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Guide to COST-BENEFIT ANALYSIS of investment projects

Structural Funds, Cohesion Fund and Instrument for Pre-Accession

Final Report

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This Guide has been written by a team selected by the Evaluation Unit, DG Regional Policy, European Commission, through a call for tenders by restricted procedure following a call for expressions of interest n. 2007.CE.16.0.AT.024.

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ACRONYMS AND ABBREVIATIONS

BAU	Business As Usual
B/C	Benefit/Cost Ratio
CBA	Cost-Benefit Analysis
CEA	Cost-Effectiveness Analysis
CF	Cohesion Fund, Conversion Factor
DCF	Discounted Cash Flow
EBRD	European Bank for Reconstruction and Development
EC	European Commission
EIA	Economic Impact Analysis
EIB	European Investment Bank
EIF	European Investment Fund
ELF	Environmental Landscape Feature
ENPV	Economic Net Present Value
ERDF	European Regional Development Fund
ERR	Economic Rate of Return
ESF	European Social Fund
EU	European Union
FDR	Financial Discount Rate
FNPV	Financial Net Present Value
FRR(C)	Financial Rate of Return of the Investment
FRR(K)	Financial Rate of Return of Capital
IPA	Instrument for Pre-Accession Assistance
IRR	Internal Rate of Return
LRMC	Long Run Marginal Cost
MCA	Multi-Criteria Analysis
MS	Member State
MCPF	Marginal Cost of Public Funds
NEF	Noise Exposure Forecast
NSRF	National Strategic Reference Framework
OP	Operational Programme
PPP	Public-Private Partnership
QALY	Quality-Adjusted Life Year
SCF	Standard Conversion Factor
SDR	Social Discount Rate
SER	Shadow Exchange Rate
STPR	Social Time Preference Rate
SEA	Strategic Environmental Assessment
SF	Structural Funds
TEN-E	Trans-European Energy Network
TEN-T	Trans-European Transport Network
VAT	Value Added Tax
WTP	Willingness-to-pay

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INTRODUCTION AND SUMMARY

1. The new edition

The present Guide to Cost-Benefit Analysis of Investment Projects updates and expands the previous edition (2002), which in turn was the follow up of a first brief document (1997) and of a subsequent substantially revised and augmented text (1999). The new edition builds on the considerable experience gained through the dissemination of the previous versions and particularly after the new investment challenges posed by the enlargement process.

The objective of the Guide reflects a specific requirement for the EC to offer guidance on project appraisals, as embodied in the regulations of the Structural Funds, the Cohesion Fund, and Instrument for Pre-Accession Assistance (IPA)[1]. This Guide, however, should be seen primarily as a contribution to a shared European-wide evaluation culture in the field of project appraisal.

The Guide has been written with a view to meeting the needs of a wide range of users, including desk officers in the European Commission, civil servants in the Member States and in Candidate Countries, staff of financial institutions and consultants involved in the preparation or evaluation of investment projects. The text is relatively self-contained and - as its previous version - does not require a specific background in financial and economic analysis of capital expenditures. Its main objective is to ensure a broad conceptual framework, a common appraisal language among practitioners in the many countries involved in EU Cohesion Policy.

The rest of this introductory chapter presents the motivations, ambitions and some caveats of the suggested approach. At the same time, it offers a concise summary of its key ingredients, both in terms of methodological assumptions and of some benchmark parameters.

2. Motivation

Investment decisions are at the core of any development strategy. Economic growth and welfare depends on productive capital, infrastructure, human capital, knowledge, total factor productivity and the quality of institutions. All of these development ingredients imply - to some extent - taking the hard decision to sink economic resources now, in the hope of future benefits, betting on the distant and uncertain future horizon. The economic returns from investing in telecoms or in roads will be enjoyed by society after a relatively short time span following project completion. Investing in primary education means betting on the future generation and involves a period of over twenty years before getting a result in terms of increased human capital. Preserving our environment may require decision-makers to look into the very long term, as the current climate change debate shows.

Every time an investment decision has to be taken, one form or another of weighting costs against benefits is involved, and some form of calculation over time is needed to compare the former with the latter when they accrue in different years. Private companies and the public sector at national, regional or local level make these calculations every day. Gradually, a consensus has emerged about the basic principles of how to compare costs and benefits for investment appraisal.

The approach of the Guide draws from real life experience, combined with up-to-date research. The aim here is to communicate to non-specialists the key intellectual underpinnings of investment project evaluation, as widely practised by international organisations, governments, financial actors and managerial teams world-wide. The specificity of the Guide lies in the broad perspective of EU Cohesion Policy in furthering investment and regional development through capital grants, as offered by the Structural and

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[1] See also the EC Working Document No 4, *Guidance on the methodology for carrying out Cost-benefit analysis*, available on URL: http://ec.europa.eu/regional_policy/sources/docoffic/working/sf2000_en.htm

Cohesion Fund, and through the leverage effect on other financial sources. This is a unique investment planning framework, perhaps not yet experienced in any other area of the world to such an extent.

3. Major projects and Cohesion Policy

The selection and management of major projects in the period 2007-2013 will involve a large number of actors and levels of decision-making. This exercise is particularly important as compared to the period 2000-2006, since it places the project appraisal activity within the more comprehensive framework of the multi-level governance planning exercise of EU Cohesion Policy.

EU Cohesion Policy regulations require a cost-benefit analysis of all major investment projects applying for assistance from the Funds. The legal threshold for the definition of the 'major' investment is €50 million in general, but for environmental projects it is €25 million and for IPA assisted projects, €10 million.

According to preliminary estimates by the Commission services, based on the indicative lists provided by the Member States along with their Operational Programmes, more than 800 major projects have already been identified at the end of 2007. Many others are in the pipeline. Including IPA, the Commission will probably need to take around 1000 decisions on the applications. This involves a huge amount of capital expenditure, drawing from the almost €350 billion budget for Cohesion Policy in 2007-2013.

In this complex framework a serious dialogue among all the players, who share different sets of information and policy objectives, should be ruled by sound incentive mechanisms for project evaluations, in order to overcome the structural information asymmetry. In this multi-level governance setting, actors should agree harmonised rules on the calculation of some key shadow prices and performance indicators (e.g. the project economic's net present value), and use them to steer the decision making process.

The rationale for having a common evaluation language between the EC and the project proponents is obvious in the EU context. While each project has its own specific features, for instance because of geography and of social conditions, the Commission services need to be able to compare data and methods with some reference approaches and performance indicators. Moreover, the EU assistance is typically in the form of a capital grant, with some co-funding by the project promoters; hence there is no collateral because no loan is directly involved. Therefore, the Commission takes a substantial risk on behalf of the EU citizens, who are the true donors of assistance for development. Sound project evaluation by the Member States (ex-ante and possibly ex-post) is the only way for all decision-makers to be accountable and to be able to tell the European citizens that their resources have been invested as carefully as possible. Moreover, decision-makers should use the information of ex-ante and ex-post analyses as an incentive mechanism for generating good projects. The systematic use of CBA, will also increase the learning mechanism among all the players. A consistent use of social CBA should be seen as the common language for this learning mechanism, which should be structured around the interplay between several actors.

4. Project cycle and investment appraisal

The Guide has been written with the ambition to be helpful to managing authorities, public administrators and their advisors in the Member States, when they examine project ideas or pre-feasibility studies at an early stage of the project cycle. In fact, a timely and simplified financial and economic analysis can do a lot to unveil weaknesses in project design. These weak points would probably become apparent at a later stage, when a lot of time and effort has been already wasted on an option that in the end has to be abandoned or thoroughly restructured. Using the tools presented in the Guide, or included in national guidelines, to check projects before preparing the application for EU assistance and build a national or regional selection process, will be beneficial to all actors involved, as their attention will focus only on the really good projects to enhance their probability of success.

Moreover, while the legal basis in the regulations mentions clear-cut thresholds to define 'major projects', in the real world the difference between a €49 million and a €50 million project is immaterial. Although a full CBA is not required by regulations as a basis for decision by the EC for a project below the investment cost threshold, clearly it is good practice that the managing authority looks at the latter in a similar way. In fact, some projects, not falling into the 'major' category, will form a sizeable share of operational programmes. National guidelines will probably use different thresholds to define the extent of CBA to be performed on any investment project included in an Operational Programme.

5. Limitations

While the project appraisal guidelines presented are intended to be both practical and well grounded in international experience and evaluation research, they have obvious limitations. CBA is applied social science and this is not an exact discipline. It is largely based on approximations, working hypotheses and shortcuts because of lack of data or because of constraints on the resources of evaluators. It needs intuition and not just data crunching and should be based on the right incentives for the evaluators to do their job in the most independent and honest environment.

Establishing this environment is largely a matter of institutional building, local culture and transparency of the decision-making process, including the political environment. No technical document can address these important issues which are beyond the scope of the Guide. In fact, the content of the CBA Guide is no more than a structured set of suggestions, a check list, but good project analysis needs adaptation to local circumstances and it should be based on professional skills and personal ability.

More expert readers may find that many issues have been dealt with too briefly or have been overlooked. The reading list at the end of the Guide, and the reference to some web-sites, can offer some additional material. However a selection was necessary and the criterion for what to include and what to exclude was simple: relevance to the EU context combined with feasibility. After all, if some techniques of analysis have been proposed or discussed until now in learned journals only, or have been applied in a very small number of cases, there was limited scope to include them here. It is not the aim, here, to cover exhaustively the huge academic literature on project analysis. Also, the Guide is a generalist text and, while it includes case studies and summary information on specific sectors, the reader in search of detailed guidelines on special fields, e.g. high speed railways, ports, health or some environmental projects, is advised to consult the specific applied CBA literature. Some key references are given in the bibliography.

6. The six steps for a good appraisal

The approach of this Guide is to suggest that a project appraisal document should be structured in six steps:

✓ *A presentation and discussion of the socio-economic context and the objectives*

The first logical step for the appraisal is a qualitative discussion of the socio-economic context and the objectives that are expected to be attained through the investment, both directly and indirectly. This discussion should include consideration of the relationship between the objectives and the priorities established in the Operational Programme, the National Strategic Reference Framework and consistency with the goals of the EU Funds. This discussion will help the Commission Services to evaluate the rationale and policy coherence of the proposed project.

✓ *The clear identification of the project*

Identification means that the object is a self-sufficient unit of analysis, i.e. no essential feature or component is left out of the scope of the appraisal (half a bridge is not a bridge); indirect and network effects are going to be adequately covered (e.g. changes in urban patterns, changes in the use of other transport modes) and whose costs and benefits are going to be considered ('who has standing'?).

✓ *The study of the feasibility of the project and of alternative options*

A typical feasibility analysis should ascertain that the local context is favourable to the project (e.g. there are no physical, social or institutional binding constraints), the demand for services in the future will be adequate (long run forecasts), appropriate technology is available, the utilisation rate of the infrastructure or the plant will not reveal excessive spare capacity, personnel skills and management will be available, justification of the project design (scale, location, etc.) against alternative scenarios ('business as usual', 'do-minimum', 'do-something' and 'do-something else').

✓ *Financial Analysis*

This should be based on the discounted cash flow approach. The EC suggests a benchmark real financial discount rate of 5%. A system of accounting tables should show cash inflows and outflows related to:

- total investment costs;
- total operating costs and revenues;
- financial return on the investment costs: FNPV(C) and FRR(C);
- sources of finance;
- financial sustainability;
- financial return on national capital: FNPV(K) and FRR(K);
- the latter takes into account the impact of the EU grant on the national (public and private) investors. The time horizon must be consistent with the economic life of the main assets. The appropriate residual value must be included in the accounts in the end year. General inflation and relative price changes must be treated in a consistent way. In principle, FRR(C) can be very low or negative for public sector projects, but FRR(K) for private investors or PPPs should normally be positive.

✓ *Economic Analysis*

CBA requires an investigation of a project's net impact on economic welfare. This is done in five steps:

- observed prices or public tariffs are converted into shadow prices, that better reflect the social opportunity cost of the good;
- externalities are taken into account and given a monetary value;
- indirect effects are included if relevant (i.e. not already captured by shadow prices);
- costs and benefits are discounted with a real social discount rate (suggested SDR benchmark values: 5.5% for Cohesion and IPA countries, and for convergence regions elsewhere with high growth outlook; 3.5% for Competitiveness regions);
- calculation of economic performance indicators: economic net present value (ENPV), economic rate of return (ERR) and the benefit-cost (B/C) ratio.

Critical conversion factors are: the standard conversion factor, particularly for IPA assisted countries; sector conversion factors (sometimes leading to border prices for specific tradable goods e.g. agricultural products) and marginal costs or willingness-to-pay for non-tradable goods (e.g. waste disposal); the conversion factor for labour cost (depending upon the nature and magnitude of regional unemployment). Practical methods for the calculation of the economic valuation of environmental impacts, the shadow price of time in transport, the value of lives and injuries saved and distributional impacts are suggested in the Guide.

✓ *Risk Assessment*

A project appraisal document must include an assessment of the project risks. Again, five steps are suggested:

- sensitivity analysis (identification of critical variables, elimination of deterministically dependent variables, elasticity analysis, choice of critical variables, scenario analysis);
- assumption of a probability distribution for each critical variable;
- calculation of the distribution of the performance indicator (typically FNPV and ENPV);
- discussion of results and acceptable levels of risk;
- discussion of ways to mitigate risks.

Other Evaluation Approaches

In some circumstances a Cost-Effectiveness Analysis can be useful to compare projects with very similar outputs, but this approach should not be seen as a substitute for CBA. Multi-criteria analysis, i.e. multi-objective analysis, can be helpful when some objectives are intractable in other ways and should be seen as a complement to CBA when, for some reason(s), the project does not show an adequate ERR, but the applicant still wants to make a case for EU assistance. This is to be regarded as an exceptional step, because CBA is a specific requirement of the Funds' regulations. In fact, focusing on CBA is consistent with the overarching goal of Cohesion Policy in terms of sustainable growth; a goal that includes competitiveness and environmental considerations at the same time. For mega-projects (relative to the country, no threshold can be given) economic impact analysis can be considered as a complement to CBA, in order to capture macroeconomic effects which are not well represented by the estimated shadow prices.

7. Contents

The structure of the Guide is as follows:

- chapter one provides a reminder of the legal base for the major project and co-financing decisions by the Commission, highlighting the main developments from the period 2000-2006;
- chapter two illustrates the standard methodology for carrying out the six steps for a CBA, especially the financial analysis, economic analysis and calculation of performance indicators;
- chapter three provides five case studies in the transport, environment and industry sectors;
- chapter four includes outlines of project analysis by sector: focusing principally on the transport, environment and industry sectors.

There are then the following ten Annexes:

- annex A: demand analysis
- annex B: discount rates
- annex C: project performance indicators
- annex D: shadow wage
- annex E: affordability
- annex F: evaluation of health & environmental impacts
- annex G: evaluation of PPP projects
- annex H: risk assessment
- annex I: determination of EU grant
- annex J: table of contents for a feasibility study.

The text is completed by a Glossary and a Bibliography.

8. Dissemination

This Guide is available in English only. Translation in other languages, reproduction in any form, long citations of part of the text are all possible provided that the source is duly acknowledged.

9. Advice

The Commission Services and the CBA Guide Team will be pleased to receive comments and to answer questions. For further information see URL: http://ec.europa.eu/regional_policy/.

CHAPTER ONE
PROJECT APPRAISAL IN THE FRAMEWORK OF THE EU FUNDS

Overview

This chapter focuses on the legal basis for the cost-benefit analysis (CBA) of major infrastructure projects in the framework of EU cohesion policy. The overarching goal of this policy is to reduce regional disparities and foster competitiveness and, in this context, major investment projects are of paramount importance within the overall strategy.

Starting from the Structural and Cohesion Fund together with the IPA Regulations, the chapter focuses on the regulatory requirements for the project appraisal process and the related co-financing decision and rationale for a CBA in this framework. It describes how the EU regulations and other EC documents define the formal requirements and scope of a CBA in the prior appraisal of investment projects and in the decision on co-financing by the EU Commission. Methodological aspects are discussed in Chapter 2, while the focus here is on the evaluation and decision process.

The key contents of the present chapter are:

- CBA scope and objectives in the context of EU Cohesion Policy;
- project definition for the appraisal process;
- information required for the ex-ante evaluation;
- responsibility for the prior appraisal.

The main message of the chapter is that the economic logic of methodology and analysis should be consistent and homogeneous for informed decision-making at all levels of government in the EU.

FOCUS: THE LEGAL BASIS FOR THE APPRAISAL OF MAJOR PROJECTS
- COUNCIL REGULATION (EC) 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 (EC) No 1260/1999 - Article 37, 39, 40, 41, 55. - Corrigendum to COMMISSION REGULATION (EC) No 1828/2006 of 8 December 2006 setting out rules for the implementation of Council Regulation (EC) No 1083/2006 laying down general provisions on the European Regional Development Fund, the European Social Fund and the Cohesion Fund and of Regulation (EC) No 1080/2006 of the European Parliament and of the Council on the European Regional Development Fund – Annex XX (Major Project Structured data to be encoded); Annex XXI (Application form for infrastructure investment); Annex XXII (Application form for productive investment). - COMMISSION REGULATION (EC) No 718/2007 of 12 June 2007 implementing Council Regulation (EC) No 1085/2006 establishing an instrument for pre-accession assistance (IPA) – Article 157. - European Commission, Guidance on the methodology for carrying out Cost-benefit analysis. Working document No 4.

1.1 CBA scope and objectives

This Guide refers to investment projects under the Structural (ERDF Regulation 1080/2006), Cohesion (CF Regulation 1084/2006) and IPA Funds (Regulation 1085/2006 and Implementing Regulation 718/2007) for major projects. According to these regulations both infrastructural and productive investments may be financed by the Community's financial instruments: mainly grants (ERDF, CF and IPA), loans and other financial tools (European Investment Bank, European Investment Fund).

EU Cohesion Policy can finance a wide variety of projects, from the point of view of both the sector involved and the financial size of the investment. While the CF mainly finances projects in the transport and environment sectors, the ERDF and IPA may also finance projects in the energy, industrial and service sectors.

In this framework, CBA provides support for informed judgement and decision making. Article 40(e) of Regulation 1083/2006 states that the managing authorities are required to provide a CBA for major projects to be financed under their Operational Programmes for cohesion policy. This makes CBA an input, amongst others, for decision making on major project co-financing by the EU. CBA, i.e. financial and economic project appraisal, including risk assessment, may be complemented by other studies, for example cost-effectiveness and multi-criteria analyses (par. 2.7.1-2), if the project is likely to have important non-monetary effects, or economic impact analysis, in the case of significant macroeconomic effects (par. 2.7.3).

Investment projects, co-financed by the Structural Funds, the Cohesion Fund and the IPA constitute implementation tools for EU Cohesion Policy and pre-accession. By means of a CBA the welfare contribution of a project to a region or a country can be measured and, in so doing, the contribution of an investment project to EU cohesion policy objectives can be assessed. For this reason, besides regulatory requirements for major projects, the Member States may also need to use CBA for projects with investment costs below the threshold mentioned in the EU regulations. In fact, most public administrations in the Member States or in the candidate countries provide further specific guidance to project promoters.

For the same reason it is also necessary to carry out a CBA for major projects implemented under CF and ERDF in order to meet the *acquis* standards. In this case, it is important to clearly assess whether the benefits of the specific option chosen to comply with the requirements outweigh its costs.

1.2 Definition of projects

In the General Regulation for the Structural and Cohesion Funds, major projects are defined as those with a total cost exceeding €25 million in the case of the environment and €50 million in the case of all the other sectors (Article 39 Regulation 1083/2006). This financial threshold is €10 million for IPA projects (Article 157(2) Regulation 718/2007). The following types of investments can constitute a 'major project':

- a project, that is an economically indivisible series of tasks related to a specific technical function and with identifiable objectives;
- a group of projects, that indicatively:
    - are located in the same area or along the same transport corridor
    - achieve a common measurable goal;
    - belong to a general plan for that area or corridor
    - are supervised by the same agency that is responsible for co-ordination and monitoring;
- a project phase that is technically and financially independent and has its own effectiveness.

In particular, the application forms for EU assistance (see section B.4.1 of application form for ERDF and CF; section B.5.1 for IPA) explicitly require that justification for the division of the project into stages and evidence of their technical and financial independence is provided.

A project phase can be considered as a major project, especially in the case where the construction phase for which the assistance of the Funds is requested cannot be regarded as being operational in its own right[2]. This is the case, for example, for an operation expected to be longer than the programming period, so the co-financing request for the period 2007-2013 is only for a phase of the entire operation (Article 40(d) 1083/2006).

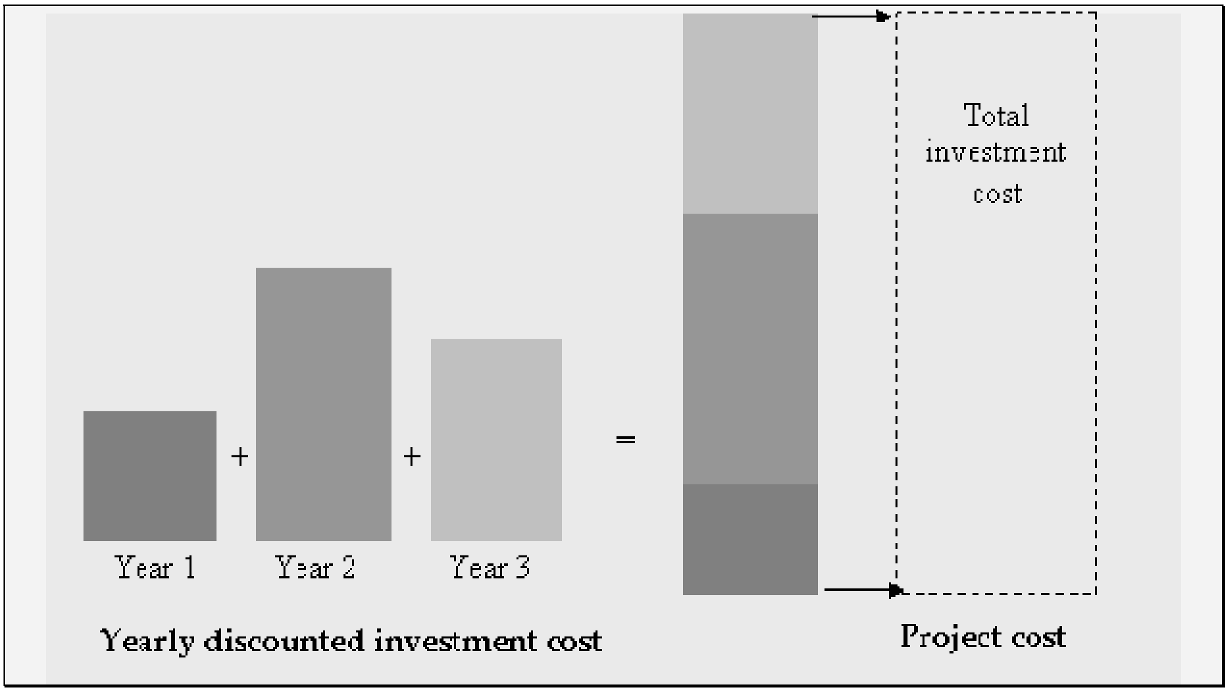
'Operational' in this context means that the infrastructure is functionally complete and is being used, even if the full design capacity of the facility cannot be exploited because of restrictions linked to incomplete subsequent phases.

[2] European Commission, Working document No 4.

Some specifications for financial thresholds are as follows:

- the key economic variable is the total cost of the investment. To evaluate that figure one must not consider the sources of financing (for example only public financing or only Community co-financing), but the sum of all the expenditures planned to acquire or build the fixed capital good and related lump-sum costs for some intangible assets;
- if one assumes that the investment costs will be spread over a number of years, then one must consider the sum of all the annual costs;

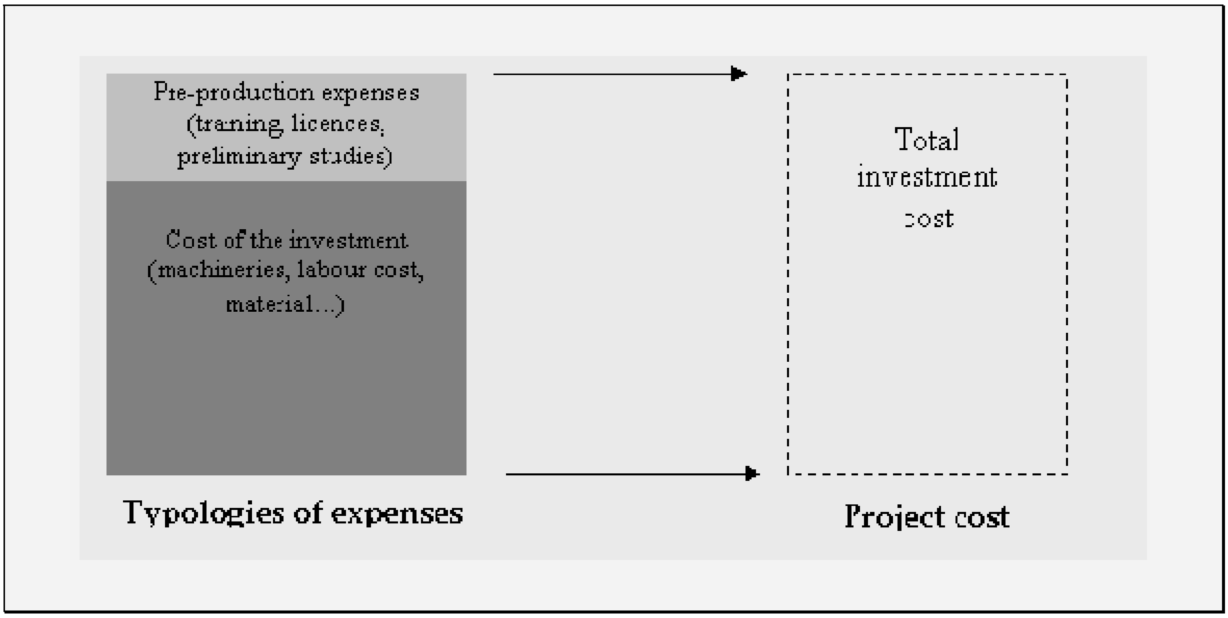
Figure 1.1 Project cost spread over the years



Source: Authors

- while one needs to consider the cost of the investment, without the running costs, it is also advisable to include any one-off expenses incurred in the start-up phases in the calculation of the total cost, such as hiring and training expenses, licences, preliminary studies, planning and other technical studies, price revision, appropriation of operating capital, etc. In the case of a project phase:
  - ♦ if the project phase is only a preparatory phase (i.e. technical studies, procurement preparation etc.) only the estimated total cost of preparatory expenses should be considered as the total investment costs;
  - ♦ if the project phase is the preparatory phase and the construction, that would be operational in its own right, the total investment cost is the sum of the two categories of expenditures;
  - ♦ if the project phase is the preparatory phase and the construction, that would not be operational in its own right, the total investment cost is the sum of the preparatory expenses and the construction phase necessary to make the project operational, whether or not co-financed in the 2007-2013 period;
- sometimes the relationships among different smaller projects are such that it is better to consider them as one large project (for example, five stretches of the same motorway, each costing €11 million, can be considered one large project of €55 million).

Figure 1.2 The project investment cost includes any one-off pre-production expenses



Source: Authors

1.3 Information required

Community regulations indicate which information must be contained in the project dossier submitted to the Commission. Article 40 of Regulation 1083/2006 stipulates its own rules for the submission of the request for co-financing of major projects. It asks for results of a feasibility study, a cost-benefit analysis, a risk assessment, an evaluation of the environmental impact[3], a justification for public contribution and a financing plan showing the total planned financial resources and contributions from the Funds and other Community sources of funding (see Focus for details). Similar information requirements apply to IPA projects.

For the formal request for contribution to the Commission, the Managing Authority should submit a standard application form (see Annexes XXI and XXII of the Implementing Regulation) which provides a detailed description of the specific information needed for each section of the feasibility, cost-benefit, environmental impact and risk analyses.

Furthermore structured data provided in the application forms will also be encoded, according to the rules for the electronic exchange of data (see Article 39-42 of the Implementing Regulation and its Annex XX).

A major project is formally notified only after the application form and the structured encoded data are submitted to the Commission.

Reading this Guide will help project proposers to better understand what information is required by the different decision-makers, and eventually by the Commission, in order to evaluate the socio-economic benefits and costs; how to consider the environmental costs and benefits; how to weigh the direct and indirect effects on employment; how to evaluate the economic and financial profitability, etc. In fact, there are different ways to respond to these requests for information: Chapter 2 stresses some fundamental questions, methods and criteria.

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3 In particular the effect on the Nature 2000 sites, and the ones protected under the 'Habitats' Directive (92/43/EEC) and the 'Birds' Directive (79/409/EEC), the polluter-pays principle and compliance with the Economic Impact Analysis and SEA directives.

FOCUS: INFORMATION REQUIRED
General Regulation (Article 40 Reg 1083/2006): The Member State or the managing authority shall provide the Commission with the following information on major projects: (a) information on the body to be responsible for implementation; (b) information on the nature of the investment and a description of it, its financial volume and location; (c) the results of the feasibility studies; (d) a timetable for implementing the project and, where the implementation period for the operation concerned is expected to be longer than the programming period, the phases for which Community co-financing is requested during the 2007 to 2013 programming period; (e) a cost-benefit analysis, including a risk assessment and the foreseeable impact on the sector concerned and on the socio-economic situation of the Member State and/or the region and, when possible and where appropriate, of other regions of the Community; (f) an analysis of the environmental impact; (g) a justification for the public contribution; (h) the financing plan showing the total planned financial resources and the planned contribution from the Funds, the EIB, the EIF and all other sources of Community financing, including the indicative annual plan of the financial contribution from the ERDF or the Cohesion Fund for the major project. IPA Implementing Regulation (Article 157 Reg. 718/2007): When submitting a major project to the Commission, the operating structure shall provide the following information: (a) information on the body to be responsible for implementation; (b) information on the nature of the investment and a description of its financial volume and location; (c) results of feasibility studies; (d) a timetable for the implementation of the project before the closure of the related operational programme; (e) an assessment of the overall socio-economic balance of the operation, based on a cost-benefit analysis and including a risk assessment, and an assessment of the expected impact on the sector concerned, on the socio-economic situation of the beneficiary country and, where the operation involves the transfer of activities from a region in a Member State, the socio-economic impact on that region; (f) an analysis of the environmental impact; (g) the financing plan, showing the total financial contributions expected and the planned contribution under the IPA Regulation, as well as other Community and other external funding. The financing plan shall substantiate the required IPA grant contribution through a financial viability analysis. Implementing Regulation-Corrigendum (Article 40 Reg. 1828/2006): The computer system for data exchange shall contain information of common interest to the Commission and the Member States, and at least the following data necessary for financial transactions: (…) e) the requests for assistance for major projects referred to in Articles 39, 40 and 41 of Regulation (EC) No 1083/2006, in accordance with Annexes XXI and XXII to this Regulation, together with selected data from those Annexes identified in Annex XX.

1.4 Responsibility for project appraisal

According to Regulation 1083/2006, Article 40, the Member State, or the managing authority of the Operational Programme under which the major project is submitted, has the responsibility to provide the Commission with the information needed for project appraisal.

FOCUS: THE INCLUSION OF MAJOR PROJECTS IN AN OPERATIONAL PROGRAMME
General Regulation (Article 37(1) 1083/2006): Operational programmes relating to the Convergence and Regional competitiveness and employment objectives shall contain: (…) h) an indicative list of major projects within the meaning of Article 39, which are expected to be submitted within the programming period for Commission approval. Implementing Regulation (Annex XVIII 1828/2006), Annual and Final reporting (contents): - ERDF/CF Programmes: Major Projects (if applicable); - progress in the implementation of major projects; - progress in the financing of the major projects; - any change in the indicative list of major projects in the operational programme. IPA Implementing Regulation: (Article 155 (2) Regulation 718/2007): Operational programmes shall contain: (…) j) for the regional development component, an indicative list of major projects, accompanied with their technical and financial features, including the expected financing sources, as well as indicative timetables for their implementation.

In this framework (according to Article 41), the Commission is responsible for the appraisal of major projects on the basis of information provided by the proposer. A project examiner will consider the list of regulatory requirements as a general indication of the minimum information needed. The major project will be appraised in the light of the factors listed in Article 40, its contribution towards achieving the goals of those priorities, and its consistency with other Community policies.

During this process the Commission may ask for integration of information if the application is incomplete, inconsistent or not of a sufficient quality. In doing so, the Commission can consult outside experts, including the EIB, if necessary. The EIB is also involved in the JASPERS initiative (see Focus below).

FOCUS: APPRAISAL BY THE COMMISSION
General Regulation Article 41 Regulation 1083/2006: The Commission shall appraise the major project, if necessary consulting outside experts, including the EIB, in the light of the factors referred to in Article 40, its consistency with the priorities of the operational programme, its contribution to achieving the goals of those priorities and its consistency with other Community policies. Article 36(3) Regulation 1083/2006: 3) The Commission may consult the EIB and the EIF before adoption of the decision referred to in Article 28(3) and of the operational programmes. That consultation shall relate in particular to operational programmes containing an indicative list of major projects or programmes which, by the nature of their priorities, are suitable for mobilising loans or other types of market-based financing. 4) The Commission may, if it considers it appropriate for the appraisal of major projects, request the EIB to examine the technical quality and economic and financial viability of the projects concerned, in particular as regards the financial engineering instruments to be implemented or developed. 5) The Commission, in implementing the provisions of this Article, may award a grant to the EIB or the EIF.

FOCUS: THE JASPERS INITIATIVE
JASPERS (Joint Assistance to Support Projects in European Regions) is a joint initiative of the EIB, the European Commission (Regional Policy Directorate-General - DG Regio) and the European Bank for Reconstruction and Development (EBRD). It is a technical assistance partnership, aimed at assisting the EU Member States covered by the Convergence Objective in preparing the high-quality major infrastructure projects to be submitted for co-financing under the Structural and Cohesion Funds. The assistance provided by JASPERS may cover any preparatory work needed to prepare an application for funds. JASPERS operates on the basis of a Country Actions Plan, prepared in partnership with the Beneficiary State and the geographical desk in DG REGIO. The completed project form must indicate the inputs of JASPERS to the national preparation and appraisal team of the project. Major projects application forms shall indicate if the project has received assistance from JASPERS and report the overall conclusions and recommendations of the JASPERS contribution. For further details see URL: http://www.jaspers.europa.eu/

The Commission's decisions concerning co-financed projects will be based on an in-depth evaluation. When the evaluation presented by the candidate is insufficient or not convincing, the Commission may ask for a revision or a more thorough elaboration of the analysis; alternatively, it may conduct its own appraisal, if necessary, availing itself of an independent evaluation. Member States often have structures and internal procedures for evaluating projects of a certain size, but sometimes difficulties may emerge in carrying out a quality evaluation. In any case, the final decision will be the result of a dialogue with the proposer, in order to obtain the best results from the investment.

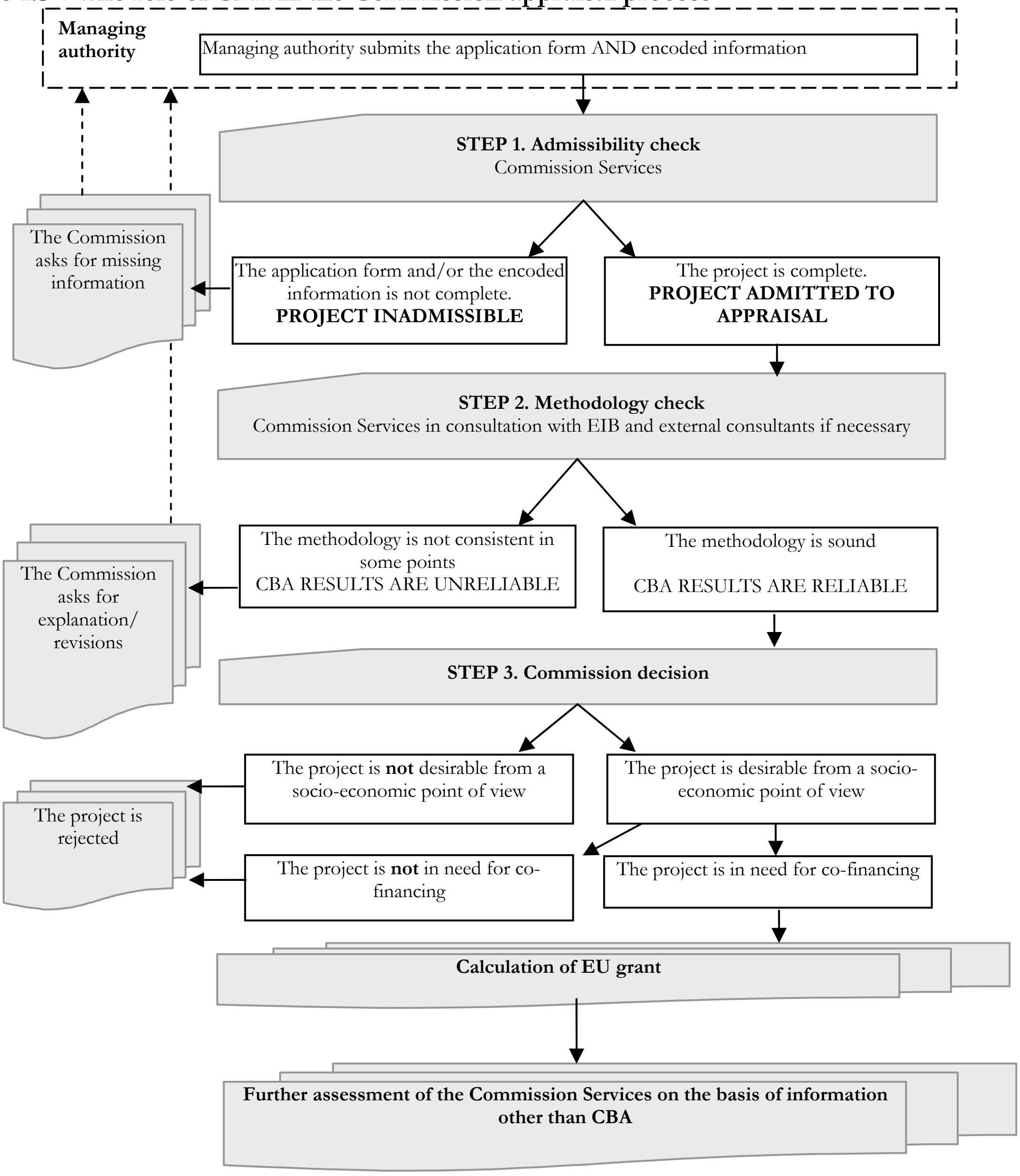
To sum up, the economic appraisal of projects by the Commission (which is just one of the aspects of the whole decision process) is based on a three-step approach. The aim of this approach is to check whether:

- the project appraisal dossier is complete. This means that all the necessary information should be available. If this is not the case the project will not be admissible;
- the analysis is of a good quality. This means that the analysis is sound in terms of coherence of the CBA with the Commission's methodology and the national CBA guidelines (where available). The working hypotheses made for the forecasts are realistic and the methods used for the calculation of the main performance indicators are correct;
- the results provide a basis for a co-financing decision.

In particular, CBA results should provide evidence that the project is[4]:

- desirable from a socio-economic point of view. This is demonstrated by the result of the economic analysis and particularly by a positive economic net present value being positive;
- consistent with the operational programme and other Community policies. This is achieved by checking that the output produced by the project contributes to the attainment of the programme and policy goals (see Chapter 2 for further details);
- in need for co-financing. More specifically, the financial analysis should demonstrate the existence of a funding gap (negative financial net present value) and the need for Community assistance in order to make the project financially viable. Alternatively (see the application form, section G, *Justification for the public contribution*), any possible involvement of State-aid rules should be declared.

Figure 1.3 The role of CBA in the Commission appraisal process



4 See also European Commission, Working Document No 4, page 5.

1.5 Decision by the Commission

After its appraisal the Commission will make its decision. This is required to define:

- the physical object;
- the amount of eligible expenditure to which the co-financing rate of the priority applies;
- the annual plan for financial contributions from the ERDF of the Cohesion Fund.

FOCUS: DECISION BY THE COMMISSION
General Regulation Article 41(2, 3) 1083/2006: 2) The Commission shall adopt a decision as soon as possible but no later than three months after the submission by the Member State or the managing authority of a major project, provided that the submission is in accordance with Article 40. That decision shall define the physical object, the amount to which the co-financing rate for the priority axis applies, and the annual plan of financial contribution from the ERDF or the Cohesion Fund. 3) Where the Commission refuses to make a financial contribution from the Funds to a major project, it shall notify the Member State of its reasons within the period and the related conditions laid down in paragraph 2.

Concerning the first point, a suitable description of the 'physical object' should be provided. As regards the co-financing rate, the one fixed at the priority axis level under which the major project is submitted should be considered.

FOCUS: THE CO-FINANCING RATE
General Regulation (Article 53 1083/2006): 2. The contribution from the Funds at the level of operational programmes under the Convergence and Regional competitiveness and employment objectives shall be subject to the ceilings set out in Annex III. 31.7.2006 L 210/51 Official Journal of the European Union EN. 3. For operational programmes under the European territorial cooperation objective in which at least one participant belongs to a Member State whose average GDP per capita for the period 2001 to 2003 was below 85% of the EU-25 average during the same period, the contribution from the ERDF shall not be higher than 85% of the eligible expenditure. For all other operational programmes, the contribution from the ERDF shall not be higher than 75% of the eligible expenditure co-financed by the ERDF. 4. The contribution from the Funds at the priority axis level shall not be subject to the ceilings set out in paragraph 3 and in Annex III. However, it shall be fixed so as to ensure compliance with the maximum amount of contribution from the Funds and the maximum contribution rate per Fund fixed at the level of the operational programme. 5. For operational programmes co-financed jointly: (a) by the ERDF and the Cohesion Fund; or (b) by the additional allocation for the outermost regions provided for in Annex II, the ERDF and/or the Cohesion Fund, the decision adopting the Operational Programme shall fix the maximum rate and the maximum amount of the contribution for each Fund and allocation separately. 6. The Commission's decision adopting an operational programme shall fix the maximum rate and the maximum amount of the contribution from the Fund for each operational programme and for each priority axis. The decision shall show separately the appropriations for regions receiving transitional support.

As regards the eligible expenditure, in the case of revenue-generating projects which are not subject to State Aid rules (Article 55 Regulation 1083/2006), the current value of the net revenue from the investment must be deducted from the current value of the investment in order to calculate the eligible expenditure (see box below).

FOCUS: REVENUE-GENERATING PROJECTS
General Regulation (Article 55 1083/2006). Eligible expenditure on revenue-generating projects shall not exceed the current value of the investment cost less the current value of the net revenue from the investment over a specific reference period for: (a) investments in infrastructure; or (b) other projects where it is possible to objectively estimate the revenues in advance. Where not all the investment cost is eligible for co-financing, the net revenue shall be allocated pro rata to the eligible and non-eligible parts of the investment cost. In the calculation, the managing authority shall take account of the reference period appropriate to the category of investment concerned, the category of project, the profitability normally expected of the category of investment concerned, the application of the polluter-pays principle, and, if appropriate, considerations of equity linked to the relative prosperity of the Member State concerned. EC Working Document No 4: in contrast to the 2000-2006 period, the eligible expenditure and not the co-financing rate is modulated in order to relate the contribution from the Funds to the revenues generated by the project. (…) It should be noted that Article 55 applies to all projects and not just to major projects. (…) Article 55 applies to investment operations which generate net revenues through charges borne directly by users. It does not apply to the following cases: - Projects that do not generate revenues (e.g. roads without tolls); - Projects whose revenues do not fully cover the operating costs (e.g. some railways); - Projects subject to State-aid rules – Article 55(6).

