EUROPEAN COMMISSION
Directorate-General Regional Policy

Ex post evaluation of cohesion policy interventions 2000-2006 financed by the Cohesion Fund (including former ISPA)

Work Package C - Cost benefit analysis of environment projects

Draft final 2nd intermediate report

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TECNINVEST

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List of Abbreviations

B/C	Benefit-Cost ratio
CBA	Cost Benefit Analysis
CF	Cohesion Fund
CO_2	Carbon Dioxide
EC	European Commission
EUR	Euro
GDP	Gross Domestic Product
GHG	Green House Gases
Ha	Hectare
H_2S	Hydrogen Sulphide
kW	Kilo Watt
LFG	Landfill gas
Nm3	Normal Cubic Metres

NPV	Net Present Value
IPP	Internal Rate of Return
PV	Present Value

1 Introduction

Purpose of 1st intermediate report

The purpose of the 1st intermediate report is to present the results of a pilot analysis carried out as a part of Task 2: Ex post project analyses. The objectives are. (1) to review the ex ante and carry out ex post cost benefit analyses (CBA) and (2) to test and possibly revise/improve the study methodology to be applied for the remaining eight ex post project analyses.

Two pilot projects

The project selected in Task 1 for pilot analysis is: Project no. 50: LIPOR - Municipal Solid Waste Integrated Management

Structure of pilot analysis reporting

The results of each of the pilot analyses are reported in line with the structure presented in the Terms of Reference - i.e.:

- Task 2.1: Revision of ex ante cost benefit analysis of each project
- Task 2.2: Carrying out ex post cost benefit analysis
- Task 2.3: Comparing the ex ante and ex port cost benefit analyses

The most comprehensive task - Task 2.2 - is further divided into five issues (in line with the brief project descriptions produced in Task 1) addressing the central elements of a cost benefit analysis that must be assessed both at the ex ante stage and at the ex post stage:

Project identification
It is essential to define the new infrastructure as a self-contained unit to which capital costs and operational costs and revenues can be attributed to. The cost benefit analysis will also concern this unit. However, possible linkages with other infrastructures may affect the operation of the new infrastructure unit, and so should be addressed in e.g. the economic analysis (see below). Furthermore, it should be analysed whether the definition of the new infrastructure is the same as the one planned at the ex ante stage - and if this is not the case, then why this is the case. Finally, the management setup for operating the new infrastructure unit should be clarified.

Project feasibility and alternative options
The main question is whether the utilisation of the new infrastructure is adequate or whether there is excess capacity or excess demand; and if inadequate, which demand assumptions made during the ex ante analysis failed. Further, it will be assessed whether or not the environmental requirements have been met. Another question to address is whether a different option would have been cho-

sen (ex ante) if the present (ex post) demand had been known. In this context, it might be assessed whether a more flexible technical option would have been feasible - i.e. an option that would allow more timely adjustments to changes in demand.

Financial analysis
The financial result might differ ex post from that expected at the ex ante stage, and so the degree of financial sustainability can have changed. This might be due to changes in the definition of the infrastructure unit, in the demand situation, or in capital and operation costs as well as in revenue levels via tariffs. In this context, it is desirable to establish the actual (ex post) unit costs at a disaggregated level - i.e. "level 3 costs".

Economic analysis
The economic analysis comprises the bulk of the ex post cost benefit analysis. It contains a presentation of the type of economic analysis applied, and of how cost and revenue elements included in the financial analysis have be converted to socioeconomic values and how other socioeconomic benefits (and costs) have been quantified via available data to enable a calculation of the economic return. Furthermore, costs and benefits that cannot be expressed in monetary terms are treated in a qualitative manner. This also includes the analysis of unintended effects as well as accompanying measures which are outside the project but intended to enhance the project success.

Risk assessment
The risk assessment both comprises the calculation of the margin of error of the ex post costs benefit analysis, and an assessment of risk mitigation measures applied during the construction and operation of the new infrastructure - hereunder the consequences of mitigated and (both foreseen and unforeseen) non-mitigated risks.

Lessons learnt

While the reporting of the results of the two pilot analyses contain some lessons learnt - hereunder for Task 3: Assessing cost benefit analysis as a method - the main lessons learnt to be used in the process of carrying out the remaining eight ex post project analyses are presented in a separate chapter.

2 Project no. 50: LIPOR - Municipal Solid Waste Integrated Management

2.1 Project Description

2.1.1 Project context

LIPOR is an association of city councils of the Porto metropolitan area, in the North of mainland Portugal. Since it was created in 1982, this association has been implementing an integrated solid waste management system encompassing 8 municipalities of the Greater Porto sub-region (NUTS III)[1].

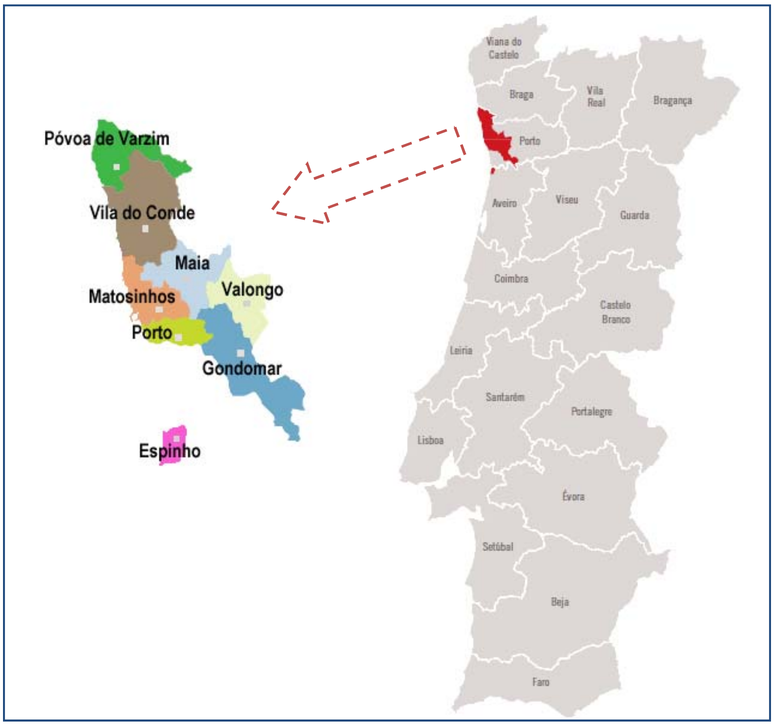


Figure 2-1 LIPOR territory in Mainland Portugal

The Greater Porto sub region has a population of 1.4 million (2007) and a surface of 817 km². It is a highly industrialised area that, together with the neigh-

[1] LIPOR membership is made up of the following city councils: Espinho, Gondomar, Maia, Matosinhos, Porto, Póvoa de Varzim, Valongo and Vila do Conde. From the 11 municipalities of the Greater Porto region, only 3 are not included in the inter-municipal association: one since long belonging to the Greater Porto (Gaia) and 2 that only recently were incorporated in the sub-region (Trofa and Santo Tirso).

bouring sub regions, is the main source of the Portuguese exports and home to one of the busiest Portuguese harbours, located in Leixões. Grande Porto serves as the commercial, educational, political and economical centre of northern Portugal.

2.1.2 Project history and timeline

LIPOR inherited some environmental facilities of their members, which included, besides a number of landfills and waste collection facilities, a composting plant created in 1966 by a private investor[2].

Since its inception LIPOR, continued to develop its environmental assets through a number of investment projects, which included the construction of an urban waste incinerator, the improvement of the landfill operations and the development of a source separated waste collection system in its area of influence. In 2000/2001 LIPOR prepared a new strategic plan covering the period 2000-2014, which entailed an investment programme of around EUR100 million (exclusive of taxes), comprising all operational areas of the company[3].

The main investment projects foreseen in this plan were organised as an investment programme and submitted to the Cohesion Fund for financial assistance. Approved by the Commission in 19/12/2002 [2002/PT/16/C/PE/002], the assistance involved a co-funding package of around EUR 26.6 million (50% of the eligible and 26% of the overall investment).

The programme was also co-funded by a loan of EUR 53 millions from the European Investment Bank, signed in 11/12/2001. The balance was provided by own funds.

2.1.3 Technical overview

The objective of the project was to complement or to extend some of the existing activities LIPOR and its city councils shareholders and to remedy some environmental liabilities, aiming at the consolidation of the integrated management system in the region. Five components were included:

Table 2-1 Overview of the components of the project

[2] Since the beginning, this composting plant was operated as a profitable private enterprise. In the early seventies this operation became unprofitable due to increasing labour costs and was acquired by some of the municipalities that later incorporated LIPOR.

