practices to foster innovation in companies
- Technical assistance on CP techniques
- Creation/Development of Networks of Centres active on CP technology transfer

Information, capacity building and awareness

- Awareness and dissemination actions
- Assistance and consultancy to companies concerning CP
- Improvement of technological skills
- Promotion of research & technological programs
- Organisation of seminars on CP
- Edition of newsletters on CP
- Creation of CP experts databases
- Dissemination of CP technical works
- Alertness on technological improvements and upgrades in the environmental markets
- Analysis of eco-efficiency in target industries
- Integration and coordination among different key agents such as chambers of commerce, business associations, governmental institutions, etc.

CHAPTER II

BOOSTING COMPETITIVENESS THROUGH CLEANER PRODUCTION: IMPRESSIVE EVIDENCE FROM 100 MEDITERRANEAN COMPANIES

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BOOSTING COMPETITIVENESS THROUGH CLEANER PRODUCTION: IMPRESSIVE EVIDENCE FROM 100 MEDITERRANEAN COMPANIES

Understanding CP benefits in the Mediterranean Region can be approached by analyzing the Med Clean case studies, which include successful stories of CP implementation. The analysis is based on data from CP/RAC MCID Database[7] which identified 176 CP techniques from 100 companies from Mediterranean countries. The objective of the analysis is to understand, in environmental and financial terms, the impact of various techniques.

An evaluation of what has been implemented is made trying to answer the three main questions: What kind of benefits and how large they are? Which CP techniques bring the highest benefit to the environment? What is the economic and financial dimension of each CP technique?

II.1 – CP CASE STUDIES IN THE MEDITERRANEAN REGION

One hundred and seventy-six CP techniques were identified and classified under their corresponding 13 groups below[8]:

- Water savings (WASI, WASA and WASO),
- Energy savings (ENSO),
- Good housekeeping and organizational measures (GHOM),
- Use of alternative production inputs (UAPI),
- Use of alternative designs (UDDS),
- Use of alternative processes (UADM),
- Use of alternative machines (UAMA)
- Organic material recovery and recycling systems (MRRO),
- Inorganic material recovery and recycling systems (MRRI),
- Gas and heat recovery and recycling systems (MGHR),
- Material and water circuit recovery and recycling systems (MWRR)
- Energy savings through boiler efficiency (ENSB),
- Water recovery systems and wastewater segregation (WARE),

In addition, the changes in environmental performance from each technique were identified, as well as the investment needed, the annual savings generated from these investments, and the pay-back period, and the return on investment ratio (ROI) recorded.

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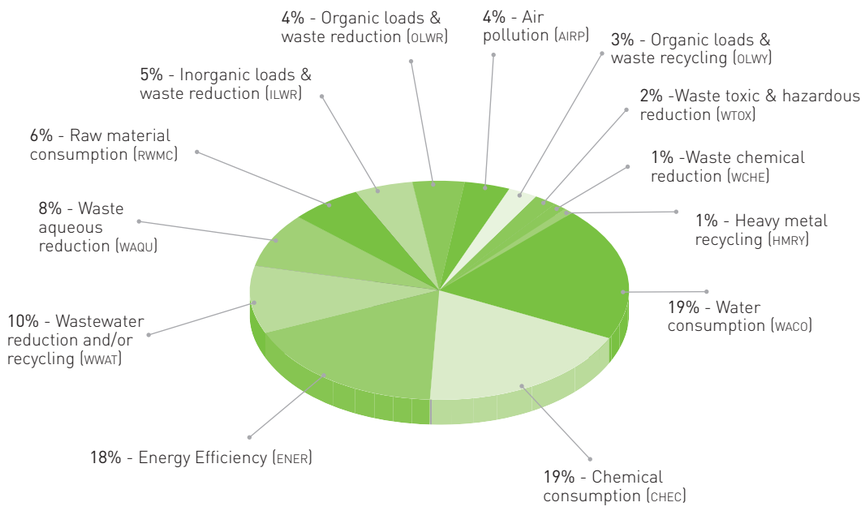
7 MCID Database was elaborated for CP/RAC by the GPAEI of the Universidad Nebrija. It has been built on the basis of the systematized analysis of the information contained in 100 MedClean files produced by CP/RAC in recent years.

8 With the aim of undertaking and providing a complete and detailed analysis, in terms of techniques and the nature of positive environmental impacts, as well as with that of facilitating comparisons with other manufacturing data within the Industrial ISIC nomenclature, in the case of industrial sector information, definitions in these three areas have been disaggregated to higher levels than those normally used in other publications and communications of CP/RAC.

A description of the correspondence between the disaggregated nomenclature created and used in the present report, and the more aggregated CP/RAC terminology is presented in Annex 3.

GRAPH II.1 - ENVIRONMENTAL BENEFITS OF 176 PC TECHNIQUES IN 100 MEDITERRANEAN COMPANIES



Environmental dimension

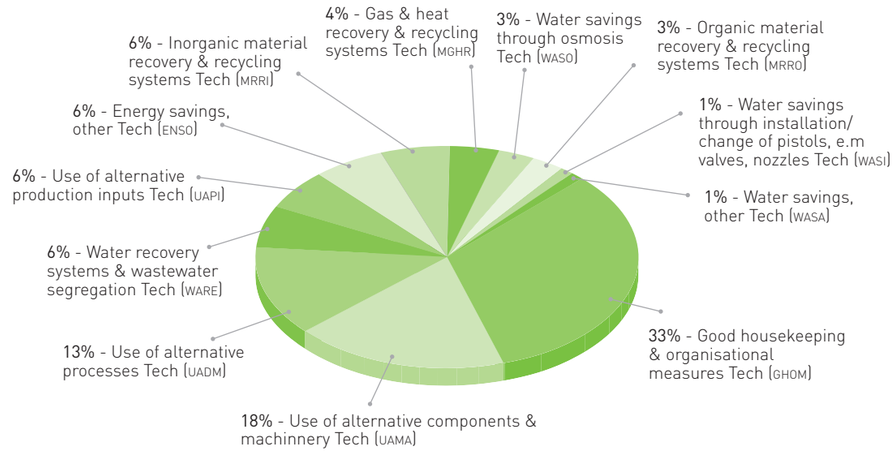
On aggregate[9], and as observed in Graph II.1, 2/3 of the main environmental benefits, due to all CP techniques recorded were of the following nature: the reduction of water consumption (19%), of chemical inputs consumption (19%), higher energy efficiency (18%), and the reduction and/or recycling of wastewater from production processes (10%).

First, Graph II.1 shows that the effects of most CP actions developed by Mediterranean companies were of a reduction of inputs/resources consumption in production processes nature (60% of the efforts were focused in resources consumption reduction while a 30% was devoted to waste processing and, finally, a 10% of such efforts were invested in recycling). Second, they mostly concentrate on the production phase. Third, just a limited number of companies' techniques were identified as taking place at final stages of production processes (recovery & recycling).

The reduction of water consumption in production processes is the most usual benefit achieved if the 176 actions are considered altogether. Among them, "Good housekeeping and organizational measures" (one third of them), the "Use of alternative components and machinery", the "use of alternative processes", and the "use of alternative production inputs" are the four most usual ones, and concentrate 70% of all actions examined (see Graph II.2), concerning the reduction of water consumption.

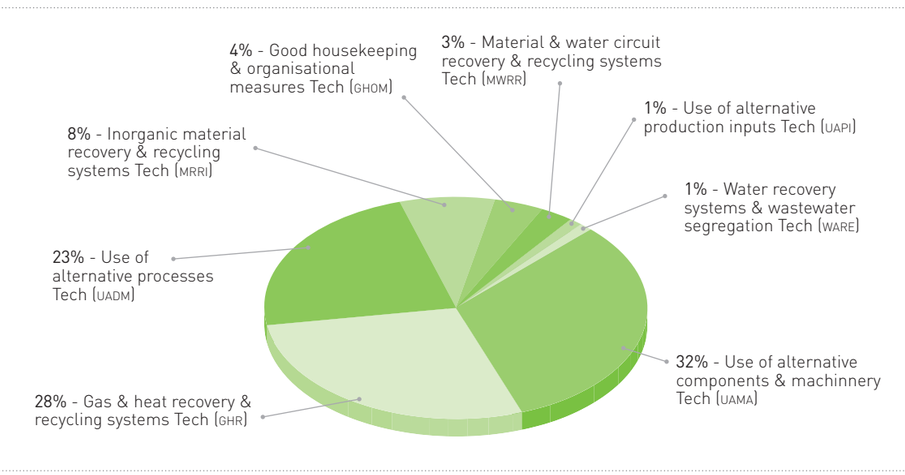
9 All calculations, tables and graphs presented in this chapter are elaborations by the author on the basis of data from the CP/RAC MCID Database.

GRAPH II.2 - REDUCTION OF WATER COMSUMPTION: MAIN TECHNIQUES



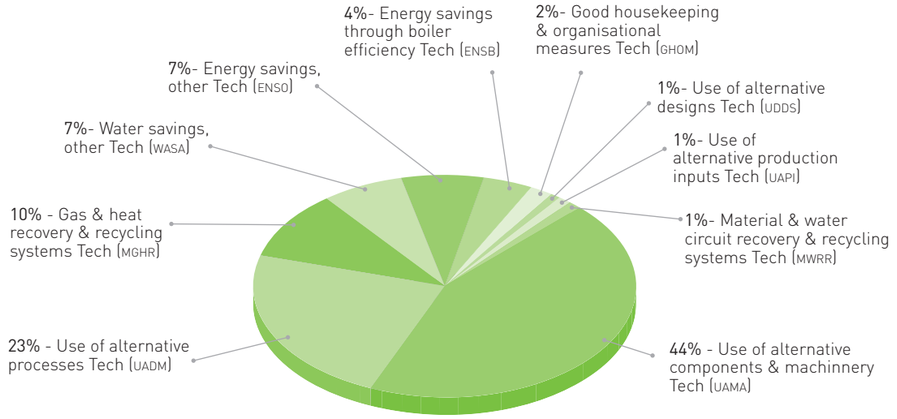
As shown in Graph II.1, reducing the consumption of chemical inputs in production processes is the second most frequent environmental benefit arising from CP experiences, the main types being: "Use of alternative components and machinery", "Gas and heat recovery and recycling systems", and "Use of alternative processes", representing up to 83% of them (Graph II.3).

GRAPH II.3 - REDUCTION OF CHEMICAL COMSUMPTION: MAIN TECHNIQUES



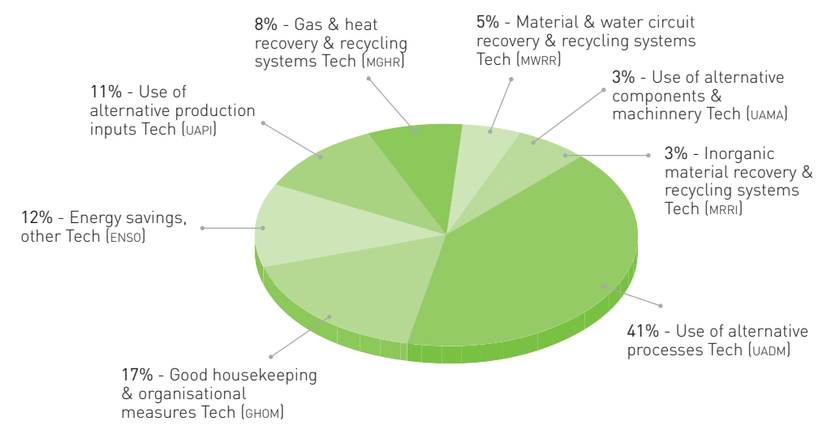
As Graph II.4 illustrates, "Use of alternative components and machinery", and " Use of alternative processes" were found to be the two most frequent CP types of techniques responsible for more than half of the total energy consumption reduction alternatives achieved by Mediterranean companies.

GRAPH II.4 - REDUCTION OF ENERGY COMSUMPTION: MAIN TECHNIQUES



In order to reduce, and/or recycle wastewater from production processes, four types of action were found to contribute to the achievement of this environmental benefit: "Use of alternative processes", "Good housekeeping and organizational measures", "energy savings" and "use of alternative production inputs". They represent as much as 81% of the cases (see Graph II.5).

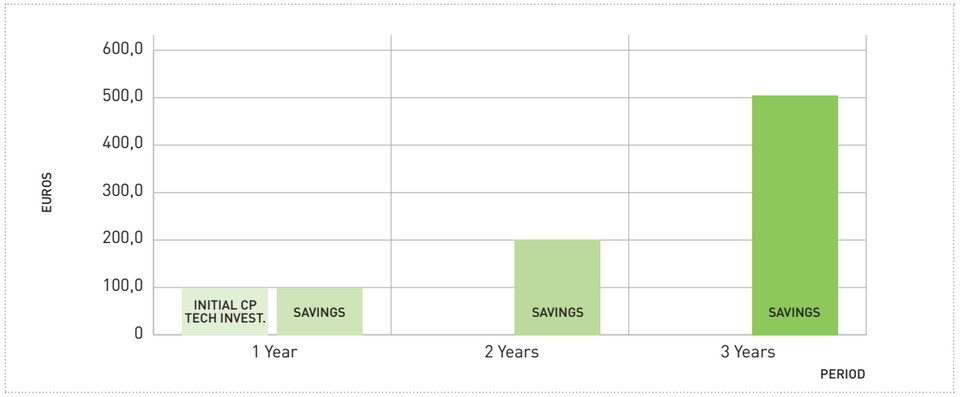
GRAPH II.5 - REDUCTION &/OR RECYCLING OF WASTEWATER: MAIN TECHNIQUES



Financial dimension

On aggregate, CP experiences were found to be profitable. Graph II.6 shows that in the middle-term CP has produced large annual savings to Mediterranean companies guaranteeing economic feasibility of their application and success in pursuing a sustainable behavior.

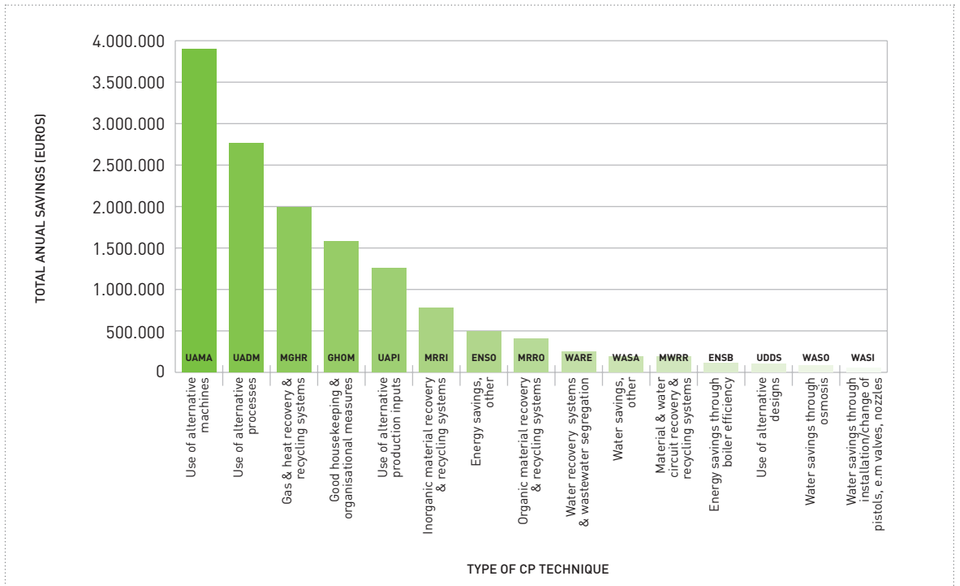
GRAPH II.6 - TOTAL SAVINGS FOR EACH 100 EUROS INVESTED IN CP TECHNIQUES BY 100 MEDITERRANEAN COMPANIES IN THE FIRST 5 YEARS



Looking at the financial dimension of specific CP experiences, Graph II.7 shows there are 6 types of techniques, generating the largest annual savings to the companies:

- Use of alternative components & machinery,
- Use of alternative processes,
- Gas & heat recovery & recycling systems,
- Good housekeeping and organizational measures,
- Use of alternative production inputs,
- Inorganic material recovery & recycling systems.

GRAPH II.7 - RANKING OF CP TECHNIQUES



GRECO INITIATIVE
GREEN COMPETITIVENESS

Most frequent types of alternatives (Good housekeeping and organizational measures, and Use of alternative processes) are also the most present in the ranking "Best 50 technologies according to payback periods" (see Annex 2, Table 1). In this Table, only alternatives requiring investments smaller that 42,000 euros.- were considered, with average individual investment of 1,800 euros.- (in 60% of the cases no investment was necessary to generate substantial annual savings), with payback periods below 3 months. The reduction of water consumption, energy use, and wastewater reduction and recycling accounted for half of the total environmental benefits generated.

Annex 2, Table 2 shows the 80 techniques with the highest annual savings. From all 80 cases, five types of experiences concentrated two thirds of total techniques: Good housekeeping and organizational measures (15 cases), use of alternative process (10 cases), use of alternative components and machines (9 cases), energy savings (8 cases), and water savings (8 cases). Most relevant examples are alternative processes technique in Croatia and Israel, whose annual savings were found to be 177 times higher than initial investment in the first case, and 145 times in the second.

Profitability of the CP technological investments made appear as inherent to the nature of the technology introduced, and relatively independent of the amounts invested. For example, small investments of 1000 euros generated annual savings equivalent to 100% of the investment, while other investments, as one of 900.000 euros recorded 161% annual saving, and one of 41.312 euros recorded 2675% annual saving.

The three dimensions of Cleaner Production

CP characterization in this report considers, in an interrelated way, three basic dimensions: technical, financial and environmental. The information collected and analyzed is presented in a triangular form relating the investment required to introduce a CP technique, the expected pay-back period of the investment, and the nature and magnitude of the corresponding environmental benefit. The 176 CP techniques are presented in two main categories:

High profitability CP techniques with significant environmental benefits:
Moderate profitability CP techniques

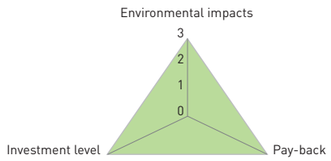
In the medium and long-term, most successful techniques will be the ones registering best records in all three tasks (reasonable investment, short payback and significant improvement on the environmental behaviour). However, techniques that do not fall within this group may still have an enormous potential for the future. All technologies identified in the present report were all found to introduce Cleaner Production profitably in each company.

II.1.1 – HIGH PROFITABILITY CP TECHNIQUES WITH SIGNIFICANT ENVIRONMENTAL BENEFITS:

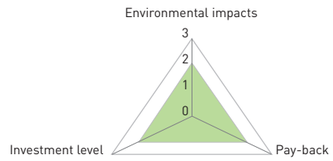
This section shows the techniques which have yielded high profits from the case studies analyzed, while providing significant benefits for the environment.

a) With higher levels of investment by company[10]

GRAPH II.8.D - GAS & HEAT RECOVERY & RECYCLING SYSTEMS (MGHR)



GRAPH II.8.B - ORGANIC MATERIAL RECOVERY & RECYCLING SYSTEMS (MGHR)



10 In the graphs II.8.x,, the three vertex of the triangles represent one dimension to be taken into account (environmental benefit, investment and pay-back), while the three axes represent a level, where 1 means little and 3 means the most

Techniques under the categories of "Gas and heat recovery and recycling systems", and "Organic material recovery and recycling systems" registered higher investment levels as well as commensurate levels of pay-back with significant ROI (ranging from 28% to 63%) already at the end of the first year, and extraordinary net accumulated benefits.

Gas and heat recovery and recycling systems technologies

Graph II.8 illustrates annual savings generated by techniques under gas and heat recovery and recycling systems. Largest annual savings came from investments with environmental benefits in seven areas, with more noticeable ones on the reduction of chemical inputs consumption (CHEC) and waste aqueous reduction (WAQU), totaling altogether 1,9 Million Euros, equivalent to one sixth of the total annual savings generated by the 176 CP techniques recorded in the Mediterranean Region.

GRAPH II.8 - GAS & HEAT RECOVERY AND RECYCLING SYSTEMS (MGHR)

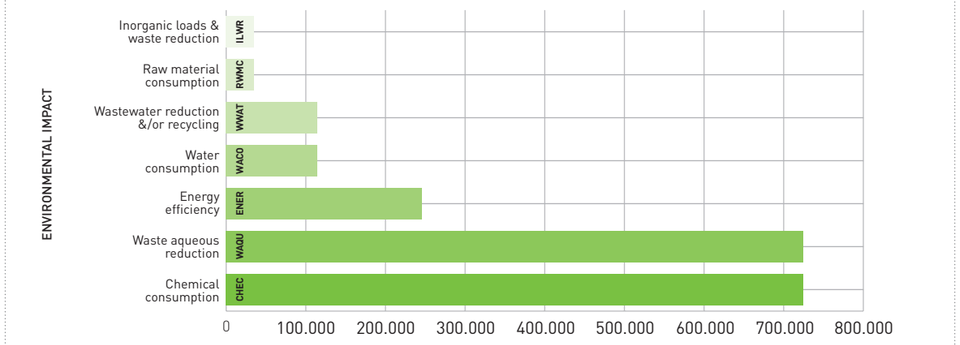


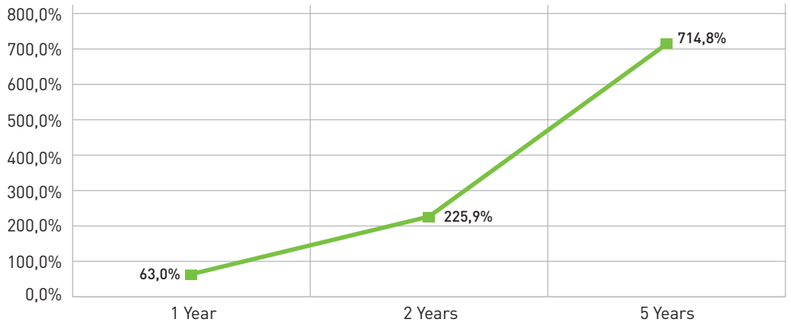
TABLE II.1 - GAS & HEAT RECOVERY AND RECYCLING SYSTEMS

Purpose	Investment	Annual savings	Payback (months)
Installation of heat exchanger to recover heat from the process	10.556 euros	193.223 euros	0,7
Steam condensate recovery	13.203 euros	39.638 euros	4,0
Vacuum evaporator fitted with a reboiler and forced circulation	900.000 euros	1.449.780 euros	7,4
Improvement of drainage & cleaning systems & cold equipment for closing water circuit	66.111 euros	81.453 euros	9,7
Installation of vacuum evaporator to treat water from the rinsing baths of electrochemical nickel plating	132.200 euros	140.000 euros	11,3
Filtration technique with semi permeable membranes & waste reduction-vacuum evaporation	79.101 euros	76.807 euros	12,4
Recovery of steam condensate	22.337 euros	12.962 euros	20,7

For example, a Turkish dyeing company achieved diverse effects through the installation of a heat exchanger to recover heat from the process. The heat exchanger let the company reduce its energy and water consumption, thus reducing wastewater.

Diversity is also large in terms of the nature of the sub-sector in which the technique was put into practice[11] . Most techniques enjoyed less than one year payback (see Table II.1). Returns on investment (ROI) ranged from 63% of investment the first year, reaching a cumulated 700% at the end of five years (see Graph II.10).

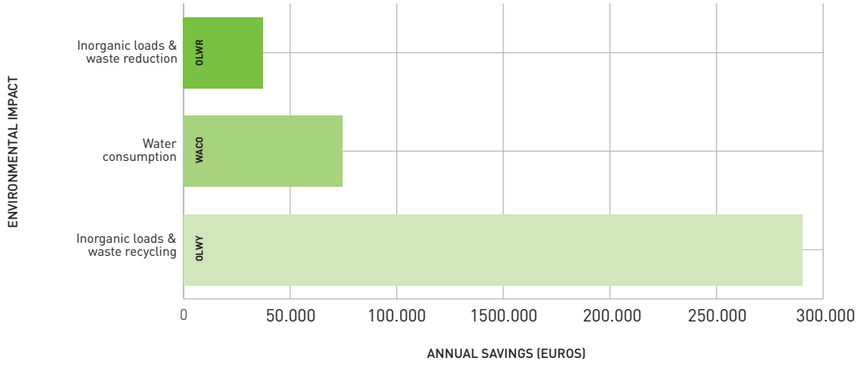
GRAPH II.10 - ROI OF "GAS AND HEAT RECOVERY AND RECYCLING SYSTEMS" (%)



Organic material recovery and recycling systems

Graph II.11 illustrates the annual savings of "Organic material recovery and recycling systems" for each type of environmental benefit. Their dimension, in terms of annual savings was found significant. The highest value of these savings is related to the recycling phase of organic loads and waste from the production process.

