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GUIDE FOR THE IMPLEMENTATION OF A POLLUTION PREVENTION AND CONTROL SYSTEM (PPCS) BASED ON THE BEST AVAILABLE TECHNIQUES AND THE BEST ENVIRONMENTAL PRACTICES IN THE MAP COUNTRIES

(PREPARED BY CP/RAC)

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MAP

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1. EXECUTIVE SUMMARY

This document contains a Guide for the Implementation of a Pollution Prevention and Control System (PPCS) based on the best available techniques (BAT) and the best environmental practices (BEP) prepared by the Regional Activity Centre for Cleaner Production (RAC/CP) with the technical support of the consulting company Garriges Medio Ambiente within the framework of the Mediterranean Action Plan (MAP) and the Protocol for the Protection of the Mediterranean Sea against Pollution from Land-Based Sources and Activities (LBS Protocol).

The guide is addressed to the Environmental Authorities of the various MAP countries, particularly the non-EU countries, with the aim of providing a tool for the design of new prevention-based environmental control systems, which will not affect the necessary economic development of these countries. The methodology outlined in the guide takes into account the different circumstances and situations of the countries that it aims to assist, and may therefore be used either by each country individually or for groups of countries, by extrapolating the creation of work groups described in the guide to a supranational level.

National experts from Croatia, Egypt, Israel, Slovenia and Syria have completed a questionnaire which has helped to determine the approach of the guide and to carry out, at the end of the guide, a preliminary analysis of the starting situation in each of these countries with respect to the implementation of the PPCS, based on the analysis of a range of facilitating factors.

To this end, the guide first establishes the scope of the PPCS for which several stages in the work required were identified:

- ✓ Identification of the sectors (generally industrial) to be monitored, by carrying out a preliminary environmental, economic and social analysis of the various sectors in each country. Thus, those sectors with the greatest environmental impact and the most economic resources will be the ideal candidates to be targeted by the PPCS.

- ✓ Setting up of work groups for each sector and of the PPCS Steering Group, with the aim of tailoring the design of the PPCS to each targeted sector, which requires the presence of technical experts on the sector and on the industry itself.

- ✓ In-depth analysis by each work group of the environmental, legal and economic situation of each sector, in order to understand the particular environmental needs of each sector as well as their flexibility and resilience.

- ✓ Identification of environmental enhancement alternatives in the various production processes in each sector. The technical experts and the industry must identify potentially cleaner production/management techniques based on the knowledge and experience they have acquired.

- ✓ Selection of the alternative BAT and BEP by means of a comparative analysis of the environmental enhancement entailed by each alternative, in addition to their economic and technical feasibility. It is here that most consideration is given to the specific circumstances of each country, since this comparative analysis is carried out within the particular context of each case. Thus, what may be considered BAT or BEP in one country may temporarily not be economically viable in another.

- ✓ Having established the BAT and BEP in each sector and the expected level of environmental enhancement, it will then be necessary to transfer the results of the previous stages to the actual circumstances of each industry. To this end, guidelines for creating new legislation (or amending existing legislation) and other administrative and supplementary measures have been identified.

  Particular emphasis is placed on the importance of integrated authorization procedures for industrial activities (a single authorization for issues relating to several environmental areas: water, air, waste, soil, etc.) as an efficient and effective method for implementing the PPCS, as well as on the importance of environmental auditing (inspections, checks, monitoring, etc.) to obtain information which will serve to evaluate the progress of the PPCS and review it periodically, along with the authorizations granted.

  It is also recommended to adopt supplementary measures facilitating the implementation of the PPCS, such as informative measures (publishing the conclusions of the work groups, setting up an information office for companies, organizing conferences or fairs, etc.) technical support measures (independent technical advisory services, assistance with administrative procedures, assistance for SMEs), financial measures (financial assistance, soft loans) in addition to promoting the implementation of environmental management systems, responsible public procurement, responsibility on the part of consumers (eco-labeling), specialized technical training, etc.

Lastly, it must be highlighted the need to identify and analyze the potential special features to be applied to the SMEs at each stage in the process, from the design of the PPCS until their implementation, as well as the particular supplementary measures to be adopted in order to facilitate the implementation of the PPCS at companies of this type.

2. SCOPE AND OBJECTIVE

There is a common consensus among Mediterranean countries that in order to attain sustainable development in the industrial sector it is necessary for companies to progressively incorporate mechanisms aimed at avoiding or, if that is not possible, reducing pollutant emissions and the impact on the environment as a whole. Nevertheless some of these countries lack the appropriate legal and institutional framework to enable companies to identify and implement those mechanisms.

In the framework of the Mediterranean Action Plan (MAP) and the Protocol for the Protection of the Mediterranean Sea against Pollution from Land-Based Sources and Activities ("LBS Protocol") those mechanisms are defined as Best Available Techniques (BAT) and Best Environmental Practices (BEP).

In the framework of the LBS Protocol BAT are taken to mean "the latest stage of development (state of the art) of processes, of facilities or of methods of operation which indicate the practical suitability of a particular measure for limiting discharges, emissions and waste". BEP are defined as "the application of the most appropriate combination of environmental control measures and strategies".[1]

Thus, promoting the adoption of BAT and BEP in the industrial sector has been a key component of MAP Initiatives and Programs for combating land-based pollution (i.e. Strategic Action Program or SAP). Nevertheless, to date MAP efforts, through its Regional Activity Center for Cleaner Production (RAC/CP), have focused on providing technical documents and training activities either identifying a number of BAT and BEP for some types of industries or proposing a methodology for the companies to identify and implement them.

However, in order to succeed in securing the adoption of BAT and BEP to the extent possible in the industrial sector of any country, it is also necessary for governments to create the appropriate regulatory and institutional mechanisms to encourage and enable companies to adopt them.

Therefore, with this document, RAC/CP aims to propose a country-level methodology that helps Environmental Authorities to:

a) Identify the Best Available Techniques (BAT), Best Environmental Practices (BEP) for the main industrial sectors of the country,

b) Adapt the existing legal and institutional frameworks for controlling the environmental impacts from industries to a PPCS based on the BAT and BEP that have already been identified,

[1] Both definitions were taken from the *Revised version of LBS Protocol (1996 Syracuse, Italy).*

c) Create the mechanisms for monitoring and enforcing the PPCS,

d) Create support mechanisms to help industry adapt to the new PPCS.

2.1 Working Method and Structure of the Guide

The steps followed to prepare the guide, were as follows:

1. Selection by RAC/CP of five Mediterranean countries: Croatia, Egypt, Israel, Slovenia and Syria.[2]

2. National experts engaged by RAC/CP (according to the proposals of the center's National Focal Points for those countries) completed questionnaires informing on both the systems of prevention and control of industrial pollution existing in their countries (legal mechanisms, targeted industrial sectors, public authorities involved, main environmental problems to be dealt with, etc) and on the political, social and economic forces at work in the country that have repercussions for the development and application of the PPCS.

3. A first draft of the Guide was drawn up concurrently with the above steps.

4. Analysis of the starting situation at the above countries for implementing a PPCS based on BAT and BEP using the methodology contained in the Guide. This analysis was based on the questionnaires completed by the national experts and on other information available in EC documentation, the UN Environment Program (UNEP) or at the RAC/CP. These reference documents are included in the Bibliography at the end of this document.

5. Drafting the final version of the guide including the analysis described in the preceding paragraph.

All of the above is structured in the guide as follows:

- **Section 3** describes the methodology to be used to define and implement the PPCS, which involves identifying the sought PPCS model (3.1), selecting the scope of the PPCS and how it must be defined in each country to reduce pollution (3.2), developing the components of the PPCS and other supplementary support measures (3.3), and some institutional factors facilitating the implementation process of the PPCS (3.4).

- **Section 4** contains a preliminary analysis of the starting situation in the five MAP countries mentioned above for applying the methodology outlined in section 3 in the respective countries.

- **Section 5** provides the bibliography used.

[2] Selection based on the special interest shown by representatives of those countries in activities on BAT and BEP performed by the RAC/CP.

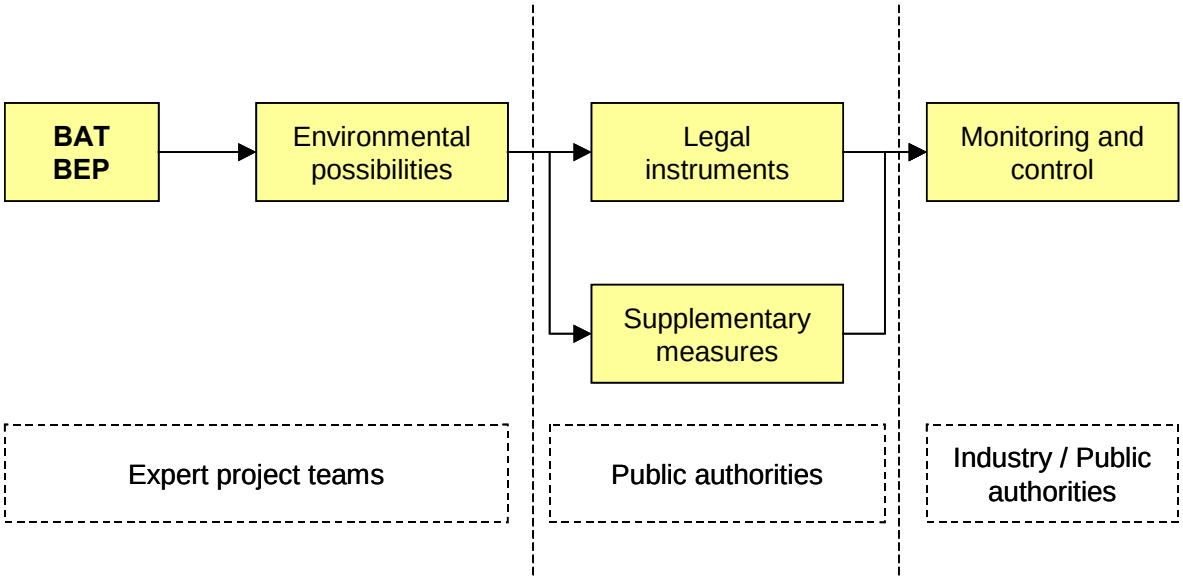
3. DEFINITION OF THE PPCS

3.1 Conceptual model

In this guide we propose the steps to be followed when establishing a PPCS, based on which the activity at the facilities belonging to certain industrial sectors, chosen by reference to their specific environmental and economic characteristics, will be subject to certain thresholds for polluting emissions, based on the BAT and BEP identified for each sector.

The main elements of the PPCS are shown in Figure 1 below:

Figure 1. PPCS Model.



As shown in the above chart, determining BAT and BEP and the possibilities for enhancing the environment that these alternatives offer must be carried out by an expert work team consisting of people who have a deep understanding of the processes used in the industry, their results and associated costs, the possibilities for enhancement and their drawbacks, etc. based on solid experience of the sector (e.g. representatives from the technical side of the industry, R&D centers, Universities, Cleaner Production Centers, etc.). This element is set out in **section 3.2**, which describes how work the teams are set up, the goals they are expected to achieve and the way in which they work.

Once the BAT and BEP have been identified for a given industry in a given country, along with the environmental limits associated with their application[3], the government must reflect these results in legal instruments applicable in the industry (e.g. via the country's system of licenses or permits or via new environmental legislation for the industry) in order for the industry to put into practice the relevant measures for reducing pollution. These measures must, according to the work team, be technically and financially viable at the companies at which they are targeted. Besides, in some cases, supplementary measures may also be necessary in order to enable adaptation of the industry to the new PPCS (adaptation periods, financial assistance, etc.). **Section 3.3** deals with these points of the PPCS, together with issues related to control of the environmental impact, which will feed information to the government on the degree of compliance with the PPCS and the results obtained.

Lastly, **section 3.4** lists some of the institutional factors which, although not *sine qua non* conditions, act as process facilitators for the implementation of the PPCS.

[3] E.g. a coolant recirculation system that makes it possible to reduce the consumption of water from 1000 m3/h to 2 m3/h, or a desulphurisation plant that makes it possible to reduce SO2 emissions from 4,000 mg/Nm3 to 400 mg/Nm3, etc.

3.2 Determining the scope of the PPCS

This part of the guide aims at answering the following questions:

- ✓ How far does the government intend to go in the prevention and control of industrial pollution?
- ✓ Which industries should be included in the PPCS by reference to their pollution load, their business structure, ease of control or any other method deemed appropriate according to the circumstances of each country?,
- ✓ How far can industry go and what measures can it use?
- ✓ What consensus measures could there be?

In other words, a methodology is proposed to determine the technically and financially viable measures that companies in an industrial sector can develop to reduce their environmental impact as much as possible. These measures will then be the BAT and BEP for that particular sector.

There are a series of steps to be followed to find the answer to the questions at the beginning of this section:

1. **Identifying and selecting the industrial sectors** to be included within the area of application of the PPCS.

2. **Identifying and setting up expert work teams**, one for each sector selected[4] which include, representatives of public authorities, experts from each sector, e.g. representatives from the technical side of the industry, technological centers, etc..

3. **Analyzing the environmental, legal and financial situation** of the sector under analysis, in order for the work team to familiarize themselves with the framework for their work.

4. **Identifying alternatives** for the selection of BAT and BEP by the work team. For each environmental impact in the sector under analysis, the work team must identify the available options for reducing and controlling the impact and that are being applied in the country, as well as any other options that have been applied, and proved effective, elsewhere.

5. **Selecting BAT and BEP alternatives,** which will be carried out by the work team. For the alternatives identified in the preceding point, it will be necessary to analyze information on environmental results, technical requirements for their implementation,

[4] More groups could be set up if there are highly specialized subsectors. In the steel industry, for example, a specific group could be set up for steel production and another for steel processing.

implementation costs, maintenance costs, financial savings, etc. to determine the viability of the alternative. Their viability will be used to determine whether certain alternatives will be considered BAT or BEP.

The bibliography set forth in Section 5 was taken into account for this subsection.

3.2.1 Identifying and selecting the industrial sectors to be controlled

What?	*Select the sectors that will be included in the PPCS*
Why?	*Not all sectors have the same environmental impact, are as easy to control, or have the same investment capacity.*
How?	*Assessment of the basic environmental, financial and social information for each sector.*

Before determining a PPCS based on BAT and BEP, it is very important to decide upon the activity sectors to control and monitor, and this decision must be taken with an extensive contribution from environmental, industry and economic authorities. This is because it might not be possible to implement BAT and BEP in all industrial and service sectors or because the cost might not be affordable for certain companies due to their size, for example. Therefore, there must be a prior step in which a decision must be taken on the scope.

In order to select the sectors or industries to control using BAT/BEP as reference points, a government has to know which sectors are the most important in relation to the current environmental burden in the country or region, by evaluating all the relevant impacts: air, water, waste, flora and fauna, soil, etc.

In general, all of the governments of the regions and countries on the Mediterranean Sea have enough knowledge about the main environmental impacts caused by industry to be able to go on to the next step. In any case, the industrial sectors in a country are well known by its authorities and it should be easy to evaluate the impacts of any given sector by using a bibliography.

