ANALYSIS OF COSTS AND BENEFITS OF INVESTMENTS IN WASTE MANAGEMENT SYSTEMS IN BULGARIA

Presiana Nenkova, Diyana Metalova
University of National and World Economy, Sofia, Bulgaria
pnenkova@unwe.bg
Diyana_metalova@yahoo.com

Abstract: *This paper represents a study employing Cost-Benefit Analisys for efficiency appraisal of a set of 19 projects for Regional Waste Management Systems (RWMS) construction, envisaged for funding under Priority axis 2: Improvement and development of waste treatment infrastructure within Operational Programme Environment 2007-2013 in Bulgaria. The member states are required to submit a Cost-Benefit Analysis to the Commission services for major projects to provide evidence that, in the framework of EU regional policy objectives, the project is both desirable from an economic point of view and needs the contribution of the Funds in order to be financially feasible. To draw the conclusion on potential impact on social welfare of the public investments undertaken in waste management ecological infrastructure costs and benefits are first identified and monetized. The aggregated model for assessing the impact of investments is based on information declared in those specific project proposals, and the data has then been processed to extract averages and aggregates needed for the purposes of analysis. Financial Analysis is employed to assess the need of co-financing by the European fund for regional development and to estimate the amount of the EU assistance. Economic Analysis is employed to determine whether the society would be better-off with the projects. According to the economic evaluation undertaken the projects' net present value is positive thus proving that investments in ecological infrastructure in Bulgaria generate net benefits for society as a whole.*

Keywords: Cost-Benefit Analisys; Regional Waste Management Systems**; financial gap**

JEL classification: D61; H23; H43; H54

1. Introduction

Urbanization, industrialisation and rising population numbers result in a continuous increase in the amount of waste components generated. The rapid growth in the quantity of generated waste increases its negative impact on the environment, making environmentally friendly waste treatment one of the most serious challenges for modern societies. At the same time, technological advancement in waste treatment provides new opportunities for using waste as an alternative source of raw materials and energy.

EU legislation poses a serious challenge for Bulgarian local authorities, with the introduction of the requirement to set up waste collection and treatment systems to cover the entire population. Bulgaria has 265 municipalities, and they generally do not have the capacity needed for developing waste treatment facilities compliant with the high EU standards. This calls for pooling together the efforts of several

municipalities to build and operate regional facilities at an affordable price, taking into account the income level of the population, as well as for sharing a regional landfill (WMA, art.23). The National Waste Management Activity Programme maps out 51 regions comprising various numbers of municipalities, ranging between 1 and 12 (NWMAP, 2009).
The EU cohesion policy makes financial support available to the member states so that they can bring their waste management activities into compliance with Community legislation. In Bulgaria, the Operational Programme Environment 2007-2013 (OPE 2007-2013) is an instrument for financing the completion of the national system of regional facilities (including landfills) which are designed to help reduce the overall amount of landfilled waste, and environmentally friendly waste recovery. Although waste disposal ranks lowest in the adopted waste management hierarchy and is one of the least favoured options, landfills are a key element in the future waste treatment infrastructure in Bulgaria, since a large portion of the existing waste dumps fall short of the requirements. The financial resources allocated to waste-related activities in the period 2007-2013 amounted to EUR 366 743 574 (MEW, OPE 2007-2013). Since these projects are not treated as major projects theire economic return has not been calculated before theire approval for financing. The purpose of our analysis is to assess the overall impact on the welfare of the population covered (about 40% of the overall population of Bulgaria), using the data from the 19 regional project proposals implemented as of 31 December 2015 under OPE 2007-2013 priority axis 2. (i.e. to produce a consolidated economic analysis).