[3] The interventions foreseen in the programme under appreciation were complementary to previous projects approved for financing under the Cohesion Fund (Ref 1993/10/61/016, Ref. 1995/10/61/023, Ref. 1994/10/61/026 and 2000/PT/16/C/PE003).

Main investment Units	Recycling	Composting	Landfill Sealing-off and Use	Energy Recovery Plants	Communication
lipor Serviço Intermunicipalizado de Gestão de Resíduos do Grande Porto www.lipor.pt					
Component	A	B	C	D	E
Description	Collection, sorting and preparation for recycling of paper, glass, plastic and metal waste	Selective collection and controlled aerobic composting of food and green waste	Sealling-off, LFG collection and burning, leachate/water processing, landscape recovery of 4 landfills	Using LFG of the 2 largest landfills to generate electricity	Awareness campaigns in various media to promote source separation practices by the public at large
Benefits	NOT QUANTIFIED Decreased air pollution and greenhouse gases (incineration), hazardous waste leaching (landfills), energy consumption, and resource consumption.	NOT QUANTIFIED Decreased air pollution and greenhouse gases (incineration), waste leaching (landfills), energy consumption, and resource consumption (fertilizers).	NOT QUANTIFIED Decreased air pollution and greenhouse gases, waste leaching and resource consumption. Use value	NOT QUANTIFIED Decreased greenhouse gases and resource consumption (natural gas)	Set of activities geared to support the execution of 2 other components (recycling and composting).

The last component, the awareness and information campaign to help motivating the population in taking up the source separation programme for the recycling and composting projects, does not stand as an investment component *per se*, as its specific objective is to provide support to the execution of other components.

The programme was carried out at 4 locations in 4 different municipalities: Valongo, at Ermesinde where the headquarters and "LIPOR I" facilities are located (sorting plant, composting plant, 1 landfill and 1 energy generating plant), Matosinhos (1 landfill and 1 energy generating plant), Póvoa de Varzim (1 landfill) and Vila do Conde (1 landfill).

The main segments of each component of the programme are depicted in Table 2 – 2.

Table 2-2 Main investment items

Programme Components	Main investment items
Recycling	• Domestic and multiple dwelling containers • Collection vehicles • Igloo containers for drop-off/collection centres • Pre-sorting platform to handle large pieces (furniture, appliances, etc.)
Composting	• New composting plant • Organic waste containers • Organic waste collection vehicles
Landfill Recovery (4 landfills)	• Confinement of the waste mass • LFG, leachate and rainwater collection and control systems
Energy Generation (2 landfills)	• Gas cleanup and compression station • Energy conversion unit (combustion engines) • Interconnection (transforming, switching, protection, metering, etc.) • Emergency flare

Recycling

This component consists in the expansion of the municipal recycling system, including the acquisition of containers and vehicles for the collection of source-separated waste and the construction of pre-sorting facilities for large pieces of waste.

Recycling activities existed before the project started, based on a sorting plant built in the eighties, which is operated by LIPOR, and various collection systems of source separated waste (both door-to-door and drop-off centres with ‘igloo’ containers) operated by 8 different city councils (the shareholders of LIPOR).

The investment aimed at expanding the capacity of the collection system. The additional containers and vehicles included in the collection system increased its operational capacity. The pre-sorting platform, as it improves the productivity of the sorting plant, allows the additional tonnage collected by the system to be handled by the existing sorting plant without further investment. Between 2003 and 2009 the tonnage of materials prepared for recycling (‘recyclates’) increased by 58% (Fig. 2 - 2). The capacity utilisation is over 70% with the current exploitation model, capacity of which can be easily expanded by increasing the number of working shifts.

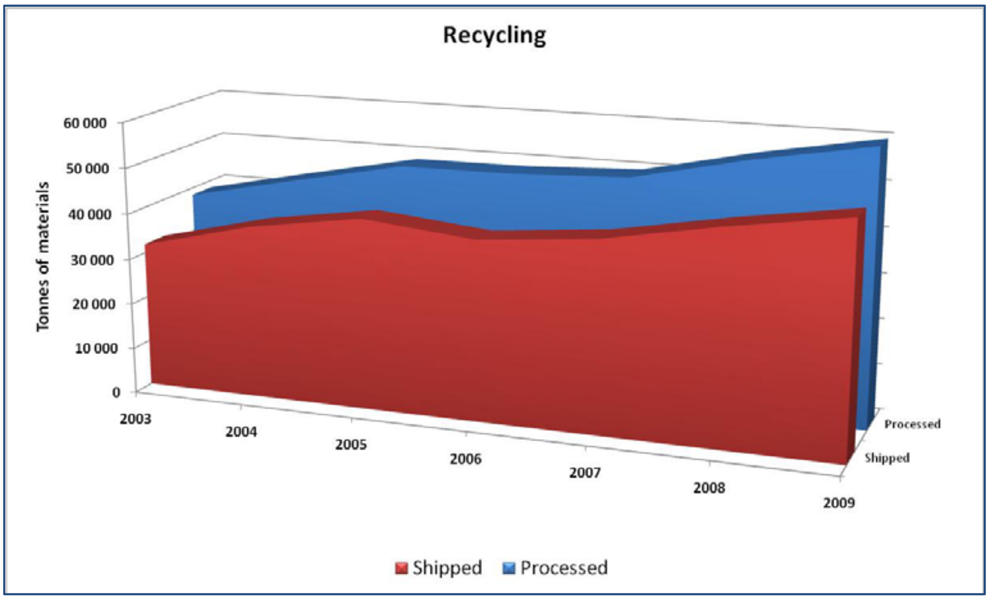


Figure 2-2 Multi-material recycling

Sorted and prepared recyclable materials are marketed directly by LIPOR. The sales are mostly made at administrative prices, under a government regulated "warranty system"[4].

The investment entailed by this component amounted to 13.3% of total.

Composting

This was the main component of the programme (46.8%). It involved the erection of a new composting plant to replace the existing one (quite old and outdated facility, continuously in operation since 1966) and the acquisition of organic waste collection containers and vehicles. It is a replacement investment of a completely depreciated facility.

The new plant is located at the Ermesinde site of LIPOR in an area of 40 thousand m^2. Its capacity allows to process 60 thousand tonnes of food and green waste per year. At full capacity the plant will generate about 20 thousand tonnes of compost. In 2009 the utilisation of this capacity was slightly over 50%.

Collection of food waste and green/park waste is done using specific networks directly operated by LIPOR.

[4] In the last 5 years the fraction of *recyclates* that were sold at "warranty" prices increased from 62 to 75%.

The operation of the plant includes four basic processes:

- Mechanical preparation of waste;
- Biological process: aerobic, in-vessel technology (tunnels)
- Correction/rectification of compost
- Storing and bagging

The plant occupies 2 adjacent buildings, one for administrative, supporting and quality control functions and a second one where the composting process takes place. To eliminate the emission of odours, the latter is completely closed, maintained under negative air pressure and the inside air is run through bio filters to scrub it of odours.

The plant is operated by a concessionaire (the same that built the plant), since 2005, for an initial period of 5 years. The concession can be renewed by 3-year periods, at discretion of LIPOR, with a 180-days notice.

The compost is marketed directly by LIPOR, under the "Nutrimais" brand name, in bulk and retail brown paper bags. The compost complies with the stability degree test Rottegrad V and its sale is made at market prices. The production of compost since the new plant was launched in 2006 increased by 150% (Fig. 2-3). However, the sales of the product are developing more slowly and even decreased in 2009 (12.6%). This was attributed to difficulties of the agricultural sector in the region and bad weather conditions in the 2008/2009 season.

The so called "information asymmetry" (buyers are not completely aware of the quality of the compost) may play a role in slowing the penetration of compost in the regional agriculture, as most consumers may not be aware of the intrinsic quality of the product. LIPOR is fighting this barrier by certifying the quality of its compost products and diversifying its range: recently LIPOR introduced a new compost specifically designed for the organic agricultural sector.