CHAPTER TWO
AN AGENDA FOR THE PROJECT EXAMINER

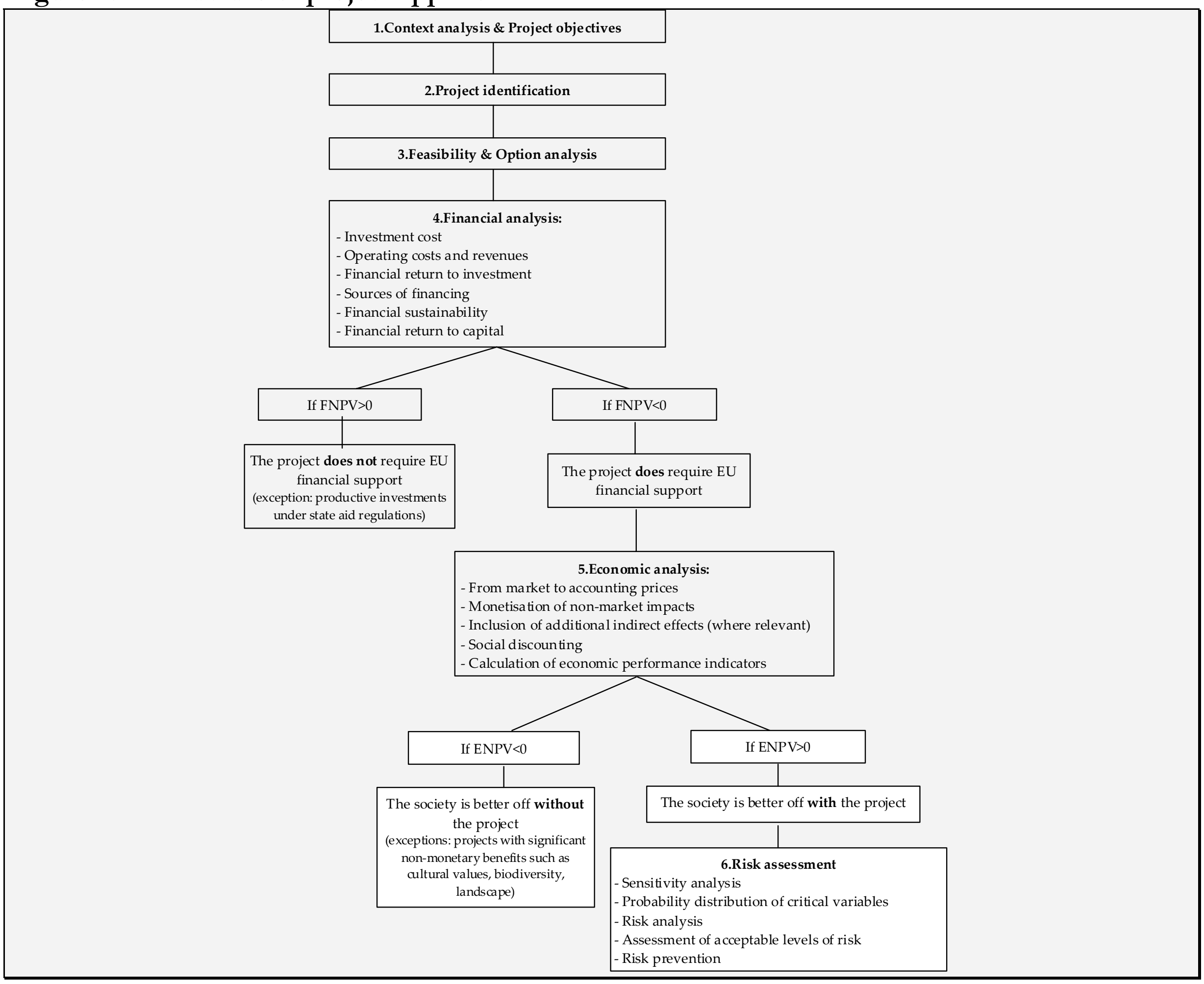
Overview

This chapter reviews the key information and analytical steps that a project examiner should consider for investment appraisal under the EU (Structural, Cohesion, IPA) Funds. It is structured as a suggested agenda and check-list for the Member States and Commission officials or for the external consultants who are involved in assessing or preparing a project dossier.

The agenda proposed for project appraisal is structured in six steps (Figure 2.1). Some of these steps are preliminary but necessary requirements for cost-benefit analysis.

- Context analysis and project objectives
- Project identification
- Feasibility and option analyses
- Financial analysis
- Economic analysis
- Risk assessment

Figure 2.1 Structure of project appraisal



Each section below will take on a strictly operational perspective and each issue will be reviewed both from the standpoint of the investment proposer and from that of the project examiner for the co-financing decision.

The chapter briefly mentions other evaluation approaches, such as cost-effectiveness analysis, multi-criteria analysis and economic impact assessment. These are to be seen as complements to CBA, not as substitutes.

2.1 Context analysis and project objectives

2.1.1 Socio-economic context

The first step of the project appraisal aims to understand the social, economic and institutional context in which the project will be implemented. In fact, the possibility of achieving credible forecasts of benefits and costs often relies on the accuracy in the assessment of the macro-economic and social conditions of the region. In this regard, an obvious recommendation is to check that the assumptions made, for instance on GDP or demographic growth, are consistent with data provided in the corresponding Operational Programme.

An in-depth analysis of the socio-economic context is also instrumental for carrying out the demand analysis, which consists of the demand forecast for the goods/services the project will generate. The forecast for demand is a key indicator for the estimation of the future revenues, if any, of the project and consequently its financial performance (for a more detailed discussion on demand analysis, see Annex A). The forecast demand is crucial for non-revenue generating projects as well and, in general, the economic performance of a project depends upon the features and dynamics of its regional environment.

Particular attention should be paid at this stage to identifying whether the project under consideration belongs to networks at national or international level. This is particularly the case for transport and energy infrastructures, which may consist of interdependent projects. When projects belong to networks, their demand, and consequently their financial and economic performance, is highly influenced by issues of mutual dependency (projects might compete with each other or be complementary) and accessibility (possibility of reaching the facility easily). Thus, the boundaries of the relevant context of the analysis, e.g. local, national or trans-national, should be identified on a case-by-case basis.

2.1.2 Definition of project objectives

A clear statement of the project's objectives is an essential step in order to understand if the investment has social value. The broad question any investment appraisal should answer is 'what are the net benefits that can be attained by the project in its socio-economic environment?'

The benefits considered should not be just physical indicators (km of roads) but socio-economic variables that are quantitatively measurable. The project objectives should be logically connected to the investment and consistent with the policy or programme priorities.

While a clear statement of the socio-economic objectives is necessary to forecast the impact of the project, it may often be difficult to predict all the impacts of a given project. Welfare changes have a number of components and there may be data constraints. For example, regional data do not usually allow us to make reliable estimates of the overall impact of individual projects on trade with other regions; indirect employment effects are difficult to quantify; competitiveness may depend on foreign trade conditions, exchange rates, changes in relative prices. For many of these macroeconomic variables it may be too expensive to conduct project-specific analysis.

The approach of the present Guide is to focus on social cost-benefit analysis. CBA aims to structure the expectations of the project promoter in a rigorous way. It cannot answer all questions about future impacts, but it focuses on a set of microeconomic variables as a shortcut to estimate the overall economic impact of the project. The key indicator for the net socio-economic benefit of the project is simply its economic net present value, as described below. The impacts on employment, the environment, and other objectives, are, as far as possible, captured by just one performance indicator, provided that the CBA is based on a sound methodology. This shortcut approach should not serve as a substitute, however, for the need to spell out clearly the project rationale in terms of socio-economic objectives and for additional analyses if needed (e.g. environmental impact analysis).

The broad purpose of CBA is to facilitate a more efficient allocation of resources, demonstrating the convenience for society of a particular project or programme against the alternatives. CBA is not suitable for appraising the macroeconomic impact of a project on, for example, regional GDP growth or trends in unemployment. Some macroeconomic estimates are however useful within the framework of CBA because, as mentioned above, the forecasts (e.g. of demand) on which the analysis is built should be consistent with the assumptions made about the socio-economic context.

2.1.3 Consistency with EU and National Frameworks

The appraisal of a major project should be seen as part of a larger planning exercise and its consistency within this framework should be assessed.

The project promoter should show how the project, if successful, will contribute to the broad objectives of the EU regional and cohesion policies. From the Commission's perspective, it is indeed important to check that the project is logically related to the main objectives of the funds involved: ERDF, CF and IPA (see Chapter 1). The project promoter should show that the assistance proposed is coherent with these objectives, while the examiner should ascertain that this coherence actually exists and that it is well justified.

In addition to the general objectives of the individual funds, the project must be coherent with EU legislation in the specific sector of assistance (mainly transport and environment) and more generally with Community legislation (e.g. public procurement, competition and State-aid).

This preliminary analysis of the objectives and context is important since it places the project appraisal activity within the more comprehensive framework of the multi-level governance planning exercise of Cohesion Policy. A more strategic approach characterises the new EU programming period. According to this approach, the rationale of each intervention should always be assessed, with reference to the consistency of objectives with the key priorities of the Operational Programmes (OPs), formulated at the national or regional level, and with the overarching strategy defined by the Community strategic guidelines for cohesion and the National Strategic Reference Frameworks (NSRF).

Whenever possible, the relationship between the project objectives and the indicators used to quantify the specific targets of the operational programmes should be clearly identified. Such identification will allow linkage of the project objectives with the monitoring and evaluation system at programme level. This is particularly important for reporting the progress of major projects in the annual implementation reports, as requested by Article 67(g) Regulation 1083/2006.

2.2 Project identification

Section 1.2 has presented the legal basis for the definition of a project. Here we develop some analytical issues involved in project identification.

In the context of the EU Funds, managing authorities can request assistance for specific phases of a project due to technical, administrative or financial constraints and thus it is important to define the scope of CBA. In particular, a project is clearly identified when:

- the object is a self-sufficient unit of analysis ('half a bridge' is not a project);
- indirect and network effects are taken into account adequately;
- a proper social perspective has been adopted in terms of relevant stakeholders considered ('who has standing?').

2.2.1 What is a project?

A project can be defined as an operation comprising a series of works, activities or services intended to accomplish an indivisible task of a precise economic or technical nature; one which has well defined goals. The appraisal needs to focus on the whole project as a self-sufficient unit of analysis and not on fragments or sections of it. Partitions of projects for purely administrative reasons are not appropriate objects of appraisal.

This may, in some cases, entail requesting the promoter to consider a set of sub-projects as in fact one large project. This might be the case with a request for EU financial support for some initial phases of an investment, whose success hinges on the completion of the project as a whole. Thus, the whole project should be considered. CBA requires going beyond the purely administrative definitions. For instance, to assess the quality of a given project, the promoter must produce an adequate appraisal, not only for the part of the project to be financed with the assistance of EU Funds, but for the parts that are closely connected to it as well and possibly financed in other ways. In other words, a consolidated CBA may be necessary in order to understand the net benefits of one section of a project.

Sometimes a project application consists of several inter-related but relatively self-standing components. For example, for a project comprising hydroelectric power, irrigation water and recreational facilities, if benefits and costs of each component are independent, then the components are separable and can be treated as independent projects. Appraising such a project involves, firstly, the consideration of each component independently and, secondly, the assessment of possible combinations of components.

When there are different feasible options for a section of a project, simplified CBA for each option may help to test their impact on the whole project (see par. 2.3.3). As an example, a project may consist of the completion of a trans-national electricity link under the TEN–E. Here, the economic appraisal should focus not on the entire link, but only on the project's section where different options are available.

The promoter should justify the project identification choice and the examiner has the task of judging the quality of this choice. In the event that the object of analysis is not clearly identified, the examiner may request that the promoter integrates the presentation dossier with a clarification of its identification ('where is the other half of the bridge?').

EXAMPLE: IDENTIFICATION OF A PROJECT
A highway project connecting town A with town B, which is justified only by the expectation that an airport will be located in the vicinity of town B and that most of the traffic will take place between the airport and town A: the project should be analysed in the context of the airport-highway system as a whole. A hydroelectric power station, located in X and supposed to serve a new energy-intensive plant in Y: again, if the two works are mutually dependent for the assessment of costs and benefits, the analysis should be integrated, even if the EU assistance is requested only for the energy supply part of the project. A large-scale productive forestation project, financed with public funds and justified by the opportunity of supplying a privately owned cellulose company: the analysis should consider costs and benefits of both components, which is to say the forestation project and the industrial plant.

2.2.2 Indirect and network effects

After having identified the project, the boundaries of the analysis should be defined. The project has a direct impact on users, workers, investors, suppliers, etc. but also indirect impacts on third parties. The risk of double counting project benefits should be carefully considered.

In general, indirect impacts in secondary markets should not be included in the economic appraisal, whenever an appropriate shadow price (see Glossary and section 2.5) has been given for the benefits and costs. For instance, the impact of a highway on the local tourism sector, e.g. through the additional employment or additional added value should not be included in the CBA when an appropriate shadow wage has been used, as will be discussed further (see par. 2.5.3). As a general rule, market effects (quantity or price changes) in undistorted secondary markets should be ignored, assuming that the appraisal has considered the appropriate shadow prices in the primary markets. Sometimes this is difficult, particularly in transport, and some secondary markets should be considered, albeit with caution to avoid double counting of effects (see Focus, below).

As regards network effects (e.g. diverted road traffic in a transport project), these should be included in the CBA through an appropriate forecasting model. For instance, in the case of a High Speed Rail link project, the diverted traffic from the conventional rail transport should be considered through a consistent traffic demand model. This specific issue will be further discussed in the transport case studies in Chapter 4.

Positive and negative externalities (e.g. environmental project externalities) should, as far as possible, always be accounted for in the cost-benefit analysis. As externalities are not captured by the financial analysis, these need to be estimated and valued in the economic analysis (see par. 2.5.2).

FOCUS: DISTINGUISHING DIRECT AND INDIRECT ECONOMIC EFFECTS IN ORDER TO AVOID THE POSSIBILITY OF DOUBLE-COUNTING BENEFITS IN TRANSPORT PROJECTS
Direct effects: effects on behavioural choice within the transport system (route choice, mode choice, departure time choice and destination choice), by users of that part of the network to which the initiative applies (e.g. the number of users of a newly planned road). **Direct network effects**: effects on behavioural choice within the transport system transferred by network flows to other users of the network who are not themselves users of the part of the network to which the initiative applies (e.g. the change in train use in the area where the new road is planned). **Indirect effects**: effects outside the transport market as the result of a transport initiative, typically including changes in output, employment and residential population at particular locations (e.g. households moving to a city because it has better connections to their work due to a new road). **Indirect network effects**: effects on the transport network of choices made in other markets (land and property markets, the labour market, product markets and the capital market), as a result of changes in generalised costs brought about by a transport initiative (e.g. the changed traffic flow within a city due to more households locating in the city because of a new road).

Source: HEATCO, 2004

2.2.3 Who has standing?

In the CBA literature, the issue of 'whose costs and benefits count?' is known as the 'standing' issue, i.e. whose welfare counts in the aggregation of net benefits.

In some cases, the identification of 'who has standing' needs to acknowledge the presence of a number of social stakeholders because costs and benefits may be borne and accrued by larger or smaller categories of economic/social actors depending on the geographical level adopted in the appraisal. For instance, in the case of a high speed train linking two major cities, local communities may be negatively affected by the project's environmental impact, while the benefits may be greater than costs if the national perspective is considered.

As mentioned in section 2.1.1, in general, a decision is required on whether the CBA analysis should be carried out adopting a local, regional, national, EU or global perspective. The appropriate level of analysis should be defined with reference to the size and scope of the project. Although it is not possible to provide a standard grid associating the kind of investment with a pre-defined level of analysis, projects belonging to some sectors frequently have a common scope of effects. For example, transport projects, even if implemented within a regional framework, should be analysed from a broader perspective since they can be considered as being part of an integrated network. The same can be said for an energy plant serving a delimited territory, but belonging to a wider system. A global perspective is recommended for environmental issues related to CO_2 emission, in order to capture the effects on climate change, which are intrinsically non-local. In contrast, water and waste management projects are mostly (but not always) of local interest.

2.3 Feasibility and option analysis

The present section provides an overview of the main features of a good project option selection. This process aims at providing evidence that the project choice can actually be implemented and is the best option of all feasible alternatives.

2.3.1 Option identification

Once the socio-economic context and the potential demand for the project output have been analysed, then the next step consists of identifying the range of options that can ensure the achievement of the objectives of the project.

Typical examples of options are:

- different routes, or different construction timing, or different technologies considered for transport projects;
- large hospital structures rather than a more widespread offer of health services through local clinics;
- the location of a production plant in area A, nearer to the end markets, versus area B, nearer to the suppliers;
- different peak-load arrangements for energy supply;
- energy efficiency improvements rather than (or in addition to) the construction of new power plants.

The basic approach of any investment appraisal aims to compare the situations with and without the project. To select the best option, it is helpful to describe a baseline scenario. This will usually be a forecast of the future without the project, i.e. the 'business as usual' (BAU) forecast.

This is also sometimes labelled the 'do-nothing' scenario, a term that does not mean that operations of an existing service will be stopped, but simply that they will go on without additional capital expenditures. In a nutshell, BAU is a no-investment forecast of what will happen in future in the context under consideration. This scenario is not necessarily non-costly, because for already existing infrastructures, it comprises incurring operational and maintenance costs (as well as cashing the revenues generated, if any).

In some circumstances, it is useful to consider, as a first project option against the 'business as usual' scenario, a 'do-minimum' project. This assumes incurring certain investment outlays, for example for partial modernisation of an existing infrastructure, beyond the current operational and maintenance costs. Hence, this option includes a certain amount of costs for necessary improvements, in order to avoid deterioration or sanctions. In some cases, for example, public investment projects are motivated by the need to comply with new regulations. The 'do-minimum' option here is the least cost project that ensures compliance. This is not always, however, the most beneficial option and in some cases the compliance investment costs can be substantial. In fact, there may be better alternatives (e.g. scrapping the old infrastructure and building elsewhere a new one, or adopting a radical change of approach to service provision, for example shifting from rail to 'sea highways').

After having defined the BAU scenario and the 'do-minimum' option, it is necessary to look for other possible alternative solutions on the basis of technical, regulatory and managerial constraints, and demand opportunities ('do-something' alternatives). One critical risk of distorting the evaluation is to neglect some relevant alternatives, in particular some low-cost solutions (i.e. managerial capacity-building, pricing changes, alternative infrastructure interventions).

In general, when dealing with options, pricing policy is often a decision variable – and will have an impact on the performance of the investment, not least through influencing demand. Thus, the relationship between each option and the assumptions on tariffs, or other prices, should be explored. The combinations of locations, investment expenditures, operating costs, pricing policies, etc., may amount to a large number of feasible alternatives, but usually only some of them are promising and worth detailed appraisal. An experienced project analyst will typically focus on the BAU scenario, the 'do-minimum' option and a small number of 'do-something' options.

2.3.2 Feasibility analysis

Feasibility analysis aims to identify the potential constraints and related solutions with respect to technical, economic, regulatory and managerial aspects. A distinction between binding constraints (e.g. lack of human capital, geographical features) and soft constraints (e.g. specific tariff regulations) may be stressed, because some of the latter can be removed by suitable policy reforms. This aspect underlines the importance and the need for co-ordination between national/regional policies and projects.

A project is feasible when its design meets technical, legal, financial and other constraints relevant to the nation, region or specific site. Feasibility is a general requirement for any project and should be checked carefully. Moreover, as mentioned, several project options may be feasible.

Typical feasibility reports for major infrastructures should include information on:

- demand analysis
- available technology
- the production plan (including the utilisation rate of the infrastructure)
- personnel requirements
- the project's scale, location, physical inputs, timing and implementation, phases of expansion and financial planning
- environmental aspects.

In many cases, the analysis of large projects entails detailed support studies (see Annex J).

FOCUS: DEMAND ANALYSIS AND FEASIBILITY
Demand analysis identifies the need for an investment by assessing: - current demand (by using models and actual data); - forecast demand (from macroeconomic and sector forecasts and elasticity estimates of demand to relevant prices and income). Both quantifications are an essential step in order to formulate an hypothesis concerning the project's induced demand and its productive capacity size. For example, it is necessary to investigate which part of the demand for public services, rail transport, or disposal of waste material will be matched by the project. Such hypotheses should be tested by analysing the conditions of both the present and coming supply that are independent from the project and the technological options available. Often such options cannot be identified along a continuum of factor combinations, but they consist of a relatively small number of alternatives characterised by discontinuity (see Annex A).

2.3.3 Option selection

EU Regulations require the proposer to provide the results of feasibility and option analysis. The main result of such analysis is to identify the most promising option on which detailed CBA should be carried out. Sometimes this selection process is managed as part of the preparation on an operational programme or masterplan.

One possible selection approach, which should perhaps allow for sectoral specificities, could be as follows:

- establish a long list of alternative actions to achieve the intended objectives;
- screen the identified long list against some qualitative criteria (e.g. a set of scores to be established in light of overall policy orientations and/or technical considerations - to be duly justified in the analysis) and establish a short list of suitable alternatives;
- establish option rankings and select preferred options based on their net present values in financial and economic terms.

Once the feasible 'do-minimum' and a small number of 'do-something' alternatives have been identified, simplified CBA should be carried out for each option in order to rank them[5].

[5] In the case of projects whose effects are difficult to be monetised, additional evaluation approaches can be considered, see par. 2.7

A simplified CBA usually implies focusing only on the key financial and economic tables (see below), with rough estimates of the data, because in a differential approach the absolute values of the variables involved are less important than in a fully developed comparison of alternatives.

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 scenario.

Under some exceptional circumstances, the BAU option should be disregarded and the do-minimum scenario used as the reference solution. In fact, in some cases, the BAU (do-nothing) scenario cannot be considered acceptable because it produces 'catastrophic' effects (see example below).

EXAMPLE: CATASTROPHIC DO-NOTHING SCENARIO
It is customary in project appraisal practice to consider at least three options: do-nothing (BAU), do-minimum and do-something. In some cases the first option may produce 'catastrophic' effects so that it has to be neglected and the do-minimum be considered as the baseline scenario. In the case of an outdated healthcare infrastructure, for example a hospital, which can no longer operate without renovation, BAU would mean the interruption of the service, which may be not acceptable to the Government. The baseline scenario should be that of renovating the infrastructure at least in a way to guarantee a minimum service. In practice, the catastrophic do-nothing option leads us to consider the partial reinvestments of the do-minimum option as the technically minimum capital expenditure to maintain the existing service. Again, there may be better do-something solutions, e.g. a new large infrastructure elsewhere, or a network of smaller clinics.

One issue that sometimes arises when considering the expansion or restructuring of existing projects is how to 'apportion' incremental flows between the old and the new capacity. Unfortunately, simple accounting apportionment rules (e.g. the share of 'old' and 'new' revenues are attributed in proportion to 'old' and 'new' capital expenditures) are often misleading. The right approach is always to compare the 'with' and 'without' project scenarios, albeit in a sketchy way. Thus, the incremental revenues or time saving benefits of the third lane in an existing tolled two-lane highway must be related to a forecast of incremental traffic and cannot be assumed to be one third of the future traffic.

In other cases, again for projects consisting of upgrading or extension of a previous infrastructure, an incremental benefit cannot always be quantified in terms of output, because the output does not change at all. In such cases, the incremental benefit should often be appraised as an improvement, for example, in service quality, or as avoided cost, because of service interruptions (e.g. based on willingness-to-pay for quality or continuity of supply of electricity).

EXAMPLE: OPTION ANALYSIS OF THE WATERWAY CROSSING MAGDEBURG PROJECT (GERMANY)
The Waterway Crossing Magdeburg is part of the German midland canal which crosses the centre of Germany from West to East, namely from the Ruhr area to Berlin. It consists of a 918 m. channel bridge above the Elbe river and it is owned and managed by the Federal German Waterway and Navy Agency. During the ex-ante project appraisal, three different do-something alternatives were considered in the options analysis: - one-way bridge (no parallel usage possible – alternative 1), - two-way bridge (bridge can be used in both directions at the same time – alternative 2), - dam alternative (independence of the water level of the river Elbe – alternative 3). The alternatives were analysed with the CBA methodology and were compared with a 'do-minimum' scenario, because some reinvestments on the existing infrastructure would have been necessary even without the implementation of any additional project. All analysed alternatives achieved very good economic results, but the 'one-way bridge' across the river Elbe showed the best Benefit/Cost ratio and was therefore the option implemented.

Source: EVA-TREN

2.4 Financial analysis

The main purpose of the financial analysis is to use the project cash flow forecasts to calculate suitable net return indicators. In this Guide a particular emphasis is placed on two financial indicators: the Financial Net Present Value (FNPV) and the Financial Internal Rate of Return (FRR), respectively in terms of return on the investment cost, FNPV(C) and FRR(C), and return on national capital, FNPV(K) and FRR(K).

The cash inflows and outflows to be considered are described in detail below. The different definitions of net cash flows for the calculation of the project performance indicators used in this Guide (as in the international practice for project appraisal) must not be confused with the 'free cash flow' under other accounting conventions, particularly those used in standard company accounts.

The methodology used in this Guide for the determination of the financial return is the Discounted Cash Flow (DCF) approach. This implies some assumptions:

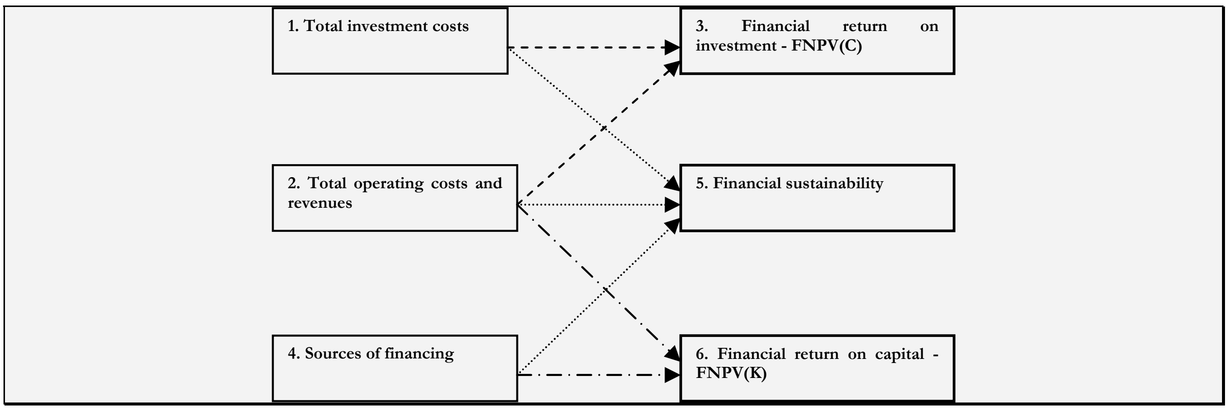
- only cash inflows and outflows are considered (depreciation, reserves and other accounting items which do not correspond to actual flows are disregarded);
- the determination of the project cash flows should be based on the incremental approach, i.e. on the basis of the differences in the costs and benefits between the scenario with the project (do-something alternative) and the counterfactual scenario without the project (BAU scenario) considered in the option analysis (see par. 2.3.1);
- the aggregation of cash flows occurring during different years requires the adoption of an appropriate financial discount rate in order to calculate the present value of the future cash flows (see Focus below).

FOCUS: THE FINANCIAL DISCOUNT RATE
The financial discount rate reflects the opportunity cost of capital, defined as 'the expected return forgone by bypassing other potential investment activities for a given capital' (EC Working document No 4: Guidance on the methodology for carrying out Cost-Benefit Analysis). There are many theoretical and practical ways of estimating the reference rate to use for the discounting of the financial analysis (see Annex B). In this regard, it is helpful to refer to a benchmark value. For the programming period 2007-2013, the European Commission recommends that a 5% real rate is considered as the reference parameter for the opportunity cost of capital in the long term. Values differing from the 5% benchmark may, however, be justified on the grounds of the Member State's specific macroeconomic conditions, the nature of the investor (e.g. PPP projects) and the sector concerned. To ensure consistency amongst the discount rates used for similar projects in the same region/country, the Commission encourages the Member States to provide their own benchmark for the financial discount rate in their guidance documents and then to apply it consistently in project appraisal at national level.

The financial analysis should be carried out through subsequent, interlinked, accounts (Figure 2.2 and Table 2.1):

1. total investment costs
2. total operating costs and revenues
3. financial return on investment cost: FNPV(C) and FRR(C)
4. sources of financing
5. financial sustainability
6. financial return on the national capital: FNPV(K) and FRR(K).

Figure 2.2 Structure of financial analysis



This approach will be presented in detail in the rest of the section. The following related topics will be highlighted along the way:

- the time horizon for different types of project (par. 2.4.1)
- social affordability (par. 2.4.2)
- the polluter-pays principle (par. 2.4.2)
- the treatment of taxation (par. 2.4.2)
- the investment profitability - FRR(C) - normally expected (par. 2.4.3)
- the adjustment for inflation (par. 2.4.3)
- the public-private partnership (par. 2.4.4)
- the return on capital – FRR(K) – to private investors (par. 2.4.6).

Table 2.1 Financial analysis at a glance

	FNPV(C)	SUSTAINABILITY	FNPV(K)
Total investment costs			
Land	-	-	
Buildings	-	-	
Equipment	-	-	
*Extraordinary Maintenance**	-	-	
Licences	-	-	
Patents	-	-	
Other pre-production expenses	-	-	
Changes in working capital	-(+)	-(+)	
*Residual value**	+		+
Total operating costs			
Raw materials	-	-	-
Labour	-	-	-
Electric power	-	-	-
Maintenance	-	-	-
Administrative costs	-	-	-
Other outflows			
Interest		-	-
Loans reimbursement		-	-
Taxes		-	
Total operating revenues			
Output X	+	+	+
Output Y	+	+	+
Sources of financing			
Community assistance		+	
National public contribution		+	-
National private capital		+	-
Loans		+	
Other resources (e.g. operating subsidies)		+	

* *In the calculation of the funding-gap rate these item are included in the discounted net revenue (DNR) and not in the discounted investment cost (DIC) because not occurring during the investment phase (see Annex I). The same applies to the capital expenditures incurred during the operational phase (e.g. replacement of short-life equipment).*

Note: The '-' and '+' signs indicate the nature of the cash-flow. For instance, national public contributions are considered as inflows when checking the project sustainability and as outflows when estimating the return on the national capital (K).

2.4.1 Total investment costs

The first logical step in the financial analysis is the estimation of how large the total investment cost will be. The investment outlays can be planned for several initial years and some non-routine maintenance or replacement costs in more distant years. Thus we need to define a time horizon.

By time horizon, we mean the maximum number of years for which forecasts are provided. Forecasts regarding the future of the project should be formulated for a period appropriate to its economically useful life and long enough to encompass its likely mid-to-long term impact.

Although the investment horizon is often indefinite, in project analysis it is convenient to assume reaching a point in the future when all the assets and all the liabilities are virtually liquidated simultaneously. Conceptually, it is at that point that one can cost up the accounts and verify whether the investment was a success. This procedure entails choosing a particular time horizon. The choice of time horizon may have an extremely important effect on the results of the appraisal process and may also affect the determination of the EU co-financing rate.

For the majority of infrastructures the time horizon is at least 20 years; for productive investments, and again indicatively, it is about 10 years. Nevertheless, the time horizon should not be so long as to exceed the economically useful life of the project.

In practice, it is helpful to refer to a standard benchmark, differentiated by sector and based on some internationally accepted practices. An example is shown in Table 2.2. Each project proposer, however, can justify the adoption of a specific time horizon based on project-specific features.

Table 2.2 Reference time horizon (years) recommended for the 2007-2013 period

Projects by sector	Years
Energy	25
Water and environment	30
Railways	30
Roads	25
Ports and airports	25
Telecommunications	15
Industry	10
Other services	15

Source: OECD (1993)

Having set the horizon, the investment costs are classified by (see Table 2.3):

- fixed investments,
- start-up costs, and
- the changes in working capital over the entire time horizon.

2.4.1.1 Fixed investments

Fixed investments are often, but not always, the largest component of total investment costs.

The information relating to fixed investments will be taken from the feasibility study data on localisation and technology. The data to consider are the incremental cash disbursements encountered in the single accounting periods to acquire the various types of fixed assets: land, buildings, machinery, etc.

The residual value of the fixed investment must be included within the fixed investment costs account for the end-year with opposite sign (negative if the others are positive), because it is considered as an inflow.

2.4.1.2 Start-up costs

According to a standard definition, all those costs that are incurred in view of the effects that will accrue beyond the financial period in which the relative disbursements were made are of an investment nature. Although the tax rules do not always allow for the capitalization of these costs, they should be included in the total investment costs. These include several start-up costs, such as: preparatory studies (including the feasibility study itself), costs incurred in the implementation phase, contracts for the use of some consulting services, training expenses, research and development, issue of shares and so on.

2.4.1.3 Changes in working capital

In some types of projects, particularly in the productive sector, the initial investment in working capital is sizeable. Net working capital is defined as the difference between current assets and current liabilities. Its increase over one period of time corresponds to an investment outlay. The estimation depends on the analysis of demand for credit from customers or other users of the service, on technological and business information on average stocks needed, on information on the credit usually offered by suppliers and on the assumption about the cash needed over time.

Current assets include:

- receivables;
- stocks at every stage of the production process;
- cash and net short term liquidity.

Current liabilities include mainly accounts payable to suppliers (but do not include mid to long term debts to suppliers of machinery).

It should be observed that, like current assets and current liabilities, the net working capital is by nature a fund: in order to be transformed into a flow, only the year-on-year increments should be considered. These increments will obviously be sizeable at the beginning, when stocks and other components need to be built-up for the first time, and subsequently they will stabilize or they may even diminish: in which case there will, respectively, be no further investments in working capital or there will be dis-investments.

Table 2.3 Total investment costs – Millions of Euros

	YEARS									
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Land	-40									
Buildings	-70									
Equipment	-43			-25			-26			
Extraordinary Maintenance					-3					
Residual value										12
Total fixed assets (A)	**-153**	**0**	**0**	**-25**	**-3**	**0**	**-26**	**0**	**0**	**12**
Licences	-1									
Patents	-4									
Other pre-production expenses	-2									
Total start-up costs (B)	**-7**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Current Assets (receivables, stocks, cash)	7	11	16	16	16	16	16	16	16	16
Current Liabilities	2	2	3	4	4	4	4	4	4	4
Net working capital	-5	-9	-13	-12	-12	-12	-12	-12	-12	-12
Variations in working capital (C)	**-5**	**-4**	**-4**	**1**	**0**	**0**	**0**	**0**	**0**	**0**
Total investment costs (A)+(B)+(C)	**-165**	**-4**	**-4**	**-24**	**-3**	**0**	**-26**	**0**	**0**	**12**

These are funds, not flows.

In this and the following tables negative numbers are outflows, positive numbers are inflows.

Residual value should always be included at end year. It is considered with a positive sign in this table because it is an inflow, while all the other items are outflows.

FOCUS: THE RESIDUAL VALUE OF THE INVESTMENT

The discounted value of any net future revenue after the time horizon is to be included in the residual value. More specifically, this is the present value at year n of the revenues, net of operating costs, the project will be able to generate because of the remaining service potential of fixed assets whose economic life is not yet completely exhausted. The latter will be zero or negligible if a sufficiently long time horizon has been selected. However, for practical reasons this is not always the case, but then it is important to record either as negative investment or as a benefit the salvage value of fixed asset or any remaining capacity to generate net revenues. In other words, the residual value can be defined as the virtual liquidation value.

It may be calculated in three ways:

- by considering the residual market value of fixed assets, as if it were to be sold at the end of the time horizon considered, and of remaining net liabilities;
- by computing the residual value of all assets and liabilities, based on some standard accounting economic depreciation formula (usually different from depreciation for the determination of capital income taxes);
- by computing the net present value of cash flows in the remaining life-years of the project.

2.4.2 Total operating costs and revenues

The second step in financial analysis is the calculation of the total operating costs and revenues (if any).

2.4.2.1 Operating costs

The operating costs comprise all the data on the disbursements foreseen for the purchase of goods and services, which are not of an investment nature since they are consumed within each accounting period. The data can be organised in a table that includes:

- the direct production costs (consumption of materials and services, personnel, maintenance, general production costs);
- administrative and general expenditures;
- sales and distribution expenditures.

These components together comprise the bulk of the operating costs.

In the calculation of operating costs, all items that do not give rise to an effective monetary expenditure must be excluded, even if they are items normally included in company accounting (Balance Sheet and Net Income Statement). In particular, the following items are to be excluded, as they are not coherent with the discounted cash flow method:

- depreciation, as it is not effective cash payment;
- any reserves for future replacement costs; in this case as well, they usually do not correspond to a real consumption of goods or services;
- any contingency reserves, because the uncertainty of future flows should be taken into consideration in the risk analysis and not through figurative costs (see par. 2.6).

Interest payments follow a different course according to the type of subsequent analysis: they are not included in the calculation of the performance of the investment FNPV(C), but are included in the table for the analysis of the return on capital FNPV(K). This will be discussed below.

Moreover, capital, income or other direct taxes are included only in the financial sustainability table (as an outflow) and not considered for the calculation of FNPV(C) and FNPV(K), which should be calculated before deductions. The rationale is to avoid the complexity and variability across time and countries of capital income tax rules.

2.4.2.2 Revenues

Projects may generate their own revenues from the sale of goods and services; for example water, public works or toll highways. This revenue will be determined by the forecasts of the quantities of services provided and by their prices.

FOCUS: THE POLLUTER PAYS PRINCIPLE
A fundamental principle for the evaluation of EU projects is the Polluter Pays Principle, which, according to regulations, should be used for the modulation of the co-financing rate. Article 52 Regulation 1083/2006 states: 'The contribution from the Funds may be modulated in the light of the following: (…) c) protection and improvement of the environment, principally through the application of the precautionary principle, the principle of preventive action, and the polluter-pays principle'. For projects co-financed by the Community the rate of assistance should be modulated to encourage the introduction of charging systems when the environmental costs of pollution and preventive measures are borne by those who cause pollution. For example, for transport infrastructure, the charge should cover not only the investment cost, but also the external costs affecting the environment. Although the introduction of higher tariffs, in line with the Polluter Pays Principle, means usually a lower contribution from the EU assistance, an appropriate charging system has a positive effect on the project financial sustainability (par. 2.4.5) and on decreasing the associated risks. There may sometimes be a trade-off between fully cost-reflective prices and affordability concerns. Traditionally in public service industries there are cross-subsidies from the intensive (rich) users and the low (poor) users. The solution of the trade-off is usually the responsibility of the regulators of the Member States. Project promoters in these industries should adequately present and discuss the issues involved and that may influence the project's financial performance. See also Annex E on the distributive impact of the tariffs and social affordability.

The following items are usually not included in the calculation of future revenues:

- transfers or subsidies;
- VAT or other indirect taxes charged by the firm to the consumer, because these are normally paid back to the fiscal administration.

In some cases (for example, for railways or aqueducts) the investor may not be the same body that will operate the infrastructure (unbundling) and it may be that the latter pays a tariff to the former. This tariff may not reflect full costs, contributing to the creation of a financing gap. The revenues usually considered for the financial analysis are those that come to the owner of the infrastructure. Nevertheless, on a case-by-case basis, it would be helpful to consider a consolidated financial analysis for both parties.

As shown in Table 2.4, the cash outflows of operating costs deducted from the cash flows of revenues determine the net revenues of the projects. These are calculated for each year of the assumed time horizon. This balance is normally quite different from gross or net profit in the conventional accounting sense (as mentioned, the table disregards interest, capital and income taxes, depreciation and other items).

Table 2.4 Operating Revenues and Costs – Millions of Euros

	YEARS									
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Raw materials	0	-23	-23	-37	-37	-37	-37	-37	-47	-47
Labour	0	-23	-23	-32	-32	-32	-32	-32	-38	-38
Electric power	0	-2	-2	-2	-4	-4	-4	-4	-4	-4
Maintenance	0	-3	-6	-6	-6	-6	-6	-6	-6	-6
Administrative costs	0	-5	-21	-21	-22	-22	-22	-22	-22	-22
Total operating costs	**0**	**-56**	**-75**	**-98**	**-101**	**-101**	**-101**	**-101**	**-117**	**-117**
Output X	0	27	60	64	64	64	64	64	64	64
Output Y	0	15	55	55	62	62	62	62	62	62
Total operating revenues	**0**	**42**	**115**	**119**	**126**	**126**	**126**	**126**	**126**	**126**
Net operating revenue	**0**	**-14**	**40**	**21**	**25**	**25**	**25**	**25**	**9**	**9**

During the first year no operating revenues and costs occur only investment costs.

2.4.3 Financial return on investment

Having collected the data on investment costs, operating costs and revenues, the next logical step in the financial analysis is the evaluation of the financial return on investment.

The indicators needed for testing the project's financial performance are:

- the financial net present value of the project (FNPV), and
- the financial internal rate of return (FRR).

The financial net present value is defined as the sum that results when the expected investment and operating costs of the project (suitably discounted) are deducted from the discounted value of the expected revenues:

$$\text{FNPV} = \sum_{t=0}^{n} a_t S_t = \frac{S_0}{(1+i)^0} + \frac{S_1}{(1+i)^1} + \ldots + \frac{S_n}{(1+i)^n}$$

Where S_t is the balance of cash flow at time t (net cash flow, Tables 2.5 and 2.8) and a_t is the financial discount factor chosen for discounting at time t (see Focus below and Annex B).

FOCUS: THE DISCOUNT FACTOR
The NPV is the sum of $S_0 \ldots S_n$ weighted by the discount factor at, defined as: $a_t = 1 / (1+i)^t$ where t is the time between 0 and n (the time horizon) and i is the discount rate of reference. The following table provides an example of the magnitude of the discount factor and how it varies in the different years depending on the choice of the discount rate:

Years	1	2	5	10	20	30	40	50
$a_t = (1.05)^{-t}$	.952 381	.907 029	.783 526	.613 913	.376 889	.231 377	.142 046	.087 204
$a_t = (1.10)^{-t}$	.909 091	.826 446	.620 921	.385 543	.148 644	.057 309	.022 095	.008 519

t = number of years

The financial internal rate of return is defined as the discount rate that produces a zero FNPV:

$$FNPV = \sum [S_t / (1+FRR)^t] = 0$$

The calculation of the financial return on investment (Table 2.5) measures the capacity of the net revenues to remunerate the investment cost.

FOCUS: ADJUSTING FOR INFLATION
In project analysis, it is customary to use constant prices, i.e. prices fixed at a base-year. However, in financial analysis, the forecast of nominal prices may reveal that relative prices are expected to change; an example is when it is known ex-ante that yearly tariff increase for the project output are capped by a regulator at no more than the inflation rate (RPI) minus an X for productivity change (RPI-X), while some costs of inputs, for instance of energy inputs, are expect to grow at a higher rate. Expected changes in relative prices, may have an impact on the calculation of the financial return of the investment. Therefore, it is recommended to use nominal prices in financial analysis, particularly when relative price changes are expected in future. When the analysis is carried out at constant prices, the financial discount rate is to be expressed in real terms, while a nominal financial discount rate must be used with current prices. The formula for the calculation of the nominal discount rate is: $(1+n)=(1+r)*(1+i)$ where: n – nominal rate, r – real rate, i – inflation rate.

More specifically, the financial net present value, FNPV(C), and the financial rate of return, FRR(C), on the total investment cost, measure the performance of the investment independently of the sources or methods of financing. The FNPV is expressed in money terms (Euro), and depends on the scale of the project. The second indicator is a pure number, and is scale-invariant. The preferred indicator should usually be the net present value because the rate of return may be somewhat misleading and contains no useful information about the 'value' of a project (for a more detailed discussion see Annex C).

Table 2.5 Evaluation of the financial return on investment - Millions of Euros

	YEARS									
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Total operating revenues	0	42	115	119	126	126	126	126	126	126
Total inflows	**0**	**42**	**115**	**119**	**126**	**126**	**126**	**126**	**126**	**126**
Total operating costs	0	-56	-75	-98	-101	-101	-101	-101	-117	-117
Total investment costs	-165	-4	-4	-24	-3	0	-26	0	0	12
Total outflows	**-165**	**-60**	**-79**	**-122**	**-104**	**-101**	**-127**	**-101**	**-117**	**-105**
Net cash flow	**-165**	**-18**	**36**	**-3**	**22**	**25**	**-1**	**25**	**9**	**21**
Financial rate of return on investment - FRR(C)					**-5.66%**					
Financial net present value of the investment - FNPV(C)					**-74.04**					

Financial rate of return on investment is calculated considering total investment costs and operating costs as outflows and revenues as an inflow. It measures the capacity of operating revenues to sustain the investment costs.

A discount rate of 5% has been applied to calculate this value.