The relevant information to consider at this point varies according to each country's situation and needs. A list is provided as a guide in the following table:

Table 1. Information to consider when selecting the target sectors

Environmental burden[5]		Economic and social sensitiveness
Solid waste /hazardous waste		Turnover
Waste water, eutrophication and toxicity		Number of employees
Air emissions, acidification, ozone depletion, global warming, and photochemical ozone creation.		Size (segmentation)
Soil pollution		Number of centers
Energy consumption		National / Multinational
Water consumption		Share of the Gross National Product
Natural resources consumption		Age of the centers (segmentation)

At this point, there are several possibilities:

i. Sectors with a low environmental burden. In a first phase it would be recommendable not to act in these sectors in order to be able to focus efforts on other sectors with a polluting potential.

ii. Sectors with a high environmental burden but very sensitive in economic and social terms. These sectors will require a very careful assessment of the financial impact of the PPCS and the environmental benefits that would be achieved if the methodology outlined in this guide were used to apply it.

iii. Sectors with a high environmental burden that can undergo changes in processes and/or products without serious economic and social damage. In principle, these sectors would be the ideal candidates for the implementation of a PPCS based on BAT and BEP, since their environmental impact would be reduced at an affordable cost for the industry.

In any event, generally speaking it must be taken into account that, in principle, the financial impact at a large company is lower than at an SME, and it would be much simpler for the government to carry out its control on a small number of large companies than on a high number of

[5] These impacts have to be evaluated in terms of the receiving environments, taking into account that their carrying capacity will determine to a large extent whether an environmental impact is relevant or not.

large companies. A balance between large companies and SMEs is therefore recommendable. The large companies could act as leaders to be followed by the SMEs. On the other hand, SMEs might need some help from the government, in the form of less demanding requirements, longer deadlines or loans and subsidies.

3.2.1.1 Specific characteristics of SMEs

As seen above, the presence of a large number of SMEs in the selected sectors is a very important issue to be taken into account in the design and subsequent development of the PPCS. In principle, there are a series of general features that may be found in the attitude of SMEs towards the environment:

- Limited environmental initiatives, consisting basically of initiatives aimed exclusively at complying with applicable legislation, and principally driven by the market (compliance with customers' requirements) and the desire to avoid penalties. These will increase in the future due to the spread of Corporate Social Responsibility policies at large companies which are clients of SMEs and to increasingly exhaustive legislation.

- Lack of information on environmental legislation and, when it does exist, lack of knowledge of how to comply with it from a technical standpoint. Absence of qualified personnel.

- Lack of awareness of the environmental repercussions of their activity. They consider that the impact of their activity is very small and insignificant. SMEs do not see how they *can* be important in the context of the local environment or how by combining their efforts they *do* have a great impact.

- Lack of awareness of how to gain access to subsidies for enhancing the environment.

- Less environmental pressure than at large companies.

- SMEs face an added risk for their activity: the risk associated with environmental accidents/incidents caused by the factors listed above.

- The existence of specific success cases in which, as well as complying with environmental legislation, SMEs also obtain financial benefits. These cases are essentially due to the activity of Cleaner Production Centers, which tend to focus their activities on SMEs from sectors with a high pollution potential.

3.2.2 Identifying and setting up expert work teams

What?	*Set up work teams with the skills required to identify BAT and BEP.*
Why?	*To design a feasible system.*
How?	*By identifying and evaluating potential BAT and BEP.*

Once the target sectors have been selected, it is time to set up work teams in order to determine the best suited BAT and BEP for those sectors.

With the development of a structure of work teams, it should be possible to find the best solutions for controlling the environmental impacts of each sector and setting realistic objectives with regard to limiting pollutants. Therefore alongside the environmental impacts, we must also take into account the economic, social, technical, legal and institutional factors related to key environmental issues in the sectors.

The work teams should include experts in different areas, in order to contrast all the strengths and weaknesses of the possibilities that may be identified. Some environmental solutions could cause other problems in addition to the ones that they are resolving. It is therefore important to have a **balanced** approach from the start: The best environmental possibilities should be implemented only if there is an overall benefit in all areas.

3.2.2.1 PPCS Steering Group

First of all, for the performance of all the activities required by the aim of this guide, it is absolutely necessary to set up a PPCS Steering Group (”Steering Group”).

The authority in charge of implementing the PPCS should name a permanent group that will manage all the aspects, activities and requirements related to the functioning of the work teams. This core group of people should be appointed at the very start of the whole process.

The members of the PPCS Steering Group should also include people from all the different areas. It would be recommendable for it to include outstanding members of all the ministries or departments involved.

The aims of this Steering Group will be:

- Set up all the necessary work teams. The Steering Group must create one work team per sector of study and will be in charge of selecting the members of each group and managing the agenda, documentation and facilities for the meetings.

- Determine the mission of each member of the group and identify their specific roles.

- Establish a working methodology. The Steering Group must implement administrative instructions and procedures, enforcement tools, staff training schemes, if necessary, and find the appropriate resources. During the setting up of the work team, the Steering Group must make sure that all the members follow the established methodology.

- Determine the type of communication to be used between the members of the work team and keep all the members informed of the latest activities and decisions made by the work team.

- Obtain all the external documentation needed for the discussion. To find the best techniques and/or practices it would be recommendable to take into account not only the internal resources, but also all the external studies performed. The Steering Group has the task of collecting all this information, making it available to all the members of the groups and updating it at the meetings.

  A member of a Work Team might identify, during or before the process, an important new document for the group. In this case, the Steering Group must evaluate and validate the new document.

- The Steering Group must have periodical meetings to monitor all the activities carried out and to discuss the next steps to take.

3.2.2.2 Work teams

There should be at least one work team per sector to be studied. The work team will be responsible for deciding which BAT and BEP should be used as a reference point in each sector to agree upon the feasible pollution limits.

All of the meetings held by the work teams should be attended by representatives of the environmental authorities and industry at least.

The first stage should be the recruitment of the members of the team by the Steering Group. These work teams would have to meet according to the schedule proposed by the Steering Group.

For this purpose, the teams must be set up by well-known experts in all the issues to be discussed, that is:

- Environmental authorities: personnel of the Ministry / Department of Environment or equivalent.
- Industry authorities: personnel of the Ministry / Department of Industry or equivalent.
- Economic authorities: personnel of the Ministry / Department of Economy or equivalent.
- Industry representatives: technical and economic experts from each sector under study. The SMEs from the sector being considered should also be represented.
- Entities for R&D or cleaner production (CP). The cleaner production entities could play an important role by taking part in representing the SMEs due to the high degree of contact they have with them.[6]
- Specialized university professors.
- Assistants from the Steering Group.

The profiles of the various experts are described in more detail below:

- Environmental authorities: personnel of the Ministry / Department of Environment or equivalent

  The relevant environmental authority should be represented by members of the Ministry. They should contribute all their knowledge on the best environmental remedies but they should

[6] CP centers and SME representatives may take part jointly in the work teams. In these cases, it is strongly recommended for preliminary studies to be carried out by CP Centers together with SMEs regarding the environmental profile and environmental possibilities of SMEs from the selected sectors, for them to be presented to the work teams so that particular consideration may be given to the SMEs in these sectors.

specifically have a fundamental role in evaluating the proposed alternatives. They should analyze whether alternatives are feasible from the standpoint of the administrative structure and resources of the government.

It is important to ensure the participation of members from different environmental sectors: air pollution, water quality, human health, etc. in order to guarantee an integrated approach to environmental problems.

- Industry authorities: personnel of the Ministry / Department of Industry or equivalent

  The participation of industry authorities is important in order to ensure the quality of technical and financial assessments.

  They will mainly take part in the identification and technical evaluation of the technological alternatives proposed as BAT, but they should also be assessing the entire process, ensuring that all the proposed alternatives can be implemented in the current situation of the sector.

  It would be recommendable for the industry authorities to be represented by people specialized in the implementation of new techniques and familiar with environmental, technical and financial assessment.

- Economic authorities: personnel of the Ministry / Department of the Economy or equivalent

  Economic authorities must play a predominant role in the financial assessment, whereby they would analyze the financial impact of the different alternatives and identify possible financial instruments to help industry with the necessary investments. The work team should be specifically set up with people who are at home with investment analysis. They should ensure the financial viability of the proposed alternatives.

- Representatives from industry: representatives from technical and business circles of the sector under study

  The companies and business associations in the sector should also be represented in the work teams. The Steering Group should select different representatives of the most important companies in the sector (both large companies and SMEs) and invite them to join.

  These members contribute to the group in both technical and financial assessments, but their participation is especially important in order to take into account the direct effects that the

new pollution prevention alternatives and limitations would have in the sector (SME growth potential, financial effects, etc.)

As mentioned above, it would be recommendable for the SMEs to have the support of the CP centers in the work team and, in particular, for both to jointly submit previously prepared environmental analyses (alternatives, risks, limits, main impacts, etc.) regarding the SMEs in the sector .

- Entities for R&D or cleaner production (CP)

  All the groups should make sure that they take into account the state of the art in terms of knowledge of pollution prevention alternatives. Therefore, the Steering Group should also use external knowledge resources.

  In this respect, there are some organizations with extensive expertise in this area, and more knowledge may be obtained from their documents (EU-BREF, UNEP, USEPA). The Steering Group should identify all of these documents and furnish them to the members of the different work teams.

- Specialized university professors

  Local knowledge plays a key role in the work team's decisions. Some BAT information will have to be taken from foreign sources but it is also important to work with local universities.

  Including these will promote further research and dissertations as part of the assessment, and creates a culture of technical innovation and restructuring which will affect future developments in the local industry. It is also possible to find academics specialized in very useful matters for the work teams.

  Therefore the university should be one of the key players in adapting the best available techniques to the local conditions.

- Assistants from the Steering Group:

  The Steering Group will be formed before the steps described above. The members of the Steering Group should be recruited by the government of each country.

  Once the Steering Group is formed, it should implement the organization and all the administrative procedures for the development of the work teams. A member of the Steering Group should always be part of them.

There are other members that should also take part in the work teams. This is the case of organizations such as environmental groups, NGOs

or trade unions, which would take part in the work teams where related to their activities.

The table below provides an orientative guide on the areas where each member of the work team should focus their work according to the recommendations in the sections below, which describe the steps to be taken in the process of evaluating BAT and BEP.

Table 2. Issues to be assessed by the various members of a work team.

Issue	Steering Group	Environment authorities	Industry authorities	Economic authorities	Industry representatives	Universities, R&D and CP centers	NGO & Trade Unions
Organization, moderation	X						
Environmental status and regulations		X			X		
Industry status and regulations			X		X		
Financial status and financing alternatives		X	X	X	X		
International commitments (environment)		X					
Environmental priorities		X			X		X
Identification of alternatives		X	X		X	X	X
Benchmarking		X			X	X	
Environmental assessment		X			X	X	
Technical assessment		X	X		X	X	
Financial assessment		X		X	X	X	
Final evaluation	X	X	X	X	X	X	

3.2.3 Analysis of the environmental, legal and financial status of the sector

What?	*Gain an understanding of the current status of the sector.*
Why?	*To find out the starting point and flexibility of each sector for the purposes of the subsequent evaluation of alternatives*
How?	*By analyzing the legal, technical and financial information supplied by the members of the work team.*

The first objective of the work teams should be to determine the current status of the sectors' main impacts and regulation systems, also considering the special eco-characteristics of the country and its surroundings (water shortage, ecosystems, etc).

At this stage, it is important to convey to all the members of the group the status of the regulations for the sector, to be able to identify the limitations and weaknesses of the existing PPCS and to draw up a brief draft of the objectives of the work team.

This knowledge, in the possession of all the members of the group, sets the basis for the rest of the work: pollutants to control, limits and techniques on which the limits were based. In this way, each member of the group will later recognize the weaknesses of the current system and they will be able to start studying different solutions based on their specific areas of expertise.

Environmental and industry status and regulations

It is a task of the environmental authorities to present to the group the current environmental regulatory system for the specific sector under study, for all the members to gain an appropriate understanding, and to receive feedback from the sector's representatives.

Later, during the process of identifying and selecting BAT and BEP, the environmental authorities should also convey to the work team any potential conflict that could arise between the proposed alternative and the regulatory system and proceed in the most appropriate way (e.g. the alternative cannot comply with the minimum environmental standards).

Environmental authorities would also have to check all the international environmental undertakings or agreements that could affect the decisions of the work team, both in terms of environmental objectives and technical information that could be useful.[7] The alternatives

[7] For example, the Stockholm Convention on POPs.

proposed by the work teams should always at least comply with these international undertakings.

On the other hand, it should be a task of the industry authorities and representatives to convey to all the members of the group the current status of the sector under study (number of companies, percentage of SMEs, most important regulations affecting it, growth trends, financial performance, employment situation, average age of the facilities and techniques, international position and threats, etc) in order to come up with the right alternatives. It is key for all the members of the group to have sufficient knowledge of the current status of the industry.

This will make it possible to detect any possible conflict or difficulty in the sector for admitting new techniques or practices (difficulties from the standpoint of the economy, permits, licenses, approvals, certifications, competence or technology).

As a work tool for further tasks, the Steering Group could prepare a "*Current industry status and regulations handbook*" with all the information in this area identified by the work team. A copy of this document should be given to each member of the work team.

Financial status and financing alternatives

On the other hand, it is essential for the BAT to be financially viable. Thus, the current financial status of the sector under study and the type of financing available for the implementation of the new techniques should also be taken into account.

The work team should also work on defining potential sources of financing for the techniques further proposed as BAT or the new practices proposed as BEP, as well as other mechanisms such as environmental tax reductions. Once the best techniques have been defined and the evaluation has been completed, the work team should study the way in which the companies are going to finance all the changes potentially required to implement them. In this respect, the authorities should evaluate the various needs and particular situation of the companies affected (SMEs / large companies, private/public companies, old/new facilities, etc.) and try to propose different financing vehicles from the public and private sectors.

Alternatives should be presented to the work teams with the participation of all the business associations in order to give them the opportunity to evaluate each financial alternative and reach an agreement.

Environmental priorities

One of the first steps for identifying the potential alternatives should be to identify the environmental priorities of the sector under study, considering some of the issues described above.

To do this it will be necessary to take into account:

- The causes of the main environmental problems in the country resulting from its particular geophysical conditions (e.g. extremely low rainfall).
- International agreements.
- The main environmental impacts inherent to the sector under analysis (e.g. CO_2 process emissions in the limestone sector).

In this respect, the work team should define the standards to be used as thresholds from which to assume that a specific environmental issue is an environmental priority, and therefore which of the issues detected should be studied in greater depth.

Given that the work team will work and base any further assessments on the environmental priorities identified at this stage, it is extremely important to make sure that they are identifying all the important environmental issues.

3.2.4 Identifying alternatives for selecting BAT and BEP

What?	*Identify the various candidates for BAT and BEP for subsequent assessment.*
Why?	*Once all the techniques and practices for preventing pollution have been identified, it will be possible to assess them.*
How?	*Through the contributions of the work team members: techniques and practices currently applied in the sector, techniques and practices included in bibliographies, new trends, etc.*

In order to determine the BAT or BEP for a selected sector, it is necessary to select the alternatives that can be used in the most financially and environmentally efficient ways. But there could be instances where at first it is not quite clear which alternative offers the highest level of protection at a reasonable cost and within a feasible technical scope.

To solve this, a further specific assessment should be carried out to determine which of the identified techniques and practices are the most suitable.

Therefore, the starting point is an initial determination of the alternatives that will be further assessed. The work team should identify the

techniques or mix of techniques that would fit in the specific processes of the selected sector in a cleaner way, or the environmental techniques which, connected to the processes, could provide the sector with better environmental performance, in order for these to be further assessed.

For this purpose, it would be recommendable to follow a "check route" through the production cycle of the industry so that all the alternatives at all stages are taken into account. This can be worked out in two ways:

a) Identifying the possibilities and resources already available to the industry (large companies and SMEs) and to the members of the work team (know-how, publications, basic bibliography, pioneer projects and other experiences).

b) Seeking recent innovations. New techniques developed by members of the group, adding some of the known techniques, etc.