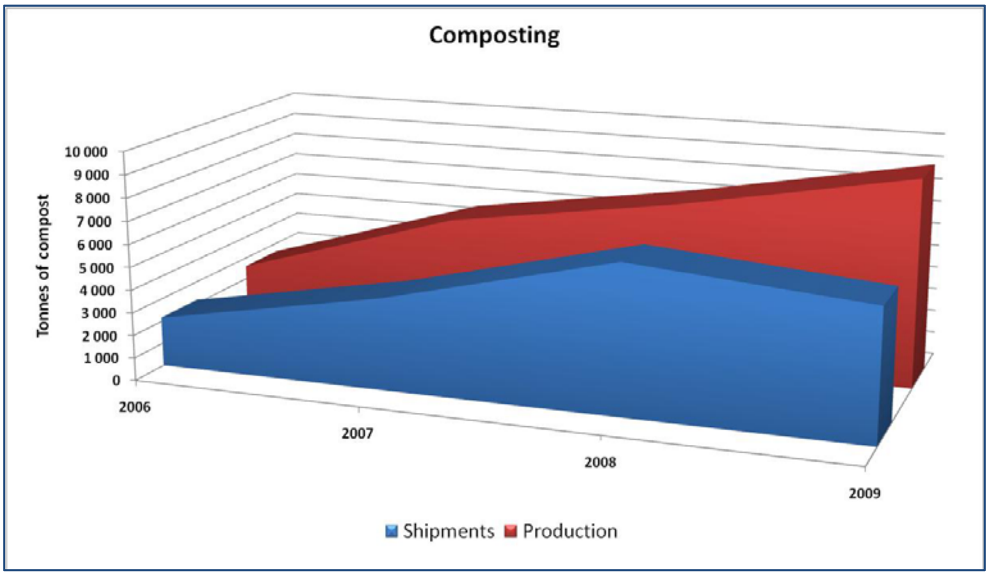


Figure 2-3 Composting

Landfill sealing and use (4 landfills)

Four old landfills were technically confined as part of the investment pro-programme. These projects correspond to about 22.3 per-cent of the overall investment.

The sealing-off procedures were conducted in agreement with Directive 1999/31/EC and involved the following main investment items for each of the 4 landfills:

- Cleaning-up the top of the landfill;
- Modelling the surface of the landfill by applying a foundation layer;
- Applying additional layers:
    - Drain for LFG (geodrains for biogas);
    - Plateau and slope sealing layers (geomembrane);
    - Drain layer for rain water;
    - Reinforced geonet;

  - Top soil;
- Construction of drain lines for leachate;
- Construction of drain lines for rain water;
- Construction of wells and piping for LFG drainage;
- Landscaping, vegetative cover;
- Monitoring systems (gas, leachate, water)

The following table shows the main attributes of the 4 landfills.

Table 2 - 3 Main features of the landfills

Landfill	Area (ha)	Landfill Gas			Leachates (m^3/h)	End of closure
		No. of wells	No. of control stations	Burning installation		
Valongo	19.0	81	4	C. Engine (3.2kVA)	20.6	2008
Matosinhos	8.0	38	2	C. Engine (0.5kVA)	1.25	2009
Póvoa de Varzim	6.9	33	4	Flare (250m^3/h)	0.14	2004
Vila do Conde	2.5	10	-	None	0.14	2004

Source: Monitoring reports, 2009, except for leachates at Matosinhos, flow of which corresponds to design data

The areas on the top of the confined waste of all landfills were recovered for various uses, mainly as recreational parks (Valongo, Matosinhos and Vila do Conde). In the Póvoa de Varzim landfill it was built an airfield for ultra-light aircrafts which is currently used by the municipal aero club. The construction of the runway and taxiways was funded by LIPOR (but not included in the investment programme) and the rest of the facilities by the city council of Póvoa de Varzim.

Except for the smallest landfill (Vila do Conde), facilities were built to burn the LFG generated after the closure of the landfills. In the Póvoa de Varzim, though, the flaring of the biogas was discontinued in 2007 due to low quantity of gas generated[5]. The larger landfills (Valongo and Matosinhos) the biogas is extracted, compressed and burned to generate energy.

The leachates generated in the 4 sealed landfills are collected and stored locally in appropriate tanks. Subsequently, they are carried by truck to nearby waste water treatment plants operated by the city councils. These are fully licensed to process this kind of waste water.

Sealed landfills are managed directly by the project owner, LIPOR.

[5] Between 2004 and 2007, the flare station operated only for 181, 9, 4 and 2 hours.

Energy recovery plants (2 plants)

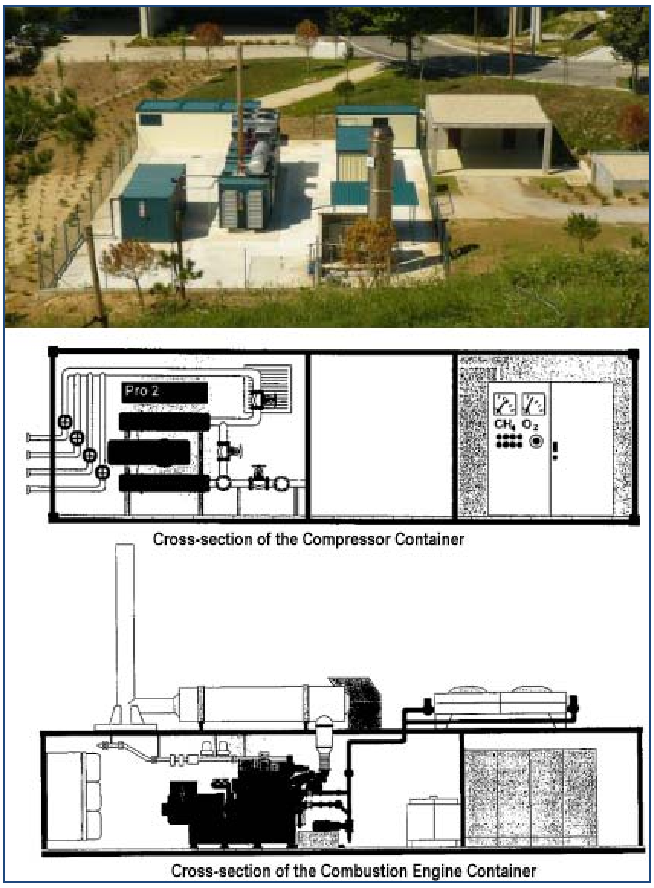
In the Valongo and Matosinhos landfills the amount of biogas to be generated after the closure was sufficient to justify the setting up of energy generating facilities. The capital cost of these facilities amounted to EUR 3.4 million or 4.2% of the overall investment.

These small-scale power plants consist of the following major components:

- Compressor unit packed into a movable steel container, including, besides the compressor, gas analysis, cleaning and control systems, electrical/mechanical instrumentation and other ancillary equipment;

- Internal combustion engine group packed into a second movable steel container, including, besides the engine (Otto cycle), ignition, starter and batteries, synchronous electricity generator, cooling and ventilation systems, interconnection (transforming, switching, protection, metering, etc.), instrumentation and control systems;

- Emergency flare station.



Cross-section of the Compressor Container
Cross-section of the Combustion Engine Container

The 2 electricity generating plants, which have different electric power capacity (Valongo: 3,225 kVA and Matosinhos: 537 kVA), are managed by 2 concessionaires. Both contracts are valid for an initial period of 10 years that can be renewed by 5-year periods. Both contemplate the voluntary resolution of the contract when the volume of extracted gas falls under the threshold of technical feasibility for energy generation.

The operations of these plants started only recently: Valongo in 2008 and Matosinhos in May 2009 (Fig. 2 - 4). The electricity is marketed directly by LIPOR at government subsidised prices (“green” energy). The capacity utilisation is low, which is not uncommon in the first years of operation of these energy plants that have difficulties in controlling the variables affecting the generation of gas.

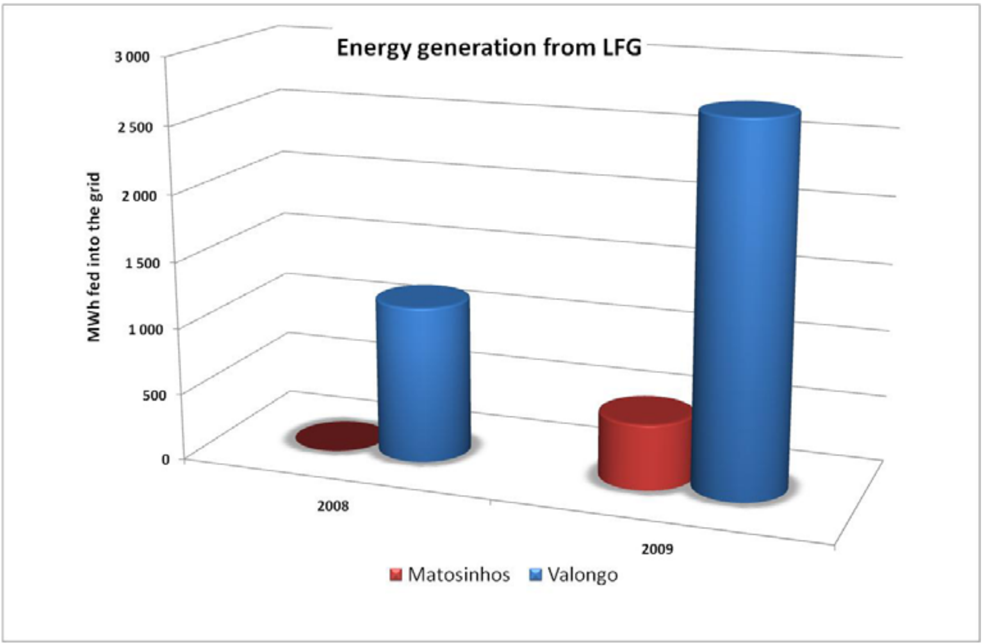


Figure 2-4 Electricity from LFG

2.1.4 Summary of project outcomes

The programme was officially closed in the 31st of March 2009. Nevertheless, there are investments underway and LIPOR expects that the overall investments (eligible and non-eligible) will be finished by 2013, with a total capital outlay of EUR 80.3 million (Table 2 - 4), about 86.3% of the amount that was planned in 2001.