Mainly, the examiner uses the FRR(C) in order to judge the future performance of the investment in comparison to other projects, or to a benchmark required rate of return. This calculation also contributes to deciding if the project requires EU financial support: when the FRR(C) is lower than the applied discount rate (or the FNPV(C) is negative), then the revenues generated will not cover the costs and the project needs EU assistance. This is often the case for public infrastructures, partly because of the tariff structure of these sectors.

FOCUS: NORMALLY EXPECTED PROFITABILITY

Normally expected profitability of an investment is that rate of return which provides enough income to cover the inputs' opportunity cost. EU regulations designing the Funds interventions consider the profitability normally expected in order not to provide over-financing.

For a project to require the contribution of the Funds, the net present value of the investment should usually be negative (and the financial rate of return lower than the applied discount rate). A very low or even negative financial rate of return does not necessarily mean that the project is not in keeping with the objectives of the Funds, but only that it is not viable in the financial market. For productive sector products (i.e. industry or telecom) the FNPV(C) is, however, usually positive, and specific rules apply under the State-aid regulations. High variations in profitability occur among sectors, with some sectors more profitable than others. In particular, industry projects tend to be the most profitable, while water supply and environmental protection projects have usually low profitability.

The following table provides an example of observed FRR(C) of a (unbalanced) sample of investment projects sponsored by the European Union in the previous programming periods.

	N. of projects	FRR(C)% average	FRR(C)% Std. Dev.	Sector average / total average
Energy production[a]	2	5.10	6.20	1.6
Energy transport and distribution[b]	5	3.08	3.86	1.0
Roads and highway[b]	16	-0.75	5.13	-0.2
Railways and underground[b]	19	0.33	3.73	0.1
Ports, airports[b]	19	1.79	6.21	0.6
Water supply and waste water treatment[b]	90	0.77	6.03	0.2
Solid waste treatment[b]	31	-3.36	4.65	-1.1
Industries, other productive investments[a]	64	19.60	14.60	6.2
Other[b]	7	1.83	7.12	0.6
TOTAL	253	3.15	6.39	1.0

a: 1994-1999 programming period; b: 2000-2006 programming period.
For returns of ISPA projects see Florio and Vignetti (2006).

Source: Authors' calculations on available DG Regio data

2.4.4 Sources of financing

The fourth step in financial analysis is the identification of the different sources of financing in order to calculate the total financial resources of the project (Table 2.6). Within the framework of EU co-financed projects, the main sources of financing are:

- community assistance (the EU grant);
- national public contribution (grants or capital subsidies at central, regional and local government level);
- national private capital (i.e. private equity under a PPP, see Focus below and Annex G);
- other resources (e.g. EIB loans, loans from other lenders).

As for the determination of the EU grant in general, see Annex H.

FOCUS: PUBLIC-PRIVATE PARTNERSHIPS (PPP)
As shown in Table 2.6, EU co-financed investment projects may be also financed by private investors. PPP may be an important tool for financing investment projects when there is appropriate scope to involve the private sector. The more common attitude of private actors towards public funding is usually grant-seeking for private investment needs and a major problem in attracting private investors is that they have different aims, aspirations and a higher aversion to risk than public bodies. However, private actors may play an active role in financing projects if some incentives are provided. Of course, the public interest must be protected at each stage of the project, from design to implementation and other issues, such as open market access, competition and affordability must be ensured. Many types of PPP exist, usually dependent on the specificities and characteristics of each project. Particular attention should be paid to the legal structure of the PPP as it may affect the project's eligible expenditure. In particular, in the context of the financial analysis, the financial discount rate may be increased to reflect the higher opportunity cost of capital to the private sector. The private investor may provide the appropriate evidence, i.e. investor's past returns on similar projects. Under PPP, the public partner is usually, but not always, the owner of the infrastructure and the private partner is the operator obtaining revenues through tariff payments. The financial analysis should not be carried out from the point of view of the owner of the infrastructure only, and a consolidated analysis should be used in order to avoid cost/benefit double counting mistakes. For a more detailed discussion on PPP and the implications on the determination of the funding gap see Annex G. .

Table 2.6 Sources of financing - Millions of Euros

	YEARS									
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Community assistance	**60**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Local level										
Regional level	15									
Central level	50	25								
National public contribution	**65**	**25**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
National private capital	**40**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
EIB loans				10						
Other loans										
Other resources	**0**	**0**	**0**	**10**	**0**	**0**	**0**	**0**	**0**	**0**
Total financial resources	**165**	**25**	**0**	**10**	**0**	**0**	**0**	**0**	**0**	**0**

Loan is here an inflow and it is treated as a financial resource coming from third parties.

The amount shown is a rough indicative estimation. For a correct determination of the EU grant please see Annex C.

2.4.5 Financial sustainability

Having determined the investment costs, the operating revenues and costs and the sources of finance, it is now possible and helpful to determine the project's financial sustainability. A project is financially sustainable when it does not incur the risk of running out of cash in the future. The crucial issue here is the timing of cash proceeds and payments. Project promoters should show how over the project time horizon, sources of financing (including revenues and any kind of cash transfers) will consistently match disbursements year-by-year. Sustainability occurs if the net flow of cumulated generated cash flow is positive for all the years considered.

The difference between incoming and outgoing flows will show the deficit (see example below) or surplus (Table 2.7) that will be accumulated each year.

The incoming flows include:

- any possible revenues for the sale of goods and services; and
- the net cash from the management of financial resources.

The dynamics of the incoming flows are measured against the outgoing flows. These are related to:

- investment costs,
- operating costs,
- reimbursement of loans and interest paid,
- taxes, and
- other disbursements (e.g. dividends, retirement bonus, etc.).

It is important to ensure that the project, even if assisted by EU co-financing, does not risk lacking of cash. The rate of return, FRR(C), may show that the investment will never be profitable from the financial standpoint in the long term. In this case, the proposer should specify what, if any, resources the project will draw on when the EU grants are no longer available. Special rules apply to productive investments under the State-aid regulations (see Chapter 1).

Where there is a pre-existing infrastructure which is managed by an established operator, a question may arise concerning the overall financial sustainability of the operator after the project. This assessment should be seen as a rather different and more comprehensive issue, that goes beyond CBA. While, in some special cases the financial sustainability of the 'stand alone' project might not be easily proven, an assessment of the long term financial position of a municipality, a railway operator, or a port authority, etc., would clearly imply additional analysis and auditing. It would normally be the responsibility of the Member States to select beneficiaries in good financial health[6].

In project analysis, a simple Table, such as 2.7 below, will show that the project per se covers its costs by a suitable combination of revenues and capital finance. If there are special concerns about the overall financial position of the beneficiary, these will be addressed in a separate way by the managing authorities and the EC Services.

Table 2.7 Financial sustainability - Millions of Euros

	YEARS									
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Total financial resources	165	25	0	10	0	0	0	0	0	0
Total operating revenues	0	42	115	119	126	126	126	126	126	126
Total inflows	**165**	**67**	**115**	**129**	**126**	**126**	**126**	**126**	**126**	**126**
Total operating costs	0	-56	-75	-98	-101	-101	-101	-101	-117	-117
Total investment costs	-165	-4	-4	-24	-3	0	-26	0	0	0
Interest	0	0	0	0	-0.2	-0.2	-0.2	-0.2	-0.2	0
Loans reimbursement	0	0	0	0	-2	-2	-2	-2	-2	0
Taxes	0	-6	-7	-8	-9	-9	-9	-9	-9	-9
Total outflows	**-165**	**-66**	**-86**	**-130**	**-115.2**	**-112.2**	**-138.2**	**-112.2**	**-128.2**	**-126**
Total cash flow	**0**	**1**	**29**	**-1**	**10.8**	**13.8**	**-12.2**	**13.8**	**-2.2**	**0**
Cumulated net cash flow	**0**	**1**	**30**	**29**	**39.8**	**53.6**	**41.4**	**55.2**	**53**	**53**

Loan here is considered at the moment it is reimbursed as an outflow. The inflow item of loan is included in the sources of financing (Tab. 2.6).

Financial sustainability is verified if the cumulated net cash flow row is greater than zero for all the years considered..

6 In other words, financial sustainability needs to be ensured for the project to cover its costs without incurring cash shortages. Moreover, where it is difficult to prove the financial sustainability of the standalone project, as in case of some projects falling under a pre-existing infrastructure, a separate audit may be needed to show the financial situation of the operator.

EXAMPLE: A FINANCIALLY UNSUSTAINABLE PROJECT										
The following table presents an example of a project which is unsustainable from a financial perspective:										
	YEARS									
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Total financial resources	165	25	0	10	0	0	0	0	0	0
Total operating revenues	0	45	115	125	108	115	115	115	115	115
Total inflows	**165**	**70**	**115**	**135**	**108**	**115**	**115**	**115**	**115**	**115**
Total operating costs	0	-56	-98	-98	-101	-101	-101	-101	-101	-101
Total investment costs	-165	-6	-2	-24	-3	0	-26	0	0	0
Interest	0	0	0	0	-0.2	-0.2	-0.2	-0.2	-0.2	0
Loans reimbursement	0	0	0	0	-2	-2	-2	-2	-2	0
Taxes	0	-6	-7	-8	-9	-9	-9	-9	-9	0
Total outflows	**-165**	**-68**	**-107**	**-130**	**-115.2**	**-112.2**	**-138.2**	**-112.2**	**-112.2**	**-101**
Total cash flow	0	2	8	5	-7.2	2.8	-23.2	2.8	2.8	14
Cumulated net cash flow	**0**	**2**	**10**	**15**	**7.8**	**10.6**	**-12.6**	**-9.8**	**-7**	**7**
The project is not sustainable because the cumulated net cash flow is negative in the years 7, 8 and 9.										

2.4.6 Financial return on capital

The final step is the appraisal of the financial return on capital (Table 2.8). The objective of this calculation is to look into the project performance from the perspective of the assisted public and possibly private entities in the Member States. These entities will for sure enjoy an increase in their potential project net returns, just because the European Union grants them funds. In other words, for a given investment cost, the beneficiary (the 'owner' of the project) will need to sink less capital in it, because the EU taxpayer covers a share of the project costs. In fact, the rationale of the EU grant itself in the framework of Cohesion Policy is to increase investment opportunities by a shift in capital needs.

In order to consider this effect, the best approach is simply to focus on the funds provided by the beneficiary ('after the EU grant'), including those funds that should be made available as national public contributions, private equity, if any, and the need to pay back loans and interest to third party financiers.

To do this, the suggestion is to build an account where the outflows are: the operating costs; the national (public and private) capital contributions to the project; the financial resources of third parties at the time in which they are reimbursed; the related interest on loans. The inflows are the operating revenues only (if any) and the residual value (including all assets and liabilities at the end year). Table 2.8 shows this account and readers may see, by comparison with Table 2.5, that the former focuses on sources of national funds, while the latter focuses on total investment costs, with the remaining items being the same.

The financial net present value of the capital, FNPV(K), is the sum of the net discounted cash flows that accrue to the project promoter due to the implementation of the investment project. The financial rate of return on capital, FRR(K), determines the return for the national beneficiaries (public and private combined).

When computing FNPV(K) and FRR(K), all sources of financing are taken into account, except for the EU contribution. These resources are taken as outflows (they are inflows in the financial sustainability account), instead of investment costs (as it is done in the calculation of the financial return on investment).

Even if the FRR(C) is expected to be very low, or even negative for public investment (especially for particular sectors, such as water), the FRR(K) will often be positive. As mentioned above, the EC standard financial discount rate is 5% real, and the return for the beneficiary should, in principle, be aligned with this benchmark (see also Annex C). In fact, when the project expects a substantial positive FRR(K), this fact shows that the grant from the EU would bring supra-normal profits to the national beneficiaries.

Under a PPP, private beneficiaries will be involved in the project. From their point of view, any grant received, either from the EU or the national public sector should be ignored in the calculation of the return on their own capital (Kp). The example below shows a simple way to disentangle the financial returns to the private capital investors.

Table 2.8 Evaluation of the financial return on national capital - Millions of Euros

	YEARS									
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Total operating revenues	0	42	115	119	126	126	126	126	126	126
Residual value	0	0	0	0	0	0	0	0	0	12
Total inflows	**0**	**42**	**115**	**119**	**126**	**126**	**126**	**126**	**126**	**138**
Total operating costs	0	-56	-75	-98	-101	-101	-101	-101	-117	-117
Interests	0	0	0	0	-0.2	-0.2	-0.2	-0.2	-0.2	0
Loans reimbursement	0	0	0	0	-2	-2	-2	-2	-2	0
National private contribution	-40	0	0	0	0	0	0	0	0	0
National public contribution	-65	-25	0	0	0	0	0	0	0	0
Total outflows	**-105**	**-81**	**-75**	**-98**	**-103.2**	**-103.2**	**-103.2**	**-103.2**	**-119.2**	**-117**
Net cash flow	**-105**	**-39**	**40**	**21**	**22.8**	**22.8**	**22.8**	**22.8**	**6.8**	**21**
Financial rate of return on national capital - FRR(K)					**5.04%**					
Financial net present value of capital - FNPV(K)					**0.25**					

Financial internal rate of return on national capital is calculated with outflows including the national (public and private) capital when it is paid up, the financial loans at the time they are paid back, in addition to operating costs and related interest, while with revenues as inflows. It does not consider the EU grant.

A discount rate of 5% has been applied to calculate this value.

EXAMPLE: RETURN ON INVESTED CAPITAL TO PRIVATE INVESTORS

Under the 2007-2013 Programming period the EU grant finances only part of the project 'funding-gap' and the rest of the capital expenditure must be matched by other sources of finance, including loans and private contributions.

The following table provides a numerical example of the return on invested capital to a hypothetical private investor operating a public water company.

Assume a major project (values are discounted):
- Total investment cost M€280
- Total operating cost M€512
- Total operating revenue M€576
- Funding Gap Rate 79%
- Interest on loans 10%
- Discount rate 5%
- The residual value is here excluded because in many PPP contracts the infrastructure is returned to the public sector at the end of the period.

Sources of financing:
- EU grant = M€159
- National public contribution = M€73
- Private equity= M€38
- EIB loan = M€10

	YEARS									
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Total operating revenues	0	72	72	72	72	72	72	72	72	72
Total inflows	**0**	**72**	**72**	**72**	**72**	**72**	**72**	**72**	**72**	**72**
Total operating costs	0	-64	-64	-64	-64	-64	-64	-64	-64	-64
Interests	0	0	0	0	-0.1	-0.1	-0.1	-0.1	-0.1	0
Loans reimbursement	0	0	0	0	-2	-2	-2	-2	-2	0
Concession fee to public partner	0	-1.55	-1.55	-1.55	-1.55	-1.55	-1.55	-1.55	-1.55	0
Private equity	-38	0	0	0	0	0	0	0	0	0
Total outflows	**-38**	**-65.6**	**-65.6**	**-65.6**	**-67.7**	**-67.7**	**-67.7**	**-67.7**	**-67.7**	**-64**
Net cash flow	**-38**	**6.45**	**6.45**	**6.45**	**4.35**	**4.35**	**4.35**	**4.35**	**4.35**	**8**
Financial rate of return on private equity– FRR(Kp)					**5.6%**					
Financial net present value of private equity- FNPV(Kp)					**0.94**					

2.5 Economic analysis

The economic analysis appraises the project's contribution to the economic welfare of the region or country. It is made on behalf of the whole of society instead of just the owners of the infrastructure, as in the financial analysis. The key concept is the use of accounting shadow prices, based on the social opportunity cost, instead of observed distorted prices.

Observed prices of inputs and outputs may not mirror their social value (i.e. their social opportunity cost) because some markets are socially inefficient or do not exist at all. Examples are monopoly or oligopoly markets, where the price includes a mark-up over marginal costs; trade barriers, where the consumer pays more than he/she could elsewhere. Prices as they emerge from imperfect markets and from some public sector pricing or rationing policies, may fail to reflect the opportunity cost of inputs. In some circumstances this may be important for the appraisal of projects. Financial data, while important for budgetary reasons, may be misleading as welfare indicators.

When market prices do not reflect the social opportunity cost of inputs and outputs, the usual approach is to convert them into accounting prices using appropriate conversion factors, if available from the planning authority (see par. 2.5.1).

In other cases, there may be project costs and benefits for which market values are not available. For example, there might be impacts, such as environmental, social or health effects, without a market price but wich are still significant in achieving the project's objective and thus need to be evaluated and included in the project appraisal.

When market values are not available, effects can be monetised through different techniques, in part depending on the nature of the effect considered (see par. 2.5.2). 'Money' valuation here has no financial implication. CBA 'money' is just a convenient welfare metric and, in principle, any numeraire can be used just as well. In the context of the EU Funds, using the Euro as the unit of account, for both the financial and economic analysis, has clear presentational advantages.

The standard approach suggested in this Guide, consistent with international practice (see the Reference section), is to move from financial to economic analysis, starting from the account in Table 2.5 (the performance of the investment regardless of its financial sources). To do so, appropriate conversion factors should be applied to each of the inflow or outflow items to create a new account (Figure 2.3) which also includes social benefits and social costs.

The methodology is summarised in five steps:

- conversion of market to accounting prices;
- monetisation of non-market impacts;
- inclusion of additional indirect effects (if relevant);
- discounting of the estimated costs and benefits;
- calculation of the economic performance indicators (economic net present value, economic rate of return and B/C ratio).

The rest of this section explains these five steps and, at the same time, highlights the following topics:

- the standard conversion factor;
- the shadow exchange rate;
- the marginal cost of public funds;
- the shadow wage (see also Annex D); and
- the social discount rate (see also Annex B).

While the approach presented in this Guide is in keeping with well established international practice, national CBA Guidelines in the Member States can be more specific on some issues. In some sectors, particularly in transport, it may be more practical to go directly into economic analysis and then to go back to financial analysis. In fact, in many transport projects, time savings generate most of the economic benefits. Benefits generated by financial cash flows (mainly resulting from the difference in operating and maintenance (O&M) costs between the baseline case and investment option) could be responsible for the generation of a small minority of total project benefits. In these circumstances, it would not be practical to calculate a conversion factor to transform the financial benefits into economic benefits. In fact, the sequence of the analysis (from financial to economic or the other way round) is not really relevant because many issues are linked (e.g. demand forecasts, investment costs, labour costs) and the appraisal process is iterative and should converge to a complete picture of the project performance. Thus the sequence of the different analyses is more a matter of presentation than of substance.

FOCUS: CBA THEORY AT A GLANCE: PARTIAL VS. GENERAL EQUILIBRIUM APPROACHES

The original intuition of CBA can be traced back to the work of the French engineer Jules Dupuit (1848). He proposed to use the concept that later came to be known as the consumer's surplus. The idea was further developed in Cambridge and integrated with the producer's surplus, by Alfred Marshall and Cecil Pigou, and is now included in standard introductory microeconomics. Given a Marshallian demand curve and supply curve in one market, the consumer's surplus is the excess of the willingness-to-pay over the price paid and the producer's surplus is the excess of revenues over costs. Summing these two welfare measures, one gets a first component of the social welfare associated with the availability of one good. To get the entire picture, however, you need to include welfare effects in other (secondary) markets because of complementarities and substitution effects. Moreover, one needs to consider externalities. CBA in partial equilibrium basically implies measuring effects on different agents and summing them. Moreover, if there is rationing on some markets, if consumers and producers are not perfectly informed, if there are income effects, etc., there are additional estimation issues for the applied economist and different definitions of a welfare change. Boardman et al (2006) offers an exhaustive and accessible review of the partial equilibrium approach.

A different CBA framework was suggested in the 1970s following research commissioned by the OECD (Little and Mirrlees, 1974), the UNIDO (Marglin, Dasgupta and Sen, 1972), the World Bank (Squire and Van der Tak, 1975). These researchers, including two future Nobel laureates in economics (James Mirrlees and Amartya Sen), concluded that, particularly in less developed economies, where prices are widely distorted, the partial equilibrium approach is cumbersome. They suggested to compute a set of 'shadow prices'. These are in principle the solution of a social planning problem and should be used systematically in the calculation of shadow social profits of projects. Shadow profits, or economic profits, are general equilibrium measures, that are defined in such a way as to include all the direct and indirect effects, so that – if you know them – you do not need to sum welfare effects in each market and for each agent. Thus, if the project has a positive net present value at shadow prices, it increases social welfare. Drèze and Stern (1987) offer the now standard theoretical presentation of general equilibrium CBA and elucidate the relationship between policies, projects and shadow prices; see Florio (2007) for an informal presentation of the approach in the EU context, and the information and incentive issues involved.

Because, however, the direct computation of the shadow prices by a general equilibrium model of the economy is constrained by lack of data, computation shortcuts have been proposed. The most famous one is the Little-Mirrlees 'border price rule' for traded goods and the 'long run marginal cost rule' for non-tradable goods. In fact, applied cost-benefit analysis needs always to deal with data limitations and the choice of a partial versus a general equilibrium approach is in fact a matter of convenience. Moreover, CBA has now been developed as a set of more or less interrelated fields (particularly transport, environment, health), each with its own tradition and style, even if with some unifying principles. In practice, often a mixture of general and partial equilibrium frameworks are used to evaluate projects.

In this Guide an approach broadly based on the general equilibrium framework is suggested; an approach in practice based on shadow prices and conversion factors. In principle, each Member State of the EU should 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. When national/regional conversion factors are not easily available, or are provided only for specific sectors, different approaches may be used. Chapter 3 offers case studies based both on standard partial equilibrium approaches (transport) and on shadow prices (solid waste, water, industry). See the References for details on CBA theory and application.

Figure 2.3 From financial to economic analysis

	YEARS									
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Total operating revenues	0	42	115	119	126	126	126	126	126	126
Total inflows	**0**	**42**	**115**	**119**	**126**	**126**	**126**	**126**	**126**	**126**
Total operating costs	0	-56	-75	-98	-101	-101	-101	-101	-117	-117
Total investment costs	-165	-4	-4	-24	-3	0	-26	0	0	12
Total outflows	**-165**	**-60**	**-79**	**-122**	**-104**	**-101**	**-127**	**-101**	**-117**	**-105**
Net cash flow	-165	-18	36	-3	22	25	-1	25	9	21
Financial rate of return on investment - FRR(C)					**-5.66%**					
Financial net present value of the investment - FNPV(C)					**-74.04**					

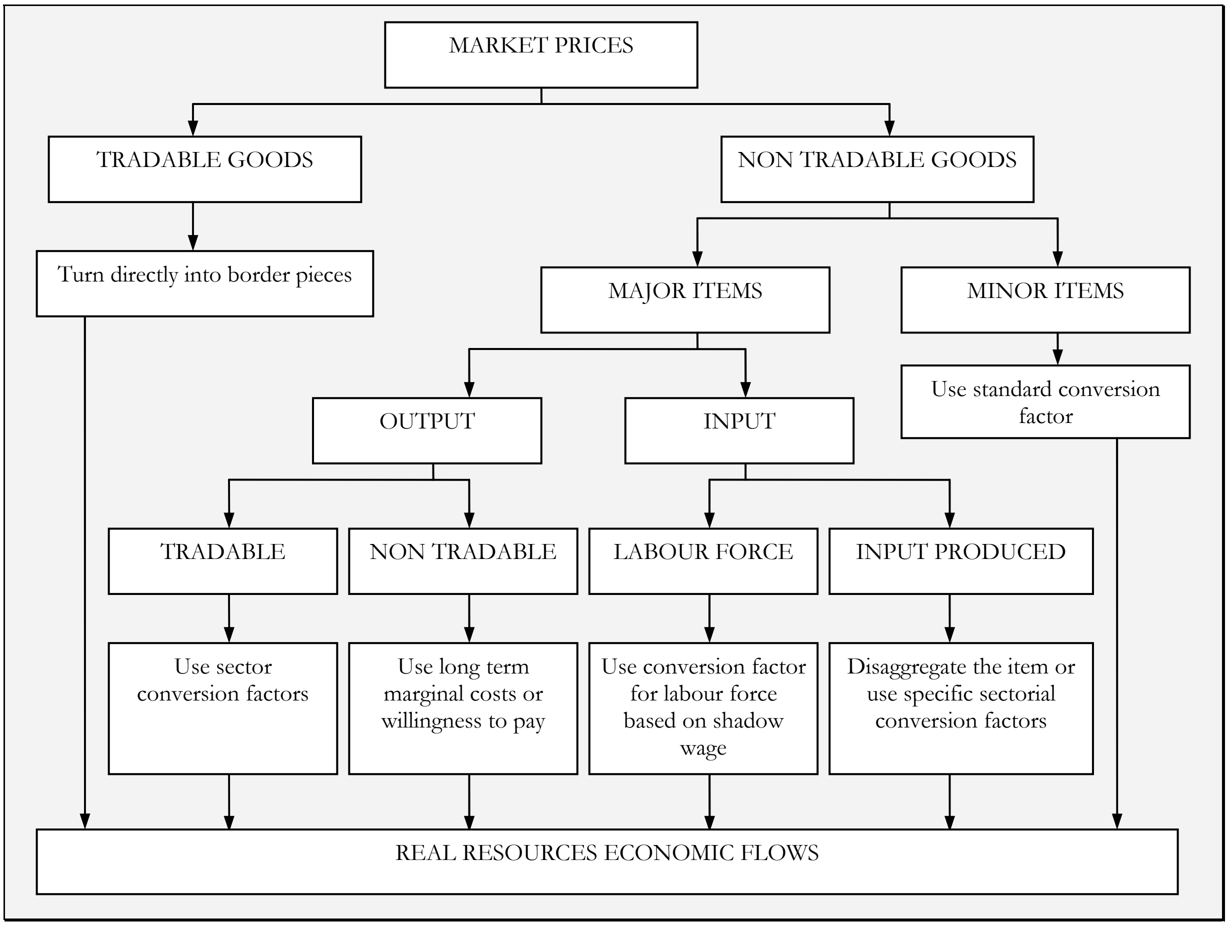
1. Conversion of market to accounting prices
2. Monetisation of non-market impacts
3. Inclusion of indirect effects (where relevant)
4. Discounting
5. Economic performance indicators

		YEARS									
	CF	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Fiscal correction*											
Decreased pollution elsewhere		0	11	11	11	11	11	11	11	11	11
External benefits		**0**	**11**	**11**	**11**	**11**	**11**	**11**	**11**	**11**	**11**
Output X	1.2	0	32.4	72	76.8	76.8	76.8	76.8	76.8	76.8	76.8
Output Y	1.1	0	16.5	60.5	60.5	68.2	68.2	68.2	68.2	68.2	68.2
Total operating revenues		**0**	**48.9**	**132.5**	**137.3**	**145**	**145**	**145**	**145**	**145**	**145**
Increased noise		0	-12	-12	-12	-12	-12	-12	-12	-12	-12
External costs		**0**	**-12**	**-12**	**-12**	**-12**	**-12**	**-12**	**-12**	**-12**	**-12**
Labour	0.8	0	-18.4	-18.4	-25.6	-25.6	-25.6	-25.6	-25.6	-30.4	-30.4
Other operating costs	1.1	0	-36.3	-57.2	-72.6	-75.9	-75.9	-75.9	-75.9	-86.9	-86.9
Total operating costs		**0**	**-54.7**	**-75.6**	**-98.2**	**-101.5**	**-101.5**	**-101.5**	**-101.5**	**-117.3**	**-117.3**
Total investment costs	**0.9**	**-148.5**	**-3.6**	**-3.6**	**-21.6**	**-2.7**	**0**	**-23.4**	**0**	**0**	**10.8**
Net cash flow		-148.5	-10.4	52.3	16.5	39.8	42.5	19.1	42.5	26.7	37.5
Economic rate of return on investment - ERR						**11.74%**					
Economic net present value of investment - ENPV						**53.36**					
B/C ratio						**1.06**					

** No fiscal correction is applied: it means no transfers, subsidies or indirect taxes have been included in the financial analysis in table 2.5.*

2.5.1 Conversion of market to accounting prices

Figure 2.4 Conversion of market to accounting prices



Source: Adapted from Saerbeek, Economic appraisal of project. Guidelines for a simplified cost benefit analysis (1990).

In CBA the objective is to appraise the social value of the investment. Observed prices, as set by markets or by governments, sometimes do not provide a good measure of the social opportunity cost of inputs and outputs. This happens when:

- real prices of inputs and outputs are distorted because of inefficient markets;
- Government sets non cost-reflective tariffs of public services.

These distortions are frequent in some less developed countries, where market opening is limited, and Government tariff policy is constrained by managerial and political issues. Some observed prices, however, can be far from social opportunity costs in any EU country (see examples in the box below and Table 2.9).

EXAMPLE: PRICE DISTORTIONS
A land intensive project, e.g. an industrial site, where land is made available free of charge by a public body, while it may otherwise earn a rent.
An agricultural project that depends upon water supply at a very low tariff, heavily subsidised by the public sector and where output prices are affected by special policy regimes (e.g. under some provisions of the EU Common Agricultural Policy).
An energy intensive project which depends upon the supply of electricity under a regime of regulated tariffs, when these tariffs are below long run marginal costs.
A power plant under a collusive oligopoly regime, which determines a substantial price divergence of electricity prices from long-term marginal costs, the former being higher than the latter: in this case economic benefits could be less than financial profits.

Whenever some inputs are affected by strong price distortions, the proposer should address the issue in the project appraisal and use accounting ('shadow') prices to better reflect the social opportunity cost of the resources (see Figure 2.4). We discuss below some shadow prices that may be needed in practice.

For some key national CBA parameters, the calculations should, in principle, be done by a planning office of the Member State and certainly not project-by-project, because of its macroeconomic nature.

- In some cases, when there is no full convertibility of the currency, one parameter for economic analysis is the shadow exchange rate (SER). This is the economic price of foreign currency, which may diverge from the official exchange rate (OER). In general, the greater the divergence between the OER and the SER, the more likely will depreciation or appreciation occur and affect project performance. While all accounts for project analysis under the EU Funds should be in euros, including those for countries which are not in the EMU, the use of a SER for the Member States is not suggested because of free currency convertibility and lack of controls on capital flows. The issue can, however, be considered for some candidate countries under IPA assistance if there is a need to add realism to project analysis when there are constraints on international capital flows.
- In general, the use of a standard conversion factor (SCF) for some project cash flows is preferred to the SER because in principle it captures the same distortions as the SER while being more consistent with the use of other (sector-specific) conversion factors. The value of the SCF is estimated on the basis of the values of exports and imports (see example below). If the planning authority does not offer its own estimates, SCF=1 should be the default rule.

EXAMPLE: CALCULATION OF THE STANDARD CONVERSION FACTOR

These are an example of data for the estimate of the standard conversion factor (Millions of Euros):

1) total imports (M)	M =	2000
2) total exports (X)	X =	1500
3) import taxes (T_m)	T_m =	900
4) export taxes (T_x)	T_x =	25

The formula to be used for the calculation of the Standard Conversion Factor is (SCF):

$SCF = (M + X) / [(M + T_m) + (X - T_x)]$

$SCF = 0.8$.

In practice, calculations may be more complex, because of non-tariff barriers and other sources of international trade distortions, for example in the foreign trade restrictions between EU and non EU countries; because of special regulations for the service sector; because of different tax patterns across countries and sectors.

- The project examiner needs to carefully assess and consider how the social costs are affected by departures of observed prices from the following reference values:
  - marginal costs for internationally non-tradable goods, such as local transport services;
  - border prices for internationally tradable goods, such as agricultural crops or some energy services or manufactured goods.

For every traded item, border prices are easily available: they are international prices, CIF for imports and FOB for exports, expressed in the same currency. Where the relevant economic border lies is a matter to be ascertained on a case-by-case basis. For example the external border of the EU may be relevant for some sectors but not for others. The key empirical indicator for assessing whether border prices should be used is the dispersion of prices across countries for the same tradable good or service. Table 2.9, showing that there is a difference up to 250% across countries for prices paid by EU consumers of electricity, provides an example.

Table 2.9 Electricity price dispersion for industry and households in the EU, year 2005, €

Electricity		2005
Industry (annual consumption: 2000 MWh)	Average	6.74
	Median price	6.46
	Coeff. of variation	18.1%
	Max/min. ratio	2.20
Household (annual consumption: 3500 kWh)	Average	10.65
	Median price	9.00
	Coeff. of variation	23.5%
	Max/min. ratio	2.50

Source: European Commission,DG ECFIN (2007)

For non-traded items: the standard conversion factor is used for minor non-traded items or the items without a specific conversion factor, while for major non-traded items sector-specific conversion factors are used, based on long run marginal cost or willingness-to-pay. See the example below:

EXAMPLE: SPECIFIC CONVERSION FACTORS BY SECTOR

Land. Assume the SCF is 0.8. Government provides the land at a price reduced by 50% compared with market prices. So the market price is double the current one. The selling price should be doubled to reflect the domestic market and, as there is no specific conversion factor, the conversion factor to turn market price into border price is the standard conversion factor. Conversion factor for land is: CF = 2 * 0.8 = 1.60.

Building. The total cost consists of 30% of non-skilled workforce (CF of non-skilled workforce is 0.48), 40% of imported material cost with import tariffs of 23% and sales of 10% (FC 0.75), 20% of local materials (SCF=0.8), 10% of profits (CF=0). Conversion factor is: (0.3*0.48)+(0.4*0.75)+(0.2*0.8)+(0.1*0) = 0.60.

Machinery. Imported without taxes and tariffs (CF=1).

Stock of raw material. Only one traded material is supposed to be used; the item is not subject to taxes and the market price is equal to the FOB price. CF=1.

Output. The project produces two outputs: A, imported and B, a non-traded intermediate item. To protect domestic firms, the government has imposed an import tax of 33% on item A. The CF for A is 100/133 = 0.75. For item B, as there is no specific conversion factor, SCF=0.8.

Raw materials. No significant distortions. CF=1.

Intermediate inputs imported without tariffs and taxes. CF=1.

Electricity. There is a tariff that covers only 40% of the marginal supply cost of electricity. There is no disaggregation of cost components and it assumed that the difference between international and domestic prices for each cost component used to produce a marginal unit of electricity is equal to the difference between all traded items considered in the SCF. CF = 1/0.4 * 0.8 = 2.

Skilled labour force. The market is not distorted. Market wage reflects the opportunity cost for the economy.

Non-skilled labour force. Supply exceeds demand but there is a minimum wage of €5 per hour. Nevertheless in this sector the last employed workers come from the rural sector, where the wage is only €3 per hour. Only 60% of non-skilled workforce wages reflect the opportunity cost. The SCF is used to turn the opportunity cost of non-skilled work into a border price. CF = 0.6*0.8 = 0.48.

EXAMPLE: CONVERSION FACTORS FOR MAJOR TRANSPORT PROJECTS IN SOUTHERN ITALIAN REGIONS

Within the framework of the 2000-2006 National Operational Programme the Italian Ministry for transport has developed a set of conversion factors for the appraisal of all railway major projects to be implemented in objective 1 regions.

The following table provide some examples:

ITEM	CF
Equipment	0.909
Labour	0.348
Freights	0.833
Expropriations	1.000
Administrative costs	0.833
Maintenance	0.909
Extraordinary maintenance	0.909

Source: Italian Transport Ministry (2001)

2.5.1.1 Shadow wages distortion

A crucial input to investment projects, particularly of infrastructure, is labour. In principle, wages should reflect the social value of working time and effort, i.e. the marginal value to society of the product of a unit of labour. In the real world, however, wage distortions occur frequently. Current wages may be a distorted social indicator of the opportunity cost of labour because labour markets are imperfect, or there are macroeconomic imbalances, as revealed particularly by high and persistent unemployment, or by dualism and segmentation of labour conditions (e.g. when there is an extensive informal or illegal economy).

The proposer, in such cases, may resort to a correction of observed wages and to the use of conversion factors for computing shadow wages.

EXAMPLE: WAGE DISTORTION
In the private sector, costs of labour for the private company may be less than the social opportunity cost because the State gives special subsidies to employment in some areas. There may be legislation fixing a minimum legal wage, even if under heavy unemployment there may be people willing to work for less. There are informal or illegal sectors with no formal wage or income, but with a positive opportunity cost of labour. There may be fundamental macroeconomic unbalances and wage rigidity.

Typically, in an economy characterised by extensive unemployment or underemployment, the opportunity cost of labour used in the project may be less than the actual wage rates.

The shadow wage is region-specific, because labour is less mobile than capital. It may often be determined as a weighted average of:

- the shadow wage for skilled workers and unskilled workers previously employed in similar activities: it can be assumed to be equal or close to the market wage;
- the shadow wage for unskilled workers drawn to the project from unemployment: it can be assumed to be equal to or not less than the value of unemployment benefits;
- the shadow wage for unskilled workers drawn to the project from informal activities: it should be equal to the value of the output forgone in these activities.

The weights should be proportional to the amount of labour resources employed in each case.

Under severe unemployment conditions and very low public unemployment benefits, the shadow wage may be inversely correlated to the level of unemployment. For a discussion of the correlation between the shadow wage and the type of unemployment, see Annex D.

Obviously if an investment project already has a satisfactory economic internal rate of return before corrections for labour costs, then it is not necessary to spend much time and effort on the detailed estimation of the shadow wage.

However, it is important to consider that in some cases the employment impact of a project may need a vary careful consideration:

- it is sometimes important to check for employment losses in other sectors as a consequence of project: gross employment benefits, since the latter may overestimate the net impact;
- occasionally the project is said to preserve jobs that otherwise would be lost and this may be particularly relevant for renovation and modernisation of existing plants. This kind of argument should be supported by an analysis of cost structure and competitiveness both with and without the project;
- some objectives of the Structural Funds are concerned with particular employment targets (e.g. youth, women, long term unemployed) and it may be important to consider the different impacts by target groups.

Annex D offers some simple hints on how to empirically estimate shadow wages.

2.5.1.2 Fiscal corrections

Some items of financial analysis can be seen as pure transfers from one agent to another within society, with no economic impact. For example a tax paid to the Member State by the beneficiary of EU assistance is offset by fiscal revenues to the government. Conversely, a subsidy from the government to the investor, is again a pure transfer that does not create economic value, while it is a benefit for the beneficiary.

Some general rules can be laid down to correct such distortions:

- all prices of inputs and outputs to be considered for CBA should be net of VAT and of other indirect taxes: taxes are paid by consumers to the project, from the project to the Tax Administration, and are then redistributed to the consumers as public expenditures;
- prices of inputs, including labour, to be considered in the CBA should be gross of direct taxes: the employee gets a net-of-tax salary, the tax goes to Government that pays it back to employees, pensioners, and their families, etc., as public services or transfers;
- subsidies granted by a public entity to the project promoter are pure transfer payments and, should be omitted from revenues under economic analysis (i.e. CF=0).

Despite the general rule, in some cases indirect taxes/subsidies are intended as a correction for externalities. Typical examples are taxes on CO_2 emissions to discourage negative environmental externalities. In this and in similar cases, it may be justified to include these taxes (subsidies) in project costs (benefits), but the appraisal should avoid double counting (e.g. including both energy taxes *and* estimates of full external environmental costs in the appraisal). Public funds transferred to economic entities in exchange for services supplied or goods produced by them (e.g. specific subsidies to schools for assisting disabled students) are not to be considered as pure transfer payments and they should be included as revenues in economic analysis, but only after checking if the subsidy reflects the social opportunity cost of the service.

Obviously, the treatment of taxation/subsidy should be less accurate whenever it has minor importance in project appraisal, but overall consistency is required.

In some projects the fiscal impact can be significant, because for example the revenues generated by the project may decrease the need to finance budgetary deficits by public debt or taxation[7].

2.5.2 Monetisation of non-market impacts

The second step of the economic analysis is to include in the appraisal those project impacts that are relevant for society, but for which a market value is not available. The project examiner should check that these effects (either positive or negative) have been identified, quantified, and given a realistic monetary value (see Table 2.10 for some examples of the assessment of non-market impacts in different sectors).

Appropriate conversion factors applied to the financial values of the operating revenues should already capture the most relevant non-market benefits a project may generate. However, if conversion factors have not been estimated or the project is non-revenue generating, alternative approaches can be used to assess non-market benefits. The most frequently used method is the willingness-to-pay (WTP) approach, which allows the estimation of a money value through users' revealed preferences or stated preferences. In other words, users' preferences can be observed either indirectly, by observing consumers' behaviour in a similar market or directly, by administering ad hoc questionnaires (but this is often less reliable). For the evaluation of some outputs, when the WTP approach is not possible or relevant, long-run marginal cost

[7] One Euro of uncommitted income in the public sector budget may be worth more than in private hands because of the distortionary effects on taxation. In principle effects of taxation. Under non-optimal taxes, Marginal Cost of Public Funds (MCPF) values higher or lower than unity should be used to adjust the flows of public funds to and from the project. If there are no national guidelines on this issue, MCPF=1 is the default rule suggested in this Guide.

(LRMC) can be the default accounting rule. Usually WTP is higher than LRMC in empirical estimates, and sometimes an average of the two is appropriate.

The use of WTP or LRMC as shadow prices is mutually exclusive to the application of conversion factors to the project's financial operating revenues. For example, if electricity services are provided at 5 cents per kWh, a tariff below unit costs, we can either multiply the tariff by the conversion factor to get the shadow price; or we can substitute the tariff by the WTP as the shadow price.

Table 2.10 Examples of non-market impact valuation

Sector	Non-market impact	Impact assessment
Transport	- Savings in travel and waiting time	- The value of working time savings is the opportunity cost of the time to the employer, equal to the marginal cost of labour.
Healthcare	- Life expectancy / quality of life	- Quality-adjusted life year (QALY) is the most commonly used measure of health benefit. Tools such as the EuroQol instrument allow the estimation of the number of QALYs gained by the recipients of the project.
	- Prevention of fatalities/injuries	- The WTP for a reduction in the risk of death or serious injury.
Environment	- Landscape	- The Environmental Landscape Feature (ELF) model constitutes a first attempt at a benefits transfer tool for appraising environmental policies. The model provides estimates of the WTP for some features (e.g. heather moorland, rough grazing, field margins and hedgerows) on an area basis, and estimates of their diminishing marginal utility.
	- Noise	- Noise is measured in Noise Exposure Forecast (NEFs); one NEF is equal to a mean exposure over time to one decibel of noise. The sensitivity of real estate prices to changes in noise level is measured by the noise depreciation sensitivity index.

Source: UK Treasury Green Book (2003)

When non-market impacts do not occur in the transactions between the producer and the direct users/beneficiaries of the project services but fall on uncompensated third parties, these impacts are defined as externalities. In other words, an externality is any cost or benefit that spills over from the project towards other parties without monetary compensation (see box for some examples).

EXAMPLE: POSITIVE AND NEGATIVE EXTERNALITIES

Benefits:

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

Costs:

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

Due to their nature, externalities are sometimes not well captured by the use of empirical WTP or LRMC, or by conversion factors based on border prices, so that they need to be evaluated separately, for example through willingness-to-pay or willingness-to-accept estimates of the external effect. Valuing externalities can sometimes be difficult (particularly environmental impacts), even though they may be easily identified. A project may, for example, cause ecological damage, whose effects, combined with other factors, will take place in the long run and are difficult to precisely quantify and value. In such a case, a 'benefits transfer' approach may be helpful: this approach applies to the project shadow prices that have been estimated in other contexts, i.e. for other projects or programmes. In practice, this approach uses values previously estimated in projects with similar (e.g. geographical) conditions as a proxy for the values of the same goods in the project under analysis. Although some adjustments are often necessary to reflect the differences between the original and the new project, this approach allows the proposer to save research efforts and to have, at the same time, reference values for the environmental benefits (or costs) that arise from the project implementation.

If a benefits transfer is not possible because of lack of data, then environmental impacts should at least be identified in physical terms for a qualitative appraisal in order to give the decision-maker more elements for a considered decision, by weighing up the more quantifiable aspects, as summarised in the economic rate of return, against the less quantifiable ones. Multi-criteria analysis is often useful in this framework (see par. 2.7). A full discussion of the assessment of environmental impact goes beyond the scope of this Guide, but CBA and environmental impact analysis are both required by EU regulations and should be considered in parallel and, whenever possible, should be integrated and consistent.

For a more detailed discussion on methodologies for the monetisation of environmental impacts and how to perform a benefits transfer see Annex F.

2.5.2.1 Accounting value of public sector owned capital assets

Many projects in the public sector use capital assets and land, which may be state-owned or purchased from the general Government budget.

Capital assets, including land, buildings, machinery and natural resources, should be valued at their opportunity cost and not at their historical or official accounting value. This has to be done whenever there are alternative options in the use of an asset and even if it is already owned by the public sector. Nevertheless, for some goods there may be no alternative use so that there is no related option value. In that case, past expenditures or irrevocable commitments of public funds are not social costs to be considered in the appraisal of new projects (e.g. 'sunk costs').

