UNIUNEA EUROPEANĂ

GUVERNUL ROMÂNIEI

Instrumente Structurale
2007 - 2013

Clarification Paper no. 7

RECOMMENDATIONS ON EXTERNALITIES TO BE CONSIDERATE IN THE COST-BENEFIT ANALYSIS OF INVESTMENT PROJECTS FINANCED FROM ERDF AND CF

January 2012

The document was prepared by experts who supported the implementation of the contract „Development of the capacity for the Cost-Benefit Analysis”, project co-financed by ERDF through TAOP

Laura Obreja Braşoveanu / professor, the Bucharest Academy of Economic Studies, Faculty of Finance, Insurances, Banks and Stock Exchanges, Department of Finance

Matei Grosu /consultant

This document has an informative character.

Project implemented by:

AAM Management Information Consulting Private Company Limited by Shares

AAM Management Information Consulting SRL

Leader A.T.E.C. SRL

Intrarom SA

Infogroup Consulting SA

CONTENT

1. INTRODUCTION

Welfare economists aim to maximize individual and social welfare through optimal resource allocation. The concept of externalities has been well established in the theory of welfare economics for more than half a century.

Externalities could be defined as: *"The costs and benefits which arise when the social or economic activities of one group of people have an impact on another, and when the first group fails to fully account for their impact*."

Externalities are common in virtually every area of economic activity. They are defined as third party (or spill-over) effects arising from the production and/or consumption of goods and services for which no appropriate compensation is paid.
Externalities can cause market failure if the price mechanism does not take into account the full social costs and social benefits of production and consumption.

In the real market, prices do not reflect the full costs or benefits of producing or consuming a product or service. As a brief definition of the notion, an externality is a cost or benefit, not transmitted through prices, incurred by a party who did not agree to the action causing the cost or benefit. A benefit in this case is called a **positive externality** or **external benefit**, while a cost is called a **negative externality** or **external cost**.

External costs and benefits are opposed to "traditional" costs and benefits such as operating costs, or income from sale of energy. Such costs and benefits are also referred to as internal or financial costs. The characteristic of such costs is that they are paid for with a price determined by the market, and this price reflects all the true costs of the good or service that it covers.

The methodology used for Economic Valuation of the Externalities generated by projects developed under FEDR and FC, mainly the investments made in order to boost the regional development and growth, investments for innovation and production efficiency, environmental sector, transport and infrastructure, is based on the Replacement Cost Method.

The difficulty of the economic valuation externalities is well known in all its phase: the identification of many of its effects, it quantification in physical terms and subsequently its valuation in economic terms. This is because a large proportion of the effects of these projects are externalities (also known as intangible effects); that is, there is no market for them and, therefore, they do not have a price. Examples of this are the contribution of tree cover to the conservation and improved quality of soil, the transcendental role of the tree masses in oxygen and carbon dioxide cycles, or the beauty of many forest landscapes.

The term 'externality' refers to the fact that the effect in question is external to the market. In our car example, the market for petrol determines what price petrol sells at, but the effects and costs of the pollution that the petrol produces fall outside this market. Users of petrol do not, currently, pay for the privilege of being allowed to pollute, and the general public are not paid for suffering the effects of the pollution.

In this context, cost benefit analysis is a technique for assessing the **monetary social costs and benefits** of a capital investment project **over a given time period**. The principles of cost-benefit analysis (CBA) are simple:

1. **Appraisal of a project:** It is an economic technique for project appraisal, widely used in business as well as government spending projects (for example should a business invest in a new information system)
2. **Incorporates externalities into the equation:** It can, if required, include wider social/environmental impacts as well as 'private' economic costs and benefits so that externalities are incorporated into the decision process. In this way, CBA can be used to estimate the social welfare effects of an investment

Time matters - can take account of the **economics of time** – known as **discounting**. This is important when looking at environmental impacts of a project in the years ahead.

Due to the fact that the quantification process of externalities (both positive and negative) is a very complex approach, which imply using econometric tools and many key variables, this paper will try to identify the most important types of externalities which have to be taken into consideration when developing a project.

The objectives of the present are the identification and proposal per investment types of the minimum set of positive and negative externalities which need to be considered when preparing the cost-benefit analysis for a certain project, no matter if these are quantifiable and monetized or not.

2. THE CASE

2.1 ADDRESSING THE EXTERNALITY ISSUES. POSITIVE AND NEGATIVE EXTERNALITIES

2.1.1 LITERATURE REVIEW

Due to the fact that conceptual issues concerning externalities have been somewhat overlooked, we consider necessary to analyze how it has been conceptualized in recent times and which are the latest theoretical positions on the subject.

Externalities are situations that occur in life that can benefit or hinder a person and are most often beyond their scope of control. Economic analyst and author, Dr. Paul Johnson, identifies them as situations in which the private cost of benefit accrues to a firm or household other than the producer or purchaser. For example, if a neighbor decides to paint their home and landscape the lawn the entire community can potentially benefit from these actions generating increased market value from curb appeal. A negative condition is realized in the attempt to ascertain the absolute age from fossils which are distorted from the exposure and effects of climate and air pollution.

