

## **CLEANER PRODUCTION AND COMPETITIVE ADVANTAGE FOR THE ENTERPRISE IN THE AGE OF ENVIRONMENTAL SUSTAINABILITY**

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### **Introduction**

United Nations Environment Program (UNEP) started talking about Cleaner Production (CP) from the end of the eighties. The definition of Cleaner Production there used is: "the continuous application of an environmental, integrated and preventive strategy to processes, products and services in order to increase global efficiency and reduce risks for human beings and environment".

This may be applied to industrial processes, products and services offered to collectivity, referring to a kind of mentality where goods and services are obtained with the minimum environmental impact and considering the present technological and economic limits.

The need to face environmental problems connected to the need to guarantee a correct social and economic development has been translated to political commitment at international level. Main sustainable development meetings, among these the "Earth Summit" of Rio de Janeiro of June 1992, allowed discussing environmental problems of our planet and their connections with the problems of economic and social development.

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In order to afford the challenge of sustainable development, protect environment and, at the same time, improve productivity and competitiveness, it is necessary using a series of innovative tools of political, financial, legal and, above all, technological nature.

Therefore, in order to connect sustainable development and economic growth, are of main importance the development and the diffusion of technologies made to reduce environmental pollution and the consumption of natural resources, improving, at the same time, the growth of the whole economic system.

The sector of environmental technologies represents one of the most dynamic and innovative sectors, offering the opportunity for a new wave of technological progress and renewal of investments, as asked by European Union.

European Union, the same, in a recent report, has showed the need to invest in development and in the introduction on the market of new environmental technologies, assuming that these may contribute to sustainable growth.

### **Diffusion and market of cleaner production**

Cleaner production sector has been pointed out as one among those with the highest development potential for next future; in European area Sweden has a position of supremacy thanks to its long tradition in environmental technologies, mainly in the areas of recycling, treatment of waters, industrial pollution control, waste treatment and air cleaning.

A constantly growing share of venture capital has been allocated to cleaner production. During 2005 the amount allocated to cleaner production increased of 35%, while in 2006 almost 3,8 billions of dollars have been invested, 2,9 of which in USA with an increase of 78% if compared to 2005. In California State more than 1 billion of dollars have been invested, corresponding to 37% of the invested amount in USA. During the last two years more than 500 operations of merge and acquisition occurred, while in the sector of clean energy during 2006 almost 30 new societies were quoted to stock exchange, corresponding to a value of 4,4 billions of dollars.

Clean technologies are at the fifth place among preferred categories of venture capital, following software, biotech, ICT, hardware and preceding semiconductors.

Considering 6,3 billions of dollars invested in USA for new enterprises, 10% goes for new materials, 8% goes for air treatment and 6% goes for recycling and natural resources. In Europe investments in venture capital have been 2,4 billions of dollars, 62% of which concentrated on energy generation.

It is, anyway, important pointing out that, even if basilar, in order to evaluate the whole contribution to economic European growth, it is preferable starting from a deepened analysis of the present situation showing out connected problems. At the present moment, unfortunately, there are no official data of the trend of the sector because of the dimension and of the non perfectly clear definition of the sector itself. The only available data are the ones connected to ecological industry (also known as green or environmental industry), intending this as the whole of industrial activities connected to providing products and services in some ways tied to the reduction of pollution.

### **Definition of green industry and resulting data framework**

According to a first definition of Green Industry formulated by European Commission in 1994, green industries are all those industrial activities which product goods and services in order to estimate, prevent, limit or repair environmental damages such as water, air, and soil pollution, as well as refuse problems or acoustic pollution. Among clean technologies there are those ones which minimize pollution and use of raw materials.

A further, more detailed definition, better in order to take a census of the sector, has been formulated in 1997 by an informal working party, purposely established in 1995 by OCSE-Eurostat. According to this party, Green Industry is characterized by all those industrial activities that produce goods and services to estimate, prevent, limit or repair air, water and soil environmental damage, as well as refuse, noise and ecosystem problems. There are also technologies, services and products able to reduce environmental risk and minimize pollution and the use of raw materials.