2. Methodology of Study

In economic theory and practice, there is a variety of methods for assessing the efficiency of public investment projects but the one most widely used is the so-called Cost-Benefit Analysis (CBA). In the 1970s, UNIDO (Marglin, Dasgupta и Sen, 1972), OECD (Little и Mirrlees, 1974) and the World Bank (Skuire и Van der Tak, 1975) commissioned numerous studies on CBA applications. The purpose of CBA is to identify all possible effects and express them in financial terms. Assessment results are then added together to arrive at a conclusion as to whether the project at hand is an appropriate way to reach the set goal and whether it should be implemented. Article 40, point (e) of Regulation 1083/2006 requires that the member states submit to the European Commission a CBA for their major projects (exceed EUR 50 million), for the following two reasons:
1) To assess whether the project *is worth* co-financing, i.e. whether it has utility in respect to a certain goal from an economic viewpoint. Does the project contribute to reaching the goals of the EU regional policy? In order to check this, it is necessary to carry out an economic analysis. If the project's economic net present value (ENPV) is positive, then the society is better off with the project.
2) To assess whether the project *needs* co-financing and what should be the support amount. The fact that a project contributes positively to EU regional policy objectives does not necessarily mean that it has to be co-financed by the EU funds. Besides being desirable from an economic standpoint a project may also be financially profitable, in which case it should not be co-financed by the EU funds. To check whether a project needs co-financing requires a financial analysis. If the financial net present value (FNPV) without the financial contribution

from EU funds is negative then the project can be co-financed.
In the analysis, cash flows are generated under the so-called *incremental approach*, i.e. a comparison is made between the scenario 'With project' and the scenario 'Without project' (EC, 2008). Cash flows are reported in the year in which they occur, within a 30-year *reference period*. The life of landfilling cells is determined by their capacity and the amount of landfilled waste.
Discounting cash flows requires the application of a suitable *discount rate*. The European Commission recommended the application of 5% financial discount rate in real terms as an indicative target for public investment projects co-financed from EU funds in the programming period 2007-2013 (EC, 2008). In his paper at the Fifth Milan European Economy Workshop in October 2006, David Evans argues for a standard benchmark European discount rate of around 3%-4% based on social time preference (Evans, 2006).
The social discount rate in our study is 5,5% in real terms, as recommended by the European Commission for member states receiving support from the Cohesion Fund, Bulgaria being one of those member states.

3. Demand Analysis

Our demand analysis covers not only waste collection and landfilling services but also the demand for side products of waste (recycled materials and compost). The need for measures in the area of waste management is evaluated using a forecast about the amount of generated waste broken down by type and taking into account the demographic trends and economic development of the population. All projects assume a negative rate of demographic growth the average of which until 2030 is approximately minus 0.63% per year. Estimates of the expected waste amounts are calculated on the basis of present values indexed with the expected real GDP growth. The projects assume a real annual GDP growth of about 3.3%.
In 2011, the waste generation rate on the territory covered by the projects was 0.93 kg per person per day but it is expected to reach in 1.1 kg per person per day in 2030. Over the entire reference period, the expected amount of waste is 28 742 442 tonnes.

4. Results from Financial Analysis

The CAPEX (capital expenditure) index per tonne of waste is BGN 60.27.

Table 1. Dynamic Unit Cost

Operating costs of RWMS, BGN	1 129 688 136
Operating costs of RWMS (PV_{2012}), BGN	549 026 072
Waste in RWMS, tonne	23 007 409
OPEX (Operating costs), BGN/tonne	49,10
CAPEX (Investment costs), BGN/tonne	41,27
CAPEX (Re-investment costs), BGN/tonne	19
DUC (Dynamic unit cost), BGN/tonne	109,37

Source: Ministry of Environment and Water (MEW), own calculations

Estimates show that the waste disposal charge should be about BGN 68.1 per tonne.
Proceeds from charges paid by legal entities account for 38% of total revenues, while the waste they produce is only 10%. At the end of the period, their relative share declines to 31% but is still not sufficient to eliminate 'cross-subsidies' from business in favour of households.