The methodology valid today and usually used to economically evaluate some of the externalities of the Restoration Projects of Basins is based on the model by J. Aguiló Bonnin (Aguiló, 1976; *Dirección General de Medio Ambiente* (General Environmental Committee), 1985; ICONA, 1987), which applies what is called the Replacement Cost Method (RCM). The basic points of the method consist in supposing that, as the absence of restoration works determines the annual and continual appearance of a series of damages, the correction of that damage would require annual investment; and that, by avoiding the restoration works that may be incurred with such costs, its total is a suitable measure of the benefit of investment. The model considers five beneficial effects of the investment in soil conservation: a) the preservation of soil quality; b) the prevention of physical damage to the soil; c) the increase in water availability through greater infiltration; d) the increase of water availability through surface storage; and e) the prevention of damages in dominated zones.

Apart from this first approach, there are other benefits of project implementation restoration he fails to include in his analysis due to the impossibility of their valuation, and that in fact may be more conclusive when deciding on the project, such as: the safety of human lives and population nuclei; increase of productivity in farming zones; avoidance of damage to infrastructure; saving of social costs due to floods; and refilling of aquifers; among others.

With other emphasis on valuation, in recent decades, the so-called *Demand Curve Approaches are developing*. The following are found within this latter approach:

a) the so called *expressed preference methods*, which rely on carefully structured surveys to elicit people's preferences about natural resources (contingent valuation methods and choice experiment or stated preference techniques); and

b) the *revealed preference methods,* which use data from selected actual markets to extrapolate people's preferences for natural resources which are assumed to be reflected in these actual markets (the travel-cost method and the hedonic price method).

2.1.2 POSITIVE AND NEGATIVE EXTERNALITIES

Both approaches are used in the environmental restoration projects, but it is important to highlight that the different nature and philosophy of both, make the monetary results obtained be, logically, of differing magnitude, and must be used as complementary measures in the decision making process. The first approach pertains to what is known in the valuation of restoration projects as *Value-To-Cost Approach* (VTC), and would be more closely linked to an approach of Cost- Efficiency Analysis (CEA), that is, once society decides to carry out specific environmental restoration, and what must be decided is among alternative projects. The second approach pertains to the so-called *Value-To-Value Approach* (VTV), and is used in restoration projects to try to estimate the Total Economic Value (TEV) of the services generated by the project, requiring techniques capable of quantifying non-use values, such as the Contingent Valuation Method, and is more closely linked to the use of the Cost-Benefit Analysis (CBA), the result of which can be compared with other alternative projects important for society of a non-environmental nature.

The externalities monetization should be done when external benefits or costs exist, and these are not included in the financial analysis or if they cannot be evidenced by using the conversion factors. The most relevant examples are the impact of projects on the environment, whether positive or negative, live saving in case of healthcare investments, time saving in case of transport sector investment. In most cases, the identification and quantification of these externalities is extremely difficult, and often the monetization is not possible because long-term effects can occur.

Monetization of externalities can be done using the willingness-to-pay (WTP) method: estimation of a money value through users' revealed preferences - surveys, questionnaires - or stated preferences - observed statistical summary, compared to other similar behaviors observed in other markets.

Currently, in Romania, there are no national regulations on the type of externalities that should be taken into account for different sectors, but general examples and methodology principles are available.

Taking into consideration types of investments made under different programs, we could consider some examples of positive externalities (improved life quality following a positive impact on the environment - through improved population health or area attractiveness increase, risk and accidents number reduction from investment projects in transport, reducing greenhouse gas emissions and fine particles from investment in energy) and negative (on the environment: the landscape destruction, loss of property value and land area due to adverse effects on environment such as noise or odor, the impact of temporary construction, increased emissions due to increased transport activity induced by the project).

It is considered that there are externalities for each proposed project, and they depend on the characteristics of the project.

EC (2008) provides more detailed explanations on the externalities, especially on their monetization. The "willingness-to-pay" method allows estimating a monetary value via user preferences, disclosed or reported.

If this method is not possible or relevant, long-run marginal cost (LRMC) can be the default accounting rule. Usually WTP is higher than LRMC in empirical estimates, and sometimes an average of the two is appropriate.

Positive externalities, or benefits, will be classed as income and the negative ones, or costs, in the category of expenses.

Positive externalities
o Advantages in terms of reduction of risk of accidents in a congested urban area as an effect of a project for the re-location of a manufacturing plant; o Individuals consuming vaccine against the influenza virus. Those who do not vaccinate themselves receive the benefit of a reduced prevalence of the virus in the community; o Damming of rivers for electricity. The damming not only provides for flood mitigation for those living downstream but also provides an area for enjoying water-based recreational activities for free;

Negative externalities
o Water pollution by industries that adds poisons to the water, which harm plants, animals, and humans; o The unregulated harvesting of one fishing company in the Mediterranean Sea depletes the stock of available fish for the other companies and overfishing may result; o When car owners freely use roads, they impose congestion costs on all other users and harmful emissions to pedestrians.

