Environmental valuation in European Union policy-making

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Abstract

This paper offers a critical review of natural resource valuation and points out the role of economic valuation in EU policy-making. First of all, we specify the meaning of the economic value of environmental amenities, illustrate the most reliable and often used economic valuation techniques, and their major weaknesses. We then point out the normative significance of environmental valuation in the evolution of the EU environmental consciousness, and distinguish between its different applications. According to this framework, we critically review the studies carried out in the last few years (1998-2001) by the European Commission DG Environment, which are both methodological and application-oriented. Furthermore, we carry out a restricted survey on research in Europe. Our analysis makes clear that the diffusion of environmental valuation in Europe is unsatisfactory and that decision-makers distrust is still strong.

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Introduction

The environmental issue is a primary matter in the agenda of every developed country. In the European Community, the Treaty of Maastricht (1992) and the Treaty of Amsterdam (1997) ratify respectively the central role of environmental protection in all union policies and the notion of sustainable development. Moreover, the Treaty of Amsterdam (section 6) attributes priority to the integration of environmental issues in the definition and implementation of all policies. Also, the following documents of the European Commission, based on the work of the European Councils of Cardiff, Vienna, Cologne, Helsinki and Gothenburg (1998-2001), underline that the goal of environmental integration must be controlled and verified closely.

Achieving the goals of environmental improvement and integration set out by those documents, however, is a problematic matter. The use of economic techniques may prove helpful in focusing on and achieving those aims, as well as for verifying the effectiveness of the environmental integration processes. These methodologies and the regulation of polluting activities are the most important pillars of environmental economics[1].

The valuation methodologies employed by environmental economics are based on neoclassic economic theory. Although it has been guilty of forgetting the natural environment until the "environmental revolution" of the late '60, economic theory has long since developed the necessary analytic tools. For example the notions of externalities and of market failure play an important role in microeconomic analysis; pollution itself is an example, as it derives from the absence (or non-significance) of prices for scarce natural resources. Indeed, economic theory, especially when concerning environmental issues, ought to avoid privileging elegance over realism, and to focus on problems and all possible solutions. Appropriately used, it can offer the analytic instruments necessary for the valuation of natural resources. In fact, the models of constrained optimization used to describe individual behaviour (utility maximization) and the behaviour of governments (welfare maximization), although obviously a bit too schematic, if

[1] In this work we separate environmental economics and natural resource economics. The latter, as Cropper and Oates (1992) state, deals with the intertemporal allocation of renewable and not renewable resources.

properly supplemented, can deal with all the challenges of environmental issues, such as property rights, markets incompleteness, and externalities.

This should not be taken as stating that environmental economics is the only paradigm orienting choices regarding the environment. Indeed, it needs to be supported by the wider and more flexible perspective of ecologic economics, but however, environmental economics can be useful in making decisions about public actions[2] concerning the environment.

This paper offers a critical review of natural resources economic valuation, as seen by mainstream economics, and of its role in Europe. First of all, we define the economic value of environmental amenities (section 1), then we investigate some of its critics (section 2).

The importance of economic valuation is studied considering the increasing attention paid by the European Union to the environment (section 3), and verifying the diffusion of valuation practices (section 4). The concluding remarks (section 5) briefly consider the economic valuation process and its success in Europe.

1 Natural resource valuation

Economics allows us to make choices and take decisions. Choices about natural resources are harder to make than those about private goods. The former, are usually public goods, and the market cannot provide a correct price for them, or derive an economic value reflecting their social importance. This market failure brings up the need of finding a right economic dimension for environmental goods and services to support decision-makers in their choices: environmental economics provides the theoretic underpinnings of this process.

1.1 Tools and reasons for natural resources valuation

We can find two different analytic categories used in environmental decision-making. The first promotes the improvement of the environment and includes incentives such as environmental taxes, subsidies, tradable pollution permits, deposit-refund schemes, and in general all the economic instruments that support and substitute traditional "command and control" regulations. The second consists in a group of analytic tools – such as cost-benefit analysis[3] – used to improve the economic efficiency of environmental actions through the production of more complete information.

Natural resources economic valuation is the operative "arm" of cost-benefit analysis, through which the latter can acknowledge the environmental impact of the actions at stake. Considering the environment as object of monetary measurement[4], natural resources valuation provides information about the economic value of environment quality and quantity changes, and informs the policy-maker about the efficiency of her choices: if the benefits are greater than the costs, the option is *prima facie* possible.

Environmental protection, as has been said, has become a priority: but the vast majority of environmental improvements don't show immediately as monetary benefits or increase in GDP, but as aspects of the quality of life. The fact that some welfare improvements have a monetary dimension[5] and some don't, is basically random. Environmental externalities – air and water pollution, noise – have been ignored for long due to the absence of money transfer between polluter and polluted, because of the non-definition of property rights – to clean air and water, to quiet. Finally, even if there is a money transfer between them, it usually doesn't appear in the national accounting. Therefore environmental benefits tend to be less clear and harder to define than market benefits; for this reason they tend to be considered less important.

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2 By actions we mean public policies, but also programs and projects.

3 Also included in this group are cost-efficacy analysis and risks analysis.

4 More about this in section 2.3.

5 Once giving a monetary value to a natural resource is ethically accepted, the use of the monetary measure is only due to practicality and convenience.

Herein we briefly describe the valuation methodologies used by environmental economics, which permit to estimate the demand function for an environmental good or service, which would otherwise be unobservable: the contingent valuation method (CV), the hedonic price method (HP) and the travel cost method (TC)[6].

To overcome the problem of the absence of a real market, the CV simulates its existence considering the potential behaviour of individuals. Basically, this methodology asks a sample of people (with sets of questions or personal interviews) how much they would pay for a good with no market (for example, air quality) and aggregates the data to draw the demand curve.

The HP, in its typical formulation, finds indirectly, via econometrical techniques, the price level of different characteristics of real estate in a chosen market (usually residential real estates). Those characteristics include environmental qualities such as air pollution, noise, and the proximity to environmental amenities.

The TC finds out the cost, in terms of travel and time, people are willing to spend to visit a place of natural interest (a natural park, a forest). Putting together the data gathered from a sample of individuals, it is possible to determine the demand curve for the environmental good, and set its economic value.

Following mainstream economics, in a world of limited resources environmental valuation forces the political debate to pay more attention to the benefits and costs of an action (or of the lack of action). So environmental valuation is an important instrument, if not the only one, for making decisions. Economics underline the following as its strengths:

- *transparency*: the results are justified by explicit theoretical assumptions and by long accepted methodologies and processes;
- *objectiveness*: the values are as objective as possible; the unit of measure (money) is a further warranty;
- *comparability*: the monetary measure allows comparisons between actions that variously affect different aspects of social welfare.

1.2 The meaning of the economic value of natural resources

According to the economic perspective natural resources – air, water, fauna, landscapes – are measurable goods because they offer a stream of services to people. The activities of the State and of other institutions, those of citizens and of companies cause changes in those streams, resulting in costs and benefits. The measurement of the changes in economic value of the natural resources services can thus be studied within a cost-benefit[7] framework.

