ScorePP is a Specific Targeted Research Project (STREP) funded by the European Commission under the Sixth Framework Programme

Report identifying socio-economic benchmarks

Deliverable No: D8.4, Date: 6th May 2010
Dissemination level: PU

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Source Control Options for Reducing Emissions of Priority Pollutants (ScorePP)
Sixth Framework Programme, Sub-Priority 1.1.6.3, Global Change and Ecosystems
Project no. 037036, www.scorepp.eu, Duration: 1 October 2006 – 31 March 2010

Deliverable number:	D8.4
Deliverable title:	Report identifying socio-economic benchmarks
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Review and assessment:	Primoz Banovec, University Lubljana
Date submitted to project coordinator:	2010-02-23; 2010-05-06
Approved by (Work package leader):	2010-05-06
Approved by Project Coordinator:	2010-05-14

Abstract (max. 200 words)

This deliverable explains and details meaningful socio-economic benchmarks in relation to technical options for reducing emissions of Priority Pollutants. A selection of the most useful benchmarks for end users is made on the basis of their usefulness in implementing a decision-making process.

The use of these benchmarks is explained at the macro and micro level. They are classified in three categories (situation, impacts and constraints). This report emphasizes that cost and benefit criteria is only one factor among many, particularly at the local level. They have a more or less important weight in the decision making process according to their impact on the financial means of each stakeholder and also according to various constraints which may have an impact. In some conditions the distribution of charges between stakeholders, the time to write off the costs and also the human resources to implement and manage the studied options are more important.

The local authorities have a key role in benchmarking emission control strategies: achieving treatment, distributing charges, inspecting, heightening public awareness and interfacing between central state and local conditions. They therefore can and must manage the discussions with the aim that different social and economic interests should meet.

Acknowledgement

The presented results have been obtained within the framework of the project ScorePP - “Source Control Options for Reducing Emissions of Priority Pollutants”, contract no. 037036, a project coordinated by Department of Environmental Engineering,, Technical University of Denmark within the Energy, Environment and Sustainable Development section of the European Community’s Sixth Framework Programme for Research, Technological Development and Demonstration.

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Acronyms

BAT:	Best Available Techniques
BMP:	Best Management Practices
EB:	Emission Barriers
ECS:	Emission Control Strategy
ES:	Emission Strings
IPPC:	Integrated Pollution Prevention and Control
GDP:	Gross Domestic Product
LCA:	Life Cost Analysis
MCA:	Multi Criteria Analysis
O&M:	Operating and Maintenance
PHS:	Priority Hazardous Substances
PP:	Priority pollutant
SCOREPP:	Source Control Options for Reducing Emissions of Priority Pollutants
WFD:	Water Framework Directive
WWT:	Waste Water Treatment
WWTP:	Waste Water Treatment Plant
WP:	Work Package

1 INTRODUCTION

1.1 Reminder of socio-economic analysis objectives

The main goal of socio-economic analysis is to assess the feasibility of source control strategies proposed in SCOREPP in order to reduce emissions of priority pollutants (PPs) from urban areas into the receiving water environment.

This socio-economic feasibility assumes that various end-users could have at every geographical level a clear and precise vision and comprehension of : 1) the specific initial situation (To), (2) the economic and financial effects that strategies or combination of strategies (e.g. one part of substitution and several treatment actions) cause at short and long term, (3) the potential economic and social impacts of these strategies and finally (4) the constraints which are necessary to take in account.

Tasks 82 and 83 have resulted in:

- Identifying the available information in the economic, institutional and social fields;
- Assessing the quality of this information under analysis to be undertaken;
- Noting the heterogeneity of available data on the one hand the socio-economic field and on the other hand the technical field (concerning substitution, reduction of use and treatment) for the definition of the ECS.

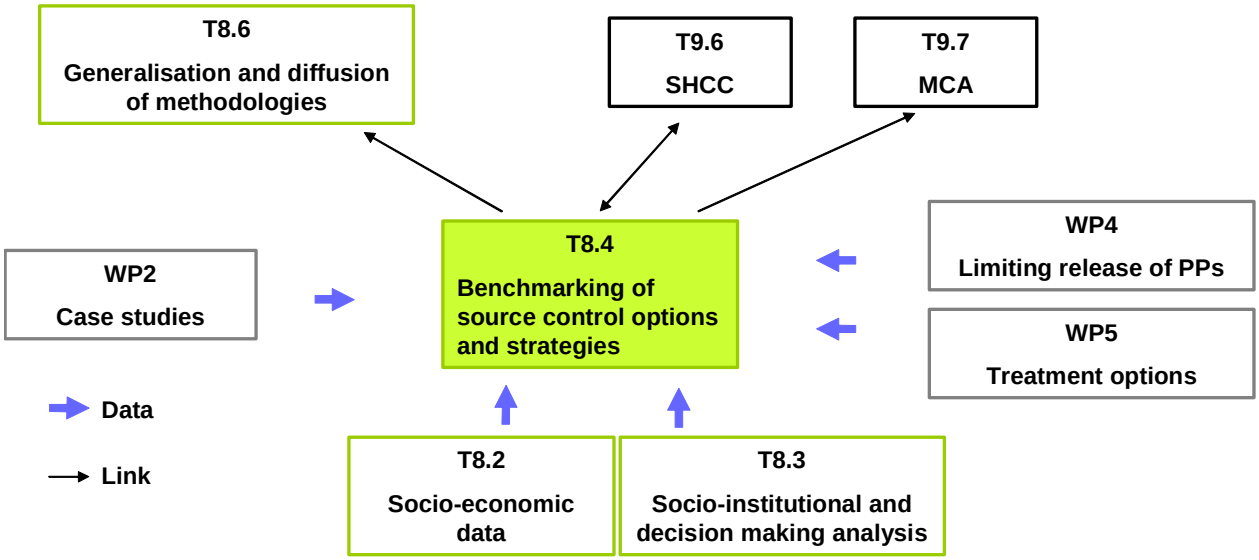
1.2 Objective and content of this report

In ScorePP, the task 8.4 is a contribution for benchmarking the source control options and strategies to limit the release of PP's from a socio-economic point of view and considering LCA.

The objective of this task is to review, from information gathered within other tasks and WPs, how to implement socio-economic criteria to technical options and strategies of control set at the conclusions of WP4 and 5 with respect to substitution and treatment of wastewaters or stormwaters. The diagram below visualises the different links between this task and others in the ScorePP project.

This deliverable is a part of this task. It explains and comments the meaningful socio-economic benchmarks in relation with technical options. A selection of the more useful benchmarks for end users is achieved on the basis of their concrete situation for implementing a decision-making process.

Figure 1 : Connection of 8.4 with other Tasks and WPs in ScorePP Project



Considering these objectives, the socio-economic benchmark work consists of:

a) Selecting and clarifying the socio-economic criteria to be considered in the analysis of options and strategies of source control of release of PPs. Thus it enables the consideration of only the essential and the criteria for which data may or may not exist (Chapter 2).

b) Describing the sequence of issues to be solved by the decision makers (Chapter 3).

c) From this point, it is necessary to operate the main conclusions of the work in tasks 4.5 and 5.6 and identify the best strategies technically feasible for each of the 12 PPs selected (Chapter 4).

d) On the basis of chapters 1 to 4, this chapter 5:

- reminds which stakeholders are concerned by the different possible EB;
- proposes three categories of benchmarks useful to decision-makers (benchmarks linking technical, economic and institutional criteria);
- expose a short list of the most key benchmarks (respectively at macro and micro level).

This chapter deals with:

- at the local level, how to evaluate the local situation, to score socio-economic benchmarks and to manage the process of discussions and negotiations between all the stakeholders;
- at the macro level, how to make point of the situation and use socio-economic benchmarks.

Conclusions and recommendations for further work are detailed at the end of the deliverable.

1.3 Reminder of methodological approach of socio-economic aspects

The application of socio-economic approach to the emission control strategies (ECS) is performed under this task with reference to methodological options defined in the framework of Task 9.5 and is consistent with the methodology outlined in the framework of Task 8.1.

This will insure consistency between this task and the macro-economic model. The results of the two tasks will be jointly used in Tasks 9.6 and 9.7.

The main methodological options selected for the socio-economic approach can be summarized as follows:

1) References as accurate as possible to initial situations (To) are made in the interest of realism which is at the heart of decision-making systems.

2) To characterize and quantify whenever possible the potential changes introduced by the different ECS which emerged in relation to the situation in To. Those characteristics of change fall into three main groups: `

- Costs and benefits involved in each emerged ECS take into account the contexts in which they would be applied. These costs and benefits are complex. The benefits are almost impossible to quantify. It should be taken into account that direct costs (e.g. treatment) represent a portion of actual costs of the implementation of a strategy. The costs of prevention, reusing and control may represent a third of total costs.

- Identification and measurement of socio-economic and institutional impacts produced by each emerged ECS; the distribution of expenses, benefits, powers and responsibilities among the main stakeholders; the relative weight of these potential impacts on resources and capacities of these stakeholders.

- Identifying and taking into account the constraints associated with different contexts in which the ECS would be applied (e.g. land availability, the complexity of decision systems or the autonomy of individual stakeholders having an influence on the consistency in the implementation of the ECS).

Finally it is essential to remember that:

- Available data on socio-economic and institutional field are rarely specific to each PP.

- The practical conditions of emission source control of PPs are such that:
  * Excepting the strategic elements of substitutions or use reductions of a PP, the possible ECS are mostly combinations of elements of strategies (substitution, source treatment, collective treatment or rehabilitation of environment).
  * The ECSs concern for a significant part:
    - Several PPs in the same time
    - Improvement of the treatment for all the water pollution (including PPs)

- Taking into account time is important for decision makers who want control over what period (short, medium or long term) efforts are being made, loads are being supported and investments are being depreciated.

- In respect to long term impact it is not possible to precisely quantify these impacts on LCA but it is possible to caracterize them as low, medium or high as was done with the analysis of substitution treaments (cf. WP 4 and WP 5°).

2 BENCHMARKING CRITERIA OF SOCIO ECONOMIC FEASIBILITY of ECS

The socio-economic feasibility must be understood in the context of this work, as the consideration of not only economic and financial elements but also the social and institutional elements (or the relationships between stakeholders).