2.5.3 Inclusion of indirect effects

Indirect effects are defined as quantity or price changes occurring in secondary markets. To better understand whether indirect effects can be ignored or not when conducting a CBA, it is important to distinguish between efficient and distorted secondary markets. A distorted secondary market is a market in which prices do not equal social marginal opportunity costs. The existence of taxes, subsidies, monopoly power and externalities is the main cause of distortion of a market.

As anticipated in par. 2.2.2, indirect effects occurring in efficient secondary markets should not be included in the evaluation of the project's costs and benefits whenever an appropriate shadow price has been given in the primary markets. The main reason for not including indirect effects is not because they are more difficult to identify and quantify than direct effects, but because they are irrelevant in a general equilibrium setting, as they are already captured by shadow prices. Adding these effects to the costs and benefits measured in primary markets usually results in double-counting (see example below).

The circumstances, however, in which indirect effects have to be measured and considered, depend upon the existence of distortions such as taxes, subsidies, monopolistic rents and externalities. These effects may be positive or negative depending on the sign of the distortion in the secondary market and the cross-elasticity of the good in the secondary market with respect to the change in the primary market. In a partial equilibrium setting, indirect effects occurring in distorted secondary markets should, in principle, be included in the CBA, because it is only in this kind of market that they may represent important costs or benefits to society. For example, if a government intervention generates changes in the quantities exchanged in secondary markets, the costs or benefits resulting from the increased (or decreased) distortion should be measured. However, in practice, this may be difficult because although distortions are easily identifiable, their sizes are often difficult to measure. In addition, to produce significant changes in secondary markets very large price changes in the primary market are usually necessary, so that the magnitude of indirect effects is often not relevant and their exclusion from CBA accounts results in only a negligible bias.

In conclusion, indirect effects should be added to CBA only when the size of the distortion is sufficiently relevant and measurable, while, in general, a good use of shadow prices and a good monetisation of externalities are usually enough to account for indirect effects.

Since the identification of which benefits are to be included in CBA is not always obvious, the box below reviews some common mistakes in benefits counting that should be avoided by the project proposer.

EXAMPLE: MISTAKES IN BENEFITS COUNTING
Double Counting of Benefits. In considering the value of an irrigation project, both the increase in the value of the land and the present value of the increase in income from farming are counted as benefits. Only one of them should be counted because one could either sell the land or keep it and get the gains as a stream of income. **Counting Secondary Benefits**. If a road is constructed, one might count the additional commerce along the road as a benefit. Problem: under equilibrium conditions in competitive markets the new road may be displacing commercial activity elsewhere, so the net gain to society may be small or zero. People forget to count the lost benefits elsewhere (e.g. for newly generated traffic). **Counting Labour as a Benefit**. In arguing for 'pork barrel[8]' projects, some politicians often talk about the jobs created by the project as a benefit. But wages are part of the cost of the project, not the benefits. The social benefit of employment is already given by using shadow wages. However, a separate analysis of labour market impact can be helpful in some circumstances and is required by the Funds regulations.

2.5.4 Social discounting

Costs and benefits occurring at different times must be discounted. The discount rate in the economic analysis of investment projects - the social discount rate (SDR) - reflects the social view on how future benefits and costs should be valued against present ones. It may differ from the financial discount rate when the capital market is inefficient (for example when there is credit rationing, asymmetric information and myopia of savers and investors, etc.).

For the 2007-2013 period, the European Commission has suggested using two benchmark social discount rates: 5.5% for the Cohesion countries and 3.5% for the others. These SDRs are based on estimates of long term growth potentials and other parameters. For a more detailed discussion about the social discount rate see Annex B. SDRs that differ from the benchmarks may, however, be justified on the basis of individual Member States' or Candidate countries' specific socio-economic conditions. Once a social discount rate is set at country level by a planning authority, it must be applied consistently to all projects belonging to the same country (the only possible exceptions being significant differences in expected growth rates at NUTS I or macro-regional level within the country).

2.5.5 Calculation of economic performance indicators

After the correction of price/wage distortions and the choice of an appropriate social discount rate, it is possible to calculate the project's economic performance using the following indicators:

- economic net present value (ENPV): the difference between the discounted total social benefits and costs;
- economic internal rate of return (ERR): the rate that produces a zero value for the ENPV;
- B/C ratio, i.e. the ratio between discounted economic benefits and costs.

[8] The term refers to the political metaphor for the appropriation of the government spending for projects that are intended to benefit particular constituents or contributors.

FOCUS: ENPV VS. FNPV
The difference between ENPV and FNPV is that the former uses accounting prices or the opportunity cost of goods and services instead of imperfect market prices, and it includes as far as possible any social and environmental externalities. This is because the analysis is done from the point of view of society, not just the project owner. Because externalities and shadow prices are considered, most projects with low or negative FNPV(C) will now show positive ENPV.

The ENPV is the most important and reliable social CBA indicator and should be used as the main reference economic performance signal for project appraisal. Although ERR and B/C are meaningful because they are independent of the project size, they may sometimes involve problems. In particular cases, for example, the ERR may be multiple or not defined, while the B/C ratio may be affected by considering a given flow as either a benefit or a cost reduction.

On the contrary, there might be cases where the use of the benefit-cost ratio is appropriate, for example under the capital budget constraints (see Annex C).

In principle, every project with an ERR lower than the social discount rate or a negative ENPV should be rejected. A project with a negative economic return, uses too much of socially valuable resources to achieve too modest benefits for all citizens. From the EU perspective, sinking a capital grant in a project with low social returns means diverting precious resources from a more valuable development use. For example, from the perspective of Cohesion Policy, a low return investment in a Convergence Objective region means that the project will contribute nothing to achieve the objective.

In some exceptional cases, however, a project with a negative ENPV could be accepted for EU assistance if there are important non-monetized benefits (e.g. for biodiversity preservation projects, cultural heritage sites, landscape). This should be seen as a rare occurrence, and the appraisal report should still specify in a convincing way, through a structured argument, sustained by adequate data, that, in some sense, social benefits exceed social costs, even if the applicant is unable to fully quantify the former. There should clearly be a strong case for such a request for co-financing of a major project.

Table 2.11 Observed ERR of a sample of investment projects sponsored by the EU during the previous programming periods

	N. of projects	ERR% Average	ERR% Std. Dev.	Sector average / total average
Energy production[a]	3	14.19	9.36	0.87
Energy transport and distribution[b]	2	12.60	6.22	0.77
Roads and highways[b]	56	15.53	9.58	0.95
Railways and underground[b]	48	11.62	8.21	0.71
Ports, airports[b]	20	26.84	28.99	1.64
Water supply and waste water treatment[b]	116	11.33	6.31	0.69
Solid waste treatment[b]	31	28.27	72.24	1.72
Industries and other productive investments[a]	2	15.17	7.30	0.93
Other[b]	11	11.96	10.53	0.73
TOTAL	289	16.39	17.64	1.0

a: 1994-1999 programming period; b: 2000-2006 programming period
Source: Authors' calculations on available DG Regio data. On ISPA projects see Florio and Vignetti (2006).

Table 2.12 Review of the main analytical items

	Definition	Value/formula	Section
National parameters			
Financial Discount Rate	The rate at which future values in the financial analysis are discounted to the present. It reflects the opportunity cost of capital.	5%, in real terms (EC Working Doc. N.4)	par. 2.4 Annex B
Social Discount Rate	The rate at which future values in the economic analysis are discounted to the present. It reflects the social view on how net future benefits should be valued against present ones.	3.5%, in real terms (EC recommendation for countries non-eligible for the Cohesion Fund) 5.5%, in real terms (Cohesion Fund eligible countries)	par. 2.5.4 Annex B
Welfare weight[1]	Weight for adjusting the project net benefits in order to include distributive effects in the analysis.	$W = \left(\frac{\overline{C}}{C_i}\right)^e$	par. 2.4.2 Annex G
Standard Conversion Factor[2]	General factor for adjusting market prices to accounting (shadow) prices.	$SCF = (M + X) / [(M + T_m) + (X - T_x)]$	par. 2.5.1
Shadow Exchange Rate[3]	The economic price of foreign currency, which may diverge from the official exchange rate.	$SER = \sum [OER_t * (CI_t / CO_t)] / n$	par. 2.5.1
Marginal Cost of Public Funds	The ratio between the shadow price of tax revenues and the population average of the social marginal utility of income.	Country-based values, dependent on taxation system	par. 2.5.1
Shadow prices	Prices to be used in the economic analysis, reflecting inputs' opportunity costs and/or consumers' willingness-to-pay for outputs.		par. 2.5.1
Traded items	The shadow prices are the international or border prices.	CIF for imports and FOB for exports	par. 2.5.1
Non-traded minor items	The national Standard Conversion Factor should be used to correct their prices.	$SCF = (M + X) / [(M + T_m) + (X - T_x)]$	par. 2.5.1
Non-traded major items[4]	Sector-specific conversion factors should be used to correct their prices.	$SCF_i = WTP/p$ or MC/p	par. 2.5.1
Shadow wage[5]	The opportunity-cost of labour. The value depends on the different types of unemployment: 1) Full employment 2) mild unemployment 3) dualistic labour market 4) strong involuntary unemployment	1) $SWR = W$ 2) $SWR = mc + zd$ 3) $SWR = n(\Delta u/\Delta L) + zd$ 4) $SWR = W(1-u)(1-t)$	par. 2.5.1 Annex D
Performance indicators[6]			
Financial net present value	The sum that results when the expected financial costs of the investment are deducted from the discounted value of the expected revenues.	$FNPV = \sum_{t=0}^{n} a_t S_t = \frac{S_0}{(1+i)^0} + \frac{S_1}{(1+i)^1} + \ldots + \frac{S_n}{(1+i)^n}$	par.2.4.5 Annex C
Financial rate of return on investment	The discount rate that zeros out the FNPV. It is compared with a benchmark in order to evaluate the project performance.	$0 = \sum \frac{St}{(1+FRRC)^t}$	par. 2.4.5 Annex C
Financial rate of return on capital	The return for the national beneficiaries (public and private combined).	$0 = \sum \frac{St}{(1+FRRK)^t}$	par. 2.4.6 Annex C
Economic net present value	The difference between the discounted total social benefits and costs.	$ENPV = \sum_{t=0}^{n} a_t S_t = \frac{S_0}{(1+i)^0} + \frac{S_1}{(1+i)^1} + \ldots + \frac{S_n}{(1+i)^n}$	par. 2.5.5 Annex C
Economic rate of return	The discount rate that zeros out the ENPV. It is compared with a benchmark in order to evaluate the project performance.	$0 = \sum \frac{St}{(1+ERR)^t}$	par. 2.5.5 Annex C
Benefit-cost ratio	The ratio of the present value of social benefits to the present value of social costs over the time horizon.	$\frac{B}{C} = \frac{PV(B)}{PV(C)}$	par. 2.5.5 Annex C

Legenda:

[1]*Welfare weight:* *C: average consumption level;* C_i*: per capita consumption; e: constant elasticity of marginal utility of income*

[2]*Standard Conversion Factor:* *M: Total imports; X: Total exports;* T_m*: import taxes;* T_x*: export taxes*

[3]*Shadow Exchange Rate:* *OER: official exchange rate; CI: currency inflow; CO: currency outflow; n: number of years; t: time*

[4]*Shadow Prices:* *MC: marginal cost; WTP: willingness-to-pay; p: price*

[5]*Shadow wage:* *W: market wage; L: labour; c: conversion factor; d: conversion factor; m: lost annual output of hiring a new employee; n: reservation wage; t: rate of social security payments and relevant taxes; u: unemployment rate; z: additional cost of transferring workers (relocation)*

[6]*Performance indicators:* *PV: present value; St: balance of cash flow funds;* a_t*: discount factor; i: discount rate*

2.6 Risk assessment

Project appraisal is a forecasting exercise rather than the formulation of an opinion. However, no forecast is without problems. For example, one may know that because of data limitations the forecasts for the demand for drinking water are affected by estimates that are prone to considerable errors. Engineers may explain that the data regarding the performance of the equipment they suggest for use are valid only approximately. One may also have doubts about some parameters crucial to the calculation of the return, such as the shadow wage.

Traditionally, a distinction between risk and uncertainty concepts is made. In the beginning there is just uncertainty, but this can be transformed into 'risk' with an assessment of probability distributions indicating the likelihood of the realised value of a variable falling within stated limits. Accordingly, it becomes apparent that risk, but not uncertainty, is subject to empirical measurement, and can be analysed and possibly managed.

Against this background, the Funds' regulations require a risk assessment for major infrastructure and productive investment projects (Article 40 1083/2006 EU Regulations).

A risk assessment consists of studying the probability that a project will achieve a satisfactory performance (in terms of some threshold value of the IRR or the NPV). Probability should here be understood as an index that takes the value 1 under full certainty that a prediction will be confirmed, a zero value for certainty that the prediction will not be confirmed, and intermediate values for anything in between the two extremes.

The recommended steps for assessing the project risk are:

- sensitivity analysis
- probability distributions for critical variables
- risk analysis
- assessment of acceptable levels of risk
- risk prevention.

The rest of the section presents the steps and highlights the following additional topics:

- the switching value (par. 2.6.1)
- scenario analysis (par. 2.6.1)
- precautionary principle (par. 2.6.4)
- optimism bias (par. 2.6.5).

2.6.1 Sensitivity analysis

Sensitivity analysis allows the determination of the 'critical' variables or parameters of the model. Such variables are those whose variations, positive or negative, have the greatest impact on a project's financial and/or economic performance. The analysis is carried out by varying one element at a time and determining the effect of that change on IRR or NPV.

The criteria to be adopted for the choice of the critical variables vary according to the specific project and must be accurately established on a case-by-case basis. As a general criterion, the recommendation is to consider those variables or parameters for which an absolute variation of 1% around the best estimate gives rise to a corresponding variation of not less than 1% (one percentage point) in the NPV (i.e. elasticity is unity or greater).

The procedure that should be followed to conduct a sensitivity analysis includes the following steps:

A. identification of variables

B. elimination of deterministically dependent variables

C. elasticity analysis

D. choice of critical variables.

A. Table 2.13 illustrates some examples for the identification of the variables used to calculate the output and input of the financial and economic analyses, grouping them together in homogeneous categories.

Table 2.13 Identification of critical variables

Categories	Examples of variables
Price dynamics	Rate of inflation, growth rate of real salaries, energy prices, changes in prices of goods and services
Demand data	Population, demographic growth rate, specific consumption, sick rate, demand formation, volume of traffic, size of the area to be irrigated, market volumes of a given commodity
Investment costs	Duration of the construction site (delays in realisation), hourly labour cost, hourly productivity, cost of land, cost of transport, cost of concrete aggregate, distance from the quarry, cost of rentals, depth of the wells, useful life of the equipment and manufactured goods
Operating costs	Prices of the goods and services used, hourly cost of personnel, price of electricity, gas, and other fuels
Quantitative parameters for the operating costs	Specific consumption of energy and other goods and services, number of people employed
Prices of outpits	Tariffs, sales prices of products, prices of semi-finished goods
Quantitative parameters for the revenues	Hourly (or other period) production of goods sold, volume of services provided, productivity, number of users, percentage of penetration of the area served, market penetration
Accounting prices (costs and benefits)	Coefficients for converting market prices, value of time, cost of hospitalisation, cost of deaths avoided, shadow prices of goods and services, valorisation of externalities
Quantitative parameters for costs and benefits	Sick rate avoided, size of area used, added value per hectare irrigated, incidence of energy produced or secondary raw materials used

B. Deterministically dependent variables would give rise to distortions in the results and double-counting. If, for example, labour productivity and global productivity appear in the model, then the latter obviously includes the former. In this case, it is necessary to eliminate the redundant variables, choosing the most significant ones, or to modify the model to eliminate internal dependencies. The variables considered must, as far as possible, be independent variables. Additionally, variables should, as far as possible, be analysed in their disaggregated form: for example 'revenue' is a compound variable, but either 'quantity' or 'price' or both separately may be critical.

It is advisable to carry out a preliminary qualitative analysis of the impact of the variables in order to select those that have little or marginal elasticity (Table 2.14). The subsequent quantitative analysis can be limited to the more significant variables. Having chosen the significant variables, one can then evaluate their impact elasticities by making the calculations. Each time, it is necessary to assign a new value (higher or lower) to each variable and recalculate the NPV, thus noting the differences (absolute and percentage) compared to the base case. Since, generally speaking, there is no guarantee that the impact elasticities of the variables will always be linear functions, it is advisable to verify this, repeating the calculations for different arbitrary deviations (see demand and productivity variables in Figure 2.3).

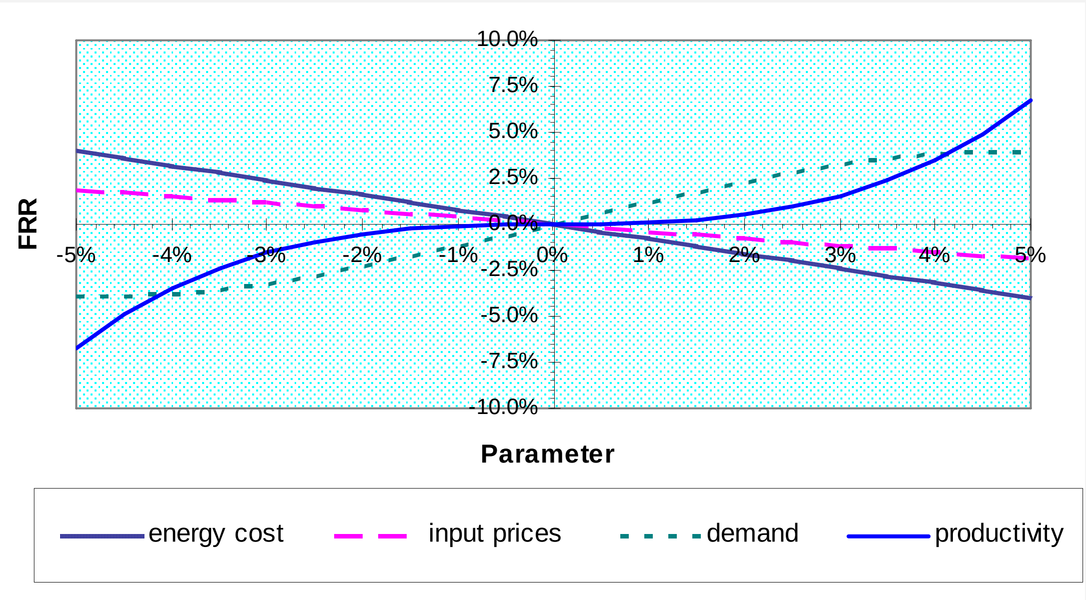
C. At the end of this selection, the critical variables will presumably be few, unless the threshold value chosen for performance elasticity is exaggeratedly small. In a project for a hospital, motorway or even an industrial plant, the key variables are few (for example the total value of the fixed investment, the size and timing of returns, the interest rate) and they dominate the effects of the others (for example, the prices of minor inputs).

Table 2.14 Impact analysis of critical variables

Categories	Parameters	Elasticity		
		High	Intermediate	Low
Price dynamics	rate of inflation	X		
	change of personnel costs		X	
	change of energy prices			X
	change of prices of goods and services			X
Demand data	specific consumption	X		
	rate of demographic growth			X
	volume of traffic	X		
Investment costs	hourly labour construction cost	X		

An example of a possible result of the sensitivity analysis is shown in Figure 2.5: according to the aforementioned general criterion (a variation of the variable of 1% corresponds to at least one percentage point variation in NPV), the critical variables are demand and productivity, while energy cost and input prices are below the threshold.

Figure 2.5 Sensitivity analysis



FOCUS: THE SWITCHING VALUE
The switching value of a variable is that value that would have to occur in order for the NPV of the project to become zero, or more generally, for the outcome of the project to fall below the minimum level of acceptability.
The use of switching values in sensitivity analysis allows appraisers to make some judgements on the riskiness of the project and the opportunity of undertaking risk-preventing actions. For example if one of the critical variables of a transport project is 'forecasted demand' and its switching value is -20%, then the proposer can evaluate if the conditions for such a decrease exist and, in a positive case may consider preventing actions (e.g. tariffs reduction).
The following table provides some examples of switching values for an agricultural project:

Variable	Switching Value (%)
- Yield per hectare	- 25
- Construction costs	40
- Irrigated area per pump	-50
- Shadow exchange rate	60

Source: adapted from Belli P. et al., Economic analysis of investment operations (2001)

2.6.1.1 Scenario analysis

Scenario analysis is a specific form of sensitivity analysis. While under standard sensitivity analysis the influence of each variable on the project's financial and economic performance is analysed separately, scenario analysis studies the combined impact of determined sets of values assumed by the critical variables. In particular, combinations of 'optimistic' and 'pessimistic' values of a group of variables could be useful to build different realistic scenarios, under certain hypotheses (Table 2.15). In order to define the optimistic and pessimistic scenarios it is necessary to choose for each critical variable the extreme values in the range defined by the distributional probability. Project performance indicators are then calculated for each combination.

Sensitivity/Scenario analysis should not be considered as a substitute for Risk Analysis, it is only an interim procedure.

Table 2.15 Example of scenario analysis

		Optimistic scenario	Baseline case	Pessimistic scenario
Investment cost	Euro	125,000	130,000	150,000
Traffic	% var	9	5	2
Tolls	€/unit	5	2	1
FRR(C)	%	2	-2	-8
FRR(K)	%	12	7	2
ERR	%	23	15	6

2.6.2 Probability distributions for critical variables

Sensitivity and scenario analyses have the major limitation of not taking into account the probabilities of occurrence of events. In fact, the practice of varying the values of the critical variables by arbitrary percentages does not have any relation with the likely variability of such variables.

The next step is to assign a probability distribution to each of the critical variables, defined in a precise range of values around the best estimate, used as the base case, in order to calculate the expected values of financial and economic performance indicators.

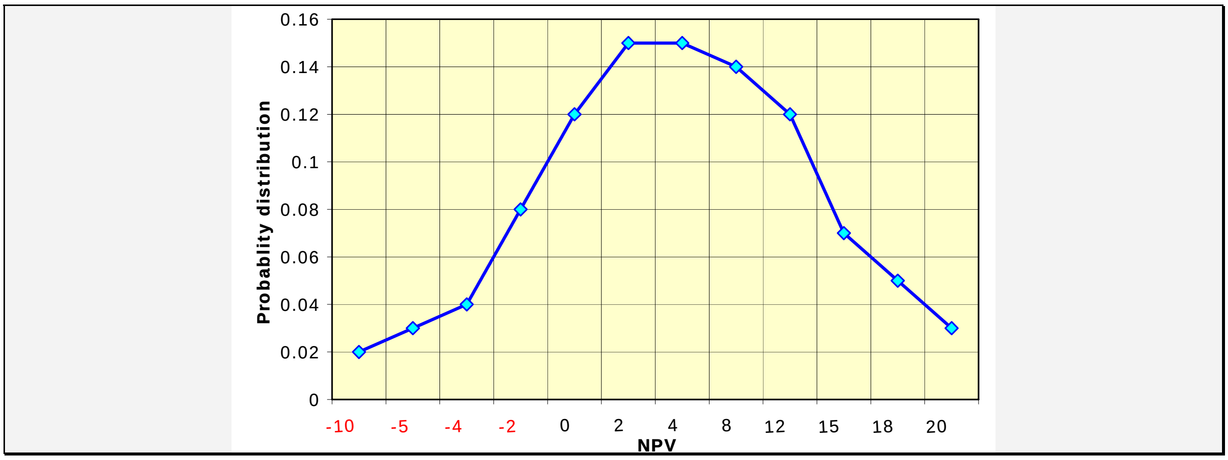
The probability distribution for each variable may be derived from different sources, such as experimental data, distributions found in the literature for similar cases, consultation of experts. Obviously, if the process of generating the distributions is unreliable, the risk assessment is unreliable as well. However, in its simplest design (e.g. triangular distribution, see Annex H) this step is always feasible and represents an important improvement in the understanding of the project's strengths and weaknesses as compared with the base case.

2.6.3 Risk analysis

Having established the probability distributions for the critical variables, it is possible to proceed with the calculation of the probability distribution of the FRR or NPV of the project. For this purpose, the use of the Monte Carlo method is suggested, which requires a simple computation software (see Annex H). The method consists of the repeated random extraction of a set of values for the critical variables, taken within the respective defined intervals, and then calculating the performance indices for the project (FRR or NPV) resulting from each set of extracted values. By repeating this procedure for a large enough number of extractions (generally no more than a few hundred) one can obtain a pre-defined convergence of the calculation as the probability distribution of the FRR or NPV.

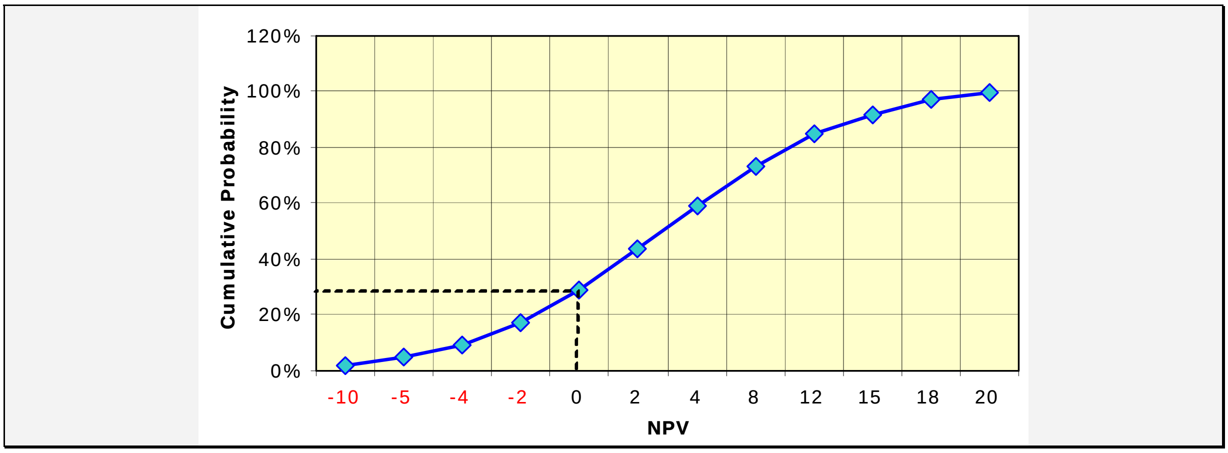
The most helpful way of presenting the result is to express it in terms of the probability distribution or cumulated probability of the FRR or the NPV in the resulting interval of values. Figures 2.6 and 2.7 provide graphical examples.

Figure 2.6 Probability distribution for NPV



The cumulative probability curve (or a table of values) permits an assessement of the project risk, for example by verifying whether the cumulative probability is higher or lower than a reference value that is considered to be critical. One can also assess the probability that the NPV (or FRR) will be lower than a certain value, which is adopted as the benchmark (e.g. zero for NPV and 5% for FRR). In the example, see Figure 2.7, there is a probability of about 30% that the NPV will be negative.

Figure 2.7 Cumulative probability distribution for NPV



2.6.4 Assessment of acceptable levels of risk

Often the NPVs and IRRs reported in project appraisal reports refer to best or baseline estimates, perhaps meaning 'most likely' values (or mode). However, the criterion for project acceptability should be that of the expected value (or mean) of such indicators, calculated from the underlying probability distributions.

For instance, if a project has an ERR of 10% but also the probability risk analysis tells us that the ERR has a value between 4 and 10 with a probability of 70% and a value between 10 and 13 with a probability of 30%, then the expected value of ERR for that project is only 8.35% [average(4,10)*0.7 + average(10,13)*0.3].

In conclusion, the procedure described allows for the selection of projects not only on the basis of the best estimate, but also based on the risk associated with it, simply by weighting the performance with the risk. In principle, the expected performance, and not the modal one, is the value that should be reported in the application form for major projects requiring EU assistance. In order to evaluate the result, one very important aspect is the compromise to be made between high risk projects with high social benefits, on the one hand, and low risk projects with low social benefits, on the other.

Generally, a neutral attitude towards risks is recommended because the public sector might be able to pool the risks of a large number of projects. In such cases, the expected value of the ERR could summarise the risk assessment. In some cases, however, the evaluator or the proposer can deviate from neutrality and prefer to risk more or less for the expected rate of return; there must, however, be a clear justification for this choice (for example, a very large project in a small country).

FOCUS: RISK AVERSION AND PRECAUTIONARY PRINCIPLE
To illustrate this concept one can consider innovative projects, which may be more risky than traditional ones. If, for example, these have only a 50% probability of achieving the expected results, then their net social value, for an investor who is neutral to risk, should therefore be halved. However innovation itself is sometime an additional criterion of preference: in that case innovative projects must be evaluated by awarding a prize to well-deserving 'innovation' and by not overlooking the risk. However, in the case of projects introducing new technologies with a potential risk of harm to the environment and/or public health, a strong aversion to risk is usually adopted, despite lack of scientific certainty about the likelihood, magnitude, or cause of that harm (precautionary principle).

2.6.5 Risk prevention

A typical source of forecasting mistakes in project appraisal is optimism bias, i.e. the demonstrated systematic tendency for project appraisers to be over-optimistic about the estimation of the key project parameters: investment costs, works duration, operating costs and benefits (UK Treasury Green Book, 2003).

Many causes may be involved in optimism bias; Table 2.16 provides some examples for transport projects.

Table 2.16 Causes of optimism bias

Causes of optimism bias	Examples
Technical causes	Imperfect information such as unavailability of data, new or unproven technology. Scope changes such as changes in relation to speed, road width, routing, safety, and environment norms. Management issues such as inappropriate calculation approach, procurement issues and risk sharing.
Psychological causes	Tendency for humans and organisations to favour optimism.
Economic causes	Construction companies and consultants have interests in advancing projects.
Political-institutional causes	Interests, power and institutions. Actors may deliberately lie in order to see their project/interest realised.

Source: UK Treasury Green Book 2003

To minimise the level of optimism bias, specific adjustments in the form of increased cost estimates and decreased, or delayed, benefit estimates should be made. Such adjustments should be empirically based, for example using data from past or similar comparable projects, whilst experts' consultancy may also be useful (see also Annex H).

Adjusting for optimism bias will therefore provide better estimates at an early stage of the appraisal process. However, these adjustments should not be seen as a substitute for risk assessment, but rather as a more accurate basis on which to develop risk analysis, which in principle is all that one would need, if conducted accurately with the use of expected indicators. Risk analysis should then be the basis for risk management, which is the identification of strategies to reduce risks, including how to allocate them to the parties involved and which risks to transfer to professional risk management institutions such as the insurance company.

Risk management is a complex function, requiring a variety of competences and resources, and it can be considered as a role for professionals, under the responsibility of the managing authority and the beneficiary. The project proposer should, however, following the risk analysis, at least identify specific measures for the mitigation of the identified risks, according to international good practice (see Annex H for some examples extracted from the World Bank Project Appraisal Documents).

2.7 Other project evaluation approaches

While cost-benefit analysis is the most commonly used technique in appraising public investment and it is the one required by the Funds regulations for major projects, other kinds of project analysis exist and are used. In this section, the main features and fields of application of Cost-Effectiveness Analysis (CEA), Multi-Criteria Analysis (MCA) and Economic Impact Analysis (EIA) are reviewed. These approaches cannot be seen as substitutes for CBA but rather as complements for special reasons, or as a rough approximation when actual CBA is impossible. Moreover, they are difficult to standardise and, under the Structural, Cohesion and IPA Funds, should be used with caution in order to avoid inconsistencies across regions and countries that will make the assessment of projects by the Commission Services more difficult.

2.7.1 Cost-effectiveness analysis

Cost-effectiveness analysis (CEA) is a comparison of alternative projects with a unique common effect which may differ in magnitude. It aims to select the project that, for a given output level, minimises the net present value of costs, or, alternatively, for a given cost, maximises the output level. CEA results are useful for those projects whose benefits are very difficult, if not impossible, to evaluate, while costs can be predicted more confidently. This methodology is often used in the economic evaluation of healthcare programmes, but it can also be used to assess some scientific research, education and environmental projects. For these examples, simple CEA ratios are used, such as the cost of research per patent, the cost of education per student, the cost per unit of emission reduction, and so on. CEA is less helpful when a value, even an indicative one, can be given to the benefits and not just to the costs.

Generally, CEA solves a problem of optimization of resources that is usually presented in the following two forms:

- given a fixed budget and n alternative projects, decision-makers aim to maximise the outcomes achievable, measured in terms of effectiveness (E);
- given a fixed level of E that has to be achieved, decision-makers aim to minimise the cost (C).

Although one could compare the simple ratios of costs to outcomes (C/E) for each alternative, the correct comparison is based on ratios of incremental costs to incremental outcomes, since this tells us how much we are paying in adding the extra, more beneficial, measure. In particular, when the alternative projects are competitors and mutually exclusive, an incremental analysis is required in order to rank the projects and single out the one that is most cost-effective.

Generally cost-effectiveness analysis is pursued to test the null hypothesis that the mean cost-effectiveness of one project (*a*) is different from the mean cost-effectiveness of some competing intervention (*b*). It is calculated as the ratio:

$$R = (C_a - C_b) / (E_a - E_b) = \Delta C / \Delta E$$

defining the incremental cost per unit of additional outcome.

While the measurement of costs is the same as in the financial analysis of CBA, the measurement of the effectiveness depends on the type of outcome chosen. Some examples of measures of effectiveness used in CEA are: number of life-years gained, days of disability avoided (healthcare projects), or test scores (education).

When a strategy is both more effective and less costly than the alternative ($C_a - C_b < 0$ and $E_a - E_b > 0$), it is said to 'dominate' the alternative: in this situation there is no need to calculate cost-effectiveness ratios, because the decision on the strategy to choose is obvious. However, in most circumstances, the project under examination is contemporaneously both more (or less) costly and more (or less) effective than the alternative(s) ($C_a – C_b > 0$ and $E_a – E_b > 0$ or, alternatively, $C_a – C_b < 0$ and $E_a – E_b < 0$). In this situation, the incremental cost-effectiveness ratios allow appraisers to rank the projects under examination and to identify, and then eliminate, cases of 'extended dominance'. This can be defined as the state when a strategy is both less effective and more costly than a linear combination of two other strategies with which it is mutually exclusive. More operationally, extended dominance is where the incremental cost-effectiveness ratio for a given project is higher than that of the next more effective alternative (see example below).

EXAMPLE: EXTENDED DOMINANCE IN COST-EFFECTIVENESS ANALYSIS

The table below shows the hypothetical incremental cost-effectiveness ratios for three interventions to improve cognitive capacity on a target of 50 children:

A) self computer-based learning;
B) education sessions to the whole sample target;
C) education sessions to small groups (up to five people).

	Cost (Euros)	**Effectiveness** (average test score)	**ΔC**	**ΔE**	**ΔC / ΔE**
A) Self computer-based learning	1,000	10	--	--	100
B) Education sessions to the whole sample target	4,000	15	3,000	5	600 (extended dominance)
C) Education sessions to small groups (up to five people)	9,000	40	5,000	25	200

In our example, strategy B is a case of extended dominance because strategy C has a lower cost-effectiveness ratio (200<600). Thus, it should be excluded from the choice of possible interventions. On the contrary, strategies A and C are both 'good buys' and their implementation will depend on the budget available.

In practice, CEA allows appraisers to exclude those options that are not technically efficient (because dominated) while for the remaining projects, the choice will depend on the size of the budget. The treatment with the lowest incremental cost-effectiveness ratio should be the first to be implemented and then other strategies should be added until the budget is exhausted.

There are also technical problems in aggregating outcomes that appear over different years, because it is not obvious what the specific discount factor should be (clearly neither the FDR or the SDR apply to discounting numbers of students, or patents or emissions).

In conclusion, cost-effectiveness analysis is a tool for project comparison when only a single dimension of outcome matters. This aspect limits significantly its field of application: in most circumstances, projects have impacts not falling into a unique effectiveness measure. Also, without valuation of benefits, CEA can only measure technical efficiency rather than allocative efficiency. The only case for which CEA is perhaps close to CBA is when the effectiveness measure captures all the social benefits delivered by a certain project, but this is a very difficult task. In health-care programmes, the 'life-years saved' (sometimes also adjusted by their 'quality') can be considered a comprehensive social welfare measure. In fact, when the planner assigns a conventional money value to the statistical life (or the quality-adjusted statistical life) in health care, as in transport or in some environmental projects, we are back to standard CBA.

2.7.2 Multi-criteria analysis

Multi-Criteria Analysis (MCA) is a family of algorithms used to select alternatives according to a set of different criteria and their relative 'weights'. In contrast to CBA, which focuses on a unique criterion (the maximisation of social welfare), Multi Criteria Analysis is a tool for dealing with a set of different objectives that cannot be aggregated through shadow prices and welfare weights, as in standard CBA.

There are many ways to design an MCA exercise. One possible approach is as follows:

- objectives should be expressed in measurable variables. They should not be redundant but could be alternative (the achievement of a bit more of one objective could partly preclude the achievement of the other);
- once the 'objectives vector' has been determined, a technique should be found to aggregate information and to make a choice; the objectives should have assigned weights reflecting the relative importance given to them by the policy-maker;
- definition of the appraisal criteria; these criteria could refer to the priorities pursued by the different parties involved or they could refer to particular evaluation aspects;
- impact analysis: this activity involves describing, for each of the chosen criteria, the effects it produces. Results could be quantitative or qualitative;
- forecast of the effects of the intervention in terms of the selected criteria; from the results coming from the previous stage (both in qualitative and in quantitative terms) a score, or a normalised value, is assigned (this is the equivalent of 'money' in CBA);
- identification of the typology of subjects involved in the intervention and the determination of respective preference functions (weights) accorded to different criteria;
- scores under each criterion are then aggregated (simply with a sum or with a non-linear formula) to give a numerical evaluation of the intervention; the result can then be compared with the result for other similar interventions.

The project examiner should then verify if:

- forecasts for non-monetary aspects have been quantified in a realistic way in the ex-ante evaluation;
- there is in any case a CBA for the standard objectives (financial and economic analysis);
- the additional criteria under the MCA have a reasonable political weight, so as to determine significant changes in the financial and economic results.

EXAMPLE: MCA AS A COMPLEMENTARY TOOL TO APPRAISE ENVIRONMENTAL PROJECTS

MCA is useful when the monetisation of costs and benefits is difficult or even impossible. Let us suppose that a certain project shows, at a discount rate of 5%, a negative economic net present value of one Millions of Euros. This means that the project examiner foresees a net social loss of the project in monetary terms. However, the project proposer could assess that, despite this, the project should be financed by the Funds because it has a 'very positive' environmental impact that it is not possible to monetise. For example the project is supposed to cut the polluter Z emissions by 10% per year.
Now one should ask if:

a) the forecast of the emission cut in physical terms is reliable;
b) one Millions of Euros is an acceptable 'price' for the reduction of 10% in the emissions;
c) such a 'price' is consistent with the weight that the government of the Member State or the Commission attaches to similar projects.

For instance, one may see whether -regularly or even occasionally- Member States have funded similar projects or, if there is no evidence of consistency, one should enquire why this deviation form previous practice is proposed for the project under EU assistance.

When the benefits are not just non-monetary, but also physically unmeasurable, a qualitative analysis should still be conducted. A set of criteria relevant for the project appraisal (equity, environmental impact, equal opportunity) is collected in a matrix together with the impacts (measured with scores or percentages) of the project on the relevant criteria. Another matrix should then assign weights to each relevant criteria. By multiplying scores and weights, the total impact of the project is obtained: this allows the selection of the best alternative. In the example shown in Table 2.17, project B has greater social impact, given preferences for the chosen social criteria. It should be stressed that these matrices are simple, but highly subjective, and much prudence is needed in the interpretation of the results.

Table 2.17 Simple multi-criteria analysis for two projects

	Project A			Project B		
	Scores*	Weight	Impact	Scores*	Weight	Impact
Equity	2	0.6	1.2	4	0.6	2.4
Equal opportunity	1	0.2	0.2	1	0.2	0.2
Environmental protection	4	0.2	0.8	2	0.2	0.4
Total	2.2: moderate impact			3.0: relevant impact		

** 0: zero impact; 1: scarce impact; 2: moderate impact; 3: relevant impact; 4: very high impact*

2.7.3 Economic impact analysis

As regards major projects, Article 40(e) 1083/2006 EU Regulations requires Member States or managing authority to provide the Commission with a cost-benefit analysis, including '*the foreseeable impact on the sector concerned and on the socio-economic situation of the Member State and/or the region and, when possible and when appropriate, of other regions of the Community*."

The discussion of the socio-economic context, as in section 2.1.1 will usually deal at least qualitatively with some project impacts at national, regional or sector level, but CBA is intrinsically a micro-economic approach. The overall social impact is captured by the ENPV and this would be a sufficient statistic of welfare changes. When mega-projects (very large projects relative to the economy) are considered, they are likely to have a macroeconomic impact (technically they are going to change the shadow prices because they are non-marginal). In such (infrequent) cases, an economic impact assessment may be carried out as a complement to CBA.

Economic impact analysis is a tool to assess the impact of a given intervention or programme on its socio-economic environment. This kind of analysis focuses on macroeconomic indicators and forecasts the influence of the project on these indicators. The results of economic impact analysis often determine whether public support should be provided on the grounds of economic benefits to a given area.

The results should be helpful at:

- sector level, in identifying critical areas and defining policy actions;
- the macroeconomic level, in defining relative contributions.

For example, the method can be used to assess the wider economic impacts of a facility or an event/attraction on a target locality. In the context of the Structural Funds, the social, economic and environmental impacts of an intervention are all interlinked. The various types of impact assessment may therefore need to be combined in an integrated impact assessment, the nature of which will vary according to the type of intervention, and the aims of cost-effectiveness of the overall impact assessment package.

Rather than an alternative to CBA, economic impact analysis is therefore recommended as a complementary tool, at least to the extent that economic impact analysis provides additional information, not deliverable by CBA, on the macro effects of project implementation (e.g. impact on regional trade, impact on GDP growth, etc.).

EXAMPLE: ECONOMIC IMPACT ANALYSIS FOR PROJECTS BELONGING TO THE TEN-T AXIS

Recent evidence shows the use of Economic Impact Analysis for major transport projects, as, for example, the Oersund Fixed link, operative since 2000 and connecting Denmark (Copenhagen) with Sweden (Malmoe).
Beyond a CBA, the economic impact of the link was evaluated, as it was built with the objective of strengthening the economic and cultural ties between Denmark and Sweden. In particular, before project implementation, the Oeresundsbro Konsortiet (the project operator) defined and evaluated the possible impacts of the link at regional level as follows:

- creation of a balance between the relatively high level of unemployment in Skane (Sweden) and the acute demand for labour in Denmark (especially Copenhagen);
- relief of the overheated housing market in the Copenhagen area whereas housing in Skane is more reasonably priced and capacities are available;
- creation of a domestic market comprising 3.6 million consumers and 220,000 Danish and Swedish companies.

Source: EVATREN

PROJECT APPRAISAL CHECK-LIST

CONTEXT AND PROJECT OBJECTIVES

- ✓ Are the social, institutional and economic contexts clearly described? Does the project have clearly defined objectives in terms of socio-economic indicators?
- ✓ Are the socio-economic benefits actually attainable with the implementation of the project?
- ✓ Have all the most important socio-economic effects of the project been considered in the context of the region, sector or country concerned?
- ✓ Is the project coherent with the EU objectives of the Funds? (Art. 3 and Art. 4 Reg. 1083/2006, Art. 1 and Art. 2 Reg. 1084/2006; Art. 1 and Art. 2 Reg. 1085/2006)
- ✓ Is the project coherent with the overarching national strategy and priorities defined in the national strategic reference frameworks and the operational programmes? (Art. 27 and Art. 37 Reg. 1083/2006, Art. 12 Reg. 1080/2006)
- ✓ Are the means of measuring the attainment of objectives indicated and their relationship, if any, with the targets of the Operational Programmes?

PROJECT IDENTIFICATION

- ✓ Does the project constitute a clearly identified self-sufficient unit of analysis?
- ✓ Have the indirect effects been properly considered (and excluded if appropriate shadow prices are used)?
- ✓ Have the network effects been considered?
- ✓ Whose costs and benefits are going to be considered in the economic welfare calculation ('who has standing')? Are all the potentially affected parties considered?