In this perspective it is necessary to take a broader view in order to see the real stream of services provided to society and to the economy by natural resources. First of all we can perceive natural resources as a source of inputs (combustible fossils, wood, minerals, and so on). Secondly, natural resources can be seen as absolutely necessary elements for human life (breathable air, proper climate for life, and so on). Thirdly they can be seen as sources of different recreational opportunities. Last, as a system able to receive and disperse the waste of human activities. Henceforth the economic value of the environment can be defined as the sum of all the net discounted values of the streams of all services that it offers. The benefits of an action that increases the stream of whatever environmental service consist in the growth of the discounted value of the service itself. In the same way pollution damages derive from the decrease of the stream of services.

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[6] Here we ignore other measurement methodologies that cannot calculate the demand function, such as the dose-response and multi-criteria approaches, not because they are not valid, but because they are beyond the scope of this paper. Other environmental economics methodologies exist though, such as the averting behaviour method and weak complementarity methods: but they are more rarely used.

[7] In the last decades the nature of such problems and the improvement of measurement techniques brought us to expand the field of investigation of both positive and negative effects (benefits and costs). Things that previously were not considered to be measurable, or even of not great importance, such as increased availability of recreational spaces or visibility improvements, are now seen as sources of value and considered measurable from an economics perspective.

The idea of value used here originates from welfare economics. The welfare/utility of a person doesn't depend only on consumed goods – public and private –, but also on the quantity and quality of the streams of goods and services without market, provided by the environmental system (for example health, outdoor recreational opportunity, and so on). Therefore the economic value of changes of the environmental system should be measured referring to its effect on human well-being[8].

If society wants to use available natural resources in the most efficient way, it needs to compare the values of the goods and services streams deriving from their use by its members (that is benefits[9]), with the values that they give up by not using these natural goods/services in other ways (that is costs). In this way, since benefits and costs are measured by considering their effect on personal welfare, the notions of "economic value" and of "welfare change" are the same.

Economic theory assumes that people have specific preferences among alternative bundles of goods and services – both market and non-market goods and services – and that preferences have the property of substitutability [10] among those goods and services. The fact that a certain amount of a good is given up to acquire a greater quantity of another good offers precious information about how much those two goods are worth for the individual involved. So the monetary value of one of the goods shows a particular example of trade-off, because the amount that somebody spends to buy that good is a proxy of the value of the other good, the use of which has to be decreased to make this transaction possible. The measure of value based on this substitution can be expressed in terms of "willingness to pay" *(WTP)* and "willingness to accept" *(WTA)*. *WTP* and *WTA* are calculated considering every other good that a person would replace to get the good that has to be measured. *WTP* represents the maximum amount that an individual would pay to avoid loosing the increased quantity of a good, for example environment quality. *WTA* represents the minimum amount that a person asks for to renounce an improvement that otherwise will happen. That is, the sum which makes an individual unconcerned for improvement or lack of improvement, when this is compensated in monetary terms. Thus the absence of improvement is the reference (of welfare/utility) for *WTP*, and the presence of improvement is the one for *WTA*.

Some observers criticize the extension of economic measurement processes to elements like health and human security, environmental amenities, the value of beauty, and the reduction of these values to a price. Basically what is questioned is the economic approach to the environment, which quantifies values and dissolves their characteristics into the neutral measure of money. Actually, a bit of skepticism towards the measuring mania of economists does no harm. But we think that this attitude shouldn't be pushed too far: stating that human health or endangered species can't be represented by monetary values isn't always true. In the real world it often happens that, for example, trade-off between intangibles and whatever other element that could have an economic value just can't be ignored. The real question is about which way should

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8 The anthropocentric focus of this point of view doesn't mean that the welfare and the survival of other species are ignored: actually people are interested in other species not only for their own utility, but also for ethical and altruistic reasons (that refers to the notion of non-use or existence value). The anthropocentric point of view is one of the problems at stake, as we shall see further.

9 The words "benefits", "damages", "environmental costs" are often used interchangeably, in a confusing way. In fact the difference derives from the reference chosen to measure the environmental changes. The benefits of an environmental change are measured by comparing the actual level of natural services with specific alternative hypotheses in which the same services are increased. The words "damage" and "environmental costs" are often understood as being specular to benefits, that means that they show the loss of natural services due to the change from an hypothetical "clean" level to the actual level of pollution.

10 That is, if the quantity of a good that is included in a bundle is decreased, it is possible to increase the quantity of any other good, so that the change makes no difference. This characteristic represents a clue to the notion of value for economics, because it opens the possibility of using trade-off between two goods that are important to people.

be chosen to identify and describe this trade-off, and about the quantity and quality of information used to make the choice.

To clarify this point we can look at a simplified situation of air pollution[11]. Let's pretend that the actual level of air pollution is causing an excessive mortality, of people at risk, of 1000 units a year, and that a 50% decrease of the output, that would costs 500,000$, would reduce the excessive mortality to 500 unit a year. Alternatively, a clearing of the output (100% control) would reduce the excessive mortality to zero, but would costs 1.5 millions$. So the problem is about the trade-off among saved lives and the value of the resources used in the output control process. If the monetary value of the saved lives were known, the reduction of the excessive mortality could be translated into a monetary measure of benefits and the right cost/benefit *ratio* could be used to find out the optimal output control level. But if there isn't a generally accepted reference point, we can't use any rule to make a decision. Yet the decision that has been made requires, and therefore reveals, a certain value for the saved lives. Considering the previous example, if the decision-maker choose a 50% pollution control, he actually "buys" 500 lives for 500,000$. Also this choice implies that the value of one life salvation is less than 2,000$, because the decision-maker gave up the possibility of "buying" the 500 lives left by spending 1 million$ more for pollution control. If the 100% pollution control would have been chosen, a value of at least 2,000$ would have been declared for every saved life[12]. Here the value is defined by the choice, instead of the other way round (the choice made considering the value).

In a democratic society, the more attentive public decision-makers are to choice problems, the more they need information to improve the decisional process: the monetary valuations certainly increase the available information. Their usefulness consist in their comprehensible methodologies and generally accepted rules to simplify all complex effects and activities to a one-dimensional measure, money. Thus the ability of organizing and simplifying all information into a quantity, money, which is measurable and as univocal as possible, is the main point of the cost benefit approach.

1.3 A necessary explanation

We believe that a more specific explanation of our view of the essence of economic valuation of natural resources will be useful. We have stated that their economic value is found by aggregating the *WTP* of people interested in the changes of the service provided by the resource itself. The *WTP* also represents individual preferences towards those variations. Therefore the economic valuation of natural resources indicates people's preferences for (or against) the streams of services provided. This process is therefore based exclusively on people's preferences. These are expressed as a monetary quantity because they are either elicited by asking people how much they would spend, or derived through observation of surrogate markets.

What is actually being measured is not the natural resource itself, but people's preferences towards quality and/or quantity changes of the resources, which cause variations in the streams of received natural services[13]. Omitting for now ethical questions[14], the problem is about the coincidence between *WTP* and the value of the environmental situation. Many observers think the

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[11] This example is taken from Freeman (1993, pp. 10-11).

[12] Three different groups of data are included in this example, so the implicit value can be found only inside intervals that are quite wide. If control costs and mortality (seen as function of the control level) can be represented by a continue function, the choice of a certain control level brings to the definition of a certain value for a saved life. Furthermore, if we see that a certain control level makes marginal benefits and costs equal, and if the marginal costs are known, we are able to find out the value of the marginal benefits.