GRAPH II.11 - ORGANIC MATERIAL RECOVERY AND RECYCLING SYSTEMS" (MRRO)



A sugar-beet factory in Morocco eliminated earth and waste which accompanies the beet, and reduced, as well, the quantity of earth sent to the decanter and to the mud ponds by the installation of a sugar-beet cleaner on the beet unloading circuit. Hence even though its main achievement was organic waste reduction, considerable decrease in water consumption was also achieved.

11 Electric/electronic, chemical, food canning, and textile sectors.

TABLE II.2 – ORGANIC MATERIAL RECOVERY AND RECYCLING SYSTEMS

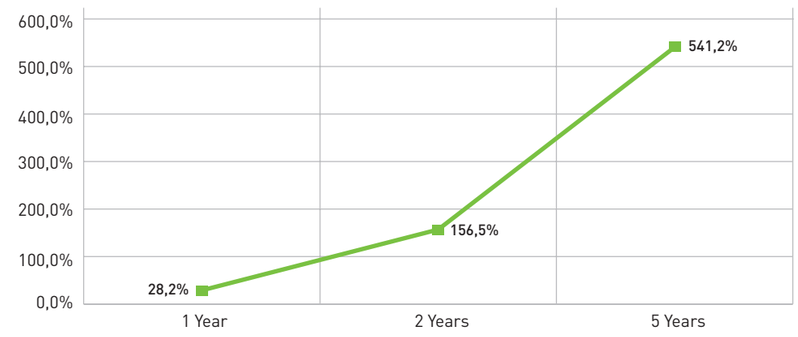
Purpose	Investment	Annual savings	Payback (months)
Compositing of organic waste	0 euros	5.477 euros	0,0
Reduction of liquor ratio bath, reuse wastewater & optim. processes	0 euros	2.008 euros	0,0
Recovery of hulls and broken seeds	2.700 euros	138.975 euros	0,2
Oil recycling	750 euros	10.500 euros	0,9
Reuse of fines from the preparation unit	3.000 euros	36.000 euros	1,0
Dry cleaning of lines for guano recovery	41 euros	191 euros	2,6
Recovery of fat	1.500 euros	4.320 euros	4,2
Tank level controls & quality valves	21.951 euros	37.266 euros	7,1
Installation of a Cyclone vacuum for recovery of fodder ingredients	37.083 euros	31.248 euros	14,2
Installation of three gravity oil separators for recovery of fat, oil and ghee	79.527 euros	59.060 euros	16,2
Recycling hot & cooling waters, new decanting basin, cleaning out of mud ponds	156.923 euros	72.426 euros	26,0
Recycling rapping material waste	10.000 euros	4.516 euros	26,6

Most of these CP techniques took place in food and agricultural sectors[12] . As shown in Table II.2, investments ranged from medium to low level and in some cases no investment was required to introduce this CP technique and get the financial and environmental results desired.

One of the most interesting examples found was the recovery of hulls and broken seeds in an Egyptian oil and soap factory, in which a very small investment generated a very high annual saving, and a pay-back period of just a few days.

These techniques generated also attractive financial results from the first to the fifth year. Mediterranean examples of organic material processing show this is a group of techniques worth to be considered in different sectors for implementation. Positive rates of ROI from first to fifth year also confirm this is a group of techniques that generate environmental and economic benefits (Graph II.13).

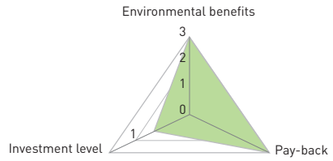
GRAPH II.13 - ROI OF "ORGANIC MATERIAL RECOVERY AND RECYCLING SYSTEMS" (%)



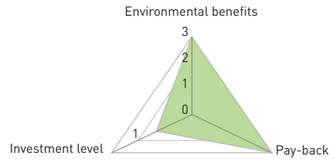
12 Food canning (fish and vegetables), sugar, dairy, etc

a) With higher levels of investment by company

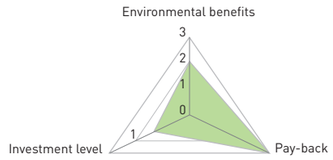
GRAPH II.8.i - GOOD HOUSEKEEPING & ORGANISATIONAL MEASURES (GHOM)



GRAPH II.8.J - USE OF ALTERNATIVE INPUTS (UAPI)



GRAPH II.8.G - ENERGY SAVING, OTHER (ENSO)



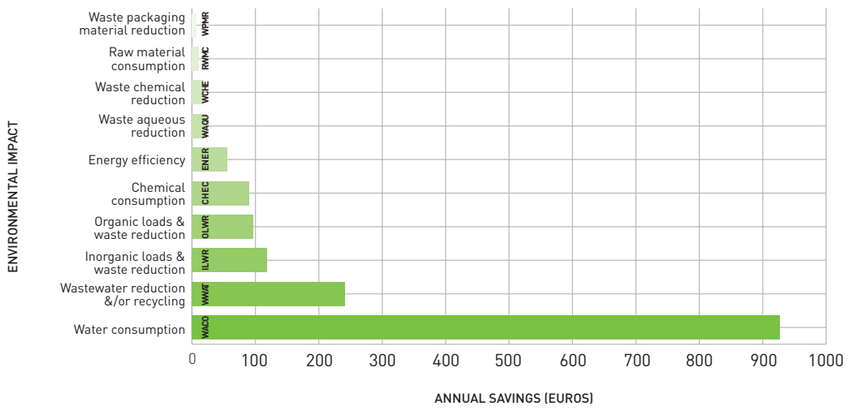
"Good housekeeping and organizational measures", "Use of alternative production inputs" and "Energy savings (other)" techniques introduced by companies were also highly profitable although they required lower initial investment levels.

From a financial perspective, the triangles above illustrate that the investments registered in all three groups were in all cases relatively smaller and frequently (particularly in "Good housekeeping and organizational measures") no investment was necessary to generate substantial profitability and environmental benefits. In general, pay-back periods were particularly short, savings at the end of the first year ranged from 75% of the investment to 622%, and the cumulated net benefit obtained at the end of five years was found to be the largest among all 176 alternatives analyzed in this report, ranging from 321,703 euros - to 7,690,737euros-

Good Housekeeping & organizational measures

Among all techniques applied, "Good housekeeping and organizational measures" is one of the groups with most diverse environmental benefits (10), and recording the largest amount of annual savings (nearly 1.5 millions euros). It is of utmost interest from both an environmental and financial perspective for Mediterranean companies and demonstrates that even by means of limited, but selective changes, important outcomes can be expected.

GRAPH II.14 - GOOD HOUSEKEEPING & ORGANISATIONAL MEASURES (GHOM)



From the case studies analyzed, the impact of this sector in reducing water consumption (WACO) in production processes was found remarkable (and thus were the corresponding annual savings). In many cases "simple measures" can make a big change like "Measuring and controlling efficiency" that changed water consumption in a chromium tannery firm in Lebanon. Consumption of chemical substances (CHEC) and wastewater reduction &/or recycling (WWAT) were other environmental impacts generated.

For example, the reuse of thermal energy from Zinc bath and monitoring of auxiliary metals reduced consumption and waste of a Bosnian enterprise of insulated wire and cable. In the same way, in Tunisia, a hotel reduced its wastewater (WWAT) thanks to adjustments in, among others, towel/linen card system and training.

TABLE II.3 – GOOD HOUSEKEEPING AND ORGANIZATIONAL MEASURES

Purpose	Investment	Annual savings	Payback (months)
Improved monitoring, record keeping, water supply management & reduce physical losses and develop UFW Reduction plan	0 euros	612.000 euros	0,0
Better housekeeping, control process &adding more tenzide in the Atrazine synthesis process improving filterability of suspension	0 euros	165.385 euros	0,0
Stop washing plates	0 euros	125.000 euros	0,0
Improving procedural instructions & supervision for loading/un-loading procedures	0 euros	59.949 euros	0,0
Omitting overflow rinsing, neutralization stages and detergent usage in cotton bleaching and dyeing processes	0 euros	58.340 euros	0,0
Research into non-halogenated solvents & synthesis stages ac-tive pharmaceutical ingredients	0 euros	46.125 euros	0,0
Good housekeeping, dyestuff parameters & dispersant change	0 euros	24.518 euros	0,0
Improve storage facilities	0 euros	6.690 euros	0,0
Watering in the evening + sprinkler system + xeriscaping (native technique for drought-resistant plants	0 euros	3.427 euros	0,0
Storage upgrade & 50% reuse of the permeate & installation of level controls	0 euros	612 euros	0,0
Management of lights, computers, air conditioning & refrigera-tor location	0 euros	406 euros	0,0
Reorganization of the deliveries	0 euros	114 euros	0,0
Continuous measuring of gas & water, reuse of thermal energy from Zinc bath & monitoring of auxiliary metals consumption	500 euros	54.204 euros	0,1
Installation of water aeration devices	8 euros	375 euros	0,3
Control flow of rinsing water and elimination of basin and rinsing bath for recovery of cooling water	500 euros	6.000 euros	1,0
Improving factory & buildings, drainage, sewers & segregation of solid wastes	3.997 euros	36.245 euros	1,3
Control flow of rinsing water and elimination of basin and rinsing bath for recovery of cooling water	1.000 euros	7.000 euros	1,7
Laboratory tests	10.800 euros	44.280 euros	2,9
Good housekeeping practices to promote more efficient water management	44.605 euros	180.544 euros	3,0
Measuring and control efficiency	2.000 euros	7.120 euros	3,4

THIS TABLE CONTINUES ON NEXT PAGE

Purpose	Investment	Annual savings	Payback (months)
Canceling rinsing bath	12.500 euros	33.000 euros	4,5
Installation of a pool cover	122 euros	310 euros	4,7
Preventive maintenance programme	4.500 euros	9.000 euros	6,0
Collecting packing material and organic waste separately and sales in the waste market	77 euros	143 euros	6,5
Installation of water aeration devices	473 euros	836 euros	6,8
Development of towel/linen card system and training	106 euros	136 euros	9,3
Elimination of cutting process	100.000 euros	70.956 euros	16,9
Construct a covered storage area that would enable better fixation of paint	18.000 euros	6.000 euros	36,0
Recycling water, reducing waste fractions sending effluents to waste manager & applying ecodesign criteria	13.226 euros	2.748 euros	57,8

This type of CP techniques was found effective for many companies active in very diverse number of subsectors[13] .

In Table II.3 above, the 30 cases in which "Good housekeeping and organizational measures" were introduced did not require high investments and generated substantial annual savings with short payback periods. In 38% of the cases, no investment was even required to generate large economic benefits and important environmental positive outcomes. Graph II.16, showing return on investment (ROI), illustrates the financial impact, at the firm level, of the technique introduced.

GRAPH II.16 - ROI OF "GOOD HOUSEKEEPING & ORGANISATIONAL MEASURES" (%)

Use of alternative production inputs

These annual savings generated reach up to 1.1 million euros as well as environmental benefits such as the reduction of air pollution (AIRP) and Organic loads and waste reduction (OLWR) as most significant ones.

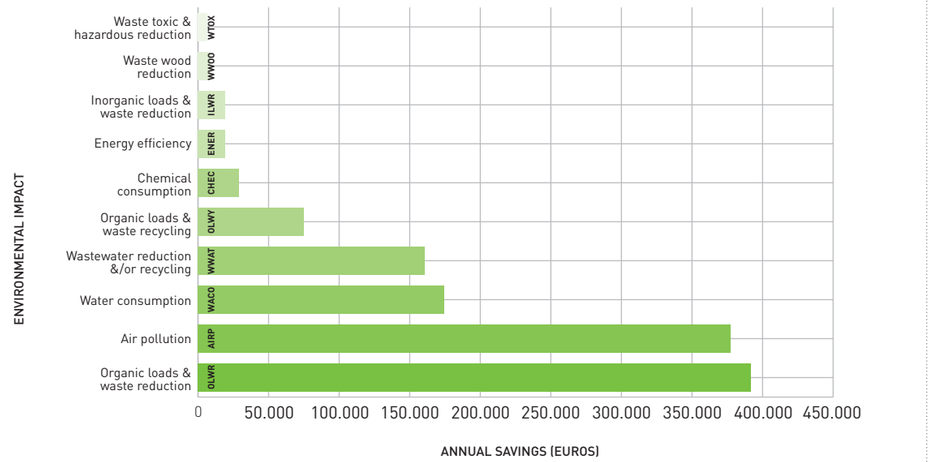
13 Meat processing, bakery, dairy, oil and soap production, textile, dyeing, tanning, offset printing and audiovisual services, hotels, surface treatment, sewage systems management, pharmaceutical products, electric/electronic and chemical sectors.

TABLE II.4 – ALTERNATIVE PRODUCTION INPUTS

Purpose	Investment	Annual saving	Payback (months)
Use of liquid caustic soda	0 euros	75.000 euros	0,0
Optimise chemical usage by substitution of some chemicals	0 euros	10.269 euros	0,0
Introduction of reusable pallets instead of non-reusable,	0 euros	9.016 euros	0,0
Replacement of the etching line using tin-lead on the printed circuit boards with a new etching line that uses only tin.	0 euros	909 euros	0,0
Cleaning cold Milk circuits with single phase detergents, purging automation & condensates recovery	23.200 euros	204.885 euros	1,4
Water recirculation, use of condensers & installing cleaning pistols	15.000 euros	115.000 euros	1,6
Substitution of sodium sulphide & dichromates	819 euros	6.277 euros	1,6
Use of ozone compound instead of CFC-113 as cleaning material	360.000 euros	754.000 euros	5,7
Replacement of cyanide salts with methyl alcohol (redesign of cementation ovens)	186.185 euros	56.941 euros	39,2
Dry cleaning of pipes (Cleaning in place system. CIP) and recirculation of water	132.610 euros	28.816 euros	55,2

The "Use of alternative production inputs" has been mainly introduced in the electronics and food products sectors[14].

GRAPH II.17 - USE OF ALTERNATIVE PRODUCTION INPUTS (UAPI)



A Spanish company producing electric engines, generators and transformers moved from using cyanide salts to methyl alcohol and redesigned cementation ovens in order to reduce considerably its consumption of chemicals, to decrease its water and energy use, and reduce the storage space required.

14 Electric/electronic, dairy, food, oil and soap products and textile sectors, among others.

As shown in Table II.4, profitability of the techniques under alternative production inputs was significant. One of the techniques required an investment of 186,185 euros.- to get 56,941 euros annual savings resulting in slightly more than 3 years payback. The point here is that this firm decided to face these changes and invest, not only to reduce its negative impact on the environment and increase its efficiency, but also to reduce the high financial and social price it was paying in dealing with pollution. Nevertheless, the cases show good financial and environmental outcomes. As an example, the use of liquid caustic soda in an oil and soap Egyptian firm (a change at no cost) yielded 75,000 euros of annual savings

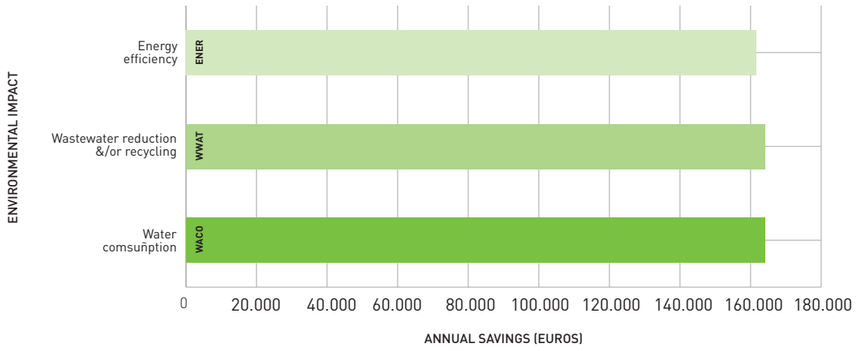
The introduction of these techniques in Mediterranean companies has generated as an average almost 80% in ROI in its first year with an increase to 700% in its fifth year.

GRAPH II.19 - ROI OF "ALTERNATIVE PRODUCTION INPUTS" (%)

Energy savings (other)

The techniques analyzed under "Energy savings" have the following characteristic: with a clear purpose to achieve efficiency in energy consumption, they exert an important effect on two other water consumption-related actions. It is the case of wastewater reduction and/or recycling (WWAT) and water consumption (WACO).

GRAPH II.20 - ENERGY SAVING, OTHER (ENSO)



A good example of this threefold effect is a Bakery in Bosnia & Herzegovina which constructed a front chamber before the entrance into a cooling chamber to keep right temperature, then it reduced energy and water consumption wasted when the cooling system needed to face significant changes in temperature due to an incorrect insulation.

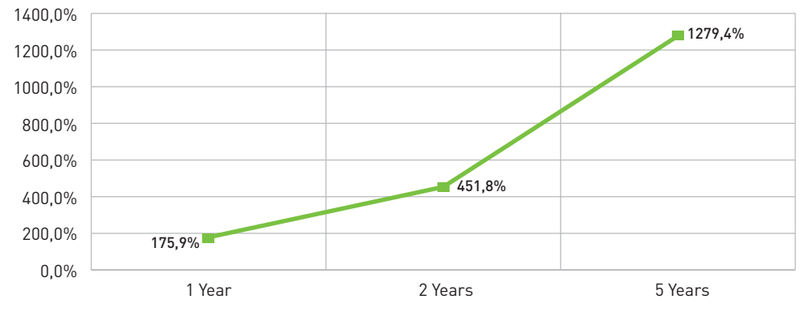
TABLE II.5 – ENERGY SAVINGS

Purpose	Investment	Annual saving	Payback (Months)
Building the insulating panel for the refrigerator	6 euros	186 euros	0,4
Use of smaller hoses for washing process, warm water circulation & employee education	31.051 euros	328.008 euros	1,1
Construction of the front chamber before the entrance into the cooling chamber	153 euros	1.595 euros	1,2
Displacement of fans for improving the effect of ventilation	453 euros	1.360 euros	4,0
Installation of pressure regulators	27.151 euros	63.604 euros	5,1
Replacement of leaking steam valves	8.707 euros	15.959 euros	6,5
Energy recovery in sterilizers and reuse heating soft water	1.741 euros	2.215 euros	9,4
Electricity consumption optimization	1.273 euros	1.389 euros	11,0
Insulation of bare steam pipes	56.965 euros	46.811 euros	14,6
Insulation of tubes and pipes	11.993 euros	9.672 euros	14,9
Lagging of pipes	5.411 euros	2.961 euros	21,9
Replacement of leaking steam valves	26.270 euros	13.190 euros	23,9
Condensate recovery	5.406 euros	2.348 euros	27,6
Lighting system improvement	916 euros	378 euros	29,1

This sort of technique was essentially introduced by companies active in the food sector[15].

One of the most interesting cases of energy savings techniques introduced that of building the insulating panel for the refrigerator in the same company mentioned above. Such a change, as shown in the Table II.5, required an investment of 6 euros and yielded an annual saving of 186 euros (30 times more) with a record pay-back period of 12 days. "Energy savings" required low average investments with attractive payback periods. ROI rates in Graph II.22, illustrates it.

GRAPH II.22 - ROI OF "ENERGY SAVINGS" (%)



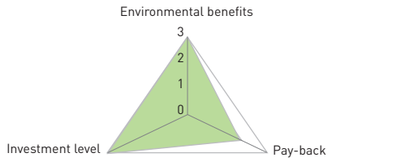
15 The dairy, canned food, as well as other food sectors.

II.1.1 – MODERATE PROFITABILITY CP TECHNIQUES

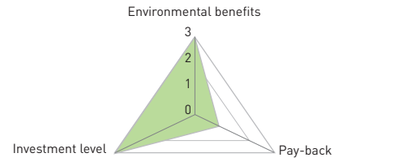
This section shows the CP techniques analysed having yielded moderate profits, split into two groups, according top the investment made

a) With higher levels of investment by company

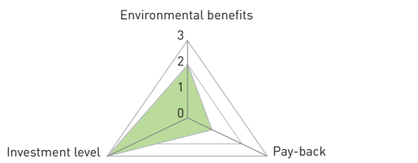
GRAPH II.8.l - USE OF ALTERNATIVE PROCESSES (UADM)



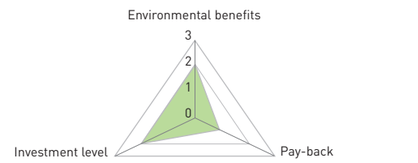
GRAPH II.8.M - USE OF ALTERNATIVE COMPONENTS OR MACHINNERY (UAMA)



GRAPH II.8.c - INORGANIC MATERIAL RECOVERY & RECYCLING SYSTEMS (MRRI)



GRAPH II.8.h - WATER RECOVERY SYSTEMS & WASTEWATER SEGGREGATION (WARE)

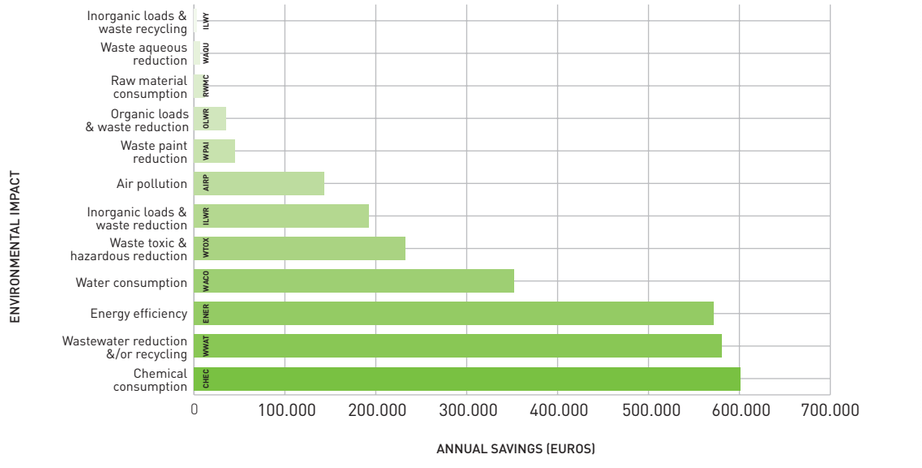


The techniques analyzed under "Use of alternative processes", "Use of alternative components or machinery", "Inorganic material recovery and recycling systems" and "Water recovery systems and wastewater segregation" required high investments but their payback periods reached moderate levels.

Use of alternative processes

As graph II.23 shows, the "use of alternative processes" rank second in terms of highest diversity of different kinds of environmental benefits, from all fifteen techniques' types analyzed in this report.

GRAPH II.23 - USE OF ALTERNATIVE PREOCESSES (UADM)



The most noticeable were reduction of chemical consumption (CHEC), wastewater reduction and /or recycling, (WWAT), energy efficiency (ENER), and water consumption (WACO).

For example, an Egyptian textile company adopted combined processing in order to reduce its environmental impact implementing the following changes: Concentrations and rates at which chemicals were added were varied as well as the temperature, number and timing of washes; two hot washes were eliminated from the half bleaching process; and more expensive chemicals were phased out and replaced with ammonium persulphate and Egyptol. The result was the combination of the scouring and bleaching processes and to phasing out the use of sodium hypochlorite. This company increased in 40% its production, while the safety condition of workers related to chemicals handling increased as well.