Another method for quantifying the externalities, if long-term effects occur, consists in including estimated shadow prices from other projects or programs.

In the same context, it must be analyzed the indirect effects, defined as quantity or price's changes occurring in secondary markets. These effects should not be included in the evaluation of the project's costs and benefits whenever an appropriate shadow price has been given in the primary markets, because they are irrelevant in a general equilibrium setting, as they are already captured by shadow prices. However, there are situations when it is required to include them in the project, depend upon the existence of distortions such as taxes, subsidies, monopolistic rents and externalities. In partial equilibrium setting, indirect effects occurring in distorted secondary markets should be included in the cost-benefit analysis, because, it is only in this kind of market that they may represent important costs or benefits to society (e.g. if a government intervention generates changes in the quantities exchanged in secondary markets).

An important measure of sustainability is associated with externalities. The environmental impacts (or damages) caused by an economic activity are labeled environmental externalities. Included in the generic term "externality" are benefits or costs resulting as an unintended byproduct of an economic activity that accrue to someone other than the parties involved in the activity or economic transaction. Sounds complicated but it happens every day. When a motorist purchases gasoline from a service station, the transaction is between these two parties. People outside of the transaction, who may not own or use cars themselves (e.g., children, elderly, disabled, etc.), have to breathe the air polluted by the car exhaust, etc.

Externalities are not easily assessed because, in some cases, the full extent of their impact is unknown. Environmentalists and economists have struggled with externalities, and the following methods of assessment are now available:

Qualitative Treatment This method requires environmental impacts to be described in descriptive terms like no impact, moderate, or significant impact.

Weighting and Ranking A cross between qualitative and quantitative methods, weights and ranks are assigned to externalities to assess their relative environmental impacts.

Cost of Control A simpler method which quantifies an externality by how much it costs to control or prevent it.

Damage Function The approach aims to determine the amount individuals are willing to pay to avoid a damage that results from a pollutant or the compensation individuals are willing to accept in lieu of the damages (climate change, biodiversity loss, etc.).

Percentage Adders A predetermined fixed percentage is added to (or subtracted from) the avoided cost of a source option. The percent amount to be added may be determined by law, judgment, or estimates of control or damage costs.

Monetization by Emission Used mostly for air pollutants, an actual cost per unit amount of pollutant is estimated from its known environmental impacts.

Multi-Attribute Tradeoff Analysis This method attempts to analyze the tradeoff between costs and benefits of different strategies and may use qualitative and quantitative measures:

For example, the effects of pollution (which could arise in many projects – industrial investments made by SMEs, environmental projects, applicable innovation into production, large infrastructure projects, etc) can generally be classified into four major categories: health impacts, direct and indirect effects on efficiency and productivity, landscape effects and effects on ecosystem. All these effects mentioned above are commonly examples of economic externalities of industrial production activity.

Cross-border projects may bring additional concessional and non-concessional funds. Positive externalities (e.g., benefits such as time and cost savings, environmental protection, and trade facilitation) and negative externalities (e.g., costs such as environmental pollution, trafficking, and the spread of communicable diseases) arise when the consequences of one or more countries' actions spill over national borders. The larger are these cross-border positive externalities, the stronger is the case for regional public goods, and therefore, the stronger is the economic rationale for regional cooperation.

The collection and disposal of waste degrades environmental quality and imposes external costs (as well as private costs) on society. The external costs take varied forms: local pollution, trans-boundary pollution, global pollution, noise nuisances, and visual nuisances.

2.2 MINIMAL EXTERNALITIES WHICH SHOULD BE CONSIDERED FOR TYPES OF INVESTMENT

- ***Regional and local transport infrastructure***

At the policy level, there are two major economic justifications for developing regional and local transport infrastructure: (i) the need to deal with project-related additionalities and positive and negative externalities and (ii) the potential to derive economies of scale in pursuit of regional goals.

Regarding the first justification for regional infrastructure, projects may bring additional concessional and non-concessional funds. Positive externalities (e.g., benefits such as time and cost savings, environmental protection, and trade facilitation) and negative externalities (e.g., costs such as environmental pollution, trafficking, and the spread of communicable diseases) arise when the consequences of one or more regions' actions are taken in consideration.

As to the second justification, regional programs can produce economies of scale in provision of public or private (marketable) goods. As such, regional development can facilitate the achievement of national goals.

The larger are these positive externalities, the stronger is the case for regional public goods, and therefore, the stronger is the economic rationale for regional and local infrastructure development.

Examples of externalities for regional and local transport infrastructure:

Reduced Travel Time and Transport Cost

An immediate outcome of building cross-border transport infrastructure is reduction in travel time and transport cost. Also, the cost of public transport is expected to decrease in real terms.

As a positive externality, we may consider the reduction of required time to reach a local health care service, a school, a market.

Increased Traffic

Reduced transport costs generate increased traffic. As positive externalities we may consider: traffic volume, number of passengers, and increase number of freight operators.

Expanded Trade

Increased traffic is explained by the expansion of regional trade due to the reduced transport costs, particularly over land in the case of road projects.