The methodology suggested by OCSE-Eurostat to classify activities belonging to green industry sector, consists in a matrix that relates various typologies of productive assets with corresponding typologies of products (material goods or services). For example in a column there are production of plants, installation and construction of components and

structures, services of design, education and so on; on a line, instead, there are control of air pollution and of solid and liquid refuses, the soil and water protection, the monitoring, clean technologies and so on.

This matrix allows to classify, in a definitive way, green industries goods and services, associating different activity typologies to various segments of environmental services and goods, setting in this way productive assets in relation to the several environmental categories.

The scheme proposed allows dividing different activities into three main groups, divided into goods, services and constructions:

- pollution control group;
- clean technologies and products group;
- environmental sources control group.

The first group includes those activities easily identifiable for their clear environmental aims, while the second group contains various activities with low environmental impact that do not consider as final aim the environmental protection and are, therefore, not easily statistically identifiable. In this way we can divide core activities and non-core activities, where the first ones include all those enterprises which have a clear environmental activity or supply products or definite services and operate in evident contexts; in second case it lacks at least one of these requisites.

Eurostat classification is based on three levels of specifications:

- the first level is related to the division into the three groups above mentioned;
- the second one consider the typologies of green industry activity: production of plants, services, constructions, installations and so on;
- the third one is about the main environmental segments: air pollution, refuses and so on.

Even if OCSE-Eurostat classification does not allow solving the problem about the census of the innumerable activities referable to green industry, it gives conceptual and methodological bases to widen observation field.

According to the European Community most reliable estimates, in 2000 worked in the Community area about 7000 enterprises supplying environmental goods and services, with a total of 3,5 millions of workers engaged in the green industry sector, giving this term the most common definition that also includes the supply of clean technologies, energy from renewable sources, preservation of the landscape, ecological requalification in the urban areas.

The core activity sector alone supplies about the half of global market with environmental technologies and services, with a 300 million Euros global market in 2000, and a 740 million Euros one before 2010; nowadays the most important export market in UE is the North American market.

The UE has also created a database about Community green industries, in order to bring into contact operators with consumers and, at the same time, giving an efficient tool to be informed about the sector trend. In Italy nowadays there are 11 associations which group several companies working into various environmental sectors, while in Germany there are 23 associations and in the United Kingdom 30.

Another attempt in order to classify green industries in our Country has been done using Seat categories belonging to the ecology sector, or rather, counting the various economical operators with a telephone service. In this way we can obtain useful, even if not complete, information about enterprises working in the decontamination and environmental protection sector which can be set into OCSE classification.

Using this methodology, we can point out 8 classes of green industry activities:

- urban refuse and waste products (waste disposal and treatment);
- street cleaning (service);
- ecology (analysis, advice and services);
- water softening (plants and devices);
- depuration of urban refuse and waste products (plants and devices);
- water treatment (services);
- depuration of air polluting substances (plants and services);
- solar and alternative energy.

Analysing the schedule, it is evident how in Italy refuse disposal and treatment is the first target, as regards to the other ones connected to the relation between production and environment.

In order to be consistent with the present international political trends aimed at a sustainable development, it is necessary to develop all those industries and environmental technologies aimed to material recycling, the use of alternative energy sources, the increase of raw materials and energy efficiency and cleaner industrial processes.

### **Application of Cleaner Production in industries**

Cleaner Production evaluation methodology is used to identify and evaluate the opportunities and to facilitate their application into industries.

It is based on five essential phases:

- design and organization;
- pre-evaluation;
- evaluation procedure;
- feasibility analysis;
- realization and continuous application.

Design process is a complete system methodology to identify Cleaner Production options in order to reduce or avoid the waste generation and can guarantee real profits in selection and execution of the better CP options.