Table 2. Financial return to investments, BGN

	Present Value
Investment costs	480 507 710,12
Investment costs excluding contingencies	458 884 863,16
Re-investment costs	221 230 944,85
Residual Value	10 551 612,49
Operating costs of RWMS	549 026 072,08
Operating revenues of RWMS	813 500 231,85
FNPV	-405 090 035,76
FIRR	-4,08%

Source: MEW, own calculations

FNPV is a negative value, and FIRR is lower than the discount rate used. This means that the revenue generated by the project is insufficient to cover its operating and investment costs. Because of that, it is necessary to support the investment partially with OPE funding. How much of that should to be financed through grant money is determined on the basis of the financial gap calculated separately for each project.
The amount of Community support is determined by reference to 'the financial gap' in the project, i.e. the percentage of discounted expenditure needed for the initial investment which is not covered by the discounted net revenue generated by the project. The financial gap for this pool of projects is 86.91%, which means that the remaining 13.09% of the investment costs can be covered by the net revenues from operations.
The total amount of investment costs for all the projects is BGN 512 552 848, of which BGN 438 547 985 is the grant amount, while the balance of BGN 74 004 863 is paid by the project beneficiaries.

5. Economic Analysis

The principles of economic assessment require that the resources invested in a project be evaluated at their opportunity cost, and that project outcomes be assessed by the willingness of users to pay for them. However, opportunity cost does not necessarily match the established financial cost. Similarly, 'willingness to pay' cannot, in all cases, be adequately reflected in the monitored market prices which may be distorted or non-existent (EC, 2006). Unlike financial analysis, economic analysis is carried out from the viewpoint of the society, and not solely from the viewpoint of the owner of the infrastructure facility.

In economic analysis, both the positive and the negative externalities are considered. Their monetary estimates are not financially relevant but are used as a measure of the change in public welfare.
The cash flows included in the financial analysis are used as a starting point for the economic analysis. When defining economic performance indicators, certain adjustments need to be made. To this end, conversion factors are applied to the cash inflows and cash outflows of the project.

5.1. Fiscal Corrections

Fiscal corrections are required for those market price elements which are not related to the opportunity costs of resources. Certain elements of the financial analysis are pure transfers from one group of economic entity to another, having no economic significance whatsoever for the welfare of society as a whole. For example, taxes included in the price of project resources are a cost item incurred by the project, yet they become a claw back to the population, in the form of public goods (EC, 2008). The opposite is true of subsidies as they reduce the prices of subsidised goods; however, a portion of the price is paid from the public budget, i.e. by the public. Since subsidised resources have a negligible share in total expenditure, they are not factored in the price adjustment.
These distortions are adjusted as follows:

- Input and output prices do not include VAT or any other indirect taxes.
- The prices of inputs include direct taxes.
- Social security contributions are deducted from labour costs.

On the basis of the considerations listed above, the investment costs in the projects under examination has been adjusted for the VAT amount. Operating costs and operating revenues are also net of VAT (19,78% of total investment costs or BGN 84 625 011). Both investment costs and operating costs have been adjusted for social security contributions with a 30% expense item.
At the same time, if certain specific indirect taxes or subsidies are designed to offset externalities (so-called *Pigouvian taxes/subsidies*), those need to be included in prices. For example, the excise duty charged on fuels is one such corrective tax through which marginal extraneous costs incurred by the public in the form of air pollution are reflected in fuel prices. Because of that, in the economic analysis, fuel costs have not been adjusted for the amount of the excise duty.

Table 3. Fiscal corrections, BGN

	Present Value
Investment costs	**477 537 444**
Investment costs excluding contingencies	**456 048 259**
Fiscal corrections – indirect taxes (VAT)	*75 295 824*
Fiscal corrections – social security contributions	*33 740 120*
Total Fiscal corrections of investment costs	***109 035 944***

Investment costs after fiscal corrections	**346 959 258**
Re-investment costs	**209 166 774**
Fiscal corrections (social security contributions)	*18 825 010*
Re-investment costs after fiscal corrections	**190 341 764**
Operating costs	**515 596 220**
Fiscal corrections (social security contributions)	*77 339 433*
Operating costs after fiscal corrections	**438 256 787**
TOTAL Fiscal corrections	***205 200 387***