These approaches may only be applied in cases where the best option is not obvious from the initial discussions. Where there is a previous obvious conclusion, or where there is a broad agreement on the preferred option for implementation, there will be no need to apply the recommendations set out above.

EXAMPLES OF ALTERNATIVES

- **Process design**: cleaner technology; low-maintenance techniques, changes or replacements in processes; alternative production designs; etc.

- **Selection of materials**: cleaner fuels, less-polluting raw materials, less-hazardous materials, recycling, improvements and preventive measures in storage, etc.

- **Process control**: optimization, computerized monitoring and control, adjustments, etc.

- **Housekeeping-type measures**: improving maintenance, predictive maintenance, waste segregation, etc.

- **Non-technical measures**: organizational changes (environmental responsibilities and objectives), training, environmental management systems, etc.

- **End of pipe technology**: techniques to control NO_x emissions, SO_2 emissions, energy recovery, volatile organic compounds recovery or incineration, material recycling, waste water treatment plants; advanced techniques (adsorption, gasification, plasma techniques…), etc.

As may be seen, the BAT and BEP include both preventive and end-of-pipe measures. Both types of measures reduce the environmental impact of the processes with which they are associated. However, all things being equal, the preventive measures should always take priority over the end-of-pipe measures, as they will have a lesser environmental impact from a global or life-cycle standpoint. A combination of the two may be necessary in many cases e.g. in a coal or lignite power station with high sulfur dioxide emissions, the substitution of the fuel used with low sulfur fuel would be a preventive measure, whereas a desulphurization plant would be an end-of-pipe measure. Given that a reduction in sulfur emissions may not be sufficient in itself, it would be advisable to apply both techniques.

It is important for all alternatives to be described in enough detail to prevent any ambiguity or misunderstanding.

Once the group has identified the different alternatives for BAT and BEP, it will then be necessary to carry out an intensive assessment of all the alternatives in order to find the best one, by reference to environmental, technical and financial factors.

After this evaluation, the work team should choose the BAT and BEP and should provide the environmental targets to be reached based on the chosen BAT and BEP.

Benchmarking

Knowledge of other countries' experiences in applying BAT and BEP is needed to ensure that the alternatives selected by the work teams are really the best way forward. It is therefore important for the work teams to take into account during the identification of alternatives the BAT or BEP considered in other countries in order to obtain greater knowledge of their feasibility and applicability in the sector under study.

3.2.5 Selecting the BAT and BEP alternatives

What?	*Select the BAT and BEP from the alternatives identified in the previous stage.*
Why?	*These will form the basis of the PPCS: they will serve as a reference point for applying limits on emissions, waste generation, consumption, etc. in the sectors concerned.*
How?	*By carrying out an environmental assessment, a technical assessment and a financial assessment.*

The BAT and BEP are selected from among the alternatives identified in the preceding point on the basis of three assessments:

1. Environmental assessment, in which the environmental impacts of each alternative are evaluated and compared (the lower the impact, the higher the score).

2. Technical assessment, in which the technical requirements necessary for implementing the alternatives are evaluated (the less demanding the requirement, the higher the score).

3. Financial assessment, in which the financial impacts of the alternatives are evaluated (the lower the financial impact, the higher the score).

Once the three assessments have been completed, the team will then be in a position to carry out a final assessment to determine which of the alternatives may be considered BAT or BEP in the sector under analysis.

Each of the three assessments are described in greater detail below.

3.2.5.1 Environmental assessment

The environmental assessment should not be very difficult; most of the environmental conflicts should be relatively easy to understand.

The work team should develop an assessment methodology for the purpose of choosing the most suitable techniques and practices from an environmental standpoint, and ensure that all conclusions will be determined in a consistent and transparent manner.

Methodology

First of all, the environmental issues associated with each alternative should be identified and evaluated.

It must be taken into account that environmental issues are not measured in the same units (e.g. emissions of 1 tonne of SO_2 cannot be compared with 1 tonne of generated waste), and therefore apparently it is not easy to find a way to compare the total environmental burden of different alternatives.

In order to solve these problems the work team should group the various types of environmental issues into environmental clusters (global warming, human toxicity, amount of waste, etc.). These clusters must be representative of different environmental impacts.

For each environmental cluster the work team would be able to determine the total environmental burden. There are comparisons available among pollutants in the same cluster for different clusters which will hugely assist with this work, as explained below in this section.

By comparing the same environmental clusters for the different alternatives, the best ones from an environmental standpoint can easily be determined.

This methodology is a useful tool for comparing options and for identifying the pollutants that are likely to cause the greatest concern.

The work team's environmental assessment could comprise the following steps:

a) Drawing up an inventory of environmental issues for each of the proposed alternatives:

   For each of the identified alternatives, the work team should draw up an inventory identifying all the related environmental issues.

   All the significant environmental releases and the resources consumed in each of the alternatives under consideration should be listed and quantified. The list should cover the pollutants released, the raw materials consumed, water consumption, energy used and the waste generated.

b) Determining the different environmental clusters

   The work team should study all the possibilities and determine the different environmental clusters in which the different impacts can be allocated.

   The different clusters proposed by the work team will depend on the main impacts of the industry under evaluation but the following general clusters could be taken into account:

   - GLOBAL WARMING
   - ACIDIFICATION
   - AQUATIC TOXICITY

- EUTROPHICATION
- OZONE DEPLETION
- PHOTOCHEMICAL OZONE CREATION
- HUMAN TOXICITY

These clusters should be carefully selected to give comprehensive coverage of the most relevant environmental impacts of the sector under study.

There are some cases where it is not necessary to create a special environmental cluster to compare the environmental impacts. Some impacts such as excess water and energy consumption, noise, odors, amount of solid waste, etc. could be compared directly from their measured values.

c) Allocation of the environmental aspects in the different clusters:

It is important to decide in which cluster it would be better to allocate each environmental aspect.

An environmental aspect may appear in more than one environmental cluster if it causes more than only one environmental impact represented by those clusters.

d) Relative quantification of the environmental impact of each cluster

Once the environmental aspects have been allocated in the different clusters, the relative environmental burden of the cluster can be calculated. It is not a direct measure of the environmental impact but it is enough to enable comparison among different alternatives.

The environmental burden of the different pollutants in any given cluster should be measured in the same units in order to calculate the total environmental burden of the cluster. Several lists quantifying the relative burden of each pollutant in each cluster can be obtained from different sources (e.g. UE IPPC Reference

Document on Economics and Cross-Media Effects[8], which has been used as a reference bibliography for this section).

The lists for each cluster present some pollutants that affect the environmental impact of the cluster. One of the pollutants is used as a reference and the other pollutants are measured in relation to the reference pollutant. For example, for the "global warming" cluster CO_2 is used as a reference pollutant and its burden is 1, then CH_4 has a value of 23 in relation to CO_2. Then, the burden of a cluster may be calculated (in order to enable comparison among alternatives) by adding the individual burdens of the pollutants multiplied by the mass of pollutant released, as shown below.

Expressing individual pollutants in the same terms allows them to be compared directly and also allows a range of pollutants to be added together to assess the significance of the total effects of the cluster.

We will now describe the proposed clusters in more detail:

Global warming

There is a need for a reduction of the so-called "greenhouse gases" in the atmosphere. These gases change the earth's climate conditions through the retention of earth radiation after solar radiation exposure. Therefore there is a wide range of consequences caused by this greenhouse effect that could lead to important adverse impacts on the sustainability of many different ecosystems.

The alternatives should take into account the greenhouse gas effects in order to consider techniques with the lowest release of these gases.

For the (relative) quantification of all these emissions, it is recommended to use the global warming potential (GWP) of each pollutant. These GWP establish the relative warming potential of each pollutant in relation to the reference pollutant (in this case, CO_2), whose GWP equals 1.

[8] European Commission. Directorate-General JRC Joint Research Centre. Institute for Prospective Technological Studies. Sustainability in Industry, Energy and Transport European IPPC Bureau. ***Integrated Pollution Prevention and Control Reference Document on Economics and Cross-Media Effects***. May 2005. (http://eippcb.jrc.es/pages/FActivities.htm). Hereinafter, **UE IPPC Reference Document on Economics and Cross-Media Effects**.

Once the GWP of each pollutant and its released mass are determined, a total value for the Global Warming potential could be established by aggregating each individual burden (the individual burden is calculated by multiplying the GWP of the pollutant considered by its released mass).

This methodology allows the alternatives to be compared in relation to global warming by using the total GWP of each alternative.

$$\textbf{Global Warming Potential } (GWP_{(total)}) = \sum GWP_{(pollutant)} \; X \; \text{Mass of pollutant released}_{(pollutant)}$$

Where:

$GWP_{(total)}$: is the global warming potential of each pollutant in relation to the reference (CO_2). They can be found for example in the UE IPPC Reference Document on Economics and Cross-Media Effects.

Mass of pollutant released $_{(pollutant)}$: is the mass of the individual pollutant that will be released into the atmosphere by the alternative technology.

Acidification

Some gases released in the atmosphere (mostly sulphur dioxide -SO_2-, ammonia -NH_3-, and nitrogen oxides -NO_X-) can react with the moisture of the air to create a new source of environmental impact. The deposition of the resulting substances causes impacts on the different ecosystems, and produces erosion on buildings and historical monuments.

The control of these gases is essential for the maintenance of some ecosystems and to minimize environmental degradation. Therefore they should be taken into account for evaluation of the techniques.

Similarly to global warming, there is an acidification reference pollutant (SO_2) and for the other pollutants there are assigned acidification potentials in relation to SO_2.

The mass of each pollutant released multiplied by its acidification potential gives the acidification burden expressed in SO_2 equivalent of such pollutant. The aggregation of all the acidification's values of the pollutants released will result in the final acidification value for the alternative.

$$\textbf{Acidification} = \sum AP_{(pollutant)} \; X \; \textbf{Mass of pollutant released}_{(pollutant)}$$

Where:

$AP_{(pollutant)}$: is the acidification potential of each pollutant in relation to the reference (SO_2). They can be found for example in the UE IPPC Reference Document on Economics and Cross-Media Effects.

Mass of pollutant released $_{(pollutant)}$: is the mass of the individual pollutant that will be released into the atmosphere by the alternative.

<u>Aquatic toxicity</u>

This cluster is used to compare alternatives in relation to the impact of their discharges to water.

The methodology is similar to the ones above, but with one particular characteristic: it is based on the value of the "Predicted no effect concentrations" (PNEC) of the pollutants instead of pollution potentials.

The toxic effect of an individual aquatic pollutant can be determined as the volume of water required for diluting a discharge to its toxicity threshold, at which no toxic effect can be detected. This toxicity threshold is represented by the "Predicted no effects concentrations", below which a pollutant does not have a toxic effect.

For the calculation of the volume of water required to dilute a discharge to its PNEC, the mass of the pollutant released should be divided by the value of the PNEC of that pollutant, as specified below:

$$\textbf{Aquatic toxicity } (m^3) = \sum \frac{\textbf{Mass of pollutant released } (\text{pollutant, kg}) \times 10^3}{\textbf{PNEC of the pollutant } (\text{pollutant, mg/l}) \times 10^{-3}} \times 0{,}001$$

Where:

Mass of pollutant released $_{(pollutant)}$: is the mass of the individual pollutant that will be discharged into the water in kg. (multiplied by 10^3 to convert into grams) by the alternative.

PNEC of the pollutant $_{(pollutant,\ mg/l)}$: is the predicted no effect concentration of each pollutant to discharge in mg/l. They can be found for example in the UE IPPC Reference Document on Economics and Cross-Media Effects. The factor of 10^{-3} converts the result into grams.

x 0,001 is to convert liters to m^3.

Eutrophication

The enhanced inputs of nutrients and organic matter in water bodies can stimulate and accelerate a plant growth that produces a reduction in dissolved oxygen in the water. Low oxygen concentrations can affect fish, invertebrates and plant. This process is called eutrophication and the pollutants that cause eutrophication are principally those that contain nitrogen and phosphorus.

The proposed methodology is similar to the ones above, using an eutrophication potential. For the calculation of each pollutant's eutrophication potential, the phosphate ion equivalent, measured in kg., is used as a reference.

$$\textbf{Eutrophication} = \sum \textbf{Eutrophication potential}_{(pollutant)} \ \textbf{X} \ \textbf{Mass of pollutant released}_{(pollutant)}$$

Where:

Eutrophication potential $_{(pollutant)}$: is the eutrophication potential of each pollutant to release in relation to the reference (PO_4^{3-}). They can be found for example in the UE IPPC Reference Document on Economics and Cross-Media Effects.

Mass of the pollutant released $_{(pollutant)}$: is the mass of the individual pollutant that will be discharged into the water by the alternative.

Ozone depletion

The ozone layer protects the earth's surface from the sun's UV-B radiation. The depletion of this layer could produce serious effects on animals, plants and also to human health.

Ozone depletion is caused by the chemical reaction of some anthropogenic gases such as chlorofluorocarbons, halons and others in the stratospheric ozone layer. Reducing the emission of these gases and stopping ozone depletion should be an aim to be taken into account in the environmental assessment.

The methodology is similar to the ones above, using an ozone (O_3) depletion potential for each pollutant. CFC-11 is used as reference pollutant.

$$\textbf{Ozone depletion} = \sum \textbf{O}_3 \textbf{ depletion potential}_{(pollutant)} \textbf{ X Mass of pollutant released}_{(pollutant)}$$

Where:

Ozone depletion potential$_{(pollutant)}$: is the ozone depletion potential of each pollutant to release in relation to the reference (CFC-11). They can be found for example in the UE IPPC Reference Document on Economics and Cross-Media Effects.

Mass of the pollutant released $_{(pollutant)}$: is the mass of the individual pollutant that will be released into the atmosphere by the alternative.

Photochemical ozone creation

At the level of the earth's surface ozone is formed by different photochemical reactions as an important secondary pollutant. It can affect mainly human health.

Ozone is formed under the influence of sunlight when certain primary pollutants such as nitrogen oxides or volatile organic compounds (VOC) are present. The evaluation of the alternatives should include the study and comparison of the ozone-creation pollutants that are released where applicable.

The methodology is similar to the ones above, using a Photochemical Ozone Creation Potential (POCP) for each pollutant. Ethylene is used as reference pollutant.

$$POCP_{(total)} = \sum POCP_{(pollutant)} \; X \; Mass\ of\ the\ pollutant\ released_{(pollutant)}$$

Where:

$POCP_{(pollutants)}$: is the photochemical ozone creation potential of each pollutant to release in relation to the reference (ethylene). They can be found for example in the UE IPPC Reference Document on Economics and Cross-Media Effects.

Mass of the pollutant released $_{(pollutant)}$: is the mass of the individual pollutant that will be released into the atmosphere by the alternative.

Human toxicity

The pollutants released to the atmosphere by some processes could directly affect humans through the inhalation of these substances. This contact of pollutants with humans could cause problems for human health. In order to prevent any human toxicity related to the identified alternatives, this must be considered during the environmental assessment.

The methodology is similar to the ones above, but with one particular characteristic: the mass of pollutant released has to be multiplied or has to be divided by the toxicity factor of the pollutant depending on the method used to obtain these toxicity factors.

In the example below, the method to calculate the toxicity factors is based on dividing the occupational exposure limit for a pollutant by the occupational exposure limit of the reference pollutant (lead). Since exposure limits are inversely proportional to toxicity (the more toxicity, the lower the limit), then the mass of pollutant released has to be divided by its toxicity factor.

$$\textbf{Human toxicity potential (kg lead equivalents)} = \sum \frac{\textbf{Mass of pollutant released to air (kg)}}{\textbf{Toxicity factor of the pollutant}}$$

Where:

Mass of pollutant released to the air: is the mass of the individual pollutant in kg that will be released into the atmosphere by the alternative.