[13] It seems reasonable enough to think that people have preferences about environmental changes, and that they would pay to foster or to prevent them.

[14] Ethical considerations are very important in the environmental debate, as we explain in the next section. We also add that to refuse the pricing of goods that seem to be out of the monetary arena for their social or distributive moral implications, is to ignore the meaning we have adopted here for economic valuation.

natural resources have an "absolute" value[15], independent of people's preferences. The economic value, the *WTP*, would be scarcely useful. But we think those two points of view aren't necessarily opposite. There's no reason to refuse this notion of "absolute" value just because the preference measurement process is used. Simply, the two work on different levels: the latter provides the (economic) value of people's preferences towards (or against) an environment change; the former looks at the natural resource itself, in terms of quality and characteristics. Concluding, economic valuation indicates the demand curve of services provided by natural resources. Opportunity reasons justify monetary measures as money is one of the very few means that highlight people's preferences. Once the existence of those two value dimensions is accepted, the problem is choosing which one should inform and help decision-makers. The answer, according to us, is that since they are both plausible, both should be used. A decision made considering only economic value, cannot satisfy all the different needs of the decision-maker. But while economic value can generally be measured, "absolute" value cannot. If the decision-maker doesn't need to know the amount of the costs and benefits involved by his choice, the absence of measure isn't important. But if he does need to know it, choosing among alternative actions with different environmental impacts becomes difficult. The practical problem of economic value is to find measures that can be reliable even when the market is absent or malfunctioning. If, in doing so, we find measures based on people's widest expression of the value of natural resources, it is possible that the measure based on people's preferences (economic value) captures, at least partly, the true value of the natural resource.

2 Some unresolved matters

However, there are still some unsolved matters concerning the economic valuation of natural resources. The nature of these doubts goes beyond the limits of economics to ethics and philosophy. After having explained briefly the main strengths of economic valuation of natural resources in the previous section, we now look into its main limits.

2.1 Anthropocentrism

Anthropocentrism puts human beings at the center of the world, certainly an incontrovertible and unavoidable fact. But in an environmental perspective, this can bring adverse consequences. According to many, the anthropocentric point of view considers other species only as instruments, denying their dignity and underestimating their importance.
The study of non-human values made by human beings is arbitrary. So giving a value to natural resources, even when considering the intrinsic element, involves only the (anthropocentric) point of view of the judge. The natural environment, which is "other" in relation to human beings, has its own life, which doesn't depend on that of humans beings, who are therefore unable to value it from their point of view. This statement seems Panglossian[16]. The existence of a strong cause-effect relationship between the object and the subject of valuation is obvious, and it is of no use stating that the environment depends only on itself, as this doesn't help to solve the problems in any way.

[15] Here, the notion of value is wider than the notion of existence value, one of the elements of the total economic value of natural resources. This is because it would like to be equal to the "true" value of the environmental resource.

[16] Pangloss, in Candide by Voltaire, believes this: all events have causes that inevitably produce some effects, so everything has a sufficient reason in itself; the latter can be explained according to the unwinding of the intrinsic cause-effect relation.

2.2 Equity (and efficiency)

The "orthodox" cost-benefit analysis considers the actual income distribution as known and it is not concerned with the equity aspects of the action that is being valued: in fact equity issues are considered at a later stage in subsequent, expressly planned, public actions. The main goal is to be able to classify actions by their economic efficiency on an aggregate level; this means that those actions are valued considering the general wealth improvement they cause. In other words efficiency maximization comes from the maximization of the difference between benefits and costs. Actually, apart from few exceptions, cost-benefit analysis is usually done by simply summing costs and benefits, without considering who they will go to. The best theoretical justification of this view could be found in the third postulate of applied welfare economics of Harberger (1971):

> *«...c) when evaluating the net benefits or costs of a given action (project, program, or policy), the costs and benefits accruing to each member of the relevant group (e.g., a nation) should normally be added without regard to the individual(s) to whom they accrue.»*[17].

This pursuit of economic efficiency has to follow some conditions that, if satisfied simultaneously, can ensure paretian efficiency[18]. The latter allows separating the decision from the subjectivity of value judgments: the social desirability of a paretian improvement becomes an objective value. On the other hand, the real problem is the existence itself of a paretian improvement: it's hard to find any good project that doesn't involve losses for somebody, especially in the environmental field.

Considering this problem, the desirability of alternative public actions should be determined also considering the distribution of the caused effects among people interested. This means that the analysis of the socio-economic desirability of a decision should include its distributional impact. Regarding this we hereby quote the USA Executive Order 12866 "Regulatory Planning and Review" of 1993, about the preparation of economic analysis for relevant regulatory actions, section 1, point 5:

> *«When an agency determines that a regulation is the best available method of achieving the regulatory objective, it shall design its regulations in the most cost-effective manner to achieve the regulatory objective. In doing so, each agency shall consider ..... distributive impacts and equity.»*

Even sharper is the document "Economic Analysis of Federal Regulations Under Executive Order 12866"[19] written jointly by the Office of Information and Regulatory Affairs and by the Office of Management and Budget of the U.S. administration in 1996. It states that distributive impacts are about the net effects of a regulatory alternative on population and the economic system, grouped in different ways (for example, by income, race, sex, industrial field); further, it states that also the impact between generations must be quantified. This document suggests that there aren't any generally accepted principles that can be used to determine which income distribution is more equitable. So cost-benefit analysis should explain and justify the particular distribution model used to value the equity of public actions. The matter of intergenerational equity, whose positive or negative impacts affect future generations, is another main point for environmental decision-making. Chichilinsky (1997) points out that no group of people should determine resources allocation choices, not now, nor in the future. If a rate of social discount other than zero would be used, the present would be dictatorial. Every value of this rate would amplify the welfare of a certain number of generations, while the one which comes next is not considered by the actual decision. This means that every positive discount rate cannot be justified in terms of intergenerational equity. Chichilinsky suggests choosing a hyperbolic discount rate, which would

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[17] Here is Boadway's opinion (1974): *«...cost-benefit analysis have proceeded by simply adding up total money costs and benefits regardless of who receives them. Indeed Harberger (1971) has argued that this be considered one of the "three basic postulates" of applied welfare economics.».*

[18] For the complete analysis of the paretian efficiency conditions see Just et al., (1982).

[19] Internet: http://www.whitehouse.gov/omb/inforeg/riaguide.html

start from a level close to the actual interest going asymptotically towards zero in the future. In this way costs and benefits would not set to zero in the future, so that welfare variations of all interested generations would be considered. Another point of view is the one offered by the Gamma discounting approach (Weitzman, 2001), which stresses the need of incorporating the distribution probability of the social discount rate directly in the analysis.

2.3 Measuring

For many commentators environmental protection involves reasons – social, ethical, spiritual, psychological – that should not (and can not) be quantified. Simply, there are some goods, and among those natural resources, for which pricing has no sense at all. This can actually be true. But at the same time it doesn't mean that people can't define the importance that some environmental amenities have for themselves. As we said before (see 1.2), economic values are determined by considering the choices people make. Economic value isn't expressed in dollars in the head of the individual who admires a breathtaking landscape; but a value can be expressed considering which things he is willing to give up to be able to see this landscape. This means that, for economic measurement, the importance of goods and services (tangible or not) is determined by whatever is given up to get them: if that is money, goods and services can be expressed by monetary value; otherwise by their natural measure unit.