Table 2-4 Overall investment (actual amounts and projections as of 2010)

Component	2000/2010	2011/2013	Total	%
A. Recycling	9.4	2.4	11.8	13.3
B. Composting	37.6		37.6	46.8
C. Landfill Sealing-off & Use	17.0	0.9	17.9	22.3
D. Energy Recovery Plants	3.4		3.4	4.2
E. Communication Campaigns	4.3	5.4	9.6	11.0
Non-allocated to the above	-	1.9	1.9	2.4
Total	**71.6**	**8.7**	**80.3**	**100.0**

Unit: EUR millions

The following table, based on the CF closing report, shows the outcomes of the programme in relation to the components considered initially.

Table 2-5 Main technical outcomes of the programme

Programme Components	Physical Indicators	No.
Recycling	Door-to-door containers and bags	1,399,563
	Collection vehicles	20
	Drop-off/collection centres	2,672
	Pre -sorting platform	1
Composting	Composting plant	1
	Organic waste containers	78,605
	Organic waste collection vehicles	11
Landfill Recovery	Landfills sealed-off	4
Energy Generation	Electricity generating plants	2
(Communication)	(Awareness campaigns)	3

2.2 Revision of ex ante cost benefit analysis

2.2.1 Use of ex ante cost benefit analysis for decision-making

The ex-ante CBA was conducted in an aggregate fashion for the whole of the programme, comprising the 5 components defined in the application (Table 2 - 1, section 2.1.3). Hence, the economic benefits were not tied to any particular project component. The exception is the financial income, calculated separately for each component, which was added to the quantified economic and social benefits without any adjustment.

Three social and economic benefits were calculated:

- "Improvement of Public Health", measured by the reduction of the number of working days lost due to illness (the *cost of illness method*). The annual figures (avoided costs of illness) were obtained by multiplying the unit cost of illness (EUR 3,990.4 for 5 days of absence[6]) by 1% (reduction of illness due to the investment programme) by the active population (assumed to be 40% of the total population of the sub region over the projection period). This benefit accounted for 38% of the total benefits.

- "Improvement of the regional value added", measured by the increase of unspecified economic activities. This economic benefit was about 5% of total benefits. The increase in regional value added was calculat-

[6] The social cost directly attached to an absence of 5 days was gauged at EUR 2,992.8 per person per 5 days (assumed as the average lost days due to illness). This amount increased by EUR 997.6 (1/3 of the former) assumed to be the social costs induced in the non-active population by illness of the active members.

ed by using a multiplier of 5 times the direct and indirect wages (these assumed to be 40% of direct wages).

- “Additional improvement of the regional value added”, measured by the increase of tourism activities. The tourism related annual income of the regional population, gauged at EUR 15 *per capita*, would have an increase of 15% due to the enhanced amenities of the region brought about by the investment. Of this income about 2/3 would represent an increase of the regional value added. To this increase 5% was subtracted to allow for the costs of unspecified mitigation measures. This benefit accounted for 3% of overall benefits.

In addition to the above, non-pegged benefits, the financial turnover of each component (except for component C and D, for which no financial income was calculated) was added as an economic benefit. It amounted to about 52% of total benefits accounted for.

2.2.2 Review of ex ante assumptions

The approach used for the CBA calculations were troubled by a number of flaws[7]:

- the investment value was submitted as a single figure, comprising all individual components, broken-down only by the nature of expenses (pre-investment expenses, construction, machinery, vehicles), thus not allowing the determination of ex ante investment unit costs, neither to compare, component by component, ex ante with ex post investment costs; overall investment comparison is included in section 2.3.2 below;

- the operational costs were broken-down by the nature of expenses (staff, energy, maintenance, insurance, transportation, indirect costs, factory overheads, etc.) and appearing to include costs not related to the activities relevant for the investments under consideration, thus not allowing the determination of ex ante operational unit costs, neither to compare, component by component by component, ex ante and ex post operational costs;

- annual turnover included income that are not related to the activities of the components under consideration (e.g.: energy from the existing incinerator, which is not part of the investment programme) or were not adjusted to the operational increment due to the incremental nature of the investment in the case of recycling, thus not allowing a comparison of ex ante and ex post revenues;

- there are unadjusted costs and non-market and/or unadjusted prices embedded in the financial turnover (e.g.: the income from sales of recycla-

7 It should be stressed that, at the time the application of the investment programme was prepared, the existing EC guidelines for carrying out CBAs were very limited and sketchy. There was a brief text, published in 1999, which was a new version of the first one published in 1997. The first edition of the CBA guide was only published in 2002.

ble materials is mostly based on government regulated “warranty” prices, electricity is marketed at “green prices”, municipal tariffs are based in political/administrative considerations);

- there was no justification and/or explanation for most of the ratios and unit values used for calculating the social and economic benefits of “improvement of public health”, “improvement of regional value added” and “additional improvement of regional value added”;
- there is the risk of double counting some benefits (e.g.: the value added in tourism activities might already been considered in the value added in unspecified activities);
- the incremental net benefits technique[8] was not followed in the case of the recycling component: the turnover considered when calculating the income was derived from the sales of all collected recyclables, while it should be only the fraction of sales attached to the capacity increase;

The reference period adopted in the CBA was of 15 years (2000/2014); the cash-flows were calculated at current prices and discounted at an acceptable 8.65% rate[9].

The performance indicators calculated from the above assumptions were as follows:

- ENPV: EUR 243.3 thousand
- EIRR: Not calculated[10]
- B/C: 1.73

2.2.3 Project identification and alternative options

As noted before (section 2.1.2) the programme submitted to the CF assistance was selected from a continuing flow of capital investment projects (including expansion, replacement and greenfield operations), which was taking place in

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8 “The calculation of the financial and economic performance indicators must be made with the incremental net benefits technique, which considers the differences in the costs and benefits between the do something alternative(s) and a single counterfactual without the project, that is, in principle, the BAU [*Business As Usual*] scenario.” Guide to Cost Benefit Analysis of Investment Projects”, European Commission, Directorate General Regional Policy, July 2008, p. 34

9 The calculation of the ENPV was conducted in PT Escudos, assuming a uniform annual inflation rate of 2.5%. The calculated value was then converted into Euros by applying the standard exchange rate of PTE 200.482 to EUR 1.0. Under these circumstances, the implicit real discount rate (at constant prices) was 6%, slightly above Guide benchmark for Cohesion countries (5.5%). Thus, ex-ante discount rate is acceptable and does not present an issue of the ex ante analysis.

10 The EIRR was not calculated because all economic cash-flows over the projection period were positive. In the cases such as this there are no positive roots (neither negative actually, there are no real roots) to the n^{th} degree polynomial equation EIRR (r) = 0. In this case all14 roots of the equation are imaginary numbers.

the various businesses of LIPOR. These investments were part of a long range strategic plan for the period 2000/2014.

A document with the main guidelines, strategic thrusts and capital improvement programmes of this plan was submitted with the application. Even though there is not any mention to alternative technical options (which is understandable due to the nature of the document), it turned up that several technical alternatives were considered during its preparation (e.g.: aerobic vs. anaerobic digestion for the composting component, internal combustion engines vs. gas turbines for the electricity generation). The selection of the preferred options were based on technical, risks and cost criteria.

2.3 Ex post cost benefit analysis

2.3.1 Project identification

The project involved a programme of investments amounting to EUR 80 millions, including the construction of various facilities, the acquisition of equipment and machinery and the remediation of historical liabilities in the environmental sector. The project was carried out by LIPOR, in several locations of the Greater Porto area.