Toxicity factor of the pollutant: is the toxicity factor of each pollutant to release in relation to the reference (lead). They can be found for example in the UE IPPC Reference Document on Economics and Cross-Media Effects.

e) Comparison of the total environmental effects of each option

Once all the environmental impacts have been quantified for each alternative, there is a total environmental impact value per each cluster, which has to be supplemented with other different values representing individual environmental impacts such as resource consumption, solid waste generation or noise.

It is recommended to draw up a report including all the environmental impacts and values of each alternative under evaluation. This report should also include any other specific environmental characteristic not previously included in the evaluation process.

f) Determination of the best environmental options

The alternatives must be ranked before the next assessments are carried out in order to facilitate the final decision. Also, for this future final evaluation it should be established by the work team whether any of the environmental clusters should have a higher importance than others, e.g. because of priorities in the country or international undertakings.

The final environmental impact values should be analyzed in order to determine which of the alternatives produce the lowest level of environmental impacts.

If following these evaluations there is an alternative that is definitely better than the others and is accepted by the work team, the assessment should be brought to an end and the alternative should be considered in the design of the PPCS.

3.2.5.2 Technical assessment

Once the different alternatives have been ranked according to their effects on the environment, there are some other evaluations to be taken into account before determining the best option on which the PPCS should be based. It is necessary to take the technical and financial assessment into account in order to ensure that the best environmental alternative is technically and financially feasible for the sector under study in order to reduce its impacts. The feasibility at SMEs should be considered separately.

The technical assessment must analyze the possibility of implementing the alternatives identified for the sector in technical terms (energy demand, spatial needs, specialized personnel, suppliers, replacements, specialized maintenance, etc.).

It is important to take the specific local resources into account, and therefore the work team should establish the technical possibilities that may be affordable in order to compare each alternative.

Nevertheless, a minimum technological level has to be established. The work team should identify what is lacking in their sector and the technical activities, materials or procedures that could be affordable. When an alternative is determined as technologically possible it means that all the engineering, purchasing, construction and start-up processes are assured by the sector and that if there is anything lacking in the process it would be remedied by affordable financial investments.

If following these evaluations there is an alternative that is clearly the most suitable for the current situation and is accepted by the work team, the study should end and the alternative should be selected for the PPCS.

3.2.5.3 Financial assessment

If there are still several alternatives at this point in the evaluation process, the financial assessment should determine the best option in financial terms.

The work team would have to determine the financial viability of the alternatives determined to be environmentally and technically feasible, as well as the investment characteristics of each alternative. As part of this aim, the work team should establish a methodology for comparing and selecting alternatives using investment analysis techniques.

In this guide the most widely used investment parameters are proposed for the financial assessment, but the work team can use any others considered to be more representative for the sector under study.

Methodology for the financial assessment

All the alternatives under study could imply a financial investment for their implementation and operation, but the attractiveness of the various alternatives depends on other factors such as the initial outlay, cash flows, operational savings, useful life of the technology, etc. The work teams should define the investment indicators to be used in assessing the financial viability of the alternatives. With these investment indicators, the work team can rank the alternatives in financial terms.

The work teams can carry out the financial assessment of the alternatives in the following steps:

a) Identification of the sources of costs and savings

The cost and savings of each alternative have to be identified and estimated.

In order to determine the indicators below, it will be necessary to carry out a cost evaluation in order to take into account all the implementation and operational costs and savings of the alternative. To do this, a thorough analysis is needed through all the processes of the alternatives.

EXAMPLES OF COST AND SAVINGS SOURCES

- **Cost sources**: project costs (design, definition…), engineering, purchase and disposal of land and systems, civil engineering work, pilot plant, training, new personnel, maintenance, replacements, pollution control costs, resources consumption (particularly energy and water), etc.
- **Additional cost sources in the case of retrofitting**: costs of dismantling installations, systems and techniques to retrofit, personnel –retraining costs, etc.
- **Savings and revenue sources**: maintenance, replacements, pollution control costs, resource consumption (particularly energy and water), taxes, sale of by-products or treated waste flows, health and security, demanding markets, environmental costs (waste landfill, ...), etc.

b) Identification and determination of the investment ratios/indicators

For the comparison of techniques, this methodology suggests the use of some of following most widely used indicators in investment analysis:

- IPP: Investment Payback Period
- NPA: Net Present Value
- IRR: Internal Rate of Return

It is recommended to use the ratios in the order in which they appear. Calculating these indicators gives the work team an idea of the financial viability of the alternative, and will ensure a reasonably good basis for deciding in all cases whether or not to accept the alternatives, making it possible to have a sound ranking of investment alternatives.

c) Calculation of the investment ratios

- Investment Payback Period (IPP)

  The length of time required to recover the initial investment through positive cash flows generated over the years from the investment is called the payback period. This period will depend on the rate at which cash flows are generated after the implementation of the technology. The best investment would be the one with the shortest payback period.

  This indicator assumes a single investment paid at the beginning of the process and equal annual cash flows:

$$IPP = \frac{INITIAL\ INVESTMENT}{ANNUAL\ CASH\ FLOWS}$$

The IPP indicator has the following limitations:

- It fails to take into account any benefits that occur after the payback period.

- It fails to take into account the time value of money

The IPP indicator could be made more reliable by taking into account the time value of money. And this is done by discounting cash flows to their value at the time of the investment (present value).

$$DCF = \frac{CF_1}{(1+r)} + \frac{CF_2}{(1+r)^2} + \ldots + \frac{CF_n}{(1+r)^n}$$

Where:

DCF: Discounted Cash Flow; r: discount rate (capital cost)

In this case the Payback Period would be the time it takes until the DCF is equal to the initial investment.

- Net Present Value (NPV)

  In order to remedy the limitations of the IPP rate, it would be useful also to take into account other more reliable investment indicators.

  Net Present Value, NPV, is used to analyze the profitability of an investment by taking into account the time values of the associated cash flows. NPV is defined as the present value of the total expected future cash flows minus the investment cost.

$$NPV = -INVESTMENT + \frac{CF_1}{(1+r)} + \frac{CF_2}{(1+r)^2} + \ldots + \frac{CF_n}{(1+r)^n}$$

NPV takes into account the time value of money, where payments and income are considered regardless of when they are paid or received. The NPV calculated this way would be the present value of the profit to be obtained from the investment according to estimated future cash flows.

- Internal Rate of Return (IRR)

  The discount rate at which the net present value (NPV) is zero is called the Internal Rate of Return (IRR). The IRR for an investment is the discount rate for which the total present value of future cash flows equals the cost of the investment.

  The different alternative investments under evaluation could be compared to one another using the IRR. The alternative with the highest IRR would be the best investment.

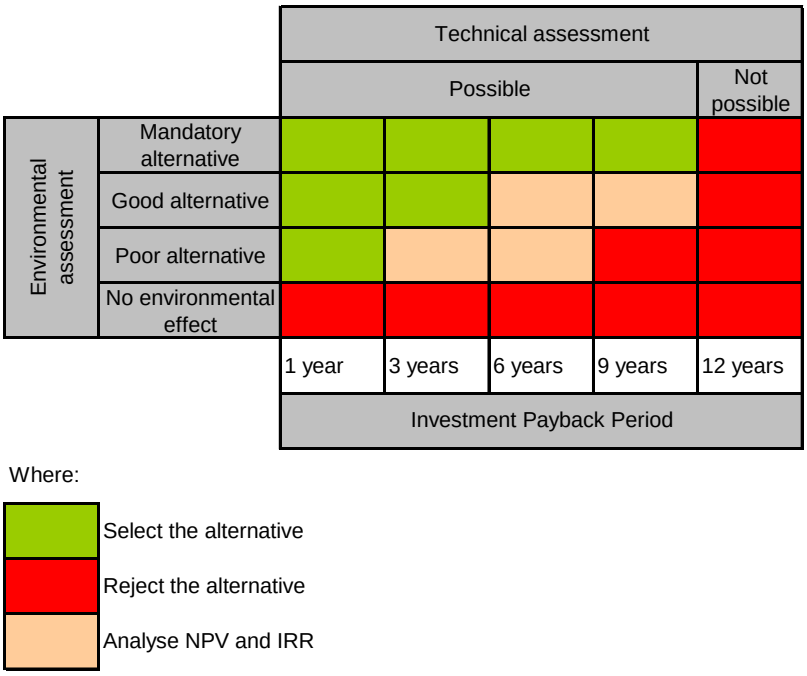
$$INVESTMENT = \frac{CF_1}{(1+IRR)} + \frac{CF_2}{(1+IRR)^2} + \ldots + \frac{CF_n}{(1+IRR)^n}$$

  The investments measured using this indicator would be financially acceptable where the IRR obtained is higher than the cost of capital (the cost of money).

d) Comparison of investment ratios and determination of the best alternative

   Once the work team has calculated the indicators to be used in their financial assessment of the alternatives, each of the environmentally and technically feasible ones should be identified as accepted or rejected from a financial standpoint. An example of how to take a decision is shown in the next figure:

Figure 2. Example for decision-making.



When it comes to analyzing the environmental investments from a general or sectorial standpoint, it should be taken into account that, broadly speaking, given that these investments are for social rather than economic reasons, they tend to have poor financial ratios (long IPP and low NPV and IRR) compared to other types of industrial investments geared more towards increasing productivity.

Far from being an insurmountable obstacle, what this requires is a more comprehensive approach, by placing value on the social benefits obtained from the planned investments. Consequently, if at this stage we are faced with several alternatives, all of which offer poor financial ratios, the process should not be brought to a halt but continued with those alternatives offering the least adverse results.

For example, where considerable particle emissions are encountered, the BAT would most probably be to install fabric filters or electrostatic precipitators at the plant. Neither option would result in any revenues for the company implementing the measure (other than avoiding the potential risk of environmental fines or taxes) but would involve certain initial maintenance costs. From this standpoint, the investment will never be profitable. Nevertheless, there would be a considerable improvement to the local environment, to agriculture and farming in the area, to

tourism (if operated in the area) and to the health of the population in the plant's surrounding area.

The alternatives finally accepted should be used as a reference point in the sector under study to design a PPCS.

3.2.5.4 Final evaluation and selection of alternatives

From the three assessments performed, the work team has enough information to determine which alternatives, if any, meet BAT and BEP standard and can be used as a basis for the PPCS.

The identification of BAT and BEP implies finding the processes and/or techniques qualifying as the best environmental alternative and which, according to the technical and financial assessment, may be implemented in the local area of study.

For the determination of the alternatives to use as reference for the design of the PPCS, the work team should identify, from among all the possibilities, the ones that are better placed in the environmental ranking and the ones that are also financially and technically acceptable. Techniques identified as not possible by reference to technical or financial factors should be deleted from the final list of possibilities.

The final list of alternatives should be numbered in order of priority, from the highest to the lowest, by reference to the environmental, technical and financial assessments. Then the work team should agree on the final alternatives that will be the basis for the PPCS. If necessary, an alternative list could be created for SMEs.

The general procedure is to agree to the alternatives at the top of the list, but the work team could also check if there are solid requirements to delete a particular alternative or to change an alternative from its initial position due to general environmental improvements or other reasons. Therefore, the final decision on the alternatives to be considered as BAT or BEP should be as strict and clear as possible.

Thus far, the work team will have focused its evaluation on the best possible environmental aims of the industry, and there is another analysis that could also be done: the cost effectiveness analysis.

The work team could use the cost effectiveness analysis to evaluate the alternatives. It is an indicator that measures the necessary investment costs to achieve a given environmental target, but in unit terms. In other words, it tells us the marginal investment cost of each unit of achievement of environmental targets.

First of all, a standard environmental benefit unit should be established in order to compare the unit costs. In this case, only alternatives with the same environmental target could be compared.

For a specific environmental target, the cost of the investment needed to reach that target using each different alternative could be compared. Set out below is an example of the determination of cost effectiveness for a specified environmental target unit:

$$\text{COST EFFECTIVENESS} = \frac{\text{ANNUAL INVESTMENT COSTS}}{\text{ANNUAL REDUCTION OF EMISSIONS}}$$

By calculating the cost effectiveness of each alternative, the most effective investment for achieving the same environmental target could be identified. Thus a new ranking list based on the costs of the environmental benefit unit achieved using each alternative could also be drawn up.

3.3 Implementing of the basic components of the PPCS

Once the alternatives are selected for a specific sector, the PPCS can be agreed. Permits, limits or other legal instruments for pollutant releases to air, water, waste generation, etc. have to be in accordance with the BAT and BEP. SMEs and other particular characteristics of the sector may be treated differently e.g. with higher limits, longer periods for retrofitting, etc. Financial aid can finally be determined at this stage.

In order to implement the PPCS, the monitoring possibilities for each alternative must be identified in the previous steps, during the identification of BAT and BEP. In order to do this, it is important to consider certain special issues that are discussed further on in this chapter (section 3.3.2).

3.3.1 Legislation and administrative issues

3.3.1.1 Introduction

When identifying the sectors to be affected by the System and the priority environmental issues and selecting the applicable BAT and BEP, as explained in the foregoing sections, it is essential to articulate the appropriate legal rules which (a) provide suitable legal coverage for implementing the BAT and BEP; and (b) serve as procedural rules for the control and ongoing supervision of the activities with a potential impact on the environment which are subject to the System.

To fulfill the aim of protecting the environment two types of legislation would be necessary:

1) Substantive legislation, establishing a specific legal regime for each environmental vector (water, waste, etc.); and

2) Procedural legislation, governing the procedure and the instruments for authorizing and controlling a specific production activity, which would thus allow the previously defined substantive provisions to be applied to each activity.

3.3.1.2 Considerations in relation to substantive legislation

This type of legislation must be prepared from the standpoint of sectors. After determining the environmental matters or sectors (waste, water, soil, air, etc.) that may be affected by the activities subject to the system,

specific legal provisions must be implemented with a substantive content, including, at least, the following issues:

(i) First, the environmental protection objectives to be reached in relation to each environmental matter must be defined and established.

For example, a general Law on waste could set encouraging reduction and reuse, etc. as objectives.

(ii) Second, specific legislation should be provided on each environmental vector.

It is no simple task to find a common regime for such diverse areas as the protection of the atmosphere, of soil or of water. Nonetheless, the substantive rules on each environmental vector should address the following issues:

a) Defining the basic concepts.

The main concepts or expressions that are going to be used in the legislation must be defined (as an illustration, a substantive provision on waste could provide a definition of “waste”).

b) Establishing the obligations applicable to all the potentially polluting parties in the vector concerned. In the area of waste, for example, an obligation could be established for waste producers to have the waste managed by an authorized manager.

c) Identifying the powers of each of the authorities involved (for example in relation to the control of authorized waste managers).

d) Instruments should be included to ensure compliance with the obligations imposed by the rule: repressive (establishing infringements and penalties); economic (economic, tax–related, measures or similar measures to encourage private environmental protection initiatives); or others.

3.3.1.3 Considerations in relation to procedural legislation

In addition to substantive legislation (on the legal regime for each activity according to its environmental impact) it is essential to have a suitably structured procedure which allows the potentially polluting activities

subject to the System to go through an administrative control process while also allowing the contents of the substantive legislation to be adapted to each specific case (namely to a specific industrial activity, to the area where it is located, the particular industrial process, etc.).

The procedural provisions must envisage and provide for measures for maintaining ongoing control of the activity and ensuring that they are constantly in line with the prevailing BAT and BEP (in relation to emissions, for example), in addition to these measures, a reduction in the environmental impact to the maximum extent possible.