Furthermore many observers attribute a measure of imprecision to the environmental measurement process. Indeed, it is often true that similar valuation exercises come to very different results. But accuracy is certainly not improved by not doing any economic valuation, nor does this improve the accuracy of the decision-making process. Even worse, the decision-maker's choice would thus be made on an entirely subjective basis. On the other hand, if economic valuation is used for limited and defined problems and if all its assumptions are made explicit, the analysis framework that it provides enables us to get results, maybe incomplete and imprecise, but certainly more objective and therefore more widely acceptable.

2.4 Preferences (virtues and vices)

Environmental valuation provides the decision-makers with normative information about the social desirability of a public action. The normative aspect is based on the assumption that the satisfaction of personal preferences increases individual and hence social welfare. The assumption of satisfaction of preferences is crucial if we don't want to undermine the validity of the entire economic valuation process. Philosopher Mark Sagoff in his critique to environmental economics clarifies his doubts about this assumption (Sagoff, 1993):

> *«My argument against using the theory of welfare economics as a basis for allocating resources is that, even if preferences did exist as a foundation for "rational" choice, economists offer no plausible reason why environmental policy should seek to satisfy them. Economists use the term "social welfare" as a proxy for the "satisfaction of preferences" and then trivially and speciously argue that the "satisfaction of preferences" produces social welfare. However, empirical evidence confirms what common wisdom suggests: not the satisfaction but the content and quality of desires correlates with what people mean by welfare or well-being.»*

Further, considering the ethical and intergenerational implications of environmental goods, value cannot be determined exclusively by single individuals. It must be an institution, well-functioning and respectful of present and future personal freedoms, to define the importance of such value and to make decisions on a democratic basis. Moreover, some critics think that environmental choice doesn't always satisfy the preferences that caused the choice, therefore if the economic value of a good is to be meaningful, a direct measuring of the welfare acquired by a person by using the good itself cannot be omitted.

Choices about the environment are certainly hard to make, but also inevitable as long as people's and governments' resources are limited. Economic analysis based on preferences provides information about how people value these choices, widening the information basis to the instances of all interested people. So, although we are aware of the limits of the observation of

environmental preferences, we still hold that individual preferences are a behavioral window essential for an efficient study of the values expressed by people.

3 European Union and environment

Until the early nineties European Union environmental policies didn't refer to economic valuation to guide decision-making, even if, starting from the seventies, the Community had introduced legislative acts about the environment and had passed four Environmental Action Programmes since 1973 [20].

In 1992 the Treaty on European Union is signed in Maastricht. It states – article 130R(3) – that benefits and potential costs of the European Union environmental policies should be specifically considered. According to its rules, the Commission should use economic analysis instruments both to put forward policies (*ex ante* point of view) and to value them (*ex post* point of view). The Treaty also introduces in the Community law system the goal of the «*sustainable and not inflationary growth*», and the principles of environmental protection, caution in the use of resources, environment integration in community policies, polluter's responsibility ("polluter pays principle") including prevention and correction of the environmental damages' source. The Treaty also passes the subsidiarity principle, by which decisions must be made by the authority which is closest to citizens.

Also in 1992 the Fifth EC Environmental Action Program was passed (Towards sustainability: COM(92)23). The document refers directly to natural resources valuation as necessary information for public decision-making:

> *«Valuation, pricing and accounting mechanisms have a pivotal role to play in the achievement of sustainable development. Economic valuations can help economic agents to take environmental impacts into accounts»,*

and it requires the use of the suitable analysis instruments:

> *«...development of meaningful cost/benefit methodologies and guidelines in respect of policy measures and actions which impinge on the environmental and natural resource stock.»*
> (European Commission, 1992).

This Program recalls the principles of the Treaty of Maastricht, but also other important elements for the integration of the environment in European policies and for their improvement. Among these are: common and shared environmental responsibility, active participation of local authorities into decision-making process (according to a "bottom-up" approach), integration of normative instruments with market ones, the use of innovative solutions to change individual attitudes, and production and consumption models. Further, in 1997 the Treaty of Amsterdam is signed. It explicitly attributes a main role to environment and sustainable development in the strengthening of European Union.

Also important is the European Spatial Development Perspective (ESDP), which illustrates the dynamics affecting the European territory and environment as well as the options for policies and actions worked out by the Union[21]. Another interesting aspect is the explicit recognition made by the Commission of the need for «*an integrated approach to urban problems encompassing social,*

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[20] Which are followed by the fifth Environmental Action Program (1993-2000) and the sixth (2001-2010), as specified later on.

[21] This document, presented as a project in Nordwijk for the European prime Ministers summit on regional policy and territory asset, focuses on the goals of the analysis and elaboration process started in 1989. The options for policies and action are based on three goals: development (to guarantee a higher competitiveness to regions, cities and European territories), balance (to guarantee economic and social cohesion) and protection (to guarantee environmental and social support to development). Those goals should be considered in different ways according to the specific local needs.

economic, and environmental factors. » (Towards an Urban Agenda in the European Union: COM(97)197)[22].

An important step forward for environment integration in European policies took place in the Agenda 2000 document and in the political agreements of the Berlin summit (March 1999). The selection of goals, geographical areas, spheres of action and instruments demonstrates the importance gained by the determination for sustainable development also in the short and medium period. And, more specifically, it is expected that the use of strategic environmental assessment (SEA) of the programming documents will be extended also to the regional level. The SEA of plans and programs is introduced in the community law system with regulation 2001/41. The importance of this step can be assessed by considering the extension of the area of application of the valuation processes for projects and works of environmental impact (regulation 97/11), and the integrated environmental authorization (regulation 96/61).

Also important are the White Paper on environmental liability (COM(2000)66), that provides an actual application of the "polluter pays" principle, and the document (COM(2001)1) about the precautionary principle which ensures a high level of environmental protection of human, animal, and vegetal health when the available scientific data don't allow a complete valuation of the risk.

Still concerning the integration of economic and environmental valuations in the programming activities and in the definition of general and local policies, we recall: the document (COM(97)9) about fiscal instruments used by member countries to increase the efficacy of environmental policy; the many documents about the strategy of environment integration in European policies and in the single market (as COM(98)333 and COM(99)263); the Green Paper on integrated product policy (COM(2001)68); the project of regulation COM(2001)139 about the application of community penal legislation for environmental crimes.

The Decision about the Sixth Environmental Action Programme 2001-2010 (Environment 2010: our future, our choice: COM(2001)31) is presented in January 2001. It underlines once more the need to use the latest scientific and economic knowledge to elaborate, apply and value environmental policies:

> *«The Commission intends to develop a systematic evaluation process in order to improve future policy and implementation and to be able to assess likely future developments. ... We need to research and define clear and consistent sets of indicators which gauge progress against identified targets, including indicators of the monetary value of the impacts of environmental degradation»*
> (European Commission, 2001)

Other confirmations of this orientation are found in the strategy elaborated in the four action priority guidelines of the Sixth Programme (climate changes, nature and bio-diversity, environment and health, sustainable use of natural resources and waste management). Each of them in fact underlined the crucial role of natural resources economic valuation.