Induced Investments

Improved local and regional transport infrastructure induces investments for new economic activities. We can consider here developing of the industrial parks generating many jobs for the local population, increase of small business, etc.

Road Accidents

One initially observable negative outcome of transport infrastructure is an increase in accidents. Increased speed cause more frequent and more severe accidents.

Illegal Logging and Deforestation

Opening of regional transport corridors can lead to more illegal logging and deforestation. Migration from outlying villages to areas adjacent to the project roads is resulting in clearing of forest buffer zones using slash-and-burn techniques. Migrants tend to clear the forest area to build their houses and to create paddy fields.

However, it can be argued that the extent of illegal logging depends on the initial quality of the road and the change in the quality due to the project. For example, if a project is upgrading from gravel to sealed road, it would not make a difference in the extent of logging or smuggling. If the existing quality of the road already enables the transport of illegal logs, further improved road quality would not have an incremental negative impact.

- ***Environment, research, technological development and innovation***

From an economic policy perspective, environmental and technology externalities raise a variety of questions. There are the 'usual suspects' of whether environmental challenges are best addressed by market-based policies or command-and-control policies and whether promoting technological progress is best achieved by non-selective measures fostering the creation and diffusion of new knowledge in general or by targeted R&D support for specific sectors, firms, or technologies. Interactions between environmental and technology policies make this question more difficult to answer. To illustrate, an emissions tax implicitly rewards clean technologies, thereby fostering not only renewable energy production, but also research directed at improving these technologies.

To discuss how environmental policies induce technological change, let us consider a tax on the emission of airborne pollutants – such as SO2, NOx, particulates, CO2 and other greenhouse gases. The purpose of an emission tax is to make polluters account for the environmental damage of their emissions. For now, we assume that the tax is set so that it fully internalizes the environmental damage, that is, the economic cost of emissions.

The static effect of taxing emissions is an increase in renewable electricity output for a given level of technological development of renewable. The dynamic effect resulting from the induced technological progress implies that output increases further.

In sum, policies to internalize the economic cost of emissions raise the production of renewable electricity directly and indirectly. The direct, static effect is due to making the cost of fossil-fuel-fired electricity reflect its negative environmental impact, thereby lowering the cost of renewable relative to the cost of fossils. The indirect, dynamic effect is due to the economic rent that producers of renewable electricity can earn if they succeed in lowering their production cost.

- ***Social and health infrastructure***

Social projects imply numerous externalities, mainly positive such as: future saving in health costs, directly proportional to the decrease in the number of people affected end/or the lesser degree of gravity of the illness due to the implementation of the project (reduced outpatient and home assistance costs for those who avoided catching the illness, lower hospital and onvalescence costs for those who have been treated more effectively); the avoided loss in production, because workers and families tend to loose lower number of working days.

- ***Development of regional and local business environment and increased energy efficiency***

Development of regional and local business projects may generate various positive as well as negative spatial externalities to the existing population in a given area.

Land use in cities is subject to continuous change, as urban dynamics because the need for new land use functions (such as infrastructure, leisure time amenities). Cities in world history have always been in a state of flux as a result of variations in population density, changes in economic structure, technological developments, and changing preferences of residents and consumers (see, for example, Ponting, 1993, and O"Sullivan, 2003).

In recent years, city planners have introduced the notion of multi-functional land use as a new concept for urban land use aimed at a spatial and socioeconomic synergy of different land use functions in order to save scarce space, while still maintaining a high level of spatial quality.

Potential benefits (positive externalities) of a multifunctional designed living area for residents include an increase in the number of shopping and non-shopping facilities in the vicinity of their home; an increase in the number of public transport options; and a possible increase in housing prices. There are, however, possible drawbacks (negative externalities) to a multi-functionally designed living area as well, such as parking nuisance of employees working in the area, the view of office buildings from home, and the abandonment of the area after office hours.

- ***Tourism***

Investment in tourism and related infrastructure generates mainly positive externalities. Investments in tourism infrastructure can help in the development and revival of local economies and general welfare. Also, over time, the entire area in the vicinity of tourism investment will increase in value, land will be more costly to acquire.

- ***Energy production and security of supplying energy***

The majority of projects in the energy field should promote sustainable and efficient energy production, use of renewable sources of energy, diversifying energy interconnection networks etc. However most energy projects "benefit" from negative externalities such as: the negative externalities of possible impact on the environment (loss of land, spoiling of scenery, naturalistic impact) and on other infrastructure, the negative externalities due to the opening of building sites, especially for urban networks (negative impact on housing, productive and service functions, mobility, agricultural framework and infrastructure); the cost of the measures necessary to neutralise possible negative effects on air, water, land.

In the following table we summarize some types of externalities depending on the project's sector of activity.