The socio economic criteria of feasibility presented in this report deal with the comparative analysis of source control strategies of PP releases.

This feasibility is necessarily assessed at two spatial levels: the macro and meso / micro level. (Cf. 2.1)

It takes into account 5 categories of criteria (Cf 2.2)

1 - The initial situation at the macro level
2 - The initial situation at the micro and meso level
3 - Costs and benefits of proposed strategies
4 - Social and economic impacts of the strategies
5 - The constraints (other than technical) to implement the strategies.

2.1 Two levels of spatial analysis of socio-economic feasibility

The two levels are macro level and micro / meso level.

2.1.1 Territories and specific stakeholders at each level

The macro level corresponds to extended spatial groups with various situations and issues. The factors taken into account are analyzed in their aggregated form (all investments, all companies, and the industrial sector). As has been indicated in D.8.1 (methodological paper on the approach by the macro-economic model), given that data are available only through national accounts, the macro level selected in the ScorePP study was defined as individual member countries or the whole EU.

At this level the main actors are in addition to the EU Commission and the central member states, trade unions of companies by sector or their associations at European level (e.g. Eurochlor) or the chemical industry union, or the metallurgical and mechanical industry unions in each member country.

The micro level represents territorial units in which questions of source control discharges of pollutants are treated by a public authority responsible of their territory and the implementation of legislation. The concerns in this study – focused on pollution in urban areas – cities or agglomerations of municipalities constituting an area managed collectively. Their interlocutors are resident households, individual companies or their local groups. Private companies of water supply and waste-water treatment services also step in when the public service is delegated or as providers of technical services for companies.

The meso level in this study corresponds to the river basin level, the spatial framework in which some issues or actions and controls of water pollution are managed by specific structures with particular reference to the WFD. In several EU countries, some decentralized state services (provincial or district) are involved in the meso level.

2.1.2 Specific elements of source control of release of PPs depending of these spatial levels

Strategies for source control of release of PPs may include various elements, including legislative measures and their implementation, voluntary or the authorised substitution of used products, imposed rules on voluntary efforts to reduce the use of some pollutants, and either individual actions or collective treatment...

Legislative or regulatory measures and substitution decisions are largely decided at the macro level. It is also the case for voluntary actions to reduce the use of some pollutants. However, actions concerning treatments and voluntary reductions of the use of PPs by users are typically measures at the micro / meso level. It is also the case for controls.

2.2 Categories of criteria to consider

Five categories of criteria are considered:

Category 1: Criteria characterizing the situation in To at macro level
Category 2: Criteria characterizing the situation in To at the micro and meso level
Category 3: Criteria of costs
Category 4: Criteria of economic and social impacts of strategies
Category 5: Non technical constraint criteria concerning implementation of strategies.

2.2.1 Category 1: Criteria characterizing the initial situation at macro level

Comparing ECSs assumes to have a clear vision of the situation these strategies will apply.
The situations at macro-level are characterized by specific criteria:

2.2.1.1 Economic data on pollutants and polluting activities

They are:

- Production, imports and consumption for each PP in the EU and each member country. The tonnages and the values of these flows are usable.

- Identification of polluting economic activities existing in each member country and EU and their importance in terms of added value and employment. The list and the percentage of Gross Domestic Product (GDP) is an appropriate indicator.

- In parallel, identification of economic activities which are sensitive to water pollution (i.e. activities that are affected by the pollutants such as fishing, tourism, some farming activities). This can be characterized by the proportion of jobs concerned or the percentage of added value for each activity listed.

- The type of water resources mainly used for each country (surface water or ground water) which pollution processes are different. This is an indicator of issues for each country. The proportion of surface water used is a useful indicator.

2.2.1.2 Economic data relating to the general level of treatment facilities

It is important to have an indicator of the level of treatment facilities which can be compared to the objectives laid down by the WFD. The data often being difficult to compare from one country to another, the amount of investment per capita required to achieve the standards of the WFD is then a good global indicator. It enables the taking into account of the age of the infrastructures in some countries with old facilities but which have been unable to regularly renew their systems.

2.2.1.3 The socio-institutional data relating to the implementation of the WFD

In principle, all member countries have to implement the WFD and deadlines imposed to meet the standards set are different according to the countries. The first important indicator is the degree of implementation of the WFD into national legislation. The second and more difficult to collect is the proportion at national level, of non-regulatory situations.

2.2.1.4 General data on institutional structuring of water and water pollution management

According to the countries, the distribution of responsibilities for water management (production of drinking water and for other uses, waste-water treatment, and the protection of water resources) and the level of decentralization in decision-making vary very strongly.
This leads to complex situations very variable in discussion between stakeholders, decision-making and implementation concerning the choice of strategies and controlling their impacts.

The following table summarizes the indicators for each criterion and the units used to quantify them.

Table 1 : Indicators for the first category of criteria: initial situation at macro level

	Type of information	Indicator	Unit
Criteria 1: Economic data on pollutants and polluting activities			
	Macro data on PP in EU	Production of each PP in EU Import of each PP in EU Consumption of each PP in EU	Tons and values Tons and values Tons and values
	Economic activities	Pollutant activities (per sector)	- List of branches per level of its potential to pollute - % of global added value
		Sensitive activities affected by the water pollution	- List of branches - % of global added value - % of global employment
Criteria 2 Economic data relating to the general level of treatment facilities			
	Global level of water treatment facilities	Amount of investment needed to reach WFD standard	€/inhabitant
Criteria 3 Socio-institutional data relating to the implementation of the WFD			
	Implementing regulations	Progress in transposing EU directives on water and pollutions	Degree of implementation % of facilities in violation
Criteria 4 General data on institutional structuring of water management			
	General organisation	Stakeholders and distribution of responsibilities	List and number of levels of decision

2.2.2 Category 2: Criteria characterizing the initial situation at micro and meso level

The situations at micro and meso level (intermediate level) are characterized by specific criteria for each level and common criteria for both levels applying to limited areas.

The situations at micro-level are characterized by specific criteria:

2.2.2.1 The geographical and demographic context

The demographic and geographical context enable knowledge of the constraints linked to the urban and land characteristics of the area studied. It also enables evaluation of the population and its dynamics. This type of data is an essential basis for any socio-economic study and will be used at each stage of analysis to plan out the ECS (assessment of the demand, capacity of financing and facility sizing).

Geographically, these criteria are concretely:

* The size of the area (the city or agglomeration or river basin)
* The importance of the coastal character of the area
* The importance of the cross-border character of the area (meso level)
* The relief
* The degree of dispersal housing.

On the demographic field, they are:

* Permanent residents
* Households (in a statistical sense)
* The seasonal population (tourist areas)

2.2.2.2 Situation concerning water pollution

The assessment of the situation in terms of water pollution occurs over the entire emission string and there are numerous indicators. However, the following indicators synthesize a global situation at the scale studied and enable a quick assessment of the potential level of pollution on the area:

- Major water pollutants observed of which PPs
- Economic activities potentially polluting
- Economic activities sensitive to water pollution
- Final destination of sludge produced by the treatments (% spreading, incinerated, buried).

Emission strings were the object of a detailed study in the ScorePP report, specifically in WP3,6 and 7. A basis of information was developed which forms an important tool in describing local situations and the identification of problems needing to be solved.

2.2.2.3 The state of facilities for wastewater treatment

The indicators below give an overview of the situation of the various waste-water facilities in the area: WWTP, sewage networks, on-site-treatments and the various flows of each emission. This will be the starting point for improving the WWT systems:

- The collective treatment of waste-waters (capacity, number of units and portion of treated waste-waters)
- The storm-water treatment (capacity and proportion of treated storm-water)
- The state of sewage networks (combined or separate sewage, length)
- Direct treatments by companies or polluting economic activities (capacity and proportion of industrial treated water, percentage of industrial waste-water discharged after treatment to the WWTP)
- Direct treatments by households (percentage of water consumption treated) before release into the collective network
- Autonomous treatment of households (percentage of water consumption treated)

An indicator gives an overview of all the efforts provided to have an updated WWT system which is the amount of investment needed to reach the WFD standard. This is also an objective to aim for.

2.2.2.4 Economic context

Three indicators enable the assessment of the current level of financing efforts for the three main categories of stakeholders that have to bear the WWT expenses. The extra costs involved by the chosen ECS will be then assessed from the basic information provided.

- Current prices for water and WWT for different categories of users: this gives the current price of the services but also the potential leeway that local authorities could have for increasing the price in case of future investments ;
- Current investment budgets and operating expenses of municipalities, companies and households in WWT: any decision for new investments will lean on this basic information;
- Size (turnover and employment) of companies involved in pollution of water (emitting or sensitive): this refers to current financial effort that companies could provide.