In this way the systematic design verifies that the CP aims and activities are constant with those identified in wider process of organization planning. All that in analysis facilitation of investment planning and decision to make.

So design and organization are the initial phases. The experience of a growing number of enterprises indicates the essential elements for the beginning of a Cleaner Production programme. An organizing methodology is necessary to identify, consider and apply the various CP options. Evaluations carried out with precision avoid or reduce the risks of a programme failure. From an organizing point of view, the staff of the programme begins, coordinates and oversees the evaluation activities following the plant-wide aims which regulate the activity.

To be operative, the staff must have a good knowledge about the process to analyse, enough creativity to develop and consider the changes, both to identify barriers and find out solutions, and enough authority to carry out the changes proposed into production.

During the evaluation phase the document is examined, and appropriate measures are proposed to reduce or prevent the material loss. During this phase the staff uses all the possible means to determine CP options. Ideas can come from a research, personal knowledge, discussions with suppliers, from experiences in other companies and from specialized data or further research and development (brainstorming).

During the evaluation phase, a number of immediate improvements can be already identified.

It is often useful dividing in conceptual way the process into three elements:

- in order to identify the source, an inventory of the material flows coming in and turning out, with their connected costs, is drawn up; then a flowchart is created, allowing to identify all the sources of emission and waste generation;
- the following phase is the cause analysis, or rather a survey about the factors that influence the amount and waste emission composition;
- finally solutions are created, in order to eliminate or control every cause of emission and waste production. After the options have been identified, they are evaluated.

The feasibility studies must demonstrate if every option is technically and economically possible and if it helps the environmental improvement. In the last phase, that one about the execution and the non-stop application, the feasible preventive measures have been carried out and there are the conditions to apply the Cleaner Production. The continuous development of a CP programme requires the control and the evaluation of results achieved through the execution of the preventive measures.

The result expected from this phase is triple:

- the application of CP preventive measures;
- the control and evaluation of progresses carried out by the execution of feasible options;
- beginning of the CP no-stop activities.

### **Political Strategy in favour of Cleaner Production**

A political structure which can favour the Cleaner Production application is not simply limited to issue some instructions like tax relief. It requires a interlacement of preventing strategies in all the parts of the government structure, to make it as a support and favourable to CP concepts.

It needs a change in formulation and realization of policies. Essentially it requires a paradigm transfer from the sensitive methodology to a preventive one. Pollution and administration in the preventive methodology are interiorized and integrated to the process of political strategy development. There are many political tools which the governments can use to encourage the CP adoption: development policies, commercial policies, industrial policies, pricing policies, fiscal policies, education policies,

technological development policies.

Many parameters can be used to classify the environmental policy tools. One of the distinctions commonly used divides the tools into three categories:

- regulation tools, authorizing or not determinate behaviours;
- market-based tools, acting as incentives for particular activities;
- information-based tools, trying to change the behaviours through the diffusion of information.

We can further subdivide these policy tools on the basis of the interaction between government and industry and the obligation level of the policy tool. The distinctions that can be made are the following:

- specific conformity: the government establishes obligatory standards to regulate the parts;
- negotiated conformity: the government and the parts interact in obligatory standards;
- co-regulation: there is a high level of interactions among the parts, but the standards acceptance is not compulsory;
- self-regulation: industry operates unilaterally in the standards regulation that are not legally applicable; these typologies do not mutually exclude one another. In some cases, a political tool can be characterized by one or more of those categories.

Examples of political tools for Cleaner Production application are:

- CP strategies and programmes: national and local authorities can lay down strategies or formal programmes in order to constitute a base for the CP application;
- to prohibit products or materials: a ban imposition for a product or a particular substance is an authoritative means for the CP promotion. This can also be carried out by the application of the "substitution principle";
- wide responsibility of the producer: it aims to produce improvements during the whole product cycle. Particularly, this one can include the take-back, recycling and product final elimination;
- request about the CP inspections: as part of their obligations, the companies could be obligated to undertake CP inspections on their plants;
- EMS and obligatory information: the companies could be obligated to apply an environmental management system;
- to encourage the companies which minimize the waste products: the promotion effective means of the CP practises supply the right incentives, by local authorities, for the enterprises which minimize the waste products;
- financial and technical reasons: the governments can stimulate the



CP measures supplying concessions, loans, favourable tax regulations, to insure technical assistance.