LIPOR invested directly in all assets, having transferred the property of some (multi-material collection equipment and vehicles) to its city council members. 3 of the facilities (the composting plant and the 2 power plants) are operated by concessionaires, which are only responsible for running and maintaining the plants, LIPOR keeping its ownership and being responsible for providing the production factors (the “raw materials”: organic waste and LFG) to the concessionaires and by marketing the results of the production.

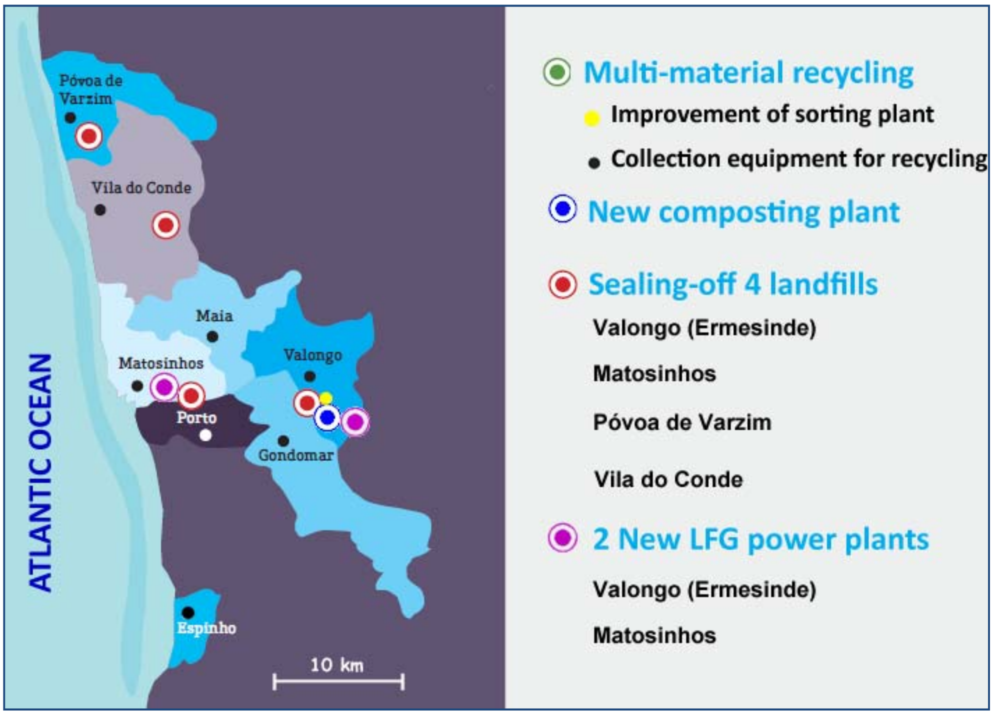

Figure 2- 5 The Programme

2.3.2 Financial analysis

Investment

While the actual amount of the eligible investment coincide whit the planned, the only difference being the time scale, the total investment costs are now estimated at EUR 80.3 million, or 28% less than the budgeted 112 millions. Part of this difference is due to the annual inflation rate embedded in the projections (2.5%), which was higher than the actual figures in the first years of the projection period.

According to the CF closing report filed by LIPOR there were 2 alterations to the investment project: (a) a new small unit to process slag from the incinerator plant was not built, because it was not possible to find any operator willing to bid for the concession of its exploitation, in spite of the international tender procedure carried out by LIPOR, (b) resources allocated to the recycling activities of the municipalities were increased. The non-used financial resources for the slag unit (about EUR 1.4 million) were applied to the composting plant (whose execution costs were higher than expected) and to strengthening the recycling components. Thus, these alterations did not have any implications in terms of differences of overall investment costs.

Thus, the reduction of planned investment costs of more than 20% can only be attributable to an overestimation of the initial projections, which is likely bearing in mind the manner the programme was prepared[11].

The time scale was altered due to some delays in the execution of the project in the first years of the investment (Figure 2 - 6), mostly due to tendering and contracting difficulties. This was one of the bases for re-programming the time scale of the CF funding that was approved in 2008.

[11] As mentioned in section 2.2.2, the investment programme was not based on specifically planned and designed investment projects, but extracted from a continuing flow of projected capital investment costs (including expansion, replacement and greenfield operations), which were foreseen in a strategic plan for the 200-2014 period. The investment values were not individualized in terms of specific projects thus making it impossible to establish which investment components were responsible for the differences between planned and executed investment costs.

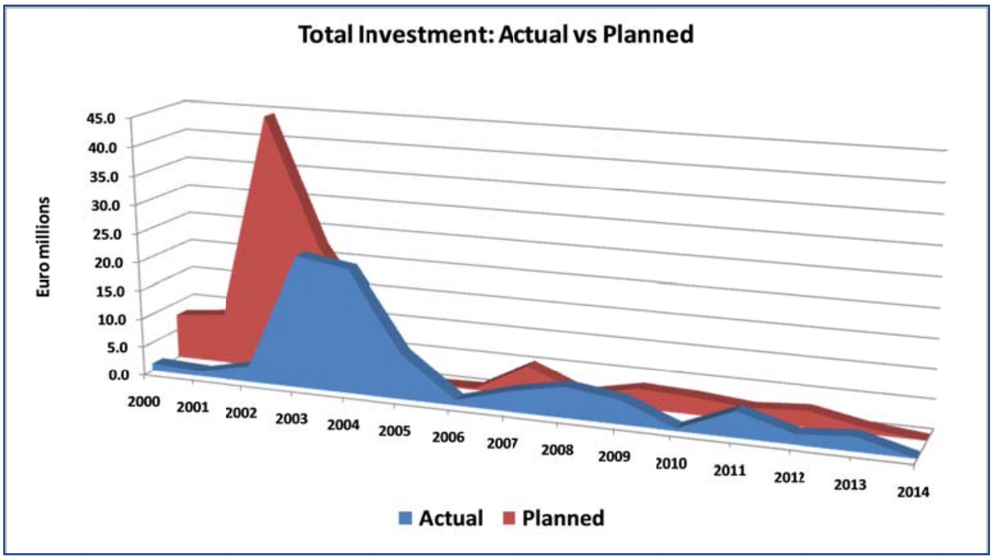

Figure 2- 6 Investments

Operational costs and revenues

In this case, the contrast between planned and actual flows is not significant because the ex-post analysis was conducted on component-by-component basis and following strictly the incremental net benefits technique, while the ex-ante was conducted in an aggregate manner and including the flaws and mistakes already described in section 2.2.2. Consequently, the flows concerning costs and revenues available from the ex ante analysis, which cannot be corrected *a posterior*, are not comparable with the relevant flows that were calculated from the historical data in the ex post analysis. The latter are described in the next paragraphs.

In the ex-post analysis, the flows of all operational costs and revenues accrued before the new capacities entered into operation (recycling: 2003, composting: 2006, closed landfills: from 2004 to 2009 and energy generation: 2008 and 2009) were excluded. In addition, in the case of the recycling component, the flows occurring after the date the new capacity was considered to start operating (2003) were apportioned between the “old” and the “new” capacity, and only the later were taken into account.

All costs and revenues not directly attached to any of the components were excluded. For instance, revenues from tariffs were disregarded as these tariffs apply only to waste sent to landfills or the incinerators, and these infrastructures, although owned by LIPOR, were not part of the investment programme under evaluation. This also applied to revenues from the electricity generated by the incinerator.

Financial result

The following table summarises the performance indicators for the components and the overall programme.

Table 2- 6 Financial performance indicators

Component	Ex post		Ex ante	
	NPV*	IRR	NPV*	IRR
A. Recycling	– 0.4	+ 7.7%		
B. Composting	– 30.6	N.A.		
C. Landfill Sealing-off & Use	– 11.1	N.A.		
D. Energy Recovery Plants	+ 0.1	+ 9.8%		
E. Communication Campaigns	Allocated to A and B			
Overall	– 42.0	**< 0**	**+ 9.6**	**7.3%**

** EUR millions.*

The differences in the overall indicators are due to the adjustments to revenue and operating costs that were introduced in the ex-post analysis, as already mentioned above.

Only one of the 4 components shows a small positive NPV, the component concerning the energy generation from LFG. In the first 2 operation years, when adjustments are needed to increase the efficiency of the extraction and generating systems (avoiding leakages, keeping a good balance between extraction flows and proper environmental conditions for the biological processes, etc.), while the results for the concessionaires are reportedly negative[12], the project shows a positive contribution for the project owner. This is due to the contractual arrangements that allocate to concessionaire most of the technical risks.