FEASIBILITY AND OPTION ANALYSIS

- ✓ Does the application dossier contain sufficient evidence of the project's feasibility (from an engineering, institutional, management, implementation, environmental…point of view)?
- ✓ Has the do-nothing scenario ('business as usual') been identified to compare the situations with and without the project?
- ✓ Has the applicant demonstrated that other alternative feasible options have been adequately considered (in terms of do-minimum and a small number of do-something options)?

FINANCIAL ANALYSIS

- ✓ Have depreciation, reserves, and other accounting items which do not correspond to actual flows been eliminated in the analysis?
- ✓ Has the determination of the cash flows been made in accordance with an incremental approach?
- ✓ Is the choice of the discount rate consistent with the Commission's or Member States' own guidance? If not, why?
- ✓ Is the choice of the time horizon consistent with the recommended value? If not, why?
- ✓ Has the residual value of the investment been calculated?
- ✓ In the case of using current prices, has a nominal financial discount rate been employed?
- ✓ In the case of revenue generating projects, has the 'amount to which the co-financing rate applies' been identified in accordance with EU regulations (Art. 55 Reg. 1083/2006)?
- ✓ Have the main financial performance indicators been calculated (FNPV(C), FRR(C), FNPV(K), FRR(K)) considering the right cash-flow categories?
- ✓ If private partners are involved, do they earn normal profits as compared with some financial benchmarks?

ECONOMIC ANALYSIS

- ✓ Have prices of inputs and outputs been considered net of VAT and of other indirect taxes?
- ✓ Have prices of inputs, including labour, been considered gross of direct taxes?
- ✓ Have subsidies and pure transfer payments been excluded?
- ✓ Have externalities been included in the analysis?
- ✓ Have shadow prices been used to better reflect the social opportunity cost of the resources employed?
- ✓ In the case of major non-traded items, have sector-specific conversion factors been applied?
- ✓ Has the appropriate shadow wage been chosen in accordance with the nature of the local labour market?
- ✓ Is the choice of the social discount rate consistent with the Commission's or Member States' guidance? If not, why?
- ✓ Have the main economic performance indicators been calculated (ENPV, ERR and B/C ratio)?
- ✓ Is the economic net present value positive? If not, are there important non-monetised benefits to be considered?

RISK ASSESSMENT

- ✓ Is the choice of the critical variables consistent with the elasticity threshold proposed?
- ✓ Has the sensitivity analysis been carried out variable by variable and possibly using switching values?
- ✓ Has the expected value criterion been used to evaluate the project performance?
- ✓ Have ways to minimise the level of optimism bias been considered?
- ✓ Have risk mitigation measures been identified?

OTHER EVALUATION APPROACHES

- ✓ If the project has been shown to have important effects that are difficult to assess in monetary terms, has the opportunity to carry out an additional analysis, such as CEA or MCA, been considered?
- ✓ Is the choice of the additional analysis suitable with the fields of application of CEA and MCA?
- ✓ If performing a CEA, have incremental cost-effectiveness ratios been calculated to exclude 'dominated' alternatives?
- ✓ If performing an MCA, are the applied weights consistent with the relative importance of the effects on society?
- ✓ If the project is likely to have a significant macroeconomic impact, has the opportunity to carry out an Economic Impact Analysis been considered?

CHAPTER THREE
OUTLINES OF PROJECT ANALYSIS BY SECTOR

Overview

This chapter extends the concepts expressed in the preceding sections, with reference to some sectors supported by EU Funds and with a particular focus on transport, environment, industry and other productive investments.

The main purpose of the chapter is to show, on the one hand, the established methods that should form the basis of a good appraisal and, on the other, some issues that deserve particular attention.

The outlines of all the sectors are organised, as far as possible, in the same way. The outlines start with an introduction to the projects through the description of the main objectives and characteristics. The scope of the feasibility paragraph is to summarise the main inputs that should, ideally, be produced, including demand forecasts, options for consideration etc., before entering the financial and economic evaluation sections, which are supported also by the case studies presented in Chapter 4.

Some sectors are treated in a more simplified way, focusing on what are considered to be the most important or complex issues for each sector. Where helpful, checklists have been provided. The outlines are based on the approach described in Chapter 2 and follow the suggested steps. Each sector presents a general description of possible project objectives as well as the main inputs for the financial and economic analysis. For some sectors this is not a trivial task. Although projects belonging to the same sector may differ substantially, the outline tries to indicate - for each sector - the main sources of social benefits and costs. As uncertainty and risk concerning variable trends and values are important points to be considered when appraising investment projects, the list of the most critical factors has been included for each sector.

Many issues raised in the chapter are treated in more detail in the Annexes. It is assumed in the outlines that there is a continuous dialogue between project evaluators and project proposers and with the common aim is to select the best possible project seeking good value for money.

3.1 Transport

This section illustrates the investments for the development of new or existing transport infrastructures. These may include new transport lines or links, or the completion of existing networks, as well as investments intended to upgrade existing infrastructures. The proposed methodology mainly focuses on road and rail transport modes. However, the general principles may also be applied to other modes; for example, carriage by sea and air.

3.1.1 Transport networks

3.1.1.1 Project objectives

The socio-economic objectives of transport projects are generally related to the improvement in travel conditions for goods and passengers both inside the study area and to and from the study area (accessibility), as well as an improvement in both the quality of the environment and the well being of the population served.

In more detail, the projects will deal with the following type of transport problems:

- reduction of congestion by eliminating capacity constraints on single network links and nodes, or by building new and alternative links or routes;
- improvement of the performance of a network link or node, by increasing travel speeds and by reducing operating costs and accident rates through the adoption of safety measures;
- shift of the transport demand to specific transport modes (many of the investments which have been made in the past few years, where the problem of environmental externalities has arisen as a critical factor, aimed to shift the modes of travel demand in the interest of minimising pollution and limiting the environmental impact);
- completion of missing links or poorly linked networks: transport networks have often been created on a national and/or regional basis, which may no longer meet transport demand requirements (this is mainly the case with railways);
- improvements in accessibility for people in peripheral areas or regions.

The first step is to clearly state the main direct objectives of the transport project (reducing bottlenecks, modal shift) as well as those related to the environment (energy savings, emission reductions) and keep them separate from the indirect ones (regional development, employment etc.). Once the objectives have been clarified, then the following step is intended to check whether the identification of the project is consistent with the objectives.

3.1.1.2 Project identification

Typology of the investment

A good starting point for briefly, but clearly, identifying the infrastructure is to state its functions, which should be coherent with the objectives of the investment. This should be followed by a description of the type of intervention, that is whether it is a completely new road, or a link to a larger infrastructure, or part of an extension or modification to an existing road or railway (for example the construction of a third lane for a two-lane motorway, the laying of a second track or the electrification and automation of an existing rail line).

Typology of investments:
- new infrastructures (road, rail, ports, airports) to satisfy increasing transport demand
- completion of existing networks (missing links)
- extension of an existing infrastructure
- renovation of existing infrastructures
- investment in safety measures on existing links or networks
- improved use of the existing networks (i.e. better use of under-utilised network capacity)
- improvement in intermodality (interchange nodes, accessibility to ports and airports)
- improvement in networks interoperability
- improvement in the management of the infrastructure

Functional characteristics of the investments:
- increasing capacity of existing networks
- reducing congestion
- reducing externalities
- improving accessibility to peripheral regions
- reducing transport-operating costs

Types of services:
- infrastructures for densely populated areas
- infrastructures for long distance travel demand
- infrastructures for freight transport
- infrastructures for passengers transport.

Territorial reference framework

Projects could be either parts of national, regional or local transport plans, or promoted by bodies of a different nature. The main elements to be considered are:

- the functional incorporation of the designed infrastructure into the existing or planned transport system (urban, regional, interregional or national), in order to consider network effects.
- the consistency of the designed infrastructure and of its management and operation with national and European transport policies: fiscal policies (i.e. taxes on fuel), proposed pricing schemes, environmental constraints or target, other incentives/transfers to the sector, technological standards.
- the degree of consistency with any other development project and/or plan that may be drawn up for the investment area, also taking into consideration projects and/or plans related to sectors that could have impacts on transport demand (land use, development plans).

Regulatory framework

Regulation of the transport sector has significantly evolved over the past ten years. This evolution has arisen from the need to overcome the inefficiency of monopolistic systems by introducing competition for transportation services and regulation instruments for 'natural monopolies', i.e. for infrastructures.

From a Community viewpoint, the European Union has gradually developed specific actions and recommendations for the Member Countries, starting in the 1990s. As regards actions, Community interventions have mainly focussed on the development of the infrastructure network (Trans European Networks – Transport, TEN-T), on regulation and competition among and between modes, and on setting prices correctly (including charging for infrastructure use and internalisation of external costs).

REGULATORY FRAMEWORK
White papers
Future development of the Common Transport Policy - White Paper/COM/1992/494
Fair payment for infrastructure use: a phased approach to a common transport infrastructure charging framework in the EU - White Paper /COM/1998/0466 final
European transport policy for 2010: time to decide - White Paper/ COM/2001
Keep Europe moving - Sustainable mobility for our continent Mid-term review of the European Commission's 2001 Transport White Paper/COM/2006/314
Trans European Networks - Transport (TEN-T)
Decision 1996/1692/EC of the European Parliament and of the Council of 23 July 1996 on community guidelines for the development of the trans-European transport network
Decision 2004/884/EC of the European Parliament and of the Council amending Decision 1692/96/EC on community guidelines for the development of the trans- European transport networks
Trans- European Networks: Towards an integrated approach, COM/2007/0135
Community financing
Regulation 2004/807/EC of the European Parliament and the Council amending Council Regulation (EC) 2236/95 laying down general rules for the granting of the Community financial aid in the field of trans-European networks
Pricing
Directive 2006/38/EC 'Eurovignette' amending Directive 1999/62/EC on the charging of heavy goods vehicles for the use of certain infrastructures (see following box)
Directive 2004/49/EC amending Directive 2001/14/EC on the allocation of railway infrastructure capacity and the levying of charges for the use of railway infrastructure and safety certification
Airport charges COM/1997/154
Green Paper on seaports and maritime infrastructure COM/1997/678)

3.1.1.3 Feasibility and option analysis

Analysis of the demand

The estimation of the existing demand and forecasts for the future are complex and critical tasks that often consume a substantial share of the resources allocated to the feasibility study. As to the reference scenario (BAU or the do-minimum scenario), the following aspects should be made clear:

- the area of influence of the project: it is important to identify the demand without the project and the impact of the new infrastructure, as well as identifying other transport modes that should be considered (e.g. corridors, where there are often several modes in competition: road, rail and air transport);

- the methods applied to estimate existing and future demand: the use of single or multi-modal models, extrapolations from past trends, fares and costs for users, pricing and regulation policies, the congestion and saturation levels of networks, expected new investments;
- the competing modes and alternative routes: fares and costs for users, pricing and regulation policies, the congestion and saturation levels of networks, the expected new investments in competing nodes;
- any deviation from past trends and comparison with large-scale prospects on a regional, national and European level.

In the presence of uncertainty about future demand trends, it may be advisable to develop two scenarios, an optimistic and a pessimistic one, and to relate the two hypotheses to GDP trends or to other macroeconomic variables.

As to the solution(s) for the project, it should first be remembered that the transport system is multi-modal. The same transport demand may, at least partially, be met by various transport modes and therefore these modes may compete for the same demand. Competition may not only occur between modes but even within the same transport mode, for example between roads or between nodes, like ports or airports.

The estimates of the potential demand should primarily clarify the composition of the traffic attracted by the project in terms of:

- the existing traffic,
- the traffic which has been diverted from other modes,
- the generated or induced traffic: the traffic that only occurs in the presence of a new infrastructure, or in the case of an increase in the capacity/speed of the existing infrastructure.

Particular attention should then be paid to the sensitivity of expected traffic flows to critical variable values such as:

- the elasticity with respect to time and costs, that is implicit in the calculation of the traffic diverted from other modes: travel demand characteristics, structure and elasticity are particularly important in those projects related to charged infrastructures, since the expected volumes of traffic are determined by the level of fares; elasticity with respect to time and costs then needs to be properly disaggregated and compared with data provided in literature or data taken from other projects;
- the levels of congestion on competing roads and the strategies in place for these modes, for example in terms of fare policies. This point is particularly relevant for long term investments: in the time span required to complete the intervention, the traffic that may be potentially acquired by the new infrastructure may shift to other modes and, if so, then it may be difficult to move it back.

In the first instance, induced traffic could be estimated on the basis of demand elasticity with respect to generalised transport costs (time, tariffs, comfort). Nevertheless, since traffic is dependent upon the spatial distribution of economic activities and households, then the recommendation for a correct estimate is to analyse the changes in accessibility to the area induced by the project. This will normally require the use of integrated regional development-transport models. In the absence of these instruments, it is necessary to estimate the generated traffic with great caution and to carry out a sensitivity or risk analysis of this traffic component.

CHECK LIST FOR THE TRANSPORT DEMAND ANALYSIS
Analysis of the demand/capacity ratio of the new infrastructure for any alternative project which may be taken into consideration. This will be based on: - the service levels of the infrastructure in terms of a traffic/capacity relationship (traffic flows on roads, passengers on public/collective transport systems, etc.). It is useful to separately analyse the different traffic components both in terms of flow types (internal, exchange or cross traffic) and on the basis of their origin (traffic diverted from other transport modes and any generated traffic); - the travel times and costs for the users; - the transport performance indicators: passengers*km and vehicles*km for passengers, tons*km and vehicles*km for goods; - the traffic safety levels in the new infrastructure or in the new configuration of the existing infrastructure; - quantification of the demand not fulfilled in the presence of several alternatives and of congestion phenomena. To find out which traffic has been ‘rejected’ is an important element to evaluate options; - definition of the relevant alternatives that will be evaluated from an environmental, financial and economic viewpoint..

Option analysis

The construction of a reference solution and the identification of promising alternatives are two aspects that will influence all the results of the following evaluations. The reference solution will generally correspond to a BAU scenario. The BAU scenario should not be a 'catastrophic' one, resulting in traffic paralysis and in very high social costs.

In the case of strong congestion phenomena, whether at present or in the future, the reference solution should include those interventions (management, maintenance, etc.), which will probably be put into action in the absence of the project.

The analysis of alternative project solutions is equally critical. After defining the BAU scenario and analysing the critical aspects in terms of a demand/capacity ratio (see below), it is necessary to identify all promising technical alternatives on the basis of physical circumstances and available technologies.

The main potential for distorting the evaluation is the risk of neglecting relevant alternatives, in particular low-cost solutions, such as managing and pricing solutions, infrastructure interventions that are considered as not 'decisive' by designers and promoters, etc.

Investment costs and operating costs

For the BAU scenario, and for each alternative, the preliminary step is to estimate all the investment costs and expenses for maintenance, ordinary and extraordinary, and for renewals, and then to allocate these costs over the time horizon.

It is necessary to ensure that the project will include all the works required for its functioning (for example, the links to the existing networks, the technological plants, etc.) as well as the relevant costs of each alternative. The estimates of costs and times need to be realistic and preferably 'on the safe side' given the uncertainties involved; the latter point is particularly important for those projects which may be of significant relevance for the local community.

For collective transport modes, it will be necessary to design an operating model and to calculate its costs. For example, a hypothesis put forward for the operation of the railway, should include the number of trains which may be offered by type of train (goods, passengers, by making a distinction between short and long-distance traffic), where each service is associated to the relating costs. The same applies for node infrastructures, such as ports and airports.

Pricing policies

Fares, tolls and other pricing policies will influence the expected volume of demand and the distribution of demand across transport modes. It is therefore important whenever a different pricing hypothesis is introduced, to reconsider the demand estimates and allocate the correct traffic volumes to each mode.

The pricing criteria for transport infrastructures are a complex issue and may generate some problems when comparing the financial and economic evaluations. It is important to distinguish between:

- the fares which maximise the proceeds for the managers/constructors of infrastructures: these kinds of fares maximise the capacity for self-financing;
- the efficiency fares: these take into consideration the social surplus and consider also the external costs (congestion as well as the environmental and safety costs).

Efficient pricing should, in principle, be based on social marginal costs and requires the 'internalisation of external costs' (Polluter Pays Principle), including congestion and environment costs. Social efficiency requires that users pay all the marginal private or internal and external costs that they impose on society. An efficient structure of charges confronts users with the marginal social costs of their decisions.

In the case of transport infrastructures, marginal social costs comprise:

- the producer's marginal costs: infrastructure wear and tear, e.g. in the road sector, damage from heavy goods vehicles increases as the fourth power of the axle weight;

- the marginal external costs: congestion costs, environmental costs, external accident costs, i.e. those costs generated by the transport activities that do not fall on those individuals whose choices have caused them, but on other individuals, or on society as a whole.

Efficient pricing should generally involve low tolls where or when there is no congestion (so as to maximise the use of the infrastructure) and high tolls where, or when, this phenomenon occurs. If the infrastructure is not congested, there might be a conflict between financial need and the optimal use of the infrastructure: in this case, tolls intended to recover a fraction of the investment costs can cause a sub-optimal use of the infrastructure. It is therefore important to clarify the pricing criteria that have been applied.

FOCUS: RAIL NETWORK ACCESS TOLLS
The pricing regimes of the railway sector represent an important factor and should be analysed with great care. There are two opposite strategies: average cost tolls (the 'Anglo-German strategy') featuring very high values and marginal cost tolls (the 'French strategy') featuring very low values. These will not completely solve either the problem of congestion tolls (when demand exceeds supply) or the problem of track allocation criteria. In fact, special services, for example at a local level, may enjoy partial or total benefits. The allocation of tracks (i.e. of capacity) may be subject to constraints for the protection of the incumbent operator ('grand-father's right'). Tolls and regulatory constraints outline a framework, which is quite complex for the correct evaluation of the flows of future proceeds, especially in the longer term.

THE EUROVIGNETTE DIRECTIVE
The harmonization of rules regarding crossing freight traffic is one of the main targets of the EU Commission in order to set a road-pricing system. On 17 May 2006 the European Parliament and the Council adopted Directive 2006/38/EC amending Directive 1999/62/EC on the charging of heavy goods vehicles for the use of certain infrastructure (so called 'Eurovignette Directive'). The Directive does not oblige Member States to introduce road pricing for trucks: Member States are free to decide whether or not to introduce so called 'user-charges' or 'tolls'. Member States may maintain or introduce tolls and/or user charges on the trans-European road network for purposes such as dealing with environmental damages, tackling congestion, minimising infrastructure damage, optimising the use of the infrastructure concerned or promoting road safety. The mark-ups are the new instrument introduced in the amended Directive, allowing Member States to add 15% or 25% to the average toll on roads in mountainous area, according to some conditions: - the road sections must be subject to acute congestion or the vehicles using these roads sections must cause significant environmental impacts; - the revenues must be invested in priority projects of the TEN-T networks; - the maximum level for mark-ups is 15% (25% in case of cross-border projects); - tolls must be proportionate to the objective pursued; - tolls must be transparent and not discriminatory. The amended Directive, moreover, allows Member States to differentiate the tolls depending on the EURO emission class, or the time of day, the type of day or season. While Directive 1999/62/EC applies to vehicles over 12 tonnes, the new Directive introduces taxes on vehicles over 3.5 tonnes, but Member States will be required to extend this obligation until 2012. The Directive recommends that the vignette revenues should be used to optimise the entire transport system (not just for roads). As this recommendation is not legally binding, some Member States may also use the revenues for non-transport purposes. The financial analysis of a road project will consider the Eurovignette revenues only when this is consistent with the national legislation.

3.1.1.4 Financial analysis

The financial analysis will generally be conducted from the viewpoint of the infrastructure manager (which might differ from the service operator). If required, it may first be carried out for the owners and the operators, and then consolidated.

Financial Inflows	Financial Outflows
▪ Tolls, fares and charges ▪ Transfers from the government (this item is to be considered only for the calculation of the return on capital)	▪ Investment costs - expenses for renewals - extraordinary maintenance operations ▪ Operating costs-road - ordinary maintenance costs of planned works - costs related to tolling ▪ Operating costs-rail - ordinary maintenance costs of planned works - costs related to charging

Financial investment costs are an outcome of the technical analysis, usually disaggregated by the type of works into which the intervention may be broken down and allocated over the construction time. The cost analysis should distinguish the elementary cost components (labour force, materials, carriage and freight) so as to facilitate the subsequent application of the conversion factors for converting financial into economic costs.

Financial inputs will be represented by the proceeds from the tolls/tariffs applied for the sale of well-defined services. The estimate for the proceeds must be consistent with the on demand elasticity and trends of explanatory variables (see the previous paragraph about pricing criteria). The financial analysis of non-revenue generating infrastructures will show the net present cost for the public sector.

With regard to the recourse to private funding or Public Private Partnerships, attention should be paid to possible inefficiencies which may result from cost recovery policies. These may, in turn, affect the quantity demanded (under-utilisation).

3.1.1.5 Economic analysis

The economic evaluation of transport investments relies on a well developed and straightforward framework and differs substantially from the financial analysis, since many of the benefits and costs are public goods, or goods without a market. Moreover, following a long and established tradition, the economic evaluation is based on a partial equilibrium approach (see box in Chapter 2).

With regard to the economic investment and operating costs of vehicles, if market prices are deemed to reflect the opportunity cost of resources, it will be necessary only to eliminate transfers from the financial costs by applying a conversion factor to each elementary cost component and to take tax burdens into account. If market prices are not deemed to reflect the opportunity cost of resources for some components, it will be necessary to apply shadow prices to correct the costs (see the general methodology described in Chapter 2 of the Guide).

Benefits result from variations in the area below the transport demand curve, as well as from the variations in economic costs, including external costs. Social benefits are obtained by adding the following components:

- variations in the consumer's surplus: change in generalised transport costs, wich incorporate the money costs travel, (i.e. the perceived cost: fares, tariffs and tolls, and vehicle costs perceived by the users[9]);
- variations in road user producer's surplus: the unperceived costs of the private the road users enter into the calculation of the road users producer's surplus as they are considered as producers of the services they supply to themeselves (car users) or to their customers (trucks). The difference between the total costs of producing these services and the vehicle operating costs perceived is defined as 'unperceived operating costs'(e.g. tyres, maintenance and depreciation). These costs enter into the calculation of the road users producer's surplus and are then added to the consumer's surplus.;
- variations in infrastructure and services operator producer's surplus: profits and losses of infrastructure managers, if available, and transport service operators;
- variations in taxes and subsidies for the government;
- variations in external costs (emissions, noise, accidents).

The calculation of the consumer's and producer's surplus and the external costs, will take into account goods that have no market (see below) and whose estimate may require special techniques. When calculating the benefits, it is recommended that a distinction be made between:

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9 There is a gap between the operating costs of road vehicles and the costs as perceived by users, the latter being lower than the real cost. In fact, for istance, car users tend just to take into account fuel expenses and underestimate other expenses. The difference between the operating costs and the perceived costs is defined as 'unperceived operating costs'.

- the benefits for the existing traffic (for example a time and cost reduction as a result of a speeding up process);
- the benefits for the traffic diverted from other modes (variations in costs, times and externalities as a result of the shift from one mode to another);
- the benefits for the generated traffic (social surplus variation), as gauged by the 'rule of the half' (see box below).

If the transport demand is fixed and total demand stays the same even when travel time and travel costs change (i.e. in the absence of generated traffic), the analysis will be restricted to the variations in the economic costs net of any transfer.

Some goods that have no market will be given great importance in the economic evaluation of transport infrastructure projects, i.e. the value of time, the environmental effects, the value of avoided accidents[10].

The value of time: time benefits often represent the most important element of a transport project benefits. Some European countries provide the evaluators with national estimates of the time value by purpose and sometimes by mode, in particular for passengers. In the absence of these reference estimates, it is possible to derive the values of time from the users' actual choices, or to re-adjust and to re-weight the estimates from other studies on the basis of income levels.

With a few exceptions, the time value of goods transport is generally low and it should be calculated on the basis of the capital lock-up.

In general, since the values attributed to time are critical, the recommendation is to clearly report the values of time adopted and to check for consistency between the values used in the demand estimate and the ones used in the evaluation.

The passengers' value of time generally distinguishes between trip purposes, and in some cases transport modes, and is largely dependent on income. The value of non-working travel time (including homework commuting) vary, in most countries, from 10% to 42% of the working time value. Savings in non-working travel time typically account for a large proportion of the benefits from transport investments.

Environmental externalities generally depend upon the travel distances and exposure to polluting emissions (except for CO_2, which is a 'global' pollutant). In order to monetise the environmental effects, in the absence of local values, it is possible to apply the shadow prices inferred from the scientific literature ('benefit transfer approach', see Annex F) to the physical estimates of pollutants. The methods, which are intended to evaluate the external costs related to the prevention of accidents, will be referred to the average danger levels according to transport mode. For example, with respect to road traffic, the average cost by vehicle-km or by passenger-km is generally calculated on the basis of the costs of all road accidents.

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10 Reference values for all the EU 25 countries can be found in the HEATCO project (URL: http://heatco.ier.uni-stuttgart.de/).

HOW TO CALCULATE ECONOMIC BENEFITS BY QUANTIFICATION OF THE CONSUMER'S SURPLUS

User benefits for transport projects can be defined by the concept of the consumer's surplus. Consumer's surplus is defined as the excess of consumers' willingness-to-pay over the prevailing generalised cost of a specific trip. Willingness-to-pay is the maximum amount of money that a consumer would be willing to pay to make a particular trip; generalised cost is an amount of money representing the overall disutility (or inconvenience) of travelling between a particular origin (*i*) and destination (*j*) by a particular mode. It can be expressed by the following:

$gc = p + z + v\tau$

where:

p is the amount paid for the trip by the user (tariff, toll)

z is the perceived operating costs for road vehicles (for public transport is equal to zero)

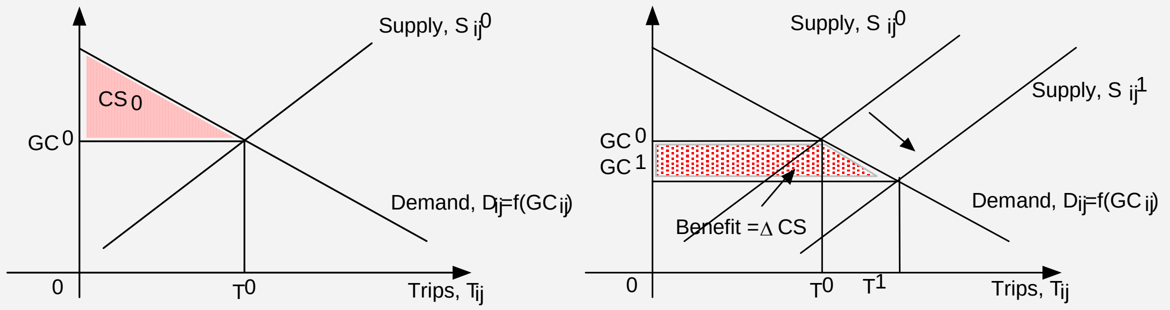
τ is the total time for the trip

v in the unit value of travel time.

Total consumer's surplus (CS^0) for a particular i and j in the business as usual scenario is shown diagrammatically in the first figure. It is represented by the area beneath the demand curve and above the equilibrium generalised cost, area CS^0.

User benefit$_{ij}$= Consumer's surplus $_{ij}^1$- Consumer's surplus $_{ij}^0$

Where 1 is the do-something scenario and 0 is the BAU scenario.



If there is an improvement in supply conditions (for example an improvement in road infrastructure) the consumer's surplus will increase by an amount of ΔCS, due to a reduction in equilibrium generalised cost.

Usually we do not know the real shape of the demand curve; we know the GC and T in the BAU scenario and a forecast for the GC and T in the do-something scenario. The demand curve is only supposed to be a straight line as shown in the figure, even it is not the case in reality. The user benefit can be approximated by the following function, known as the rule of a half[11]:

$$\Delta CS = \int_{GC_1}^{GC_0} D(GC)\,dGC \approx \text{Rule of one Half } (RoH) = \frac{1}{2}(GC_0 - GC_1)(T_0 + T_1)$$

When the effect of a project can be captured in the form of a reduction in generalised costs between particular origins and destinations, the rule of a half is a useful approximation of true user benefits.

It is advisable to use the rule of a half to calculate user benefits in most cases.

DIVERTED TRAFFIC WELFARE CHANGES

The benefits of traffic diverted in the two case studies (Chapter 4) were measured according to the following criteria:

- when the diversion was between different routes but within the same transport modes, as in the motorway case study, the benefits were estimated on the basis of the changes in total users costs, and the new and the existing links were considered as perfect substitutes;
- when the diversion was between different modes, as in the railway case studies, the benefits were estimated on the basis of the change in surplus of the two markets, road and rail. It is important to note that the relevant prior generalised cost against which the change in travel costs was assessed, were those for the mode to which users have switched, not the costs associated with the mode used in the BAU scenario. In the case of a totally new infrastructure the measurement of the benefits depends on the nature of the new mode, its placement in the mode hierarchy and transport network and should be derived from the users' willingness-to-pay.

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11 $(CG^0 - CG^1) \times T^0 + (CG^0 - CG^1) \times \frac{T^1 - T^0}{2} = (CG^0 - CG^1)\left(T^0 + \frac{T^1 - T^0}{2}\right) = (CG^0 - CG^1)\left(\frac{2T^0 + T^1 - T^0}{2}\right) = (CG^0 - CG^1)\left(\frac{T^0 + T^1}{2}\right)$

The following tables show some reference monetary values for freight and passenger time savings, CO_2 emissions and accidents derived from the HEATCO study. The study provides estimates for the EU25; the following tables include also values that have been estimated by JASPERS for Bulgaria and Romania by applying a simplified approach using linear extrapolation of GDP per capita to values of time and values of accident casualties in Eastern European countries.

Table 3.1 Estimated values of travel time savings

Country	Business			Freight	
	AIR	BUS	CAR, TRAIN	ROAD	RAIL
Austria	39.11	22.79	28.40	3.37	1.38
Belgium	37.79	22.03	27.44	3.29	1.35
Bulgaria	15.96	9.93	11.58	1.80	0.73
Cyprus	29.04	16.92	21.08	2.73	1.12
Czech Republic	19.65	11.45	14.27	2.06	0.84
Denmark	43.43	25.31	31.54	3.63	1.49
Estonia	17.66	10.30	12.82	1.90	0.78
Finland	38.77	22.59	28.15	3.34	1.37
France	38.14	22.23	27.70	3.32	1.36
Germany	38.37	22.35	27.86	3.34	1.37
Greece	26.74	15.59	19.42	2.55	1.05
Hungary	18.62	10.85	13.52	1.99	0.82
Ireland	41.14	23.97	29.87	3.48	1.43
Italy	35.29	20.57	25.63	3.14	1.30
Latvia	16.15	9.41	11.73	1.78	0.73
Lithuania	15.95	9.29	11.58	1.76	0.72
Luxembourg	52.36	30.51	38.02	4.14	1.70
Malta	25.67	14.96	18.64	2.52	1.04
Netherlands	38.56	22.47	28.00	3.35	1.38
Poland	17.72	10.33	12.87	1.92	0.78
Portugal	26.63	15.52	19.34	2.58	1.06
Romania	17.36	10.12	12.60	1.90	0.78
Slovakia	17.02	9.92	12.36	1.86	0.77
Slovenia	25.88	15.08	18.80	2.51	1.03
Spain	30.77	17.93	22.34	2.84	1.17
Sweden	41.72	24.32	30.30	3.53	1.45
United Kingdom	39.97	23.29	29.02	3.42	1.40
EU (25)	**32.80**	**19.11**	**23.82**	**2.98**	**1.22**
Switzerland	45.41	26.47	32.97	3.75	1.54

Source: HEATCO, Deliverable 5, 2004, Business passenger trips (€$_{2002}$ per passenger per hour, factor prices) - Freight trips (€$_{2002}$ per freight tonne per hour, factor prices). JASPER for Bulgaria and Romania.

Table 3.2 Recommended values for CO_2 emissions

Year of application	Central value (€/ton CO_2)		
	Lower value	Central value	Upper value
2010	7	25	45
2020	17	40	70
2030	22	55	100
2040	22	70	135
2050	20	85	180

Source: Impact Handbook on estimation of external costs in the transport sector

Table 3.3 Estimated Values for casualties avoided (€$_{2002}$ Purchasing Power Parity, factor prices)

Country	Fatality	Severe Injury	Slight Injury
Austria	1,685,000	230,100	18,200
Belgium	1,603,000	243,200	15,700
Bulgaria	573,646	78,951	5,670
Cyprus	798,000	105,500	7,700
Czech Republic	932,000	125,200	9,100
Denmark	1,672,000	206,900	13,200
Estonia	630,000	84,400	6,100
Finland	1,548,000	205,900	15,400
France	1,548,000	216,300	16,200
Germany	1,493,000	206,500	16,700
Greece	1,069,000	139,700	10,700
Hungary	808,000	108,400	7,900
Ireland	1,836,000	232,600	17,800
Italy	1,493,000	191,900	14,700
Latvia	534,000	72,300	5,200
Lithuania	575,000	78,500	5,700
Luxembourg	2,055,000	320,200	19,300
Malta	1,445,000	183,500	13,700
Netherlands	1,672,000	221,500	17,900
Norway	2,055,000	288,300	20,700
Poland	630,000	84,500	6,100
Portugal	1,055,000	141,000	9,700
Romania	641,083	87,150	6,289
Slovakia	699,000	96,400	6,900
Slovenia	1,028,000	133,500	9,800
Spain	1,302,000	161,800	12,200
Sweden	1,576,000	231,300	16,600
Switzerland	1,809,000	248,000	19,100
United Kingdom	1,617,000	208,900	16,600

Source: HEATCO, Deliverable 5, 2004. JASPER for Bulgaria and Romania.

Economic impact assessment

Transportation projects may have an impact on the economic structure of the regions. This is a controversial issue from the theoretical viewpoint and the only conclusions that seem to be universally acknowledged are that the impacts can be both positive and negative. In the presence of market distortions, the increased accessibility of a suburban area or region may result in a competitive advantage, but also in a loss of competitiveness if the industry is less efficient than in the central regions. In this case, the increased accessibility may force the local industry to go out of business. It is therefore necessary to proceed with great caution when assigning these kinds of benefits to the project and, in any case, they should be excluded from the calculation of profitability indicators.

The routine procedure for evaluating these benefits in terms of an income multiplier/accelerator might be seriously biased. Actually, these multipliers may be applied for any public expenditure. It is therefore necessary to calculate the differential between the multiplier for the investments in the transportation sector and the multiplier for other sectors. This is a method that does not appear to be advisable, except for some special cases.

In any case, if there are no major distortions in the transport-using sectors, i.e. markets are reasonably competitive, the use of transport costs and benefits (time savings, externalities, etc.) could be considered an acceptable approximation of the final economic impact of the transport projects.

3.1.1.6 Risk assessment

Due to their criticality, it is advisable to carry out a sensitivity analysis of the money values assigned to the goods without any market, i.e. values of time and externalities. Other sensitivity tests may be focused on investment and operating costs or on the expected demand, in particular the generated traffic.

Critical factors

- Investment and operating cost overruns
- Implementation time
- Transport demand (optimism bias)
- Competition with other existing infrastructure

Main variables to consider	
	- Assumption on GDP and - Other economic variables trend - Rate of increase of traffic over time - Value of time - Number of years necessary for the realization of the infrastructure - Number of years necessary for the full efficiency of the infrastructure - Investment costs (disaggregate) - Maintenance costs - Pricing policies - Regulatory policies

3.1.2 CBA of High Speed Rail investment in Europe[12]

High Speed Rail (HSR) normally means rail technologies capable of speeds in the region of 300km/h on a dedicated track. Such systems offer journey times that are more competitive with other modes, as opposed to traditional train services, and have very high capacity. However, their capital cost is also high.

Costs

HSR involves the construction of new lines, stations, etc. and the purchase of new rolling stock, additional train operating costs and externalities (land take, visual intrusion, noise, air pollution and global warming effects). The first three externalities are likely to be much stronger where trains go through densely populated areas. Since high speed trains are invariably electrically powered, air pollution and global warming impacts depend on the primary fuel used to generate the electricity. As costs are high it follows that the strongest case for High Speed Rail is where traffic volumes are high.

Benefits

The principal benefits from HSR are:

- time savings
- additional capacity
- reduced externalities from other modes
- increased reliability
- generated traffic
- wider economic benefits.

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12 De Rus, G. and Nombela G. (2007). De Rus, G. and Nash C.A. (2007).

One of the key values is the expected time saving. Evidence from case studies[13] shows that when the base case is a conventional line (with operating speed of 190 km/h for distances on the range of 350-400 km) a typical HSR yields 45-50 minutes savings. Compared with a conventional train running at 160 km/h, a high speed train will save some 35 minutes on a journey of 450 km. Where the existing infrastructure is of poorer quality or is congested, the time savings may be substantially greater. Additional capacity is only of value if demand is exceeding the capacity of the existing route. Where the effect is to divert traffic from other modes, the benefits are given by the net user benefits plus net reduction in externalities minus the net cost of the change of mode. There is also clear evidence that running rail infrastructure less close to capacity benefits reliability; it may also lead to less overcrowding on trains. Generated traffic leads directly to benefits for users, which are generally valued at half the benefit to existing users according to the 'rule of half'.

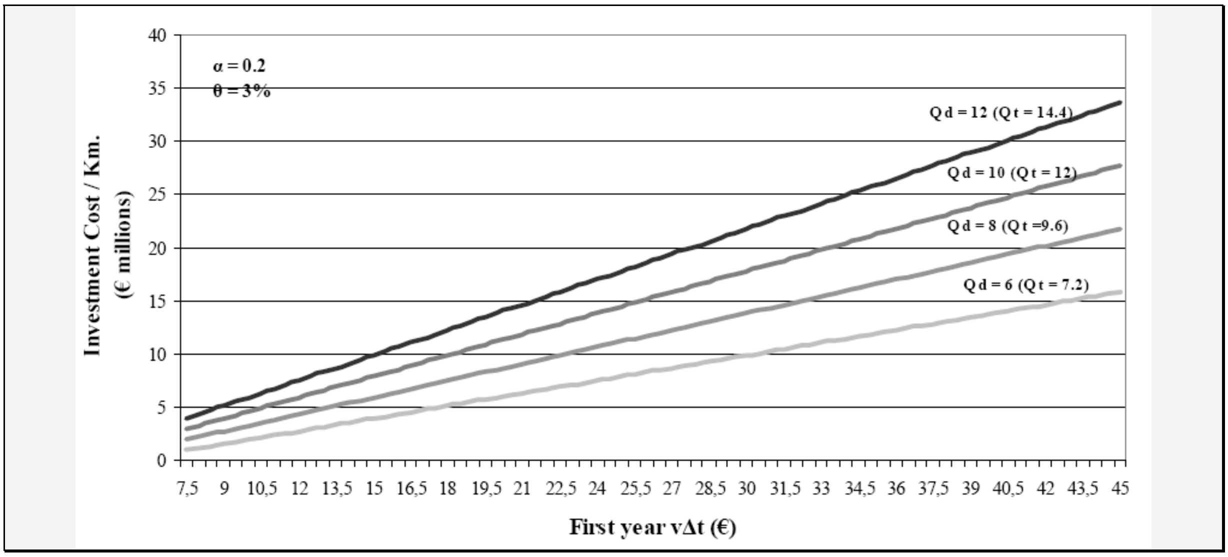
There has been much debate as to whether there are wider economic benefits that are not captured in a traditional cost-benefit analysis. The conclusion is that HSR may yield additional benefits, although the effects are extremely variable and difficult to predict and are likely to be much less important than the direct transport benefits of HSR.

Economic net present value

The case for building a new HSR infrastructure depends on its capacity to generate enough social benefits to compensate for the high construction, maintenance and operation costs. Whether HSR investment is socially profitable depends on local conditions, which determine the magnitude of costs, demand levels and external benefits such as reduced congestion or pollution from other modes. Given the costs, the expected net social benefit of the investment in HSR relies heavily on the number of users and its composition (diverted and generated passengers), and the degree of congestion in the corridor affected by the investment. HSR projects require a high volume of demand with a high willingness-to-pay for the new facility.

Figure 3.1 reports the minimum level of demand from which a positive economic net present value could be expected when new capacity does not provide additional benefits beyond time savings from diverted and generated demand.

Figure 3.1 First year demand required for ENPV=0 (α=0.2, θ=3%)



Qd: diverted demand *Qt: total demand Qt=Qd(1+a)* *a: proportion of generated traffic*
θ: annual growth of net benefits *v: average value of time* *Δt: average time saving per passenger*

[13] Steer Davies Gleaves, High Speed rail: international comparisons. Commission for Integrated transport, London, 2004.

As shown in Figure 3.1, only under exceptional circumstances (a combination of low construction costs plus high time savings) could a new HSR line be justified with a level of patronage below 6 million passengers per annum in the opening year; with typical construction costs and time savings, a minimum figure of 9 million passengers per annum is likely to be needed.

3.1.3 Ports, airports and intermodal facilities

3.1.3.1 Project objectives

Projects in these sectors aim to increase accessibility and promote transport intermodality as well as completing the national and international transport networks. Moreover, in many cases, these infrastructures are expected to support local economic development and employment through support to productive activities and the satisfaction of the transport needs of the local population.

3.1.3.2 Project identification

The first step in evaluating the project is to clearly specify whether it is a new construction, extension or upgrading of an existing one and to describe its scope, objectives and technical and physical characteristics. In order to be fully exploited, ports, airports, inter-modal facilities and nodal centres need to have appropriate connections with the inland networks (road, rail, inland waterways). The project identification should therefore include all the relevant investments needed to guarantee the correct functioning of the entire system.

MAIN ENGINEERING FEATURES TO BE CHECKED
Physical features (for example): - Airports: number and total length of runways; - Ports: number and total length of piers or quays; - Inter-modal facilities: storage area, parking terminals. **Technical characteristics of the major structures** (for example): - Airports: sections of runways; - Ports: structural arrangement of the quays; - Inter-modal facilities: capacity. **Equipment** (for example): - Airports: equipment for computerised traffic control; - Ports: cargo handling facilities, storage areas, roads and rail tracks, operational building, electronic equipment for cargo handling; - Inter-modal facilities: cargo handling facilities, storage areas, logistics services. **Levels of services** (for example): - Airports: maximum capacity of runways, passengers and tons moved; - Ports: servicing time, number of ships; - Inter-modal facilities: servicing time, reliability.

3.1.3.3 Feasibility and option analysis

In order to verify the feasibility of the project, the key issue is the quantification of the present volume of passenger and/or goods traffic, based on daily and seasonal trends and forecasts for the future pattern of traffic flows.

Traffic projections should, as far as possible, subdivide freight flows by type of commodity and handling characteristics (containers, liquid and solid bulk, etc.,) and passenger flows according to purpose of trip (business, tourism and leisure). Indeed, the different flows might have quite different growth rates as well as behavioural parameters (value of time, elasticities). Quite often ports, airports and intermodal and logistics facilities compete with other similar infrastructure. The strategies of competing nodes should be explicitly considered in the estimate of future demand.

Alternative technical solutions to be explored could include the upgrading of existing facilities, for instance by adding a new berth, or the use of new technologies, like innovative air traffic control devices. The advantages and drawbacks of each solution are to be carefully compared.

3.1.3.4 Financial analysis

Examples of financial inflows and outflows are:

Financial Inflows
▪ Revenues from landing fees,
▪ Rents
▪ Taxes
▪ Payments for additional services
- Water supply
- Fuel supply
- Catering
- Maintenance services
- Storage services
- Logistics services
- Shopping malls

Financial Outflows
▪ Investment costs are mainly
- Civil works
- Land acquisition
- Equipments
- Road and rail links to the main networks
- General expenses
▪ Operating costs
- Technical and administrative personnel costs
- Energy
- Maintenance costs
- Materials

The time horizon for project analysis is usually around 30 years.

Investors and operators may be different, so the financial analysis will generally be conducted from the viewpoint of the infrastructure owner. If required, the analysis may initially be carried out separately for the owners and operators and then in a consolidated way.