There are two types of models available for this purpose:

- A sector-based model, which involves different control procedures for each environmental vector.

- An integrated model, which involves a single control process for the entire activity.

Bearing in mind that the environment is a single whole and that anything that harms one of its environmental vectors ultimately causes deterioration in the others, we consider the second of the processes mentioned above to be more advisable. Namely, it would be more advantageous to have, for all of the activities, a single control and environmental authorization or license process for all of the elements related to the various environmental vectors (water, soil, air emissions, waste, use of energy, risks of accidents, etc.) as opposed to adopting a sector-based approach that treats each sector separately and fails to take in coordination of the activities of the various public authorities involved in the protection of each of those environmental vectors.

Thus, the authorization or permit granted upon completion of a single control process will particularize the provisions already existing in substantive legislation for each vector in line with the specific project and it will do so with respect to all of the potential environmental impacts that must be taken into account.

Also, an integrated control process should not impose excessive administrative burdens and it should be an expedient process involving cooperation and coordination between the public authorities taking part in it and the participation of the private parties potentially affected by the conduct of the activity.

3.3.1.4 Issues to be taken into account in the design of an integrated administrative authorization procedure

The procedural legislation should, in our view, encompass the elements listed below.

For this purpose, in essence, we have taken as our model the environmental legislative policy on this subject put in place in the various European Union countries[9] which is based on Council Directive 96/61/EC, of 24 September 1996, concerning integrated pollution prevention and control.

Based on the above, we set out below the essential issues that must be addressed, in our opinion, in the design of any procedure for authorizing an activity included in the System.

1) Adapting the limits of substantive legislation to each specific case.

   It is necessary for procedural legislation to take into account, for each activity, the quality conditions of the environment potentially affected, the characteristics of the affected activities, transfers of pollution from one environment to another, the type of polluting substances or the general climate conditions. This procedure would serve to individualize the substantive provisions to each specific case.

2) Modulating of the requirements in the process according to the environmental impact of the activity.

   In view of the fact that not all activities have the same impact on the environment since they may have a greater or lesser impact, a specific integrated procedure could be set up with more or less formalities, depending on the polluting potential of the activity subject to the System, given that an activity with a greater polluting potential will need a much greater amount of administrative inspection and control than a less harmful activity.

   When deciding whether an activity should go through one process or another, there are several criteria to be taken into account, such as the intensity of the effect of the activities on the environment or even

[9] Examples of these procedural laws are, in the case of Spain, central government Law 16/2002, of July 1, 2002, on integrated prevention and control of pollution, or Catalan Law 3/1998, of February 27, 1998, on comprehensive supervision by the environmental authorities. The aim of these laws is not to regulate substantive issues, but rather they seek to regulate the control systems to be applied by the competent authorities with respect to activities that could potentially have an effect on the environment, and personal safety and health. The varying intensity of public supervision and the diverse functions assumed by these authorities give the grant and control procedures envisaged by the Laws their own particular characteristics which set them apart from the rest.

the type of production industry concerned (consideration could be given to the characteristics of the companies operating in each specific sector of business, in particular their economic and technical capacity to adapt to the control systems that are established)[10].

3) Simplifying the administrative process through an integrated approach (a single general procedure for authorizing an activity). Phases in the procedure.

As mentioned above, it would be advisable for the procedural legislation to be geared towards a single administrative process for granting environmental permits for the activities subject to the System.

An integrated procedure allows the project to be taken as a whole thereby enabling better assessment of the elements for and against the installation of an industrial facility or activity.

An integrated approach would also enhance the remediation of environmental impacts and provide greater legal certainty to the extent that the decisions would be more predictable for private parties in terms of time and the administrative ruling (since there would be a single authorization, and therefore time limits would be uniform and as regards administrative decisions, private parties would be guaranteed greater certainty and a greater degree of predictability concerning the decisions).

The phases of the abovementioned procedure should include (in all cases and subject to the particular characteristics that have to be added for each block of activities that may be set up, in accordance with the comments made in the previous section) the following:

a. The application must be made by the interested party and be accompanied by the relevant documentation on the applicant and the project.

   One of the basic requirements for obtaining the environmental permit would be for the applicant to submit with the application a series of documents defined in the procedural legislation which

[10] One of the recommendable ways of modulating the requirements in the process according to the environmental impact of the activity is to add Annexes to the procedural legislation, in order to set up a single integrated procedure for each of these Annexes with different phases and formalities, thereby allowing variations in public authority supervision and their supervision to be more or less intense or even not to exist for activities with very little or no environmental impact. This is the criterion followed by Council Directive 96/61/EC, of September 24 1996, concerning integrated pollution prevention and control and, for example, Law 3/1998, of February 27, 1998, on integrated supervision by the environmental authorities in Catalonia.

would enable a thorough assessment by the competent authorities of the impact of the activity. These documents should include:

- A technical project design signed by an authorized specialist in the area.

  This project design should contain detailed information on the activity sought to be conducted, in addition to the facilities, raw and auxiliary materials that are planned be used, the processing processes, the energy used, the products needed for the conduct of the activity, etc.

  It should also include information regarding emissions into the air and water or soil, the types of elements and compounds that could be emitted and the expected size of these emissions.

  In any event, it would not be enough just to mention the emissions that could be caused since the technical project design should also contain the techniques used for the prevention and reduction of possible emissions, including the relevant BAT and BEP, the measures for managing the waste generated or the systems for controlling emissions, just to give a few examples.

- A certificate evidencing that the project is consistent with the zoning regime for the area (adaptable according to the country concerned).

  It would be advisable for the permit application to include a public document determining whether the activity to be installed is consistent with the planned uses for the area. The would clarify right from the outset a requirement which, if not met, could prevent the future conduct of the activity.

- Evidence of the quality of the land to be occupied and that the land is compatible with the conduct of the activity.

  To obtain the permit from the granting public authority it must be proved that the land to be occupied has the quality needed for this purpose and that the conduct of the activity is consistent with the type and quality of the land.

- Documentation relating to fire and accident prevention and health protection.

  It would also be appropriate for the procedural legislation to stipulate that the application for authorization or a license must be accompanied by the relevant information on fire and accident prevention and health protection measures to

be implemented, since these prevention and protection measures are essential for carrying out an industrial type activity.

b. The procedure should include a public information period.

Before granting the environmental permit, the necessary measures should be adopted to guarantee that applications and the relevant documents are made available for public examination for a certain period of time, to give the interested or affected parties the chance to make any pleadings or comments they consider necessary on the documents in the file. This would not apply to any information which is confidential for intellectual property or any other reasons.

This would ensure that all the potential effects and losses that may be caused to the various affected parties may be taken into account in the decision on the application.

The method used to make the application for the environmental permit public could consist of a combination of two steps: publishing a notice on the application in the relevant official gazette and on the notice board of the municipal council for the place where the activity is to be installed; and sending an express notice to the neighbors adjacent to the land where the facility is intended to be installed.

c. Need to coordinate the supervision of the competent authorities.

As mentioned in the introduction, the method deemed to be most suitable for simplifying the administrative process would be to follow an integrated approach, in other words, despite the potential involvement in the process of various authorities with powers in the area, there would be a single process resulting in a single authorization.

It is essential, in this respect, for coordination between the various public bodies to be perfectly regulated. Cooperation between the public authorities should imply that they exchange information on, among other issues, the BAT and BEP, their control specifications and any variations in them.

In this respect, whenever there are various competent public authorities the power to grant or deny the permit could be granted to one of them, depending, for example, on the potential environmental impact of the activity (the greater the impact the greater the importance of the supralocal authority), and the others

could supervise through binding reports in areas falling within their powers[11].

d. A hearing of the applicant.

Once the relevant reports are available and the interested parties have made their pleadings, if any, in the procedure, it would be appropriate to hold a hearing with the applicant so that he can give his opinion on the steps taken in the procedure.

e. Decision on the procedure.

Once the application has been filed, the interested parties have made their pleadings, the relevant public reports have been issued resulting from the necessary coordination between public authorities, and the hearing formality has been fulfilled, it would be incumbent upon a certain previously identified public authority to grant the permit for installation of the facility, in a written decision, accompanied by the conditions to guarantee that the facility and the activities performed in it satisfy the requirements established in substantive legislation.

The decision rendered by the competent body on the application filed would bring the procedure to an end, although an appeal may be lodged against it within a certain time limit which must be specified in the legislation and consistent with the legal system in each country.

The foregoing decision would also have to be rendered within a specific time limit running from the filing date of the application, although, in exceptional cases, based on the complexity of the file, the body responsible for rendering the decision should be able to extend this time limit by a founded decision.

The running of the period would be tolled in cases where an improvement or amendment to the filed documents is requested, and would resume once the documents have been modified or amended.

If no decision is rendered within the time limit established in procedural legislation, consideration should be given to whether or not the application filed for obtaining the permit would be considered to be granted due to the passage of time.

[11] In Spain, for example, although the municipal councils are not authorized to grant the permit, they give their opinion in a binding report on the elements of the project design related to zoning and the noise and vibrations that the activity could emit, as these are matters that do fall within the powers of these municipal council.

We would underline the importance of regulating administrative silence in connection with applications from private parties, structured as a means of protection as it allows a decision to be obtained, although not in writing, which may be positive (granting the authorization) or negative (denying it) according to the option adopted by each State, if the competent authority fails to decide within the time limit stipulated in the legislation.

Generally speaking, the ultimate aim of protecting the environment justifies having the absence of a reply from the authorities within the agreed period imply a denial of the application, although the applicant may lodge an appeal against the denial.

f. Content or scope of the permit.

The environmental permit granted under the decision should, in our opinion, include the following contents[12]:

(iii) The emission limit values for the polluting substances associated with the conduct of the activity concerned.

(iv) The applicable BAT and BEP, in order to attain the necessary consistency in applying the System.

(v) Determining the potential measures relating to operating conditions that could affect the environment, such as leaks, operating failure, outages or the opening or closure of operations.

(vi) Establishing guarantees (such as sureties or third-party liability insurance, for example) to cover the liability for the damage or obligations that could arise from the activity performed, from the work on protection of the environment or recovery of the affected environment, in addition to potential

[12] Similar in content to, for example, the Italian Legislative Decree, of February 18, 2005, "Attuazione integrale della Directiva 96/61CE relativa alla prevenzione e riduzione integrate dell'inquinamento", or Catalan Law 3/1998, of February 27, 1998 on integrated supervision of the environmental authorities.

Another potential content to be included in the permit, depending on the degree of implementation of substantive legislation, would be, for example, to determine the measures needed to reduce long-distance pollution, under international legislation in this area. In cases where the activity falls outside its scope of application it would also be appropriate to take this issue into account to prevent activities in one State from harming the territory of another different State. It might be advisable to sign International Treaties for cooperation between States in order to avoid such pollution.

payments of penalties arising from incorrect performance of the activity.

(vii) Determining the measures for protecting subsurface land and ground water

(viii) Determining measures relating to management of the waste generated by the facility, where applicable.

(ix) Specifying the measures for protecting against fire and serious accident and protecting health.

(x) The obligation to regularly notify the competent environmental body of the information required to determine compliance with the contents of the permit.

Lastly, the decision would have be notified to the interested parties and be made accessible by the public except for any confidential information.

4) Adaptation to the substantive legislation in force at any given time.

To keep the granted environmental permit in force and ensure that it conforms to the substantive legislation in force at any given time, it would be appropriate to have mechanisms for updating it including review systems.

In this respect, in our opinion, permits for the installation of facilities and the conduct of the activities planned to be carried out in them, besides being regulated permits (namely whether they are granted or denied would depend exclusively on compliance with all of the requirements stipulated in the legislation), they should be structured to allow for “ongoing compliance” in that the procedural legislation should establish the obligation for such permits to be adapted to legal obligations that are successively introduced.

Namely, a legislative technique should be found which would allow amendments to be made periodically in order constantly to keep the authorizations in line with the legislation in force. Environmental supervision cannot be confined to controlling the activity on a single occasion and in a negative manner. Thus, the public authorities’ task does not end with the initial control of the activity, since it is necessary to impose conditions on the conduct of the activity. These conditions could vary, within certain limits, according to the characteristics of the activity in each case. The public authority will retain at all times the power to impose new measures and even to revoke the authorization if it fails to conform to the legal regime on the activities.

The would prevent the environmental permits from falling out of line with a legislative framework that is constantly being reviewed, updated and adjusted to keep up with the times.

In any event, it would be advisable for procedural legislation to include various types of controls: initial and periodical controls or one-off reviews.

(i) Initial controls.

In the start-up phase of the activity, the competent public authority should confirm that the activity fulfills all of the conditions and has in place all of the measures set forth in the permit and that it may therefore be commenced.

This control could be carried out by both the public bodies of the country concerned or by private entities which, subject to the appropriate regulations, will cooperate with those bodies to perform the control, which will therefore entail the assignment of certain public powers to these private entities.

(ii) Periodical controls.

It would be advisable for the permit to be subject to a periodical review a few years after it is granted, which must be strictly determined in procedural legislation in order to confirm on an ongoing basis that the permit conforms to the conditions established in the legislation and in the authorization or license itself.

Therefore, the authorized activities would be subject to control once they were fully operational on an ongoing basis.

In any event, controls would be more or less frequent depending on the type of activity, and therefore not all of the activities would be likely to receive periodical controls with the same regularity.

(iii) One-off reviews.

In addition to the initial and periodical controls referred to above, it would also be necessary to provide for the possibility of performing specific reviews of the instrument or permit granted for an activity, where, for example:

- The pollution caused by the activity makes it necessary to review the emission limit values established in the permit, or it should be necessary to add new values.

- A major variation has taken place in the conditions present in the recipient environment at the time the permit was granted.

- Significant changes take place in the BAT and BEP which would allow a significant reduction in emissions.

- The safety of the operations of the process or of the activity make it necessary to use other techniques.

- Or where so required by applicable environmental legislation, industry legislation or the applicable legislation on fire or serious accident prevention or health protection.

Any change caused by the controls or reviews described will not, in principle, generate entitlement to indemnification for the owner of the activity, who should assume those costs as being inherent to the legal nature of permits of this type. This element should, in any event, be appropriately reflected in the rules on the procedure.

5) Distinction between the status of the existing facilities and of the new ones.

It is clear that in legislation of this type provisions should be designed in relation to new activities to be installed but it cannot be ignored that the starting point is an existing landscape with various activities already up and running. It would be possible to apply this legislation only to the facilities set up after it entered into force, but the creation of new procedural rules could be a good opportunity to review the status of existing facilities and adapt their legal regime and operating conditions to the principles inspiring the provisions outlined in this report.

There are three issues to be considered in this last case:

a) First it would be necessary to grant a time limit for adaptation to the new legislation. It would not be unusual to find activities that have been up and running for years which, in order to complete the administrative process and obtain the environmental permit adapted to the substantive legislation in force would very likely have to make changes to their process and apply new BAT or BEP.

b) Second, the administrative procedure will have to be adapted to the fact of dealing with existing activities which, in principle, should have some type of prior environmental authorization or permit. In these cases, the documentation to be submitted could be confined to a report on the operation

of the activity and its environmental impact, with or without prior supervision, as deemed appropriate, by an independent expert approved by the authorities, and the formalities for public information and notification to interested parties could be omitted.

c) Third, the competent authorities should equip themselves with sufficient resources to deal with processing a large number of applications. Otherwise, they will run the risk of a collapse of administrative resources which will hinder or, in any event, delay achievement of the goals sought by the legislation. In this area it might be appropriate (a) to add tests to distinguish between types of activities in order to establish different adaptation schedules according to the activity concerned; and (b) to secure the assistance of the private entities mentioned in the preceding paragraph, which, after going through an approval process, will be able to assist with the performance of administrative tasks. This assistance could basically involve analyzing the status of the facilities which would end with the preparation of a specific independent report which would be submitted to the competent authorities for subsequent review.