TABLE II.6 – USE OF ALTERNATIVE PROCESSES

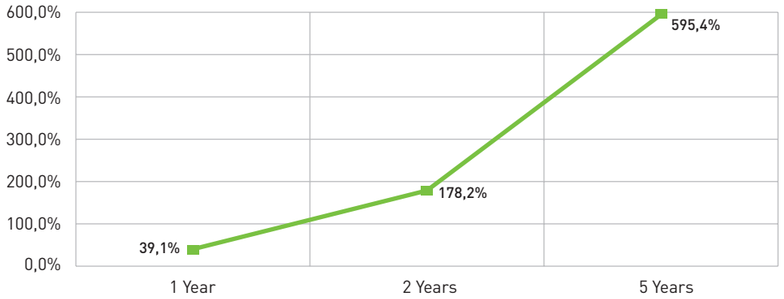
Purpose	Investment	Annual savings	Payback (months)
Shovel spill paste back into paste hopper rather than into smelting oven	0 euros	479.546 euros	0,0
Introduce ink new formulation & replacement of viscosity adjustment solvent by osmosis water	0 euros	99.775 euros	0,0
Implementation of Cleaner Production option: Washes temperature, timing, elimination & chemicals replacement	0 euros	64.446 euros	0,0
Training and new distribution systems	0 euros	35.399 euros	0,0
Simple modification of pipe network	415 euros	73.274 euros	0,1
Switch from normal painting gums to HVLP painting gums	600 euros	87.000 euros	0,1
Bottle dryer performance (only 3 compressed air nozzles) and reorganization of production area heating	88 euros	2.209 euros	0,5
Adaptation of cleaning circuitry and air purge adaptation	177 euros	3.418 euros	0,6
New process treatment of abbattage effluents	58 euros	925 euros	0,8
Replacing the single line and introduction new process parallel lines eliminating intermediate cleaning operations	3.005 euros	36.722 euros	1,0
Eliminate the process of tank formation	100.000 euros	683.000 euros	1,8
Substitute some areas of supports & improve inside structure for drainage operations	3.606 euros	20.441 euros	2,1
Counter current flow in Kyoto range	12.910 euros	65.064 euros	2,4
Optimization of regeneration process of resins softening raw process water with reduction of water, energy chemicals	20.000 euros	57.680 euros	4,2
Introduction of short washing process performed at filtration stage	204.000 euros	250.000 euros	9,8
Hair saving system: Remove hair before dissolved & discharged in swage system	63.907 euros	75.777 euros	10,1
Introduction of new approach to chlorides removal from cacodylic acid aqueous solution	59.388 euros	50.500 euros	14,1
Immunization of the hair with an alkaline such as Sodium hydroxide & research & adaptation of industrial facilities	600.962 euros	372.260 euros	19,4
Eliminating cyanide by shifting from cyanided alkaline zinc bath to Zinc bath without Cyanide	22.580 euros	13.034 euros	20,8
Varnish application line, change solvent-based pr. & UV lamps for drying & finishing	32.044 euros	17.740 euros	21,7
Introduce new technological processes of wire surface preparation prior to rolling, based on blasting and sand	297.435 euros	147.707 euros	24,2
Introduction of automatic system for ink preparation using reduced number of based colors	285.572 euros	82.461 euros	41,6
Introducing high chrome exhaustion techniques	35.000 euros	9.180 euros	45,8
Introduce changes in metal treatment line & raw material substitution	248.675 euros	40.873 euros	73,0

"Use of alternative processes" has been introduced in diverse sectors[16], resulting in reasonable annual savings. Even high investments like "Immunization of the hair with an alkaline such as Sodium hydroxide & research & adaptation of industrial facilities" (the highest investment among all the cases in this sector) generated significant annual savings (around 50% of the investment).

As Table II.6 suggests, the use of alternative processes involves techniques that range from very specific and complex ones, like introduction of automatic system for ink preparation in a Spanish plastic material enterprise for printing, to very simple and valid for any kind of sector like "training", that in this case was applied in a dairy company in Egypt.

The rate of profit that shows the success in the application of this kind of technologies can be seen in the ROI of Graph II.25.

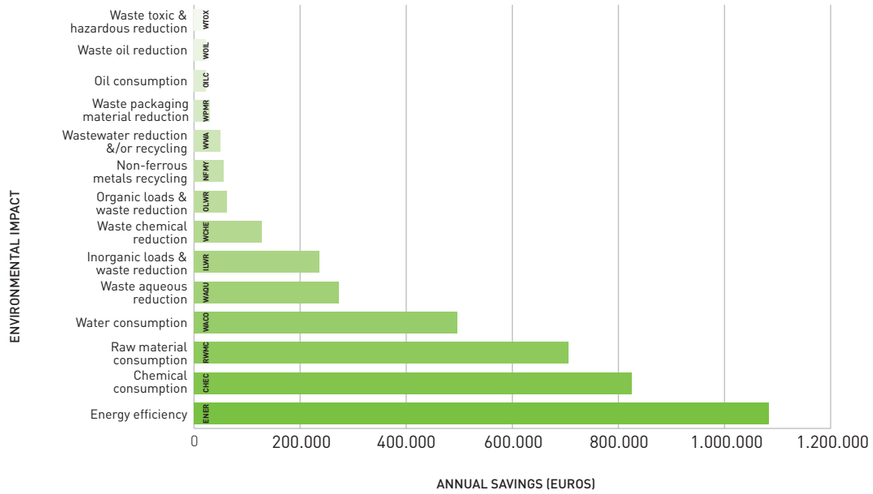
GRAPH II.25 - ROI OF "ALTERNATIVE PROCESSES" (%)



Use of alternative components or machinery

Techniques under the group "Use of alternative components or machinery generated the widest variety of environmental benefits (14) and the largest annual savings (nearly 3,8 millions euros) in the first year of investment, the four main kinds concentrating on the reduction of consumption of inputs in production processes.

GRAPH II.26 - USE OF ALTERNATIVE COMPONENTS & MACHINNERY



An interesting case was a French cheese factory that made changes to reduce energy consumption: new boiler, repair the valves and reevaluating the dimension of the choke circuit. Resulted in reduction consumption, waste, productivity increase, and safer processes for employees.

16 Meat processing, dairy, beverages, textiles, tanning, printing, electricity generation, surface treatment of metals, , pharmaceutical and other chemical industries, etc..

CP techniques of this group were mainly introduced in the basic metals and the chemical industries, although applications could be found in other sectors as textile or food processing[17].

These technologies recorded high investments with lower but significant annual savings and payback periods. Table II.17 shows that in 60% of the 23 cases in which alternative components and machinery have been introduced, pay-back periods were shorter than two years.

TABLE II.7 – USE OF ALTERNATIVE COMPONENTS OR MACHINERY

Purpose	Investment	Annual savings	Payback (months)
Installation of three guns and an electrostatic paint line to replace the airless-type guns.	41.312 euros	1.105.032 euros	0,4
Insulation of steam and hot water networks	14.083 euros	39.646 euros	4,3
Installation of automatic shut off valves in bleaching ranges & recycling water	19.511 euros	54.602 euros	4,3
Installation of an equipment for vacuum evaporation	82.079 euros	135.072 euros	7,3
Installing air-water heat exchangers at end of stenters for reduction of steam and energy consumption	328.820 euros	513.000 euros	7,7
Installation of filtering system of hydraulic oil filters in the oil circuits of the machines	12.069 euros	16.637 euros	8,7
Installation of a system to join two parts using ultrasound or vibration welding	51.700 euros	70.752 euros	8,8
Installation of an automatic system for dehumidification based on weather conditions for set point adjustment	46.000 euros	50.000 euros	11,0
Install a temperature monitoring system to adjust oven	1.000 euros	1.000 euros	12,0
Replacement of overflow machines with ULLR (ultra low liquor ratio) type jets to improve liquor ratio	968.629 euros	609.530 euros	19,1
Installing a moisture analysis oven	1.000 euros	500 euros	24,0
Liquid lead atomization mill	200.000 euros	98.263 euros	24,4
Purchase of new boiler for optimization of steam production system & leak elimination	240.000 euros	97.500 euros	29,5
Installation of automated control cleaning system (PLC)	36.061 euros	12.516 euros	34,6
Fully automated plating plant eliminating cyanide copper plating	1.800.000 euros	590.000 euros	36,6
New installation to replace the process of chemical pickling through trimming machine	106.284 euros	31.084 euros	41,0
New containers and recipients	102.596 euros	29.906 euros	41,2
Implementing system with machine vision unit to collect & transport waste that separates required metals from waste	284.000 euros	79.336 euros	43,0
Introduction of cogeneration system to cover demand for electricity and heat in the hospital	1.030.000 euros	285.000 euros	43,4
Installing new cleaning machines at end of every line eliminating rough edges	79.393 euros	16.364 euros	58,2
Installation of a vacuum evaporator	140.005 euros	23.802 euros	70,6
Installation of automatic cleaning solving machine & mixing and replacement of mixing pans	575.345 euros	43.333 euros	159,3

17 Dairy and other food sectors, textile, automobile, surface treatment of metals, chemical, mineral, and other sectors.

In one particular case, a longer pay-back period, influencing the average payback of this group, was observed.

An implementation in a Spanish factory of silicone and sealers required an investment of ½ a million Euros and shows low annual savings with a pay-back period which is, the largest of all technological techniques by companies included in this report (159 months).

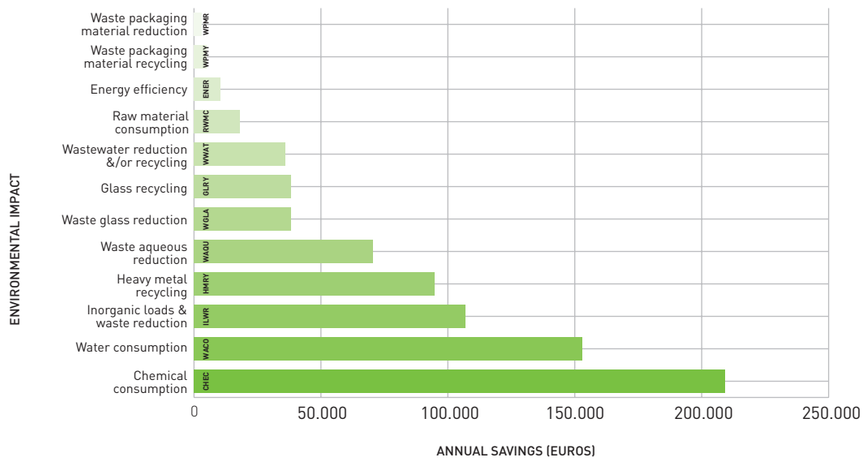
The highest annual savings belong to "Installation of three guns and an electrostatic paint line to replace the airless-type guns" in an Spanish company for repairing and cleaning merchant vessels that achieved the amazing amount of 1,105,032 euros.- of annual savings with an initial investment of just 41,312 euros.-, 25 times the initial investment (a pay-back period of less than 15 days). This is also illustrated by ROI in Graph II.28.

GRAPH II.28 - ROI OF "ALTERNATIVE COMPONENTS AND MACHINNERY" (%)

Inorganic material recovery & recycling systems

Techniques under "Inorganic material recovery and recycling systems" up to 12 different environmental benefits' types. The most significant effects were on the reduction of the consumption of chemicals in industrial processes (CHEC), and in water consumption (WACO), although inorganic loads and waste reduction (ILWR), and heavy metal recycling (HMPY), were also noteworthy.

GRAPH II.29 - INORGANIC MATERIAL RECOVERY & RECYCLING SYSTEMS (MMRI)



Chrome and nickel tanks installation in a surface treatment of metals plant in a Turkish company had effects in its environmental impact as much as in its productivity. The installation of these tanks was part of a complete renovation of the old and very pollutant machines this company used to have, with the final purpose to improve production and minimize ecological harm.

CP techniques of this kind were introduced in various subsectors[18].

In financial terms, annual savings and payback periods were significant but somewhat less attractive than in the case of previous CP techniques analyzed, as shown in Table II.8.

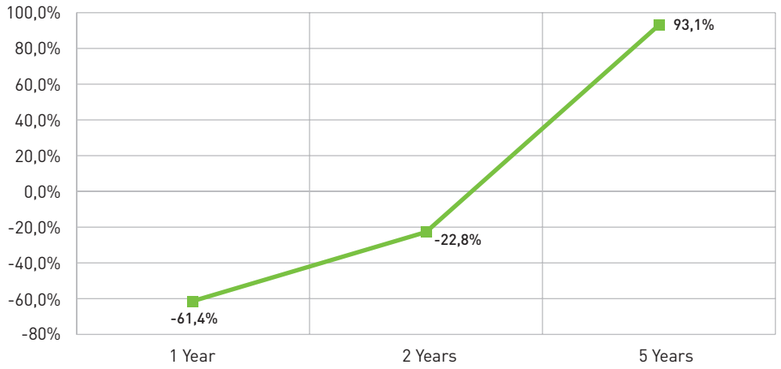
TABLE II.8 – INORGANIC MATERIAL RECOVERY & RECYCLING SYSTEMS

Purpose	Investment	Annual saving	Payback (months)
Full capacity use of atomization equipment to transform highly briny liquid waste into reusable sodium sulphate	0 euros	59.231 euros	0,0
Recycle drops to the strap casting pot rather than to the smelting oven	0 euros	20.520 euros	0,0
Collection/recycling packaging material	0 euros	308 euros	0,0
Nickel economy tank	2.000 euros	23.000 euros	1,0
Chrome economy tank	2.000 euros	20.000 euros	1,2
Reuse of cardboard packages	154 euros	512 euros	3,6
Shaking the salted hides before soaking and recycling rinsing wash for soaking	8.800 euros	28.000 euros	3,8
Residual from wash lime used as accelerator	8.800 euros	5.600 euros	18,9
Reintroducing dope waste in the manufacturing process	144.543 euros	82.509 euros	21,0
Installation of a compact vacuum distillation system for continuous recovery of solvent	82.068 euros	43.808 euros	22,5
Recycling lime/sulphide liqors	85.000 euros	44.200 euros	23,1
Recovery of the picking liquor at the outlet from tubes and reintroducing it into the process	21.456 euros	9.809 euros	26,2
Installation of underground tank, recirculation, cutting-oil & tangential microfiltration	34.067 euros	14.734 euros	27,7
Chromium reduction & recycling: using methods for recovering chromium from the tanning process	288.605 euros	111.512 euros	31,1
System for the collection & transport of common waste containing glass & glass recovery	239.530 euros	76.646 euros	37,5
Installation of propylene waste extrusion and grinding system for reuse of recycled surplus	141.599 euros	40.155 euros	42,3
Drains installed in all electroplating machines	919.548 euros	189.221 euros	58,3
Recover the tooling and cutting oil generated in the tooling of metal parts	30.000 euros	5.670 euros	63,5

18 Tannery, surface treatment, electronics, manufacture of inks and varnishes for printing, beverage production sectors.

This was also the case in terms of ROI (Graph II.31) below.

GRAPH II.31 - ROI OF "ALTERNATIVE COMPONENTS AND MACHINNERY" (%)

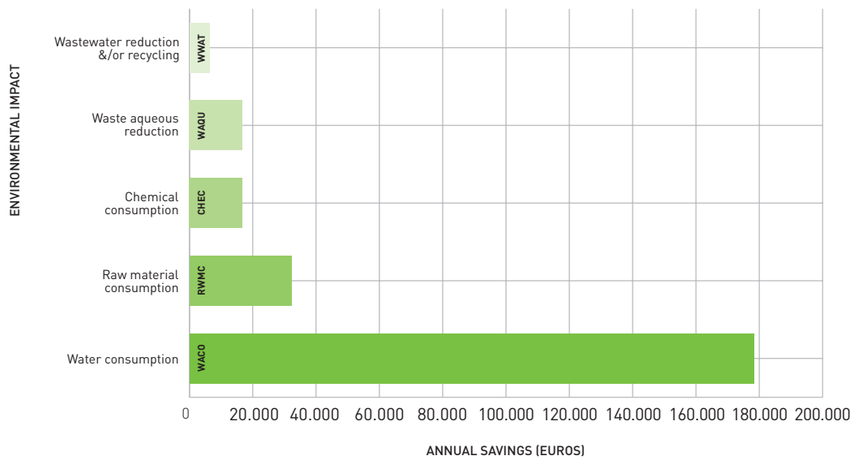


Nevertheless, "Inorganic material recovery and recycling systems" seem to be techniques combining diversity of environmental benefits with relatively lower returns as its accumulated net benefits and ROI show (Graph II.31). At the fifth year accumulated net benefits related to inorganic material recovery and recycling systems introduced in Mediterranean countries doubles the initial highest amount invested.

Water recovery systems and wastewater segregation

Techniques under "Water recovery systems and wastewater segregation" had their main results on the reduction of water consumption, and to a lesser extent, on raw material inputs consumption. In addition, certain specific benefits on the final phase of production come up through waste water reduction and recycling (WWAT) and waste aqueous reduction (WAQU).

GRAPH II.32 - WATER RECOVERY SYSTEMS & WASTEWATER SEGGREGATION (WARE)



A good illustration is an Italian factory of ceramic tiles which introduced two changes through "Water recovery system and wastewater segregation" technologies with the intention to reduce water consumption and facilitate recycling by improving of the water treatment plant. Actions taken were the installation of seven new bathtubs contributing to amplify the homogenization of cleaned water and updating of remote management with new software.

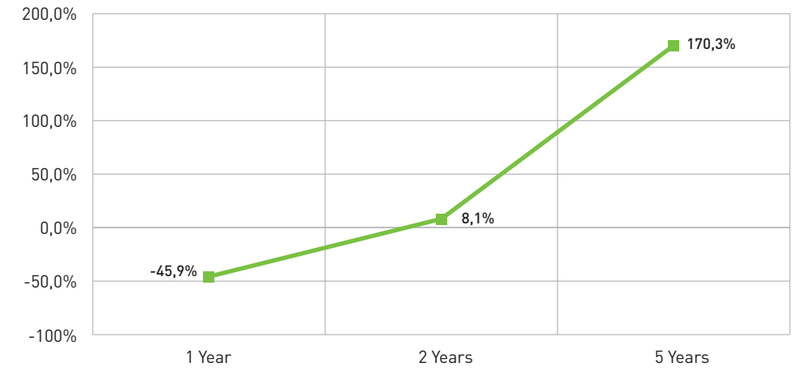
Table II.9 illustrates the various cases analyzed.

TABLE II.9 – WATER RECOVERY SYSTEMS AND WATER SEGREGATION

Purpose	Investment	Annual savings	Payback (months)
Segregating process effluents coming from the refinery	0 euros	5.400 euros	0,0
Reduce water flow to the finishing roller on paste machine	0 euros	2.000 euros	0,0
Rehabilitation of the water collection system	2.587 euros	7.344 euros	4,2
Reuse of condensates from air conditioning & replacing equipment for demineralized water and of tight bath and washes	56.000 euros	64.501 euros	10,4
Installation of cooling tower to recover & recycling cooling waters	25.953 euros	26.438 euros	11,8
Change of cooling water system to closed cycle system + new pumps and filters	50.000 euros	25.000 euros	24,0
Segregation of cooling water, vacuum water & processed waters and use of cooling towers	63.936 euros	34.874 euros	22,0
Filter press and sludge dryer	120.000 euros	50.000 euros	28,8
Improving water treatment plant/installation 7 new bath tubes & amplify the homogenization of the cleaned water.	65.000 euros	24.224 euros	32,2
Recycling water (reuse tightening water, cooling water, floor washing)	79.398 euros	10.474 euros	91,0

These techniques showed frequently pay-back periods over two years and lower ROI (Graph II.34). The greatest payback period was that of a Slovenian factory of canned fruit and vegetables seeking to reduce water consumption and recycle water.

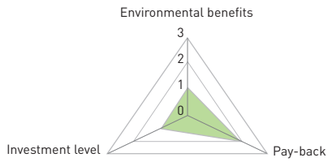
GRAPH II.34 - ROI OF "WATER RECOVERY SYSTEMS & WASTEWATER SEGGREGATION" (%)



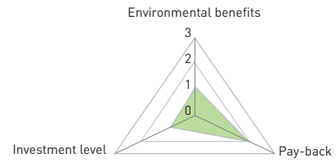
b) With relatively lower levels of investment by company

The four families of CP techniques shown below are characterized by cases of relatively lower investments and paybacks while environmental benefits from the introduction of these techniques in Mediterranean firms were usually small in number and diversity.

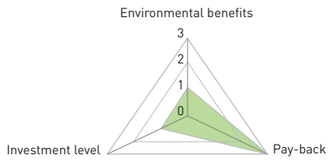
GRAPH II.8.F - ENERGY SAVING THROUGH BOILER EFFICIENCY (ENSB)



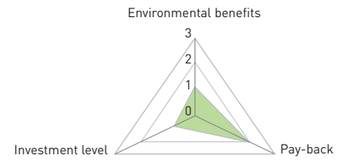
GRAPH II.8.E - MATERIAL & WATER CIRCUIT RECOVERY & RECYCLING SYSTEMS (MWRR)



GRAPH II.8.A - WATER SAVINGS (WAS)



GRAPH II.8.h - WATER RECOVERY SYSTEMS & WASTEWATER SEGGREGATION (WARE)



However, we include schematic information on these types of techniques below, particularly, on their environmental benefits and profitability.

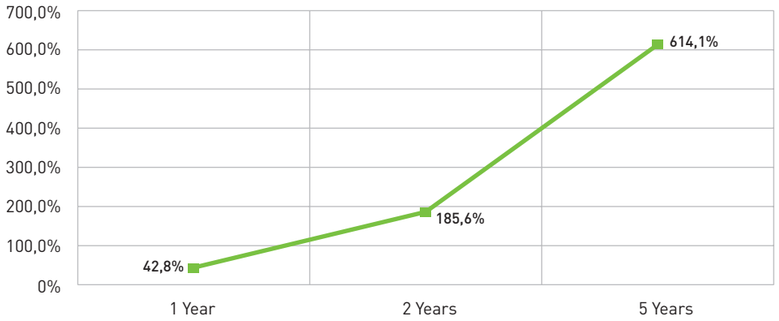
Energy savings through boiler efficiency

GRAPH II.32 - ENERGY SAVINGS THROUGH BOILER EFFICIENCY (ENER)

TABLE II.10 - ENERGY SAVINGS THROUGH BOILER EFFICIENCY

Purpose	Investment	Annual savings	Payback (months)
Boiler efficiency	0 euros	15.337 euros	0,0
Boiler tune up & upgrade	592 euros	10.924 euros	0,7
Boiler efficiency	1.531 euros	4.390 euros	4,2
Installing a new heating system through purchase of new boiler & adoption of compact immersed piping solution	75.000 euros	79.500 euros	11,3

GRAPH II.37 - ROI OF "ENERGY SAVINGS TROUGH BOILING EFFICIENCY" (%)



Material recovery & water circuit & recycling systems

GRAPH II.38 - MATERIAL & WATER CIRCUIT RECOVERY & RECYCLING SYSTEMS (MWRR)

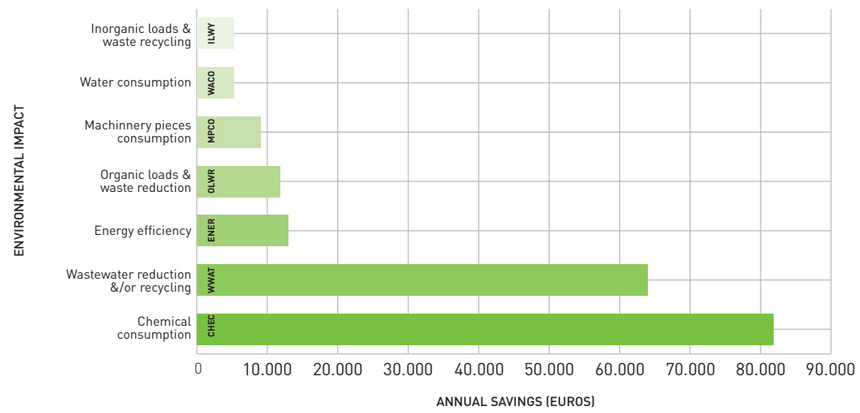
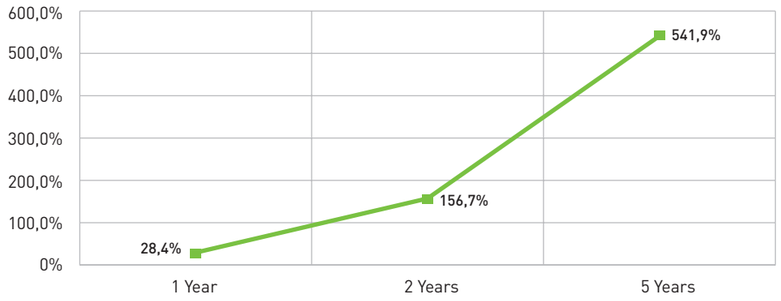


TABLE II.11 – MATERIAL & WATER CIRCUIT RECOVERY & RECYCLING SYSTEMS

Purpose	Investment	Annual saving	Payback (months)
Savings in rinsing procedure	250 euros	29.000 euros	0,1
Recovery of cooling water from flame singeing of Goller machine	250 euros	13.000 euros	0,2
Recovery of cooling water from flame singeing of Goller machine	250 euros	11.000 euros	0,3
Recovery of cooling water from flame singeing of Goller machine	250 euros	9.000 euros	0,3
Recovery of cooling water from flame singeing of the Denim-range toward the Frigotol cooling basin	500 euros	16.000 euros	0,4
Recovery of cooling water from flame singeing of the Denim-range toward the Frigotol cooling basin	1.000 euros	19.000 euros	0,6
Installation of a refrigeration system for refrigeration efficiency	7.861 euros	11.741 euros	8,0
Implementation of an automatic washing system	86.245 euros	65.537 euros	15,8
Optimize cleaning process through installation of hoses high-pressure auto shut-off nozzles and a water flow control unit	50.611 euros	15.648 euros	38,8
Use of soft water for washing & recovery of tins & lime deposits	842 euros	142 euros	71,0

GRAPH II.37 - ROI OF "MATERIAL & WATER CIRCUIT RECOVERY & RECYCLING SYSTEMS" (%)