3.1.3.5 Economic analysis

The main benefits and costs are as follows:

Benefits	- time savings: waiting and servicing time for ships, travel time as well as time wasted in modal changes and on the transport networks linking the nodal facilities to the origin/destination of the flows - reduction in operating costs, in the nodal infrastructure as well as on the links connecting the nodal facilities to the origin/destination of the flows - time and cost savings as a result of the shift from other modes - environmental impact reduction, due to better performing infrastructure and equipments, modal shift from highly polluting modes (motorways of the sea) etc. - safety improvements and accident reduction, for modernisation projects, for both users and staff - indirect positive impacts on land values and real estate near to a port or an airport, on economic activities (retail, hotels, restaurants etc.), with the warning to avoid double counting - lower costs and time of intermodality
Costs	- indirect negative impacts on land values and or economic activities - increased noise and pollution - environmental impacts and congestion due to traffic increase on the links connecting the nodal facilities to the main networks

3.1.3.6 Risk assessment

Critical factors

- Transport demand
- Investment and operating cost overruns
- Coordination with complementary projects (investments on the connecting links)

Main variables to consider	- Assumptions concerning GDP - Rate of increase of traffic over time - Competition with other existing infrastructure - Value of time for users - Investment costs - Maintenance costs - Fares and tariffs of the projected facility and of the competing ones

3.1.3.7 Other project evaluation approaches

Ports and other nodal infrastructures are often a part of broader strategies aiming to raise the modal share of non-road modes, namely short sea shipping, inland waterways and railways. In these cases, the analysis should be broadened in order to also include the impacts in terms of modal changes. Careful checks should be made to avoid double-counting.

3.2 Environment

This section deals with projects aimed at the preservation and protection of the environment. Specifically, waste management plants and integrated water supply services for civil use were analysed along with natural risk prevention projects. The European Union considers natural disasters a serious challenge for many countries in which such events have recently produced severe environmental and economic damages.

3.2.1 Waste treatment

The focus in this paragraph is both new plants and investment in the renovation and modernisation of waste management plants. Projects may refer to solid waste collection and solid waste sorting plants, incinerators (with or without energy recovery), landfill or other waste disposal and waste removal plants.

The solid waste involved is:

- waste listed in the EU directives;
- waste encoded in the European Catalogue of Waste (Commission Decision 2000/532/EC[14] – see box below);
- other national types of waste.

MAIN TYPOLOGIES OF WASTE IN THE EUROPEAN CATALOGUE OF WASTE	
	(Commission Decision of 3 May 2000[15])
(01)	Wastes resulting from exploration, mining, quarrying, physical and chemical treatment of minerals
(02)	Wastes from agriculture, horticulture, aquaculture, forestry, hunting and fishing, food preparation and processing
(03)	Wastes from wood processing and the production of panels and furniture, pulp, paper and cardboard
(04)	Wastes from the leather, fur and textile industries
(05)	Wastes from petroleum refining, natural gas purification and pyrolytic treatment of coal
(06)	Wastes from inorganic chemical processes
(07)	Wastes from organic chemical processes
(08)	Wastes from the manufacture, formulation, supply and use (MFSU) of coatings (paints, varnishes and vitreous enamels), adhesives, sealants and printing inks
(09)	Wastes from the photographic industry
(10)	Wastes from thermal processes
(11)	Wastes from chemical surface treatment and coating of metals and other materials; non-ferrous hydro-metallurgy
(12)	Wastes from shaping and physical and mechanical surface treatment of metals and plastics
(13)	Oil wastes and wastes of liquid fuels (except edible oils, 05 and 12)
(14)	Waste organic solvents, refrigerants and propellants (except 07 and 08)
(15)	Waste packaging; absorbents, wiping cloths, filter materials and protective clothing not otherwise specified
(16)	Wastes not otherwise specified in the list
(17)	Construction and demolition wastes (including excavated soil from contaminated sites)
(18)	Wastes from human or animal health care and/or related research (except kitchen and restaurant wastes not arising from immediate health care)
(19)	Wastes from waste management facilities, off-site waste water treatment plants and the preparation of water intended for human consumption and water for industrial use
(20)	Municipal wastes (household waste and similar commercial, industrial and institutional wastes) including separately collected fractions.

[14] As amended by: Commission Decision 2001/118/EC, Commission Decision 2001/119/EC and Council Decision 2001/573/EC. Annex II A of the Directive 2006/12/EC of the European Parliament and of the Council of 5 April 2006 on waste gives a list of disposal operations such as they occur in practice. See Annex I of the aforementioned Directive 2006/12/EC of the European Parliament and of the Council of 5 April 2006 on waste. The Article 1 of this Directive gives the following definition: '(a) 'waste' shall mean any substance or object in the categories set out in Annex I which the holder discards or intends or is required to discard;'. As amended by: Commission Decision 2001/118/EC, Commission Decision 2001/119/EC and Council Decision 2001/573/EC. Commission Decision of 3 May 2000 replacing Decision 94/3/EC establishing a list of waste product pursuant to Article 1(a) of Council Directive 75/442/EEC on waste and Council Decision 94/904/EC establishing a list of hazardous waste pursuant to Article 1(4) of Council Directive 91/689/EEC on hazardous waste.

[15] Commission Decision of 3 may 2000 replacing Decision 94/3/EC establishing a list of wastes pursuant to Article 1(a) of Council Directive 75/442/EEC on waste and Council Decision 94/904/EC establishing a list of hazardous waste pursuant to Article 1(4) of Council Directive 91/689/EEC on hazardous waste.

3.2.1.1 Project objectives

The general objectives are usually related to local and regional development and environmental management. Specific objectives involve:

- the development of a modern local and regional waste management sector;
- the reduction of health risks linked to an uncontrolled management of municipal and industrial waste;
- the curbing of raw material consumption and the planning of the final phases of material production and consumption cycles;
- the reduction of polluting emissions such as water and air pollutants;
- innovation in technologies for waste collection and treatment.

To highlight the general and specific objectives, the project should define carefully the following characteristics:

- the population covered by the projects, tons of waste collected and treated by type of waste (hazardous waste, municipal waste, packaging waste);
- type of technologies implemented (methods of treatment);
- economic impacts on the local economy (in terms of revenues and employment[16]);
- risk reduction due to the implementation of the waste management strategy;
- savings in raw material consumption (such as, for example, metal and metal compounds, reclaimed and/or regenerated solvent, glass, plastics, fuel and other products of recovery operations[17]);
- reduction in air, water and soil pollutants and types of environmental damage to soil and groundwater avoided.

3.2.1.2 Project identification

Typology of the investment

The main types of waste management facilities are[18]:

- investments in facilities for the collection, temporary storage and recycling of waste (whether collected separately or not), such as municipal collection centres;
- compost production facilities;
- investment in facilities for physical and chemical treatments, such as oil waste treatment facilities;
- household and industrial waste incineration plants and incinerators (with or without combined heat and power);
- landfill sites.

A map of the plant proposed will be attached to the project for a better comprehension of the local economic and environmental impacts. Some information on the area covered by the waste collection will also be included. In addition, data are needed on the origin of waste: local, regional, national or country of origin (for waste imported from another European or non-European country).

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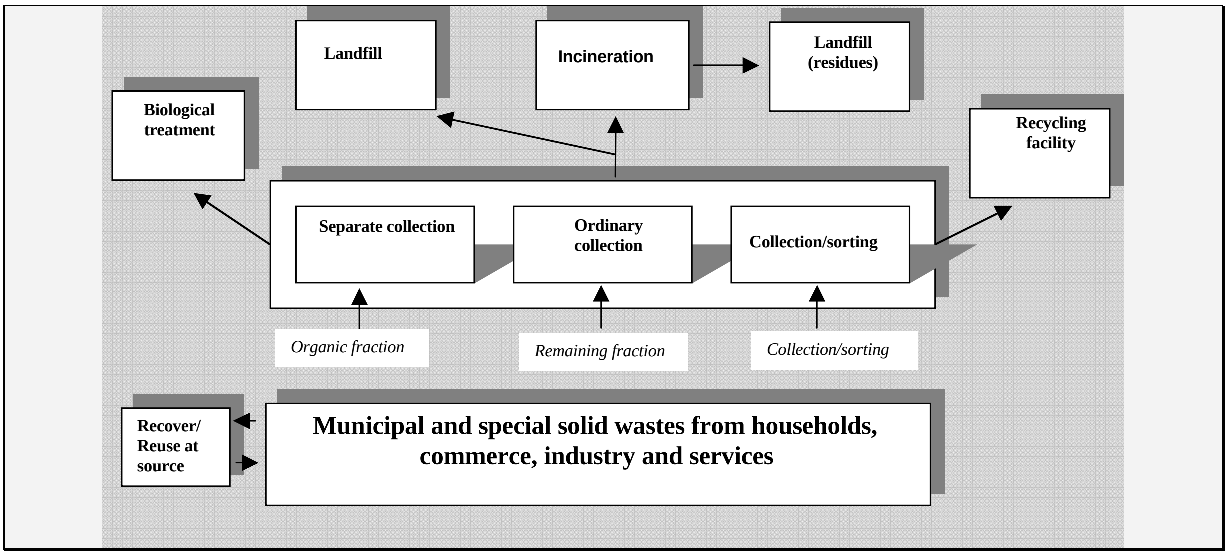
16 While, obviously, this is not a primary objective of the project.

17 Annex II B of the Directive 2006/12/EC of the European Parliament and of the Council of 5 April 2006 on waste lists the recovery operations as they occur in practice.

18 See also the aforementioned Annex II A of the Directive 2006/12/EC.

Figure 3.2 Waste management systems from waste source to final disposal or removal



Regulatory framework

The project selection process will comply with general and specific legislation on waste management and with the principles, that guide the EU's policy in the sector (see box).

The main principles are:

- the Polluter Pays Principle (PPP)[19]: implies that those who cause environmental damage should bear the costs of avoiding it or compensating for it. For the project, attention will be paid to the part of the total cost which is recovered by charges supported by polluters (the holders of waste).

LEGISLATIVE FRAMEWORK
Waste framework - Hazardous Waste Directive (Council Directive 1991/689/EEC as amended by Council Directive 1994/31/EC) and by Commission Decision 2000/532/EC - Directive on environmental liability with regard to the prevention and remedying environmental damage (European Parliament and Council Directive 2004/35/EC) - Directive on Waste (European Parliament and Council Directive 2006/12/EC) **Specific Waste** - Disposal of waste oils (Council Directive 1975/439/EEC) - Protection of the environment, and in particular of the soil, when sewage sludge is used in agriculture (Council Directive 1986/278/EEC) - Directive on batteries and accumulators and waste batteries and accumulators and repealing Directive 1991/157/EEC (European Parliament and Council Directive 2006/66/EC) - Packaging and packaging waste (Council Directive 1994/62/EC as amended by European Parliament and Council Directive 2004/12/EC) - The disposal of PCB/PCV (Council Directive 1996/59/EC)- Directive on end-of life vehicles (Council Directive 2000/53/EC) - Directive on waste electrical and electronic equipment (WEEE) (European Parliament and Council Directive 2002/96/EC as amended by European Parliament and Council Directive 2003/108/EC) - Directive on the management of waste from extractive industries and amending Directive 2004/35/EC (European Parliament and Council Directive 2006/21/EC) **Processes and facilities** - Reduction of air pollution from existing municipal waste-incineration plants (Council Directive 1989/429/EEC) - Reduction of air pollution from new municipal waste-incineration plants (Council Directive 1989/369/EEC) - Incineration of hazardous waste (Council Directive 1994/67/EC) - Directive on the landfill of waste (Council Directive 1999/31/EC) - Directive on port reception facilities for ship-generated waste and cargo residues (European Parliament and Council Directive 2000/59/EC) - Directive on the incineration of waste (European Parliament and Council Directive 2000/76/EC) **Transport, Import and Export** - Rules on shipments of waste (European Parliament and Council Regulation (EC) No 1013/2006 as partially amended by European Parliament and Council Regulation (EC) No 1379/2007 and by European Parliament and Council Regulation (EC) No 1418/2007)

[19] « In accordance with the 'polluter pays' principle, the cost of disposing of waste must borne by: (a) the holder who has the waste handled by a waste collector or by an undertaking as referred to in Article 9 and/or (b) the previous holders or the producer of the product from which the waste came» (Art. 15, Directive 2006/12/EC).

- Waste Management Hierarchy rules on the export for recovery of certain waste (European Parliament and Council Regulation (EC) No 801/2007). Waste management strategies must aim primarily to prevent the generation of waste and to reduce its harmfulness. Where this is not possible, waste materials should be re-used, re-cycled, or used as a source of energy. As a final resort, waste should be disposed of safely (by incineration or in authorized landfill sites). In project analysis, an option on prevention of waste generation or waste re-use and re-cycling will be systematically presented to compare the difference in costs between prevention, recycling and final waste disposal facilities. In any case, the choice of an incinerator or a landfill should be argued by the existence of very large costs occurring in waste prevention and recycling options.
- the proximity principle: waste should be disposed of as close to the source as possible, at least with the objective of self-sufficiency at Community level and if possible at Member State level.

The project will measure the distance between the area of production of the waste and the localization of the plant and the related costs of transport. High transport costs or long distances should be explained by specific reasons, such as the nature of the waste or the type of technology used.

3.2.1.3 Feasibility and option analysis

Some scenarios have to be set up for the purpose of choosing the best option from different available alternatives. The potential scenarios are as follows:

- a BAU scenario;
- some available alternatives;
- global alternatives to the project (for example the study of an incinerator as an alternative to a landfill, or a separate collection centre for recycling in place of a final disposal plant as a landfill).

Against the BAU scenario, the project analysis will give the reasons for the choice of 'doing something' instead of maintaining the status quo option. The arguments will focus on the economic, social and environmental benefits of the project and should emphasize the resulting cost for the status quo option in terms of economic costs, environmental and human health impacts.

In the second case, the feasibility study will expose the technical alternatives to the option selected. It could be for an incinerator, for example, the type of furnace or the adjunction of a steam boiler for energy recovery.

Eventually, for the global scenario the study will focus on the different methods for waste management in the context of the project. The project should distinguish one alternative focusing on the prevention, the re-use, the recycling or the recovery to be compared with the option chosen. The aim is to fulfill the hierarchy principles and initiate their concrete integration into waste management project analysis.

Demand analysis

The demand for waste recovery and disposal is a key element in the decision concerning the building of a waste treatment facility. The estimation will often be based on:

- the evaluation of the production by type of waste and by type of producer, in the geographical area of the project;
- present and expected changes in national and European norms in waste management.

The evaluation of the future demand for municipal waste management will take into account the demographic growth and the migratory flows. For industrial waste, the key parameter will be the expected industrial growth in relevant economic sectors. In any case, it is important to bear in mind the possible evolution in waste producer behaviour, such as the increase in consumption correlated with the standard of living, the increase in recycling activities or the adoption of clean products and clean technologies (with their potential consequences on waste streams), variation in the type of waste produced and the decrease or increase in waste production.

Norm compliance must also be considered in the demand estimation. According to the waste management hierarchy and the considerations included in the applied directives (for example the Packaging Directive 2004/12/EC), the need for waste management treatment is expected to be increasingly satisfied by prevention, recycling, composting and energy recovery (heat or power). Consequently, the size of an incinerator or a landfill has to be gauged in relation to these future trends.

The steps for the demand estimation are:

- the demand forecast which is derived from current demand and the demographic and industrial growth predictions;
- the adjusted demand, according to the potential changes in waste producer behaviour and according to the compliance with current and expected policies and legislations.

Phases of the project

The following different phases of the project must be specified: conception and financial plan, technical studies, investigation phase to find an appropriate site, building phase and management phase.

Any delays occurring in these phases could be important, especially the search time required for finding an appropriate site. For hazardous treatment plants, for example, there is often hostility observed from the population, which, may result in disruptions to the building and the normal managing of the plant with negative consequences on financial and economic flows (see also the section on risk assessment).

MAIN ENGINEERING FEATURES TO BE CHECKED AND ANALYSED
The description of the technical characteristics of the plant are crucial for a better comprehension of the economic and social local impacts of the projects, its environmental impacts and the total financial and economic costs and benefits involved. In addition, detailed technical information is required for the monitoring and the evaluation activities required by Structural Funds evaluation process. This section should at least give the following data: - basic socio-economic data: the number of inhabitants served; the number and the type of productive structures served; - basic data on waste: the type (municipal waste, hazardous waste, packaging waste, waste oils) and quantity (t/d, t/y, t/h) of product to be treated; secondary raw materials recovered; energy produced (Mega Joules of heat or MWh of power); - physical features: area occupied by the plant (in thousand m^2), covered and uncovered storage areas (in thousands m^2), the distance from main agglomerates and discharge systems for effluent water and fumes; - information on building techniques and building phases; - processing techniques for the treatment plant: technology used, energy and material consumed and others goods and services consumed.

3.2.1.4 Financial analysis

The financial inflows and outflows are:

Financial inflows	Financial outflows
▪ Price for treatment paid by private users ▪ Price for treatment paid by public users ▪ Sales of products recovered (secondary materials and compost) ▪ Sales of energy produced (heat and power)	▪ Investment costs - Land acquisition - Building - Equipments - Replacement costs - Feasibility investment studies and all other intangible assets ▪ Operating costs - Energy - Materials - Services - Technical and administrative personnel costs - Maintenance costs - Management and administrative costs

The time horizon for a project analysis is usually around 30 years.

The time horizon depends on the type of waste treatment facility used and the type of waste collected. The aforementioned time horizon is generally well suited to investments in incinerators and large waste treatment and recycling facilities. In same cases (such as for investments in temporary storage waste facilities or collection centres or some kinds of physical and chemical treatment plants, etc.) shorter values of the time horizon may be used; in other cases, a time horizon in excess of thirty years could be suitable. For example, in the case of an investment in a landfill, the horizon for the analysis has to be adjusted for the planned useful life of the landfill.

3.2.1.5 Economic analysis

The main benefits and costs are as follows:

Benefits	- The treatment of waste, which minimises impacts on human health, urban environment, etc. (do nothing alternative) - Energy recovery
Costs	- Impacts on human health (morbidity or mortality due to air, water or soil pollution) - Environmental damages induced such as water and soil contaminations - Aesthetic and landscape impacts and the economic impacts, such as changes in land prices or economic development induced by the project - Impacts on mobility, existing infrastructures and so on, due to the increase in local traffic deriving from the waste transported to the landfill or treatment plant

When the methodologies proposed are controversial, or data are lacking, then a qualitative analysis of the externalities can be conducted. However, in such a case, results cannot be used in the monetary analysis and must be inserted in a multi-criteria analysis.

The conversion factors

The items to be considered for the calculation of the conversion factors for the waste treatment facilities are the investment costs, the intermediate stocks, the products sold on the market (secondary materials, gas, heat or power), operational costs (including labour costs) and decontamination and dismantlement costs. The estimates will be different when considering traded items (raw materials, energy, commodities and other capital goods or services) as opposed to non-traded items (electricity and gas recovery, land, some raw materials or unskilled labour). Externalities are to be considered as special non-marketed goods or services.

For waste treatment plants, conversion factors will be calculated as follow:

- For traded items:
  - ♦ Equipment

Equipment for waste management is frequently traded. This is the case for incineration equipment, such as furnaces, filters and boilers, but also for collection and recovery equipment. CIF and FOB prices can be applied, if needed.

  - ♦ Recycled materials

Many recovered materials are traded, such as metallic materials, paper or glass. Prices are strongly correlated with international market prices of raw materials and energy. The information required for the calculation of conversion factors for traded items could be based on eco-industries datasets, or by national and international statistical offices or Customs.

- For non-traded items:
  - ♦ Buildings

The conversion factors are estimated according to a process analysis, which differentiates traded items from non-traded items. Information required for the calculation of conversion factors can, in some cases, be found in regularly published official statistics.

♦ Electricity produced, gas and heat recovery

The conversion factor for electricity, considered as an inputs, can be estimated as follow: a) an existing macroeconomic study that tries to estimate the opportunity costs of electricity production (the 'top down' approach), b) a process evaluation that proceeds by breaking down the marginal cost structure of the production process (the 'bottom up' approach); c) the application of a standard conversion factor when electricity is a minor input.

If electricity is sold at a price below long-run marginal cost, then the latter information should be used to calculate the correction for actual tariffs. In a final step, the domestic market price has to be converted, if necessary, into a border price by applying a suitable conversion factor (the SCF may be used).

Gas and heat are products usually sold in local markets. If they are at the origin of a minor financial flow, as it usually occurs, then the SCF could be applied to express local prices in relation to border prices. Otherwise (for example in the case of methane), the ratio of the international price to the price of the direct substitute could be used as an adjustment factor.

♦ Land

Land is generally of minor importance for plant projects (e.g. incinerators, treatment and/or recycling waste facilities, compost production plants, etc.) and may be converted from market into border prices by the SCF. When land is important, for example in the case of a landfill, its economic value is determined by the valuation – at border prices – of the net output that would have been produced on the land if it had not been used by the project.

♦ Skilled and non-skilled labour.

The labour force involved in waste management facilities is mainly non-skilled. For a discussion of the shadow wage see Annex D.

3.2.1.6 Risk assessment

Critical factors

- Demand elasticity
- Key input dynamic costs
- Recovered product prices
- Costs of remediation and other environmental costs

Main variables to consider	- The change in demand for waste disposal related to the diffusion of new products or new technologies - The change in behaviours - The variation in economic or population growth or decrease - Energy costs - Raw materials costs - Variations in the sales price of recovered products - The dynamics of costs over time of some goods and critical services for certain projects - The cost of electricity - The cost of fuel - The cost of remediation and decontamination of the sites

Another type of risk analysis could be performed regarding the social risk related to the possible rejection of the project because of its potential impacts on quality of life in the area concerned. The risk is usually called NIMBY (not in my backyard) and can be investigated by a qualitative analysis based on a questionnaire or direct contacts with the stakeholders involved (e.g.: public consultation on the Environmental Impact Assessment).

3.2.1.7 Other project evaluation approaches

Environmental analysis

For a large number of waste treatment projects, an Environmental Impact Assessment (EIA) is required by EU directives[20], especially in the case of hazardous waste deposits, removal plants or for some types of waste treatment plants such as authorized landfills. Furthermore many plants, like landfills or incinerators, require permits for prescribed activities which set out conditions for risk management, dangerous substance management and pollution control[21].

The main elements of an EIA are the following:

- emissions into the atmosphere, especially greenhouse gas emissions (impacts relevant for incineration);
- waste water discharges and soil contamination (impact relevant for land-filling and incineration);
- impacts on biodiversity (impact relevant for major projects built near protected areas);
- impacts on human health, linked to pollutant emissions and contamination of the environment (impact relevant for any waste treatment facility);
- noises and odours (impacts relevant for many waste treatment plants);
- aesthetic impact on landscape (impact relevant for landfill and incineration);
- impacts, which may negatively affect mobility, existing infrastructures and so on, due to the increase in local traffic due to waste transportation to the landfill or treatment plant;
- risk management of the site such as fire and explosions (impact relevant for some specific waste treatment plants such as oil waste treatment plants and incinerators);
- in urban areas, disruptions can also accur during the construction phase, while, in management phase, in addition to those listed above, disturbances are likely to be linked to the collection of waste.

A qualitative approach to environmental impacts could always be used in order to rank the potential environmental impacts according to the type of damage or its danger level. For example, the major impacts of a landfill are likely to be soil and water contamination, while, for incineration, impacts on air quality will be more relevant.

3.2.2 Water supply and sanitation

The focus here is on investments in the integrated water supply service (IWS) for civil use and for other uses. The IWS segments include the supply and delivery of water as well as the collection, removal, purification and elimination of sewage. The re-utilisation of waste water, while not strictly part of the IWS, is also discussed.

The selection of projects will comply with the general and specific legislation on water and waste water service management and with the principles, that guide the EU policy in this sector. The European policy on water is set out in a far-reaching key directive, i.e. the Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy. The implementation of the aforementioned Directive is under development (see the box below on the legislative framework).

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[20] Council Directive 85/337/EEC of 27 June 1985 on the assessment of the effects of certain public and private projects on the environment (as amended by Directive 97/11/EC).

[21] European legislation on pollution control and risk management sector is set out in the IPPC (Integrated Pollution Prevention and Control) Directive (96/61/EC) as amended by the European Parliament and Council Directives 2003/35/EC and 2003/37/EC and by the European Parliament and Council Regulation (EC) No. 1882/2003, in the Large Combustion Plants Directive (88/609/EEC) and the Seveso II Directive (96/82/EC) as extended by the European Parliament and of the Council Directive 2003/105/EC.

LEGISLATIVE FRAMEWORK
Water use framework - European Parliament and Council Directive 2000/60/EC establishing a framework for Community action in the field of water policy **Water and water ambient protection** - Consequent to the Water Framework Directive - Directive about the bathing water quality (European Parliament and Council Directive 2006/7/EC) - Directive dealing with the protection of groundwater against pollution and deterioration (European Parliament and Council Directive 2006/118/EC) *Other Directives* - Council Directive 1976/464/EEC on pollution caused by certain dangerous substances discharged into the aquatic environment - Council Directive 1991/676/EEC of 12 December 1991 concerning the protection of waters against pollution caused by nitrates from agricultural sources **Specific water and waste water** - Council Directive 1998/83/EC regulating the quality of water to be used for human consumption, - Council Directive 1991/271/EEC concerning urban waste-water treatment

The main objective of the Water Framework Directive is to achieve good water status for all waters by 2015. The Directive, therefore, pursues protection of all water bodies, including inland surface waters, transitional waters, coastal waters and groundwater.

Even if activities to implement the Water Framework Directive are now under way in Member States and European countries under a common implementation strategy[22], the main principles, that are relevant for the water project analysis, can be clearly outlined:

- integrating the management of water resources on a river district scale. The 'river basin district' is the administrative and territorial unit basis for the management of water from all points of view and is defined as a set of terrestrial and marine areas, which include one or more neighbouring basins;
- economics integrated into the management of the water services. The Water Framework Directive clearly integrates economics into water management and water policy decision-making. To achieve its environmental objectives and promote integrated river basin management, the Directive calls for the application of economic principles (e.g. water pricing). The Directive requires an economic analysis of the different uses of resources and water services[23];
- the total cost recovery: the tariff policies for attaining the goal of economically and environmentally sustainable use of water resources, must take into account the 'total water costs':
    - ♦ financial costs: these are the costs of providing and administering water services, namely operating costs, and maintenance costs of capital for the renewal of equipment and new plants (capital and interests and the possible return on equity);
    - ♦ environmental costs: these are related to damage to the environment, and to those who use it, caused by the environmental impact of the construction of the project infrastructures and by the subsequent use of the water;
    - ♦ resource costs: these represent the costs of foregone opportunities that other users suffer due to the depletion of the resource beyond its natural rate of recharge or recovery (e.g. costs related to groundwater over-abstraction). These users can be either those of today, or those of tomorrow, who will also suffer if water resources are depleted in the future. In principle, the goal of making

[22] See: European Commission, Common Implementation Strategy for the Water Framework Directive, Guidance Document No 1 'Economics and the Environment – The Implementation Challenge of the Water Framework Directive' produced by Working Group 2.6 – WATECO, 2003.

[23] The main features of the economic analysis can be summarised as follows (see also WATECO 2003): to carry out an economic analysis of water uses in each River Basin District; to assess the 'total water costs' and to assess current levels of cost-recovery; to assess trends in water supply, water demand and investments; to identify areas designated for the protection of economically significant aquatic species and to designate heavily modified water bodies based on the assessment of changes to such water bodies and of the impact (including economic impact); to support the selection of a programme of measures for each river basin district on the basis of cost-effectiveness criteria and to define the implications of the programmes for cost-recovery; to estimate the need for potential (time and objective) derogation from the Directive's objectives based on an assessment of the costs and benefits and of the costs of alternatives for providing the same objective.

every user support the total costs related to their consumption of water or water discharged should be pursued. For civilian, agricultural and industrial users, service tariffs must be applied (no later than 2010) in order to offset the total water costs, as defined above. However, in applying this principle, Member States may take into account the social, environmental and economic impact of cost recovery, together with geographical and climatic conditions of individual regions. Full cost recovery of the service is a guiding principle to be pursued, but only if socially affordable. Other economic instruments such as a grant subsidies, incentives, tariff discrimination, royalties and taxes on the use of resources and polluting discharges can still be applied, but only if justified by specific conditions.

- the Polluter Pays Principle (PPP): the Polluter Pays Principle implies that those who cause environmental damage should bear the costs of avoiding it or compensating for it. For the project, attention must be paid to that part of the total cost which is recovered by charges supported by polluters (the users of the various water services).

3.2.2.1 Project objectives

The proposer shall place the project within a general framework, which is intended to show that the planned investments will have the effect (main purpose) of improving the quality, effectiveness and efficiency of the performed service.

It is necessary to provide for the ex ante quantification of the significant parameters of such an objective, such as for example:

- the extension of the supply and delivery of sewer and purification services;
- the volume of water saved in civil, industrial or irrigation networks as a result of the reduction of water leaks and/or the rationalisation of delivery systems;
- the smaller quantity taken from polluted sources (for example rivers or natural lakes which have been strongly impoverished by resource depletion or coastal and salty groundwater's, etc.);
- the amount of raw water purified to make it drinkable by humans (Council Directive 1998/83/EC);
- increasing the quantity and improving the reliability of water supply to drought prone areas[24];
- anywhere, the improvement of the water delivery system in dry weather conditions, taking into account the inherent variability of the locally available amount of resources for the supply of natural water resources;
- the continuity of service (frequency and duration of interruptions);
- the polluting load that has been removed, particularly from rivers[25], lakes[26], transition waters nearer the coast, and sea water[27];
- the improvement of environmental parameters (European Parliament and Council Directive 2000/60/EC and Member State legislation);
- the reduction of operating costs.

Moreover, it is necessary to establish some specific objectives. From this point of view, the investments in the sector may be grouped into two project categories:

- the projects intended to promote local development[72]. In this case, it is necessary to establish the specific objectives of the investment, i.e. the population that will be served and the average resource

[24] See also the Commission Staff Working Document COM(2007 214 Final on 'Addressing the challenge of water scarcity and droughts in the European Union'.

[25] The European Commission adopted a proposal for a new Directive to protect surface water from pollution on 17 July 2006 (COM(2006)397 final): Surface Water Protection against Pollution under the Water Framework Directive

[26] See the footnote above.

[27] See European Parliament and Council Directive 2006/7/EC.

availability (litres/inhabitant*day[28]) or the hectares which shall be irrigated, the types of crops, the average expected production, the resource availability (litres/hectare*year), the time and periodicity of waterings, etc.

- the projects may have non-local objectives, for example on a regional or interregional scale. This is the case with aqueducts for the long-distance transportation of water from relatively rich areas to arid zones or the construction of dams intended to supply wide regions, which may be also far away from their location. In this case, the specific objectives shall also refer to the volumes made available (millions of cubic metres per year), the maximum conveyed flow rates (litres/second), and the overall capacity of the long-term resource regulation, which has been realised by the system.

Typology of the investment

We list below some examples.

FOCUS: TYPOLOGY OF INVESTMENTS AND OFFERED SERVICES
Type of actions: - construction of entirely new infrastructures (aqueducts, sewer systems, depurators), intended to meet increasing needs, - works intended to complete aqueducts, sewers and depurators that have been partially realised, including the completion of water supply networks or sewer systems, the construction of trunk lines for connection to existing conditioning systems, the construction of conditioning systems for the existing sewer systems, the construction of waste water treatment plants with tertiary treatment sections for the reutilization of conditioned sewage, - actions intended to improve the efficiency of the water asset management, - partial modernisation and/or replacement of the existing infrastructures in compliance with the strictest rules and laws in force, - works intended to increase water availability, - works intended to assure water availability in dry weather conditions (on a seasonal, annual basis), - actions intended to save water resources and/or to provide for its efficient use, - actions intended to rationally replace the use of the resource when it is not regulated (for example irrigation with private uncontrolled wells). **Prevailing typology of investments:** - works meant for the collection, regulation or production of the resource, even on a pluriennial basis, - works meant for water transportation, - works meant for the local distribution of water resources as well as for civil, industrial or irrigation purposes, - works meant for the treatment of primary water (clarification, desalination, purification) - works meant for the collection and elimination of sewage, - works meant for the treatment and discharge of conditioned sewage, - works meant for the reutilization of treated sewage. **Services offered:** *Civil services* - infrastructures and/or plants serving high-density urban areas, - infrastructures and/or plants serving the districts of towns or villages, - infrastructures and/or plants serving small (agricultural, mining, tourist) settlements and/or isolated houses, - infrastructures and/or plants serving high-density industrial settlements and/or industrial areas, - rural aqueducts. *Irrigation service* - district aqueducts for collective irrigation, - local aqueducts for individual or small-scale (oasis-like) irrigation, *Industrial service* - district aqueducts, sewage nets and depurators for large industrial areas, industrial districts, technological parks or similar industrial concentrations, - local infrastructures for individual factories and for small craft/industrial areas, *Mixed service* - aqueducts for irrigation and civil and/or industrial service, - industrial and civil aqueducts.

[28] If the resource is destined to the service of tourist areas, it is necessary to take into account the fluctuation of the population and the seasonality of the demand.

Territorial reference framework

If the project is placed within its territorial planning framework, this will provide for a precise identification of the investment.

The proposer will also supply the elements required to ascertain the project's consistency with the sector planning, at least from the following four points of view:

- consistency with the framework for Community action in the field of water policy, as it may be inferred by the legislation acts under the common and/or national implementation strategy of the Directive 2000/60/CE;
- consistency with the economic-financial planning of the water sector, as may be inferred from the pluriennial schedules for the use of Community and national financing that have been approved for the various countries or regions;
- consistency with the national sector policies, in particular the project shall significantly foster the industrialisation objectives of the sector, for the countries where this process is under way;
- consistency with the Community, national and regional environmental policies, mainly for the use of water for human purposes, the treatment of sewage and the protection of water bodies (see also the box on communitarian legislation).

The SWOT analysis, which evaluates the project's potential and risks deriving from the institutional and legal rules and the economic and social context in which the project is developed, may also be helpful in some cases.

3.2.2.2 Feasibility and option analysis

Demand analysis

The demand for water may be broken down into separate components according to the use (demand for drinking water, for irrigation or industrial purposes, etc.), and the timing of demand (daily, seasonally, etc.).

The estimation of the demand curve may be based on data gained from previous experience in the area involved or on published forecasting methods often based on the concept of the consumer's willingness-to-pay[29].

In case of replacements and/or completions, it is also useful to make reference to the data on historical consumption, provided that these data have been measured by reliable methods (for example from the readings of meter consumption).

Demand is fundamentally made up of two elements:

- the number of users (civil use), the surfaces that will be irrigated (agricultural use) or the production units which shall be served (industrial use);
- the quantity of water, that is being or will be delivered to users for a given period of time[30].

It is important to consider the elasticity of demand with respect to tariffs. In some cases it will be necessary to estimate the elasticity for different income groups and also for small and large users, because it may have quite different values and distributive impacts.

In any case, the elasticity of water demand with respect to service price should be estimated on a local basis. In fact these parameters vary considerably in different geographical areas that are otherwise similar.

The project will focus on a demand forecast for the period corresponding to the project cycle. It shall take into account the demographic forecasts and the migration flows for an estimate of the users and the

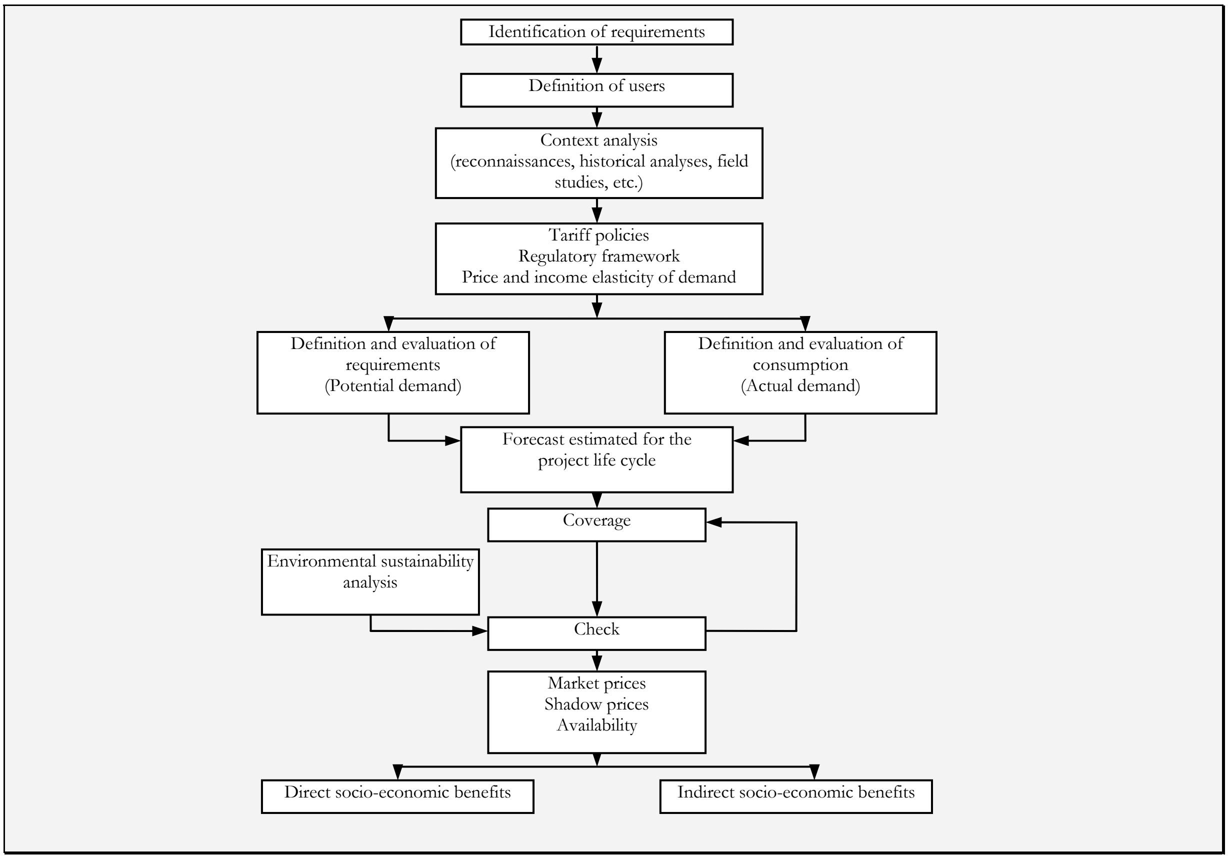
[29] J. Kindler, C.S. Russell, 1984 and D. C. Gibbons, 1986

[30] Mainly, but not only, in cases where the water network had not been well maintained in the past. It is important to consider, that the analysis of demand has to include the problem of leakages. That is to say that the total water supply consists of the final consumption and the leakages.

agricultural or industrial development plans in the other cases[31].

In general, one can make a distinction between potential and actual demand (or water consumption). The potential demand (or water resource needs) will correspond to the maximum requirement, which will be taken into account for that investment. For example, for civil purposes it may be evaluated on the basis of the water requirements for the same use (generally expressed on a daily and seasonal basis) arising out of the comparison with any situation which will be as close as possible to the one facing the project and have a good service level. For irrigation purposes, it may be estimated on the basis of specific agronomic studies or, even in this case, by analogy. The actual demand is the demand which is actually fulfilled by the investment in question and which corresponds to the expected consumption. The actual starting demand is represented by the actual consumption before the intervention.

Figure 3.3 Chart of the analysis of the water demand



A first obvious evaluation criterion of the investment depends upon the extent to which the actual demand may be close to the potential demand. It is necessary to consider also the environmental and economic sustainability of the investment (Water Framework Directive 2000/60/EC). The demand the investment can actually satisfy corresponds to the supply, net of any technical resource loss and release.

Whenever the project may imply the use of water (surface or subsurface) resources, the actual availability of the resource flows required will be clearly shown by appropriate hydrological studies.

If the project involves the treatment and discharge of sewage, it is necessary to analyse the capacity of the body intended to receive the load of polluting and nourishing substances, in a way compatible with environmental protection (Directive 2000/60/EC).

31 The time structure of the short-term demand (daily, seasonal, etc.) will be considered only for the technical design of the infrastructures.

Cycle and phases of the project

Great attention needs to be paid to the preparatory stages e.g. the search for new subsurface resources and their qualitative and quantitative assessment by means of scout borings or hydrological surveys and studies intended to identify the best location of dams and crosspieces, their dimensioning, and so on.

Moreover, it is necessary to consider the institutional and administrative aspects related to the project as well as the expected execution and building times. Particular attention should be paid to the legal structure of the PPP projects, as this may affect the eligibility of expenditure (see below).

The technical features

The analysis should also be completed through the identification of technical features.

Identification of basic functional data

- Number of inhabitants served;
- Irrigated surface (hectares);
- Number and type of production units served;
- Water availability per capita (l/d*inhabitant) or per hectare (l/d*hectare);
- Water quality data (laboratory analysis);
- Number of equivalent inhabitants, flow rates and parameters of the polluting load of the water that will be treated (laboratory analysis) and quality constraints of the water that will be drained (defined by the law).

Identification of the territorial construction data of the infrastructure:

- Location of the works on the territory, shown by properly scaled topographical maps (1:10,000 or 1:5,000 for networks and plants; 1:100,000 or 1:25,000 for collection and supply works, trunk lines);
- Physical connections between the structures and the (new or existing plants); it may be useful to enclose technical drawings of a schematic kind;
- Any interference and/or interconnection with the existing infrastructures of any other type (streets, railways, electrical lines, etc.).

Identification of physical and characteristic data:

- Total length (km), nominal diameters (mm), nominal flow rate (l/s) and differences in height (m) of suppliers or trunk lines;
- Nominal filled volumes (millions of m^3) and height (m) of dams (location plans and sections attached hereto);
- Number, length (m) and nominal flow rate (l/s) for running water taking works (attaching location plans and sections);
- Number, depth (m), diameter (mm), drained flow rate (l/s) for wells fields (attaching properly scaled location plan);
- Linear development (km) and characteristic diameters (mm) of aqueducts or sewers (attaching properly scaled location plan);
- Capacity (m^3) of tanks (attaching location plans and sections);
- Occupied surface (m^2), nominal flow rate (l/s) and difference in height (m) of any lifting apparatus (attaching location plans and sections);
- Nominal flow rate (l/s), production (m^3/g) and absorbed / consumed power (kW or Kcal/h) of purification or desalination plants (attaching lay-out and flow pattern);
- Technical features and configuration of the main structures, for example by enclosing one or several typical sections and/or sketches (sections of ducts, layouts of control rooms, etc.) and by specifying the parts that have recently been built;
- Technical and constructive features of the main lifting apparatus, production or treatment plants, by enclosing functional layouts in details;
- Nominal flow rate (l/s), capacities (equivalent inhabitants), conditioning efficiency (at least on BOD, on COD, on phosphorous and nitrogen) of purification plants as well as the technical and constructive features of drain pipes (attaching location plans, lay-outs and flow patterns);
- Number, location in the networks, types, manufacturing technology and quality of the measuring instruments (flow rates, pressures, volumes, etc.) and of the meters for users;
- In the case of projects of network rehabilitation, the technical data regarding the to be rehabilitated (pipe lengths and diameters, materials, operating pressures and flows, leakage rates, maintenance state, etc.) must be provided, which clearly demonstrates the necessity and appropriateness of the designed intervention;
- Technical and constructive features of the buildings or other service structures, by attaching location plans and sections;
- Relevant technical elements, such as crossings, cave tanks, galleries, remote control plants or computerised service management plants, etc. (by attaching data and lay-outs);
- Identification of the main components and materials proposed by the project, by specifying their availability (of local production or importation) in the investment area;
- Identification of any technology that may have been proposed for the realisation of the infrastructure, by specifying its availability and convenience (for example from the viewpoint of maintenance);
- In the case of conditioners, identification the options for the disposal of treatment mud. In the case of desalination plants, identify the options and infrastructures for the disposal of concentrated brine.

The quantity, the distribution in the network and the proper functioning of the instruments for measuring the key process parameters (e.g. the water flow and/or water quality and the meters for the final users) have to be assessed. This is one of the most important parts of the feasibility analysis[32].

Option analysis

The analysis should include a comparison with:

- the current situation (the 'business as usual' scenario);
- the possible alternatives within the same infrastructure, for example: different location of wells, alternative routes for aqueducts or trunk lines, different building techniques for dams, different positioning and/or process technology for plants, utilisation of different energy sources for desalination plants, etc.;
- the possible alternatives of sewage drains (lagoons, different receptors, etc.);
- the possible global alternatives, for example: a dam or a system of crosspieces instead of a wells field or the agricultural re-utilisation of properly treated sewage, a consortium depurator instead of several local depurators, etc.