2.2.2.5 Institutional structuring of water management in the area

This criterion gives information on the context in which the decision process occurs. The mode of management and the complexity of the decision making process is approached here:

- Degree of privatization or delegation of water and WWT services
- Degree of complexity in the distribution of responsibility for water and WWT

2.2.2.6 Structuring of relationships between stakeholders

The following indicators clearly highlight the relationships between stakeholders:

- Existence of discharge conventions with potentially polluting companies
- Existence of educational actions, awareness actions and consultation with users

- Existence of incentive measures to reduce pollution of water

Table 2 : Indicators for the second category of criteria: initial situation at micro/meso level

	Type of information	Indicator	Unit
Criteria 2.1: The geographical and demographic context			
	Geographical features	Area Relief Coastal situation Cross border situation Type of housing	Km² Hilly/not hilly Yes/No Yes/No Dispersed/Not dispersed
	Demographic features	Permanent residents Households Seasonal population	Number Number Number
Criteria 2.2: Situation concerning water pollution			
	General pollution	Major water pollutants observed of which PPs	List with standard exceeded
	Economic activities affected	Economic activities potentially polluting Economic activities sensitive to water pollution	List of employment List of employment
	Sludge	Final destination of sludge produced by the treatments	Tonnes and % for spreading, incinerated and buried
Criteria 2.3: The state of facilities for wastewater treatment			
	State of facilities	Collective treatment of wastewaters Stormwater treatment Sewage networks Direct treatments by companies Direct treatments by	Capacity Number of WWTP % of wastewater treated Quality level/standard Capacity Number of units % of stormwater treated Km of combined network Km of separated network Quality level Capacity Number of companies % of treated industrial wastewater % of treated industrial wastewater discharged into the collective network Quality level/standard % of water consumption of

		households Autonomous treatment of households Amount of investment needed to reach WFD standard	households Quality level/standard % of water consumption of households Quality level/standard €/inhabitant
Criteria 2.4: Economic context			
	Price of WWT	WWT price	€/m3 (micro) €/m3 mini and maxi (meso)
	Cost of WWT	WWT investment cost/ local stakeholders WWT operating cost/ local stakeholders	€/inhabitant (Local authority) €/m3 (companies) €/Household €/inhabitant (Local authority) €/m3 (companies) €/Household
	Company profile	Size of companies	Turnover (€/year) Number of employment
Criteria 2.5: Institutional structuring of water management			
	Management mode	Degree of privatization or delegation of water and WWT services	% of wastewater services privatized
	Decision making process	Distribution of responsibilities	Number of decision grades or autonomous stakeholders
Criteria 2.6: Structuring of relationships between stakeholders			
	Modality	Contracts and conventions Information and training actions Incentive measures	Existence or not Existence or not Existence or not

2.2.3 Category 3: Criteria of costs

These costs relate specifically on the one hand actions to reduce the PPs by substitution of products used or reducing the use of PPs; on the other hand actions to wastewaters or stormwaters contaminated by PPs.

Other than excepting the increases of activity for the producers of substitutes and sensitive economic activities, the benefits are often cost reductive for some categories of stakeholders (such as reducing health care expenses among users, or the reduction of treatment costs for companies producing drinking water).

The cost criteria show three categories of costs: investment, operation and controls.

2.2.3.1 Application field of the costs

They apply to the substitution actions:

- Changes in the production of PPs (loss of investments which are not yet fully depreciated, decrease of turnover)
- Changes in the production of substitutes (investment needed to increase production, increase of turnover ...)
- Changes in production processes among users

They apply to actions relating to water contaminated by the PPs:

- The collective treatment of wastewater in WWTP by municipalities
- The collective treatment of stormwater by municipalities
- Treatments by companies or other major users
- Treatments by individuals

In terms of contaminated water, in addition to the treatment (pre-treatment and treatment), the costs of pollution prevention and the costs of recycling or recovery of waste water should also be taken into account.

2.2.3.2 Indicators and their availability

Regarding the possibilities of substitution, only the macro-economic approach enable the assessment of the economic values of the changes introduced.

Regarding the treatment options:

- Direct costs of treatment for each PP according to the usable processes are measurable by means of reference costs. However, in such cases, there is no usable information on the costs of controls specific to the facilities in polluting companies.
- The available information is not specific to any PP concerning collective treatment of either waste-water or storm-water. However the available reference costs enable the ability to distinguish between 1) the treatment of metals and toxic products, 2) the treatment of hydrocarbons, or 3) other filtrations. Other reference data are also available for additional expenses related to treatment, such as, the elimination of

pesticides not used or the creation of ponds for protection. There is also information on the costs of implementation or adjustment of the networks.

- As regards to the WWT in households, only data on the overall treatments possible to use are available for autonomous treatments.

2.2.3.3 Examples

- *Specific Treatment: case of benzene treatment by industrial processes*

The table below shows types of cost estimations which can be made for the treatment of one PP in particular according to two different types of processes.

Table 3 : Costs of treatment of Benzene by industrial process[1]

Category of cost	Process B14: Stripping	Process B9: Adsorption
Investment cost	1.0 – 165.0 €/m3/h	1.5 - 14.3 €/m3/h
O&M cost	5 €/m3	1200 – 5000 €/ton GAC 0.1 €/m3 wastewater
Control cost	*	*

*Not determined

- *Non Specific Treatment: case of WWTP*

The table below shows also types of cost estimations which can be made to improve treatments in the context of a collective WWT. This therefore takes into account the network costs and variants according to the level of performance targeted.

This example deals with the improvement of treatment of metals and toxic products through the strengthening of a WWTP in a 50,000 inhabitant's city.

Table 4 : Costs for improvement of networks, new WWTP and additional investment

Category of cost	Adaptation of networks into separative	New WWTP	Additional investment to improve the treatment
Investment cost Depreciation cost / year	115 millions € 1.44 millions €	10 millions € 0.4 millions €	4 to 25 millions € 0.4 to 2.5 millions €
O&M cost	1.7 millions €	0.3 millions €	0.12 to 0.75 millions €
Control cost	?	?	?

In this example, if the WWTP is relatively new and is already reaching the European standards, only the additional investment to improve the treatment remains to be provided and resulting in the possible doubling of the network to make it separate.
The additional investment has an average cost of about the basic WWTP cost.

[1] *Laura Raggatt, Lian Scholes, Mike Revitt (2009).* Feasibility of treatment options: Comparison of the approaches evaluated to maximise removal of PPs.Deliverable No: D5.6

We also note the importance of investment in the collecting network even if its depreciation cost over a longer period approximates a range of depreciation cost between one of the networks and the WWTP.

2.2.4 Category 4: Criteria of economic and social impacts of strategies

These criteria are determinative. Indeed, beyond the circumstances and costs induced by each of the proposed ECS, potential impacts will directly influence the positions taken by different stakeholders. These criteria express the weight in relative terms of these strategies on the resources of each of the stakeholders, their responsibilities and on the sustainability of the environmental situation.

These criteria concern thus three fields:

1) The direct economic impacts
2) The impact of social and institutional nature
3) The impacts on the environment

They can usefully be appreciated at all levels (macro, meso and micro).

2.2.4.1 Direct economic impacts

They have to be specifically considered for each main category of stakeholders i.e. public authorities, companies and households.

For local public authorities, the sensitive economic impacts are:

- The amount of investment required by each strategy (or elements of strategy in the case of a combination of actions) on the total investment budget of the local communities. The change these amounts may induce in relation to the total annual investment for WWT of local public authorities has to be assessed:
  - Given the possibilities of grants by central organisations or river basin districts, the indicator to consider is the net investment that the local communities have to bear.
  - Given the possibilities of financing by borrowing, the indicator to consider is the net annual cost on resources of local communities.
- The net change of amount of operating expenses concerning WWT. It should be taken into account that these operating expenses are recurring.

For river basin districts, the economic impacts are primarily linked to the amount of subsidies that are granted, and according to the ECS chosen by local the authorities working in partnership with them.

For central public authorities, the economic impacts are most often directly linked to environmental impacts. However, in countries where cost recovery is not yet complete and where funding for WWT are still wholly or partly supported by taxes, the choice of strategies has a direct economic impact on the finances of the State.

For households (and companies treated as individuals), the economic impacts occur on two points:

- The changes in the price of WWT in the water bill;
- The expense relative to incomes according to the household resource level;

Additionally, the case studies show the importance of taking into account both the importance of the price increases in recent years and the local level of that price compared to similar locations of the same region or area.

A third indicator has to be taken into account when the ECS assumes that households invest in treatment facilities before discharging into the collective network or in their own on-site treatment facilities: the amount of investments (net of grants) relative to household incomes.

For companies, it is necessary to distinguish the impacts for companies producing PPs or substitutes, the impacts for companies using PPs and finally the impacts for companies sensitive to the level of pollution.

For companies producing PPs, the impacts will depend on the importance of the production reduction and in particular if a total ban or only a ban on some uses will occur.
The impact should be assessed not by gross but by net when the substitute product is manufactured by the same company.
These impacts are assessed at the macro level.

For companies using PPs which may treat their effluence before discharge, impacts are assessed in terms of investment relative to their turnover, in particular additional operating expenses related to such treatment and expenses of control. The real impact of these cost increases varies significantly depending on whether or not the companies concerned are likely to pass on these costs in their sale prices and therefore on to their consumers (households or companies in case of intermediate products).
For these companies, the ECS are also sensitive to the contributions they pay for their discharges into the general network. These contributions could, depending on municipal policies, increase the expenses of companies (a part of which is transferred to individuals) or otherwise enhance the charge with a progressive tariff system set according to the volume consumed and discharged (a policy adopted in recent years by some large cities).

For companies working and producing equipment for treatment facilities, the impact on the demands on the amounts of investment remains. Its measurement is more reliable at the macro-economic level.

2.2.4.2 The impact of social and institutional nature

Three predominate impacts are identified as follows:

1) Changes in employment
2) Changes in the actors involved
3) Changes in sensitivity to the environment.

Changes in employment

The changes in employment must be assessed:
- At the macro level as regards the choice of the ECS related to substitutions (net effects)
These impacts can be positive in the EU if the substitute products are manufactured in the EU whereas the PPs substituted come from imports. They may be negative in the opposite case. They can be quantitatively negligible if the destruction and creation of jobs are balanced. In this case, however, there may be some repercussions if the location of production is not the same.
- Meso or micro level concerning the effects on employment of activities sensitive to pollution that will benefit opportunities of development or resumption of activity.
The employment impacts are measured in number or percentage.

Changes in the involved stakeholders

Referring to different case studies conducted under ScorePP, four changes tend to occur in this area in connection with the implementation of the WFD and more generally with the strengthening of the efforts to reduce water pollution:

1) A greater involvement of individuals to contribute for the limitation of diffuse releases (or to invest directly in on-site treatment before discharge into the sewage network).

2) A greater involvement of companies using PPs in the direct treatment of effluents, the control of discharges in the collective sewage network (including the reduction or removal of direct discharges into the environment) and in sludge management.

3) A significant involvement of professional associations using or producing PPs to develop and support voluntary programs leading to the reduction of some substances or removal of some uses.

4) The development of consultations between cities under agglomerations and between national or international inter-areas under river basin districts.

The different ECSs variably use such changes. It is useful to take into account these impacts through simple notations:
No influence: 0
Low influence: 1
Direct influence: 2

Changes in sensitivity to the environment

This type of impact is difficult to measure. However, some ECSs will have an impact on the sensitivity to the environment because they involve their defined user associations, collectives, individuals and companies by providing information, education and activities.