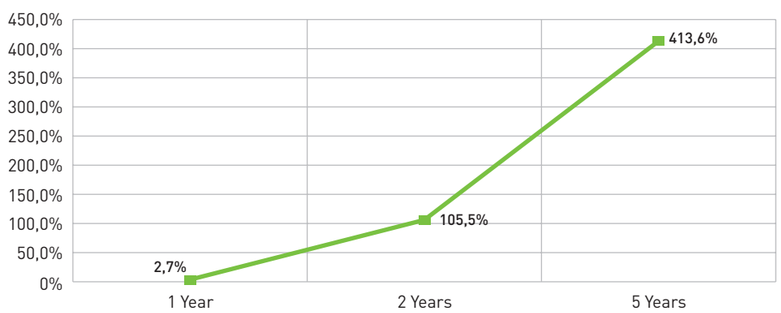
Use of alternative designs

GRAPH II.41 - USE OF ALTERNATIVE DESIGNS (UDDS)

TABLE II.12 – USE OF ALTERNATIVE DESIGNS

Purpose	Investment	Annual savings	Payback (months)
Introduction of new designs for packing of solid and whipped final product	0 euros	23.295 euros	0,0
Changes in carton design	0 euros	30.300 euros	0,0
Design for molding improvement	100.000 euros	49.132 euros	24,4

GRAPH II.37 - ROI OF "ALTERNATIVE DESIGNS" (%)



Water saving

GRAPH II.44 - WATER SAVING (WAS)

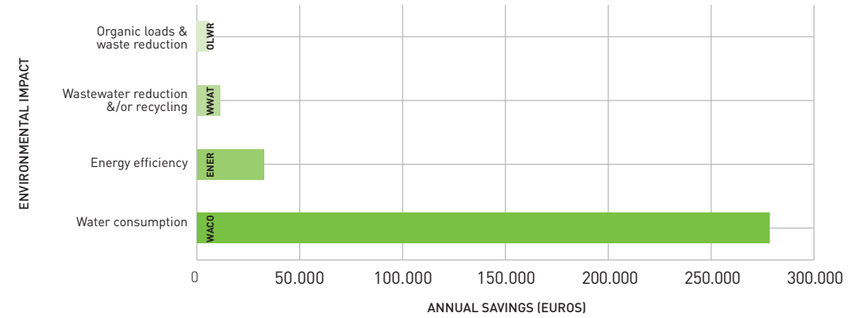
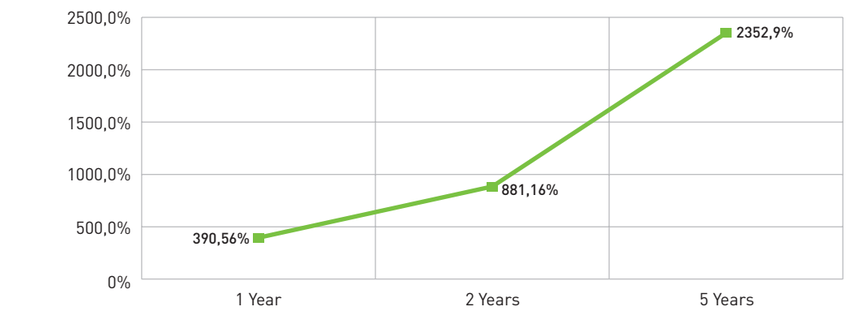


TABLE II.13 – WATER SAVINGS

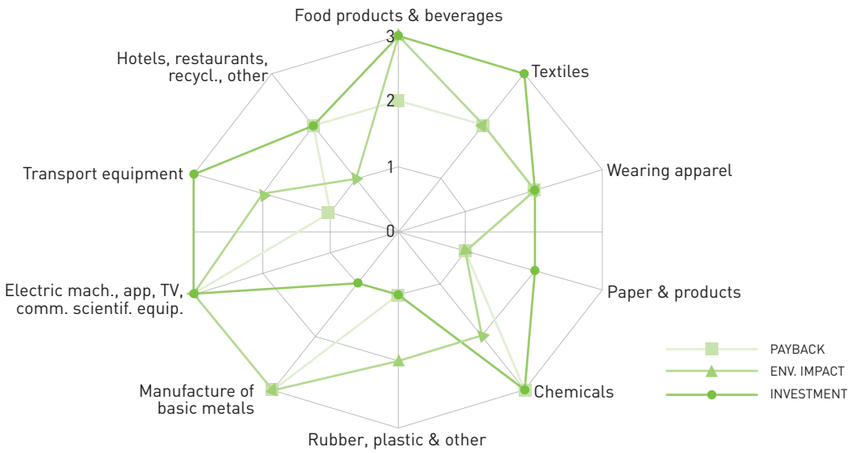
Purpose	Investment	Annual savings	Payback (month)
Change of nozzles of machines for the rinsing of slaughtered broilers for water saving	246 euros	18.260 euros	0,2
Upgrade steam network	9.000 euros	165.888 euros	0,7
Installation of electro-magnetic valve on the compressor power units for water saving	562 euros	4.072 euros	1,7
Installation of hose nozzles to allow water flow only when required	1.499 euros	2.754 euros	6,5
Installation of small nozzles for cleaning lines and floor	123 euros	218 euros	6,7
Installation of pistols with spray nozzles on rubber hoses for water saving	299 euros	496 euros	7,2
Construction of a process water well for water saving	17.895 euros	20.875 euros	10,3
Filters, heat, oil & fuel recovery	8.988 euros	4.903 euros	22,0
Reverse osmosis	159.303 euros	86.555 euros	22,1
Closed circuiting	988 euros	282 euros	42,0
Improvements in grid and bin washing systems	3.942 euros	607 euros	78,0

TABLE II.46 – ROI OF "WATER SAVINGS" (%)

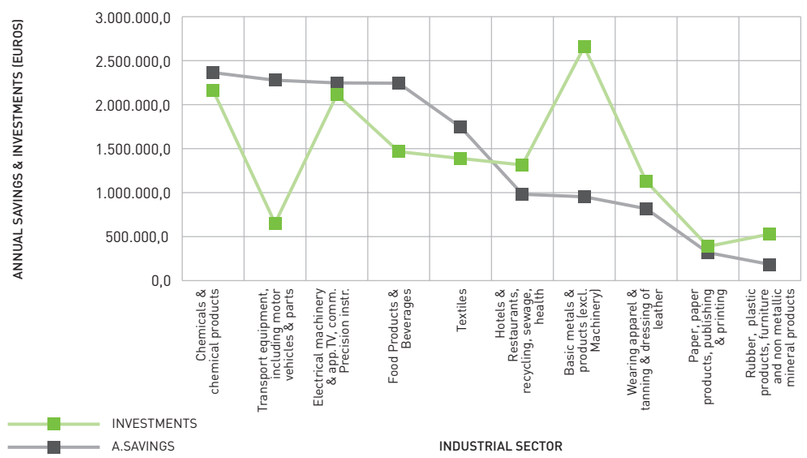


II.2 – ANALYSES BY SECTOR

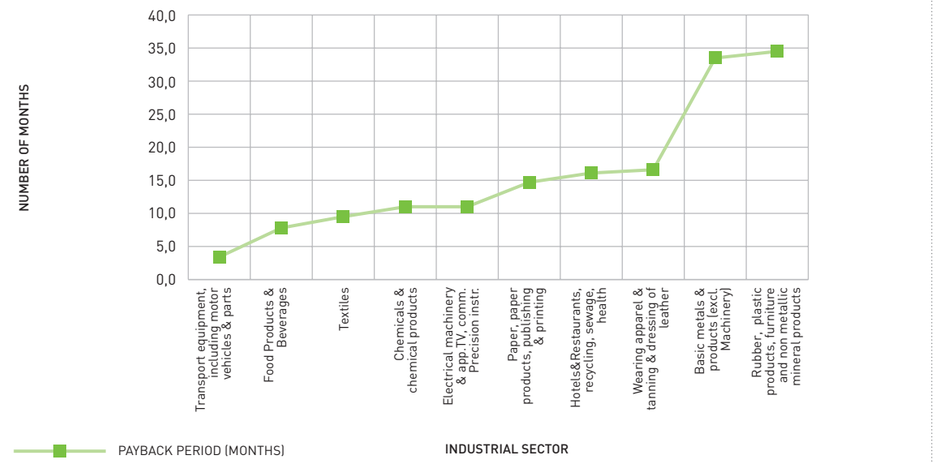
GRAPH II.47 - INVESTMENT, ENVIRONMENTAL IMPACT AND PAYBACK PERFORMANCE BY INDUSTRY



GRAPH II.68 - ANNUAL SAVINGS FROM CP TECHNOLOGICAL INVESTMENTS BY SECTOR



GRAPH II.69 - PAYBACK PERIOD (MONTHS) BY SECTOR



Correspondingly, and as shown in Graph II.69 above, payback periods confirm the financial efficiency of techniques for each industrial sector. According to that, sectors were classified in two main groups depending on the degree of profitability of average cases from each sector. The data and information below is presented in a summarized graphic form showing with the environmental, as well as the financial nature of cases from each of the mentioned groups.

a) Sectors in which CP cases recorded higher profitability

• Manufacture of electrical appliances

GRAPH II.48 - MANUFACTURE OF ELECTRICAL APPLIANCES MAIN TECHNIQUES

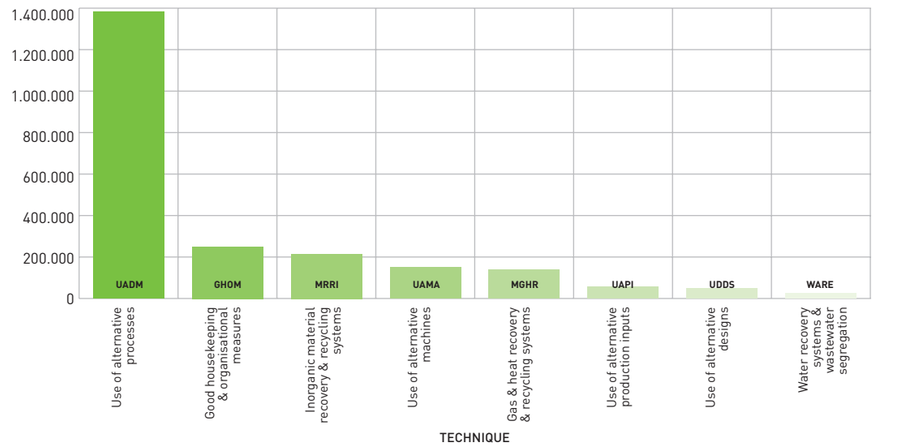
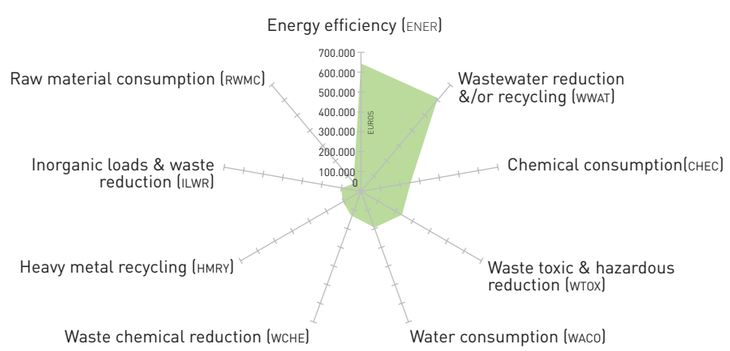


TABLE II.14 – MANUFACTURE OF ELECTRICAL APPLIANCES

Manufacture of electrical appliances	Country	Investment	Annual Saving (euros)	Payback (months)
Accumulators, primary cells and batteries	Tunisia	0,0 euros	20.520,0 euros	0,0
Accumulators, primary cells and batteries	Tunisia	0,0 euros	2.000,0 euros	0,0
Accumulators, primary cells and batteries	Tunisia	0,0 euros	125.000,0 euros	0,0
Accumulators, primary cells and batteries	Tunisia	0,0 euros	479.546,0 euros	0,0
Electronic valves, tubes, etc.	Spain	0,0 euros	908,8 euros	0,0
Electricity distribution & control apparatus	Croatia	414,5 euros	73.273,5 euros	0,1
Insulated wire and cable	Bosnia Herzeg.	500,0 euros	54.204,0 euros	0,1
Accumulators, primary cells and batteries	Tunisia	100.000,0 euros	683.000,0 euros	1,8
Electronic valves, tubes, etc.	Italy	46.000,0 euros	50.000,0 euros	11,0
Lighting equipment and electric lamps	Spain	132.200,0 euros	140.000,0 euros	11,3
Accumulators, primary cells and batteries	Tunisia	1.000,0 euros	1.000,0 euros	12,0
Accumulators, primary cells and batteries	Tunisia	100.000,0 euros	70.956,0 euros	16,9
Accumulators, primary cells and batteries	Tunisia	1.000,0 euros	500,0 euros	24,0
Insulated wire and cable	Bosnia Herzeg.	297.435,0 euros	147.707,0 euros	24,2
Accumulators, primary cells and batteries	Tunisia	100.000,0 euros	49.131,7 euros	24,4
Accumulators, primary cells and batteries	Tunisia	200.000,0 euros	98.263,4 euros	24,4
Electric motors, generators & transformers	Spain	186.185,0 euros	56.940,6 euros	39,2
Electronic valves, tubes, etc.	Malta	919.548,0 euros	189.221,0 euros	58,3
Industrial process control equipment	Spain	30.000,0 euros	5.670,0 euros	63,5
Total		**2.114.283 euros**	**2.247.842 euros**	**11,3**

GRAPH II.49 - MANUFACTURE OF ELECTRICAL APPLIANCES: ENVIROMENTAL BENEFITS



• Manufacture of chemical products

GRAPH II.50 - MANUFACTURE OF CHEMICAL PRODUCTS: MAIN TECHNIQUES

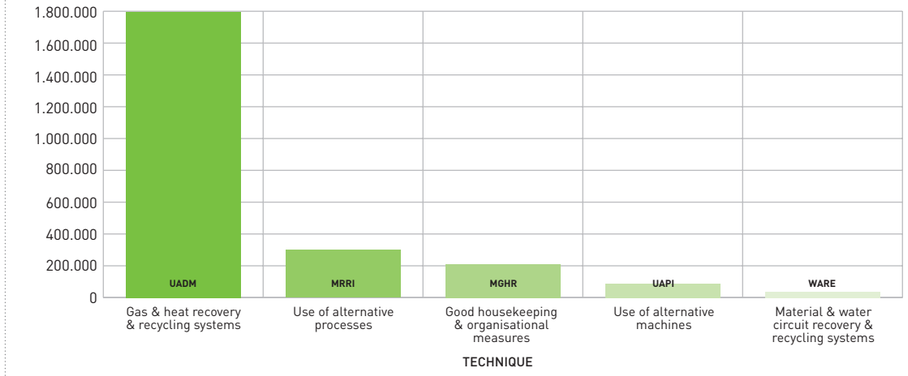
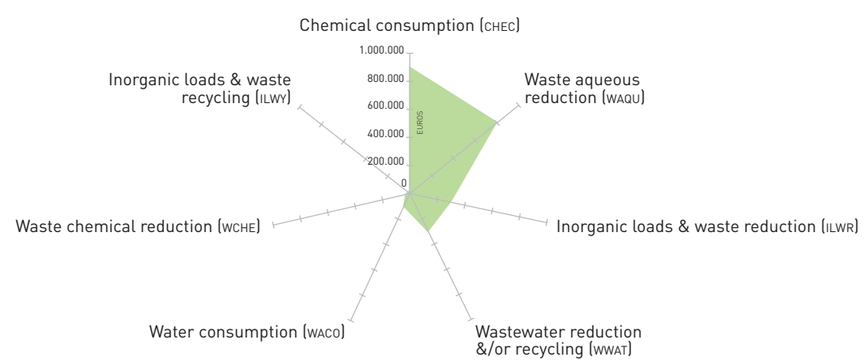


TABLE II.15 – MANUFACTURE OF CHEMICAL PRODUCTS

Manufacture of chemical products	Country	Investment	Annual Saving	Payback (months)
Basic chemicals, except fertilizers	Spain	0,0 euros	59.231,4	0,0
Pesticides and other agro-chemical products	Croatia	0,0 euros	165.384,7 euros	0,0
Pharmaceuticals, medicinal chemicals, etc.	Spain	0,0 euros	46.125,0 euros	0,0
Pharmaceuticals, medicinal chemicals, etc.	Spain	900.000,0 euros	1.449.780,0 euros	7,4
Soap, cleaning & cosmetic preparations	Spain	66.111,3 euros	81.453,4 euros	9,7
Pesticides and other agro-chemical products	Israel	204.000,0 euros	250.000,0 euros	9,8
Soap, cleaning & cosmetic preparations	Spain	79.100,9 euros	76.807,1 euros	12,4
Pesticides and other agro-chemical products	Israel	59.388,0 euros	50.500,0 euros	14,1
Man-made fibers	Spain	144.543,0 euros	82.509,0 euros	21,0
Paints, varnishes, printing ink and mastics	Spain	82.068,2 euros	43.807,7 euros	22,5
Paints, varnishes, printing ink and mastics	Spain	50.611,2 euros	15.647,6 euros	38,8
Paints, varnishes, printing ink and mastics	Spain	575.345,0 euros	43.333,4 euros	159,3
Total		**2.161.168 euros**	**2.364.579 euros**	**11,0**

GRAPH II.51 - MANUFACTURE OF CHEMICAL PRODUCTS: ENVIROMENTAL BENEFITS



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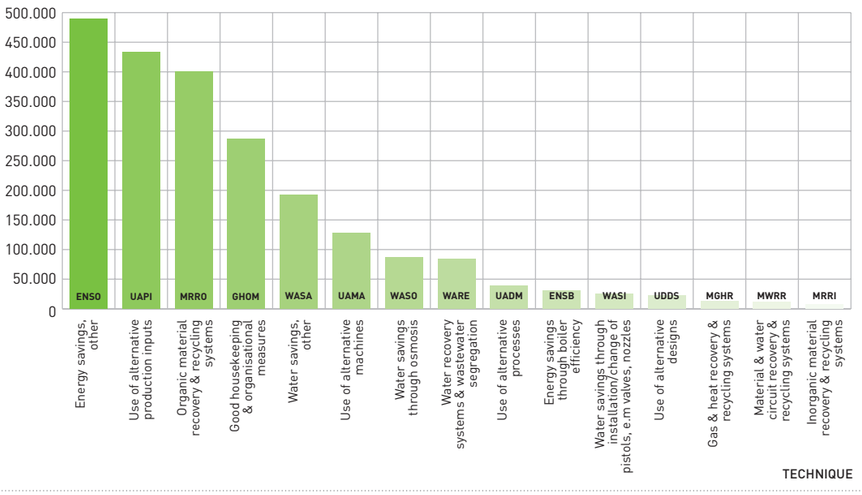
• Food and beverages

GRAPH II.52 - FOOD & BEVERAGE: MAIN TECHNIQUE



GRAPH II.53 - FOOD & BEVERAGE: ENVIRONMENTAL BENEFITS

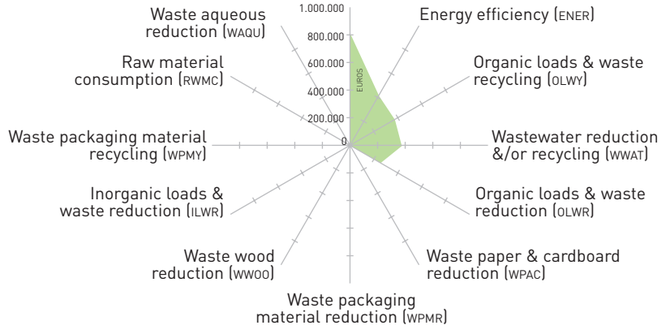


TABLE II.16 - MANUFACTURE OF FOOD & BEVERAGE

Manufacture of food products and beverages	Country	Investment	Annual saving	Payback (months)
Processing/preserving of fruits and veget.	Bosnia Herzerg.	0,00 euros	5.477,00 euros	0
Processing/preserving of fruits and veget.	Egypt	0,00 euros	15.337,00 euros	0
Vegetables and animal oil and fats	Egypt	0,00 euros	5.400,00 euros	0
Vegetables and animal oil and fats	Egypt	0,00 euros	59.949,10 euros	0
Vegetables and animal oil and fats	Egypt	0,00 euros	75.000,00 euros	0
Dairy products	Egypt	0,00 euros	612,00 euros	0
Dairy products	Spain	0,00 euros	9.015,50 euros	0
Dairy products	Spain	0,00 euros	23.295,40 euros	0
Dairy products	Egypt	0,00 euros	35.399,00 euros	0

Manufacture of food products and beverages	Country	Investment	Annual saving	Payback (months)
Bakery products	Bosnia Herzegov.	0,00 euros	114,00 euros	0
Bakery products	Bosnia Herzegov.	0,00 euros	406.00 euros	0
Soft drinks and mineral water	Bosnia Herzegov.	0,00 euros	308.00 euros	0
Processing/preserving of meat	Bosnia Herzegov.	246,00 euros	18.260,00 euros	0,2
Vegetables and animal oil and fats	Egypt	2.700,00 euros	138.975,00 euros	0.2
Bakery products	Bosnia Herzegov.	6,00 euros	186,00 euros	0,4
Soft drinks and mineral water	Bosnia Herzegov.	88,00 euros	2.209,00 euros	0,5
Dairy products	Egypt	592,00 euros	10.924,00 euros	0,7
Vegetables and animal oil and fats	Egypt	9.000,00 euros	165.888,00 euros	0,7
Processing/preserving of meat	Bosnia Herzegov.	58,50 euros	924,50 euros	0,8
Vegetable and animal oil and fats	Egypt	750,00 euros	10.500,00 euros	0,9
Vegetable and animal oil and fats	Egypt	3.000,00 euros	36.000,00 euros	1
Dairy products	Croatia	31.051,00 euros	328.008,00 euros	1,1
Bakery products	Bosnia Herzegov.	153,00 euros	1.595,00 euros	1,2
Dairy products	Egypt	3.997,00 euros	36.245.00 euros	1,3
Dairyproducts	Spain	23.200,00 euros	204.885,00 euros	1,4
Dairy products	Croatia	15.000,00 euros	115.000,00 euros	1,6
Processing/preserving of meat	Bosnia Herzegov.	562,00 euros	4.072,00 euros	1,7
Processing/preserving of meat	Morocco	40.80 euros	191,40 euros	2,6
Processing/preserving of meat	Croatia	44.605,00 euros	80.544,00 euros	3
Soft drinks and mineral water	Bosnia Herzegov.	154,00 euros	512.00 euros	3,6
Bakery Products	Bosnia Herzegov.	453,00 euros	1.360,00 euros	4
Vegetabe and animal oil and fats	Egypt	1.500,00 euros	4.320,00 euros	4,2
Processing/preserving of fish	Morocco	1.531.50 euros	4.390,20 euros	4.2
Processing/preserving of fruits and veget.	Egypt	t2.587,00 euros	7.344,00 euros	4.2
Processing/preserving of fruits and veget.	Egypt	7.151.00 euros	63.604,00 euros	5,1
Vegetable and animal oil and fats	Egypt	4.500.00 euros	9.000,00 euros	6
Bakery products	Bosnia Herzegov.	77,00 euros	143,00 euros	6,5
Processing/preserving of fruits and veget.	Egypt	1.499,00 euros	l2.754,00 euros	6,5
Processing/preserving of fruits and veget.	Egypt	8.707,00 euros	15.959,00 euros	6,5
Processing/preserving of fish	Morocco	122,50 euros	218,40 euros	6,7
Dairy products	Egypt	21.951.00 euros	37.266,00 euros	7,1
Processing/preserving of meat	Bosnia Herzegov.	299,00 euros	496,00 euros	7,2
Dairy products	Egypt	7 .861,00 euros	11.741.00 euros	8
Processing/preserving of fish	Morocco	1.740,80 euros	2.215,30 euros	9,4
Processing/preserving of meat	Bosnia Herzegov.	17.895,00 euros	20.875,00 euros	10,3
Processing/preserving of fish	Morocco	1.272,60 euros	1.388,50 euros	11
Processing/preserving of fruits and veget.	Egypt	25.953.00 euros	26.438.00 euros	11,8
Vegetabe and animal oil and fats	Egypt	37.083.10 euros	31.247,50 euros	14,2