In any event, in order to adapt the activities performed by the companies existing before the new legislation came into force, it would be advisable to establish a legal regime for gradual adaptation to the new requirements, due to the difficulties, in particular economic difficulties, that immediate application would entail for the companies. It is therefore recommendable to prepare temporary conformity plans or, even reach agreements with the interested parties or grant economic subsidies.

An example of this gradual adaptation may be found in the autonomous community of Catalonia (Spain), where it is allowed to grant a temporary exemption from certain emission limits to the owner of an activity that has to be adapted to the new legislation. In this case, the owner of the activity must produce a program for gradual reduction of emissions, which will be authorized if the status of the recipient environment so permits and the program that enabled the legal limits to be reached does not extend beyond two years.

6) Inclusion of a penalty system.

The procedural legislation should establish the enforcement powers of the authorities and a penalty system to this end.

It would be appropriate for the legislation to class as administrative infringements all acts and omissions that contravene the obligations established in procedural legislation, with liability for the individuals or legal entities that had taken part in the infringing event.

In any event, administrative infringements must be clearly classified and defined.

Infringements would need to be classified according to the severity of the infringing event; one option would be to distinguish between minor, serious, or very serious. This distinction would have a direct impact on the amount of the penalty.

The following are examples of the definitions of the infringements that could be included in procedural legislation:

- Conducting, or substantially changing, the activity without having the relevant environmental permit, or without having performed the relevant verifications.

- Not carrying out the required reviews or periodical reviews.

- Concealing or altering information for obtaining the permit or doing so in any of the reviews or changes.

- Forging technical certificates.

- Reoccurring infringements.

- Transferring the permit without notifying the competent body.

- Preventing, delaying or hindering inspection activities ordered by the competent authorities.

- Incurring an unjustified delay in producing the documents requested by the authorities.

We would make two final additions in relation to the penalty system.

First, the penalty should be of a sufficient size to clearly discourage any departure from the provisions in the legislation.

Second, it would also be appropriate to consider whether in the framework of an enforcement proceeding or as part of the decision process in such a proceeding, the competent authority should be allowed to order temporary or final closure of the facility. If this initiative were adopted prior to the decision on the proceeding it would be classed as an injunctive remedy and would be justified by the damage or potential damage that the conduct of the activity could cause to the environment, or to personal health or safety. If it is adopted upon completion of the decision it could be based on similar arguments as before or, in addition, as a measure to restore legality as an activity is being conducted without the permit for doing so or without satisfying the requirements established in the permit. The

activity could be suspended until the deficiency concerned is remedied.

3.3.2 Environmental control and monitoring

As stated in the previous section, the environmental vectors (air, water, solid waste, etc) regulated by permits or other legal instruments (Laws, Regulations, Decrees, Orders…) have to be monitored, at least, to verify compliance with these legal requirements.

Nevertheless, monitoring emissions is a very widely used tool, not only for this purpose but also for environmental reporting (voluntary or compulsory), for ascertaining the total discharge (matter balances, efficiency analysis), for environmental taxes and, in some cases, for process control. In these cases it is highly recommended to find synergies and use the monitoring for different purposes. Once monitoring is a legal obligation, governments can take advantage of this and create periodic reporting mechanisms and emissions registers.

Several points have to be taken into account in the design of a system for controlling and monitoring the emission of pollutants from facilities:

- Understanding and objectives of the monitoring process.
- Other uses for the data collected.
- Methods for monitoring and standards, reliability and comparability.
- Frequency of the monitoring process.
- Responsibilities in the monitoring process.
- Reporting.
- Data analysis and further actions.

The highest added value may be obtained from monitoring by ensuring its reliability and comparability among facilities.

3.3.2.1 Understanding and objectives of the monitoring process

Once the decision to monitor has been taken for a given sector or facility, it is important that the authorities, the facilities and other parties involved (e.g. independent monitoring entities, inspectors, etc.)

understand the objectives, the monitoring process and all the requirements (methodology). And this can be done by including a written description in the relevant permit and contract with a third party involved (if that is the case) or through legislation or a combination of both options.

The objectives of the monitoring process must include, at least, information on the emitted pollutants required for the permit and other parameters necessary for reliability and comparability (e.g. in air emissions, temperature, velocity, flow, O_2 concentration, dilution rate, etc.) according to the selected methodology (see below in this section).

The objectives can be extended to other requirements if the monitoring process is used for additional purposes (e.g. statistics at national level, other national programs, etc.).

3.3.2.2 Other uses for the data collected

As mentioned above, the data collected in a monitoring process can be used for other purposes. In this case, the objectives and methodology of the monitoring process must be reviewed to ensure that they comply accurately with the new purposes.

Monitoring can be a shared process for different activities (inspection, process or efficiency control, etc.) and the appropriate design, so that it covers the different requirements of all the related activities, can save time and costs.

This is recommended for facilities where the monitoring process has become an obligation and has not been carried out before so that they can study how the new data that will be obtained may be useful for the company for other purposes (e.g. process control) and then design the monitoring process with both legal and specific requirements.

3.3.2.3 Methods for monitoring, standards, reliability and comparability

Emissions monitoring can be implemented in different ways, depending on the goals and, generally, on the viability of the process. It is possible to monitor the emission of a pollutant by:

- Sampling and analysis of the pollutant or surrogate parameters.

- Calculation through detailed mass balances or through emission factors.

- Other particular calculations and estimates.

Direct measurements obtained by sampling and chemical analysis of the pollutant (or surrogate parameters when a good connection is known) are preferable, but in some cases it could be technically difficult or expensive. In these cases the calculation methods can be used when a well-documented relationship exists.

Surrogate parameters are measurable or calculable parameters that show a close well-known connection with the pollutant to monitor. This relationship between surrogate parameter and pollutant must be documented and reported. The use of these parameters is recommended when financial, accuracy and/or technical reasons justify the decision. Examples of surrogate parameters are total VOC[13] emissions instead of particular VOC emissions, COD[14] in waste water instead of the organic pollutants individually, etc. and, particularly, toxicity tests of an effluent as a whole instead of each particular pollutant within the effluent.

It is important to consider the cost of the various monitoring methods in order to select those that give the expected results but with an affordable cost. Costs can come from different sources, e.g.:

- Construction and maintenance of particular infrastructure
- Acquisition of equipment.
- Calibration.
- Sampling (personnel, security, special bottles, equipment for maintaining special conditions, etc.) and sample transport costs.
- Sample labeling, storage and maintenance.
- Sample pre-treatment and sample analysis (laboratory costs, including personnel costs).
- Special software, elaboration of reports, etc.

[13] Volatile organic compounds.

[14] Chemical oxygen demand.

Sampling and analysis

To enable comparison it would be very useful to use the same standard procedures for sampling, chemical analysis, statistical treatments, etc. (e.g. ISO, CEN, USEPA) at least at sector level. Similarly, it is important to ensure the traceability of the samples in the monitoring chain (from sampling to the laboratory, etc.).

These standards ensure the reliability and comparability of the monitoring process when well implemented. Also, calibrated and certified instruments have to be used.

Additionally, the units have to be chosen in which the data has to be provided according to the expected objectives. Usually the data is provided in concentration units (mg/m^3, mg/l) and/or in total amount of pollutant released in a predefined timeframe (kg/h, kg/day). Furthermore, there are other possibilities that may be considered for providing data, such as specific units (e.g. amount of pollutant per unit of production or per unit of consumption), previously defined units for the sector, emission factors, etc.

The limit of detection (LD) of the selected method has to be in accordance with the emission limit of the pollutant that is monitored, e.g. 10% of the emission limit is a good percentage for a LD. Because of this, when determining an emission limit for a pollutant, the available monitoring techniques and their restrictions should be taken into account. Also, the uncertainty of the monitoring method has to be reported. The uncertainty is generally represented as an interval around the obtained result (e.g. 50 +/- 2) with a statistical confidence level of 95%. During the process where the pollution limits have to be selected, considerations regarding the uncertainty of the future monitoring results have to be taken into account and it is recommended to give both a limit and an associated uncertainty (e.g. 10% of the limit, 5%, etc.).

When there are values under the LD, it is recommended to give the result as an interval: the lower limit of the interval is the value obtained considering as 0 all the results under the LD and the higher limit of the interval is the value obtained considering all the results under the LD as the value of the LD itself. For example:

Table 3. Example for handling values under the LD.

Values obtained (ppm, LD = 7,5 ppm)		
8.0	7.9	Under LD
8.5	Under LD	8.0
8.3	7.9	Under LD
Average		
Value* = 5.4 – 7.9		

*The lower limit was calculated considering “under LD = 0 ppm” and the higher limit was calculated considering “under LD = 7.5 ppm”.

Other options are possible (e.g. an average value between 0 and the LD or other estimates) but have to be agreed at least at sector level.

Also the outliers (statistical deviations) have to be reported and classified as such when the deviation does not concern the source of pollution (e.g. external influences). It is important to know the operations of the facility very well and to use statistical tests to evaluate the value.

Finally, the reference conditions in which the monitoring process has been carried out (generally standardized) have to be reported jointly with the results obtained. For example, dilution, O_2 concentration, water content, standard T and P, velocity, flow, etc. The results have to be reported in the same conditions for all the factories in order to enable comparison and conversions to reference conditions must be used.

Independently, flow is very important information. It has an extreme influence on the results concerning the total release of a pollutant to the environment in a given time frame. Measurements of the flow have to be very accurate and representative because insignificant errors in the flow measurements can generate important errors when multiplied by the pollutant concentration and by the time frame in the calculation of total releases. In some cases measurement can be substituted with calculations of the flow.

Calculations

Calculations can be used to estimate a pollutant release to the environment. In these cases, mass balances are useful when the inputs and outputs of a process are well known.

An environmental release is estimated using the following formula:

Environmental release = process inputs - process outputs - accumulations

Whereas inputs are all the incoming substances, outputs are the products of a process including transfers (waste, by-products, etc.), and accumulations are the substances and materials that accumulate in the process. Uncertainties have to be considered and errors in the calculation can give rise to important errors in the estimated release.

Otherwise, emission factors could be used to estimate pollutant releases. Emission factors are given after testing exercises of systems and could have important uncertainties. It is recommended that if it is necessary to use emission factors, they be previously agreed upon at the sector level and approved by the authorities.

In any case, the relationship between calculation parameters / emission factors and pollutant releases must be documented and reported.

3.3.2.4 Frequency and timing of the monitoring process

The frequency of pollutant release monitoring will depend on several factors. Some of these factors could be:

- Accuracy and cost of the selected method of monitoring.
- Technical and financial implications of continuous monitoring.
- Pollutant concentrations and total releases.
- End-of-pipe treatments adopted and performance.
- Production regime and emission stability.
- Other fluctuations.
- Maintenance of the equipment involved in the emission to monitor and age.
- Reaction capacity in the event of emergency.
- Meteorological conditions.
- Sensitivity of the local environment, etc.

In selecting the frequency, these and other particular factors have to be analyzed in terms of risk for the environment, so as to ensure that the higher the risk the greater the monitoring frequency. Therefore, it is necessary to strike a balance among the various factors mentioned.

Having said this, the lowest frequencies (e.g. once per year) can be assigned to factories located far away from a sensitive area, with low pollutant releases and concentrations, a predictable and stable regime, good maintenance and with the degradation and corrosion of the (source) systems well-covered by design.

The highest frequencies (e.g. continuous[15]), on the other hand, can be found in factories with high releases and concentrations, special pollutants, an unstable production regime with unpredictable peaks, bad or no maintenance of the sources, old systems, located in sensitive areas, etc.

Obviously, there may be a large spectrum of situations ranging from once-per-year to continuous monitoring frequency or a combination of both options.

In terms of the actual time for sampling, it is very important to take particular situations into account and avoid them, unless they are the target of the monitoring, such as start-ups / shutdowns, malfunctions, accidents, leaks, etc. It is also important to give consideration to ensuring that the time when the sample to be analyzed is taken is sufficiently representative of the emission, and to decide whether a continuous or composite sample is necessary. This depends on the process, the chosen methodology; the pollutant analyzed, the time between peaks, the instability of the process, etc.

When a process is very stable and no peaks are detected the time for taking the samples and the time for sampling are not very important, nor is the frequency. In highly variable processes with high peaks of pollutant releases a continuous sampling is necessary.

The cases in-between fall into two types: peak emissions that cover practically the total amount of pollutant released or peak emissions that contribute very little to the total amount of pollutant released. In the first case (e.g. a batch process) it is enough to monitor the peaks and in the second case the fact of focusing on the peaks depends on the amount of the pollutant released.

[15] The monitoring system continuously gives an average result for short periods of time (a few seconds), e.g. NO_x concentration measured in the last 10 seconds.

Monitoring records must be retained by the facilities for a period previously determined by the authorities in order to make them available upon request.

3.3.2.5 Responsibilities in the monitoring process

Responsibilities in the monitoring process depend on the purpose of the process. In this case, they are related to the evaluation of compliance with the emission permit or other legal requirements.

The responsibilities may be shared by different parties. Generally speaking, it is very common for the polluting facilities to carry out a self-monitoring process and for the authorities to carry out (through an independent officially approved monitoring entity) programmed, random or suspicion based monitoring initiatives.

It is also common for it to be compulsory for facilities to report periodically to the authorities the results of a monitoring process carried out by an independent officially approved monitoring entity and to preserve the records of the self-monitoring process, which may also be carried out by an authorized independent contractor.

Nevertheless, particular requirements may be established in the permitting process by reference to the characteristics of the facility, the pollutants, the environmental status of the zone, etc.

It is very important for responsibilities to be properly assigned and understood by the participants in the monitoring process. Third parties (authorized contractors) may only have limited responsibilities because they neither operate nor control a facility where a pollutant is emitted and they only take and analyze samples, and therefore contractors have to work on behalf of the monitored facility.

3.3.2.6 Reporting

What, how, when and to whom to report the results are questions that have to be agreed upon before the measurements.

During the permitting process (or the law-making process), these questions must be clearly defined. The contents of the report, its scope, frequency, units, measurement conditions, etc. have to be detailed and can be agreed upon with the sector, e.g. by standard reporting formats. Results below LD, uncertainties, outliers and other special circumstances have to be considered carefully. It is also recommended

to include trends (last years results) in the reports, accompanied by comments and explanations.

The report can cover not only the end-of-pipe emissions, but also fugitive, diffuse or other exceptional emissions, discharges, etc. to the environment.

Furthermore it could be compulsory for the companies to prepare annual (or other frequency) verified public reports, but this is a decision to be agreed upon with the various sectors. In this case, it is recommended for the format and the contents of the public report also to be agreed upon previously and that they include a non-technical summary of the results in order to facilitate their comprehension by the general public.

3.3.2.7 Data analysis and further actions

The authorities have to review that all the monitoring requirements have been complied with (measurement conditions, conversion to standard conditions, units, uncertainties, standards, sampling procedure, etc.).

Once compliance with the report has been checked, the monitored pollutant can be evaluated by comparing it against the established limit (by law, decree, permit…). Then a measured value can be:

- Compliant: the value, including the uncertainty, is under the limit. For example, PM_{10} = 31 +/-2 mg/Nm^3 and the limit is 50 mg/Nm^3.