From the beginning of the environmental policy, main strategy for the fight against pollution has generally been the use of regulation means, a public service which regulates standards and controls, punishing the infringements by legal sanctions. These regulations can, for example, define an environmental aim, as the reduction of carbon dioxide emissions for a certain date, or they can be aimed at the spreading of a technology use or of a particular process. This methodology gives the greatest authority and the control about how the resources are allocated, to realize the environmental aims and gives the regulator a reasonable predictability degree about the reduce of pollution level. There are particular situations in which the regulating tools can be seen as the more suitable means to realize an environmental result.

### **The specific and negotiated conformity**

In the OECD (Organisation for Economic Co-operation and Development) industrialized Countries, the regulating programmes are the bases which the environmental quality has been developed on. These Countries have mainly relied, although not exclusively, on a specific conformity: particular requires that have been imposed by the regulated communities, with few exceptions. This style, which can be defined authoritative, has certainly improved the environmental conditions. Nevertheless it has got some meaningful disadvantages. The regulated community tends to deviate from the State and to combine to the relative opposition; this methodology has also encouraged the use of end-of-pipe technologies and average specific technologies.

The negotiated conformity methodology instead adopts a more cooperative system among the regulation parts and to enforce standards. This shares the responsibilities between the government and industry, increases the probability of an exchange of information and allows a greater flexibility about the means to correspond to the standard. A certain number of Countries has begun to develop the regulations where are fixed the achievement of certain aims, but the real means to carry out these aims are left to the industries (not normative regulations). This process can increase the cost effectiveness. But this more cooperative methodology is not suitable for all the cases and it must be supported by proper procedures.

With the growing appreciation of the limits of classical political tools, governments are proceeding towards self-regulatory and co-regulatory tools in order to promote CP.

Self-regulatory and co-regulatory tools are:

- negotiation of agreements between the regulating enterprises and the companies in the private sector or the sectoral organizations;
- compulsory information: like the Pollution Release and Transfer Registers in USA, Canada, Australia, United Kingdom, environmental obligatory report in Denmark and the "PROPER" initiative in Indonesia;
- Environmental management systems (EMAS) , as ISO 14001;
- Public voluntary programmes (as in the USA the EPA 33/50, Waste Wi\$e and Green Lights) where the sharer enterprises take the advantage through a public acknowledgment, access to technical government assistance and the cut in costs;
- Professional moral codes of industry, as the Chamber of Commerce Business Charter for Sustainable Development, the chemical Industry's Responsible Care Programme and the Japanese business sector's Keidanren Global Environmental Charter. In order that these codes are operative, the mechanisms must be on the spot to encourage the execution, to control and report publicly the assent, to have significant sanctions or simply to lobby.

The market-based tools try to pay attention to the problem of environmental externalities including the pollution company environmental cost in the firm exclusive cost (i.e. by tax), or generating the property rights and establishing a market (i.e. using commercial licenses of pollution).

The market-based tools are economically the more creative means. This because they justify the development of these preventing technologies that fight against pollution and allow choosing the prevention strategy or the technologies. But there are particular bonds to the introduction of these market-based tools. Before introducing them, the governments should identify and consider all the economic incentives that could already operate. They include i.e. the use of grants to make local enterprises more competitive. Many of these policies conduct to artificially low prices for the resources, as energy and water, proving an abuse of them, which causes both pollution and their scarcity.

Taxes, costs and duties can be used to promote CP practises, raising the emission costs or giving incentives to promote a more streamlined use of the natural sources.