Sector	Non-market impact	Impact assessment
Transport	Savings in travel and waiting time	The value of working time savings is the opportunity cost of the time to the employer, equal to the marginal cost of labor
Healthcare	Life expectancy / quality of life	Quality-adjusted life year (QALY) is the most commonly used measure of health benefit.
	Prevention of fatalities/injuries	reduction in the risk of death or serious injury the recipients of the project
Environment	Landscape	heather moorland, rough grazing, field margins, hedgerows
	Noise	exposure over time to one decibel of noise; real estate price variation

2.3 CASE STUDY

In this section we will take into consideration a specific case study for externalities for an investment project of 89 mil EUR in the environmental sector. The case study is constructed in order to give a numerical example of some positive and negative externalities which are typically for a major investment project developed in the environmental sector.

The benefits and costs are present for the whole prognosis period, and are computed on categories.

The analysis is performed for 30 years, and the externalities are grouped into benefits and costs. We performed the calculation for each year for the net benefits.

The aim of the considered investment project is to provide water and collect waste water for a large community. Therefore, we took into consideration both fixed and variable externalities.

When quantifying the variable external costs in more detail, the total effects can methodologically be split into a chain of causalities, where each link in the chain is determined independently of the others. This is called the *impact pathway methodology*. The impact pathway methodology traces the passage of a pollutant from the place where it is emitted to the final impact on the receptors that are affected by it. Depending on the type of emission and the location of the facility, a group of receptors (human beings, buildings, animals, etc.) is exposed to the substances in a certain dose depending e.g. on how long time the exposure lasts. This dose will give a negative effect in terms of for example health impacts, and, finally, these impacts will give rise to costs to society.

The presentation of externality costs is based on costs obtained from the literature. **The case study does not aim at constructing new estimates for the valuation of externalities, but an outline of the values presented in the literature.**

In this case study, receptors are defined as members of households, from urban and rural area and institutions that are adversely affected by the quality of water provided and the lack wastewater discharge. The damages resulting from various effects on receptors could be grouped into the following categories:

- Human health effects - mortality
- Human health effects – morbidity
- Damage to buildings
- Climate change
- Effects on the ecosystem

Benefits		y1	y2	y3	y4	y5	y6	y7	y8
Acces to drinking water									
Nr. of household in project areas	number	0	80597	80683	80764	80844	80925	81006	81087
Value per household	Euro/hh/year	0	141	141	141	141	141	141	141
Total benefit	**Euro**	0	11364177	11376303	11387679	11399067	11410466	11421877	11433298
Improvement of water bodies (use value)									
Number of people living in the project service area	number	0	226478	226719	226946	227173	227400	227627	227855
Value per person	Euro/hh/year	21	22	23	24	24	25	26	27
Total benefit	**Euro**	0	4,982,507	5,214,542	5,446,703	5,452,149	5,685,002	5,918,314	6,152,088
Improvement of water bodies (non use value)									
Number of household in project areas	number	0	80597	80683	80764	80844	80925	81006	81087
Length of river	km	16	16	16	16	16	16	16	16
Value per household per km of river	Euro/hh/year	0.0011	0.0012	0.0012	0.0013	0.0013	0.0014	0.0015	0.0016
Total benefit	**Euro**	0	97	97	105	105	113	122	130

Cost saving to customers - private well									
Number of household newly connected	number	720	720	720	720	720	720	720	720
Value per household	Euro/hh/year	315	315	315	315	315	315	315	315
Total benefit	**Euro**	226800	226800	226800	226800	226800	226800	226800	226800
Cost saving to customers - sewage disposal									
Number of household newly connected	number	0	0	14800	14800	14800	14800	14800	14800
Value per household	Euro/hh/year	348	348	348	348	348	348	348	348
Total benefit	**Euro**	0	0	5150400	5150400	5150400	5150400	5150400	5150400
Cost saving to operator water abstraction									
Incremental water savings	m3	998130	1018093	1038454	1059224	1080408	1102016	1124056	1146538
Water abstraction fee	Euro/m3	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013
Total benefit	**Euro**	12976	13235	13500	13770	14045	14326	14613	14905
Cost saving to operator - energy consumption									
Energy savings	KwH	0	4313400	4313400	4313400	4313400	4313400	4313400	4313400

Specific emission factor for Romania	t CO2 per MWh	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9
0	Euro/tone	31	31	32	32	33	33	34	34
Total benefit	**Euro**	0	120344	124226	124226	128108	128108	131990	131990
Total benefits		**239,776**	**16,707,159**	**22,105,868**	**22,349,683**	**22,370,675**	**22,615,215**	**22,864,115**	**23,109,611**
Benefits		y9	y10	y11	y12	y13	y14	y15	y16
Access to drinking water									
Nr. of household in project areas	number	81168	81249	81331	81412	81493	81575	81657	81738
Value per household	Euro/hh/year	141	141	141	141	141	141	141	141
Total benefit	**Euro**	11444732	11456176	11467633	11479100	11490579	11502070	11513572	11525086
Improvement of water bodies (use value)									
Number of people living in the project service area	number	228083	228311	228539	228768	228997	229226	229455	229684
Value per person	Euro/hh/year	28	29	29	30	30	31	31	32
Total benefit	**Euro**	6,386,323	6,621,020	6,627,641	6,863,037	6,869,900	7,105,995	7,113,101	7,349,899
Improvement of water bodies (non use value)									
Number of household in project areas	number	81168	81249	81331	81412	81493	81575	81657	81738
Length of river	km	16	16	16	16	16	16	16	16