The marginal unprofitability of the recycling component (NPV: – 0.4 millions; IRR: + 7.7%) is very low when compared with the allocation of a substantial part of the investment costs of communication/awareness activities. These costs, which are instrumental to 2 components (recycling and composting), were allocated to these components *pro rata* of respective investments costs. Thus it is not correct to conclude precipitously that recycling component is financially unprofitable because the negative value of its NPV falls within the unavoidable margin of error brought about by any allocation exercise. The activity is financially rewarding before the allocation of indirect “marketing expenses” (the cost of communication/awareness activities), which is equivalent to say that its gross margin[13] is financially.

2.3.3 Economic analysis

The LIPOR investment programme comprised 4 investment projects which can and should be analysed individually under an “effect-by-effect” CBA. The fol-

[12] “Relatório de Exploração 2009” (*Exploitation Report 2009*), RESIDEL, January 2010, pp. 7-8.

[13] Gross margin, or gross profit, is the excess of sales over the inventory cost of googs sold, including fixed indirect manufacturing (Horngreen, Charles T., “Cost Accounting”, 4th edition,Prentice-Hall 1977, p.58.

lowing paragraphs report the results of the individual ex-post economic analysis, which were carried out for 3 of the 4 components. For one of them, recycling, it was not possible to find the specific data that would permit a meaningful exercise. All cash-flow were discounted at the same discount rate (8.65%, current prices), the same used in the ex ante analysis, which is deemed to fall within acceptable limits.

Component A – Recycling

In general, recycling is viewed as virtuous activity as it allows, besides the reduction of waste and its externalities, the reduction of consumption of natural resources and contributes to greater energy efficiency. The official policy of the Commission is to promote recycling because "if waste cannot be prevented, as many of the materials as possible should be recovered, preferably by recycling"[14]. The *Thematic Strategy*[15] on the prevention and recycling of waste is one of the seven thematic strategies programmed in the 6th Environmental Action Plan. The Commission has defined several *waste streams* for priority attention, including packaging waste, end-of-life vehicles, batteries, electrical and electronic waste. There are EU directives requiring member states to introduce legislation on waste collection, reuse, recycling and disposal of these waste streams. This view is quite widespread; for instance a relatively recent OECD book asserts "A policy to recycle more waste materials, for example, would need to take account of the upstream savings in virgin materials. Using less virgin material – timber, say – would mean that various environmental impacts from forestry could be reduced. Those reduced environmental impacts are a benefit that can legitimately be credited to the recycling policy."[16]

However, there are many research studies that cast doubts about whether waste recycling is a socially desirable and worthy option. In a recent article[17] that scrutinised 37 'effect-by-effect' English language studies of waste policy options, five critical areas where CBAs are often inconsistent with each other were identified: the types of environmental impact and their valuation; the relevance of upstream externalities; whether there is a scarcity externality; the economic significance of householder efforts; and the need to drive towards long-term sustainability through eco-restructuring. The main conclusion is that, in addition to biases that arise more often than not in research studies (e.g.: methods of valuation, excluded or unvalued components), the balance between benefits and costs depends on the specific situation under consideration and the use

14 "Environment – Waste", European Commission Web site (http://ec.europa.eu/environment/waste/index.htm, assessed 24/09/2010).

15 Communication from the Commission to the Council, the European Parliament, the European Economic and Social Committee and The Committee of the Regions - Taking sustainable use of resources forward - A Thematic Strategy on the prevention and recycling of waste {SEC(2005) 1681} {SEC(2005) 1682}/* COM/2005/0666 final */.

16 David Pearce, and all., "Cost-Benefit Analysis and the Environment – Recent Developments", OECD, 2006, p. 56

17 Joe Pickin, "Representations of environmental concerns in cost–benefit analyses of solid waste recycling", in Resources, Conservation and Recycling, 53 (2008), Elsevier B.V., pp. 79–85

of valuations selected from specific cases in different contexts does not lead to sound, well grounded results.

In the case of the recycling component of the LIPOR programme, it was not possible to obtain and validate any data upstream the operation of sorting the recyclable materials[18]. It is well know the importance of this upstream direct costs and externalities as the «price of a good carries the costs of the entire economic life cycle»[19] thus environmental effects should also be included. Thus any attempt to conduct a C/B analysis in the absence of local specific data would be speculative and unreliable.

The alternative of approaching the analysis of the recycling component using the contingent valuation method was not a feasible option due to time and scope restrictions[20]. To this respect it is also interesting to be aware of that, at least in some EU member states, the public does not place a high value in packaging and organic material recycling programmes as opposed to the values that the contingent valuation method arrives for the more perceptible and obvious landfill improvement programmes[21].

Component B - Composting

Aerobic composting is one of several methods of turning biodegradable organic waste (food, green, etc.) into a usable material, a fertiliser that can be applied in agriculture. Composting is preferred to other methods of organic waste disposal, landfill and incineration, because the first one can cause environmental and social externalities through leachate discharges, gaseous emissions, loss of landscape amenities, unpleasant odours and the sheltering of pests that may carry diseases, and the second (incineration) can generate toxic emissions, if not properly controlled.

Thus, by reducing the amount of biodegradable waste to landfill, composting can decrease its potential for polluting. A European Landfill Directive

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18 The collection at source separated recyclable materials in Greater Porto area is carried out by 8 different city councils, the shareholders of LIPOR. It is not a practice of these councils to gather and assemble cost and other data (such as the average distance travelled by collection trucks per tonne of recyclable materials) on a systematic and reliable way.

19 Joe Pickin, "Representations of environmental concerns in cost–benefit analyses of solid waste recycling", in Resources, Conservation and Recycling, 53 (2008), Elsevier B.V., pp. 79–85

20 The contingent valuation method involves conducting surveys to collect stated preferences from the population to estimate a value function that 'explains' their willingness to pay for a positive change in their environment. These surveys should be done before or at the time the environmental change takes place.

21 See, for instance, R. Bluffstone and J.R. DeShazo, "Upgrading Municipal Environmental Services to European Union Levels: A Case Study of Household Willingness to Pay in Lithuania" in Environment and Development Economics 8: 637–654, Cambridge University Press, 2003

(1999/31/EC of 26 April 1999) introduced significant changes in the treatment of waste in Europe. This Directive, which was mainly concerned with ensuring that landfill standards and waste acceptance standards are uniform across the EU to avoid dumping of hazardous waste into low standard sites, also sets up targets for the reduction of biodegradable municipal waste in the European Union[22].

The composting component of the LIPOR investment programme follows the objectives of Landfill Directive as well as the Portuguese legislation[23] that transposed and extended this Directive.

C/B analysis used the cost and revenue flows of the financial analysis, after being corrected, in the absence of standard conversion factors of the Portuguese "planning authority"[24], by determining specific parameters from public datasets[25] to adjust investment and operative costs (as advised by the Guide[26]). Financial income was not corrected as it is based on market driven prices formed under competitive conditions with internationally traded commodities.

An additional benefit, encompassing economical, social and environmental components, was added to the adjusted financial flows: the avoided external net costs of the next-best alternative (incineration). Incineration was adopted as the next-best alternative, because (a) it is so considered by the Commission: "Where possible, waste that cannot be recycled or reused should be safely incinerated, with landfill only used as a last resort."[27] and (b) this view is followed by the Portuguese authorities "(. . .) elimination by deposition in landfill as the last option to be considered"[28].

To calculate the net costs of the next best alternative, it is necessary to compute the unit value of the benefits (direct income derived from generating electricity at its opportunity cost in Portugal, minus the negative externalities of Portuguese electricity system when generating the same amount of electricity) to

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22 All EU countries must, pursuant to the Landfill Directive, reduce the amount of biodegradable waste disposed to landfill by 50% by 2010.

23 The most important legislation to this respect is PNGR, the National Plan for Managing Waste (Decree-Law no. 310/95 and 239/97) and PERSU, the Strategic Plan for Municipal Solid Waste (published in July 1997 by the Waste Institute.

24 According to the CBA Guide, the "authority" (or the "Member State") is supposed, in principle, to "develop its CBA guidelines focusing on the estimation of a set of national parameters, including some key shadow prices or conversion factors, in the context of the EU Cohesion Policy priorities". Guide to Cost Benefit Analysis of Investment Projects", European Commission, Directorate General Regional Policy, July 2008, pp. 47-48.

25 BP Stat (on line statistics of the Bank of Portugal). http://www.bportugal.pt/EstatisticasWeb/(S(5wwyn245upbfn355owjekt55))/DEFAULT.ASPX?Lang=en-GB, accessed November 2010.

26 Guide to Cost Benefit Analysis of Investment Projects", European Commission, Directorate General Regional Policy, July 2008, pp. 91-92.