An important bond for the market-based tools diffusion is the fact that, often, raising the tax system in order to realize the environmental aims is not politically possible. Environmental taxes are often perceived as a way to increase revenues and so governments have a lot of resistances to face.

Moreover, the execution of these tools needs a powerful system of control, collection of incomes and application.

Responsibility rules can be a powerful economic incentive. Many Countries have found out that enterprises which cause environmental damages, if they have environmental responsibilities, often minimize their risks and start to use preventive measures. Successful responsibility systems depend on application and legislative system of the Country.

For example, financial grants in form of low interest loans, direct concessions or tax preferential treatments can be assigned to enterprises in order to improve technological development.

Information-based strategies. Governments can stimulate the application of CP practices by informative measures. These ones can be used to give the right incentive, for example by public survey of environmental performances of industries or by publication and diffusion of pertinent surveys. The examples of based-information tools that can be introduced by Government include:

- to encourage the approval of high level demonstrative projects, to show techniques and saving opportunities of CP costs;
- colleges which include environmental preventive management in their business and engineering courses;
- to ask for public surveying of information about environmental performances, i.e. with a issuing and transfer register of polluting substances;
- supporting and/or starting measures to direct consumption, as schemes eco-identifying or environmental declaration of the product;
- promotion of training initiatives;
- prizes for enterprises which had effectively carried out C.P. .

### **Tools for enterprises**

Several itineraries have been followed at international and European level to realize a conversion of economic system in C.P. point of view.

Main tools are of normative and voluntary nature.

Among normative tools, IPPC (Integrated Pollution Prevention and Control) provision asks the enterprises which are into IPPC application BAT (Best Available Techniques) adoption, or rather cleaner and more eco-efficient technologies and manufacturing techniques, through which obtain the integrated pollution prevention and control target.

Peculiar elements of this provision are:

- Integrated approach to pollution prevention and limitation for a high level of the whole environmental protection (enterprises have to reduce their emissions in the air, water and soil and to reduce amount and dangerousness of refuse);
- Evaluation of environmental conditions in zones where operate industries and their allowable emissions in those zones;
- Adoption of best possible techniques in order to guarantee respect of limiting values fixed for respect of local environmental rules to minimize the cross-border diffusion of pollution;

The main tools of environmental management and cleaner production are divided into the following categories:

- environmental management tools of processes;
- ecological tools of products and services;
- territorial environmental management tools.

Among the environmental management tools of processes there are:

- Environmental Technology Assessment: it is an evaluation process to find out possible impacts on environment, on human health, on the ecosystem stability, connected to the use of a new or existing technology, through integration of strictly economic aspects (costs and benefits of a certain technology) with natural, environmental, social and political ones;
- Environmental management systems, according to the schemes proposed by CE 761/2001 regulation ( Eco Management and Audit Scheme - EMAS II) and by international rule UNI EN ISO 14001;
- Enterprise environmental accounting: drafting of Budgets and Environmental Relations and Budget of Sustainability;
- Environmental agreements.

Among the ecological tools of products and services there are:

- Ecological labels: these ones are about labelling of products and services that are different from the others for their environmental performance. Ecological European quality seal "Ecolabel" is an example of an ecological label which fixes, for every kind of product, specific parameters of performance and environmental impact; the other ecological label is the

Environmental Product Declaration (EPD);

- Life Cycle Analysis (LCA): it is an evaluation process of environmental impacts of a product, a process or an activity, through identification and quantification of energy and used materials and environmental refuse, in order to evaluate these emissions and realize the opportunity of an environmental improvement;
- Integrated product policy: an approach aimed to ecological design of products and services and aimed at information and incentive actions which support adoption and use of such products and services.

Among the tools of environmental territorial management there are:

- Local Agenda 21, a multisectorial participative process aimed at targets of local sustainable development;
- Environmental Certification of District, which induces to sustainable management courses of wide territories involving entire production districts and dies;
- Environmental Strategic Evaluation (VAS) and Environmental Impact Evaluation (VIA) ;
- Environmental Public Accounting.