Manufacture of food products and beverages	Country	Investment	Annual saving	Payback (months)
Processing/preserving of fruits and veget.	Egypt	56.965.00 euros	46.811,00 euros	14,6
Sugar	Croatia	11.992,70 euros	9.671,50 euros	14,9
Vegetabe and animal oil and fats	Egypt	79.527,30 euros	59.059,80 euros	16,2
Processing/preserving of fruits and veget.	Egypt	t22.337.00 euros	12.962,00 euros	20,7
Processing/preserving of fish	Morocco	411,20 euros	2.960,80 euros	21,9
Vegetabe and animal oil and fats	Egypt	63.936,40 euros	34.874,40 euros	22
Processing/preserving of fruits and veget.	Lebanon	8.988.00 euros	4.902.50 euros	22
Processing/preserving of meat	Croatia	159.303.00 euros	86.554,80 euros	22,1
Processing/preserving of fruits and veget.	Egypt	26.270,00 euros	13.190,00 euros	23,9
Sugar	Morocco	156.923,10 euros	72.426,00 euros	26
Processing/preserving of fruits and veget.	Bosnia Herzegov.	10.000,00 euros	4.516,00 euros	26,6
Processing/preserving of fish	Morocco	5.406,00 euros	2.348,20 euros	27,6
Processing/preserving of fish	Morocco	916,30 euros	377.80 euros	29,1
Dairy products	France	240.000,00 euros	97.500,00 euros	29,5
Sugar	Spain	2.596,00 euros	29.906,00 euros	41,2
Processing/preserving of fish	Morocco	988,30 euros	282.10 euros	42
Bakery products	Spain	132.610,00 euros	28.815.90 euros	55,2
Processing/preserving of fish	Morocco	842.30 euros	142,40 euros	71
Processing/preserving of fish	Morocco	3.942,00 euros	606,80 euros	78
Processing/preserving of fruits and veget.	Slovenia	879.398.00 euros	10.474,20 euros	91
Total		**465.739,20**	**2.244.374,10**	**7,8**

• Manufacture of textiles

GRAPH II.54 - MANUFACTURE OF TEXTILES: MAIN TECHNIQUE

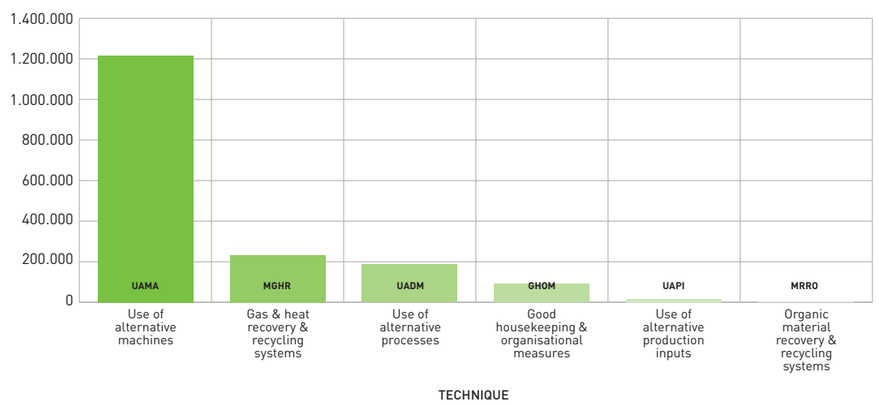
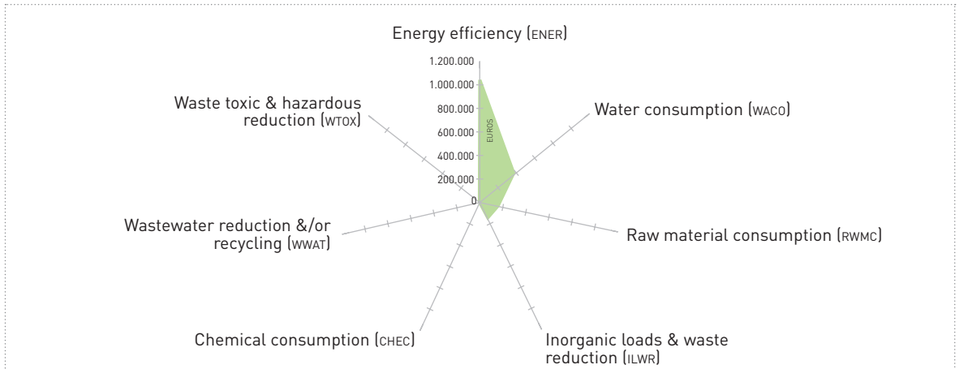


TABLE II.17 - MANUFACTURE OF TEXTILES

Manufacture of textiles	Country	Investment	Annual Saving	Payback (months)
Textile fiber preparation; textile weaving	Turkey	0,0 euros	2.007,5 euros	0,0
Textile fiber preparation; textile weaving	Egypt	0,0 euros	6.689,5 euros	0,0
Textile fiber preparation; textile weaving	Turkey	0,0 euros	24.518,0 euros	0,0
Textile fiber preparation; textile weaving	Egypt	0,0 euros	10.269,0 euros	0,0
Textile fiber preparation; textile weaving	Egypt	0,0 euros	64.445,7 euros	0,0
Knitted and crocheted fabrics and articles.	Turkey	0,0 euros	58.340,0 euros	0,0
Textile fiber preparation; textile weaving	Turkey	10.556,0 euros	193.223,0 euros	0,7
Textile fiber preparation; textile weaving	Egypt	818,7 euros	6.276,9 euros	1,6
Textile fiber preparation; textile weaving	Egypt	12.909,6 euros	65.064,4 euros	2,4
Textile fiber preparation; textile weaving	Egypt	13.203,0 euros	39.638,3 euros	4,0
Knitted and crocheted fabrics and articles.	Turkey	20.000,0 euros	57.680,0 euros	4,2
Textile fiber preparation; textile weaving	Egypt	14.083,2 euros	39.646,0 euros	4,3
Textile fibre preparation; textile weaving	Egypt	19.511,1 euros	54.601,8 euros	4,3
Knitted and crocheted fabrics and articles.	Turkey	328.820,0 euros	513.000,0 euros	7,7
Textile fibre preparation; textile weaving	Turkey	968.629,0 euros	609.530,0 euros	19,1
Total		**1.388.530,6 euros**	**1.744.930,1 euros**	**9,5**

GRAPH II.55 - MANUFACTURE OF TEXTILES: ENVIRONMENTAL BENEFITS



• Manufacture of transport equipment, including motor vehicles and parts

GRAPH II.54 - MANUFACTURE OF TRANSPORT EQUIPMENT (INCLUDING MOTOR VEHICLES AND PARTS): MAIN TECHNIQUE

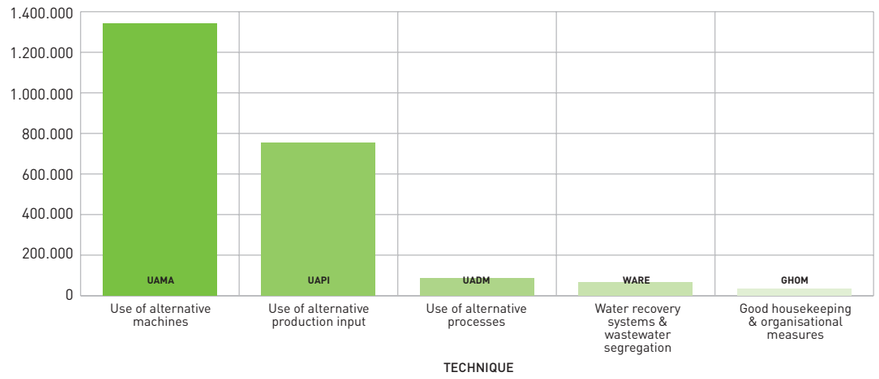
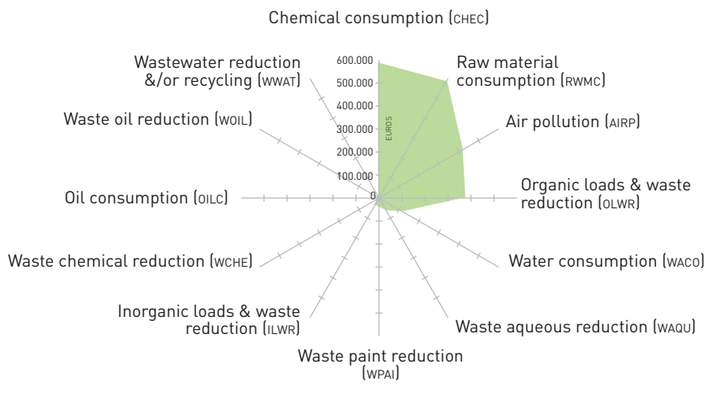


TABLE II.18 - MANUFACTURE OF TRANSPORT EQUIPMENT, INCLUDING MOTOR VEHICLES AND PARTS

Manufacture of transport equipment, including motor vehicles & parts	Country	Investment	Annual Saving	Payback (months)
Aircraft and spacecraft	Israel	600,0 euros	87.000,0 euros	0,1
Building and repairing of ships	Spain	41.312,4 euros	1.105.032,1 euros	0,4
Aircraft and spacecraft	Israel	12.500,0 euros	33.000,0 euros	4,5
Aircraft and spacecraft	Israel	360.000,0 euros	754.000,0 euros	5,7
Parts/accessories for automobiles	Spain	82.078,9 euros	135.071,6 euros	7,3
Parts/accessories for automobiles	Spain	12.068,7 euros	16.637,0 euros	8,7
Parts/accessories for automobiles	Spain	51.700,0 euros	70.752,0 euros	8,8
Parts/accessories for automobiles	Spain	56.000,0 euros	64.500,6 euros	10,4
Parts/accessories for automobiles	Spain	36.061,0 euros	12.515,7 euros	34,6
Total		**652.321,0 euros**	**2.278.509,1 euros**	**3,4**

GRAPH II.57 - MANUFACTURE OF TRANSPORT EQUIPMENT (INCL. MOTOR VEHIC. AND PARTS: ENVIRONMENTAL BENEFITS



b) Sectors in which CP cases recorded moderate profitability

Sectors with relatively higher CP Technology investment levels:

• Manufacture of basics metals and metal products excluding machinery and equipment

GRAPH II.58 - MANUFACTURE OF BASICS METALS AND METAL PRODUCTS (EXCL. MACH. AND EQUIP.): MAIN TECHNIQUES

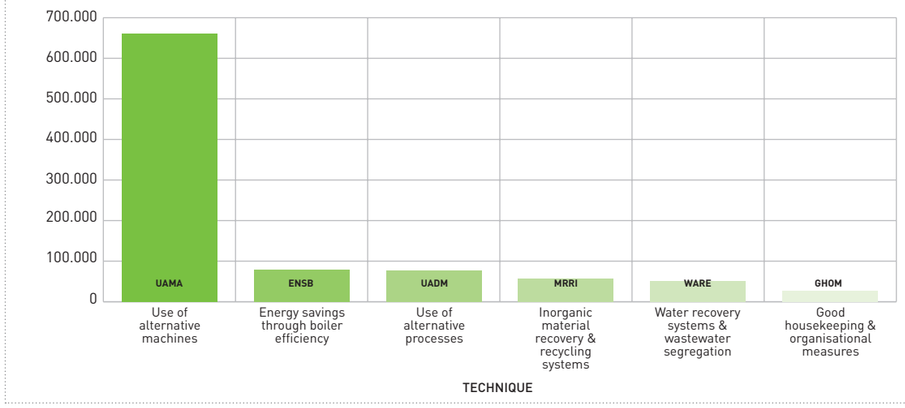
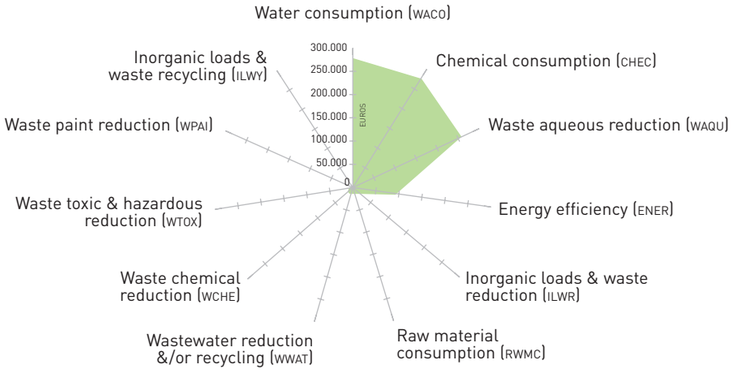


TABLE II.19 - MANUFACTURE OF BASICS METALS AND METAL PRODUCTS (EXCLUDING MACHINERY AND EQUIPMENT

Manufacture of basic metals & metal products excluding machinery and equipment	Country	Investment	Annual Saving	Payback (months)
Treatment & coating of metals	Spain	177,0 euros	3.418,1 euros	0,6
Treatment & coating of metals	Turkey	2.000,0 euros	23.000,0 euros	1,0
Treatment & coating of metals	Turkey	2.000,0 euros	20.000,0 euros	1,2
Treatment & coating of metals	Spain	3.606,0 euros	20.441,0 euros	2,1
Treatment & coating of metals	Spain	6.667,0 euros	20.500,0 euros	3,9
Basic iron and steel	France	75.000,0 euros	79.500,0 euros	11,3
Treatment & coating of metals	Spain	22.580,0 euros	13.034,0 euros	20,8
Tanks, reservoirs and containers of metal	Spain	34.067,0 euros	14.734,0 euros	27,7
Treatment & coating of metals	Turkey	120.000,0 euros	50.000,0 euros	28,8
Tanks, reservoirs and containers of metal	Bosnia Herzg.	18.000,0 euros	6.000,0 euros	36,0
Treatment & coating of metals	Turkey	1.800.000,0 euros	590.000,0 euros	36,6
Metal forging/pressing/stamping/roll-forming	Spain	106.284,0 euros	31.084,0 euros	41,0
Treatment & coating of metals	Spain	79.393,0 euros	16.364,0 euros	58,2
Treatment & coating of metals	Spain	140.005,0 euros	23.802,0 euros	70,6
Treatment & coating of metals	Spain	248.674,8 euros	40.873,2 euros	73,0
Total		**2.658.453,8 euros**	**952.750,3 euros**	**33,5**

GRAPH II.59 - MANUFACTURE OF BASICS METALS AND METAL PRODUCTS (EXCL. MACH. AND EQUIP.): ENVIRONMENTAL BENEFITS



• Wearing apparel, tanning and dressing of leather

GRAPH II.60 - WEARING APPAREL & LEATHER PRODUCTS: MAIN TECHNIQUE

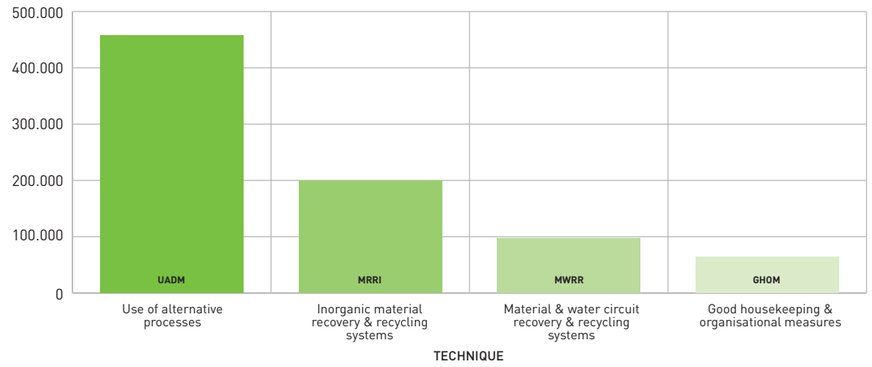
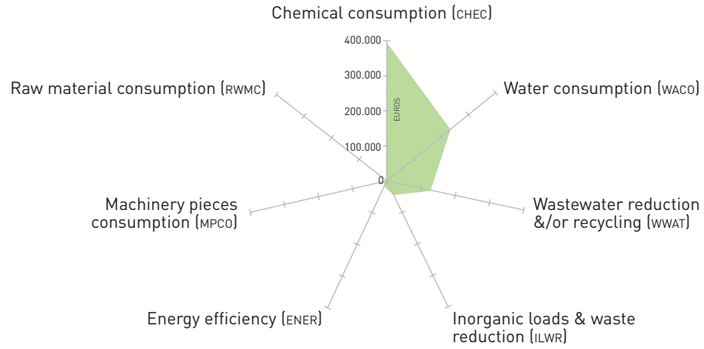


TABLE II.20 - WEARING APPAREL, TANNING AND DRESSING OF LEATHER

Wearing apparel, tanning and dressing of leather	Country	Investment	Annual Saving	Payback (months)
Wearing apparel, except fur apparel	Tunisia	250,0 euros	29.000,0 euros	0,1
Wearing apparel, except fur apparel	Tunisia	250,0 euros	13.000,0 euros	0,2
Wearing apparel, except fur apparel	Tunisia	250,0 euros	11.000,0 euros	0,3
Wearing apparel, except fur apparel	Tunisia	250,0 euros	9.000,0 euros	0,3
Wearing apparel, except fur apparel	Tunisia	500,0 euros	16.000,0 euros	0,4
Wearing apparel, except fur apparel	Tunisia	1.000,0 euros	19.000,0 euros	0,6
Wearing apparel, except fur apparel	Tunisia	500,0 euros	6.000,0 euros	1,0
Wearing apparel, except fur apparel	Tunisia	1.000,0 euros	7.000,0 euros	1,7
Tanning and dressing of leather	Lebanon	10.800,0 euros	44.280,0 euros	2,9
Tanning and dressing of leather	Lebanon	2.000,0 euros	7.120,0 euros	3,4

Wearing apparel, tanning and dressing of leather	Country	Investment	Annual Saving	Payback (months)
Tanning and dressing of leather	Lebanon	8.800,0 euros	28.000,0 euros	3,8
Tanning and dressing of leather	Croatia	63.907,2 euros	75.777,4 euros	10,1
Tanning and dressing of leather	Lebanon	8.800,0 euros	5.600,0 euros	18,9
Dressing & dyeing of fur; processing of fur	Spain	600.962,0 euros	372.260,0 euros	19,4
Tanning and dressing of leather	Lebanon	85.000,0 euros	44.200,0 euros	23,1
Tanning and dressing of leather	Spain	21.456,0 euros	9.809,0 euros	26,2
Tanning and dressing of leather	Croatia	288.604,8 euros	111.512,0 euros	31,1
Tanning and dressing of leather	Lebanon	35.000,0 euros	9.180,0 euros	45,8
Total		**1.129.330,0 euros**	**817.738,4 euros**	**16,6**

GRAPH II.61 - WEARING APPAREL, TANNING AND DRESSING OF LEATHER: ENVIRONMENTAL BENEFITS



Sectors with relatively lower CP Technology investment levels:

• Hotels, restaurants, hospitals & recycling companies

GRAPH II.62 - HOTELS, RESTAURANTS, HOSPITALS & RECYCLING COMPANIES: MAIN TECHNIQUE

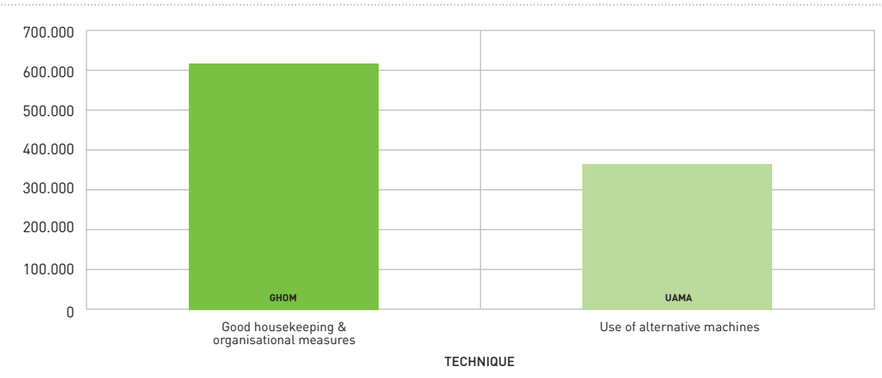
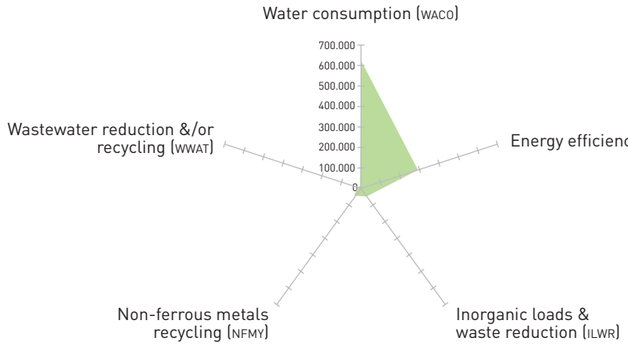


TABLE II.21 - HOTELS, RESTAURANTS, HOSPITALS & RECYCLING COMPANIES

Hotels, Restaurants, Hospitals & Recycling companies	Country	Investment	Annual Saving	Payback (months)
Hotels, rooming houses, camps and other lodging places	Tunisia	0,0 euros	3.427,5 euros	0,0
Sewage and refuse disposal, sanitation and similar activities	Bosnia Herzeg.	0,0 euros	612.000,0 euros	0,0
Hotels, rooming houses, camps and other lodging places	Tunisia	8,2 euros	375,4 euros	0,3
Hotels, rooming houses, camps and other lodging places	Tunisia	122,4 euros	310,1 euros	4,7
Hotels, rooming houses, camps and other lodging places	Tunisia	473,3 euros	836,5 euros	6,8
Hotels, rooming houses, camps and other lodging places	Tunisia	106,1 euros	136,3 euros	9,3
Recycling of metal waste and scrap	Spain	284.000,0 euros	79.336,0 euros	43,0
Hospital activities	Croatia	1.030.000,0 euros	285.000,0 euros	43,4
Total		**1.314.710,0 euros**	**981.421,7 euros**	**16,1**

GRAPH II.63 - HOTELS, RESTAURANTS, HOSPITALS & RECYCLING COMPANIES: ENVIRONMENTAL BENEFITS



• Manufacture of rubber, plastic products, furniture and non-metallic mineral products

GRAPH II.64 - MANUFACTURE OF RUBBER, PLASTIC PRODUCTS, FURNITURE AND NON-METALLIC MINERAL PRODUCTS: MAIN TECHNIQUE

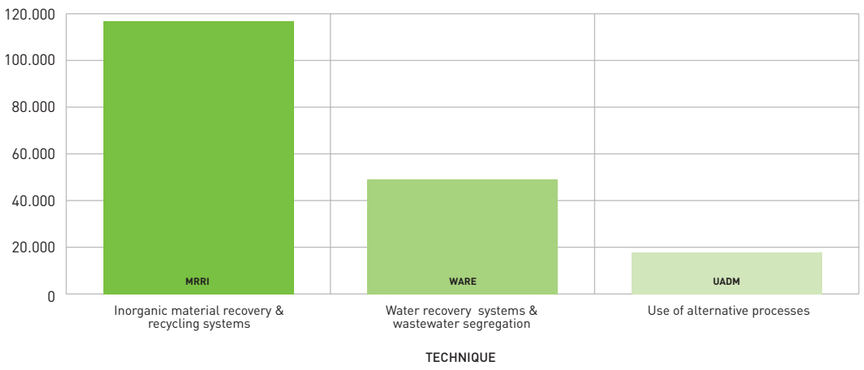
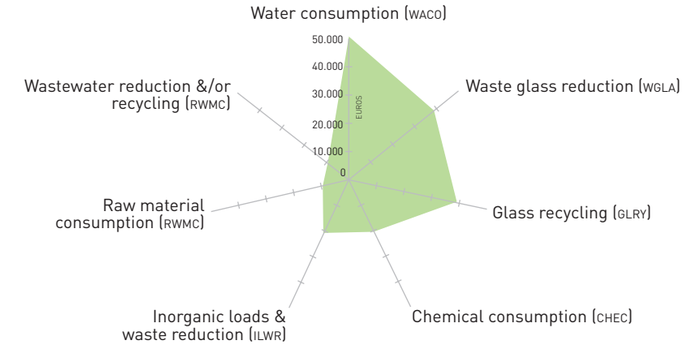