The proposal of a European strategy for a sustainable development presented in May 2001 (A sustainable Europe for a better world: COM(2001)264), underlines that the systematic and transparent economic valuation of costs and effects of environmental aspects of policies, is also necessary to reach the goal of sustainability.

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[22] The urban and local environmental action process occurs in October 1998, when the Commission presents a document (Sustainable urban development in the European Union: a framework for action" COM(98)605), which is discussed during the urban forum of Vienna (November 1998) and is later accompanied by a new document (Community Framework of cooperation for the sustainable development of urban environment: COM(99)557). These two documents, defining goals and actions for the urban support, consider local action, improvement of government, decentralized capacities and participation of the social authorities as very important matters. In 1998 there also is the Fifth Framework Program for research and technological development for the period 1999-2002 (Decision 198/1999 of 12/22/1998), which is mostly focused on the definition and diffusion of highly innovative solutions for sustainable development.

4 Diffusion of natural resources valuation in Europe

Natural resources valuation was a typically Northern American practice until the seventies; since then it has gained importance also in Asian, Latin American, and African countries[23]. This diffusion is evidenced by the great number of handbooks produced by the most important international *NGOs* (*OECD*, *UNEP*, *UNDP*, World Bank, Asian Development Bank, *WHO*), mostly about third world countries, and by the many handbooks made for the United States[24].

On the other hand, in Europe this diffusion occurred later and was less lively. In this section we want to analyse the diffusion, at an institutional level, of natural resources valuation. In the conclusion we also pay some attention to the academic debate concerning these methodologies.

4.1 Institutional diffusion

For a systematic study of valuation processes at the institutional level it is necessary to distinguish between the different kinds of uses they are put to. Environment economic analysis can be used in four main ways, within the processes of valuation of the environmental effects of:

- project evaluation;
- policy review;
- natural resource damage assessment;
- environmental accounting.

Project evaluation

The valuation of non-market goods, such as environmental resources, was developed in the United States around the fifties. A part of the project valuation process, its aim was the systematic incorporation of intangibles in economic analysis. So the environmental valuation techniques were mainly used for this purpose in the United States and in other, culturally similar, countries.

As we said previously, the theoretical and practical possibilities of economic analysis were appreciated later, and developed at a slower pace, in Europe than in the United States. In some European countries economic analysis was used to support public choices, mostly about the construction of various infrastructures. But usually the environmental impact was not considered[25]. In truth, economic analyses were systematically applied to transportation in the United Kingdom since the sixties, while in recent years benefit valuation has also been applied to the environmental, health and energy sectors. Moreover, the United Kingdom has issued an economic analysis valuation scheme for investment projects, but the monetary valuation of environmental impacts is left out.

In 1997 the DG Regional Policy has issued a handbook on cost-benefit analysis of major projects. It highlights how to conduct a socio-economic analysis of costs and benefits for major projects financed by cohesion and structural funds. Unfortunately it doesn't mention natural resources valuation.

Policy review

This is one of the most important and problematic aspects of environmental valuation. The value added of this kind of use is the objective information that it provides to decision-makers. A

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[23] In the third world countries the input was given by the practice of development banks that used it to support their decisions about financing projects.

[24] We are mostly talking of the Water Resources Council's Principle and Standards, of the U.S. Forest Service's Resource Planning Assessment, of the Oil Pollution Act, of the Comprehensive Environmental Response Compensation and Liability Act (CERCLA), of the Natural Resource Damage Assessment (NRDA) and of the recent Guidelines for preparing economic analysis from the Environmental Protection Agency and of the Economic Analysis of Federal Regulations Under Executive Order 12866, from the Office of Management and Budget USA.

[25] With the exception of the German experience in which the replacement costs approach was used for noise, air pollution, and traffic impacts, and of the Norwegian one which relied on contingent valuation to quantify environmental and health impacts of transportation projects.

peculiar characteristic of this area is that its use changes private consumption and production rules, so that results depend on the respect of these same rules.

Cost-benefit analysis of environmental policies has had a limited diffusion in Europe: we recall the Norwegian project "Locally Adapted Regulatory Impact Analysis (LARIA)", started in 1986 to provide a priority scale for regulative actions in highly polluted areas. It provides each possible regulation with a cost-benefit indicator: benefits are calculated by using a weight set drawn from Norwegian and American experiences.

Some *ex-ante* and *ex-post* damages valuations, at national and regional level, have been conducted for new regulations in Germany and The Netherlands[26]. Since 1990 the British government has worked on a cost-benefit analysis model which is able to incorporate also environmental aspects through non-market valuation methodologies, but this model hasn't had great success

As we will say later, some progress was made by the European Union DG Environment in the diffusion of natural resources valuation of policies. In fact it promoted many important studies of environmental impacts valuation, mostly to support decision-making. On the other hand the absence of economic aspects in the documents regarding structural funds valuation for the programming period 2000-2006[27], which were included in the previous one (1994-1999), seems to be a set-back.

Natural resource damage assessment

Environmental externalities' quantification affects natural resources damages valuation. The notion of responsibility in natural resources damages valuation processes, carried out using non-market valuation methodologies in the United States' legal system, does not have the same importance in contemporary European legislation. But the "polluter pays" principle introduced by the Treaty of Maastricht, foreshadows a greater diffusion of this practice in European countries. Recently (May 2001) a study for the valuation and restoration of natural resources damages has been carried out by the European Commission in order to define the concept of environmental responsibility, as we will explain later on.

Environmental accounting systems

It is widely believed that ignoring the services provided by natural resources results in an underestimation of the aggregate measure of economic activity. Only recently a better effort was made to integrate the value of natural resources services in traditional public accounts by relying on the pricing of those services by means of economic valuation.

Norway was the first European country – in the seventies – to establish an environmental accounts system that incorporated data about energy sources, forests, minerals, and fishing. Environmental accounting was later applied in other European countries: The Netherlands, Germany, Sweden, and Denmark. The European Union, thanks to its office of statistics Eurostat, is experimenting and developing a general model of environment accounting based on the Dutch National Accounting Matrix including Environmental Accounts (NAMEA). But economic valuation still has only a minor role in providing the data used in environmental accounting.

4.2 European Commission DG Environment studies

The European Commission DG Environment has shown increasing attention to natural resources economic valuation. This is demonstrated by the latest studies carried out, listed below.

Two concerns have driven the choice of the works to be included. First of all, we present theoretic studies concerning some major methodological aspects, because they will provide an institutional reference for future applications. Then we discuss studies with relevant policy implications, which set a monetary value to environmental goods.

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[26] The Dutch valuation studies aren't generally based on demand curve methods, but on losses of productivity and on other non-economics based methodologies.

[27] The documents of the DG Regional Policy refer only to environmental valuation in terms of strength and weakness, and to a general valuation of environmental impact.

4.2.1 Methodological studies

As we hinted before, methodological studies can be intended as guidelines for natural resources valuation. Their goal is to facilitate the application and to increase the diffusion of valuation technique. They mainly contribute to the refinement of economic valuation techniques, i.e. those techniques which derive the demand curve of environmental goods.