About Environmental Public Accounting it is important to point out that CP challenges and ambitions correspond to the same informative and monitoring requirements in order to measure progresses made in this direction.

There is a growing exigency to record environmental variable through methodologies which guide development choices and decisions, but nowadays there are no consolidated and recognized international methodologies which could give a strong base from which we can show environmental capital and verify in a better way its time evolution.

In order to overcome inadequacy of present accounting systems several attempts have been made to define a public environmental accounting system; European Community and Countries have developed several models:

- System of Environmental and Economic Accounts (SEEA);
- European System of Environmental Pressure Indices (ESEPI);
- European System for the Collection of Economic Information on the Environment (SERIEE);
- Driving Forces-Pressures-State-Impacts-Responses (DPSIR);
- National Account Matrix including Environmental Accounts (NAMEA) by Dutch statistical Institute.

The definition of a consolidated model is still probably far, but it is important to underline that the adoption of political strategies and of CP and Sustainable Development choices, asks as precondition the possibility to elaborate a more integrated and reliable measure of environmental, economic and social performances of a Country or a zone.

### **Conclusions**

In spite of interesting economy and important reductions of environmental impacts, CP diffusion is still limited. So the main difficulties to cleaner technological development are, at present, the penetration on market and its development.

The greatest application possibilities of innovative solutions provided for next years are:

- Energy saving, conversion and utilization;
- Transports;
- Industrial sources utilization;
- Refuse management;
- Information and communication technologies.

The use of opportune technologies in these sectors can make a higher use of sources, through a process improvement of products substituting the raw materials or reducing their material content or increasing information content.

The determining role of such technologies is also confirmed in the Sixth Community Program in Environmental Subject, instituted in 2002 and valid until 2012, to guarantee a high level of global ecosystem preservation, both the environment and the human health, in order to improve quality life, dividing environmental pressures from economic growth. The Program represents the base of the Environmental Community Policy, setting also priorities.

Among the main difficulties to the CP diffusion there are, above all, the shortage of information about their potential that stops the development, adding the lack of sufficiently qualified personnel, non-acceptance of the people and the difficulty to find out the best distribution channels. There are also technological, economic and normative limits. It has been verified that, for example, the lack of relation between prizes and social and environmental costs does not make easier the use innovative technologies, especially for PMI which are discouraged by high initial costs and by

the lack of long lasting certainties. Investing in cleaner technologies, in fact, is often considered risky, so it is necessary to develop financial tools, as risk funds, thanks to involvement of financial institutes like BEI, the European Found of Investments and European Commission. Besides the financings, it is important to use aimed economic incentives, but, above all, to eliminate all those difficulties caused by price distortions, like, for example, grants that support most polluting technologies. Lawmaking activities represent another important means which can impose these technologies on market; in fact, the creation of new checking and experimentation protocols, and of universally recognized standards makes a long lasting guarantee, both for technology producers and for PMI.

Finally, consumers' involvement, through sensitization and information campaigns, in order to encourage the use of products and services of low environmental impact, would give a great stimulus to environmental technologies sector. As already demonstrated by environmental labels of products, the great power of consumers can be activated in order to indirectly incentive the environmental technology demand.

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**Consulted web sites**

Il Sole 24 Ore [www.ilsole24ore.com](http://www.ilsole24ore.com)

European Environment Agency [www.eea.eu.int](http://www.eea.eu.int)

Swedish Trade Council [www.swedentech.swedishtrade.se](http://www.swedentech.swedishtrade.se)

Ecosistemi S.r.l. [www.ecosistemi-srl.it](http://www.ecosistemi-srl.it)

Cleaner Production in China [www.chinacp.com](http://www.chinacp.com)

Environment Park Torino [www.envipark.com](http://www.envipark.com)

Greenpeace [www.greenpeace.org](http://www.greenpeace.org)