2.2.4.3 Environmental impacts on L.C.A.

The impacts induced by the implementation of ECS are in principle positive and provide benefits in particular collective benefits.

Two criteria can be particularly used:

1) The impact on health expenses
2) The impact on the overall environment expenses.

The long-term reduction of health expenses

Reducing PP pollution of water will have some impact on the decrease of several diseases (e.g. cancer, thyroid disorders). The various specialized research in this field have shown that it was difficult to significantly measure corresponding benefits which will be in any case staggered and spread over time. However it is still interesting to characterize some ECS based on anticipated effects (low, medium or high) on the decrease of some diseases.

The indicators have to be chosen according to the identified sanitary consequences linked to each PP identified in the area studied.

The impact on the overall environment expenses

Insufficiency of source control of release of PPs necessarily entails a gradual accumulation of pollutants in sediments, groundwater, in some soils after sludge spreading and into the sea after terminal discharges in surface waters.

The implementation of the ECSs, are expected to reduce costs for the rehabilitation of the environment supported by central organisations (macro level), intermediate organisations (meso level) and local organisations (micro level).

These collective benefits would balance the additional expenses borne by the users of PPs to ensure treatments.

This type of benefit is not quantitatively isolated in all expenditures related to the rehabilitation of the environment. However it is possible to assign a positive coefficient for the ECS designed especially for PPs that are identified as non-degradable and as tending to accumulate.

Ces difficultés dans les measures illustrent la remarque générale faite dans l'introduction concernant l'impossibilité actuelle de mener une LCA au sens stricte en matière de strategies de contrôle des PPs.

Table 5: Indicators for the fourth category of criteria: Impact of strategies

	Type of information	Indicator	Unit
Criteria 4.1: Direct economic impacts			
Local public authorities			
	Investment expenses	Net investment	€/year
	Operating expenses	Net change of amount of operating expenses	%
	Weight on total resources	Net annual cost on resources of local communities.	%
River basin district			
	Investment expenses	Amount of subsidies they grant	€/year
Central public authorities			
	Investment expenses	Amount of subsidies they grant	€/year
Households			
	WWT annual expenses	Price of WWT Average cost on annual incomes (medium income) Average cost on annual incomes (low income)	€/year % %
	Investment for on-site treatment	Investments (net of grants) relative to household incomes.	%
Companies producing PPs (macro level)			
	Production change	Amount of production reduction of PPs Amount of production increase of substitute Change of turnover	€/year €/year %
Companies using PPs			
	On-site treatment cost	Investment relative to their turnover Additional operating expenses related to turnover Expenses of control related to turnover	% % %
	WWT annual expenses	Global cost for treatment (including bills and taxes) related to turnover	%
Companies working and producing equipment for treatment facilities			
	Demand	Increase in orders	% of annual turn over

Criteria 4.2: The impact of social and institutional nature			
	Changes in employment	Change of employment per factory producing PPs Change of employment per company affected	Number and % Number and %
	Changes in the involved stakeholders	Individuals	No influence; Low influence, Direct influence
		Companies using PPs	No influence; Low influence, Direct influence
		Professional associations using or producing PPs	No influence; Low influence, Direct influence
		Cities or inter-areas	No influence; Low influence, Direct influence
	Changes in sensitivity to the environment	Specific to the area	
Criteria 4.3: Impacts on the environment			
	Health expenses	Specific to the area	
	Overall environment expenses	Specific to the area	

2.2.5 Category 5: criteria of the constraints to implement these strategies

Beyond their technical qualities (comparative effectiveness and control of effects induced) and their qualities in the economic, social and institutional field (ratio efficiency / price adjustment to the resources of stakeholders, distribution of responsibilities, possibilities of consistent and complementary decisions...), the assessment of possible ECS must necessarily take into account some constraints that may make their application difficult, impossible or even slow.

These constraints, other than technical or costs, may in particular relate to:

- The institutional structuring
- The characteristics of the housing
- The economic environment in the city or studied area.

2.2.5.1 The potential institutional constraints

The potential institutional constraints are:

- The delays in the transposition of the regulation including bye-laws and the monitoring of the implementation process. Indeed it is necessary that European directives are transposed into national law but also that regulations are enforced within the country.
- The existence in some countries or localities of strengthened regulation compared to the WFD, which increase both the performance targets and the levels of investment borne.

- The difficulties for small and medium size cities to dispose of control services with human and equipment resources appropriated to controls more complex.
- The structure of polluted water treatment and the degree of complexity of decision-making systems based thereon. Moreover, the considered ECS is a combination of various elements and the more complex the structure, will result in a longer and more difficult decision-making process. The complexity is divided into three levels and scored as: Simple 1, Complex 2 and Very Complex 3. This scoring is a synthesis of the three above indicators.
- The level of cooperation of river basins (cross-border and national) has three levels of measurement: non-existent, medium, active.
- The sensitivity of different stakeholders to reduce pollution. For example, the resistance of polluting companies to enhance their treatments and controls can constitute curbs or significant barriers. Similarly, the existence of dynamic local environmental associations may lead to the strengthening of the options taken.

2.2.5.2 Urban settlement

The main points in this area for the implementation of ECSs are:

- The availability of land (particularly for building treatment facilities but also for the final destination of sludge).
- Some characteristics of urban housing (e.g., older housing stock which make the implementation of sewage networks both difficult and costly, or conversely, highly fragmented housing, or, some terrain features that force an increase in the number of lift facilities or WWT facilities...).

2.2.5.3 The economic environment in the city or studied area

The case studies highlight two common constraints:

- The size of polluting companies (small or medium companies have more difficulties to face heavy investments)
- The existence of a significant proportion of low income households

Table 6 : Indicators for the fifth category of criteria: constraints of strategies

	Type of information	Indicator	Unit
Criteria 5.1: The potential institutional constraints			
	Legislation in force	Transposition of the WFD into national law Presence of other more stringent regulations	Completed/ Advanced/ Moderately advanced Yes/No
	Degree of legislation enforcement	Presence of river basin district Cost recovery of the wastewater treatment cost Capacity to control : human and equipment resources	Yes/No % Low, Medium, High
	Degree of complexity of decision processes	Degree of delegation of the water service Number of stakeholders involved concerning waste water treatment Level of their mutual independence (affect the incoherence decision risk)	Public 0%. PPP X%. Private100% Number Low, medium, high
	Cooperation/consultation degree	The level of cooperation of river basins	Non-existent, Medium, Active
	Awareness of stakeholders	Sensitivity of different stakeholders to reduce pollution	Low, Medium, High
Criteria 5.2: Urban settlement			
	Availability of land	Area available	Km^2
	Typology of the housing	Urban settlement Other main features linked to the area (hilly, near sea sensitive environment..)	Concentrated, semi-dispersed, dispersed
Criteria 5.3: The economic environment in the city or studied area			
	Companies	Size of polluting companies	Small/Medium/Large
	Households	Portion of low incomes	%

3 CONCRETE QUESTIONS THAT DECISION MAKERS HAVE TO SOLVE

The application of socio-economic criteria for the assessment of the ECS must be made from elements of strategy highlighted in the analysis of 1) the possibilities and limitations of substitutions (T.4.5.) and 2) the efficiency and feasibility of different treatment processes (T.5.6.).

Furthermore, the implementation of socio-economic criteria has to be performed under the best conditions by decision makers, as issues to solve, progressively occur.

The sequence of issues to be solved by decision makers is summarized as follows:

Table 7 : Sequence of issues to be solved by decision makers

Stage	Decision to make and Stakeholders involved	Result	Level of decision
1	Choice of bans of uses per PP Choice of the stakeholders involved in the preparation of the decision	Total or partial use bans Implementation dates % of releases remaining to eliminate Polluting activities eliminated Polluting activities remaining	EU Collective professional organisations
2	Implementation of monitoring	Control and reminders (if necessary)	Country
3	Programs of voluntary regulation by companies	Reduction of used tonnages by PP concerned	Macro Professional groups
4	Organisation of substitutions	Developing new productions Adaptation of production processes of users	Companies
5	Description of the area (city, agglomeration, extended area) Identification of PPs to eliminate and sources in the area concerned	Knowledge of main demographic and geographic characteristics, economic activities and WWT facilities Knowledge of volumes to treat, pathways where intervening (polluting companies, diffuse pollution, households and similar activities, public communities)	Municipality or agglomeration
6	Choice of treatment processes by source * technical choice according to their efficiency * review of investment and operating costs * assessment of the impacts * identification of the constraints	% treated by WWTP by source % treated by companies before release by source % treated by stormwater treatment facilities by source % treated by individuals by source % not treated	Local

7	Discussion and strategy selection between stakeholders involved Cross border consultations Inter-communal or inter-agglomeration or River basin consultations	Total % treated by process % not treated Agreements between stakeholders concerning the ECSs Distribution of tasks	Local River basin Country
8	Selection of locations and conditions of water releases after treatment	Quality of water released	Local River basin Country
9	Sludge destination choice	Distribution of sludge destination according to their components and the various processes	Local Country
10	Selection of the modalities and responsibilities of control	Pollution monitoring	Local River basin
11	General action selection on the water environment	Preventive actions Rehabilitation actions Awareness actions	Local River basin State

Comments:

Stages 1 to 4: Substitution and use reduction (macro level)
They correspond to a work of specialists at the macro level of the EU, the States and professional groups (including the chemical industry).
In the following stages the problems to solve by the strategies of wastewater treatment will depend on the decisions taken during these first stages. Indeed, the choices of strategies at the local level will be influenced by choices made at the macro level.

Stage 5: Description of the situation (micro/meso level)
This stage uses the database developed in WP3 and the lessons learned from WP2.

Stage 6: Analysis of the situation (micro/meso level)
This stage applies to studied local conditions the lessons learned from WP 4 and WP5.
This implies that the information provided in these two fields is sufficiently homogeneous to be able to effectively choose between multiple solutions under comparable conditions. This also implies getting available information that enables the assessment of the efficiency of various processes according to the volumes treated and the efficiency of those processes for treatment of several PPs at the same time. Indeed, the wastewater from some polluting industries simultaneously includes combined pollutants.