Economic evaluation of environmental policies and legislation (EEPL) - 1998

This report analyses how cost-benefit analysis (*CBA*) and cost-efficiency (*CEA*) analyses have been used to define environmental legislation and policy-making. It is divided in two parts: the first is a general survey of the 15 EU countries plus Australia, Canada, Japan and the United States; the second part is about Canadian, Dutch and British case-studies. Empirical verification of *CBA* and *CEA* diffusion, shows that partial valuation exercises are often used. Actually in Europe the United Kingdom is the only country to use monetary valuation to estimate the effects on environment and human health of regulations and of policies. The majority of other countries only define the costs for industry and government, without trying to monetize the intangibles. A development of this analysis is the study "*Induced and opportunity cost and benefit patterns in the context of cost-benefit analysis in the field of environment* (1999)", which devotes a chapter to valuation techniques of environmental, human mortality and morbidity impacts.

A study on the economic valuation of environmental externalities from landfill disposal and incineration of waste (SELI) - 2000

This work offers methodological suggestions for the use of environmental cost-benefit analysis for two waste management options: landfill disposal and incineration. Among various matters it deals with externalities arising from the two different alternatives. It also includes a survey of main valuation techniques, based on existing literature.

Analysis of the fundamental concepts of resource management (ARM) - 2000

This document, at point 4.4, defines the meaning of total economic value of natural resources and presents a taxonomy of valuation methods, separating direct from indirect ones. The former, that investigate directly individual preferences for natural resources, can be ascribed to contingent valuation techniques. The indirect ones, which study preferences using market information, are the following: loss in productivity, defensive expenditure, averting cost, replacement cost, relocation cost, dose-response, hedonic analysis, travel cost.

Technical report on methodology: cost-benefit analysis and policy responses (TRM) - 2000

This report is the section devoted to environmental policy cost-benefit analysis of the document "*European environmental priorities: an integrated economic and environmental assessment*". But, for our purposes, it seems less significant and comprehensive than other similar documents[28].

Concerted Action on Environmental Valuation in Europe (EVE) - 1998-2000

These studies are an important part of the policy briefing series documents issued by the *Concerted Action on Environmental Valuation in Europe* (EVE), a program sponsored by European Commission DG Research and coordinated by *Cambridge Research for the Environment* (CRE). From June 1998 till November 2000, it has involved 14 European teams on environmental valuation matters. Briefly, considering that environmental valuation aims to provide economic agents with the total environmental cost of their activities (i.e. internalising externalities), these studies deal with the different pricing methodologies of intangibles to be used in cost-benefit analyses. Subsequently they focus on non-economic valuation methodologies, such as multicriterial analysis and adaptive management and participatory approaches. Finally they investigate the ethical aspects of environmental matters.

These studies basically provide a multidisciplinary vision that widens the focus on economic valuation by framing it in a realistic and practical context.

[28] In fact it is mostly concerned with the statistic value of life.

Study on valuation and restoration of biodiversity damage for the purpose of environmental liability (SVRB) - 2001

This is probably the most relevant methodological study to support economic valuation in the European Union. It was carried out for the DG Environment to integrate the White Book on environment responsibility (February 2000). It's main goal is the investigation of the various responsibility systems for natural resources and biodiversity damages. Its importance lies in the fact that it provides the Commission with a general framework for economic valuation and cost-benefit analysis to support environmental decision-making.

It basically focuses on three main points:

- the definition of the importance of natural resources damages and of the minimum levels of restoration of these damages;
- the potentialities of economic valuation techniques[29] for quantifying natural resources damages;
- the functionality of cost-benefit analysis to find the most efficient restoring option.

The last two points, which have a broader relevance, demonstrates this document's nature as guideline. It starts from an analysis of economic valuation techniques (separating techniques that refer to expressed preferences and others that refer to revealed preferences, and including the "benefit transfer" approach). Subsequently it shows criteria that can uphold the selection of a specific valuation technique. Finally it provides a cost-benefit analysis framework.

The following table offers a synopsis of analysed studies.

Table 1 – Synopsis of methodological studies

Study	Valuation object	Valuation technique (demand – non-demand)	Type of study
EEPL – 1998	Environmental policies; environmental legislation	Both demand-curve and non-demand-curve	Survey
SELI – 2000	Waste	Both demand-curve and non-demand-curve	Technical – Survey
ARM – 2000	Natural resources	Both demand-curve and non-demand-curve	Technical
TRM – 2000	Policies	Only demand-curve	Technical
EVE – 1998-2000	Natural resources	Both demand-curve and non-demand-curve	Technical
SVRB – 2001	Biodiversity	Only demand-curve	Technical

4.2.2 Application-oriented studies

Here we focus on those studies whose results were or can be, in any way, used by the DG Environment itself: that is institutional studies which are directly relevant to policy-making.

Economic evaluation of air quality targets for tropospheric ozone (EEA) - 1998

This study identifies and measures costs and benefits arising from complying with environmental quality standards (different limit/goal values sets) for tropospheric ozone in EU. The study rely on the RAINS model (*Regional Air Pollution Information and Simulation*, developed by the *International Institute for Applied System Analysis* – IIASA) to analyse the strategies to decrease emissions that damage the tropospheric ozone. This model works on scenario analysis, following the emissions' path, from the source to the environmental impact. The methodology used to quantify those impacts refers to the *ExternE* project (European Commission, DG XII), based on a stepwise logical progression from emissions, to changes in the exposure, to the definition of impacts using dose-response functions, to the monetization in terms of *WTP/WTA*. According to this study, the major categories of benefits are the ones affecting human health and agricultural productivity, while effects on forest productivity and materials are trivial, and effects on the ecosystem are not quantified. In general, the study concludes that for the achievement of the target emission scenarios, total estimated benefits exceed costs. This information should help

[29] i.e. monetary valuation techniques deriving a demand curve.

the decision-makers in setting the levels of ozone concentration considered dangerous for human health and the environment.

Economic evaluation of a directive on national emission ceilings for certain atmospheric pollutants (EED) - 1999

This study develops further the *EEA* – 1998 study at member country level. It underscores which group of national emissions limits would be most efficient to achieve the many possible goals of ozone and acidification reduction. It depicts six different scenarios and calculates for each one the emissions limits that would allow achieving the EU countries' goals in the most effective way. The methodology followed is once more the one of the *ExternE* framework. The most important impacts are on human health and agricultural productivity, and costs are greater than benefits in achieving EU countries' goals.

Economic evaluation of air quality targets for CO and benzene (EECO) - 1999

The goal of this document is the identification and estimation of the costs and benefits deriving from the observation of environmental quality standards for carbon monoxide and for benzene both in the hotspots and in three urban backgrounds (Athens, Cologne, and London). The emerging costs and benefits are then compared to costs (forgone benefits) deriving from not applying other regulations besides the current one. Costs are calculated for the most efficient solutions. The methodology, developed from the *ExternE* project (dose-response approach) monetizes the costs and the benefits deriving from the achievement of goals. The results highlight that costs tend to exceed benefits both for carbon monoxide and benzene for all areas and scenarios.

Economic evaluation of quantitative objectives for climate changes (EECC) - 1999

The overall goal is the economic valuation of the consequences of the emission limits set by the Kyoto Protocol for EU countries (a 8% reduction of climate-change gases during 2008-2012, respect to the 1990 baseline). More specifically, this study aims to:

- identify the cheaper group of actions to achieve the set goals;
- analyse costs and impacts of an emission trading system for carbon dioxide.