TABLE II.22 - MANUFACTURE OF RUBBER, PLASTIC PRODUCTS, FURNITURE AND NON-METALLIC MINERAL PRODUCTS

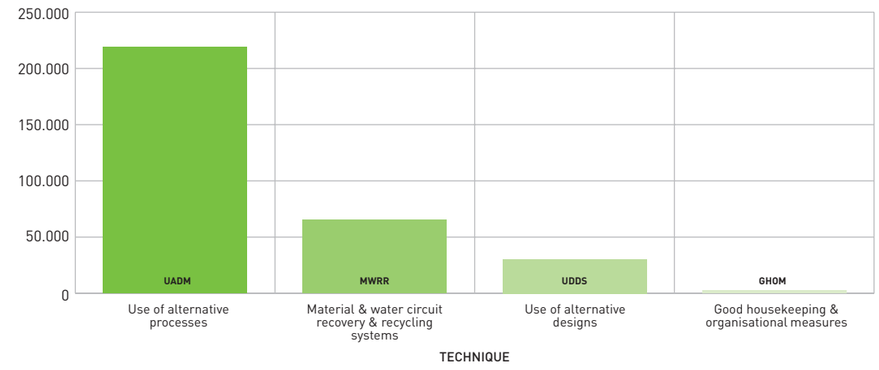
Manufacture of rubber, plastic products, furniture and non metallic mineral products	Country	Investment	Annual Saving	Payback (months)
Furniture	Spain	32.044 euros	17.740 euros	21,7
Rubber tires and tubes	Turkey	50.000 euros	25.000 euros	24,0
Refractory ceramic products	Italy	65.000 euros	24.224 euros	32,2
Glass and glass products	Spain	239.530 euros	76.646 euros	37,5
Plastic products	Spain	141.599 euros	40.155 euros	42,3
Total		**528.173 euros**	**183.765 euros**	**34,5**

GRAPH II.65 - MANUFACTURE OF RUBBER, PLASTIC PRODUCTS, FURNITURE AND NON-METALLIC MINERAL PRODUCTS: ENVIRONMENTAL BENEFITS



• Manufacture of paper, paper products, publishing and printing

GRAPH II.66 - MANUFACTURE OF PAPER, PAPER PRODUCTS, PUBLISHING AND PRINTING: MAIN TECHNIQUE

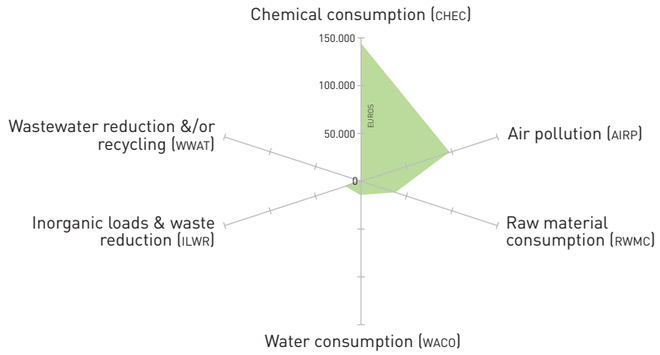


GRECO INITIATIVE
GREEN COMPETITIVENESS

TABLE II.23 - MANUFACTURE OF PAPER, PAPER PRODUCTS, PUBLISHING AND PRINTING

Manufacture of paper, paper products, publishing & printing	Country	Investment	Annual Saving	Payback (months)
Pulp, paper and paperboard	Malta	0 euros	30.300 euros	0,0
Printing	Spain	0 euros	99.775 euros	0,0
Manufacture of off-machine coated, glazed, gummed, laminated paper and paperboard	Spain	3.005 euros	36.722 euros	1,0
Printing	Spain	86.245 euros	65.537 euros	15,8
Printing	Spain	285.572 euros	82.461 euros	41,6
Printing	Spain	13.226 euros	2.748 euros	57,8
Total		**388.048 euros**	**317.543 euros**	**14,7**

GRAPH II.67 - MANUFACTURE OF PAPER, PAPER PRODUCTS, PUBLISHING AND PRINTING: ENVIRONMENTAL BENEFITS



CHAPTER III

THE FUTURE: IDENTIFYING LONG-TERM BUSINESS OPPORTUNITY SCENARIOS FOR MEDITERRANEAN COMPANIES

CHAPTER III
THE FUTURE: IDENTIFYING LONG-TERM BUSINESS OPPORTUNITY SCENARIOS FOR MEDITERRANEAN COMPANIES

Prospective analysis tools can be very useful for assessing : i) Which are the main explicative variables characterizing Cleaner Production techniques and their economic and environmental impacts; and ii) Addressing possible future scenarios in the 10-15 years perspective through the identification of what we may call the "CP Green competitiveness critical paths" based upon historical experiences.

A prospective exercise was developed, on the basis of MCID Database, and through a structural analysis methodology presented in Annex 4. The main findings of this analysis are presented below and seek to identify the main "critical paths" or business opportunity scenarios. These are directions under which certain CP techniques, profitability and environmental outcomes could be privileged first.

III.1 – SELECTING TECHNIQUES

Six types of CP techniques were identified for the Mediterranean Region in the previous chapter as having been the most influential throughout the whole CP investment-environmental benefits-annual savings-payback, from the 100 case studies analysed:

- UAMA: Use of alternative components & machinery
- UADM: Use of alternative processes
- GHOM: Good housekeeping and organizational measures
- MGHR: Gas & heat recovery & recycling systems
- MRRI: Inorganic material recovery & recycling
- UAPI: Use of alternative production inputs

The introduction of these techniques has a key influence in terms of environmental benefits and economic returns generated. They can be a source of sustainability as well as of competitiveness and economic growth throughout the Mediterranean.

Looking at the future, these techniques could become the key drivers of CP green competitiveness in the Mediterranean, because of their higher returns and profitability (higher payback performance) that. The reason: companies will progressively reorient their actions towards more competitive techniques in economic and environmental terms.

UADM: USE OF ALTERNATIVE PROCESSES

UAMA: USE OF ALTERNATIVE COMPONENTS & MACHINERY

In the next 10 to 15 years, the new CP scenario could continue to be driven by two main influential types of techniques, from the case studies analysed: UADM (use of alternative processes), and UAMA (use of alternative components & machinery). In the case of UADM, it is a type of technique with payback periods of just 8 months, and returns on investment (ROI) of 39% already in the first year of introduction. UADM, is expected to reduce significantly the consumption of chemical inputs, increase energy efficiency and result in significant reductions in wastewater. These would benefit the largest number of sectors. In the case of UAMA, with relatively less performing paybacks (19 months) and positive ROI of 26,7%, only in the second year, energy efficiency would also be reinforced, as well as reductions in the consumption of chemicals and other types of inputs in production processes. Most of the Mediterranean countries analyzed are very active introducing these two types of CP solutions in the production processes of a large variety of industrial sectors.

GHOM: GOOD HOUSEKEEPING & ORGANIZATIONAL MEASURES

The introduction of good housekeeping and organizational measures appears in the system as an extremely dependent variable on annual savings generated by its impact in companies' industrial processes, as well as on the high payback performance of its techniques. In the coming decades, GHOM could influence, increasingly, the behavior of Mediterranean companies.

This prospective trend, at the light of GRAPH II.14, II.15 and II.16, indicates a logical influential spread of this technology, which recorded a high return on investment (ROI) of 622% for the first year, and a payback period for all GHOM techniques together of less than two months. This type of technique could concentrate most of its main environmental returns in the reduction of water consumption in industrial processes, with a somewhat relatively lower impact expected on wastewater reduction &/or recycling. Electrical machinery and the food products sectors seem to be the most promising ones, according to the case studies analysed.

MGHR: GAS AND HEAT RECOVERY AND RECYCLING

With Đ2 million, nearly 15% of all annual savings generated through all CP experiencies recorded, MGHR (Gas & heat recovery & recycling systems) is already today the third most important type of CP techniques observed among the 100 Mediterranean industrial companies. The overall payback period is of 7 months, with a corresponding ROI of 63% already from the first year.

The environmental benefits of a reduction of consumption of chemical inputs and of aqueous waste from industrial processes could be reinforced,. especially in the Mediterranean chemical industry, and to a lesser extent in the textile sector, according to the case studies analysed.

MRRI: INORGANIC MATERIAL RECOVERY AND RECYCLING SYSTEMS

It is a group of techniques whose main function is to recover or recycle all types of inorganic material. According to the case studies analysed, its main environmental benefits could continue to be (see Graphs II.29, II.30 and II.31) the reduction of chemical inputs consumption and water consumption. In addition expected benefits would also be registered in the future in waste type of inorganic loads from industrial processes reduction and recycling. The main sectors concerned could be the rubber and plastic products sector, followed by electrical machinery and wearing apparel and leather tanning and dressing.

UAPI: USE OF ALTERNATIVE PRODUCTION INPUTS

From the Med Clean case studies, the use of alternative production inputs in industrial processes in Mediterranean companies is presently the fifth CP type of technique in the Mediterranean region in terms of annual savings generated from investments (more than Đ1M). Empowered by its increasingly high dependence on its own investment profitability, with only 6 and a half months overall payback, and ROI of 76% already from the first year of the investment, these techniques are expected to maintain their relevance and even grow in importance in coming decades.

The use of alternative production inputs, to replace those generating negative environmental consequences, means keep on acting competitively at the source, and not end-of-pipe. According to the prospective model, intensification of the use of these kind of techniques would have important benefits in reducing organic loads and waste, as well as in air pollution terms, and to a lesser extent in water consumption and wastewater reduction. These technologies would be applied mainly in the food products & beverages sector, as well as in the transport equipment sector, including aircraft.

Graph III.2 in Annex 4 summarizes the prospective discussion above, showing prospects for each CP technique in terms of increasing or decreasing their influence/link/dependence role for the future, and so their prospects in the coming 10 to 15 years. Annex 4 includes all other Graphs illustrating prospective trends expected in the case of environmental and sector variables of the model.

Other promising CP techniques

There is a group of techniques which, although they are exerting at present relatively low levels of influence and dependence, and so cannot be considered as key drivers of the CP green competitiveness system, according to the model, they nevertheless are expected to slightly gain in importance, due to the direct and indirect effects of savings and profitability in the coming years. It would be the case of:

ENERGY SAVINGS (OTHER) (ENSO)

In the case of ENSO, although ranking today 6th in terms of annual savings generated from investments, it is a kind of technique which depends strongly on the potential of its high ROI (176% already in the first year) and its high payback performance (4 months).

WATER RECOVERY SYSTEMS & WASTEWATER SEGREGATION (WARE)

WARE ranks today 9th in terms of annual savings generated (with less than 200,000Đ annual savings). With a payback performance of slightly less than two years and 8,1% ROI only in the second year, these technologies are expected, however, to gain in importance. According to the model, up to 80% of environmental benefits would be generated in the reduction of water consumption, and to a lesser extent in reducing raw material inputs in production processes. These developments would take place mainly in companies from the rubber & plastic products, food products and electrical machinery sectors, and to a lesser extent in the transport equipment and Basic metal product sectors.

WATER SAVING TECHNOLOGIES (WASA and WASI),

Still represent today low amounts of investments. Prospects for their introduction come from the growing impact in the system that would be exerted by these technologies given their high returns (ROI of 846% in the case of WASI and of 372% in the case of WASA, both in the first year), and high payback performance of only 1 month in the case of WASI, and of 2 months and a half in the case of WASA. In environmental performance terms, 90% of the benefits raise from reducing water consumption, and this would take place mainly in the food products sector.

III.2 – ENVIRONMENTAL BENEFITS

Green competitiveness is expected to spread in the coming years through CP actions in Mediterranean countries. It has been observed above that these are expected to have important environmental and economic consequences. A quick look at structural analysis results, in strictly environmental benefit terms, allows the presentation of future prospects below, according to the model and the case studies analysed:

WACO: REDUCTION OF WATER CONSUMPTION

WAQU: REDUCTION OF WASTE AQUEOUS POLLUTION

They are already today the most important benefits of the CP experiences recorded. Water consumption (WACO) represents 20% of all environmental benefits derived from the 176 CP technological techniques from the MCID Database. According to the model, in the coming decades, it is expected to remain the highest dependent environmental benefit. In other words, the result of future progressive implementation of CP actions identified in the present report would continue to have, in "water", the key environmental aspect for a sustainable future of the Mediterranean.

Waste aqueous reduction (WAQU) represents 8% of all environmental benefits from the 176 CP techniques in MCID Database. However, this environmental impact would remain highly sensitive (the second in sensitiveness) to most relevant CP technologies of a high investments – high annual savings nature.

ENER: REDUCTION IN THE CONSUMPTION OF ENERGY INPUTS (ENERGY EFFICIENCY)

CHEC: REDUCTION IN THE CONSUMPTION OF CHEMICAL INPUTS

According to the model, CP techniques of a highly profitable, large investments and large annual savings nature would continue to contribute, in the coming years, to the reduction of both types of inputs in production processes. Energy efficiency represents today 18% of all generated environmental benefits from MCID Database. Although to a lesser extent than water consumption mentioned above, it keeps a third rank in terms of sensitiveness to the introduction of highly profitable CP techniques. It is a "technology profit driven" positive environmental impact with a large potential for growth in the future. In the case of the reduction in the consumption of chemical inputs, representing today 19% of environmental benefits in MCID Database, the same is true although to a lesser extent than in the case of energy efficiency impacts.

RWMC: REDUCTION IN THE CONSUMPTION OF RAW MATERIAL INPUTS

WWAT: REDUCTION &/OR RECYCLING OF WASTEWATER
Of a "link" character as well, WWAT benefits, 10% of all those generated by all CP techniques in the MCID database, is expected to grow in importance in the coming decades according to the model, because of its "technology profit driven" positive environmental impact variable nature. The same is true in the case of reduction or recycling of wastewater from production processes RWMC, 6% today of all environmental benefits recorded.

ILWR: REDUCTION OF INORGANIC LOADS & WASTE

WTOX: REDUCTION OF TOXIC & HAZARDOUS WASTE
Although today ILWR type of environmental benefits represents only around 5% of all of them generated by the 176 CP techniques in MCID database, according to the model, it is expected to grow in importance because of it is medium-level sensitiveness to low payback highly profitable (high ROI) types of techniques whose use is expected to progress significantly. In the case of the reduction of toxic & hazardous waste, it represents only 2% of all environmental benefits recorded today but is also a medium-level "technology profit driven" positive environmental impact and is consequently expected to gain in importance.

III.3 – PROMISING SECTORS

Companies introducing "annual savings driven" CP techniques are most likely to proliferate in countries whose sectors record the highest influence in terms of direct and indirect effects of prospects for annual savings, from CP techniques, to be generated in the coming decades. The following is not a ranking of present importance of green competitiveness, but of future prospects of the most likely sectors according to the model, where companies would experience the largest benefits from the promotion of green competitiveness.

MACH: ELECTRICAL APPLIANCES
In the coming years, this sector would be expected to rank first according to the model, because of its potential to benefit from companies introducing "annual savings driven" techniques. This sector represents (2002-2004 average) 17% of all Mediterranean manufacturing added value. It is a highly sensitive sector to the promotion of green competitiveness. Thus, it has an enormous potential to increase its share in Mediterranean manufacturing added value in the case of a conscious and proactive Mediterranean countries' increased support to these new forms of green competitiveness.

FOOD: FOOD AND BEVERAGES SECTOR
This sector represents 13% of all Mediterranean manufacturing added value. CP successful experiencies arising from companies in this sector obtained the second largest results in terms of ROI and profitability. Its importance in both investment and savings generated contribute to the model direct and indirect effects making of it the second largest most promising sector for green competitiveness in the Mediterranean. Nearly all countries covered by MCID database have recorded successful green competitiveness experiences in this sector and could foster green competitiveness expansion in coming decades.

META: BASIC METALS AND FABRICATED METAL PRODUCTS SECTOR
This sector, representing 16% of all manufacturing added value in the Mediterranean, is one in which companies are expected to grow in green competitiveness dynamism. Although showing low profitability, in comparison to other sectors, the present importance of CP actions taking place in it (the first sector today in terms of CP investments) may explain why the model foresees even a slight increase in green competitiveness effects in this sector for the coming decades.

TEXT: TEXTILES SECTOR
Green competitiveness is expected to have here a positive influence. It represents around 5% of all Mediterranean manufacturing added value, but ranks third in terms of profitability of CP techniques by

sector. This fact is interiorized by the model which shows, consequently, an increasing importance of CP experiences taking place in this sector in coming decades.

CHEM: CHEMICALS AND CHEMICAL PRODUCTS SECTOR
Companies in this sector recorded the highest CP investments and obtained, as well, the highest annual savings, ranking fourth in terms of profitability. In the coming decades the model shows practically no movement from present high records in terms of green competitiveness. This could grant a stable growth of the sector as a result of an increasing implementation of CP approaches.

TRAN: TRANSPORT EQUIPMENT INCLUDING MOTOR VEHICLES' SECTOR
Today, the sector represents 11% of Mediterranean manufacturing added value. It is a pure CP "technology profit driven" sector. Present CP investments are low but prospects for coming decades are of an increasing importance being devoted to the development of green competitiveness, in line with the already very successful experiences recorded in the building and repairing of ships, and in the aircraft sector.

SERV: HOTELS AND RESTAURANTS, SANITATION, RECYCLING AND OTHERS SERVICES
In the case of this sector, the model expects CP techniques to tend to grow in the coming decades.

WEAR: WEARING APPAREL, DRESSING AND DYEING LEATHER SECTOR
Prospects for the coming years in this low CP investments - low annual savings - and medium payback periods – sector are of maintaining its importance through green competitiveness.

PLAS: RUBBER, PLASTIC, FURNITURE & NON-METALLIC MINERAL PRODUCTS SECTOR
Finally, prospects for this sector in terms of green competitiveness are not evident, according to the model. It is the less performing sector in terms of recorded payback performance of CP importance, and ranks also last in terms of CP investments and annual savings from it. However, the sector is important in terms of its weight (16%) in total Mediterranean manufacturing added value.

CHAPTER IV

FINAL RECOMMENDATION: LAUNCHING “THE GRECO INITIATIVE”

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In recent years, governments and international institutions have been promoting environmental protection by means of tools, agreements and laws for appropriate environmental compliance. The present report shows how, independently from the support of public institutions, private initiatives can make a great contribution to protect the environment, without losing perspective on its competitiveness goals, and without needing to concentrate their efforts exclusively on complying with regulation. Using the appropriate tools, companies can reduce potential damages to the environment and fully benefit, in successful (ROI) terms, from implementing CP.

In the Mediterranean Region, in addition to environmental regulation and the introduction of economic instruments, there is a need to consider strengthening entrepreneurship based on green competitiveness. The issue is one of wiring up the innovation framework to create favorable conditions for companies to engage in voluntary, profitable and competitive eco-innovation activities in their production processes[19]. CP entrepreneurship constitutes a feasible policy approach recommended by the present report, and presupposes widespread environmentally proactive companies, as well as a new division of labor between the public and private spheres in achieving this challenge.

The core idea is that new Mediterranean development scenarios, including North-South and South-South cooperation, are possible through an integrated approach centered on "green competitiveness / sustainability" co-development tools promoted through the pioneering work of a new initiative: "the GRECO Initiative". The aim of the new initiative will be to boost green competitiveness in the Mediterranean and enhance the visibility of the enormous financial opportunity that the environment offers to those integrating it in their practices.

The idea of the Initiative began to take shape during the 11th[20] Euro-Mediterranean Economic Transition Conference "Mediterranean economies and the immediate environmental challenge" in June 2007. In that Conference, one of the most salient conclusions was the lack of information, by the economic sector, of the large economic benefits that can be obtained by implementing best environmental practices, best available techniques and Cleaner Production – all similar concepts with a common goal: to facilitate achieving green competitiveness as a key contribution to sustainable development in the Mediterranean.

The present report, based upon very successful experiences of 100 Mediterranean companies, shows how the role of eco-innovation in industrial production processes, the key to Cleaner Production, constitutes, in turn, the engine of green competitiveness and one of the most promising tools for spreading sustainable production in the Mediterranean. As it has been shown, Cleaner Production does not focus simply in resource use or pollution reduction, but equally on value creation. Therefore, green competitiveness is about maximizing resource productivity at the firm level, rather than simply minimizing wastes and pollution associated to a given product .

The report illustrates how companies have been faced, in recent years, with many opportunities for obtaining profits through the introduction of various CP successful techniques. These opportunities have proven to be cost effective, and many others remain to be exploited. In today's global context, the key to capture and exploit environmental innovation is increasingly a shared responsibility of public and

19 See Andersen, M.M. (2004)

20 For a more detailed description of issues related to eco-efficiency in businesses see: Ayres, R.U. (1995).

private actors. Companies need to get the right access to competitive environmental information, and the public sector needs to integrate in its policies, projects and programs, the necessary ingredients for the promotion of green competitiveness.
The GRECO Initiative seeks to achieve simultaneously the two goals formulated in the previous paragraphs. The first chapter of the present report has shown that there are initial and significant signs of green competitiveness actions starting to be identified in certain Mediterranean countries. The GRECO Initiative should start to be developed around these initial actions. GRECO is not an isolated initiative since recent initiatives, of a similar nature, are being developed at a national level and are pursuing similar goals in the framework of specific policies[21].
Present activities of a green competitiveness nature, starting to take place today in certain Mediterranean countries, could benefit from the findings of the present report and from the GRECO Initiative business components. The time is right for the design of a "road map", a program of work to be developed in close collaboration with the Mediterranean business community and strong public-private partnerships. The program could address, initially, the following suggested lines of work:

Towards a GRECO Program of work
A technical assistance program on Green Competitiveness should be designed to foster the generation, diffusion and transfer of successful CP techniques being identified. Technical assistance could also focus on the promotion of N/S public-private partnerships for green competitiveness. GRECO is seen as a shared public/private endeavor to be developed in a reinforcing path between governments, financial institutions, and Mediterranean companies;
Special attention should also be devoted to the development of the most appropriate financial tools and mechanisms to support the progressive introduction, by companies, of CP techniques.
Today, the unilateral production of published material on CP by public institutions is starting to show its limits. GRECO is a system in itself, and systematic information and its transfer requires the development of advanced virtual platform systems for a continuous feeding and feed back of CP information which is crucial for green competitiveness. In order to ensure maximum efficiency in the generation, diffusion and appropriation of these successful experiences, the creation of a Digital CP Information Platform for companies, using advanced web tools, in order to provide access and feed-back to private and public Mediterranean actors would also be considered.
GRECO would launch a yearly publication in the form of a GRECO Annual Report integrating all information, strategies and benchmarks regarding Mediterranean companies' green competitiveness. Above all, GRECO should ultimately reinforce companies' incentives for a widespread and successful profit-driven introduction of CP solutions in the coming decades.
There is also a need to integrate public actors from the economic spheres. In this regard, economic and Industrial Ministries from Mediterranean countries should start increasing their roles and participation in green competitiveness issues and, in particular, throughout the identification and implementation of future GRECO Initiative actions;
Research on green competitiveness should be conducted further. More research and analyses are needed to identify the sources of green competitiveness, the key to the diffusion of CP knowledge and the mechanisms such as technical cooperation, financial tools or technnical information platforms to facilitate these processes.

21 A good illustration is Finland's Program "Getting more and better from less", a program to promote sustainable consumption and production, by the Committee on Sustainable Consumption and Production, Finland. See Committee on Sustainable Consumption and Production, Finland (2007).