Value per household per km of river	Euro/hh/year	0.0017	0.0018	0.0019	0.002	0.0021	0.0022	0.0023	0.0024
Total benefit	**Euro**	138	146	155	163	171	179	188	196
Cost saving to customers - private well									
Number of household newly connected	number	720	720	720	720	720	720	720	720
Value per household	Euro/hh/year	315	315	315	315	315	315	315	315
Total benefit	**Euro**	226800	226800	226800	226800	226800	226800	226800	226800
Cost saving to customers - sewage disposal									
Number of household newly connected	number	14800	14800	14800	14800	14800	14800	14800	14800
Value per household	Euro/hh/year	348	348	348	348	348	348	348	348
Total benefit	**Euro**	5150400	5150400	5150400	5150400	5150400	5150400	5150400	5150400
Cost saving to operator water abstraction									
Incremental water savings	m3	1169468	1192858	1216715	1241049	1265870	1291188	1317011	1343352
Water abstraction fee	Euro/m3	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013
Total benefit	**Euro**	15203	15507	15817	16134	16456	16785	17121	17464

Cost saving to operator - energy consumption									
Energy savings	KwH	4313400	4313400	4313400	4313400	4313400	4313400	4313400	4313400
Specific emission factor for Romania	t CO2 per MWh	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9
0	Euro/tone	35	36	37	38	39	40	41	42
Total benefit	**Euro**	135872	139754	143636	147518	151400	155282	159164	163047
Total benefits		**23,359,467**	**23,609,804**	**23,632,082**	**23,883,151**	**23,905,707**	**24,157,512**	**24,180,346**	**24,432,890**
Benefits		y17	y18	y19	y20	y21	y22	y23	y24
Access to drinking water									
Nr. of household in project areas	number	81820	81902	81984	82066	82148	82230	82312	82394
Value per household	Euro/hh/year	141	141	141	141	141	141	141	141
Total benefit	**Euro**	11536611	11548147.2	11559695.4	11571255	11582826.3	11594409	11606003.6	11617610
Improvement of water bodies (use value)									
Number of people living in the project service area	number	229914	230144	230374	230604	230835	231066	231297	231528
Value per person	Euro/hh/year	32	33	33	34	34	35	35	36
Total benefit	**Euro**	7,357,248	7,594,750	7,602,344	7,840,551	7,848,392	8,087,306	8,095,393	8,335,017

Improvement of water bodies (non use value)									
Number of household in project areas	number	81820	81902	81984	82066	82148	82230	82312	82394
Length of river	km	16	16	16	16	16	16	16	16
Value per household per km of river	Euro/hh/year	0.0025	0.0026	0.0027	0.0028	0.0029	0.003	0.0031	0.0032
Total benefit	**Euro**	205	213	221	230	238	247	255	264
Cost saving to customers - private well									
Number of household newly connected	number	720	720	720	720	720	720	720	720
Value per household	Euro/hh/year	315	315	315	315	315	315	315	315
Total benefit	**Euro**	226800	226800	226800	226800	226800	226800	226800	226800
Cost saving to customers - sewage disposal									
Number of household newly connected	number	14800	14800	14800	14800	14800	14800	14800	14800
Value per household	Euro/hh/year	348	348	348	348	348	348	348	348
Total benefit	**Euro**	5150400	5150400	5150400	5150400	5150400	5150400	5150400	5150400

Cost saving to operator water abstraction									
Incremental water savings	m3	1370219	1397623	1425575	1454087	1483169	1512832	1543089	1573950
Water abstraction fee	Euro/m3	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013
Total benefit	**Euro**	17813	18169	18532	18903	19281	19667	20060	20461
Cost saving to operator - energy consumption									
Energy savings	KwH	4313400	4313400	4313400	4313400	4313400	4313400	4313400	4313400
Specific emission factor for Romania	t CO2 per MWh	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9
0	Euro/tone	43	44	45	46	47	48	49	50
Total benefit	**Euro**	166929	170811	174693	178575	182457	186339	190221	194103
Total benefits		**24,456,005**	**24,709,290**	**24,732,686**	**24,986,714**	**25,010,394**	**25,265,168**	**25,289,133**	**25,544,655**
Benefits		y25	y26	y27	y28	y29	y30		
Access to drinking water									
Nr. of household in project areas	number	82477	82559	82642	82724	82807	82890		
Value per household	Euro/hh/year	141	141	141	141	141	141		
Total benefit	**Euro**	11629227.2	11640856	11652497.3	11664149.8	11675814	11687489.74		
Improvement of water bodies (use value)									