At this stage (micro and meso level), possible technical choices are:

- For polluting companies:
  - Limiting the quantities used (higher productivity)
  - Using the processes of direct treatment, PP by PP.
  - Using the processes for the strengthened direct treatment but for all waters including PPs and other pollutants

- For municipalities and organisations in charge of WWT:
    - Strengthening treatments for all pollutions and appropriate processes
    - Development of strengthened processes targeting some categories of PPs (e.g. heavy metals or toxics)
    - Development of processes of stormwater treatment according to the set objectives

For individuals, the possible technical choices are more limited and concern all PPs except some toxic liquid products which are specifically recovered from waste disposal (no discharge into the sewage network or autonomous WWT facilities).

This stage 6 is the central stage where it is appropriate, given the knowledge of the characteristics of the area (stage 5), to apply the criterion of costs and benefits, and attempt to measure and assess the impact criteria and finally to describe and assess the constraints to be taken into account

Stage 7: Choice of ECS: consultation between stakeholders (micro/meso level)
The consultative processes are particularly important for the quality of decision-making to be effective and when the effectiveness of the strategies depends on the co-ordinated actions of several actors from different areas (case common by nature when the concerned area is directly drained by a river).
To be realistic, the final choice of the WWT strategy implies that different partners have been able to express their views and their constraints. For example, not all polluting industries have the specialisation or the skills required to make the treatment of polluted waters for themselves.
In addition, sub-contracting solutions should be considered, discussed and developed. For example, big WWTP of Barcelona specifically treats (under separate contract) the polluted waters of some polluting companies which are then transported by tanker truck.

Furthermore, as for countries in the EU, deadlines for compliance are more often than not negotiated between the municipality and the stakeholders involved.

The assessments related to impact and constraint criterion are in particular topics of dialogue and discussion because they have relative values. The opinions may differ about their potential weight in the decision.

The consultation must seek consensus between stakeholders that may have different interests or priorities.

It is important to remember that the decisions of collective treatment and stormwater treatment by local authorities concern by definition all the pollution. Also the goals about PPs should be integrated into broader decisions concerning the limitation of releases of pollutants.

Stage 8: Post environmental release issue
The choice of conditions of release of water after treatment involves several stakeholders:

- those who carry out the treatment;
- the local public authority responsible for water management and who must give its approval and carry out the controls;
- the river basin district concerned with the releases into surface waters;
- the specialized central authorities responsible for releases into the sea and the groundwater.

Stage 9: Sludge fate issue
The sludge treatment is essential for the outcome of the ECSs in the way where a lot of PPs (in particular heavy metals) are persistent in the sludge.
The various processes of sludge treatments have a significant impact on treatment costs.
The stakeholders involved are more numerous because the agreement of State services is essential, and in case of sludge spreading the agreement of sludge users is essential too.

Stage 10: Control structuring
The selections in undertaking the controls, in particular, require that the actual capacity of the institutions responsible for conducting these controls is taken into account. This also includes both the choice of methods and frequencies.

Stage 11: Rehabilitation of contaminated areas and awareness of stakeholders
In this stage, the role of some local non-collective organisations is essential because they must monitor and intervene to take into account in particular the pollution that comes from untreated stormwater and non-treated releases from individuals or some companies.

4 TECHNICAL DATA USABLE FOR SOCIO ECONOMIC ANALYSIS

During the progress of the ScorePP study, it was decided to decrease the number of PPs to study in some field in order to achieve more detailed and consistent analyses. Twelve PPs from the entirely primarily list have been chosen considering their representativeness to other PPs, their dangerousness (they are all PHS) and the fact that more information are available on these. The present task deals with these twelve PPs. The following tables recapitulate technical information provided by WP 4 and 5 which are introduced in the deliverable 4.5 and 5.6.

4.1 The usable results concerning substitution, voluntary actions and reduction of uses

The deliverable 4.5 give the following information:

- The possibilities of substitution according to the use,
- The substitutes produced or not by the companies producing the PP eliminated,
- The potential risks of pollution by the substitutes,
- The existence of programs of voluntary reduction of use of PP,
- The degree of importance/impact of the possible consequences concerning investment or other costs linked to these substitutions (for example when the substitute have a cost significantly higher than the PP or when using a substitute means to change the process and therefore requires investments for the users),
- The possibilities of reducing emissions provided by the application of existing regulations
- The way of reducing emissions via the application of the Best Available Techniques (BAT),

On the basis of this information, it is therefore possible to have a situation between:

- PPs for which substitutions will be low and voluntary reduction programs will remain marginal or nonexistent.
- PPs for which substitutions or voluntary reduction programs can have a significant impact on the quantities released and induce the reduction or elimination of some sources of emissions of these PPs.

In the case of small substitutions, most of the releases will remain to be treated at the level of industrial facilities and/or collective treatment facilities (wastewater and stormwater) or individuals' facilities.

However, it should be taken into account that the WP4 and especially the synthesis available in D45 gives no indication on the proportions of consumption of each PP which may be eliminated if the possibilities of substitution or voluntary reduction are actually exploited.

The database developed as part of WP3 identifies various potential sources of release by PP. WP 6 and various models can locate these discharges and to take into account all the accumulated releases.
From this information from the 4.5, it is possible, locally or globally to identify which sources will be reduced or eliminated and the sources that will remain problematic. These sources must be the major targets of the strategies.

The results of deliverable 4.5 resulted in scores by PP in substitution and/or reduction of emission of pollutants. These scores have been established with reference to

- Technical feasibility
- Technical efficiency
- Probability to reach WFD target
- Operational costs
- Investment costs
- Impact on the supply chain
- Impact on employment
- Impact on drinking water
- Delay of implementation

Scores are assigned for the main types of possible measures including:

- Substitution
- IPPC directive BAT
- Process improvement
- Regulations
- Voluntary initiative
- Waste Water Treatment

In these conditions, the scoring by PPs enables in principle to compare in which way a substitution strategy may be more or less interesting than a wastewater treatment strategy.

The usable conclusions of WP4 for the socio economic analysis are resumed in the table below:

Table 8 : Resume of conclusions of deliverable 4.5 usable for the socio-economic analysis

PPs	Possibility of substitution	% of consumption	Companies producing PPs and its substitutes in the same time	Possibility of reduction	% of consumption
Benzene Raw material	No substitute	-	-	Yes	-
Solvent	Yes	?	?	-	-
Gasoline	No	-	-	No	-
By product	No	-	-	No	-
Benzopyr. (PAH)	A few possibilities Only production and use of creosote	Low compared to the unavoidable by-product from combustion processes	-	Strict application of the legislation Incentives to increase Efficiency of combustion devices	Sufficient for compliance with WFD
Cadmium	Several	Progressively a large part	-	-	?
Chlorpyrifos	Possible but after new research	-	-	Yes	Sufficient for compliance with WFD
DEHP	-	?	-	-	?
Diuron	Difficult	-	-	Yes	Sufficient for compliance with WFD
EDC For PVC	No	-	-	Possible	Sufficient for compliance with WFD
Raw material	No	-	-	No	-
HCB	No	-	-	Yes Strict application of the legislation Incentives to increase Efficiency of combustion devices	?
Lead	Partially	?	-	Yes for some uses (eg.PVC stabilizers)	?

Mercury	Several	?	-	Several	?
Nonylphén. Raw material	Yes	?	Yes	-	-
Formulations	Yes	-	Yes	Possible	-
Degradation	Yes	-	Yes	Possible	-
PBDE Flame retardant	No	-	-	Yes	?

- : No data
? : Data not available

The table below present the best scoring to consider by PP

Table 9: Best scoring of deliverable 4.5 by PP

	Substitution	**Voluntary initiatives**	**WWTP**	**Regulations**
Benzene Raw material		14	14	14
Solvent	12	12	14	
Gasoline			14	
By product			14	14
Benzopyr. (PAH)			14	
Cadmium	13-14	13 (stabilizers in plastics)	14	13 (batteries)
Chlorpyrifos		12	14	
DEHP				
Diuron		13	14	
EDC For PVC		12		
Raw material			14	14
HCB		14	15	
Lead	13-14 (weights, solder alloys and pigments)	13 (pigments)	14	
Mercury	14-15	13 (Cell process)	14	
Nonylphén. Raw material	12		14	14
Formulations	12		14	13
Degradation	12		14	13
PBDE Flame retardant		11 – 12	13-14	13

We can note that treatments are in any case among the best solutions except for heavy metals (persistence properties in the sludge after treatment) and nonylphenol. Voluntary initiatives are able to lead to more efficient solutions for pesticides or uses related to plastics.

Overall, it appears that the substitutions of PPs studied are relatively difficult to predict at least in the short or medium term.
Some substitutions however seem possible for a part of uses of heavy metals and the PPs used as solvents.
It may be noted that in the context of voluntary agreements with industries and awareness campaigns, it seems quite possible to obtain reductions in emissions of several PPs at levels that reach the WFD objectives. This is particularly the case for pesticides, benzopyrene and EDC.
For other PPs, strict enforcement of existing regulations could enable a significant reduction of emissions and therefore to come closer to the WFD objectives.

Three types of PPs could be pointed from the tables presented above:

1- The PPs which can be substituted and could lead to important reduction of emissions. The decision is taken at central level.
2- The PPs of which release reduction is possible but mainly depends on voluntary actions developed both at central and local level.
3- The PPs of which substitution and voluntary reductions are impossible or marginal. The treatment strategies will be therefore decisive.

It is important to note that concerning reductions in consumption of PPs, a part of the results will be obtained through programs decided at the central level of the EU or national organisations of companies using PPs. Another part of the results depends on more local decisions, especially for awareness for individuals. Similarly, a significant portion of emission reductions could come from a strict enforcement of regulations already in force. In practice, this part of results in term of reducing releases of PPs will depend on the organization and quality of controls at local or river basin level.

4.2 The usable results concerning treatment

The WP 5 and more particularly its synthesis presented by the deliverable 5.6 provides the following information about treatment for each of the 12 PPs selected:

- The choice of five criteria to assess the different processes of wastewater treatment
- An analysis based on these criteria on the main processes of industrial wastewater treatment
- An analysis based on these criteria on the best management practices (BMP) of stormwater treatment
- An analysis based on these criteria on municipal wastewater treatment studied as corresponding to a single process

From each analysis a score by criteria is established. Given that data are insufficient or not computable, the scores of criterion for some processes cannot be estimated. In these cases, the total score by process cannot either be calculates.
Thus, for industrial treatments, total scores could be calculated for 5 of the 12 PPs studied.