The analysis of the design alternatives must always be consistent with the investment category (see 'Typology of the investment'). In the literature it is possible to find extensive references for the various types.

In selecting the options, the constraints arising because of the legislative framework (EU acquis), and in particular, from the European policy on water (see above) have to be taken into account. In addition, the design alternatives to be evaluated must meet the water sector programmes (planned of use of water sources, programme of construction of new water infrastructure, rules of management of water services, plan of waste water disposal and/or re-use, etc.) of the Member State. Options that respect both design alternatives and the policy constraints detailed above, will then be ranked using financial and economic considerations according to the methodology developed in section 2.3.3.

3.2.2.3 Financial analysis

The financial inflows and outflows are:

Financial inflows
▪ Tariffs or fees applied for the water services ▪ Possible reimbursements for the collection and transport of rainwater ▪ Possible proceeds for the sale of water in case of reuse ▪ Prices of any additional service the utility may offer to the user (for example hooking up, periodic maintenance, etc.)

Financial outflows
▪ Investment costs - Land acquisition - Works - Equipments - Legal fees - Start-up costs ▪ Operating costs - Energy - Materials - Services - Technical and administrative personnel costs - Maintenance costs

The time horizon for project analysis is usually 30 years.

32 For example, instruments designed for an aqueduct or a water supply network should allow the calculation of the water balance at different time scales (annual, monthly, daily, etc.) during operation. Instruments designed for a sewerage and a wastewater treatment plant should allow the verifying of both the wastewater collected and treated and the the quality of water discharged into the receiving water body.

One of the most important aims of the financial analysis in the water services sector is to demonstrate the long term financial sustainability of the project.

In the case of a PPP project, the financial analysis should show how the improved financial performance of the project, as allowed by the EU grant, is shared between the public and the private partner of the PPP. This depends precisely upon the amount of public and private funding and how the charges (and risks) of future management are broken down among the partners of the PPP.

After a consolidated financial analysis, the above mentioned issue could be addressed, for example, by calculating an FRR(K_g) and an FRR(K_p), respectively for the public and the private investor. To compute these performance indicators it is sufficient to change the capital outlays in the FRR(K) or FNPV(K) calculation accordingly (for an application see the water waste case study in Chapter 4).

For the outflow, the purchasing price of the products and services, necessary for both the operation of the plant and the additional services supplied, should be considered. Since water infrastructures are generally characterized by a long period of useful life, the financial analysis should consider the residual value of the investment, according to the methods, that were described in the second chapter of the Guide.

3.2.2.4 Economic analysis

The benefits and economic costs of projects in the water supply and waste water treatment sector have to be identified on a case-by-case basis, as they are strongly related to the type of investment and services offered, which in this sector show a very large variability with respect to the project objectives, the uses of water, the prevailing type of investments, etc. (see project identification). In any case, according to the aforementioned Directive 2000/60/EC, the analysis must both the costs and benefits arising to the users, and the costs and benefits arising for the water resource itself, and for the environment in general, have to be taken into account.

The main benefits can be identified as follows with respect to the type of project and its objectives:

a) *Water supply projects, with the aim of increasing the quantity and / or the reliability of water supply for civilian uses, irrigation and industrial purposes.*

   The main social benefit in the economic analysis may be evaluated according to estimates of expected demand for water resources that the investment will satisfy. In other words the benefit is equal to the water demand satisfied by the project and not satisfied in the do-nothing alternative, suitably valued.

   The water service is a classic case of natural monopoly. Market prices generally suffer considerable distortions. The basis for the estimation of an accounting price for water may be the user's willingness-to-pay for the service[33].

   The willingness-to-pay (WTP) can be estimated empirically by applying the market prices of alternative services (tank trucks, bottled drinking water, distribution of drinks, purification by means of devices installed by the users, in situ sanitary processes for potentially infected waters, etc.). In other words, the social benefits of the water service can be evaluated by considering the best alternative technique feasible for the supply of the same catchments area (backstop technology) and by quantifying the price of the alternative service.

   Otherwise, a conversion factor (CF) may be applied to the revenues deriving from the water service, realised or improved by the project. The CF is based on a planning parameter, that can be defined, as an example, by calculating the mean value between the willingness-to-pay (see above) and the long term marginal cost of the service and adjusting the result in order to take into account the distributive effects. This method must be used with caution and only in cases where it is not possible to

[33] Alternatively, for any water infrastructure meant for the service of industrial or agricultural areas, it is possible to evaluate the added value of the additional product, that has been gained through the water availability. But the adequacy of this approach for determining the economic benefits must be carefully evaluated on a case-by-case basis.

determine directly the willingness-to-pay. Other methods can be adopted, which may be found in literature.

b) *Water supply projects, with the aim of protecting the resources of high quality and environmental value.*

Some projects aim at avoiding over-exploitation or some water sources and at identifying alternatives. An example is the replacement of water extracted from coastal aquifers, which have become salty due to pumping excessive volumes of resource, with water produced from other sources, such as desalination, wastewater reuse, surface water sources, etc. The benefit (or non use value) is given by the water preserved for other uses, current or future. The possible alternative uses of the saved water have to be accurately identified and, for each of them, the related potential demands quantified. When this is done, the benefits can be valued by means of water accounting prices as in the previous case.

c) The main benefit of the interventions aimed at limiting water leaks is the reduced volume of water used for supplying the networks compared to an equal or greater quantity of distributed water. Examples are projects for network rehabilitation or, more in general, of 'water asset management'. As in the previous case, the benefit is given by the water preserved for other uses, to be quantified as said above.

d) For any intervention, that is intended to guarantee the availability of drinking resources in areas with sanitary problems, and where water sources are polluted, the benefit may be directly estimated by valuing the deaths and illnesses that can be avoided by means of an efficient water supply service. To make an economic valuation, it is necessary to refer on one hand (illnesses) to the total cost of hospital or out-patient treatments and to the income loss due to possible absence from work, and on the other hand (deaths) to the statistical life value quantified on the basis of the average income and residual life expectancy or with other methods.

e) The social benefits of sewer and depurator projects may be evaluated on the basis of the potential demand for sewage, that will be fulfilled by the investment and estimated according to an adequate accounting price[34]. Alternatively, if possible, direct valuation may be applied to benefits such as:

- The value of the illnesses and deaths avoided thanks to an efficient drains service (see above);
- The value derived from preserving or improving the quality of the water bodies or the lands in which the waste water discharges and the related environment. This value is made up of both 'use' and 'non-use' values (see the diagram below).

f) For 'white' or mixed drains projects, the benefit is the damage avoided to land, real estate and other structures due to potential flooding or unregulated rainwater, valorised on the basis of the costs for recovery and maintenance (avoided costs).

In any case, if no standard economic appraisal method is applicable for the specific project, it is possible to resort to comparisons with any similar project, that may have been developed in a context as close as possible to the one in the affected area. Obviously, in the case of projects that have multiple objectives and, therefore, derive from a combination of two or more of the categories above, the benefits are given by a proper combination of those described above.

For any project, the positive or negative externalities due to the impact of the infrastructure's construction and the use of the water resources, have to be carefully taken into account, as far as possible, by means of a quantitative approach. Various methods exist for the valuation of environmental costs and benefits and these can be found in the literature (see Annex F)[35].

As mentioned in Chapter 2, taxes and subsidies should usually be treated as transfers within society and should therefore be excluded from the estimation of economic costs. However, in the water service

[34] Basically the same as the demand for water, applying an appropriate reduction factor of the flow rates waste water discharged in the sewerage network (as an as an example from literature: 0,8).

[35] See, as example, Pearce D., Atkinson G. and Mourato S. 'Cost-Benefit Analysis and the Environment: Recent Developments' (2005).

projects, as in other sectors in which a strong connection with the natural environment exists, it is important to distinguish between general taxes and environmental taxes and subsidies:

- General taxes need to be deducted from economic costs;
- Environmental taxes and subsidies may represent internalised environmental costs or benefits and, as such, should not be deducted from economic costs or revenues (but attention should be paid in such case to avoid double-counting of externalities).

3.2.2.5 Risk assessment

Critical factors

- The forecasts of the demand dynamics
- The rate of change in tariffs or fees, largely dependent upon the decisions taken by the national or regional regulatory bodies
- The lack of capacity to respond to shocks (which often requires excess capacity in the first operating periods)
- The determining influence of collateral interventions (for example, the effectiveness of water supply is strictly related to the good state of repair of distribution networks)
- The dynamics of costs over time of some critical goods and services for certain projects

Main variables to consider

- The cost of the investment
- The rate of demographic growth
- The forecasts of any migration flow
- The development rate of crops and the national and/or international dynamics of the sale prices of agricultural products (for irrigation purposes)
- The variation in tariffs or fees over a period of time
- The demand and price dynamics of the water that may be recovered in case of reutilization;
- The operating costs (maintenance, management, etc.)
- The cost of fuels and/or
- The cost of electric energy for desalination plants
- The cost of chemical additives and the mud disposal cost for depurators

3.2.2.6 Other project evaluation approaches

In addition to what has already been stated in previous paragraphs, it may be useful to produce a special evaluation of the effectiveness of the proposed system when the location for the project is a sensitive area from an environmental point of view.

In any case, an evaluation of the environmental effects (or costs) of water use, implied by the project under analysis, has to be presented by the proposer in accordance with the previously mentioned Water Framework Directive 2000/60/CE.

During the evaluation stage, it is necessary to analyse, even if briefly[36], the environmental impact of the work to be realised with the project and to check any deterioration effect on the soil, the water bodies, the

[36] Legislation in the majority of Member countries requires the compulsory evaluation of the environmental impact for some of these infrastructures (e.g. dams, large aqueducts, depurators, etc.), in the approval stage of projects.

landscape, the natural environment, etc. In particular, great attention shall be paid to the use of valuable areas, such as natural parks, protected areas, natural sanctuaries, Site of Community Importance (SCI)[37] and Special Protection Zones (SPZ)[38], sensitive areas, etc. In some cases, it is also necessary to take into account the extent to which the wild fauna life may be disturbed by the construction of the infrastructures and the associated management activities. As for the investments affecting urban centres (sewer systems or water networks), it is necessary to consider the impacts due to the opening of yards which may negatively affect mobility, existing infrastructures and so on.

The analysis above falls within a more general evaluation of sustainability according to the environmental constraints and development hypotheses of the proposed investment, for which it is necessary to evaluate not only the economic and environmental benefits, but also the extent to which its realisation may cause such a deterioration of the natural functions of the area that may compromise any potential future utilisation, in the broadest meaning of the term, i.e. including the natural use of wide areas.

Such an evaluation shall also consider the alternative, even future, utilisation of the same (surface, subsurface) water body which shall be understood as a source of water resource or as a receiving body and, as a consequence, the impacts of a decrease in the flow rate and a change in the river regime, resulting from its barrage by a dam, may have on the anthropic activities performed in the same natural environment (flora, fauna, water quality, climate, etc.). For some countries it is necessary to evaluate the positive or negative investment contribution to the desertification processes underway, etc.

A quantitative approach can successfully use multi-criteria analysis methods. The results of this analysis may sometimes bring about a serious modification of the proposed investment or its rejection. Whenever their quantification is methodologically possible, the estimated positive and negative impacts shall fall within the monetary evaluation of the social benefits and costs of the investment.

3.2.3 Natural risk prevention

3.2.3.1 Project objectives

Natural disasters constitute a serious challenge, particularly for a number of countries where the impacts of these disasters are substantially larger than the average, due to higher degrees of vulnerability.

CBA in the context of disaster risk management can be used for three main purposes:

- it can be employed to evaluate risk management measures for making exposed infrastructure or other facilities more hazard-resilient;
- it may be used to incorporate disaster risk into project and development planning, the so called mainstreaming of risk. Mainstreaming of risk involves accounting for disaster risk in the economic appraisal and helps with projecting probable shortfalls in project or development outcomes. This allows for better and more robust development planning;
- outside the project cycle, CBA can be an important instrument for natural risk awareness-raising and education. By showing that investment in disaster risk management pays, the decision- making process can be positively influenced.

The most frequent natural disasters in EU countries are floods and blazes. Hence, the assessment of projects aiming to prevent natural risk should be based on 'state-of-the-art' economic assessment in flood and blaze risk management.

[37] See: Council Directive 92/43/EEC.
[38] See: Council Directive 79/409/EEC.

3.2.3.2 Project identification

MAIN FEATURES TO BE CHECKED AND ANALYSED
Basic data for the project: (for example): - geographical location of the intervention, - actual measures used for risk prevention, - forecasting and early warning systems. **Technical and engineering features** (for example): - location and surface of the involved area, - number of services in the area, - data about the population in the involved area, - natural or valuable cultural sites.

REGULATORY FRAMEWORK
The European Union has outlined a strategy to cope with the floods that have struck, even more seriously, many of the member countries, such as Austria, France, Germany and Romania. This is the objective of Directive 2007/60/EC on the assessment and management of flood risks. The new directive has been carefully crafted for compatibility with the Water Framework Directive (2000/60/EC). It applies to all types of floods whether they originate from rivers and lakes, or occur in urban and coastal areas, or arise as a result of storm surges and tsunamis. The purpose of this Directive is to establish a framework for the protection of inland surface waters, transitional waters, coastal waters and groundwater which: - prevents further deterioration and protects and enhances the status of aquatic ecosystems; - promotes sustainable water use based on a long-term protection of available water resources; - aims at enhanced protection and improvement of the aquatic environment; - ensures the progressive reduction of pollution of groundwater and prevents its further pollution; - contributes to mitigating the effects of floods and droughts. The Directive requires Member States to carry out a preliminary assessment by 2011 to identify the river basins and associated coastal areas at risk of flooding. Member States shall identify the individual river basins lying within their national territory and shall assign them to individual river basin districts. For such zones they will need to draw up flood risk maps by 2013 and establish flood risk management plans focused on prevention, protection and preparedness by 2015. The European Commission will adopt specific measures against the pollution of water by individual pollutants or groups of pollutants presenting a significant risk to or via the aquatic environment, including such risks to waters used for the abstraction of drinking water. Member States shall take appropriate steps to coordinate the application of this Directive for improving efficiency, information exchange and for achieving common synergies and benefits regarding the environmental objectives.

3.2.3.3 Feasibility and option analysis

Disaster risk reduction measures may consist of:

- policy planning: policy and planning measures are implemented at the national or regional level and help to integrate disaster risk measures into the policy framework;
- physical components: physical measures are designed to reduce the vulnerability and exposure of the infrastructure to natural hazards (prevention) as well as to provide coping and adaptive infrastructures in case of a disaster.

Increasing importance is given to measures that are designed and implemented at the Community level, particularly the strengthening of community networks to better respond and cope with a disaster event through training and capacity building.

Projects should take into account four main steps:

- information;
- prevention (for example limiting the use of flood plains, through land use planning);
- protection (for example, building dams or dykes to reduce possible impacts of flooding, or improving a fire protection system);
- emergency (for example, actual implementation of an emergency plan in case of floods or blazes).

Options analysis is particularly important and should consider global alternatives as well as solutions closely linked to the local context.

3.2.3.4 Financial analysis

Any financial inflows hardly ever exist and financial outflows differ according to the type of project:

Financial outflows
▪ For policy and planning measures: - costs relating to institutional and capacity building of appropriate national, regional and local institutions - costs relating to technical assistance, institutional and capacity building ▪ For physical measures: - investment costs - maintenance/operational costs - administrative and technical personnel - expropriations

The time horizon for project analysis is usually around 50 years.

3.2.3.5 Economic analysis

Estimating project costs for the prevention or mitigation of the effects of a natural disaster is generally straightforward. Estimating the projected benefits of prevention investments, however, is more difficult. First, and quite obviously, it is not possible to predict when an actual disaster will occur and with what intensity. Second, the effectiveness of the investments is estimated through vulnerability assessments that include a degree of uncertainty. Therefore, in disaster mitigation projects, while costs are well defined, benefits derived from likely or avoided losses are not definitive, but are rather probabilistic, at best. Third, in many cases the benefits are public goods (preserving biodiversity, avoiding the loss of cultural inheritances, saving lives) and indirect benefits may also represent a very substantial part of the overall returns from a project. The time horizons for natural risk projects often exceed 50 years.

As regards the discount rate, this is a case where discounting for the very long term implies that a discount rate that declines over time is appropriate; see, for example, Green Book (UK), HM Treasury (2003).

In the case of a disaster, the following effects may occur:

Direct Effects	- physical impacts on capital stock, such as infrastructure, machinery, and buildings - losses of lives and people injured
Indirect Effects	- production losses

3.2.3.6 Risk assessment

Critical factors
- Investment costs
- Identification of possible risks
- Lack of data
- Possible responses to natural risk

Main variables to consider	- Imminent protection measures for vulnerable areas - Natural risk frequency or probability of disaster occurrences - information regarding historical disaster occurrences - Technical and physical information - Identification of one of the four ways of responding to identified risks: acceptance, avoidance, transfer or mitigation

3.2.3.7 Other project evaluation approaches

Given the difficulties of measuring the benefits in monetary terms, then in some circumstances cost-effectiveness may be applied to help select from alternatives that try to achieve the same result with different technologies.

CHECKLIST
✓ State if the project consists of policy planning actions or in the realization of physical components. ✓ Options analysis is particularly important and should consider global alternatives as well as solutions closely linked to the local context. ✓ In this case, a discount rate that declines over time is appropriate (see Annex B). ✓ No financial inflows will usually come from the implementation of these kinds of projects; the benefits will be represented only by public goods like preserving biodiversity, avoiding the loss of cultural inheritances, saving of lives.

3.3 Industry, energy and telecommunications

The scope of this broad category of investment projects is promoting the installation and development of new industrial plants and supporting the production and distribution of energy and the development of telecommunication systems.

Particular emphasis is often placed on energy sustainability, while in the industrial sector the main achievements should be economic growth and the creation of new employment. Telecommunications is a pivotal sector for the flow of information in a modern economy.

3.3.1 Industries and other productive investments

3.3.1.1 Project objectives

The co-financing of productive investments usually has the following objectives:

- encouraging the industrialisation of specific sectors in areas that are relatively backward;
- developing new technologies in specific sectors or applying more promising technologies which require a high initial investment;
- creating alternative employment in areas where there has been a decline in the existing productive structure.

3.3.1.2 Project identification

The first essential aspects to be covered are:

- a description of the company proposing the investment project (multinational, local, SME cluster, etc.);
- the sector in which the company intends to operate (hi-tech, innovative, mature, traditional);
- the nature of the intervention (new plant, modernisation or expansion of existing plants).

In order to identify the project in a more specific way, it would be useful to provide the following information:

MAIN FEATURES TO BE CHECKED AND ANALYSED
Physical data (for example): - the location of the company, the characteristics of the area and the buildings; - discharge points for liquid and/or gas waste and a description of treatment plants; - waste products (type and quantity) and disposal/treatment systems; - links with the transport networks. **Specific productive features** (for example): - the categories of goods or services produced by the company before the intervention and those predicted as a result; - the annual volumes of production input in terms of raw materials, semi-finished articles, services, workforce (disaggregated according to category and specialisation), etc. both before and after the intervention; - the turnover, gross operating margin, gross and net profit, cash-flow, debt ratio and other balance sheet indicators, both before and after the intervention; - a description of the market covered by the company and its positioning before and after the intervention; - company structure (functions, departments, procedures, quality systems, information systems, etc.) before and after the intervention.

REGULATORY FRAMEWORK: STATE AID
Even if the European Union declares the principle of incompatibility between State Aid and the common market, some derogations have been established (Art. 87.3a and 87.3c of the Treaty which establishes the European Community). From such derogations it follows that Member States may grant aid for investment in disadvantaged regions (the so-called 'Regional Aid Schemes') or rather targeted at particular sectors (the so-called 'horizontal aid' to small and medium sized enterprises, R&D, professional training, protection of the environment etc.) respecting the Guidelines on State Aid, through a prior authorization scheme from the Commission of the aid proposed by the Member State. Implementing Article 87 (3a,c) of the Treaty, the Commission may consider state aid as compatible with the common market when granted to improve the economic development of certain disadvantaged areas within the European Union. These kind of aid are commonly referred to as Regional State Aid. This is considered indeed financial support for investments favouring large enterprises, or rather, in certain circumstances, operating aid destined to specific regions, in order to re-balance regional disparity. Such aid, by addressing the handicaps of the disadvantaged regions promotes the economic, social and territorial cohesion of Member States and the Community as a whole. Local specificity is indeed a differentiator between the regional State aid and the other forms of horizontal aids, such as aid for research, development and innovation, employment, which pursue different objectives of common interest. In line with the relevant provisions of the EC Treaty, the European Commission adopted new Community Guidelines for Regional State aid (2006/C 54/08), to be applied between 2007-2013. The Guidelines specify rules for the selection or regions, that are eligible for regional aid, and define the maximum permitted levels of this aid. With the Regulation (EC) 1628/2006 the Commission expressly established that 'transparent' regional aid shall be exempt from the notification requirement to the European Union; to this end, regional aid schemes will be 'transparent' when it is possible to calculate precisely the Gross Grant Equivalent as a percentage of eligible expenditure ex ante, without need to undertake a risk assessment. State Aid may be declared compatible when pursuing Community interests, or when the Commission establishes, in absence of it, that the market forces would not allow beneficiary businesses to adopt some target desirable behaviours. The Commission's assessment is based on the following principles: a compensatory justification and the real need for the aid; following these directions, various categories of 'horizontal aid' have been identified. This is, indeed, a State aid applicable without geographical constraints, whose aim is to support business modernization and development and to address certain problems of general scope. Horizontal classifications, providing the criteria establishing when a certain aid may benefit of a presumption of compatibility, are related at present to aid for small and medium-sized enterprises, employment, training, research, development and innovation, aid for the environment, and for risk capital.

3.3.1.3 Feasibility and option analysis

The feasibility of the project should be verified evaluating both the technological features (e.g. the production technologies employed) and the economic/financial ones (the financial solidity and the economic efficiency of the company and the possible dynamics of the product market). Moreover, it could be important to make a more in-depth analysis with regard to the:

- management skills and capabilities;
- organisational activities described in the business plan supplied by the companies, like logistics, supply chain and commercial policies.

The options analysis should consider:

- location;
- alternative methods of financing (e.g. financing the interest account instead of the capital account, financing a leasing contract, or other methods of financing);
- technical or technological alternatives to the proposed project and the global alternatives (e.g. supplying low-cost real services).

3.3.1.4 Demand analysis

The forecast for the future market demand for the products to be produced is a key issue in order to evaluate the profitability and sustainability of an industrial investment project.

The first step should be a general overview of the estimated Gross Domestic Product over the next ten years.

After this, it would be essential to assess growth dynamics or the specific productive segment. The key questions are: 'is this an innovative (fast growing but potentially high-risk) industrial sector?' and 'how is the future demand likely to depend on the economic cycle and eventual global economic weakness?'

It would be useful to try to make some assumptions about the yearly percentage growth of the sector. Starting from this point, analysts should try to deduce the relative performance of the company as compared to the sector as a whole.

In order to evaluate the overall impact of demand, analysts should also estimate the product price dynamics in the international market. These dynamics should be adjusted in accordance with the specific pricing policy the company intends to adopt.

3.3.1.5 Financial analysis

Given the short economic lives of some assets, the time horizon for project analysis is often around 10 years. The financial inflows and outflows attributable to the investment project are:

Financial inflows	Financial outflows
▪ Sales of the new products ▪ Increased sales of existing products ▪ Other incremental revenues	▪ Investment costs - works - general expenses - expenses for new equipment ▪ Operating costs - raw materials for production - maintenance - technical and administrative personnel costs - fuel and electricity - sales expenses

3.3.1.6 Economic analysis

Investments in the industrial sector usually exhibit a better financial and economic performance than investments in other sectors. The economic analysis requires attention to be focussed on the shadow prices, particularly the shadow wage, and the conversion factors required to adjust financial values.

The main external costs and benefits are related to the environmental impact of the investment. A new plant will increase air pollution because of polluting emissions; on the contrary, for example, a project involving the renovation or conversion of an old plant, could reduce emissions.

Other non-financial costs and benefits can come from the improvement or deterioration in the safety conditions faced by the workers.

3.3.1.7 Risk assessment

Critical factors

- Economic growth
- Market demand for the products
- Product price dynamics
- Investments costs
- Operating costs

Main variables to consider	- GDP growth - Specific sector growth foreseen - Relative weight of the company on the total sector - The price of the products the company is expected to produce - The cost of the new plant - The cost of machinery - The cost of labour - The cost of raw materials - The cost of energy

3.3.1.8 Other project evaluation approaches

Indirect effects, in particular on employment and regional development, should be taken into consideration even they are difficult to quantify and evaluate. For the purpose of a more complete evaluation of the project it is advisable to make a careful appraisal of these impacts, even if it is only in terms of physical indicators. In particular, the effects on employment should be a crucial matter to focus on, since maintaining or developing employment is a central objective in many incentive programmes for the productive sector, for social reasons.

The main economic impacts of these types of projects could be:

- Creation of new firms that are born as suppliers of the company that realizes the project.
- Relocation effects: small or medium-sized firms moving into the region in which the investment is realized in order to supply the company.
- Displacement effects: companies that move outside the region (or close) because they are not able to compete with the company that has implemented the investment project.
- Synergy with other companies: it is plausible that the establishment in a region of a new productive plant of a large company (or group of companies) can create an added value for the region itself thanks to interactions among the companies operating in related sectors.
- Increasing the human capital stock.
- Creation of entrepreneurial and management know-how.

CHECKLIST
✓ Predict the specific productive segment growth dynamics and the relative performance of the company as compared with the sector as a whole
✓ Estimate the prices at which the products could be sold and the price dynamics in the future: better to be conservative about price movements
✓ Try to estimate the operating costs as a percentage of the revenues from sales. If the increases in operating costs are likely to be transferred to the sale price, the percentage could remain mostly constant; vice versa, there will be a reduction of the operating margin
✓ For the economic analysis, it is advisable to consider the financial inflows and outflows, as conveniently converted in order to reflect the economic values, and the environmental effects
✓ As regard the polluting emissions, the benefits transfer method could be used.

3.3.2 Energy transport and distribution

3.3.2.1 Project objectives

Projects in this sector may include, inter alia:

- construction of a storage regassification unit (onshore or other technologies);
- distribution networks for gas in industrial or urban areas;
- construction of power lines and transformation stations;
- electrification of rural areas;
- in the future, construction of systems for the production, transport and distribution of hydrogen in liquid form or otherwise.

3.3.2.2 Project identification

In order to correctly identify the project it is useful to:

- state its scale and dimension, accompanied by an analysis of the market where the product will be placed,
- describe the engineering features of the infrastructure with:
  - ♦ basic functional data: transport tension and capacity for power lines, nominal load and amount of gas transported annually by gas pipelines, storage capacity installed and nominal gas production rate

for regassification plants, number of inhabitants served and power or average supply per inhabitant for the networks;

- physical features: route and length of power lines or gas pipelines, section of electricity conductors or nominal diameters of the gas pipelines, morphological, geological, topographical and other environmental elements of the site of a regassification unit, the size of the area served by the networks and their routes;
- characteristics of the network and location of internal nodes and links with networks and/or pipelines;
- typical sections of the gas pipelines;
- typical construction of power lines;
- technical features of the plants for depression and pumping, or regassification (for gas), or transformation, or sectoring stations (for electricity);
- technical features of the other service structures;
- significant technical elements: important intersections, overcoming large gradients, marine pipelines for gas, remote control and telecommunications systems (with data and sketches).

3.3.2.3 Feasibility and option analysis

The key information is the demand for energy, seasonal and long-term trends and the demand curve for a typical day.

The options analysis should consider, for example, different technologies for transporting electricity (direct or alternating current, transport tension etc.), alternative routes for gas pipelines or power lines, different sites or various technologies (Onshore, Offshore Gravity Base, Offshore FSRU[39] or other technologies) for a regassification terminal, different district networks, and alternatives for satisfying the demand for energy (e.g. mixed use of gas and electricity instead of just electricity, the construction of a new power station on an island instead of underwater power lines, etc.).

3.3.2.4 Financial analysis

The financial inflows and outflows are:

Financial inflows
▪ Fees for energy transport ▪ Other revenues

Financial outflows
▪ Investment costs - design - works - land - testing of the infrastructure ▪ Operating costs - goods and services for production - maintenance - technical and administrative personnel costs - fuel and electricity

Among the investment costs, in addition to spending for the design, land, construction and testing of the infrastructure, we must also consider those due to the renewal of the short-life components. The typical time horizon is 15-25 years.

The maintenance and operating costs mainly comprise labour, materials and spare parts. In the case of the financial analysis of a regassificator project, the purchases of energy, commodities, goods and services used as inputs and needed for the day-to-day running of the plants, have additionally to be taken into account.

39 Floating Storage Regassification Unit.

Forecasts for price dynamics are critical and require a good understanding of the highly unstable trends in energy prices.

3.3.2.5 Economic analysis

Environmental impact and risk assessment are essential aspects. Externalities to be considered are:

Benefits	- the valorisation of the area served, quantifiable by the revaluation of real estate and land prices
Costs	- the negative externalities of possible impact on the environment (loss of land, spoiling of scenery, naturalistic impact, loss of local land and real estate value due to disamenity, such as noise) and on other infrastructure - the negative externalities due to the risk of accident, such as fire and explosions, for regassification plants - the negative externalities due to the opening of building sites, especially for urban networks (negative impact on housing, productive and service functions, mobility, agricultural framework and infrastructure)

3.3.2.6 Risk assessment

Critical factors

- Demand dynamics
- Operating costs

Main variables to consider	- Forecasts of growth rates - Forecasts of the elasticity of electricity consumption - The dynamics of purchase prices of gas and electricity, conveyed by the transport and/or distribution infrastructure and often purchased abroad - The dynamics of the sale prices of substitutes electricity or gas

Another type of risk that my be important (e.g.: for regassification terminals) is the possible adverse attitude of the local population. This risk should be duly considered and appropriate mitigation measures should be planned.

3.3.3 Energy production and renewable sources

3.3.3.1 Project objectives

Projects in this sector may include:

- construction of plants to produce electricity from renewable energy sources (RES), such as (European Parliament and Council Directive 2001/77/EC): wind energy, biomass, geothermal energy, hydropower, photovoltaic and solar thermal energy (including also the concentrating solar power plants), energy from tides and waves[40];
- investments directed at energy saving by improving energy efficiency (e.g.: co-generation, European Parliament and Council Directive 2004/8/EC);
- construction of plants to produce electricity from any other source;
- prospecting and drilling for natural gas or oil.

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[40] Landfill gas, sewage treatment plant gas and biogases are renewable energy sources, too; the investments dealing with these forms of energy generation are usually ancillary compared to the main purpose of the installations.

Examples of objectives are:

- change in the mix of energy sources, e.g. increasing the share of renewable sources in the energy balance, with a view to achieving the objective - international, European and national – of reducing greenhouse gas emissions;
- modernisation of the existing plants for energy production, e.g. for reasons of environmental protection;
- reduction of energy imports through substitution by local or renewable sources;
- increased energy production to cover growing demand.

Regulatory framework

The development of renewable energy is a central aim of the European Commission's energy policy[41], with the objective of reducing carbon dioxide (CO_2) emissions, which is a major Community objective (in order to meet the Kyoto agreement). Other Community targets are: increasing the share of renewable energy in the energy balance in order to enhance sustainability, improving energy efficiency[42], improving the security of energy supply by reducing the Community's growing dependence on imported energy sources[43].

The European Commission's 'White Paper for a Community Strategy' (COM(97)599 final) sets out a strategy to significantly improve the share of renewable energies in gross domestic energy consumption in the European Union by 2020 (EU targets stated on January 2008: 20% renewable energy, 10% biofuels and 20% energy efficiency), including a timetable of actions to achieve this objective in the form of an Action Plan[44]. The proposed auctioning of carbon credits for the energy sector under the European Union Emission Trading Scheme (EU ETS)[45] is also an important part of European energy policy.

In this framework the European Parliament and Council Directive 2001/77/EC was adopted with the aim of promoting the electricity produced from renewable energy sources in the internal electricity market and creating a basis for a future Community framework. The Directive states indicative national targets for the contribution of electricity produced from renewable sources to gross electricity consumption by 2010. In summary, the guiding principles of the aforementioned Directive are as follows:

- quantified national targets for consumption of electricity from renewable sources of energy;
- a national support scheme (including any incentives) plus, if necessary, a harmonized support system;
- simplification of national administrative procedures for authorisation;
- guaranteed access to transmission and distribution of electricity from RES.

Other numerous directives dealing with energy production and renewable energy sources are detailed in the box below.

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41 See also the following web site: http://ec.europa.eu/energy/res/index_en.htm

42 Increase by 20% until 2020 compared to 1995.

43 Renewable energy sources are expected to be economically competitive with conventional energy sources in the medium to long term.

44 The main features of the Action Plan include internal market measures in the regulatory and fiscal spheres; reinforcement of those Community policies that have a bearing on increased penetration by renewable energies; proposals for strengthening co-operation between Member States; and support measures to facilitate investment and enhance dissemination and information in the renewable energies field.

45 In January 2005 the European Union Greenhouse Gas Emission Trading Scheme (EU ETS) commenced operation as the largest multi-country, multi-sector Greenhouse Gas emission trading scheme world-wide, and as a major pillar of EU climate policy. The scheme is based on Directive 2003/87/EC, which entered into force on 25 October 2003. In January 2008, the European Commission proposed a number of changes to the scheme, including a centralized allocation system (no more national allocation plans), a turn to auctioning a greater share of permits rather than allocating them freely, and inclusion of the greenhouse gases nitrous oxide and perfluorocarbons. Also, the proposed caps foresee an overall reduction of greenhouse gases for the sector of 21% in 2020 compared to 2005 emissions.

POLICY AND LEGISLATIVE FRAMEWORK
Energy and RES framework - Directive to limit carbon dioxide emissions by improving energy efficiency (SAVE) (Council Directive 1993/76/EC) - Directive establishing a scheme for greenhouse gas emission allowance trading within the Community and amending Council Directive 1996/61/EC (European Parliament and Council Directive 2003/87/EC) - White Paper on Energy Policy – COM(95)682 Final (January 1996) - White Paper on Renewable Energies – COM(97)599 Final (November 1997) - Communication from the Commission on the implementation of the Community Strategy and Action Plan - COM(2001)69(01) - Directive restructuring the Community framework for the taxation of energy products and electricity (Council Directive 2003/96/EC) **Electricity from RES** - Directive on the promotion of the electricity produced from renewable energy sources in the internal electricity market (European Parliament and Council Directive 2001/77/EC), as amended by the European Parliament and Council Directive 2006/108/EC (accession of Bulgaria and Romania) and by the Treaty of accession of ten new Member States (Annex II, Chapter 12(A) 8) **Other renewable energy sources** - Directive on the energy performance of buildings (European Parliament and Council Directive 2002/91/EC) - Directive on the promotion of the use of biofuels and other renewable fuels for transport (European Parliament and Council Directive 2003/30/EC) - Directive on the promotion of cogeneration based on a useful heat demand in the internal energy market (European Parliament and Council Directive 2004/8/EC) - The Green Paper 'A European Strategy for Sustainable, Competitive and Secure Energy' – COM(2006) 105 final - Directive on energy end-use efficiency and energy services (European Parliament and Council Directive 2006/32/EC)

Under certain constraints the ERDF supports energy projects under both the Convergence objective[46] and the regional Competitiveness and employment objective[47]. Similar principles are adopted for the Cohesion Fund.

In all cases, several alternative financing forms have to be considered, not only the grant based scheme, and the most appropriate have to be identified for the specific project in question. The project could be alternatively financed by loan funds, interest rate subsidies, or guarantee schemes, or by creating revolving funds with public money, or by other schemes. For example, in the case of projects dealing with energy-efficient buildings with a longer pay back period, by providing investment capital from the fund at lower than market interest rates, a capital mix can be reached for those projects that reduce pay back periods to acceptable levels in order to stipulate good energy service contracts with Energy Service Companies (ESCO) existing in the market[48].

3.3.3.2 Project identification

When defining the functions of the project, it is advisable to:

- specify the site and location of the potential area served (e.g. research and drilling of a new well field may have as its objective the supply of energy for more than one country, a new power station may serve an entire region, and so on);
- describe the projected positioning of the product on the market;
- describe the institutional context and the legal framework into which the project fits, at UE and State level; specifically describe the sale tariff regimes for energy production and any incentives, or contributions, or minimum prices, or tax exemptions, etc., for the production of energy, (for example, from renewable sources);
- state the phases of the investment; e.g. for a well field the prospecting and research within the target area, initial test drilling, mining and commercial exploitation, closure, site clearance and

[46] Regulation(EC) No 1080/2006, Art. 4-9 'energy investments, including in improvements to trans-European networks which contribute to improving security of supply, the integration of environmental considerations, the improvement of energy efficiency and the development of renewable energies; 10. education investments, including in vocational training, which contribute to increasing attractiveness and quality of life'.

[47] Regulation(EC) No 1080/2006, Art. 5-2(c) 'stimulating energy efficiency and renewable energy production and the development of efficient energy management systems'.

[48] In some of the Member states Energy Service Companies (ESCO) successfully offer energy service contracts. The basic idea is that the company undertakes the necessary energy upgrading investments and runs the heating and cooling systems. The service package offered by the company is paid out of the energy saved.

decontamination if any;

- the technical characteristics and the state of the high voltage grid that interconnects the project energy generating plant; particularly, for installations that generate discontinuous and variable electricity power (wind, photovoltaic, tidal, waves), the technical capacity of the electricity grid to compensate for these changes should be demonstrated;
- describe the engineering features of the infrastructure, as follows:
  - ♦ basic functional data, such as: type of plant for producing electricity[49], installed capacity (MWe) and energy produced (TWh/year); annual potential capacity of well fields (millions of barrels/year or millions of m^3/year), tons of CO_2 saved;
  - ♦ key parameters for the RES plants, such as: level of resource risks (wind/hydro), estimated load factors, supply during peak demand, levelled generating costs;
  - ♦ physical and site characteristics[50],
  - ♦ building, technological and processing techniques for the production plants;
  - ♦ building techniques and technical features of the plants for mining wells, e.g. off-shore platforms, attaching building and functional sketches;
  - ♦ building techniques and technical features of the other service structures;
  - ♦ treatment systems for waste water and fumes, with the number and positioning of stacks and water discharges;
  - ♦ significant technical elements, such as the constructions in caverns, dams, special technical solutions for waste treating, computerised control systems, telecommunications systems, etc.

3.3.3.3 Feasibility and option analysis

Key information: the demand for energy, seasonal and long-term trends and also, for electricity power stations, a typical graph of the daily demand for electricity.

The comparison in the options analysis should consider possible alternatives within the same infrastructure (e.g. different technologies for production and drilling, different technologies for ash and waste treatment, etc.). Possible realistic alternatives for producing the energy required should also be considered (e.g. launching actions and policies aimed at energy saving, instead of building a new power station).

3.3.3.4 Financial analysis

The financial inflows and outflows are:

Financial inflows
▪ Sale of energy - Sale of gas - Sale of electricity - Sale of heat ▪ Additional State incentives ▪ Reduced costs for the purchase of energy

Financial outflows
▪ Investment costs - works - land - test of the infrastructure ▪ Operating costs - goods and services for production - maintenance - technical and administrative personnel costs - fuel and electricity

The time horizon is usually around 15 – 20 years.

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49 In the case of hydroelectric plants (production and/or pumping) linked to aqueducts, one must also bear in mind the technical data suitable for the aqueduct sector (see the relative outline).

50 For example: the area covered by the well field (Km^2) and the position. In the case of off-shore drilling, it would also be useful to provide local bathymetric profiles; average depth of deposits (m); area occupied (Km^2) by plants (thermo-electricity) and relative storage areas, location of dams, pressure water-pipes and generators for hydro-electric production; area occupied by fields of photovoltaic or wind generators (Km^2) and their location, area covered by geothermal well fields (Km^2) and plant position.

The financial inflow comes from selling the energy (gas, electricity, heat). The income quantification has to take into account different components of revenue, if any. If, for example, policies to support the production of energy from renewable sources exist, when performing the financial analysis on profitability of the equity capital (FNPV(K), FRR(K)), the financial inflows arise not only from the sale of the electricity at the current prices charged by the (national or regional) grid operator, but also from other additional financial incentives[51], that are set out differently in the different Member States[52].

In the case of investments for energy savings, the financial analysis should cover the entire system affected by the intervention. In this way, the financial flows resulting from reduced costs for the purchase of energy (energy saved = less energy consumed) can be properly taken into account.

In any case, the financial analysis should carefully assess the extent to which the investment and equity returns depend upon the public sector incentives. Otherwise, the incentives for energy produced from renewable sources should not be taken into account when calculating revenue in the financial analysis of the profitability of the investment (FNPV(C), FRR(C)).

Forecasts are required for:
- the dynamics of energy tariffs;
- price dynamics;
- development scenarios for the other sectors (trends in energy demand are strongly related to the dynamics in other sectors).

3.3.3.5 Economic analysis

Benefits	- The monetary value of benefits. They should be quantified, first, as the revenue from the sale of energy (at appropriate shadow prices). The latter can be proxied, wherever possible, by estimating the willingness-to-pay for energy, for example, by quantifying the marginal costs the user should incur to acquire energy (e.g. installing and using private generators) - The aforementioned estimated accounting price does not, however, include the additional social economic benefit deriving from the implementation of projects that use renewable energy or from energy-saving interventions. These are general and broad benefits, resulting from a reduction in greenhouse gases that affect the global climate of the earth, but also in the production of polluting gases, liquids and solids of various kinds, which have the potential to adversely affect the environment and human health. In addition, the amount of fossil fuels or of other non-renewable energy sources saved can be used for other purposes or kept in situ for the future. To give a value to this benefit, a suggestion is to use a standard shadow price, e.g. for the carbon dioxide emissions avoided (see the discussion in Annex F on the valuation of environmental impacts). The shadow price should be attributed to the quantities of energy, produced or saved. As a shortcut alternative, if the data for the former approach are not available, the financial value of the incentives for the production of energy from renewable sources (such as the exchange value of green certificates), can be taken as a proxy of the willingness-to-pay of the whole society for the environmental benefits from the renewable sources - The aforementioned shadow price could be applied as well to the amount of the saved energy (or consumption avoided) in the energy saving projects - The value attributed to a greater or lesser dependence on energy from abroad. The evaluation should be conducted by applying appropriate shadow prices53 to the substituted imported energy
Costs	- The cost of the measures necessary to neutralise possible negative effects on air, water and land, both due to the construction and the operation of the plant - The cost of other negative externalities that cannot be avoided such as loss of land, spoiling of scenery - The identification of the opportunity cost of the various inputs. The economic costs of raw materials should be evaluated by considering the loss to society by the diversion of them from the best alternative use. Use suitable conversion factors (CF's)

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51 A widespread type of RCS incentive is the so-called green certificate. Green Certificate also known as Renewable Energy Certificates (RECs), or Green Tags, Renewable Energy Credits, or Tradable Renewable Certificates (TRCs) is a tradable commodity proving that certain electricity is generated using renewable energy sources. Typically one certificate represents generation of 1 Megawatthour (or 1,000 kWh) of electricity. The certificates can be traded separately from the energy produced. The financial value of the green certificate varies over time from country to country.

52 According to the energy regulation of certain Member States, incentives for renewable energy are disbursed by the state in the form of rebates on taxes. In this case, the financial analysis should calculate the performance indices (FNPV(C), FRR(C), FNPV(K), FRR(K)) after taxes, in order to take into account the global effects of real cash flows.

53 If, as often happens, there are strong distortions in the energy market (duties, internal taxes, prices levied, incentives, etc.) it would be wrong to assess the value of import substitution using these distorted prices.

3.3.3.6 Risk Analysis

Critical factors

- Investment costs and length of the cycle
- Demand dynamics
- Dynamics of the incentive regimes

Main variables to consider	
	- Cost of the research phase (meaning the prospecting phase for new deposits or research into new technological processes) - Cost of the project realisation phase (site costs) - Forecasts of growth rates - Elasticity of electricity consumption - Sales price dynamics for energy produced (or energy products) - Financial values for the energy generated by RES - Mix and dynamics of critical input costs (fuels, etc.)