- Non-compliant: the value, including the uncertainty, is over the limit. For example, PM_{10} = 57 +/-2 mg/Nm^3 and the limit is 50 mg/Nm^3.

- Borderline: the limit is inside the uncertainty of the measured value. For example, PM_{10} = 49 +/-2 (or 51 +/-2) mg/Nm^3 and the limit is 50 mg/Nm^3.

Once the compliance of the measured value is analyzed and compared with the relevant legal limit, the authorities have to take a decision on whether to validate the result or to require further information or measures or even to close the facility.

Furthermore, the authorities can create a registry of emissions per sector for the facilities involved in the PPCS based on BAT and BEP, in order to monitor changes in the sectors and to easily calculate total burdens per year in the country. The authorities can report these results yearly (total or anonymous figures if confidentiality is desired) to promote benchmarking among companies.

3.3.3 Supplementary measures

When implementing a PPCS such as the one described in the previous sections, it is very important for it to be accompanied by a series of supplementary measures to secure that it is put in place efficiently .

The purpose of measures of this type is to provide the company with useful, clear and direct support for adapting to the new legal framework in which it suddenly finds itself, and to permit a more fluid relationship between the government and the company and compliance with environmental objectives at national level. There are a number of measures that may be considered, and they will depend on the line traditionally following by each country in similar matters. A series of generally applicable ideas are set out below, grouped under the following headings:

- Informative measures
- Technical support measures
- Financial measures
- Other measures

3.3.3.1 Informative measures

These measures are intended to provide the company with information, not only on the new legal framework in which it finds itself, but also on environmental impacts, sustainability, environmental management, administrative organization, steps, etc.

It is highly recommendable for the conclusions of the work teams to be set out in publishable documents to be delivered free of charge to the companies concerned. This will enable the companies to inform themselves in detail of the environmental issues associated with their processes, the practices and techniques that could be used to deal with their environmental impacts, the possibilities for environmental enhancements, the most recommendable solutions in principle, available assistance, etc.

The following are examples of the measures that could be considered:

- Creation of an environmental information office for companies (for industrial activities in particular), which is dependent on the government and has branches in the

largest industrial areas. It may be extended to other issues such as safety at the workplace, etc.

The creation of this office should be supported by:

- A large-scale ongoing communication campaign to inform companies of the existence of the office.

- Proactive nature of the office: if the company does not come to the office, the office will go to the company. A cordial relationship should also be maintained between branches and the companies in their areas.

The information that could be considered of particular interest in each case includes the following:

- Environmental legislation in force.

- Legislation being produced and future scenarios.

- Government objectives.

- Environmental impacts of each sector.

- Measures (preventive and corrective) for adapting to the legislation and for eliminating or mitigating environmental impacts and their technical and financial characteristics, etc.

- Talks and presentations: the performance of a circuit of environmental talks on legislation, objectives, possible solutions, BAT and BEP, etc. in industrial circles could be used as a tool for supporting the authorities in encouraging environmental activities at companies.

3.3.3.2 Technical support measures

Another type of supplementary measures are those aimed at providing the company with technical advice geared towards compliance with legislation, which adds value to this group. These measures involve presenting various options to companies for the same environmental problem, and the pros and cons of each, based on the results obtained by the work teams.

It should be taken into account here that the Clean Production Centers that already exist in the country would potentially be suited to this task. If the task is performed by these Centers, it is recommended for them to take part in the work teams set up to design the PPCS and to have sufficient funds for this new responsibility.

The a similar method to that described in the previous subsection for informative measures may be used to implement these measures. It should also be taken into account that one of the consequences of having information offices is that any companies that have queries on the information provided by them could go to these offices to request further technical and legal explanations, which means that it is recommendable for these offices to have staff who are qualified for this kind of task or for them to be located in the same office as technical support.

As may be seen above, it is very important during the design phase of the PPCS for the work teams to produce reports containing their conclusions and analyses in order to enable application of these technical support measures.

The following may also be considered:

- Specific assistance for SMEs, in which existing Clean Production Centers could play an important role. It would also be recommendable in this connection to carry out projects prior to the design of the PPCS in order to find out the environmental status and possibilities of SMEs in each sector and make this information available to the work teams.

- Production and distribution of technical sectorial environmental guides.

- Company training initiatives.

3.3.3.3 Financial measures

These are one of the factors that are most highly valued by companies and will be determined by the financial viability study carried out by the work teams during the design phase of the PPCS.

Generally speaking, these are measures that have already been used in the past (subsidies, soft loans) and require no further explanation. In the case at hand, it would be highly recommendable for this assistance to be used exclusively for the adaptation of companies to the identified BAT

and BEP and not for anything else, and for the control instruments necessary to guarantee satisfaction of this condition to be established.

Depending on the analysis of the work teams, it may be recommendable give one type of investment priority over another in those BAT or BEP for which there is an identified need for a greater level of investment or where it is decided to support one option over others.

3.3.3.4 Other measures

Other measures that could be adopted to facilitate the implementation of a prevention and control system of this type could be as follows:

- Promoting the execution of voluntary agreements with industry for the application of BAT and BEP in specific sectors or in the form of pilot experiments.

- Promoting the implementation of standardized environmental management systems (e.g. ISO 14001 or EMAS) among the most polluting industries.

- Implementing environmental management systems for public authorities.

- Including restrictive environmental requirements for the selection of suppliers in public procurement processes.

- Promoting specialized training (environmental engineering) and work experience for students at environmental companies.

- Promoting use by the general public of environmental products and creating eco-labels for environmentally responsible companies.

3.4 Facilitating factors for bringing the PPCS into operation

In order to undertake a project of this kind, both the institutional factor and fluidity in industry-government relations are of key importance. Thus, for example, a culture of incentives for modernizing technology or of more or less habitual cooperation by industry in national plans and programs are elements that favor the implementation of a PPCS based on BAT and BEP according to the methodology established in this guide.

Moreover, the legal framework of each country should be consistent with the existence of a PPCS, and there should already be in place environmental

legislation imposing limits on industrial pollution. On this basis, incorporating new legislation or updating existing legislation with new limits associated with BAT and BEP may be considered part of the natural course of the legislation in force in each country.

There are also other institutional factors that create a favorable framework and enable the transition to a more demanding PPCS which is better suited to the circumstances of each country (e.g. the existence of lobby groups, demanding legislation in force, the obligation to perform pollution controls, etc.).

From this standpoint, the following facilitating factors have been considered, which, without being exclusive, favor the design and implementation of a PPCS based on BAT and BEP within a specific geographic framework:

A) Organizational and administrative factors

1. The existence of a specific and exclusive ministry for environmental affairs, which has sufficient power and is active in the area of industry, since support for a project of this type depends on the importance and power of the Ministry of the Environment compared to other ministries and industry. It is therefore preferable for this ministry to have a department specialized in industrial affairs.

2. The existence of a public agency that will oversee implementation of environmental legislation and act as technical support for both the ministry and industry. The existence of an agency to implement monitor and support legislation is very useful when creating an environmental culture in the industrial fabric and to enable implementation of the PPCS being sought.

3. High degree of awareness, in the other ministries involved (industry, agriculture, water, etc.) and in the government's general policy, regarding the environmental impact associated with industrial activity and its harmful effects on the health and wellbeing of the population. It is essential for the project to be supported and promoted by all the authorities that could play an important role in defining the PPCS to ensure its complete success.

4. The prior existence of national plans or programs for the promotion of clean production and sustainable techniques. If these were already in place, the project would not entail a radical change for industry, but an updating and adaptation of the country's environmental policy to the circumstances of each sector.

5. The existence of a culture of active participation by industry in the design of national plans and programs. It is essential for industry to form part of the work teams that will design the PPCS. If this is already

habitual practice it will be easier to train and develop the relevant work teams.

6. The existence of a culture of fluid communication among the various levels of public authorities.

B) Legislative factors

7. The existence at national level of a culture of voluntary agreements between industry and the public authorities on environmental matters. As with the previous case, this experience will help with the functioning of the work teams.

8. A requirement for regulations on Environmental Impact Assessment (EIA) as a prior condition for the installation of an industrial activity. The fact of giving consideration (to a greater or lesser extent) to the environmental impact of an industrial facility before it is brought into operation creates a suitable environment for implementing the PPCS.

9. The existence of environmental legislation that covers all environmental issues (air, water, land, waste, etc.) and imposes emission limits for pollutant substances. As with the previous case, the existence of prior environmental legislation (the more demanding the better) and compliance with this legislation creates an environmental culture and awareness that is very important.

10. The existence of prior specific environmental legislation on cleaner production (the use of clean technologies). The existence of prior legislation in this respect and compliance with this legislation means that the new project will not entail a sudden change in the usual style of legislation to which the industry is accustomed.

11. The obligation for industry to take periodic measurements and submit regular environmental reports to the authorities. The PPCS will involve measuring and submitting regular reports on the environmental impact of facilities, which means that the existence of these requirements in the legislation in force and compliance with them will allow a simpler implementation of the new PPCS.

12. The prior existence of environmental legislation of a sectorial nature. The fact of giving consideration to different sectors separately in the environmental legislation in force and compliance with this legislation will favor the development of a project of this type, since the pollutant emission limits and other requirements resulting from the PPCS to be designed will be specific to each sector.

C) Financial assistance

13. The existence of financial assistance for implementing techniques and mechanisms for reducing the environmental impact at the origin of industrial processes (cleaner production). This will make it easier for companies to put BAT and BEP in place to comply with the new PPCS.

14. The existence of financial assistance for measures to reduce environmental impact other than cleaner production (e.g. end of pipe measures). Even though there is no specific assistance for cleaner production, they will make it easier for companies to use BAT and BEP to comply with environmental legislation.

15. The existence of financial assistance for modernizing industrial technology. The use of BAT will entail in many cases a modernization of technology (either process (preventive) or purely environmental (corrective)), which means that this type of aid will favor the implementation of BAT.

16. The existence of specific financial assistance for SMEs related to industrial or environmental technology. As indicated above, SMEs do not have large amounts of funds available to invest in environmental protection.

D) Bodies and organizations

17. The existence of universities offering industrial and environmental studies will favor the presence of qualified specialists to form work teams (professors, lecturers) and to join the industry (students).

18. The existence of R&D institutions related to industrial, environmental or cleaner production technology. They may also take part in the work teams set up to identify and select BAT and BEP and later provide technical support to the industry.

19. The existence of an official industry body which is widely recognized. The existence of a recognized industry spokesperson, particularly for each sector concerned, will favor the creation of work teams and their development as well as the acceptance of results by that industry

20. The existence of public lobby groups and other environmental lobbies which actively publicize the environmental impact of industry and its importance. These lobbies may be a another driver for industry to implement BAT and BEP.

E) Other factors

21. The existence of mechanisms to help industry find information on pollution control and clean production and financing opportunities.

22. The existence of a high percentage of companies with voluntary environmental management systems.

4. PRELIMINARY ANALYSIS AT FIVE MAP COUNTRIES

This chapter provides a preliminary diagnosis of the situation of five given countries, namely Croatia, Egypt, Israel, Slovenia and Syria[16], in relation to their starting point for being able to implement a PPCS such as that defined in this document. As we mentioned at the beginning of the guide, besides having the information that already exists at the RAC/CP, a questionnaire was sent to the participating countries to obtain further details on their starting point for implementing a PPCS based on BAT and BEP. The key matters for implementing the PPCS that were surveyed were as follows:

1. Industrial framework.

2. Main environmental impact associated with the industrial activity.

3. Political, academic and industrial organization.

4. Environmental, industrial and administrative legislation.

5. Individual expert's assessment on the suitability in the country of a PPCS based on the best available techniques (BAT) and the best environmental practices (BEP).

This preliminary analysis therefore consists of two basic elements:

a) First, in section 4.1., we identify the most problematic environmental issues relating to the most important industrial sectors. This provides an initial idea of where best to focus efforts to control and prevent pollution and which industries to target these efforts at.

b) Next, in section 4.2., we perform a preliminary benchmarking study of the institutional and legal framework in each country with a view to assessing the suitability of these frameworks for implementing the PPCS under analysis.

The conclusions drawn from this preliminary analysis of the countries mentioned are detailed below[17], along with a comparison, where possible, of the situation of the various countries.

[16] As mentioned in chapter 2, the countries were selected as a result of the particular interest shown by representatives from those countries in activities on BAT and BEP developed by the RAC/CP.

[17] Disclaimer: The information given in this chapter is based exclusively on prior information from the MAP (section 4.1) and that furnished by the national experts consulted.

4.1 Identifying and selecting the industrial sectors to be controlled

The largest environmental problems in the targeted countries reflect, to a large extent, their industrial history and their climatic and geographical circumstances. Industry has played a very important role in the history of these countries which has produced relatively high levels of pollutant discharges into water, air emissions and waste production, which, generally speaking, have not been managed in the most complete way possible until recently.

Moreover, in recent years tourism and urban development, combined with aggressive agricultural practices, have become another key factor contributing to pollution in these countries.

An initial overview of the environmental management landscape for industry in the targeted countries may be summarized as follows:

- ✓ Climate is a key factor with regard to water management. The Mediterranean countries under analysis have relatively dry conditions, particularly Egypt, Israel and Syria. These countries should therefore place particular emphasis on this issue when it comes to analyzing applicable BAT and BEP, as a basis for the PPCS to be implemented.

- ✓ As is to be expected, there are high levels of air pollution in the more industrialized areas of each country, often originating from the petrochemical industry, although the influence of other industries such as the cement, metallurgy and chemical industries cannot be disregarded. Each country should decide on the relative importance of these emission industries/points when applying the methodology set out in section 3, the first step of which is to select the sectors or industries targeted by the PPCS, based on the specific features of each country.

- ✓ Furthermore, we also identified that waste management (from the prevention stage through to the final management stage) was not very efficient for a variety of reasons. In particular, there has been a significant increase in waste generation in recent years and saturation at the final waste management points (especially in Egypt, Israel and Syria). It is also important to bear in mind the lack of space and waste dumps in certain countries (e.g. Slovenia, Israel and Croatia) which means more attention must be paid to preventive measures. Elsewhere, past industrial practices, combined with inadequate environmental management, have had a considerable impact on the land (e.g. Croatia, Slovenia and Syria).

  As it may be seen, industrial waste generation is a problem shared by all of the countries under analysis and should be taken into account when designing the PPCS, using the identified BAT and BEP as a point of reference.

Based on the completed questionnaires and the information already available, it may be seen that the main polluting industrial sectors are practically identical in the countries under analysis[18]:

- Cement industry
- Petrochemical and derivatives
- Chemical industry / agrochemical
- Food industry
- Ferrous/non-ferrous metal industries
- Textile, leather and/or tannery
- Pulp and paper industries
- Pharmaceutical industry
- Electric and electronic devices and machinery

On the other hand, there are other sectors that are of considerable importance in specific countries e.g. Shipyards (Croatia), the ceramic industry (Croatia, Syria), the glass industry (Croatia, Egypt), the wood industry (Croatia, Slovenia) etc.

The most typical pollutants in these sectors are detailed in the table below:

[18] Only industrial sectors have been included, as they are the target of this guide. Tourism, agriculture, urban growth and transport are also causes of serious environmental problems. Those sectors which have been identified as main causes in three or more countries have been identified.