However for stormwater treatment, total scores are all calculated (considering that financial criteria which is not estimated for the same 4 BMP's treatment because data are not available, is not taken into account).

In general, the financial criterion only takes into account the dimension of direct cost (investment and operation). The economic and financial dimension of strategies significantly exceeding this purely financial aspect, it is more consistent to use the results of the deliverable 56 by taking into account only the three technical criteria (feasibility, efficiency and environmental impact).

In these conditions, it is noticed:
- 5 total scores are available on the 12 PPs in industrial treatments but 15 total scores on 15 concerning stormwater BMPs.
- Elements of assessment are available to enable comparisons between the efficiency of the industrial treatments processes for 6 of the 12 PPs.
- The efficiency of approximately 35% of the studied processes has been able to be assessed.
- 6 technical total scores are available for the WWTP
- Concerning stormwater BMPs, all the 15 technical total scores show that the two same processes are always the best (infiltration basin and subsurface flow constructed wetlands), and another one in many cases (surface flow constructed wetlands). The others have always lower performances.

The usable results are resumed in the following table. Only the two best scoring of industrial treatment (IT) and the three best ones of stormwater BMP (SW BMP) have been reported.

Table 10: Scores of treatments per PP [2]

	IT 1	IT2	WWTP	SW BMP1	SW BMP2	SW BMP3
Benzene	B9 (3)	B14 (3)	(4)	IB (4)	SSFCW (4)	SFCW (4)
Benzopyrene	*	*	(4)	IB (4)	SSFCW (4)	SFCW (4)
Cadmium	A2 (5)	C2 (5)	*	IB (4)	All (5/6)	All (5/6)
Chlorpyrifos	*	*	*	IB (4)	SSFCW (4)	SFCW (4)
DEHP	*	*	(4)	IB (4)	SSFCW (4)	The others (5)
Diuron	*	*	*	IB (4/5)	SSFCW (4/5)	The others (5/8)
EDC	B14 (7)	B14+C3 (7)	*	IB (4)	SSFCW (4)	SFCW (4)
HCB	*	*	(4)	IB (4/5)	SSFCW (4/5)	The others (6/7)
Lead	*	*	(8)	IB (4)	SSFCW (4)	The others (5)
Mercury	B3+B10 (5)	*	*	IB (4)	SSFCW (4)	SFCW (4)
Nonylphénol	-	-	(6)	IB (4)	SSFCW (4)	The others (5/6)
PBDE	-	-	*	*	*	*

( ): score of the process (the lowest scores are the best)
*: Insufficient data available
A2: Settling/sedimentation/clarification
B3: Chemical Oxidation
B9: Adsorption
B10: Ion Exchange
B14: Stripping
C2: Biological removal of sulphur and heavy metals
C3: Aerobic Treatment
IB: Infiltration Basin
SSFCW: Sub-surface flow constructed wetlands
SFCW: Surface flow constructed wetlands

For benzopyrene, the technical efficiency of industrial treatment processes studied is not determined because insufficient data are available.
For cadmium, the technical efficiency of WWTP is not determined because insufficient data are available.
For chlorpyrifos, the environmental impact of WWTP and industrial treatment processes studied are not determined because insufficient data are available.

[2] Laura Raggatt, Lian Scholes, Mike Revitt. (2009) Feasibility of treatment options: Comparison of the approaches evaluated to maximise removal of PPs, Draft report 5.6, ScorePP

For DEHP, the environmental impact of industrial treatment processes studied is not determined because insufficient data are available. However, it can be noted that the score of treatment by supercritical water oxidation does not exceed 5 (average).
For diuron, the environmental impact of WWTP and industrial treatment processes studied are not determined because insufficient data are available. The efficiency of industrial treatment processes is only determined for wet air oxidation. Its total score would be therefore a maximum of 6 (average) if the environmental impact is the worst.

For EDC, the efficiency and environmental impact of WWTP are not determined because insufficient data are available.
For lead, only one industrial treatment process (filtration+ nanofiltration and reverse osmosis) has a determined efficiency but its environmental impact is not determined. Its scores does therefore not exceed 5 (with a bad environmental impact).

For industrial treatment of mercury, the technical efficiency and environmental impacts are determined for 5 processes on 12 studied but there is only one case where both criteria are determined for the same process. In all cases, the environmental impact is high (score 3).
For PBDE and nonylphenol, no industrial treatment has been studied. The environmental impact of WWTP is not determined. The efficiency and environment impact of stormwater BMPs are either not determined.

Regarding the stormwater BMPs, the same processes are always the most efficient (infiltration basin and subsurface flow constructed wetlands) and frequently the surface flow constructed wetlands have the same scores.
The 12 other processes have identical scores (average of 5 or 6) for 8 PPs. For the 4 other PPs, scores of these other processes have rather low performances.

For industrial treatments, the performances of some processes are actually good only for 5 PPs (benzene, chloropyrifos, DEHP, diuron and lead)

For the WWTP, the performances are good for 7 PPs. They are estimated as low for 2 PPs (lead and mercury) and medium / low for diuron.

The comparison between WWTP and industrial treatments lead to believe that for some PPs, the controlled management of industrial release by the WWTP would have better results. This applies to benzopyrene, cadmium, DEHP, HCB, PBDEs and nonylphenol.

In general, the performance of some stormwater treatment processes is good. However, they generally cannot compete with other processes which occur on different sources of pollution. This suggests that the development of actions in this reducing pollutant sector could be effective when some PPs existing in the rainwater are identified as important.

5 THE USE OF SOCIO-ECONOMIC CRITERIA FOR ASSESSING THE EMISSIONS BARRIERS AND EMISSION CONTROL STRATEGIES

5.1 Benchmarks for the various stakeholders and emission barriers

The socio-economic analysis concretely applies to a set of emission barriers (EB) proposed on the basis of technical analyses at the local or global situation.

All EBs involve many stakeholders. To study their situation and define their position, it is necessary to determine the socio-economic benchmarks appropriated to their case.

The table on the next page summarizes the major categories of EB and stakeholders who are involved by each EB.

5.2 Three categories of benchmark

The criteria to use necessarily refer to the various aspects which characterize the ScorePP approach:

1. The geographical area concerned (macro or meso/micro);
2. The field concerned (technical, economic, socio – institutional);
3. The nature of what is measured (baseline, impacts of proposed actions, constraints identified).

5.2.1 The geographical area concerned

The macro analysis (EU or State Member) mainly relate to:

- The substitutions and the program of voluntary reduction of PP emission adopted by the main stakeholders who are releasing these ES
- The all regulations enforceable in the EU
- The global financial impacts concerning sewage treatment and rehabilitation of environment.

The meso/micro analysis (regions or cities) mainly relate to:

- The treatment of wastewaters and stormwaters (including the removal of sludge after treatment) both *in-situ* (industries or households) and more frequently on collective means (WWTP, stormwater treatment systems).
- The local voluntary use reduction programs
- The collective or coordinated actions implemented.

The table next page shows the most frequent situation in the EU concerning decision making power for each field and for each stakeholder category.

Table 11 : Most frequent situations of decision making power in the EU

EB	EU MS	Territ. torial autho-rities	Spe-cial bodies	Produ cers. PP	Produ. cers subs titut tor	Compa. nies emet-ting PPs	House-holds + APAD	Water opera-tor	Environ nement assoc.-
Regulations * conception	**X**	**X**		**X**					
* application	**X**	**X**	**X**	**X**		**X**	**X**	**X**	**X**
Imports' Inspection	**X**								
Substitution				**X**	**X**	**X**			
Limitation use						**X**	**X**		**X**
Onsite Treatment * industrial		**X**				**X**		**X**	**X**
* Households + APAD		**X**					**X**		**X**
Collective treatment in WWTP		**X**	**X**					**X**	**X**
Stormwater treatment		**X**	**X**			**X**	**X**	**X**	**X**
Action on not catched stormwater		**X**	**X**						**X**
Terminal release of treated water	**X**	**X**	**X**			**X**	**X**	**X**	**X**
Destination of sludge	**X**	**X**	**X**			**X**	**X**	**X**	**X**
Environment site remediation	**X**	**X**	**X**						**X**

5.2.2 The field concerned

5.2.2.1 Technical and physical characteristics

The main characteristics concerning the EB are:

- **The feasibility** (the technical solutions are existing and can be implemented in real situations): it may vary according to the PPs and their use.
- **The efficiency:** it may vary according to the PPs, the concentrations, the volumes.
- **The impact on environment**, especially the importance of the persistence of the PPs after the EB (especially for the treatments)

5.2.2.2 Economic characteristics

The main characteristics are:

- **The supply and demand** of PPs or their substitutes.
- **The costs and benefits** which add up costs and benefits of PP producers, of PP users and more largely those which emit PPs, actors which manage autonomous treatment, the local authorities and the Member States (in case of reduction of environmental rehabilitation expenses). Those costs and benefits refer to investment and O&M but also the training expenses and the control.
- **The employment**: both in the activities producing or emitting PPs and activities of production of the substitutes, of treatment, of stormwater implementation.

5.2.2.3 Socio – institutional characteristics

Three aspects are decisive:

- **The level of regulation and its enforcement**
- **The distribution of the expenses** between the various stakeholders involved
- **The organization of the responsibilities and of the decision-making process**

5.2.3 The nature of what is measured

The control strategies of PP releases deal with combining EBs for reducing the ES considering the context where they should be implemented.

These ECS take into account:

- **The situation concerning the PPs** (production, consumption, releases), their regulation, the infrastructures and the sewage management
- **The predictable impacts of the potential EBs:**
  - On the release of PPs
  - On the enduring existence of PPs in the environment
  - On the development of specific activities for implementing managing the EBs (works, removal of sludge, controls)
  - On the employment and the activity globally and locally
- **The local constraints** where these EBs will be implemented. This includes the land availability and the organization of the decision-making process (complexity and risks of incoherence, time for decision and implementation, need for long preliminary studies).