Source: MEW, own calculations

5.2. Conversion Factors

Market prices of public goods will reflect accurately the value of inputs only provided that they are traded on the domestic market, that the market is not distorted, and if the project is relatively small, so that it would not cause relative prices of resources to vary. In an open economy and imperfectly competitive markets, resource prices may be strongly distorted, which requires their revaluation to 'shadow prices' when assessing the project, in order to reflect more accurately the opportunity cost to the public (Brusarski, 2007). To this end, conversion factors are calculated, in order to convert market prices into shadow prices (WB, 2001). The values of certain key national parameters may be suggested by the government and not calculated for each project separately. Each member state develops its national CBA methodology designed to assess certain national parameters comprising certain key 'shadow prices' and conversion factors, in the context of the priorities set in the European cohesion policy. In 2010, as part of the JASPERS (Joint Assistance to Support Projects in European Regions) initiative, Guidelines for CBA of projects in Bulgaria were developed for 3 sector, with the support of experts – solid waste, water and transport.
The use of conversion factors requires grouping expenses into the following several categories: tradable goods; non-tradable goods; skilled labour; unskilled labour.

This exercise can easily be done for *tradable goods* as their world prices are as follows: CIF prices for imports and FOB prices for exports, respectively. No special adjustment is needed, since it is assumed that market prices reflect public opportunity costs. This group comprises most of the investment cost items incurred in the projects, since they are contracted by means of international public procurement tenders.
Goods and services *not tradable* on international markets include domestically produced items and reflect trade tariffs and barriers. This group comprises some construction works, electricity, water and other supplies. To those, a standard conversion factor (SCF) is applied when dealing with minor goods or goods for which no specific conversion factors exist. SCF is calculated using the import and export values from the table below.

Table 4. Standard Conversion Factor, 2012

Import (M)	BGN 47694,67 million
Export (X)	BGN 40665,22 million
Total value of duties on import (Tm)	BGN 7908,9 million
SCF=(M+X) / (M+X+Tm)	0,918

Sourse: Balance of Payments of the Republic of Bulgaria, 2012; Annual Report of Bulgarian Customs Agency, 2012; own calculations

Labour force can be the core input for certain investment projects. Wages must reflect society's assessment of working hours, i.e. the marginal public value of the unit productivity of labour. In real life, wages are often distorted. In such cases, monitored prices need to be adjusted by applying conversion factors to determine the 'shadow wage'. This is regionally specific due to the weak mobility of labour resources in comparison to the mobility of capital.

Rates for *skilled labour* do not need to be adjusted as they are assumed to reflect the opportunity cost of the time of those employed.

As regards labour costs for *unskilled labour*, it is necessary to determine a conversion factor for rates of pay, so as to make sure that they are adequate to the economic cost, considering the higher supply of unskilled labour in the conditions of unemployment, i.e. it is necessary to determine the so-called 'shadow wage rate factor' (SWRF). It is calculated using the following formula:

$$SWRF = (1-u)*(1-t)$$

Where: u – regional unemployment rate; t – rate of social security payments and relevant taxes

Total tax and social security burden for 2012 in Bulgaria is: 37% (0,303+0,1*(1-0,303))

$$SWRF = (1-0,123)*(1-0,37) = 0,877*0,63 = 0,5525$$

In 2009, economists from the University of Milan calculated SWRF for 4 groups of NUTS-2 regions in the EU. For countries in Eastern Europe, the SWRF is 0.62. (Del Bo, Florio, M. and Fiorio, C., 2009).

Since the factor is less than 1, the economic costs of unskilled labour will be lower than the financial costs. In the 'Without project' scenario, a portion of that labour force would have remained unemployed, thus lowering the opportunity costs of that resource. This adjustment, which results in lower economic cost of labour, improves the economic profitability of the projects.