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ANNEXES

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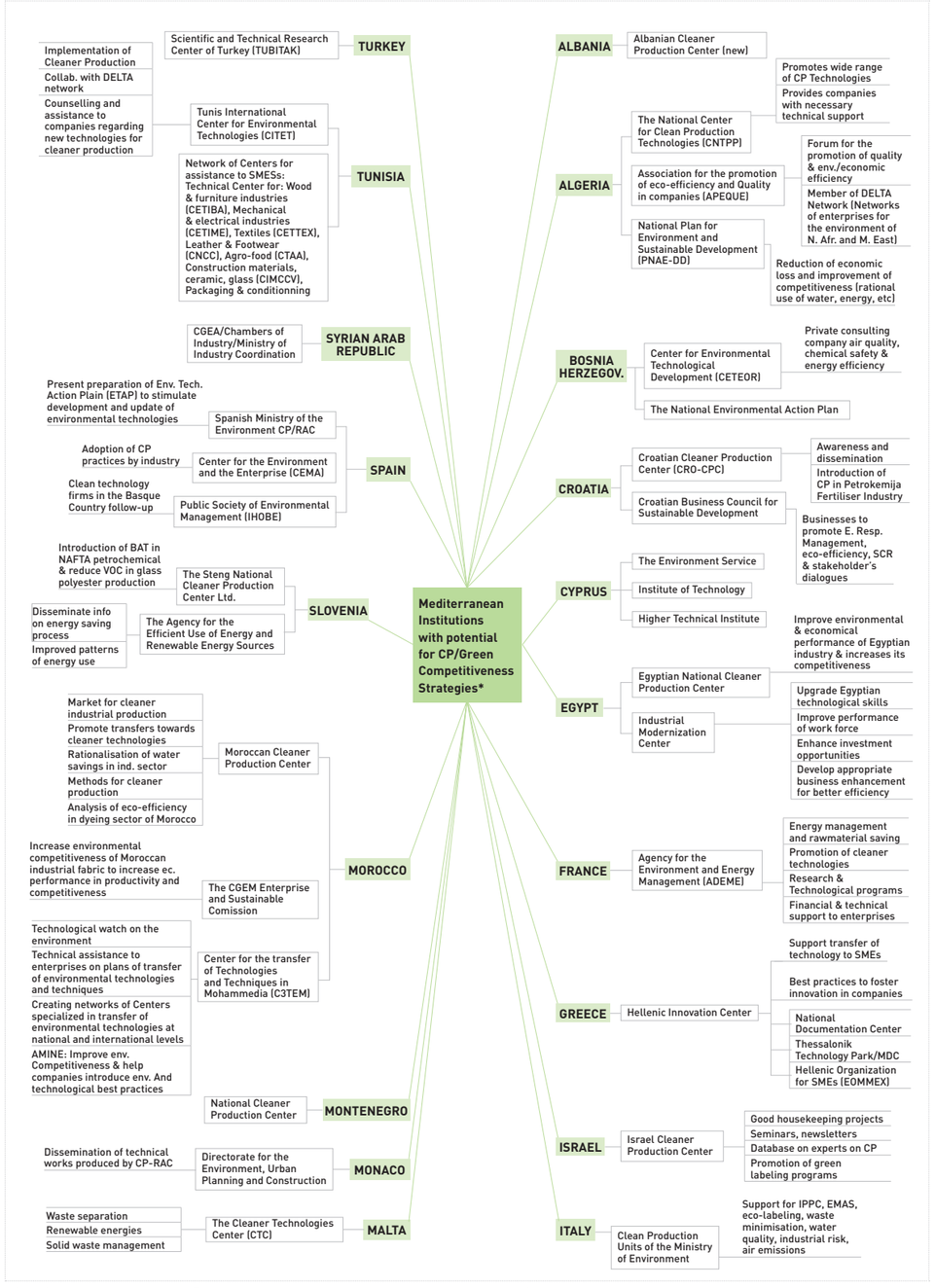
ANNEX I
NATIONAL CLEANER PRODUCTION CENTERS, PROJECTS, PROGRAMS AND TOOLS

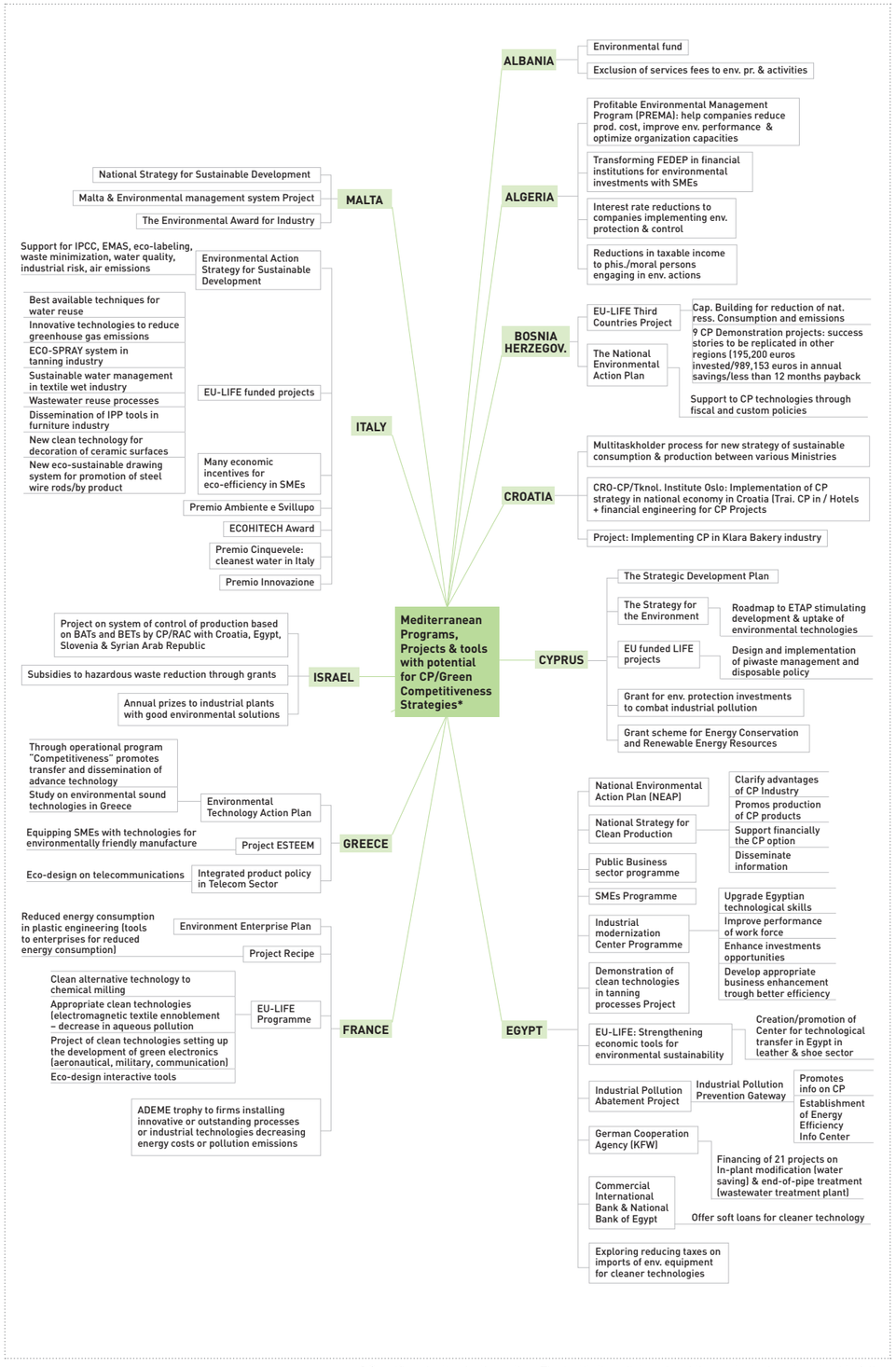
GRAPH I.2.A



* Specific selection by the author. The institutions listened and the contents do not pretend to fully reflect information contained in the document referred to in the source below

SOURCE: Elaboration by the author on the basis of CP/RAC (2006). See bibliography in this report

GRAPH I.2.B – FIRST PART



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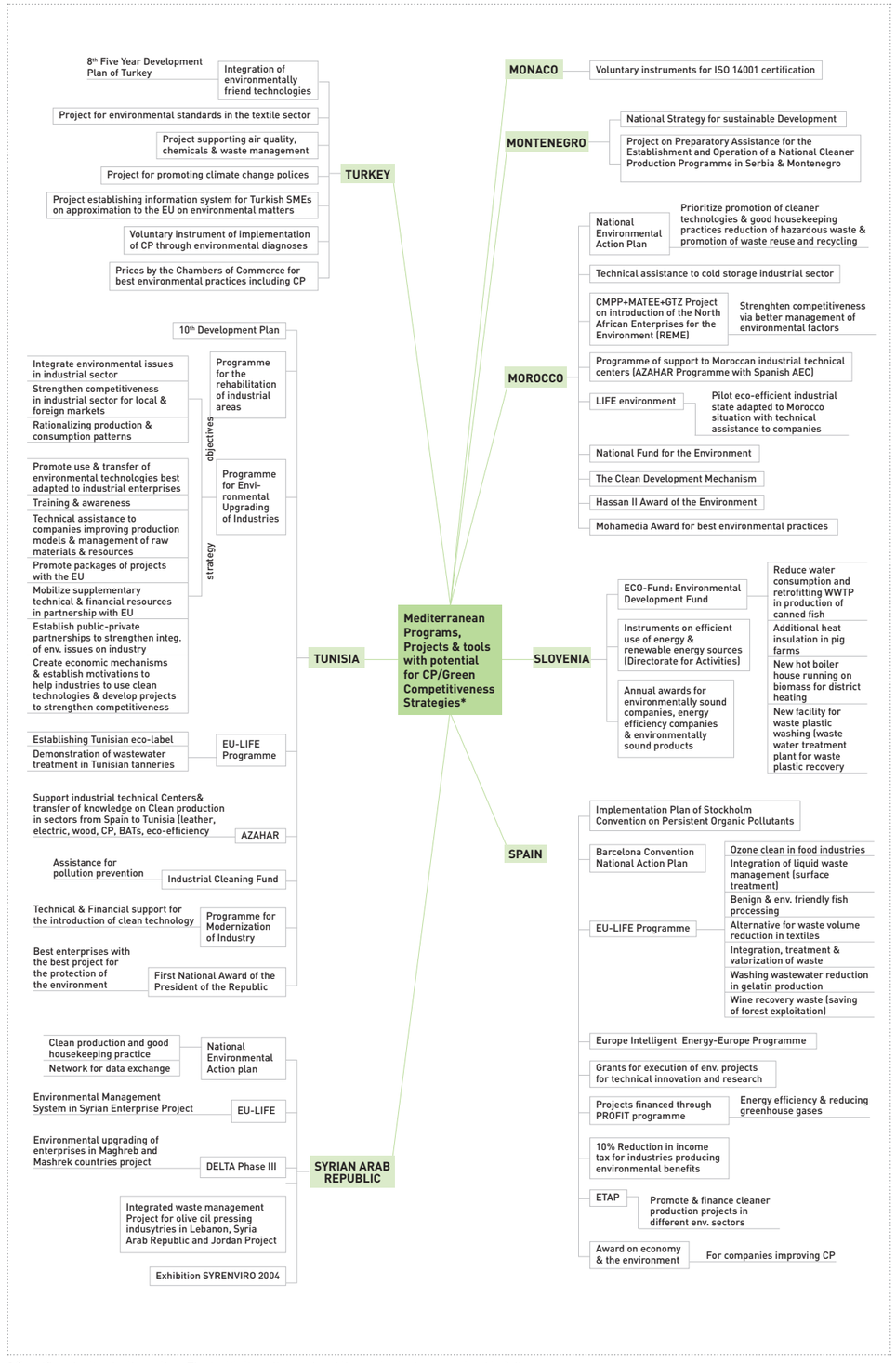
GRAPH I.2.B – SECOND PART



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ANNEX II
MOST RELEVANT CP TECHNIQUES IN TERMS OF PAYBACK AND OF ANNUAL SAVINGS LARGER THAN 100% OF INVESTMENT

TABLE I – BEST 50 TECHNIQUES ACCORDING TO PAYBACK (LESS THAN 1 MONTH)

Tech. Code	Technology Purpose	Environmental Impact	Investment	Annual Savings	Payback Months
WASI	Water savings through installation/ change of pistols	WACO	246 euros	18260 euros	0,16
WASA	Water savings, other	ENER	9.000,0 euros	165.888,0 euros	0,65
MRRO	Organic material recovery & recycling systems	OLWY	0,0 euros	5.477,0 euros	0
	Organic material recovery & recycling systems	OLWY	750 euros	10500 euros	0,85
	Organic material recovery & recycling systems	OLWY	2.700,0 euros	138.975,0 euros	0,23
	Organic material recovery & recycling systems	WACO	0,0 euros	2.007,5 euros	0
MRRI	Inorganic material recovery & recycling systems	WPMR	0 euros	308 euros	0
	Inorganic material recovery & recycling systems	ILWR	0 euros	59231,38 euros	0
	Inorganic material recovery & recycling systems	RWMC+ENER	0 euros	20520 euros	0
MGHR	Gas & heat recovery & recycling systems	ENER	10 556 euros	193223 euros	0,65
MWRR	Material & water circuit recovery & recycling systems	WWAT	1000 euros	19000 euros	0,63
	Material & water circuit recovery & recycling systems	WWAT	500 euros	16000 euros	0,375
	Material & water circuit recovery & recycling systems	MPCO	250 euros	9000 euros	0,33
	Material & water circuit recovery & recycling systems	CHEC	250 euros	11000 euros	0,27
	Material & water circuit recovery & recycling systems	ENER	250 euros	13000 euros	0,23
	Material & water circuit recovery & recycling systems	WWAT	250 euros	29000 euros	0,10
ENSB	Energy savings through boiler efficiency	ENER	592 euros	10924 euros	0,65
	Energy savings through boiler efficiency	ENER	0 euros	15337 euros	0
ENSO	Energy savings, other	ENER	6 euros	186 euros	0,38
WARE	Water recovery systems & wastewater segregation	WACO+WWAT	0 euros	2000 euros	0
	Water recovery systems & wastewater segregation	WWAT	0 euros	5400 euros	0
GHOM	Good housekeeping & organizational measures	WACO	8,16	375,38 euros	0,26
	Good housekeeping & organizational measures	OLWR	0 euros	59949,1 euros	0
	Good housekeeping & organizational measures	OLWR	0 euros	612 euros	0
GHOM	Good housekeeping & organizational measures	ENER	0 euros	114 euros	0
	Good housekeeping & organizational measures	ENER	0 euros	406 euros	0
	Good housekeeping & organizational measures	WWAT	0 euros	6689,5 euros	0
	Good housekeeping & organizational measures	WACO+CHEC	0 euros	24518 euros	0
	Good housekeeping & organizational measures	WACO	0 euros	58340 euros	0
	Good housekeeping & organizational measures	ILWR+WWAT	0 euros	165384,7 euros	0
	Good housekeeping & organizational measures	CHEC+WAQU	0 euros	46125 euros	0
	Good housekeeping & organizational measures	WWAT	0 euros	125000 euros	0
	Good housekeeping & organizational measures	WACO	0 euros	3427,45 euros	0
	Good housekeeping & organizational measures	WACO	0 euros	612000 euros	0
UAPI	Use of alternative production inputs	OLWY	0 euros	75000 euros	0
	Use of alternative production inputs	WWOO	0 euros	9015,5 euros	0
	Use of alternative production inputs	CHEC	0 euros	10269 euros	0
	Use of alternative production inputs	WWAT+WTOX	0 euros	908,75 euros	0
UDDS	Use of alternative designs	WPAC	0 euros	23295,4 euros	0
	Use of alternative designs	RWMC	0 euros	30300 euros	0
UADM	Use of alternative processes	WACO+ILWR	3005,06 euros	36721,84 euros	0,98
	Use of alternative processes	AIRP+WPAI	600 euros	87000 euros	0,08
	Use of alternative processes	ENER+WACO	414,5 euros	73273,51 euros	0,06
	Use of alternative processes	ENER+ILWR	88 euros	2209 euros	0,47
	Use of alternative processes	OLWR	0 euros	35399 euros	0
	Use of alternative processes	WACO+ENER	0 euros	64445,7 euros	0
	Use of alternative processes	AIRP	0 euros	99775 euros	0
	Use of alternative processes	CHEC+WWAT+ ENER	0 euros	479546 euros	0
	Use of alternative processes	WACO+RWMC+ WAQU	58,45 euros	924,5 euros	0,75
	Use of alternative processes	WPAY+ILWY+ CHEC	177 euros	3418,1 euros	0,62
UAMA	Use of alternative machines	CHEC+RWMC	41312,39 euros	1105032,12 euros	0,44

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TABLE.II– 80 TECHNIQUES WITH HIGHEST ANNUAL SAVINGS (OVER 100% OF INVESTMENT)

	Technology purpose	MCI Sub-Sector	Country	Investment	Annual Savings
1	Use of alternative processes	Electricity generation	Croatia	414,5 euros	73273,51 euros
2	Use of alternative processes	Coating, electronics and painting	Israel	600 euros	87000 euros
3	Material & water circuit recovery & recycling systems	Denim-Indigo fabrics	Tunisia	250 euros	29000 euros
4	Good housekeeping & organizational measures	Wire & wire products	Bosnia Herzeg.	500 euros	54204 euros
5	Water savings through installation/change of pistols, e.m valves, nozzles	Poultry slaughterhouse & chicken processing	Bosnia Herzeg.	246 euros	18260 euros
6	Material & water circuit recovery & recycling systems	Denim-Indigo fabrics	Tunisia	250 euros	13000 euros
7	Organic material recovery & recycling systems	Oil and soap	Egypt	2700 euros	138975 euros
8	Good housekeeping & organizational measures	Hotel	Tunisia	8,16 euros	375,38 euros
9	Material & water circuit recovery & recycling systems	Denim-Indigo fabrics	Tunisia	250 euros	11000 euros
10	Material & water circuit recovery & recycling systems	Denim-Indigo fabrics	Tunisia	250 euros	9000 euros
11	Material & water circuit recovery & recycling systems	Denim-Indigo fabrics	Tunisia	500 euros	16000 euros
12	Energy savings, other	Bakery & cake products	Bosnia Herzeg.	6 euros	186 euros
13	Use of alternative machines	Repair & cleaning merchant vessels	Spain	41312,39 euros	1105032,12 euros
14	Use of alternative processes	Drinks production	Bosnia Herzeg.	88 euros	2209 euros
15	Use of alternative processes	Surface treatment (painting)	Spain	177 euros	3418,1 euros
16	Material & water circuit recovery & recycling systems	Denim-Indigo fabrics	Tunisia	1000 euros	19000 euros
17	Energy savings through boiler efficiency	Milk & derivatives	Egypt	592 euros	10924 euros
18	Water savings, other	Oil and soap	Egypt	9000 euros	165888 euros
19	Gas & heat recovery & recycling systems	Dyeing	Turkey	10556 euros	193223 euros
20	Use of alternative processes	Meat treatment at slaughter factory	Bosnia Herzeg.	58,45 euros	924,5 euros
21	Organic material recovery & recycling systems	Oil and soap	Egypt	750 euros	10500 euros
22	Use of alternative processes	Adhesive and pasted products	Spain	3005,06 euros	36721,84 euros
23	Organic material recovery & recycling systems	Oil and soap	Egypt	3000 euros	36000 euros
24	Good housekeeping & organizational measures	Denim-Indigo fabrics	Tunisia	500 euros	6000 euros
25	Inorganic material recovery & recycling systems	Surface treatment	Turkey	2000 euros	23000 euros
26	Energy savings, other	Milk & derivatives	Croatia	31051 euros	328008 euros
27	Energy savings, other	Bakery & cake products	Bosnia Herzeg.	153 euros	1595 euros
28	Inorganic material recovery & recycling systems	Surface treatment	Turkey	2000 euros	20000 euros
29	Good housekeeping & organizational measures	Milk & derivatives	Egypt	3997 euros	36245 euros
30	Use of alternative production inputs	Milk & derivatives	Spain	23200 euros	204885 euros
31	Use of alternative production inputs	Sulphide black-dyeing process	Egypt	818,7 euros	6276,9 euros
32	Use of alternative production inputs	Milk & derivatives	Croatia	15000 euros	115000 euros
33	Water savings through installation/change of pistols, e.m valves, nozzles	Poultry slaughterhouse & chicken processing	Bosnia Herzeg.	562 euros	4072 euros
34	Good housekeeping & organizational measures	Denim-Indigo fabrics	Tunisia	1000 euros	7000 euros
35	Use of alternative processes	Car battery for automobiles	Tunisia	100000 euros	683000 euros
36	Use of alternative processes	Chromium plating	Spain	3606 euros	20441 euros
37	Use of alternative processes	Cotton and blended yarn fabrics	Egypt	12909,6 euros	65064,4 euros
38	Organic material recovery & recycling systems	Canned fish	Morocco	40,84 euros	191,43 euros
39	Good housekeeping & organizational measures	Chromium tannery	Lebanon	10800 euros	44280 euros
40	Good housekeeping & organizational measures	Meat processing	Croatia	44605 euros	180544 euros
41	Good housekeeping & organizational measures	Chromium tannery	Lebanon	2000 euros	7120 euros
42	Inorganic material recovery & recycling systems	Drinks production	Bosnia Herzeg.	154 euros	512 euros
43	Inorganic material recovery & recycling systems	Chromium tannery	Lebanon	8800 euros	28000 euros
44	Gas & heat recovery & recycling systems	Cotton and blended yarn fabrics	Egypt	13203 euros	39638,3 euros
45	Good housekeeping & organizational measures	Surface treatment	Spain	6667 euros	20500 euros
46	Energy savings, other	Bakery & cake products	Bosnia Herzeg.	453 euros	1360 euros
47	Organic material recovery & recycling systems	Oil and soap	Egypt	1500 euros	4320 euros
48	Energy savings through boiler efficiency	Canned fish	Morocco	1531,46 euros	4390,2 euros
49	Water recovery systems & wastewater segregation	Preserved food	Egypt	2587 euros	7344 euros
50	Use of alternative machines	Cotton and blended yarn fabrics	Egypt	14083,2 euros	39646 euros

	Technology purpose	MCI Sub-Sector	Country	Investment	Annual Savings
51	Use of alternative machines	Cotton and blended yarn fabrics	Egypt	19511,1 euros	54601,8 euros
52	Good housekeeping & organizational measures	Coating, electronics and painting	Israel	12500 euros	33000 euros
53	Good housekeeping & organizational measures	Hotel	Tunisia	122,4 euros	310,1 euros
54	Energy savings, other	Preserved food	Egypt	27151 euros	63604 euros
55	Use of alternative production inputs	Coating, electronics and painting	Israel	360000 euros	754000 euros
56	Good housekeeping & organizational measures	Oil and soap	Egypt	4500 euros	9000 euros
57	Good housekeeping & organizational measures	Bakery & cake prod-ucts	Bosnia Herzeg.	77 euros	143 euros
58	Water savings through installation/change of pistols, e.m valves, nozzles	Preserved food	Egypt	1499 euros	2754 euros
59	Energy savings, other	Preserved food	Egypt	8707 euros	15959 euros
60	Water savings through installation/change of pistols, e.m valves, nozzles	Canned fish	Morocco	122,5 euros	218,43 euros
61	Good housekeeping & organizational measures	Hotel	Tunisia	473,31 euros	836,46 euros
62	Organic material recovery & recycling systems	Milk & derivatives	Egypt	21951 euros	37266 euros
63	Water savings through installation/change of pistols, e.m valves, nozzles	Poultry slaughterhouse & chicken processing	Bosnia Herzeg.	299 euros	496 euros
64	Use of alternative machines	Fabrication of gear box & back wheel axes of ind. vehicles	Spain	82078,9 euros	135071,6 euros
65	Gas & heat recovery & recycling systems	Pharmaceutical products	Spain	900000 euros	1449780 euros
66	Use of alternative machines	Various textile	Turkey	328820 euros	513000 euros
67	Use of alternative machines	Interior modules motor vehicles	Spain	12068,66 euros	16637 euros
68	Use of alternative machines	Plastic parts for automobiles	Spain	51700 euros	70752 euros
69	Gas & heat recovery & recycling systems	Cosmetics	Spain	66111,33 euros	81453,37 euros
70	Material & water circuit recovery & recycling systems	Milk & derivatives	Egypt	7861 euros	11741 euros
71	Good housekeeping & organizational measures	Hotel	Tunisia	106,08 euros	136,28 euros
72	Energy savings, other	Canned fish	Morocco	1740,76 euros	2215,31 euros
73	Use of alternative processes	Liquid fertilizers	Israel	204000 euros	250000 euros
74	Water savings, other	Poultry slaughterhouse & chicken processing	Bosnia Herzeg.	17895 euros	20875 euros
75	Water recovery systems & wastewater segregation	Electronics & equipment for autos	Spain	56000 euros	64500,63 euros
76	Gas & heat recovery & recycling systems	Illumination appliances	Spain	132200 euros	140000 euros
77	Energy savings, other	Canned fish	Morocco	1272,59 euros	1388,53 euros
78	Use of alternative machines	Semiconductor manufacturing	Italy	46000 euros	50000 euros
79	Energy savings through boiler efficiency	Tubes for bearings industry	France	75000 euros	79500 euros
80	Water recovery systems & wastewater segregation	Preserved food	Egypt	25953 euros	26438 euros
81	Use of alternative machines	Car battery for automobiles	Tunisia	1000 euros	1000 euros

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ANNEX III
CORRESPONDENCE BETWEEN CLASSICAL CP/RAC NOMENCLATURE AND THE NOMENCLATURE USED IN THE PRESENT REPORT

The numbers that follow each one of the items below refers to the categories indicated in annex 4 (see list of variables for Structural Analysis). As the categories in annex 4 do not exactly correspond to classical CP/RAC ones, the correspondence indicated below refers to the most usual correspondence, upon the recorded experiences.