27 "Waste", European Commission, Environment, http://ec.europa.eu/environment/waste/index.htm, accessed October 2010.

28 "PERSU II – Plano Estratégico para os Resíduos Sólidos Urbanos 2007-2016" (*Strategic Plan for Urban Solid Waste 2007-2016*), Ministério do Ambiente, do Ordenamento do Território e Desenvolvimento Regional, 2007, p. 44.

which it should be deducted the costs incurred by incinerating 1 tonne of organic waste (only the external costs are relevant, as the collection costs are also incurred when the same tonne is composted, and there are no other direct costs).

Table 2 - 7 summarises the calculations and shows the sources of the data.

Table 2- 7 Calculation of the Net External Cost of Incineration

Sign	Variable	Value type and source
Externalities of incinerating 1 tonne of organic waste		
+	Health	Avoided externality, Benefit transfer[29]
+	Materials and agricultural crops	Avoided externality, Benefit transfer[29]
+	Disamenity	Avoided externality, Benefit transfer[29]
+	Climate change	Avoided externality, Benefit transfer[29]
+	Transport-related	Excluded. Same for incinerating or composting
+	Solid and chemical waste residues	Avoided externality, Benefit transfer[26]
=	**External costs of the next-best alternative**	
–	Opportunity cost of electricity in Portugal	Forgone benefit. Direct calculation[30]
+	External cost of electricity in Portugal	Avoided externality. Direct calculation[31]
=	**Net forgone benefits of the next-best alternative**	
Σ	**Net external costs of the next-best alternative = EUR – 1,528,048**	

The following table summarises the calculation of the net present value of the composting component.

Table 2- 8 Net present value of Composting

Flow	Present value EUR	Remarks
Investment costs	– 20,987,317	From financial analysis, adjusted
Operating costs	– 7,757,560	From financial analysis, adjusted
Sales revenue	+ 2,050,904	From financial analysis, unadjusted
Net external avoided cost	+ 1,528,048	Benefit transfer and direct calculations
Residual value	+ 3,214,629	From financial analysis, adjusted
Total	– 21,951,296	Net Present Value of Component B

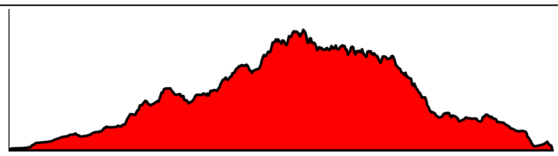
29 Heleen Bartelings et Al., "Effectiveness of landfill taxation", Institute for Environmental Studies, Vrije Universiteit, Amsterdam, November 2005, pp. 69-113.

30 Specific unit energy production assumed an average lower heating value (LHV) for the organic waste processed in the composting plant of 5.42 MJ/kg (50% of water content) and adjusting to 80% water content, lead to a technical coefficient of 169.75 kWh per tonne of organic waste. Source for prices: "MIBEL: The Iberian Electricity Market. Prices for 2007-2010", http://www.erse.pt/pt/electricidade/mibel/Paginas/default.aspx, accessed October 2010

31 "External costs of electricity production", European Environment Agency, http://www.eea.europa.eu/data-and-maps/indicators/en35-external-costs-of-electricity-production, accessed on October 2010

A Monte Carlo simulation was used to explore probabilistically the significant uncertainties of several input variables: Total investment, operating costs and avoided costs of the next-best alternative. The results are shown in Figure 2 – 7.

NET PRES VAL			
Expected value	-27227		
10%	-28226		
50%	-27207		
90%	-26292	-29268	-25470
NPV / PV INV			
Expected value	-1.2017		
10%	-1.2464		
50%	-1.2005		
90%	-1.1605	-1.2865	-1.1226



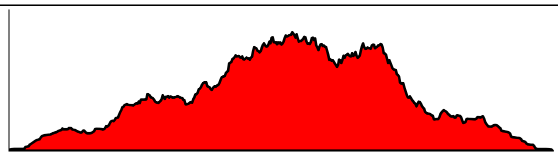


Figure 2-7 Composting: Probability distribution of the results

The expected value was reduced from the deterministic EUR – 21.95 million to EUR – 27.23 million. On the basis of the uncertainties that were made explicit in this exercise, the probability of this component being economically feasible is zero.

Component C - Landfill sealing-off and use

This component of the LIPOR investment programme has many similarities with component A (dubbed "the environmental minimum") of the "Solid Waste Management in Madrid", pilot case ES13. In both cases the intervention consisted in the technical confinement of landfills in agreement with Directive 1999/31/EC. Main differences were basically the size of the landfills (LIPOR with a total area of 36.4 ha vs. 110 ha in Madrid) and the number of landfills (LIPOR closed 4 landfills against only 1 in Madrid).

Thus, it is little wonder that the approach used in the calculating benefits and costs were the same as in the Madrid's. Two benefits were considered and quantified:

- The willingness to pay by the affected population for the improved amenity of the sites where the landfills are placed.
- The reduction of GHG emissions that was made possible by the capture of LFG.

As in the Madrid case, it was used the method of benefit transfer to calculate the first category of benefits, based on the same study of the Hiriya landfill in Israel[32]. Similar adjustments were also carried out to the specific conditions of Portugal and the areas where sites are located.

[32] O. Aylon, N. Becker and E. Shani, "Economic aspects of the rehabilitation of the Hiriya landfill", in Waste Management 26 (2006), pp. 1313-1323

The second benefit (avoidance of GHG emissions) was calculated also the same way, bearing in mind the actual developments in the area. As already mentioned the 2 smaller landfills were closed in 2004. For the smallest (Vila do Conde 2.5 ha), it was never intended to extract and burn the expected small volume LFG that would be generated in the remaining life of the landfill. In the next one (Póvoa de Varzim 6.9 ha) a drainage piping and a flare were installed since the inception. Though, after a couple of years of operation, the LFG flaring was discontinued due to the low volume of gas generated in the landfill. In the larger landfills (Valongo 19.0 ha and Matosinhos 8.0 ha), the efficiency of gas extraction has been also impaired by technical difficulties since the starting of operation in 2008 and 2009. Thus, the design calculations were reviewed to adopt more conservative rates of efficiency.

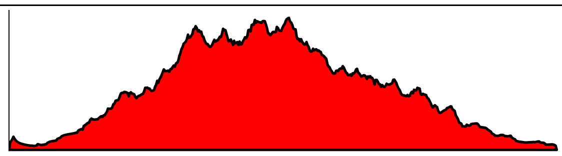
Next table summarises deterministic calculations for the component under appreciation.

Table 2- 9 Performance indicators of Landfill sealing-off

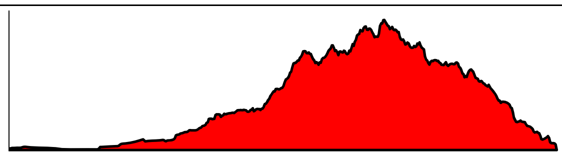
Flow	Present value EUR	Remarks
Investment costs	– 8,609,274	From financial analysis, adjusted
Operating costs	– 44,036	From financial analysis, adjusted
Willingness-to-pay (BT)	+ 6,250,313	Transfer from Hiriya study (Footnote 32)
Avoided GHG emissions	+ 3,114,134	Direct calculations[33]
Residual value	0	From financial analysis, adjusted
Total	+ 711 137	Net Present Value of Component C
EIRR	9.93%	Economic Internal Rate of Return
B/C Ratio	1.08	Benefits/Costs Ratio

The risk analysis used a Monte Carlo simulation that conducted to the results shown in Figure 2 – 8.

NET PRES VAL	
Expected value	708
10%	-2882
50%	594
90%	4529



INT R OF RET	
Expected value	9.2271
10%	2.8141
50%	9.6440
90%	15.17



[33] "MIBEL: The Iberian Electricity Market. Prices for 2007-2010", http://www.erse.pt/pt/electricidade/mibel/Paginas/default.aspx, accessed October 2010 and "External costs of electricity production", European Environment Agency, http://www.eea.europa.eu/data-and-maps/indicators/en35-external-costs-of-electricity-production, accessed on October 2010

NPV / PV INV	
Expected value	0.0760
10%	-0.3112
50%	0.0639
90%	0.4847

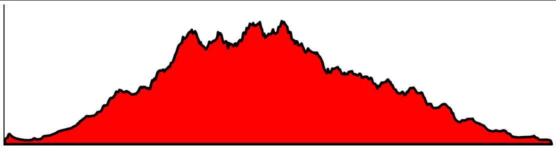


Figure 2- 8 Sealing-off landfills: Probability distribution of the results

The expected values were similar to the deterministic ones. On the basis of the uncertainties associated to the randomised variables (investment costs, operating costs, price of CO_2 and avoided volume of GHG captured), the likelihood of having a positive net present value is over 50%.