Table 5. From market prices to shadow prices, BGN

	%	**CF**	**Present Value**
Investment costs after fiscal corrections			**347 480 914**
Tradable goods	*31%*	*1*	108 044 447
Non-tradable goods	*44%*	*0,918*	140 193 903

Skilled labour	*20%*	*1*	69 951 854
Unskilled labour	*5%*	*0,553*	8 617 584
Converted Investment Costs			**327 992 397**
Re-investment after fiscal corrections			**190 341 764**
Tradable goods	*30%*	*1*	57 102 529
Non-tradable goods	*40%*	*0,918*	69 893 496
Skilled labour	*10%*	*1*	19 034 176
Unskilled labour	*20%*	*0,553*	21 051 799
Converted re-investment costs			**167 082 001**
Operating costs after fiscal corrections			**438 256 787**
Tradable goods	20%	1	87 651 357
Non-tradable goods	30%	0,918	120 695 919
Skilled labour	15%	1	65 738 518
Unskilled labour	35%	0,553	84 824 601
Converted operating costs			**358 910 396**
TOTAL costs after corrections and conversions			**853 984 793**

Source: MEW, own calculations

5.3. Non-Market Impacts

The next step in the economic analysis is to include in the assessment the project effects that are important for society but have no market value. The most common approach is that of the 'willingness to pay'. It enables the assessment of a monetary value by revealing consumer preferences. To assess certain products for which the willingness-to-pay approach is not applicable, we can use the approach of long-term marginal costs, also called the 'willingness-to-accept' approach. The use of these two approaches precludes the application of conversion factors to the financial operating revenues from project operations.

Hence, in addition to the market effect from the sale of side products, the implementation of the projects under consideration will also bring about effects which do not have any market price. The analysis includes the following economic benefits:

- *Savings from resource costs*. On the one hand, the separated recovered materials and the side products obtained from processing waste (compost and energy) have a value if sold on the market. On the other hand, they reduce the amount of waste disposed in landfills, which leads to an extended economic life of the landfills. The first effect is reflected in the financial analysis as an actual cash flow while the second effect is reflected in the economic analysis as an intangible benefit with no market price.
- *Preventing the discharge of infiltrate into the soil and water*. The analysis uses an average standard value of EUR 1.52 per tonne of waste which is

not properly disposed of in a landfill equipped with a suitable system for infiltrate collection and treatment (EC, DG Environment, 2000).

- *Reducing greenhouse gas emissions*, in particular CH_4 and CO_2, which usually represent 64% and 34%, respectively, of the volume of gases released during the decomposition of waste. It is believed that those greenhouse gases contribute the most to global warming. In the Guidelines for CBA of projects in Bulgaria, the impact of one metric tonne of CO_2 is estimated at EUR 25 as of 2010 and goes up, in real terms, to EUR 45 in 2030.

The most important environmental effect of an improved management of household waste is the reduction of greenhouse gas emissions. In 2011, greenhouse gas emissions produced by waste management account for about 2,9% of the total GHG emissions in the EU, and in Bulgaria that percentage was 5,7%. In terms of greenhouse gas emissions per capita in the waste sector, Bulgaria ranks fourth in the EU. The composition of GHGs shows that methane, one of the six gases monitored under the Kyoto Protocol, has the prevailing share. Of these methane emissions, 30% are associated primarily with waste disposal operations. Greenhouse gas emissions in the 'Without Projects' scenario for the 30-year reference period total 22 720 576 tonnes, while the 'With Projects' scenario brings that cumulative amount down to 4 058 710 tonnes, i.e. almost 6 times less.
The assessment of economic benefits is shown in the table below:

Table 6. Economic benefits, BGN

Economic benefits	**Present Value**
Revenues from compost	14 997 031
Revenues from recycling materials	94 772 904
Savings from disposal costs	321 559 434
TOTAL Savings from resource costs	***431 329 370***
Preventing the discharge of infiltrate	**32 806 005**
Reducing greenhouse gas emissions	**567 021 012**
TOTAL ECONOMIC BENEFITS	**1 031 156 387**

Source: MEW, own calculations

The table below shows the calculation of indicator values.