Types of action
Product redesign: 13
Good housekeeping practices: 2, 11
Material substitution: 12
Changes in technologies: 1, 3, 8, 9, 14, 15
Recycling at source: 4, 5, 6, 7, 10

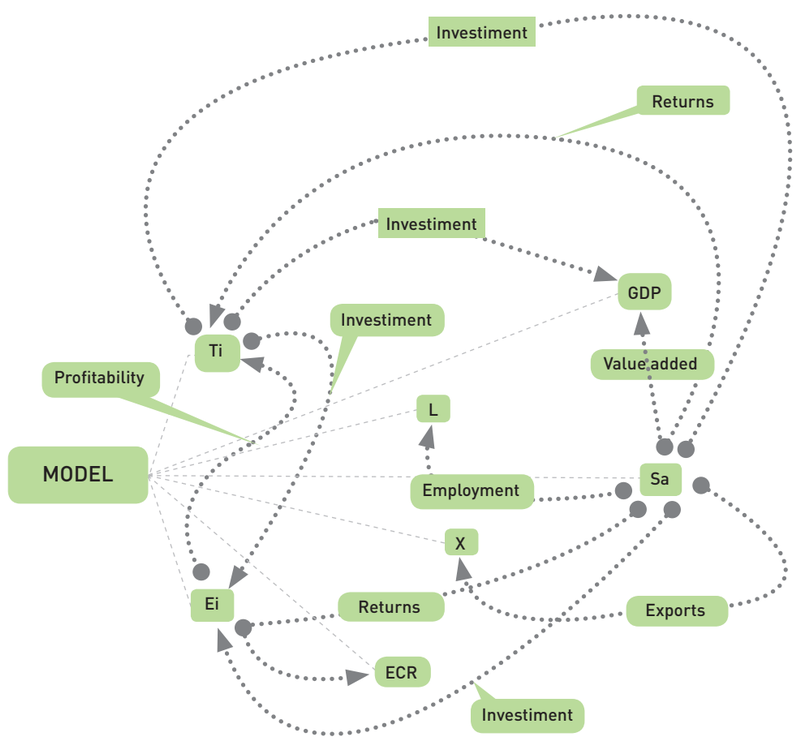
Sectors
Electric/electronic: 23
Surface treatment: 22 (partially)
Metal including machinery: 22 (partially)
Plastic and rubber: 21
Textile: 17, 18 (partially)
Chemical: 20
Food and beverages: 16
Tanning: 18 (partially)
Printing: 19
Waste management: 25 (partially)
Mineral products: 22 (partially)
Other industrial sectors: 24
Other services: 25 (partially)

Environmental benefits
Reduction in water consumption: 27
Reduction in raw materials consumption: 28, 29, 30, 31
Reduction in energy consumption: 32
Wastewater minimization: 33, 34
Waste reduction: 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50
Minimisation of air emissions: 26

ANNEX IV
METHODOLOGY AND RESULTS FROM THE CP STRUCTURAL ANALYSIS MODEL

Methodology
Methods of structural analysis of complex systems, and in particular Interpretive Structural Modeling (ISM) developed by John Warfield (1976), DEMATEL (Fontela, Gabus, 1976) and MICMAC (Godet, 1977), can be applied in contexts with very diverse elements (e.g. problems, variables, objectives, goals, activities), and types of relations (e.g. influence, impact, comparative, temporal). The matrices establishing relations between elements provide the knowledge base for the structural analysis using graphs and matrix decomposition techniques.

In structural analysis the common idea is that complex systems could be decomposed into elements and relations leading to a matrix portraying these relations. Elements here are the different types of techniques (Ti), the sectors in which companies introduce their technologies and get significant environmental and profitable/competitiveness gains (Si), and the types of environmental benefits generated by the future prospects of investments in these CP techniques and annual savings got from them (Ei). Relations among these variables are of the type "a development in a component A should stimulate another development in a component B". Once the matrix is established, Boolean algebra, graph theory of matrix computation can help identifying basic structural characteristics. The Graph below shows how these variables interrelate and configure the prospective model.



In the present report, the dynamic complex system considered is the existing scientific and technological convergence between three main dimensions of Cleaner Production technical actions.

Once three dimensions interactions where introduced in the model, the model was run and the influence/dependence map was drawn as shown in the first Graph appearing in Annex 1. Variables were identified as influencing, link variables or dependent variables of the model. Running the model allowed to identify indirect effects. Translations in the Graph between direct and indirect exercises indicate future possible developments of the three types of variables. Finally, Graph III.1 below presents full results of the model and supports the discussion and results obtained presented in the following sections of the present chapter.

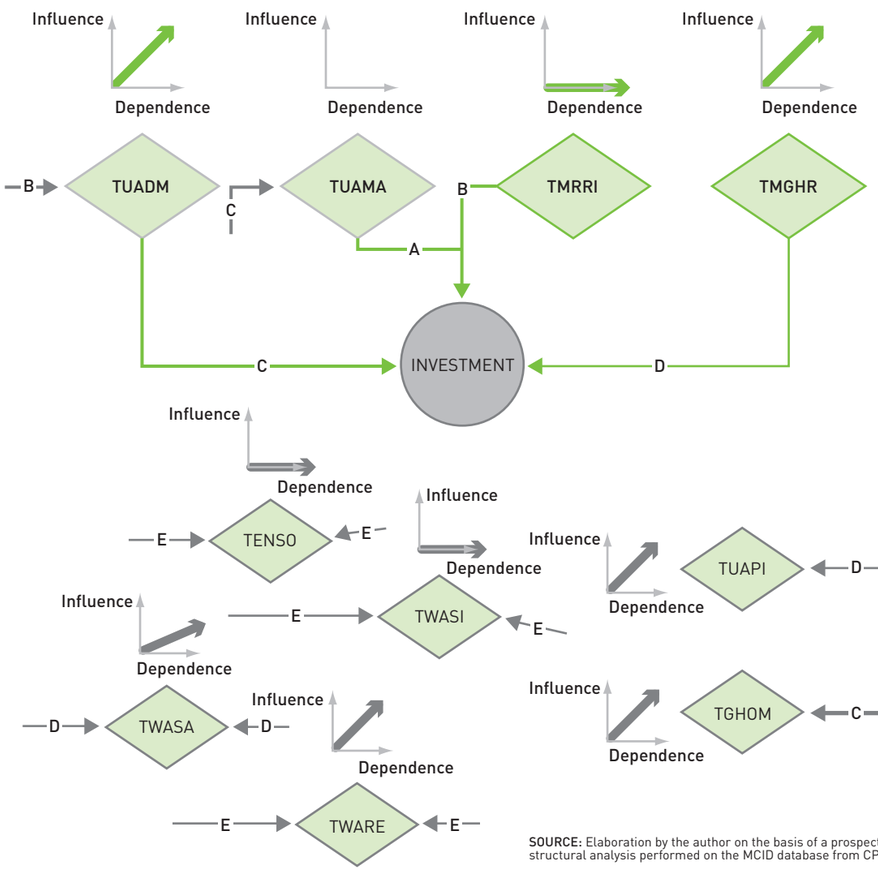
KEY INTERACTIONS AMONG CP MAIN DRIVING VARIABLES OF THE GCM MODEL

List of variables for Structural Analysis

1. Water savings through osmosis (TWASO)
2. Water savings through inst, & chge. pistols, valves, nozzles (TWASI)
3. Water savings, other (TWASA)
4. Organic material recovery & recycling systems (TMRRO)
5. Inorganic material recovery & recycling systems (TMRRI)
6. Gas & heat recovery & recycling systems (TMGHR)
7. Material & water circuit recovery & recycling systems (TMWRR)
8. Energy savings through boiler efficiency (TENSB)
9. Energy savings, other (TENSO)
10. Water recovery systems & wastewater segregation (TWARE)
11. Good housekeeping & organizational measures (TGHOM)
12. Use of alternative production inputs (TUAPI)
13. Use of alternative designs (TUDDS)
14. Use of alternative processes (TUADM)
15. Use of alternative machines (TUAMA)
16. Food and beverages (SFOOD)
17. Textiles (STEXT)
18. Wearing app., dressing/dyeing , tanning, (SWEAR)
19. Paper, paper products, publishing & printing (SPAPR)
20. Chemicals and chemical products (SCHEM)
21. Rubber, plastic prod., furniture, other non met.min.prod. (SPLAS)
22. Basic metals & metal prod. excl.machinery & equip. (SMETA)
23. Electrical appliances. (SMACH)
24. Motor vehicles & other transport equipment (STRAN)
25. Hotels & Restaurants, recycling, sewage & refuse disposal, health, sanit. (SSERV)
26. Air pollution reduction (EAIRP)
27. Water consumption (EWACO)
28. Chemical consumption (ECHEC)
29. Machinery pieces consumption (EMPCO)
30. Oil consumption (EOILC)
31. Raw material consumption (ERWMC)
32. Energy efficiency (EENER)
33. Wastewater reduction &/or recycling (EWWAT)
34. Waste aqueous reduction (EWAQU)
35. Waste glass reduction (EWGLA)
36. Waste wood reduction (EWWOO)
37. Waste paper & cardboard reduction (EWPAC)
38. Waste packaging material reduction (EWPMR)
39. Organic loads & waste reduction (EOLWR)
40. Inorganic loads & waste reduction (EILWR)

41. Waste chemical reduction (EWCHE)
42. Waste oil reduction (EWOIL)
43. Waste paint reduction (EWPAI)
44. Waste toxic & hazardous reduction (EWTOX)
45. Inorganic loads & waste recycling (EILWY)
46. Organic loads & waste recycling (EOLWY)
47. Non-ferrous metals recycling (ENFMY)
48. Waste packaging material recycling (EWPMY)
49. Glass recycling (EGLRY)
50. Heavy metal recycling (EHMRY)
51. Environmental costs reduction (MECOR)
52. GDP (MGDPR)
53. Exports (MEXPO)
54. Employment (MLABR)

GRAPH III.2 – STRUCTURAL ANALYSIS. TECHNOLOGICAL PROSPECTIVES TRENDS



SOURCE: Elaboration by the author on the basis of a prospective structural analysis performed on the MCID database from CP/RAC

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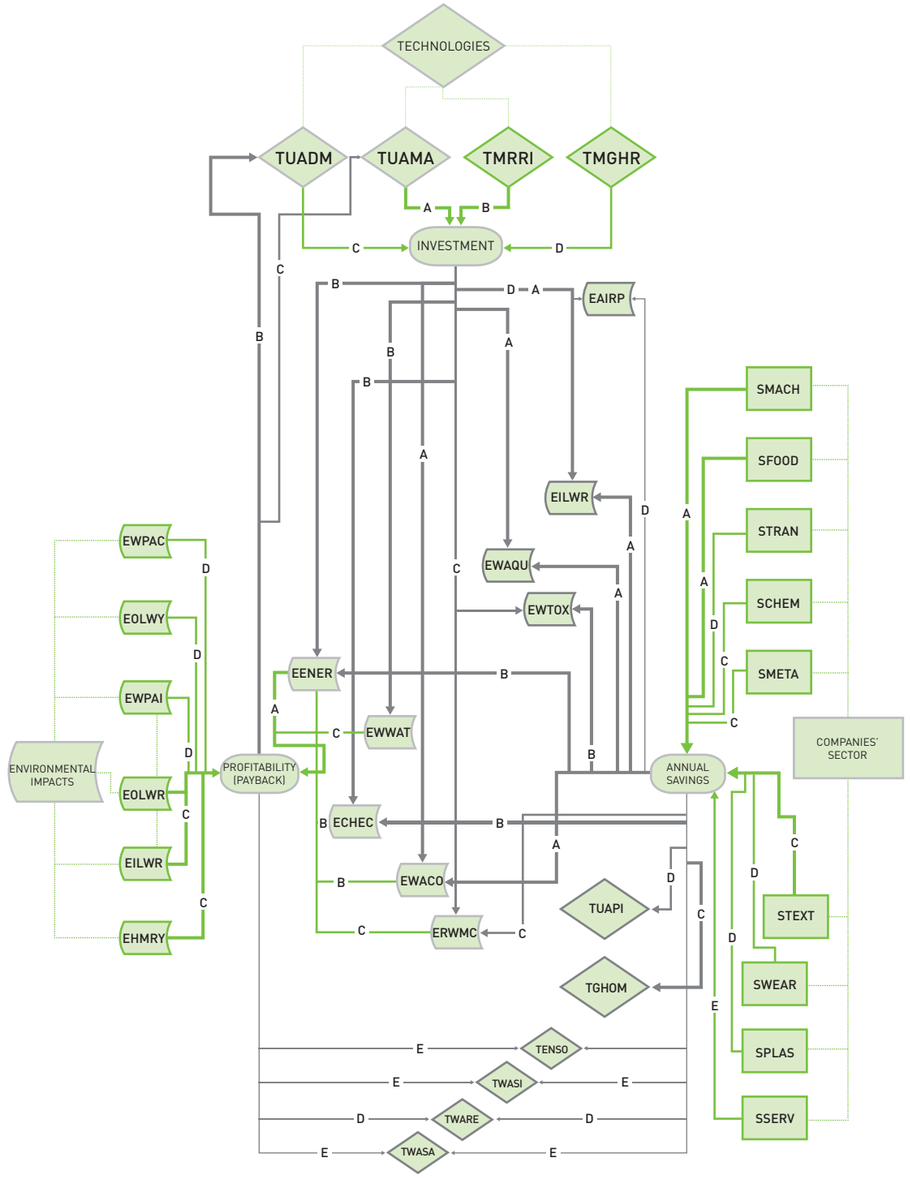
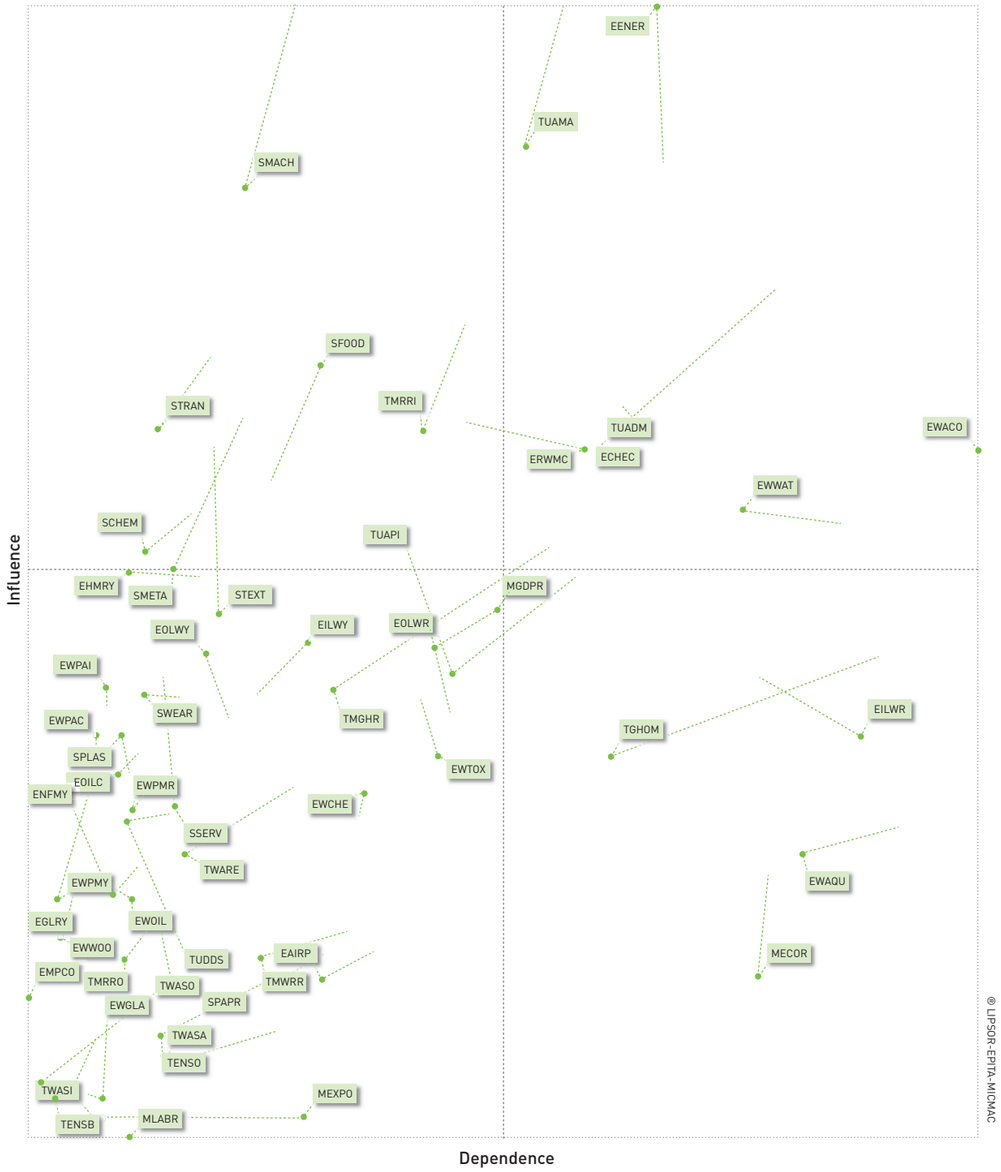
GRAPH III.1 – STRUCTURAL ANALYSIS. TECHNOLOGICAL , ENVIRONMENTAL & SECTORIAL .DIRECT AND INDIRECT EFFECTS



SOURCE: Elaboration by the author on the basis of a prospective structural analysis performed on the MCID database from CP/RAC

GRAPH – GREEN COMPETITIVINESS MODEL. STRUCTURAL ANALYSIS. DIRECT AND INDIRECT EFFECTS BETWEEN MAIN CLEAN PRODUCTION VARIABLES



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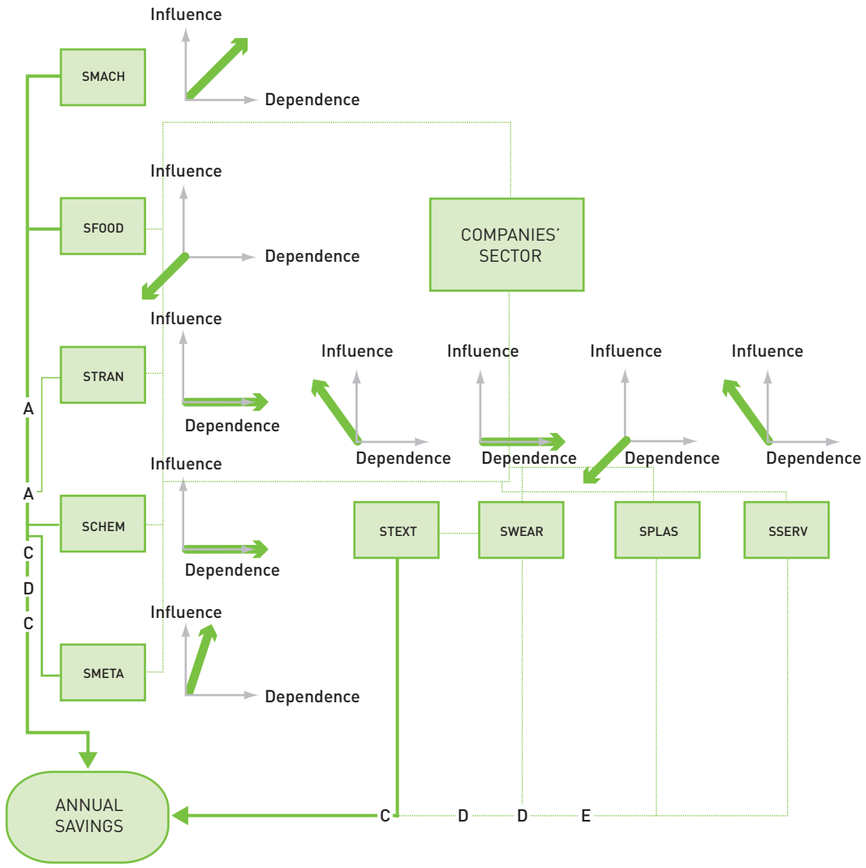
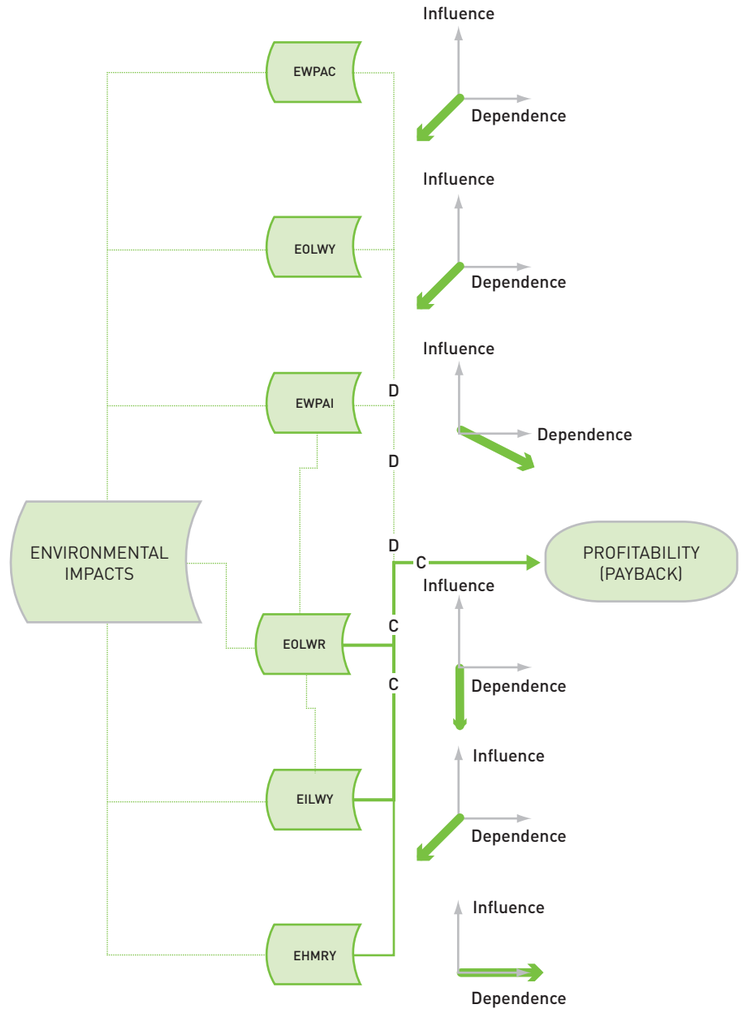
GRAPH A.1 – STRUCTURAL ANALYSIS. COMPANIE'S SECTORS PROSPECTIVE TRENDS



SOURCE: Elaboration by the author on the basis of a prospective structural analysis performed on the MCID database from CP/RAC

GRAPH A.2 – STRUCTURAL ANALYSIS. PROFITABILITY IMPACT PROSPECTIVE TRENDS



SOURCE: Elaboration by the author on the basis of a prospective structural analysis performed on the MCID database from CP/RAC

GRECO INITIATIVE
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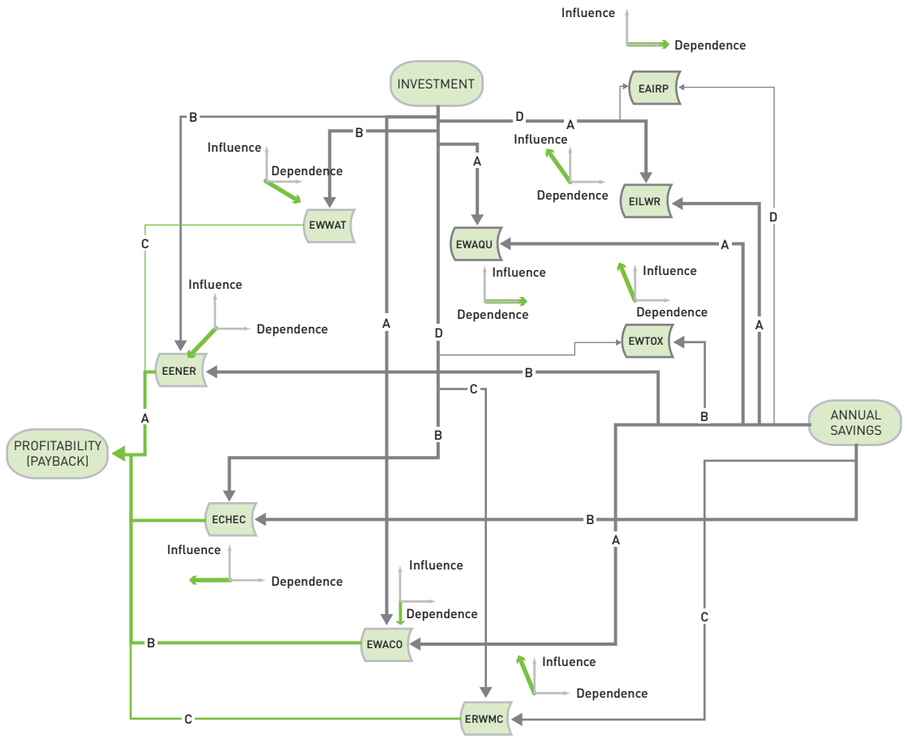
GRAPH A.3 – STRUCTURAL ANALYSIS. ENVIRONMENTAL IMPACT PROSPECTIVE TRENDS



SOURCE: Elaboration by the author on the basis of a prospective structural analysis performed on the MCID database from CP/RAC