Table 4. Main environmental features of the industries identified[19]

	AIR EMISSIONS					DISCHARGE TO WATER			WASTE	USE	
	Acids	NO_x	SO_2	PM	VOC	SS	COD/BOD/ Organics	Metals	Dangerous Waste	Energy	Water
Cement industry		■	■	■		■				■	■
Petrochemical and derivatives	■	■	■	■	*	■	■	■	■	■	■
Chemical industry/agrochemical	■	■	■	■	*	■	■	■	■	■	■
Food industry						■	■			■	■
Ferrous/non-ferrous metal industries	■	■	■	■	*	■		■	■	■	■
Textile, leather and/or tannery					■	■	■	■			■
Pulp and paper industries	■	■	■	■	■	■	■	■	■	■	■
Pharmaceutical industry					■		■		■	■	■
Electric and electronic devices and machinery				■	■	■		■	■		

(*) Depending on each particular case polychlorinated dibenzo-p-dioxins (PCDD), polychlorinated dibenzofurans (PCDF) and Polycyclic Aromatic Hydrocarbons (PAH) may also appear.

[19] The table shows the most significant pollutants in each industry. Other pollutants of relatively less importance are not included

Finally, the gaps and deficiencies found in the information provided in the questionnaires completed by the national experts of the countries included in the sample have made it impossible to carry out a diagnosis in terms of the economic profile of the main polluting industries. The intention was to draw up a basic profile of the industry structure in order to set limits on the pollution levels that would probably be higher than those currently in place and to draw some initial conclusions in this respect.

Nevertheless, at the very least, the following socioeconomic indicators should be analyzed to provide a guide for implementing the PPCS in each country:

- The industry's share of GDP (% of the total)
- Number of employees in the sectors (% of the country's total working population)
- Number of centers per sector
- Turnover per employee
- Number of employees per center

The first two indicators serve to gauge the specific socioeconomic weight of each sector within the national economies. This is important for assessing the sensitivity of the economy to pollution control measures, based on the potential economic impact in each industry.

The third indicator allows an assessment to be made of the level of atomization of each sector, and gives an idea of the dispersion of the generation of pollution, and therefore of the level of complexity when it comes to implementing the PPCS.

The turnover per employee allows a somewhat indirect evaluation to be made of the ease of implementation of the PPCS. In principle, the higher the ratio, the more likely it is that there are sufficient funds to invest in pollution control measures.

The number of employees per center allows us to gauge the average size of the companies to be targeted by the PPCS. The smaller the company, the more potential difficulties there are to implement pollution control measures, owing to a lack of available resources.

4.2 Institutional framework: benchmarking study of facilitating factors

4.2.1 Objective

This section contains a preliminary diagnosis of the situation of the countries referred to above in relation to the starting situation for defining and implementing a PPCS based on BAT and BEP. This diagnosis is based on an assessment of the facilitating factors defined in section 3.4., using the following methodology. [20]

4.2.2 Methodology

The methodology used to perform the analysis consists of providing a score, ranging from 0 to 2, for the current situation of each of the factors provided above in each country. The higher the score, the greater the ease of implementation of a PPCS based on BAT and BEP. The scores are determined as follows:

- A score of 2

  The factor concerned exists in the country and plays an active role and it offers tangible results.

  Examples:

  i. There is a Ministry exclusively for environmental affairs, with a department for the environmental affairs of industry which prepares, implements, completes or updates legislation on a regular basis, in conjunction with industry, and performs inspections, publishes annual reports, organizes conferences etc.

  ii. There are industry representatives who organize work teams for legislative and/or environmental affairs, working with the government, sharing information, etc.

  iii. There is environmental legislation which is generally complied with by the industry.

  iv. There are technically experienced cleaner production centers which have an in-depth knowledge of a particular industrial sector.

[20] Factors 6, 20 and 21 appearing in that section are not assessed as there was not enough information.

- A score of 1

  The factor concerned is at the design stage, was very recently created or already exists in the country but does not play a particularly active role, it does not offer tangible results and/or is not complied with in a generalized manner.

  Examples:

  i. There is a ministry of the environment which carries out a number of initiatives in relation to the natural and urban environment, but does not control industry or regulate a lot of issues in relation to the industrial environment.

  ii. There are industry representatives, but they are not cooperative in relation to environmental affairs and do not work with the public authorities.

  iii. There is environmental legislation but generally speaking industry fails to comply with it or is unaware of it.

  iv. There are cleaner production centers which have some technical experience, but lack in-depth knowledge of any of the industrial sectors.

- A score of 0

  The factor under analysis does not exist in the country in the terms defined by the methodology of the guide.

  Examples:

  i. There is no ministry of the environment.

  ii. There are no industry representatives.

  iii. There is no environmental legislation imposing limits on pollution.

  iv. There are cleaner production centers, but they are only involved in raising awareness and training, and have no technical experience.

As explained above, we only analyzed those facilitating factors for which we had obtained quality information for all of the countries from the questionnaires completed by the national experts from the countries taking part. Nevertheless, most of the identified factors were analyzed.

To enable analysis of the results, we have set them out in a table and a figure to give a visual presentation of the overall result of the assessment of each factor for the countries as a whole, the overall result for each country for the facilitating factors as a whole and the results of the evaluation of each facilitating factor in each country.

4.2.3 Results

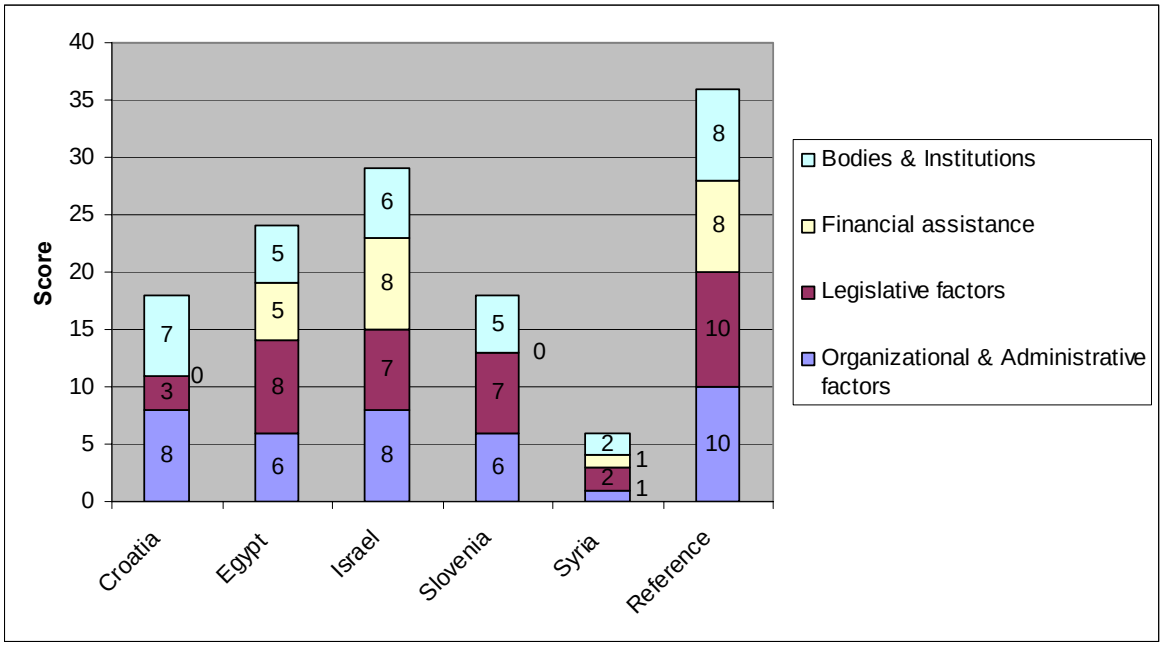
In accordance with the methodology described above, the results of the analysis performed are set out in the following table and chart:

Table 5. Preliminary diagnosis of the institutional situation of the countries under analysis based on the identified facilitating factors

	Croatia	Egypt	Israel	Slovenia	Syria
ORGANIZATIONAL AND ADMINISTRATIVE FACTORS					
Is there a specific ministry for the environment and does it play an active role in industry?	2	1	2	1	1
Is there an agency to support the implementation of environmental policy and does it play an active role in industry?	0	1	2	2	0
Do other ministries have sufficient environmental awareness?	2	1	1	2	0
Are there any plans or programs with regard to CP, or with a direct impact on CP?	2	2	2	0	0
Does industry take part in the design of environmental strategies, plans or programs?	2	1	1	1	0
Total organizational and administrative factors	**80%**	**60%**	**80%**	**60%**	**10%**
LEGISLATIVE FACTORS					
Are there any voluntary environmental agreements with industry?	0	1	1	1	0
Has environmental legislation on EIA or equivalent been implemented on a generalized basis?	2	2	2	2	1
Is there any environmental legislation that imposes limits on pollution?	1	2	2	2	1
Is there any environmental legislation on CP?	0	2	0	0	0
Is industry required to carry out periodic environmental controls or inspections (other than EIA)?	0	1	2	2	0
Total legislative factors	**30%**	**80%**	**70%**	**70%**	**20%**
FINANCIAL ASSISTANCE					
Is there any financial support for CP?	0	1	2	0	0
Is there any financial support for improving environmental issues generally?	0	2	2	0	0
Is there any financial support for modernizing industrial technology?	0	0	2	0	1
Is there any specific financial assistance for SMEs related to industrial technology or the environment?	0	2	2	0	0
Total financial assistance	**0%**	**63%**	**100%**	**0%**	**13%**
BODIES AND INSTITUTIONS					
Are there technical universities able to supply qualified staff in order to form work teams on BAT and BEP?	1	1	2	1	1
Are there any R&D or CP Centers which may take part in work teams on BAT and BEP?	2	0	0	0	0
Is there a recognized and active body of industry representatives?	2	2	2	2	0
Are there any environmental lobbies?	2	2	2	2	1
Total bodies and institutions	**88%**	**63%**	**75%**	**63%**	**25%**
TOTAL (average %)	**50%**	**67%**	**81%**	**50%**	**17%**

The table shows the individual score for each factor in each country, in addition to a series of percentages reflecting the level of satisfaction in each country for the factors mentioned. The evaluation is reflected in the figure below.

Figure 3. Score for the groups of factors and comparison with best benchmark value



The above chart shows the following:

Croatia obtained a score of 50% with respect to the benchmark score although, as a EU candidate country, it is currently in the process of harmonizing its environmental legislation with that of the EU, and will therefore also adopt the IPPC Directive. With respect to this country:

- ✓ There is a specific ministry for environmental affairs which plays a very active role in industry and could lead the project and help with putting it into practice. Furthermore, other ministries are sensitive towards environmental matters.
- ✓ Plans and/or programs with a direct influence on Cleaner Production are already in place, and the PPCS would therefore be a logical continuation of these measures.
- ✓ Industry takes part in the design of environmental strategies and/or plans and/or programs.

- ✓ There is a considerable amount of environmental legislation, including EIA, although this is not put into practice on a generalized basis.

- ✓ There is no specific legislation on Cleaner Production.

- ✓ There is no obligation for industry to carry out periodic environmental checks or inspections.

- ✓ There is no financial assistance support for environmental enhancement or specific assistance for SMEs, and this may hinder the implementation of new techniques and technologies by companies.

- ✓ The official industry representatives and R&D and Cleaner Production Centers can take part in the work groups necessary for the design of the PPCS.

- ✓ There are also environmental lobby groups.

Egypt has favorable conditions for implementing the PPCS, as it achieved 67% of the benchmark score of the diagnosis, due to the following general characteristics:

- ✓ There is a specific ministry for environmental affairs, which will facilitate implementation of the PPCS under its management, although this ministry should be more active with respect to the relationship between the environment and industry. Similarly, there is an Agency which could facilitate its implementation in industry, although it has not performed any similar tasks to date.

- ✓ Other ministries show a certain amount of sensitivity towards environmental matters, although this concern is not particularly widespread. The participation and commitment of other ministries and the government is necessary for successful implementation of the PPCS.

- ✓ There are already plans and/or programs in existence with a direct influence on Cleaner Production, and the PPCS would therefore be a logical continuation of these measures.

- ✓ Industry takes part in the design of environmental strategies and/or plans and/or programs, although this is not particularly widespread. Similarly, there are voluntary agreements, although they are not particularly widespread either. Industry must take part in the design of the PPCS, and therefore previous experience of cooperation provides a favorable starting point.

- ✓ There is a considerable amount of environmental legislation, including EIA, which is put into practice on a generalized basis, thus providing a favorable basis for the implementation of the PPCS.

- ✓ There exists specific Cleaner Production legislation which is applied, and its direct relationship with the PPCS means that the process can be considered to have started.

- ✓ There is legislation requiring compulsory periodic controls and inspections by industry, although this has not yet been put into practice on a generalized basis. The PPCS touches on this aspect and its existence is therefore considered to be favorable factor.

- ✓ With regard to financial assistance, there are some incentives for environmental enhancement, particularly for SMEs. Implementing the PPCS could require an outlay for companies, and therefore the existence of specific financial assistance, particularly for companies with fewer financial resources, is considered to be a favorable factor.

- ✓ The official industry representatives can take part in the work groups needed to design the PPCS.

- ✓ In addition, there are environmental lobby groups.

In **Israel** we can see a significant environmental culture (81% of the benchmark score), which allows an ambitious and highly-developed PPCS to be implemented. The favorable characteristics for its implementation include the following:

- ✓ There is both a ministry and a specific agency for environmental affairs which are also highly active in industry and could lead the project and facilitate its implementation.

- ✓ Plans and/or programs with a direct influence on Cleaner Production are already in place, and the PPCS would therefore be a logical continuation of these measures.

- ✓ Although not particularly widespread, there are voluntary agreements between government and industry, and industry takes part in designing environmental strategies and/or plans and/or programs. Industry must participate in the design of the PPCS, and previous experience of cooperation is therefore considered a favorable factor.

- ✓ There is a considerable amount of environmental legislation, including EIA, which is put into practice on a generalized basis, and this favors the implementation of the PPCS.

- ✓ Industry is required to carry out periodic checks and inspections, and this obligation is generally satisfied.

- ✓ With regard to financial assistance, this is one of Israel's clear strengths, as there are subsidies for environmental and technological improvements, including specific assistance for SMEs, which will facilitate the implementation of new techniques should this be required.

- ✓ Official representatives from industry and even from academic institutions can take part in the work groups necessary for the design of the PPCS.

- ✓ There are also environmental lobby groups.

Slovenia obtained a score of 50% with respect to the benchmark score, although as it recently entered the EU, it will have to adopt the IPPC (Integrated Pollution Prevention and Control) European Directive, which entails the implementation of a PPCS based on BAT and BEP. With respect to this country, the following points are worth highlighting:

- ✓ There is a specific ministry for environmental affairs, which will facilitate the implementation of the PPCS under its management, although the ministry should be more active with respect to the relationship between the environment and industry. There is, however, an agency which does play an active role in this area. Furthermore, there are other Ministries which are sensitive towards environmental matters, and their backing of the PPCS may prove crucial.

- ✓ There are no plans and/or programs with a direct influence on Cleaner Production which could serve as a "bridge" for the implementation of the PPCS.

- ✓ Although this practice is not very widespread, industry does take part to some extent in the design of environmental strategies and/or plans and/or programs. Similarly, there are some voluntary agreements in place, although these are not particularly widespread.

- ✓ There is a considerable amount of environmental legislation, including EIA, which is put into practice on a generalized basis, and this will favor the implementation of the PPCS.

- ✓ There is no specific legislation on Cleaner Production.

- ✓ Periodic checks and inspections must be carried out by industry, and this obligation is generally satisfied.

- ✓ There is no financial assistance for environmental enhancement or any specific assistance for SMEs, a fact which would hinder the adoption of new techniques and technologies by companies.

- ✓ The official industry representatives can take part in the work groups necessary for the design of the PPCS.

- ✓ There are environmental lobby groups.

Syria has obtained a poor score and this may reflect that the implementation of the PPCS can be difficult.

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