Component D – Energy generation from LFG

Just like the previous (Landfill sealing-off) this component is similar to Madrid's pilot project B component. In both cases, the project concerned setting up electricity generating facilities close to sealed-off landfills to use LFG to generate electricity. Main differences concerned the scale: the size of landfills (around 27 ha in the LIPOR case versus 110 ha in Madrid's) and the number (2 plants with 3 combustion engines vs. one plant with 8 in Madrid) and generating capacity of the plants.

Calculation of benefits was conducted the same way, basically consisting of adjusting financial analysis to the social and economic standpoint. Besides the adjusted investment and operating costs derived from the financial analysis, it was computed a benefit corresponding to the value of the energy generated during the economic life of the 2 projects (2009 to 2016/2017).

The energy generated was valued at its opportunity cost (market price of electricity in the Iberian Peninsula), added of the external cost of energy generation in Portugal. Following table summarises the calculations

Table 2- 10 Performance indicators of energy generation from LFG

Flow	Present value EUR	Remarks
Investment costs	– 1,707,571	From financial analysis, adjusted
Operating costs	– 997,292	From financial analysis, adjusted
Direct opportunity costs	+ 1,258,160	Direct calculation[34]
Avoided GHG emissions	+ 1,478,910	Direct calculations[35]

[34] "MIBEL: The Iberian Electricity Market. Prices for 2007-2010", http://www.erse.pt/pt/electricidade/mibel/Paginas/default.aspx, accessed October 2010.

Residual value	0	From financial analysis, adjusted
Total	+ 32,207	Net Present Value of Component D
EIRR	+ 8.89%	Economic Internal Rate of Return
B/C Ratio	1.01	Benefits/Costs Ratio

The risk analysis used a Monte Carlo simulation that conducted to the results shown in Figure 2 – 9.

NET PRES VAL	
Expected value	634
10%	-464
50%	518
90%	1949
INT R OF RET	
Expected value	12.45
10%	4.9573
50%	12.27
90%	20.46
NPV / PV INV	
Expected value	0.2284
10%	-0.1672
50%	0.1864
90%	0.7020

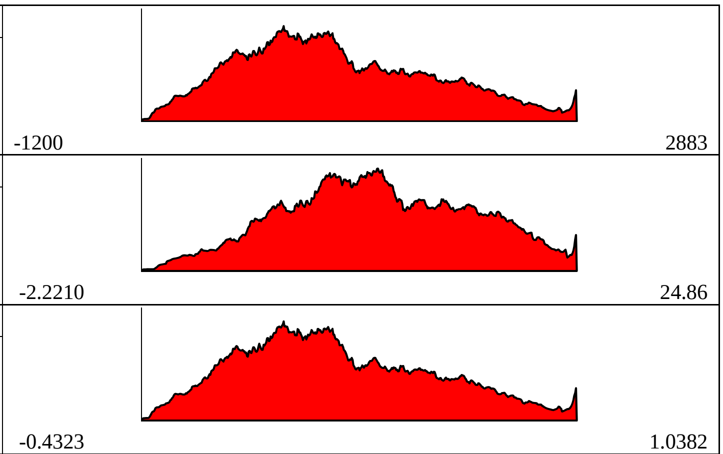


Figure 2- 9 Energy generation: Probability distribution of the results

Expected values and probability distributions from the risk assessment show a feasible, though rather timid project.

2.4 Comparing the ex ante and ex post cost benefit analyses

Because component A was not appraised under the CBA approach, it is not possible to perform a full comparison between the ex-ante and ex-post analyses. On the other hand, as the ex-ante analysis was conducted on an aggregated way, a component-by-component assessment it is not possible either.

Though, bearing in mind that component A only represents only 13.3% of total investment, the following conclusions stand:

[35] "External costs of electricity production", European Environment Agency, http://www.eea.europa.eu/data-and-maps/indicators/en35-external-costs-of-electricity-production, accessed on October 2010

- It is highly probable that the overall investment would have a negative social and economic present value (EIRR) if a proper ex-ante CBA was carried out.
- The global unfeasibility is due to one component only (composting, the major one contributing with 46.8% to total investment), as the other 2 assessed (landfills sealing and energy generating) proved both feasible and it is quite likely that the recycling component would be economically feasible or only marginally negative.
- The unfeasibility of the composting is quite acute as shown by the risk analysis (the probability of having a positive economic net present value is nil).
- The ex ante analysis did not incorporate any quantified risk assessment;
- It should be stressed that there is in general[36] a high level of uncertainty, mostly due to the lack of specific analysis aiming at monetising direct benefits and externalities of most of the components of the programme. A single example shows how wide could be the range of variability of the chain-composed uncertainties (compound probabilities) of the variates: the global climate change potential of methane is usually taken by the specialised literature to be close to 21 (one tonne of methane has the same damaging effect than 21 tonnes of carbon dioxide), but there are many recent specific studies placing this conversion rate in range from 11 to 30[37].
- Should the ex-ante CBA be performed on an effect-by-effect basis in the LIPOR case, maybe the composting component would have been looked into more closely and would encourage carrying out a more specific to the local situation and detailed feasibility analysis.

- The discount rate used for the financial and economic analysis (8.65% at current prices) fall within acceptable limits[38], for which they were kept in the ex post analysis and its adjustment to the currently recommended (but not prescribed) by the Guide would not have any material effect in the conclusions. So, discount rate is not an issue in financial and CBA analyses.

- As far as it could be grasped in the documentation or in the interviewing programme there was no unintended effect worth mentioning.

[36] The possible exception is the electricity generation. Though, as this component started recently, the operational experience is not sufficient to remove the technical uncertainties.

[37] Heleen Bartelings et Al., “Effectiveness of landfill taxation”, Institute for Environmental Studies, Vrije Universiteit, Amsterdam, November 2005, p. 86.

[38] The equivalent real rate (at constant prices ex post and ex ante) would be 5.9 and 6%. These are slightly above the Guide benchmark for Cohesion countries (5.5%).

2.5 Project specific lessons

Key issues	LIPOR - Municipal Solid Waste Integrated Management
Identification of project	The Applicant extracted from a continuing flow of capital investment projects (including expansion, replacement and greenfield operations), which were foreseen in its strategic plan, a selection of projects that were put together and submitted to the Cohesion Fund and prepared a slim economic study to barely comply with the existing requirements at the time. Frequently CBA is viewed mainly as an unavoidable requirement, which does not add any value to the standard financial analysis.
Other aspects justifying the decision process?	As in many similar situations the strategy behind the investment programme meets the policy orientations of both the Commission and the Portuguese government. Project components are instrumental to fulfil regional and national goals, which are grounded in overall mandatory or quasi-mandatory directives.
Options	A separate evaluation of all project components could have resulted in a more economically efficient project.
Wider observations	• The **Benefits Transfer** method consists in taking a unit value for a non-market good estimated in an "original study" and using this estimate, after some adjustments, to value the benefits (or costs) that arise when a policy or project is implemented "elsewhere". As the time goes by the probability of finding more than one "original study" on which such transfer can be based increases and with it increases the variety of different estimates for the benefits that are being transferred to the "elsewhere" project, possibly leading to contradictory outcomes. This raises the issue of what criteria for selecting the "original study" should be applied and the possible introduction of a novel concept (inspired on the opportunity cost concept) of *next-best original study* to be used. This is an issue that needs to be seriously addressed, so the idea that the benefits transfer method is a scientifically unfounded expediency can be faded away. • As mentioned in the Guide, the member states of the EU were supposed to provide estimates "of a set of national parameters, including some key **shadow prices or conversion factors**, in the context of the EU Cohesion Policy priorities". In the cases reviewed in this research study no sign of the existence of such parameters was found. Little wonder that no conversion or shadow prices are being used in CBAs, with the possible exception of shadow wages calculated by the simplified method prescribed by the Guide. Thus, for CBA to become a reliable way of improving public interest decisions something should be done to persuade EU member states to develop the their set of national parameters to be used in CBAs. • Contrary to what happens in the transportation sector, for which it is possible to resort to a number of European well grounded calculations of externality parameters, in the environmental area the absence of consistent resources in externality calculations is notorious. There is a proliferation of studies offering quite different ratios, coefficients, unit values, for every type of variable needed to perform the **monetisation of environmental externalities**. This is clearly calling for an EU effort to scientifically standardise these variables, which are of a paramount importance for conducting meaningful CBAs.