5.2.4 Summary of benchmark criteria

Integrating the different approaches needs to define the criteria which could be usefully kept for the comparison between the ECS on the one hand for the macro analysis and on the other hand for the micro/meso analysis combining technical, economic and socio-institutional aspects.

The table below presents the main criteria to take into account in both cases.
The criteria highlighted in blue are specific to the macro analysis. The ones highlighted in yellow are specific to the micro analysis. The other criteria not highlighted are commons to both levels but their scoring is different (global data for macro and local data for micro).

Those criteria have to be assessed in the first steps of the MCA. However, in order to synthesize the analyses and to compare the results (or tendencies) between the various ECS studied, only the criteria which have a more significant value need to be kept. Therefore, it reduces the criteria to measure to 10 criteria per level.

Table 12: The main criteria to take into account

Field	Technical/Physical		Economic		Socio - institutional	
Level / Nature	Macro	Micro	Macro	Micro	Macro	Micro
Baseline	Feasibility of substitutions and voluntary programs	Feasibility of treatments	Sewage infrastructure situation Level of prices of sewage treatment	Sewage infrastructure situation Level of prices of sewage treatment	Regulation	Enforcement of the regulation
Impacts	Efficiency of substitutions and voluntary programs on the release of PPs	Efficiency of treatments on the release of PPs	Supply/Demand of PPs Supply/Demand of substitutes Global costs Invest. + O&M for PPs users concerning change of process Global costs Invest. + O&M for improving the treatments Reduction of health and environmental expenses Increase of turn over for sensitive activities	Global costs Invest. + O&M for PPs users concerning change of process Global costs Invest. + O&M for treatment : - industries - households - collectives Employment Environmental expenses reduction Increase of turn over for sensitive activities	Distribution of the costs and benefits between the actors Development of voluntary programs Increase of awareness of the actors.	Distribution of the costs and benefits between the actors Increase of awareness of the actors.
Constraints	Time of research	Land availability		Financial capacities of SME, small and medium local authorities Level of incomes of poor households	Time to implement the WFD, regulations and supplementary programs	Control capacity Organization complexity Availability of expertises

5.3 Proposal of a « short » list of criteria

- ***10 criteria at the macro level :***

A- Technical and physical criteria
1) Feasibility of substitutions and voluntary programs
2) Efficiency of substitutions and voluntary programs

B- Economic criteria
3) Sewage infrastructure situation (by country)
4) Impact on supply and demand (PP + substitute)
5) Impact on the supply chain
6) Impact on global investments
7) Impact on employment
8) Reduction of environmental expenses of water bodies

C- Socio-institutional criteria and combinations (technical/regulatory or socio/economic)
9) Time to implement (research + enforcement of regulation)
10) Change of the distribution of costs and benefits (between companies, households, local authorities, States)

- ***10 criteria at the micro level***

A- Technical and physical criteria
1) Feasibility of treatment options (taken in account the land availability)
2) Efficiency of treatment options

B- Economic criteria
3) Level of price of sewage treatment: it is the most relevant because it shows the level of infrastructures but also the effort to make for recovering the old and news costs. These costs will accumulate and will strengthen the impact on the actors.
4) Global costs for improving the treatment (combining all kind of treatment)
5) Reduction of environmental expenses
6) Impact on employment (including the increase of production of sensitive activities)
7) Financial capacity of the main stakeholders

C- Socio-institutional criteria and combinations (technical/regulatory or socio/economic)
8) Change of the distribution of expenses between actors
9) Capacity to implement the regulations (it synthesizes the enforcement of regulation and the capacity of control)
10) Complexity of organization and decision-making process

5.4 A three step approach at the local level

For each specific target area an initial evaluation is done based on a three level classification as follows: 1 (weak influence) 2 (moderate influence) 3 (strong influence).

5.4.1 Situation of the area

Size:

Medium	= 1	Fewest specific problems to solve
Large	= 2	Potential for complex problems with collection networks and stakeholders
Small	= 3	Limited resources and direct impact often without compensation

Aspects of location (mountainous, coastal, transborder)

1 aspects	= 1
2 aspects	= 2
3 aspects	= 3

Population

Small to medium (< 300,000 inh)	= 1
Large (> 300,000 inh)	= 2
Seasonal > 25 % permanent population	= 3

Areas of high seasonal populations face problems of treatment capacity, economic activities sensitive to pollution, major fluctuations in the usage of water and a high proportion of secondary residences.

Overall scoring

From this evaluation an overall rating can be assigned to each target area:

Low level	= 3 to 4
Medium level	= 5 to 6
High level	= 7 to 9

Ce score global synthétise les différents score partiels examines précédemment et permet en consequence de caractériser le niveau plus complexe des problèmes à prendre en compte localement en matière de pollution par les PPs

Example : of the studies completed to date, the following scores can be calculated:

Table 13 : Examples of an overall scoring for the area situation

	St Malo	San Sebastian	Prague	Barcelona	Mountain resort	Voirons
Size	1	1	1	2	3	1
Location aspects	2	2	1	2	1	1
Population	3	3	2	3	3	1
Total	**6**	**6**	**4**	**7**	**7**	**3**

Note that very large urban conglomerations and tourist areas present high levels of special issues. On the contrary cities, large or small don't present many distinctive features. These cities represent the vast majority of cases. They can therefore persue their analysis of possible strategies for the control of PPs based on current technical solutions.

5.4.2 Impact of the pollution on the emission strings.

For decision makers the PPs could lead to improving treatment processes either by private industries or by public authorities. It is important to understand from the beginning which PPs pose problems and from which industrial source they originate. This will indicate how dispersed the PPs are and what focus needs to be put on the treatment of stormwater.

Pollution levels

It will be useful to assign on overall pollution level indicator for each area as follows:

1PP = 1
2 or 3 PP = 2
More than 3 PPs = 3

Polluting economic activities;

Less than 10 % of total employment = 1
10 to 20 % of employment = 2
More than 20% of employment = 3

Economic activity sensitive to pollution

Less than 10 % of employment = 1
10 to 20 % of employment = 2
More than 20% of employment = 3

Treatment of sludge

Less than 15 % dispersed or buried = 1
15 % to 30 % dispersed or buried = 2
More than > 30 % dispersed or buried = 3

Effectively, based on disposal possibilities, the problems of pollution are very different. In particular for heavy metals that persist in sludge, dispersal or burial is problematic.

Overall scoring:

It is also possible to add these three indicators in order to determine a global coefficient of the pollution situation in the area. Two examples:

1. An urban area with minimal types of pollutants originating from few sources, a large number of important economic activities sensitive to pollution and using primarily disposal by incineration results in the following scores; e.g. Saint Malo.
2. An area with medium amounts of different pollutants originating from several sources, minimal sensitivity to pollution with no incineration of sludge; e.g. Voiron/Annemasse

Table 14 : Examples of an overall scoring for the situation of the pollution

	1.City like St Malo	2.City like Voirons
Level of PPs	2	2
Polluting economic activities	1	2
Sensitive economic activities	2	1
Sludge	1	3

Total	**6**	**8**

A minimum score of 4 would relate to an urban area with minimal pollutants originating from few sources, minimal sensitivity and approaching total incineration of sludge.

The maximum possible score of 13 appears unlikely. Scores of 9 or 10 seem entirely probable.

The overall scores identify the level of difficulty from each area while allowing for the identification of the origin of specific issues. Identical overall scores of 6 could be caused by sludge disposal or a high sensitivity to pollution. (reliance on fishing industry).

5.4.3 Status of collection and treatment infrastructure for waste water

A simple analysis of existing infrastructure both at the public and industry level is required. It is increasingly recognised that a considerable amount of PPs are transported in stormwater runoff. In this respect public infrastructure is the key element

Accordingly it is critical to determine each areas capabilities relative to their ability to meet the commissions standards and more specifically their ability to adapt to elevated standards required for the elimination of PPs.

Each indicator listed below is composed of two factors; capacity relative to required capacity, use of recent/advanced technology equipment.

Public treatment of waste water;

Excess capacity plus modern technology = 1
Limited capacity plus modern technology = 2
Insufficient capacity plus outdated/obsolete technology = 3

5.5 Scoring of criteria at the micro level and information sources

A- Technical and physical criteria

1) Feasibility of treatment options: cf. scoring in D56
2) Efficiency of treatment options: cf. scoring in D56

B- Economic criteria

3) Level of price of sewage treatment: cf. D82 and database in 85

Scoring:	High level of price (+ 30% of national average)	= 1
	Medium level of price	= 2
	Low level of price (- 30% of national average)	= 3

4) Global costs for improving the treatment: cf. database 85 and D56

5) Reduction of environmental expenses: cf. scoring in D56 (Assumption: the reduction of environment expenses is proportional to the environmental impact).

6) Impact on employment
   Assumption: the volume of investments to improve the treatments will have an intensity impact on the same order. The presence of beneficial sensitive activities will reinforce the impact.

Scoring:	High investments + beneficial sensitive activities	= 1
	Medium investments + no beneficial sensitive activities	= 2
	Low investments + no beneficial sensitive activities	= 3

7) Financial capacity of the main stakeholders
   This is measured mainly according to the size of the actors as corporate or politic bodies and the median income of inhabitants.
   Scoring:

Big corporations + big cities + median income of inh. equal to national median income = 1
SME + big cities + median income of inh. equal to national median income = 2
SME + medium cities + median income of inh. 20% lower than national median income = 3

C- Socio-institutional criteria and combinations

8) Change of the distribution of expenses between actors

Scoring:	No change	= 1
	Small change	= 2
	The new expense is transferred to one actor	= 3

9) Capacity to implement the regulations: cf. D83

Scoring:	Big city with or without specialized operator	= 1
	Medium city with specialized operator	= 2
	Small city without specialized operator	= 3

10) Complexity of organization and decision-making process: scoring on the basis of analysis of D83

5.6 Exchanges and negotiations between stakeholders

Many criteria cannot be measured with precision. In particular the consequences in the medium and long term are difficult to quantify; they increase the analysis uncertainties.
In addition, the weighting of these criteria is inherently subjective.