This complex and ambitious work analyses separately some pollutants (carbon dioxide, methane, nitrogen monoxide) and the potentiality of emissions' reductions for specific sectors (energy, industry, domestic services, transportations, waste, agriculture). For every sector it defines the specific measures of emission in terms of direct costs (investment costs, operative and management costs) set equal for every EU country. These costs are then split to consider each pollutant with respect to the emission's reduction expressed in millions of equivalent tons of CO_2. Therefore this study basically indicates the specific costs of the reduction of emissions, expressed in ECU for an equivalent ton avoided of CO_2.

Economic evaluation of PVC waste management (EEPVC) - 2000

This study highlights the main economic implications of the different PVC waste management alternatives. It estimates the financial costs undergone and avoided for three analysis scenarios, and quantifies the main environmental impacts. The greatest benefits, calculated with a dose-response function according the *ExternE* approach, occur when PVC waste is recycled as opposed to incinerated.

Socio-Economic Impacts of the Identification of Priority Hazardous Substances under the Water Framework Directive (SEPHS) - 2000

This study underlines a methodological process to value the socio-economic impacts of the so-called priority hazardous substances (*PHSs*), which are highly harmful elements for the water environment, according to the Water Framework Directive. It also shows qualitative results based on existing literature. Its importance lies in the fact that it can be taken as the starting point for a more detailed future study on these same issues.

Study on the economic, legal, environmental and practical implications of a European Union system to reduce ship emissions of SO_2 and NOx (SESN) - 2000

The goal of the study is the assessment of values and the proposal of different policy options to reduce negative environmental impacts of the SO_2 and NOx emissions caused by crafts operating in European waters. It is interesting to point out that this study suggests command and control policies as well as approaches based on incentives, and that for both it analyzes incremental costs (associated to investment made to limit emissions) and incremental benefits (that is less harbor taxes for less pollutant crafts).

Economic evaluation of air quality targets for PAHs (EEPAH) - 2001

The Commission, after regulating the emissions in the atmosphere of pollutants such as sulfur dioxide lead and carbon monoxide, intends to regulate Polycyclic aromatic hydrocarbons (*PAHs*) emissions, which are highly carcinogenic. So throughout this study it analyzes, via a dose-response approach, benefits for human health arising from keeping emissions under five possible limit-values (0.01, 0.05, 0.5, 1.0, 5.0 ng/m^3 benzo[a]pyrene). It shows the costs necessary to reach those limit-values before 2010.

Evidence show that according to a cost-benefit perspective, despite the high level of uncertainty, the efforts to reduce the *PAHs* emissions should focus on limiting the use of wood and carbon for home heating. Measures about mobility and specific industrial sectors seem to be less effective and should be regulated by other means.

Economic evaluation for air quality targets for heavy metals (EEHM) - 2001

The goal of this study is the identification and the estimate of benefits and costs for attaining the limit values for air quality regarding the following heavy metals: arsenic, cadmium, nickel and (partly) mercury. The study concerns the EU countries and the six countries which are candidates for entry in the EU; it focuses on sixteen sectors and it uses the following approaches:

- analysis of sector characteristics;
- analysis of emission sources;
- analysis of the current air quality data;
- verification of the available emission reduction techniques;
- estimate of the future air quality level for a *business as usual* scenery of 2010;
- comparative analysis of the future air quality level and of potential limit values;
- verification of experimental techniques of emission reduction;
- identification of a cost-effective strategy (via a detailed costs analysis);
- analysis of the environmental and human health benefits.

For every sector the study indicates compliance costs for each heavy metal, according to various hypotheses of emission reduction, and applying different discount rates (2, 4, and 6 %). It also defines benefits according to risks analysis: estimated values, although potentially underestimated, are lower than costs.

Economic evaluation of sectorial emission reduction objectives for climate change (EESCC) - 2001

This study identifies the most efficient combinations of emissions from different sectors and of different pollutants in order to reduce greenhouse gases according to Kyoto protocol. Furthermore, it illustrates a group of measures that could facilitate the achievement of those goals, for every sector and for each element.

This study combines and compares “top-down” and “bottom-up” methodological approaches. According to the former all options are analysed at the same time, so that results are fully consistent with the model. According to the latter, it identifies different technological options to reduce greenhouse gases emission, it calculates its direct costs and the costs for equivalent ton of CO_2. The estimated marginal cost of emissions reduction is 20 $€_{99}$ for each equivalent ton of CO_2. At UE15 level, attainment costs are 3,7 billions of $€_{99}$ for each in the 2008-2012 period (0,6% of UE GDP in 2010). The study also highlights the six main courses of action, which are the following: reduction of petroleum use in the energy sector, energetic efficiency improvement,

further reduction of nitrogen monoxide, reduction of methane emissions, reduction of CFC use, transportation efficiency improvement.

European environmental priorities: an integrated economic and environmental assessment (EEP) - 1997-2001

In 1997 the DG Environment underwent a general and multi-sectorial study to identify the environmental priorities that Europe would have to face in the following years, and to estimate its economic impacts. More specifically, the selected environmental priorities were analysed in a cost-benefit framework as displayed below.

Acidification, eutrophication and tropospheric ozone (A)

A dose-response function of the impact on human health, materials, air pollution and agricultural productivity is used to calculate the costs of acidification and eutrophication. Tropospheric ozone benefits are considered as avoided damages to agricultural production and human health thanks to low level ozone control (i.e. giving unit damage costs to its precursors). These benefits are non-trivial for the different reference scenarios.

Biodiversity loss (B)

The report defines in this section the total economic value[30] of the benefits of different aspects – 9 – of biodiversity in terms of individual *WTP* (€ per year), as estimated by many European studies relying mostly on contingent valuation methodologies. The economic dimensions of estimated individual *WTP* for the various areas of biodiversity are between 1.8 and 120.9 € per year.

Chemicals, particulate matters, human health, air quality and noise (C)

This section estimates benefits in terms of *WTP* for the reduction of chemical pollutants use (lead, cadmium, dioxins, pesticides), reviewing the existing literature. It also portrays the analysis of benefits arising from PM_{10} control, which are between 14 and 24,2 billions €, and of costs coming from noise for the whole EU area (13,2 billions €).

Climate change (CC)

This section of the report is based on damage models caused by climate changes for the main greenhouse gases (CO_2, CH_4, N_2O). It estimates the marginal damage according to a dose-response approach: benefits are therefore the damages avoided due to stricter controls on emissions. Their value for the entire EU in 2010 is estimated as a maximum of 33 billions €.

Soil degradation (S)

Because of the lack of data, only damages to cultivable areas in terms of lost agricultural production are considered. This value for EU countries is between 612 and 2,873 billions € (between 0.5% and 2.2% of European agricultural sector added value in 1990).

Ozone depletion (O)

This section estimates only the benefits deriving from existing policies implemented according to the Montreal Protocol and its amendments. Those benefits are calculated as avoided damages coming from skin cancer, that is 12 billions €. The methodology used is a dose-response one.

Waste management (WM)

In this section the environmental impact of the different waste management methods (landfill disposal, incineration with or without *WTE*, composting, recycling) is monetized. The valuation techniques used combine a life cycle analysis approach with economic values deerived from existing literature. Considering the different scenarios, the monetary benefits in 2010 (billions of €) are generally lower than costs.