Table 7. Economic return indicators, BGN

		Present Value
1	Converted investment costs	327 992 397
2	Converted re-investment costs	167 082 001
3	Converted operating costs	358 910 396
4	TOTAL costs after corrections and conversions	853 984 793
5	Residual value	9 231 919
6	*Economic benefits*	

7	*TOTAL Savings from resource costs*	*431 329 370*
8	*Preventing the discharge of infiltrate*	32 806 005
9	*Reducing greenhouse gas emissions*	567 021 012
10	TOTAL ECONOMIC BENEFITS	1 031 156 386,97
11	Net Cash Flow (10+5-4)	186 403 512,78
12	ENPV (10+5-4)	186 403512,78
13	EIRR	9,22%
14	Benefit/Cost Ratio ((10+5)/4)	1,21

Source: MEW, own calculations

Calculations demonstrate that after the relevant fiscal corrections and transformations in the financial costs, after measuring and costing non-market effects, ENPV is a positive value. That bears evidence that the society stands to gain from the implementation of the projects for developing integrated waste management systems. The net benefit is expected to amount to about BGN 186.4 million. IRR, the relative efficiency indicator, also confirms the positive impact, standing at 9.22%, with a 5.5% real discount rate. The B/C ratio shows that for each Bulgarian lev invested in cost, the public receives a benefit of BGN 1.21. All three indicators point to the same conclusion, namely, that the projects are efficient from society viewpoint.

6. In Conclusion

For the scores of small municipalities, building and maintaining the necessary infrastructure single-handedly is not just economically unprofitable, it is even an impossible task, considering the budgets available to them. At the same time, waste treatment must be done in an environmentally friendly way and in compliance with the EU directives. It is necessary to unite the efforts of several municipalities and build regional waste management systems.

The financial gap emerging from the aggregated financial analysis is 87%. This means that, in the Bulgarian waste sector, revenues cover operating costs and only a small portion of the proceeds is available for investing in capital improvements. That explains why it is a common practice to dispose of waste by discarding it on waste dumps. For a member state of the EU, that is inadmissible and runs counter to the adopted strategy of turning Europe into a recycling society minimising waste production. Significant financial resources have been allocated to this goal via OPE 2007-2013.

The economic analysis we performed produced evidence that allows us to conclude that investments in environmentally friendly infrastructure for improving the quality of waste management contribute to better public welfare. The main benefits for the public are the avoidance of harmful emissions and cost savings from the avoided waste disposal.

References

Brusarski, R. (2007) *Theory of Public Finance,* Sofia, UNWE.

Del Bo, Ch., Florio, M. and Fiorio, C. (2009) *Shadow wages for the EU regions*. University of Milan.

European Commission, DG Environment (2000) *A study on the Economic Valuation of Environmental Externalities from Landfill Disposal and Incineration of Waste*. COWI.

European Commission, Council Regulation No 1083/2006 of 11 July 2006 laying down general provisions on the European Regional Development Fund, the European Social Fund and the Cohesion Fund and repealing Regulation No1260/1999, OJ L210, 31.7.2006, p. 25–78.

European Commission, DG Regional Policy (2006) *Working document 4 „Guidance on the Methodology for carrying out Cost-Benefit Analysis".*

European Commission, DG Regional Policy (2008) *Guide to cost-benefit analysis of investment projects.*

European Commission, Directive 2008/98/EC of the European Parliament and of the Council of 19 November 2008 on waste and repealing certain directives (Waste Framework Directive). OJ L312 of 22.11.2008, pp. 3-30.

Evans, D. (2006) *The social discount rates for the European Union*. Fifth Milan European Economy Workshop. Milan.

JASPERS (2010) Bulgaria – General Requirements for CBA of projects, co-financed by European Regional Development Fund and the Cohesion Fund 2007-2013.

JASPERS (2010) Bulgaria – Methodology for preparation of CBA in solid waste sector.

Ministry of Environment and Water, (2009) *National Programme for Waste Management Activities 2009-2013.*

Ministry of Environment and Water, *Operational Programme Environment 2007-2013.*

Waste Management Act, Bulgaria (Promulgated, State Gazette No. 53 of 13.07.2012, effective13.07.2012).