Number of people living in the project service area	number	231760	231992	232224	232456	232688	232921
Value per person	Euro/hh/year	36	37	37	38	38	39
Total benefit	**Euro**	8,343,352	8,583,687	8,592,271	8,833,319	8,842,152	9,083,915
Improvement of water bodies (non use value)							
Number of household in project areas	number	82477	82559	82642	82724	82807	82890
Length of river	km	16	16	16	16	16	16
Value per household per km of river	Euro/hh/year	0.0033	0.0034	0.0035	0.0036	0.0037	0.038
Total benefit	**Euro**	272	281	289	298	306	3150
Cost saving to customers - private well							
Number of household newly connected	number	720	720	720	720	720	720
Value per household	Euro/hh/year	315	315	315	315	315	315
Total benefit	**Euro**	226800	226800	226800	226800	226800	226800
Cost saving to customers - sewage disposal							

Number of household newly connected	number	14800	14800	14800	14800	14800	14800
Value per household	Euro/hh/year	348	348	348	348	348	348
Total benefit	**Euro**	5150400	5150400	5150400	5150400	5150400	5150400
Cost saving to operator water abstraction							
Incremental water savings	m3	1605429	1637538	1670289	1703695	1737768	1772524
Water abstraction fee	Euro/m3	0.013	0.013	0.013	0.013	0.013	0.013
Total benefit	**Euro**	20871	21288	21714	22148	22591	23043
Cost saving to operator - energy consumption							
Energy savings	KwH	4313400	4313400	4313400	4313400	4313400	4313400
Specific emission factor for Romania	t CO2 per MWh	0.9	0.9	0.9	0.9	0.9	0.9
0	Euro/tone	51	52	53	54	55	56
Total benefit	**Euro**	197985	201867	205749	209631	213513	217395
Total benefits		**25,568,907**	**25,825,179**	**25,849,720**	**26,106,745**	**26,131,576**	**26,392,193**

3. CONCLUSIONS

The analysis and evaluation of externalities is an important tool for the Cost Benefit Analysis mostly for those projects with relatively low income and significant economic benefits.

There is substantial need for further research and substantial efforts should be put into establishing data required for more exact analyses.

We can summarize four important issues related to externalities:

1. Determine externality cost by normalizing it to some unit of service for consistent comparison. In a power plant, the emission released from the machinery used to generate power infringes upon the natural environment and becomes a hazard cost.
2. Recognize what factors can be measured or derived. Emission factors are derived from the BTU of fuel consumer and heat is determined from the number of BTU per kilowatt, and the value of environmental damage can be obtained from the EPA or similar regulatory agency.
3. Consider this sample equation as one of the many possible applications. In the aforementioned example, multiply emission factor time's heat rate time's value of environmental damage to compute the externality cost. Depending on the business or situation involved, the calculation of externalities must combine all of the external factors, both positive and negative, that are impacted by the activities of that entity.
4. Understand that most organizations do not factor the cost externalities into their operations (supply/demand). Externalities represent costs or benefits that are beyond the control of their operations.

Taken into consideration the relationship among externalities and types of investments, we could stress:

Examples of **positive externalities** (beneficial externality, external benefit, external economy) other than those presented in the paper up to this point include:

- A company planting an attractive garden in front of the building/offices may provide benefits to others living in the area, and even financial benefits in the form of increased property values for all property owners. – could be taken into consideration for private investments made by SMEs
- A public organization that coordinates the control of an infectious disease preventing others in society from getting sick. – could be taken into consideration for those projects developed by local public authorities
- A project interconnected in a network will conduct to the increase of WiFi products (produced by others), generating a network effect, thus the product reaches general acceptance and near-universal usage. – could be taken into consideration for projects developed by enterprises
- Knowledge spillover of inventions and information - once an invention (or most other forms of practical information) is discovered or made more easily accessible, others benefit by exploiting the invention or information. Patent law is a mechanism to allow the inventor or creator to benefit from a temporary,

state-protected monopoly in return for "sharing" the information through publication or other means. – could be taken into consideration for innovation projects developed by companies

- Education creates a positive externality because more highly educated people are less likely to engage in violent crime. This makes everyone in the community better off, regardless of their level of education. – could be taken into consideration for educational projects

Examples of **negative externalities** (external costs) other than those presented in the paper up to this point include:

- Air pollution from burning fossil fuels causes damages to crops, (historic) buildings and public health – could be took into consideration in environmental projects, constructions, production
- Anthropogenic climate change is attributed to greenhouse gas emissions from burning oil, gas, and coal. – could be taken into consideration for projects developed in environmental sector, and those developed by innovative companies
- Water pollution by industries that adds poisons to the water, which harm plants, animals, and humans. – could be taken into consideration for those investment projects developed in environmental sector, in industry and farming
- When car owners use roads, they impose congestion costs and higher accidents risks on all other users. – could be taken into consideration for those projects developed in transport sector
- Consumption by one consumer causes prices to rise and therefore makes other consumers worse off, perhaps by reducing their consumption. These effects are sometimes called "pecuniary externalities" and are distinguished from "real externalities" or "technological externalities". – could be taken into consideration for those investment projects developed by companies
- The consumption of alcohol when it leads to traffic or other accidents that injure or kill others. – could be taken into consideration for those projects related to transport and infrastructure
- Shared costs of declining health and vitality caused by smoking and/or alcohol abuse. Here, the "cost" is that of providing minimum social welfare. Economists more frequently attribute this problem to the category of moral hazards, the prospect that a party insulated from risk may behave differently from the way they would if they were fully exposed to the risk. – could be taken into consideration in projects developed by local public authorities in order to improve quality of life

The cost of storing nuclear waste from nuclear plants is included in the cost of the electricity the plant produces – could be used in projects developed by companies, or in projects developed in environmental sector

4. REFERENCES

1. Carosi, L., Villanacci, A., 2005. Relative wealth dependent restricted participation on financial markets. Report 271, University of Pisa, Italy.