In these circumstances it is decisive that the information is shared between the stakeholders, that the analyses are discussed and that the optimal solutions (maximizing the effect on PPs and minimizing costs or ensuring an equitable and realistic distribution) are commonly defined.

This implies that the stakeholders are identified and are aware of the criteria taken into account by each other.

5.7 Integration of economic and socio-institutional analyses at macro level

The macroeconomic analysis is the subject of another report (D85). Nevertheless it is useful to recall here briefly the outlines of the benchmarks that are used to this level of analysis. Indeed, the macro approach determines in part the approach at the micro level by decisions taken there.

At macro level, the analysis will firstly focus on actions to reduce the use of PPs (mainly by substitution and voluntary reduction programs). For these PPs, it should be taken into account the results of basic analyses of feasibility presented in D.4.5.

This analysis will thus focus on the few cases where reductions are possible. Specifically for the 12 PPs analysed in depth, this includes:

- By substitution: cadmium, lead, benzene as solvent and nonylphenol
- By voluntary reduction program: cadmium, lead, some uses of mercury, EDC as a stabilizer for PVC, PBDEs and diuron.

These products are mainly heavy metals, solvents and some uses of pesticides still allowed yet.

This involves taking into account all socio-economic indicators presented in Chapter 2 concerning costs and benefits, impacts and constraints given the indicators characterizing the situation in To at macro level.

Concretely, this means:

- To appraise how (in percentage) the ECS will change the production, the turnover, the import and consumption of each PP. Insofar as we do not have for these products computed values on the proportion that could be affected by substitutions or voluntary reductions, it is only possible to measure the potential impacts based on assumptions.

- To identify the countries and regions expected to be affected because of their significant portion of polluting activities. European statistics on the industry by region according to the sectors and branches enable this location.

- To identify the countries or regions expected to benefit from reduction of pollution because of their important sensitive activities. Same remarks as for the previous indicator. European statistics enable also this location.

- To identify the main recipient countries concerning reduction of need of drinking water treatment given the importance of their use of surface water for drinking water supply. The general table on the importance of using surface water as resource for drinking water identifies the countries which may have more benefits from source reduction of emissions of PP (ie by reducing their use).

- To assess the costs induced by the ECS for producers of PPs based on information gathered by the WP4 and notably the scoring.

- To assess the impact on the turnover of producers of substitutes. This impact will normally be of the same order of growth magnitude that the impact of reduction of the turnover of the product substituted. Assumptions will be also proceeded for this assessment.

- To appraise the impact on users through the changes broad or not of production processes based on information gathered by the WP4 and notably the scoring.

- To appraise the impact of employment based on information gathered by the WP4 and notably the scoring.

- To appraise the impact on the sensitivity linked to the environment.

- To assess the variation on health and overall environment expenses. Variations of these expenses can be classified into low, medium or high. These variations are predictable mainly for reductions of discharges of heavy metals whose persistence in sludges and sediments poses a problem in direct correlation with the degree of consumption of these products. For health expenses, only tendencies will be taken into account insofar as no direct and precise measures of effects on health of individual PPs concerned are available.

It should finally be taken into account additional indicators concerning constraints of decision making and implementation: This is notably the case:

- For regulations, it should be take into account the current level of implementation of EU regulations and the global control capacity in each state;

- For decision making, it should also be taken into account the organisation of management of issues relative to water for each country, since that organisation will influence the implementation of European decisions concerning substitution;

- For voluntary reductions, regulatory and decision-making aspects will play a more important role. In addition concerning voluntary commitments, the micro-economic dimensions will also be important.

This table is an overview of each category of stakeholder's responsibilities based on their expertise.

Table 15 : Decision power of stakeholders

Stakeholder	Local authorities	Private Enterprise	HH/APAD/ non profit organization	Operator	Association	State/Basin
Area						
Evaluation current situation	S	S		S	S	F
Studies	S	S		S	S	
Technical choices	D	D	D	D/N		
Pricing	D	N	L	N	L	F
Economic potential		D	D			
Investment financing	D	D	D	N		D
Inspection	I	I		I	L	F
Management of collection/treatment	D	D	N	N	L	F
Regulation	D				L	D
Water release	D	N	N	N	L	A
Elimination of sludge	D	D	N	N	L	A
Followup/eval.	F	F		F	F	F

This process involves stakeholders with separate areas of expertise and responsibilities.

- Studies S
- Decisions D
- Negotiations N
- Lobbying L
- Authorisations A
- Inspections I
- Follow-up evaluation F

6 CONCLUSION

The comparison of ECS in terms of socio-economic development leans primarily on the strategies identified in the technical standpoint. They are:

- The possibilities of substitution or voluntary reduction of use.
- The various possibilities of treatments targeting the PPs released locally. They relate to treatment processes, management of sludge and management of waters released after treatment or not.

These technical options lead to two different and complementary processes of socio-economic analyses:

- The macro-economic analysis: it mainly deals with the potential impacts of substitution options and general programs of voluntary reduction options.
- The micro-economic analysis: it mainly deals with the potential impacts of treatment strategies and more largely the management of wastewaters and stormwaters in the urban area. This is however influenced by the decisions taken at macro level. These decisions determine whether at short or medium term some PPs will be banned or strictly limited and therefore will be less problems to be solved locally.

Each of these analysis processes involves different actors, interests and specific impacts.

A macro-economic model has been presented in D.8.2. It develops macro analyses and appraisals which can be often used for each PP. An example of its application on Slovenia is described in D8.5.

At the micro and meso level, the socio-economic analysis mainly deals with the impact of treatment strategies or more largely of the potential emission barriers (EB) of PP sources.

Locally, the ES of PPs mainly refer to only several pollutants according to the type of activity in the area and in the nearby territories.

Except some special cases where there is ES for only one PP (i.e. some industries), the main EB are necessarily designed for several PPs and widely other classical pollutants. This is essential to treat stormwaters, household wastewaters and the major part of companies' wastewaters.

The ECS are therefore combinations of technical options which can provide the best reduction of PP release.

The socio-economic analysis process has consequently to apply on this basis.

The various situations and practices in the Member States and in the case-cities have been reviewed. The main useful lessons from this study concerning the definition of an ECS at micro and macro level are described below.

1) The contexts and situations in To are decisive. They directly affect the other decision-making factors. Indeed, they induce physical or financial constraints; they constitute the basis for assessing the impacts (real costs, benefits in case of sustainable pollution of the

environment, time for implementation ...). Accordingly, preliminary studies relative to criteria of situation described in Chapter 1 deserve attention.

2) The local authorities are central to all decisions and at the interface of all stakeholders. They are actually in position:

- To negotiate the control, the conditions of release or agreements for a special treatment with companies operating in their territory. A contractual approach clarifies the monitoring of the implementation of part of ECS that companies have to develop.

- To set the conditions for applying the rules of autonomous sewage treatment (including individuals or small activities that are not classified as polluters). Their PP release may be important and so the definition and implementation of specific strategies could be a significant advance.

- To develop their action in relation to runoff waters which are a major source of PP releases in water. It will affect the level of treatment of these waters, the distribution of responsibilities concerning a part of these water coming from private areas, the pollution loads released into surface waters (which will have to be treated downstream by the public authority) or groundwater (transfers of long-term costs to all authorities in the basin). These non point sources involve non identified stakeholders, induce consequences difficult to locate and to quantify and so require the development of procedures for consultation.

- To largely influence on the distribution of sewage treatment costs and therefore additional costs caused by the reduction of discharges of PPs. Indeed, they set the price of sewage treatment for each category of users. They may also affect the costs borne by industries and individuals for investment, for example on stormwater management.

- To establish their options for sewage networks and WWTP. The potential economies of scale give importance to the cooperation between nearby territorial authorities. Indeed, their choices are particularly sensitive relating to the medium and long term. In this view, references are not the comparisons of immediate investment cost. The long-term forecasts of changing requirements of treatment can lead to organize the development of technical characteristics of WWTP towards tertiary treatment. All options (wastewater treatment, stormwater treatment and network configuration) have to be taken into account and not the components alone.

- To adopt a solution for high proportion of PPs including heavy metals which are persistent in sediments. Their long-term accumulation represents a substantial economic burden delayed in time for rehabilitating the environment. Experience shows that these charges are very important in relation to the charges for gradually removing these PPs (in particular for the treatment of stormwaters). Taking into account environmental impacts in the long term becomes a reference not to be neglected although these impacts are not directly visible.

- To contribute for developing a sustainable solution for the disposal of sludge. Technical solutions exist but the information is not sufficiently disseminated. The positions of

major stakeholders vary from one area to another, from one country to another regarding the various technical options and the induced authorizations. To adopt sustainable appropriate solutions with appropriate stakeholders is essential, and this constitutes an important benchmark in the strategic option choices so that local stakeholders can effectively organize.

3) The multiplicity of identifiable and unidentifiable sources of ES on the same territory that ECS induces is combinations of different options among the feasible and sufficiently efficient EB.

Therefore the socio-economic analysis should focus on benchmarks or criteria following:

- Cost analysis:
  - The sum of costs (*in-situ* treatments, collective treatments, networks, control, disposal of sludge and terminal release of water after treatment).
  - The amount distributed among different stakeholders (polluting companies, households and local authorities).
  - The amount distributed over time (through depreciation costs in particular).
  - The amount including elements that may or not receive grants i.e. a national or basin contribution.

- Impact analysis:
  - On households (through the wastewater treatment price but also autonomous treatment costs).
  - On companies (including all costs, treatments, connection to the network, sludge disposal).
  - On local authority resources.
  - On nearby areas and authorities and their ongoing coordination.

- Constraint analysis including:
  - Sludge disposal
  - Terminal release and other objectives on water (quality of the resource, floods)
  - Technical expertises which are able to be mobilized for correctly managing and controlling the implementation of selected options.

4) Finally, only the stakeholders can decide what weight they give to each factor or benchmark.

The need at the local level to find compatibility between the concerns of each stakeholder usually leads to emphasis on strategies that minimize the burdens and the negative impacts for everyone. This is emphasised by the strategies:

- which divide the responsibilities and burdens
- which do not generate recurrent costs steadily increasing (especially new and high operating costs).

The solutions corresponding to the best performance or the lowest costs are thus relativized.

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