Water quality and quantity (W)

The approach used here to estimate the economic value of water, drawn from existing literature, is the one of the maximum individual *WTP* for water quantity and quality improvement. Results, organized by kinds of waters (superficial, ground, costal and fluvial) and by countries, present high variability.

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[30] *Total economic value* (TEV) is the sum of *direct use value*, of *indirect use value*, of *option value* and of *non-use value*.

The synoptic table below represents the main characteristics of the studies considered. It occurs to us that almost all of these studies don't deal with demand-curve valuation methodologies. This, in turn, seems to suggest that EU institutions don't have much trust, strictly speaking, in economic valuation methodologies.

Table 2 – Synopsis of application-oriented studies

Study	Valuation object	Pollutant/s	Valuation technique
EEA – 1998	Air quality (tropospheric ozone)	SO_2, Nox, VOC	Dose-response (ExternE)
EED – 1999	Air quality (tropospheric ozone - acidification)	SO_2, Nox, VOC	Dose-response (ExternE)
EECO – 1999	Air quality	CO, benzene	Dose-response (ExternE)
EECC – 1999	Air quality (climate changes)	CO_2, CH_4, N_2O	Cost analysis
EEPVC – 2000	Waste management	PVC	Dose-response
SEPHS – 2000	Water quality	PHSs	Multiple
SESN – 2000	Air quality	SO_2, NOx	Cost analysis
EEPAH – 2000	Air quality	PAHs	Dose-response
EEHM – 2001	Air quality	Arsenic, cadmium, nickel (mercury)	Cost analysis Risk analysis
EESCC – 2001	Air quality (climate changes)	All greenhouse gases	Cost analysis
EEP – 1997-2000			
A	Acidification, eutrophication, tropospheric ozone	PM_{10}, O_3, SO_2, VOC, NOx, NH_3	Dose-response
B	Wildlife, woodlands, wetlands, sensitive areas, moor land, watercourses, agricultural landscapes, endangered species	–	Mostly contingent valuation (from survey)
C	Human health, air quality, noise	Chemicals (lead, cadmium, dioxins, atropine), PM_{10}	Mostly demand-curve methods (from survey)
CC	Air quality (climate changes)	CO_2, CH_4, N_2O	Dose-response
S	Arable land	Soil erosion	Loss of productivity
O	Air quality (ozone	SO_2, NOx, VOC	Avoided deaths from skin cancer
WM	Waste	Incineration with and without WTE, composting, recycling	Demand-curve methods (from survey) life cycle analysis
W	Water	NO_3, N, quantity	Mostly contingent valuation (from survey)

4.3 Academic activity

A complete review of the European academic activity in the field of natural resources economic valuation is beyond the scope of this paper. But it is useful to note that, according to the report *"Assessment of Environmental Valuation Reference Inventory – EVRI – and the expansion of its coverage to the EU*[31]*"* (DG Environment, 2000) European studies that rely on environmental valuation economic techniques (contingent valuation, other stated preferences techniques – conjoint analysis, choice experiment, contingent ranking, etc – travel cost method, hedonic price/wage method) are at least 650, 192 of these carried on only in the United Kingdom.

[31] The aim of this study was to verify the adaptability of EVRI to Europe: the final judgement is widely positive

We assume that the number of European studies included in an important database for the improvement of benefit transfer practices, the EVRI (Environmental Valuation References Inventory, developed by Environment Canada with the support, among others, of the EU – European Environment Agency), can be taken representative of European academic activity. In this perspective, only 56 European studies were included in the EVRI when the report was delivered (March 2000). Today (December 2001) they are 81, and The UK is still by far the major contributor. The following table illustrates the different economic valuation techniques used in European studies.

Table 3 – Valuation techniques of European EVRI studies

Valuation techniques	Number
CV and other stated preferences	62
Travel cost	8
Hedonic price/wage	5
Others	6

Source: database EVRI – December 2001

5 Concluding remarks

The awareness of the relevance of environmental matters (climate change, ozone depletion, excessive use of resources, biodiversity loss) imposes upon Western countries the moral obligation to deal with them. This implies making important choices, for ourselves and for our descendants. Any instrument that improves the rationality (and efficacy) of the choice should be used: despite its limitations, environmental valuation is one of these. Once experience has shown the ineffectiveness of simpler approaches, and the necessity of developing new skills for solving environmental problems has become evident, the role of environmental valuation has begun to grow. In other words the marginal return of controlling pollution decreases[32], while its cost increases. In this context it is therefore necessary to develop a univocal unit of measure for environmental costs and benefits of alternative measures. The economic valuation of environmental amenities is able to provide a more complete picture[33]. In fact it is becoming more and more important for backing environmental choices. However, neither environmental policy, nor specifically environmental decision-making have become more efficient. In our opinion this paradox can be justified by considering the political economy aspects of environmental choice. Besides a normative approach, which provides good ideas that become good theories and foundation of acceptable decisions, it would be helpful to explore the positive approach too, which means trying to understand how the political process affects policy results, and eventually to suggest appropriate and possible solutions.

At the same time, as we have seen, the diffusion in Europe of natural resources valuation is still unsatisfactory[34]. It is necessary, therefore, to highlight the factors, which, we believe, cause diffidence in European decision-makers, and therefore limit its use.

First of all we must point out that environmental valuation techniques are both time and resource intensive[35]. The time required is often not feasible in the light of European political timing. Moreover the significant financial effort involved in environmental valuation implicates a

[32] We could also say that, while in the first stages of pollution control we worked on a segment of the curve of pollution abatement marginal costs which was low and not very steep, now we are on the increasing and steepest part of the curve, as many studies are proving.

[33] The information provided by the approximation of the area below the demand curve is precious enough, so we don't need more sophisticated measures to indicate the exact consumer's surplus.

[34] Especially regarding empirical applications. It is as if natural resources valuation methodologies were only academic speculations, not really useful to deal with reality.

[35] As demonstrated by the increasing attention for benefit transfer practices.

high level of commitment by decision-makers, this in turn depends on their complete understanding of the potentialities of environmental valuation, which is not always the case. Basically it seems that at the institutional level the perception is that achieving precise estimates is such a long and difficult task that it is better to use partial and qualitative analyses.

The measuring process itself involves ethical doubts and technical perplexities for decision-makers. We have already dealt with the former (see 2.3). Concerning the latter, it seems that the main problem in Europe is understanding the importance of non-use values, the role they play in defining an economic value acceptable by everyone involved in public decision-making. Furthermore, the distributive issues and the selection of the correct social discount rate, which are still unresolved problems (see 2.2), don't seem to ensure, from a social perspective, the optimal choice.

Besides the above points, which are certainly important, we believe that the limited diffusion of valuation practices in Europe also has a stronger and deeper reason. In our opinion the main concern of policy-makers is that the systematic nature of the approach, combined with the monetary quantification of all relevant environmental effects, results in an apparent precision that will result in the choice becoming too rigidly fixed. This means that, even if it is possible to consider monetary values as uncertain data, European decision-makers are afraid that the valuation's result could be considered to be identical to their choice. This wouldn't leave space for other elements – political, economical, social, practical ones – which, in the complex European reality, have a most important role.

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