2. Citanna, A., Polemarchakis, H. M., Tirelli, M., 2006. The taxation of trades in assets. Journal of Economic Theory 126, 299-313.

3. Florenzano, M., 2003. General equilibrium analysis, existence and optimality properties of equilibria. Kluwer Academic Publishers.

4. Geanakoplos, J. D., Polemarchakis, H. M., 2008. Pareto improving taxes. Journal of Mathematical Economics 44, 682-696.

5. Heidhues, P., Riedel, F., 2007. Do social preferences matter in competitive markets? Working paper 392, Institute of Mathematical Economics, University of Bielefeld.

6. del Mercato, E. L., 2006. Existence of competitive equilibria with externalities: A differential viewpoint. Journal of Mathematical Economics 42, 525-543.

7. Authority for the Coordination of Structural Instruments, (2008). *Ghid național pentru analiza cost – beneficiu A proiectelor finanțate din instrumentele structurale,* Retrieved February 11, 2011 from http://www.metodologie.ro/Ghid%20ACB% 20RO%20proiect.pdf

8. Caracota Dimitriu, M. & Caracota, D. (2004). *Evaluarea investitiilor de capital*, Ed. Fundatiei Pro, Bucuresti

9. Duplouy, J.C. & Ciobanu, A. (2005). *De la Phare la fondurile structurale: Programarea si implementarea asistenței de pre-aderare pentru PHARE CES si tranziția spre Fondurile Structurale - modul A 2.1 Instruire pentru analiza economică si financiară si evaluarea riscurilor*, Retrieved March 6, 2011 from http://www.productive.ro/dyn_doc/a2-1%20corectat.pdf

10. European Commission (Directorate-General Regional Policy). (2006). *Working DocumentNo. 4: - The New Programming Period 2007-2013: Guidance on the methodology for carrying out cost-benefit analysis*, Retrieved March 22, 2011 from http://ec.europa.eu/regional_policy/sources/docoffic/2007/ working/wd4_cost_en.pdf

11. European Commission (Directorate-General Regional Policy), (2008). *Guide to cost-benefit analysis of investment projects - Structural Funds, Cohesion Fund and Instrument for Pre-Accession,* Retrieved October 3, 2010 from http://ec.europa.eu/ regional_policy/sources/docgener/guides/cost/guide2008_en.pdf

12. Ghinea, A. & Negoiță, D. (2008). *Analiza cost-beneficiu*, Retrieved April 2, 2011 fromhttp://mdrl.ro/_documente /politici_publice/ informatii_utile/analiza_economica.pdf Government of Romania, (2008). Governmental Decision no. 28/2008 from 09/01/2008 regarding the approval of the technical and economic documentation content framework for public investment, and the structure and methodology of the general estimate for investments and interventions objectives, published in Romanian Official Monitor, no. 48 from 22nd of January, 2008

13. Ministry of Development, Public Works and Housing, (2008). Order no. 863/2008 from 02/07/2008 regarding the approval of "Guidelines for certain provisions implementation of Governmental Decision no. 28/2008 from 09/01/2008 regarding the approval of the technical and economic documentation content framework for public investment, and the structure and methodology of the general estimate for investments and interventions objectives", published in Romanian Official Monitor, no. 524 from 11th of July, 2008

14. Mosteanu, T. & Iacob, M, (2007). Teorii si abordări privind scopul si principiile analizei cost beneficiu, International Conference “Politici financiare si monetare in Uniunea Europeana” (Supplement of Theoretical and Applied economics Revue), Asociatia Generala a Economistilor din Romania, Bucuresti, pp 7-13, Retrieved April 4, 2011 from http://www.asociatiaeconomistilor.ro/documente/Conferinta_FABBV_romana.pdf

15. Vasilescu, I. & Cicea, C. (2004). Eligibilitatea proiectelor de investiții, Proceedings of the international symposium „Alternative Economic Strategies”, URSA Gheorghe Cristea, Ed. Era, Bucuresti, pp. 17-26

Any comments or suggestions regarding this document may be submitted on:
http://www.evaluare-structurale.ro/index.php/en/cost-benefit-analysis/forum

Additional information are available on internet:
http://www.evaluare-structurale.ro

Contract No 46 / 8.12.2010

„Development of the capacity for the Cost-Benefit Analysis”

Project co-financed by the European Regional Development Fund through the Technical Assistance Operational Programme 2007-2013