3.3.3.7 Other project evaluation approaches

This section refers to:

- evaluation of the impact on the environment (visual, noise, pollution, and refuse) which, according to the laws of Member States, must be a part of the approval procedures.
- evaluation of the indirect economic costs, for example those deriving from the use of exhaustible resources, not previously included in the estimates. They can be measured as standard physical indicators for incorporation into a multi-criteria analysis of the project.
- similar approaches may be suggested with the aim of assessing the indirect economic benefits resulting from the use of renewable resources in those cases where it is not possible to quantify the benefits directly using the methods suggested in the previous paragraph. Also, these economic values can be measured as standard physical indicators for inclusion in a multi-criteria analysis.

3.3.4 Telecommunications infrastructures

3.3.4.1 Project objectives

Project objectives differ according to the nature of the project. It is possible to distinguish between two main types of telecommunications infrastructures according to their local or non-local scale.

Local scale projects:

- local cabling or relay systems to extend services to areas not covered,
- cabling a city, metropolitan or industrial area, etc. to provide faster, more powerful networks,
- construction or modernisation of units for band switching with wider networks,
- the laying of cables and construction of relay or satellite stations to link isolated areas.

Broader scale projects:

- the development of international communications systems, to increase the capacity, power and speed (e.g. launching telecommunications satellites, building satellite radio stations, etc.),
- increasing the capacity, power and speed of inter-regional communications networks,
- the technological updating of the network to enable connection with new services (e.g. multi-media services, portable telephones, cable television, etc.).

3.3.4.2 Project identification

MAIN FEATURES TO BE CHECKED AND ANALYSED
Specific data of the project: - A clear idea should be given of two aspects, which are strongly interrelated, - type(s) of telecom service offered, - the implementation programme and the target market share. **Technical and engineering features** (for example): - physical data such as the length of cables (km) and area covered by the network (square km), the number and position of commutation/connection nodes, - data, building techniques and technical features of networks, - data, building techniques, technical features and layout of auxiliary plants e.g. electricity supply, lighting, and remote control, - covered area (square metres). **Functional features** (for example): - type of communications infrastructure, traffic volume and type, - maximum communication speed (baud), - the functional and physical links between the projected infrastructure and the existing telecommunications system, - type of commutation, communication protocol, frequency bands (GHz) and power (kW).

3.3.4.3 Feasibility and option analysis

In order to verify the feasibility of the project, the key issues are the volume of traffic and the daily, weekly and seasonal trends (the optimum capacity must be a reasonable compromise between the highest peak levels of traffic and that which the system can handle).

The different options in these kinds of projects could be related to:

- possible technical alternatives within the same infrastructure (e.g. different types of cables, different transmission protocols, different commutation/connection technologies etc.),
- alternative locations for radio stations, possible global alternatives for the projected infrastructure, which can offer similar services such as a satellite transmission or mixed network (air-cable) rather than optic fibre cables.

3.3.4.4 Financial analysis

The financial inflows and outflows are:

Financial inflows
▪ Sales for services (tariff based) ▪ Rent of equipments ▪ Accession charges

Financial outflows
▪ Investment costs - works - general expenses - expenses for new equipment ▪ Operating costs - raw materials for production - maintenance - technical and administrative personnel costs - fuel and electricity

The time horizon is usually 20 years for cabled networks and long distance cables but shorter (10 years) for other components.

3.3.4.5 Economic analysis

The benefits of a telecom project are mainly to be found in the increasing efficiency and accessibility of the existing services and in the additional services provided.

Benefits	- the time saved for each communication (waiting time, transmission time, etc.), quantifiable by appropriate measurement units according to type of service; for valuation purposes the users may be divided into categories, for example in the household sector reference can be made to the average income of users, and in the business sector to the average added value - the new additional services, that would be unavailable without the project. In some cases the time saved method can be applied for their quantification and valuation, but in most cases it is possible to estimate the willingness-to-pay for the service by the users
Costs	- local environmental impacts

3.3.4.6 Risk assessment

Critical factors
- Future demand
- Investment costs
- Technological evolution and probable obsolescence of the infrastructure

Main variables to consider	- Growth rates for the population and businesses - Dynamics of the sales prices for services - Investment costs for technological development - Length of the substitution cycles (ageing, technical obsolescence) of the equipment installed

3.3.4.7 Other project evaluation approaches

An important aspect that might be highlighted is the flexibility of the project and its adaptability to future development in the field of telematic and multi-media services. It could be useful to check for the adaptability, in technological terms, to wider needs stemming from likely future development (for example: cable versus wireless local networks).

CHECKLIST
✓ Try to estimate the volume of traffic and the daily, weekly and seasonal trends ✓ In the case of telephones, the existence of government-regulated tariffs may help in forecasting price dynamics ✓ In addition to the financial revenues, the following economic effects should be taken into account: - the time saved for each communication (users may be divided into categories), - the new additional services, which would be unavailable without the project (willingness-to-pay).

3.4 Other sectors

3.4.1 Education and training infrastructures

3.4.1.1 Project objectives

Projects may focus on one or more of the following:

- basic education
- vocational needs
- higher education (universities, business schools, etc.)
- particular needs for specialisation in productive areas
- improvement of the positioning of young people in the labour market
- elimination of discrimination between social classes, genders
- better opportunities for the disabled.

3.4.1.2 Project identification

In order to evaluate the project it would be advisable to specify the following features:

MAIN FEATURES TO BE CHECKED AND ANALYSED

Engineering data:
- covered area and uncovered equipped area,
- typical construction designs for buildings intended for pedagogical purposes (classrooms) and for related activities (laboratories, libraries, etc.),
- internal viability systems and links with local communication routes,
- significant technical elements, such as particularly important architectonic constructions, laboratory or complex calculating equipment, etc.
Other data:
- level and type of educational activity,
- number of pupils and geographic catchments area,
- associated services (libraries, sports-recreational activities, canteens, etc.),
- the proposed training plan over a number of years:
  - number and type of courses,
  - length of courses,
  - number and type of subjects taught,
  - duration and timing of pedagogical and related activities,
  - didactic methods,
  - diplomas and other qualifications obtainable.

3.4.1.3 Feasibility and option analysis

This kind of analysis must focus on evaluating the demographic and labour market trends, which determine the potential number of pupils and the opportunities available to them.

The description should include:

- demographic trends, disaggregated by age range and by geographical area,
- the rates of enrolment, attendance and completion of studies; this information will be even more useful if broken down by sex and geographical area.
- employment forecasts for various sectors, including forecasts of the organisational changes within the various productive segments; it is important to forecast the growth of new professions and the decline of others.

The alternative feasible options for the project can be differentiated by the following aspects:

- target (unemployed, young people, disabled etc.),
- economic sectors involved in the training programmes,
- connections with the local economic environment.

3.4.1.4 Financial analysis

The financial inflows and outflows are:

Financial inflows
▪ School fees ▪ Annual subscriptions ▪ Prices of possible paid auxiliary services ▪ Transfers from the central government

Financial outflows

▪ Investment costs
  - land acquisition
  - buildings
  - recreational facilities
  - equipment and materials
▪ Costs of personnel and maintenance
  - full time staff
  - other personnel
  - materials (text, pc etc.)
  - maintenance

The time horizon is usually around 15-20 years

3.4.1.5 Economic analysis

The following variables may provide a starting point for the identification of the benefits:

- effective enrolment rates compared to potential ones,
- the proportion of students repeating the year,
- the percentage of pupils who complete the whole training course (drop-out rates),
- the average attendance rate per pupil,
- the achievement of pre-established, measurable learning standards,
- the quality of pedagogic material,
- the suitability of equipment and its rate of use,
- the levels of preparation and commitment of the teaching staff, based on objective examination,
- the fungibility of the pedagogical content in as many and varied contexts as possible.

These projects are expected to have relevant social impacts on the labour market. The main benefits/costs and externalities could be as follows:

Benefits	- The number (or percentage) of pupils who have found (or who are expected to find) productive employment and who, without this specific training, would have been unemployed or under-employed. Forecasts for this variable can be based on the long term studies carried out in other countries or regions - If the priority is to improve the opportunities of potential students in the labour market, the benefits may be quantified and valorised by the expected increased income of the students due to the training received (avoided under-employment, better positioning on the market) - An alternative method, is to refer to the willingness-to-pay, valuable as the average fees students would have to pay to take similar private courses. Great care should be taken when following this method due to possible estimation bias: e.g. there may be a difference in quality between the training offered by the investment and what is already available privately, or there may be differing degrees of risk aversion according to income levels, and so forth
Costs	- Apart from the costs listed in the financial analysis as converted in economic prices, the only costs that might be considered are the ones due to increased transport flows in a congested urban area

3.4.1.6 Risk assessment

Critical factors

- Investment and operating costs
- The demographic dynamics in the catchment's area
- The success of the educational programmes

Main variables to consider	- The rate of growth of the population in the catchment's area - The future composition of the population in the catchment's area - The current enrolment rate - Effective enrolment rates compared to potential ones - The percentage of pupils who complete the whole training

3.4.1.7 Other project evaluation approaches

Sometimes it is helpful to have an independent evaluation, from a *panel of qualified experts*, of the ability of the educational investment to meet the proposed objectives and social needs, along with an assessment of the suitability of the types of training programmes.

CHECKLIST
✓ Through the identification of the unemployment rate in the area it should be possible to estimate the potential demand for more specific education ✓ Employment forecasts for various sectors should be made; it is important to forecast the growth of new professions and the decline of others ✓ The main economic effect to be considered for these projects is the creation of job opportunities for students that, in the absence of the educational programme, would have been unemployed or under-employed. This benefit can be evaluated: - through the benefits transfer method - through the expected increase in income of the students due to the training received (avoided under-employment, better positioning on the job market).

3.4.2 Museums and cultural sites

3.4.2.1 Project objectives

Investments in museums and cultural sites, e.g. archaeological parks, mostly have local objectives but may also have a more general value of a cultural nature. These kind of projects could support the tourist industry in some specific areas or simply improve the quality of life.

3.4.2.2 Project identification

In general, the projects are one of three types: building of new structures, renovation, or extension of existing ones.

MAIN FEATURES TO BE CHECKED AND ANALYSED
Engineering data (for example): - the number of expected visitors (per day, season, year, etc.) and the maximum capacity of the structure, - covered and showroom areas (square metres) for museums and historical monuments or buildings, total area of parks or archaeological areas (square metres), number of seats, usable area (square metres) for theatres, - viability and access systems and links with the local networks, - significant technical elements, such as particularly exacting architectural features, experimental restoration technologies, communication systems, safety equipment. **Other basic data** (for example): - type of infrastructure affected by the action (creation, renovation or extension): museums, historical monuments or buildings, archaeological parks, industrial archaeology, theatres, etc., - the services offered (research centres, information and catering services, internal transport. etc.).

3.4.2.3 Feasibility and option analysis

The potential flow of visitors, broken down according to type (for example: youngsters or adults, residents or tourists, etc.) is the main variable to be analysed in the feasibility analysis, along with the construction or restoration costs.

The comparisons in the options analysis should consider:

- variations in structural arrangement or lay-out of the infrastructure,
- possible alternative technology and methods of restoration/recovery for existing buildings,
- alternative choices of infrastructure (e.g. one could consider establishing a museum of technology on a new site instead of recovering a historical industrial structure, etc.).

3.4.2.4 Financial analysis

The financial inflows and outflows are:

Financial inflows
▪ Admission fees ▪ Sales of collateral services ▪ Sales of commercial activities

Financial outflows
▪ Investment costs - works - general expenses ▪ Operating costs - maintenance costs - electricity - technical and administrative personnel costs

The time horizon is usually around 10-15 years

3.4.2.5 Economic analysis

Benefits	willingness-to-pay for the service on the part of the public, for museums, archaeological parks etc. induced increases in incomes in the tourism sector (increased flow and longer average length of stay).
Costs	apart from the costs listed in the financial analysis as converted to economic prices, the costs related to increased transport flows might be considered

3.4.2.6 Risk assessment

Critical factors

- Operating costs
- The rate of growth of effective demand (number of visitors per year)

Main variables to consider	- Personnel costs - Maintenance cots - The costs related to possible damage, regardless of the cause - The long-term dynamics of admission fees, - Different typologies of visitors with specific willingness-to-pay for cultural sites

3.4.2.7 Other project evaluation approaches

They should give a clear cultural and artistic profile of at least the medium-term programmes. The opinions of independent experts are especially important.

CHECKLIST
✓ It is necessary to estimate the potential flow of visitors in the future ✓ It would be very useful to have a break-down of the future demand according to the type of visitors, because each has a different willingness-to-pay for cultural sites ✓ Try to forecast accurately the costs for personnel and for maintenance, including contingencies for possible damages to the site

3.4.3 Hospitals and other health infrastructures

3.4.3.1 Project objectives

These types of investment projects are correlated with the prevention and/or treatment of pathologies and refer to different categories of the population. The overarching goals are increasing life expectancy and life quality.

3.4.3.2 Project identification

Due to the complexity of a health care infrastructure, there is a need to clearly describe the objectives and characteristics of the project proposed. The main typologies of features to be considered are the following:

MAIN FEATURES TO BE CHECKED AND ANALYSED
Functional features (for example): - the group of pathologies involved, - the scope of the target population, - the diagnostic functions, - the short or long term treatment. **Basic data** (for example): - the average and maximum numbers of users per day, month, year, - a list of the departments for assistance and prevention, treatment and diagnosis. **Physical data** (for example): - the surface area and covered area, - number of treatment rooms, wards, prevention and/or diagnostic consulting rooms, - existence and size of outpatients department. **Technical and engineering features** (for example): - arrangement of internal/external areas (lay-out), - description of the principal equipment and machinery for diagnosis and/or treatment (e.g. X-ray, scans, nuclear medicine, endoscopes etc.), - construction, and layout of buildings or parts, - viability and access systems (plus possible car parks) and links with the local communication routes.

3.4.3.3 Feasibility and option analysis

The feasibility of the projects should be verified according to patient flows and trends and by taking into consideration the epidemiological data available.

For the alternative options, the critical issues to establish are:

- different medical-technological solutions;
- the construction of a new infrastructure, or the enlargement of an old one;
- different treatment systems.

3.4.3.4 Financial analysis

The financial inflows and outflows are:

Financial inflows
▪ Fees for hospital admission ▪ Fees for diagnosis ▪ Fees for treatment ▪ Additional services - single rooms ▪ Transfer from government budget

Financial outflows
▪ Investment costs - works - general expenses - expenses for special equipment ▪ Operating costs - raw materials for operation - maintenance - medicines - medical and administrative personnel costs - *out-sourced* medical services

The time horizon is usually around 20 years

3.4.3.5 Economic analysis

The benefits of the investments in health infrastructures relate to people is welfare and can be derived primarily from morbidity and mortality changes, added quality of services or efficiency gains. Assigning a monetary value to health benefits is complex. The most prominent techniques are to refer to the market prices of the service (willingness-to-pay) or to use standard methods, such as the indices for increased life expectancy suitably adjusted by the quality (e.g. Quality Adjusted Life Years) which can be valorised according to the principle of lost income or to similar actuarial criteria (see Box in annex E).

The two most important techniques to evaluate the statistical life value are:

- human-capital approach: this considers the improvements in health status as investments that yield future gains in productivity. The limit of the approach is that it examines only the effects of health on economic output and ignores the consumption value of health (e.g. even after retirement, life has a value);
- willingness-to-pay: this is the most widely-accepted measure; estimates are derived from revealed preference studies examining earnings' premiums for risky jobs or safety expenditures by consumers.

Benefits	- The future savings in health costs which are directly proportional to the decrease in the number of people affected and/or the lesser degree of gravity of the illness - The avoided loss in production, due to the lower number of working days lost by the patient and his or her family - The reduction in suffering on the part of the patients and their families, identifiable as, the increased life expectancy of the patient and the improved quality of life for the patient and his or her family - The number of deaths prevented (the value of statistical life)
Costs	- Apart from the costs listed in the financial analysis as converted into economic prices, are the costs related to increased transport flows could be considered

3.4.3.6 Risk assessment

Critical factors

- Reliability of epidemiological data for the catchment's area
- Operating and investments costs
- The risks incurred by administering new diagnostic or therapeutic treatment, etc.)

Main variables to consider	- The percentage incidence of pertinent morbidity, disaggregated by pathological type, age range, sex, profession, etc. - The cost of personnel - The cost of maintenance - The cost of new equipment - The cost of replacing old equipment - Possible costs deriving from the carrying out of diagnoses or treatment

3.4.3.7 Other project evaluation approaches

It may be helpful to evaluate the benefits in terms of simple physical indicators, e.g. an analysis of the cost-effectiveness, which is largely used in the health sector and offers comparable data. In this case, costs are related to the deaths prevented and the morbidity years avoided.

A panel of independent qualified experts should also illustrate the intrinsic value of the project for the health system.

CHECKLIST
✓ Try to forecast and analyse carefully the patient flows and trends in the area involved in the project ✓ Special attention should be paid to the choice of the epidemiological data sources ✓ Try to forecast the trend in operating costs, specifically with reference to personnel, maintenance and the replacement of equipment ✓ Considering that the main economic benefits of health infrastructure investments are related to the human life value, analysts should focus on value of statistical life evaluation approaches

3.4.4 Forests and parks

3.4.4.1 Project objectives

Forestry and park projects can have different primary objectives:

- increasing the production of wood or cork for commercial or energy purposes;
- safeguarding the environment (prevention of soil erosion, control of water, environmental protection);
- promotion of tourist-recreational activities.

3.4.4.2 Project identification

The main features to take into consideration are shown in the box below:

MAIN FEATURES TO BE CHECKED AND ANALYSED
Technical and engineering features (for example): - geographic position and altitude; - surface area; - maps showing position and description of biotypes and other interesting natural phenomena (waterfalls, caves, springs, etc.). **Functional features** (for example): - detailed description of projected operations, the extent (number of trees to be removed or planted, etc.) and methodologies (chosen species, type of cultivation, etc.), time period, form of management, type of treatment and execution period; - number, position and lay-out of service buildings, such as visitor centres, lodgings, canteens, observation posts, warehouses, sawmills; - number, position and capacity of possible tourist reception structures, such as hotels, refuges, restaurants, etc.; - access routes and links with the local and regional road networks.

3.4.4.3 Feasibility and option analysis

In order to evaluate the feasibility of the project, different variables need to be analysed according to the type of project:

- for projects directed at increasing the production of wood or cork, the demand for the type of wood to be produced;
- for projects directed at promoting tourist-recreational activities, the forecast trends for tourist flows, including their seasonal trends etc.

An impact analysis showing the sustainability of the proposed project, from an environmental point of view, would be helpful.

Option analyses to be considered for comparisons are:

- different areas of intervention within the same forestry district;
- different methodologies for amelioration, reforestation and cultivation;
- different routes or typologies for footpaths, tracks and equipped areas;
- different positioning of entrances, visitor centres, car parks, camp sites, etc. for projects for equipped parks and forested areas.

3.4.4.4 Financial analysis

The financial inflows and outflows are:

Financial inflows
▪ Admission fees ▪ Sales of collateral services ▪ Sales of commercial activities

Financial outflows
▪ Investment *costs* - works - general expenses - expenses for special equipment ▪ Operating costs - raw materials for operation - maintenance - administrative personnel costs

The time horizon for project analysis is around 25-35 years

3.4.4.5 Economic analysis

Benefits	- The benefits arising from the utilisation and transformation of wood, valued using the added value of forestry companies - The tourist-recreational benefits: they can be quantified and valued using the visitors' 'willingness-to-pay' method or the 'travel cost' method (particular care must be taken to avoid double counting of benefits) - If predictable, one should also consider the increased income for the tourist sector and related activities in the areas adjacent to or linked with the park or forest involved compared to a situation without (consistency is however needed in the CBA approach, and an income multiplier effect cannot be used at the same time as a shadow wage) - The benefits arising from the improvement of the countryside and environmental protection, and the benefits arising from hydro-geological protection; they can be evaluated on the basis of the costs due to flooding, landslides etc. that will be avoided thanks to the project and, if demonstrable, the higher added value of woodland production compared to a situation without the intervention
Costs	- Apart from the costs listed in the financial analysis, as converted into economic prices, the costs related to increased transport could be considered

3.4.4.6 Risk assessment

Critical factors

- Trends in tourist flows
- Operating costs

Main variables to consider	- The dynamics of the tourism sector in the region - The structure of preferences of tourists - The risk of depreciation of the natural asset

3.4.4.7 Other project evaluation approaches

Whenever the proposed project contains any elements, which are of naturalistic, environmental, or scientific importance in themselves (e.g. the protection of a threatened species), then these should be confirmed by a *panel* of qualified independent experts.

3.4.5 Industrial zones and technological parks

3.4.5.1 Project objectives

The main objectives pursued in these kinds of projects are:

- The establishment of the infrastructure for industrial zones, commercial and service areas;
- The relocation of productive plants from excessively congested or polluted areas;
- The setting up of new companies and supporting existing ones in a technological park.

3.4.5.2 Project identification

The main features to take into consideration are shown in the box below:

THE MAIN FEATURES TO BE CHECKED AND ANALYSED
Basic data (for example): - identification of the catchments area, the size of target companies (e.g. craftsmen, SME's, medium and large.) and the productive segments, - the number, size and type of companies involved, - the types of real services and scientific/technological laboratories, if present. **Technical and engineering features** (for example): - location and surface of the equipped area and the breakdown into plots, - internal viability and links with external networks, - significant technical elements, such as specialised laboratories, multimedia services centres, etc.

3.4.5.3 Feasibility and option analysis

The feasibility of the project should be verified by estimating the demand from existing companies to relocate to the new industrial area and the number of new companies that would be born thanks to the new equipped area.

The options analysis should consider alternative policy approaches, e.g. direct subsidies to companies for moving premises, purchases of real services, technological innovation, new production lines or newly constituted companies, etc.

3.4.5.4 Financial analysis

Financial inflows	Financial outflows
▪ Rent or licensing costs of land ▪ Rent or licensing costs of warehouses ▪ The sales prices of real services	▪ Investment costs - works - general expenses - expenses for special equipment ▪ Operating costs - goods and services necessary for the running of the infrastructure - maintenance - technical and administrative personnel costs - energy

The time horizon for project analysis is usually around 20 years

3.4.5.5 Economic analysis

The strategic goal for these types of investments is usually to create a favourable environment for the economic growth of a relatively depressed area. This long-term objective should be achieved through:

- diffusion of entrepreneurial knowledge and skills among the beneficiary companies
- the re-training of personnel
- the birth and/or relocation of new service companies
- reputational effects
- general reduction of start-up related business costs.

Anyway these aspects should be fully analysed in an economic impact analysis.

A Cost-Benefit Analysis should consider:

Benefits	Better positioning in the market for existing companies. To evaluate the benefit arising from the better positioning, it is necessary to consider: - savings in transport costs - effect of possible promotional activities - lower costs for basic services - technological improvements - availability of real services
Costs	In addition to the costs listed in the financial analysis, the other costs that might be considered are: - environmental costs - urban and transport congestion caused by the realisation of the infrastructure. Note, however, that since the impacts considered increase in the area surrounding the new infrastructure, they should decrease in the rest of the catchments area; the global effect – which is what should be considered in the analysis – may be for the better or for the worse

3.4.5.6 Risk assessment

Critical factors

- Investment costs
- Difficulty in forecasting the real rate of penetration in the catchment area, from the point of view of both the relocation of companies and the development of new businesses

Main variables to consider	- Expropriation costs - Equipment costs - The rate of installations in the area - The birth and early mortality rate of new businesses

CHECKLIST
✓ Estimate the demand from existing companies to relocate to the new industrial area ✓ Forecast the number of new companies that would be born thanks to the new equipped area ✓ Evaluate carefully possible expropriation costs ✓ The main economic benefits are represented by the cost savings that being located in such an area could ensure for the companies. In evaluating the cost savings it is necessary to forecast the costs that a company is expected to sustain if located in an industrial zone and the costs the same company would have sustained in another location with the same business level.

CHAPTER FOUR
CASE STUDIES

Overview

This chapter presents five case studies providing worked examples of the methodology presented in the previous chapters. The case studies include:

- investment in a motorway
- investment in a railway line
- investment in an incinerator with energy recovery
- investment in a waste water treatment plant
- industrial investment

Each case study is organized in such a way to allow, as far as possible, a 'horizontal' reading structured alongside the six steps required for a consistent project appraisal. Nevertheless, they are at the same time 'personalized' in order to take into account sectoral specifics and to show the operational application of some of the guidelines proposed in Chapter 2 and Chapter 3.

As already mentioned, the economic evaluation of transport projects is traditionally based on a partial equilibrium approach. For this reason, in the first two case studies, the economic analysis is presented before the financial analysis and the economic benefits are obtained by adding the consumer with the producer's surpluses and not by applying conversion factors to the project revenues.

The other three case studies are based on a general equilibrium approach, which implies the use of shadow prices. Each has, however, developed in more depth a certain topic to provide the reader with a practical application of the concepts illustrated in Chapter 2. For example:

- both the environmental case studies use an adjustment for the change of real prices (i.e. relative to general inflation);
- the incinerator case study presents a valuation of a negative externality by means of an hedonic price (see also Annex F);
- the waste water treatment plant investment offers an example of PPP and how to calculate the return on own capital to private investors (K_p);
- the industrial investment shows how risk analysis can question the project design, because, despite the baseline case seems to be acceptable, there is a high probability of a negative economic return.

The case studies are illustrative examples of the methodology of project analysis presented in the previous Chapters. They are not to be seen as synopsis of complete reports. All figures are purely indicative and should not be taken as benchmark values[54].

[54] Particularly transport projects are often based on highly variable assumptions, for example because of different traffic models, the network or corridor considered, etc. The case studies cannot represent a 'typical' project, because each actual project will be based on specific ingredients.

4.1 Case Study: investment in a motorway

4.1.1 Introduction

Recent developments in a Convergence region has been accompanied by fast growth in the volume of traffic along the corridor between two medium size urban areas. The existing local road network was designed to accommodate lower volumes of traffic and it is now reaching its full capacity. Congestion problems are expected to increase in the future due to the foreseen growth in both passengers and freight transport demand. Furthermore, the existing network runs across the most densely populated areas of the region thus causing serious environmental and safety problems for the people living in the area. For these reasons, the planning authority has proposed to assess the feasibility of a new motorway link by-passing the more densely urbanised areas. The main objectives of the project are therefore to reduce future congestion and to limit the population exposure to transport emissions. In addition, the project should also contribute to a reduction in accidents by diverting traffic, particularly by diverting the freight from the existing network to the new infrastructure. As well as the traffic diversion from the existing roads, the new motorway is expected to induce some newly generated traffic, but as the area is already densely populated, and congestion is highly localised, the additional traffic will be limited.

The benefits of the new 72 km motorway are to be found mainly in time savings, abatement of emissions exposure and a reduction in accidents. The reduction in kms travelled and consequently the ‘vehicle operating costs’ (VOC) savings made by the flow of traffic running through the whole motorway are outweighed by the additional kms travelled in order to access and egress the motorway by the traffic using only some stretches of the new infrastructure. The new motorway link will generate some additional traffic which in turn, will produce additional external costs, which would not have been produced without the new link.

The options considered were a free motorway or a tolled motorway.

4.1.2 Traffic forecast

Traffic forecast is based on the expected growth of GDP and population in the area and builds on the past trends re-adjusted by the most recent national forecast. The study area covers all the area directly affected by the project. The network considered is the entire road network of the area. Consequently, the flows considered are the ones using this network.

Different growth rates were applied for passengers and freight flows. Passenger demand has been disaggregated according to the trip purpose, in order to apply the appropriate ‘values of time’ (VOT). Future demand with and without the project has been estimated with the support of a road traffic model[55].

To assess the benefits of the new connection, total traffic on the new motorway has been sub-divided into three different components:

- the first is the diverted traffic, consisting of the freight and passengers who will be switching from the old route to the new motorway. This traffic will benefit from the reduced travel time due to the higher speeds and the absence of congestion and, at least partly, due to reduced distance;
- the second component is the traffic ‘generated’ by the new link: this traffic, consisting of new road users, is induced by the increased accessibility to the area. The benefits of the newly generated traffic is represented by the changes in consumer’s surplus, defined as the excess of consumer’s willingness-to-pay over the actual generalised costs of travel (travel time, vehicle operating costs and, for the option of the tolled motorway, toll fees). The generated traffic will also be responsible for additional external costs in terms of environmental emissions, noise and global warming;

[55] The details of the traffic model forecasts are not reported in this illustrative case study.

- finally, there is the traffic that will remain on the existing network which will take advantage of the reduced congestion thanks to the traffic diverted to the new motorway. Traffic reduction will contribute to a reduction in environmental emissions and noise.

As for some users, the value of time savings would not outweigh tolls, the free-of-charge option would imply a higher volume of traffic on the motorway.

Transport demand has been estimated for the entire corridor and for each of the two options it assessed against the BAU scenario. The most important inputs for the modelling process is the existing traffic data and the macro-economic, socio-economic and demographic data for the base year, for the forecast horizon (year 25) and for an intermediate year. After year 25, travel demand is assumed to remain constant. The transport model is a classical one consisting of trips generation, distribution and assignment. The following Table 4.1 summarises the total freight and passengers flows along the corridor connecting the two cities in the opening year of the new motorway:

- the traffic on the existing network in the BAU scenario;
- the traffic with the new free-of-charge motorway (diverted, generated and remaining on the existing network);
- the traffic with the new tolled motorway (diverted, generated and remaining on the existing network).

Table 4.1 Traffic forecast

DAILY TRAFFIC AT THE OPENING YEAR*				
	New motorway			Existing network
	Diverted from the existing network	Generated	Total on the motorway	
BAU scenario				
Heavy vehicles				7,086
Passengers vehicles				114,542
With the new free of charge motorway				
Heavy vehicles	5,867	1,200	7,067	1,219
Passengers vehicles	18,667	2,800	21,467	95,875
With the new tolled motorway				
Heavy vehicles	4,889	240	5,129	2,197
Passengers vehicles	15,556	910	16,466	98,986

**n. of standardised units*

4.1.3 Investment costs

The second step in the appraisal, in parallel with the forecast of the expected demand, has been to calculate the financial costs of the new motorway. Financial investment costs have been provided by the project engineers. Two separate estimates have been made, one for the free motorway and one for the tolled option. The costs for the second option are higher due to the need for segregated access ramps, equipment and buildings for collecting tolls. Costs have been disaggregated into the main type of works and on the basis of cost components (labour force, materials, carriage and freight). This enables the subsequent application of the conversion factors from financial costs into economic costs, see Table 4.3.

For the investment costs, two sets of estimates have been produced: one for the free motorway and the second for the tolled option. In the latter case, the costs related to toll collections have been included. The personnel, materials, freight and carriage costs have also been specified in this case.

The technical life of the infrastructure is 70 years and its residual value, considering the different components of the investment, has been set at 40% of the initial value.

The motorway construction will be completed in four years.

Table 4.2 Investment Costs

INVESTMENT COSTS				
	Free motorway		Tolled motorway	
	Millions	%	Millions	%
Works	502	59%	545	61%
Junctions	230	27%	230	26%
Land acquisition	60	7%	60	6%
General expenses	42	5%	42	5%
Other expenses	18	2%	18	2%
TOTAL	852	100%	895	100%

4.1.4 Economic analysis

A preliminary financial analysis, (not reported here), has evaluated cash inflows and outflows of the two options, and has concluded that the NPV(C) of the tolled road option is better (i.e. less negative) than for the free access option. This is because the former generates some toll revenues, whilst the latter generates only costs. The financial criterion however, from a regional development perspective, is not sufficient to make a decision and an economic analysis must be performed. The economic evaluation of the new road should consider any social cost and benefit that may be generated by the project. A detailed financial analysis will be performed (see below), on the preferred option according to the economic appraisal.

Firstly, the financial investment and maintenance costs have been adjusted for fiscal components. As to the labour force, the personnel cost has been adjusted for national insurance contributions and income taxation. The conversion factor is equal to 0.6 because the reservation wage has been taken into consideration for this area that is characterised by very high unemployment.

For the overheads calculation, the financial costs have been assumed to be representative of the economic cost, and therefore no conversion factor has been applied. The same is also true for the land acquisition, where the expropriation costs reflect the opportunity costs of land, thus the conversion factor is equal to 1 in this case too. Specific conversion factors, calculated as a weighted average of the conversion factors of the single components (labour, equipment, energy etc. see Table below), have been applied to investments and maintenance costs as well as to the tolling system. A standard conversion factor for raw materials equal to 0.98 has been calculated. The reference social discount rate is 5.5%.

Table 4.3 Conversion factors for each type of cost

Type of cost	CF	Notes
Unskilled labour	0.600	Shadow wage for high unemployment
Skilled labour	1.000	The labour market is assumed to be competitive
Land acquisition	1.000	Expropriation costs reflect market prices
Raw Materials	0.980	Traded good: Standard Conversion Factor
Energy	0.492	Net of excise taxes
Works	0.794	40% Not-skilled Labour, 8% Skilled Labour, 45% Raw materials, 7% Energy
Maintenance	0.754	37% Not-skilled Labour, 7% Skilled Labour, 46% Raw materials, 10% Energy
Tolling System	0.705	73% Not-skilled Labour, 10% Skilled Labour, 17% Raw materials
Residual value	0.785	59% Works, 27% interference resolution, 7% land acquisition, 5% overheads, 2% general expenses

The project will generate positive impacts on:

- the users of the new motorway, including the traffic diverted from the existing network and the generated traffic. They will save time and, in some cases, operating costs because the new route is shorter, but these savings will be outweighed by an increased distance to access and egress the motorway;

- the users who will remain on the existing network; goods and passengers will take advantage of the traffic reduction due to the diversion of flows toward the new motorway, which will reduce congestion and increase speeds.

The project benefits have been subdivided into the following components:

a) consumer's surplus

b) gross producer's surplus of the motorway operator

c) road users producer's surplus

d) changes in fiscal revenues for the Government (gasoline taxes)

e) net environmental benefits

f) reduction in accidents

The above-mentioned benefits were calculated according to the following conventions:

a) Consumer's surplus: changes in the area under the demand curve in excess of the users' generalised perceived costs (perceived 'vehicle operating costs' (VOC), including tolls in option 2, and value of travel time).

   In the modelling exercise passengers and freight will choose their route, or are induced to travel on the basis of the VOC they perceive. These will include for cars: fuel, lubricants and tolls if applied, and for trucks: fuel lubricants, a fraction of the maintenance, insurance and driving cost. Consistently, with the assumption on which the demand has been estimated, consumer's surplus relies only on the perceived component of the travel costs. The travel times will be reduced both for the diverted traffic and the traffic remaining on the old road. Three different time values have been applied to the passenger traffic, according to purpose of travel: business, commuting and other purposes. No differentiation in value of time has been considered for goods. The values of average perceived operating costs and time per trip in the three alternatives, BAU, Motorway free of charges and Motorway tolled, (separately for freight and for passengers), are reported in Table 4.4[56] . As shown in Table 4.4 the perceived VOC are slightly increasing in the entire area due to the increased distance travelled by some users to access and egress the new link, and in the tolled alternative due to the tolls paid for the use of the motorway. But these increased costs are more than outweighed by the reduction in travel time. The total generalised perceived costs per trip are lower in both the alternatives as compared with the BAU. Table 4.5 illustrates how the consumer's surplus is calculated, starting from the overall demand in the three scenarios, through the unit benefits calculated as the difference between the total generalised costs of the alternative considered and the BAU for the existing (diverted and not diverted) traffic in the entire network (with and without the new motorway), and half of this benefit for the generated traffic[57]. The total consumers' benefits are calculated by multiplying the unit benefits for the volume of traffic in the alternative[58].

b) Gross producer's surplus of the motorway operator: revenues from the motorway tolls are considered as being part of the producer's surplus (Table 4.6). All the calculation of surplus have been made separately for freight and passengers. For these reasons, the new motorway maintenance and operating costs are included directly in Tables 4.9 and 4.10 (economic analysis), as it was not possible to split the costs between the two types of traffic flows.

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56 The costs are calculated as average costs on the entire network considered in the analysis, as a consequence they reflect the different distribution of traffic between motorway and conventional road, which implies also changes in distance travelled. For this reason the difference between the generalised costs in the two options is less than the value of the toll applied in the tolled option.

57 For instance, for passengers in the free of charge option the unit benefits of the diverted traffic are given by (9.43 – 7.95) = 1.48 and for the generated traffic (9.43 – 7.95)/2 = 0.74.

58 For instance, the consumer's surplus in the two above mentioned cases is 1.48 Euro*32.2 million trips = 47.6 Millions of Euros and 0.74 Euro*0.8 million trips = 0.6 Millions of Euros.

c) Road users producer's surplus: the road users (cars and trucks) produce the services they supply to themselves (car users) or to their customers (trucks). The difference between the total costs of producing these services and the VOC perceived is defined as unperceived operating costs[59]. These enter into the calculation of the road users surplus (Table 4.6).

d) Government net revenues: thanks to the changes in distance travelled due to the re-routing of part of the existing traffic and to the generated traffic, the revenues from fuel taxes will increase, and the Government will increase its revenues. Part of this additional income and increased perceived costs paid by the users cancel each other out, but for the generated traffic this will represent a net benefit for the project.

e) Net environmental benefits: the shift of traffic flows from the existing network, (that runs across a densely populated and environmentally sensitive area), to the new motorway, (that crosses a rural area), generates a positive environmental externality despite the increase of air pollutants emissions due to a higher transport demand. Only the main pollutants have been taken into account for the evaluation of the environmental externalities. Two factors have been considered. The total amount of energy consumption and CO_2 emissions (as a function of the volume of vehicles' kms, and the shares of kms travelled in urban and non-urban areas). For air pollution, the monetary value applied to the emission in urban areas is higher than in non-urban areas as it is calculated on the basis of the population exposed to it. Reference monetary values were derived from those explicitly recommended for the region by the national planning authority.

f) Accident reduction: due to the diversion of traffic from the old road to the new one with a higher safety standard. From the available statistics the accident rates per million vehicles per km for road and motorway are respectively 0.32 and 0.09. Therefore a reduction in accidents is foreseen due to the diversion of traffic from the road network to the new motorway link. The values of statistical lives saved applied are those adopted by the national planning authority.

The following tables report how some components of the project benefits have been calculated for the motorway opening year.

Table 4.4 Generalised user costs (€)

Generalised user costs			
	BAU	**Free of charge**	**Tolled**
Passengers			
VOT/trip	6.45	4.83	5.42
Perceived operating costs per trip	2.98	3.12	3.61
Total generalised costs per trip	9.43	7.95	9.03
Freight			
VOT/trip	8.93	5.83	7.28
Perceived operating costs per trip	16.08	16.80	17.52
Total per trip	25.01	22.64	24.80

59 For instance, in the case of car users maintenance costs, tyre consumptions and asset's depreciation are not included in the perceived costs.

Table 4.5 Consumer's surplus

Passengers	Passengers trips (Millions)			Unit Benefits (€)		Benefits (Millions of Euros)	
	BAU	Free of charge	Tolled	Free of charge	Tolled	Free of charge	Tolled
Existing traffic	32.2	32.2	32.2	1.48	0.40	47.6	12.9
Generated traffic	0.0	0.8	0.3	0.74	0.20	0.6	0.1
Total	32.2	32.9	32.4			48.2	12.9
Freight	**Tons (Millions)**			**Unit Benefits (€)**		**Benefits (Millions of Euros)**	
	BAU	**Free of charge**	**Tolled**	**Free of charge**	**Tolled**	**Free of charge**	**Tolled**
Existing traffic	2.1	2.1	2.1	2.4	0.2	5.0	0.5
Generated traffic	0.0	0.4	0.1	1.2	0.1	0.4	0.0
Total	2.1	2.5	2.2			5.5	0.5

Table 4.6 Gross Producer's Surplus (motorway operator) and Road User's Surplus

	Revenues and costs (Millions of Euros)			Benefits (Millions of Euros)	
	BAU	Free of charge	Tolled	Free of charge	Tolled
Passenger					
Motorway operator revenues	0.0	0.0	19.6	0.0	19.6
Car users unperceived operating costs	-76.4	-82.0	-77.9	-5.6	-1.5
Total	-76.4	-82.0	-58.4	-5.6	18.1
Freight					
Motorway operator revenues	0.0	0.0	8.9	0.0	8.9
Trucks unperceived operating costs	-21.3	-26.1	-24.5	-4.7	-3.2
Total	-21.3	-26.1	-15.6	-4.7	5.7

Table 4.7 Government net revenues

Fuel taxes	Total Revenues (Millions of Euros)			Benefits (Millions of Euros)	
	BAU	Free of charge	Tolled	Free of charge	Tolled
Passengers	68.8	73.9	70.2	5.0	1.3
Freight	23.7	29.0	24.8	5.3	1.0

Tables 4.9 and 4.10 summarises the calculations of social costs and benefits of the two options. The Economic Net Present Values and the Rates of Return of the two options considered are:

	Free motorway	**Tolled motorway**
ENPV (Millions of Euros)	212.9	-41.3
ERR (%)	7.8	5.0
B/C Ratio	1.3	0.9

The results of the analysis show that there is a substantial advantage in the performance of the indicators for the free motorway option. Traffic on the motorway is much higher and as a consequence both users and society are better off, as total time savings are higher and externalities lower than in the tolled alternative. With the introduction of a tolling system the new motorway would remain under-utilised during the initial years. This is due to the fact that, although there is some congestion along the existing network, this is not high enough to induce a significant proportion of the demand to pay for the increased speed advantages allowed by the new motorway. The introduction of a pricing scheme only on some links of the network, as in this case, shifts traffic from the priced modes or links of the network to the other non-priced links or modes. From a welfare point of view, this could lead to a less positive effect. In order to maximise the net benefits of the investment, the analysis shows that it might be better to postpone the introduction of a tolling system to a second stage, (i.e., where traffic flow growth is sustained).

4.1.5 Scenario analysis

Two scenario analyses have been conducted on the two alternatives, each considering 20% changes in a variable baseline value:

- reducing the value of time savings;
- increasing the vehicles operating costs;
- increasing investment costs.

The analysis demonstrates that the performance of the free motorway is robust, while the results for the tolled option are more controversial. The ranking of the two options is not affected by the values applied to time savings and externalities. In fact, for both options the project remains feasible from a socio-economic point of view even when taking into account a lower value for the externalities and time savings. The results of the sensitivity analysis are shown in the following Table.

Table 4.8 Project performances in the scenario analysis

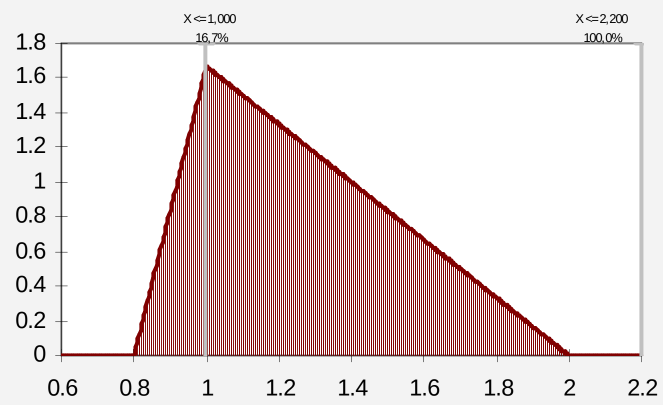
Tolled motorway	ERR (%)	ENPV (Millions of Euros)
Baseline case	5.0	-41.3
- 20% value of time	3.8	-144.4
+20% vehicles operating costs	4.8	-63.4
+ 20% investment costs	3.9	-158.0
Free motorway	**ERR (%)**	**ENPV (€)**
Baseline case	7.8	212.9
- 20% value of time	6.2	72.1
+ 20% vehicles operating costs	7.8	239.9
+ 20% investment costs	7.1	195.0

4.1.6 Risk assessment

The risk assessment has been conducted on the investment costs, which emerged as a critical variable in the sensitivity test: it has been completed only on the selected option, the free motorway, and only for the economic performance indicator ERR.

An asymmetric triangular probability distribution has been assumed with the following range of values: the investments costs can be lower than the estimated ones by maximum 20% and they cannot be higher than twice the estimated ones. These basic assumptions have been derived from the data collected for similar projects. The probability distribution is shown in the following Figure 4.1:

Figure 4.1 Probability distribution of investments costs, Triang (0.8; 1; 2)



The results of the analysis are presented in the following Figures, which show that the project risks are high since there is a 44.9% probability that the ERR will fall below 5.5%. Therefore, the results of the analysis suggest that a risk management procedure should be incorporated into the project implementation.

Figure 4.2 Results of the risk analysis for ERR

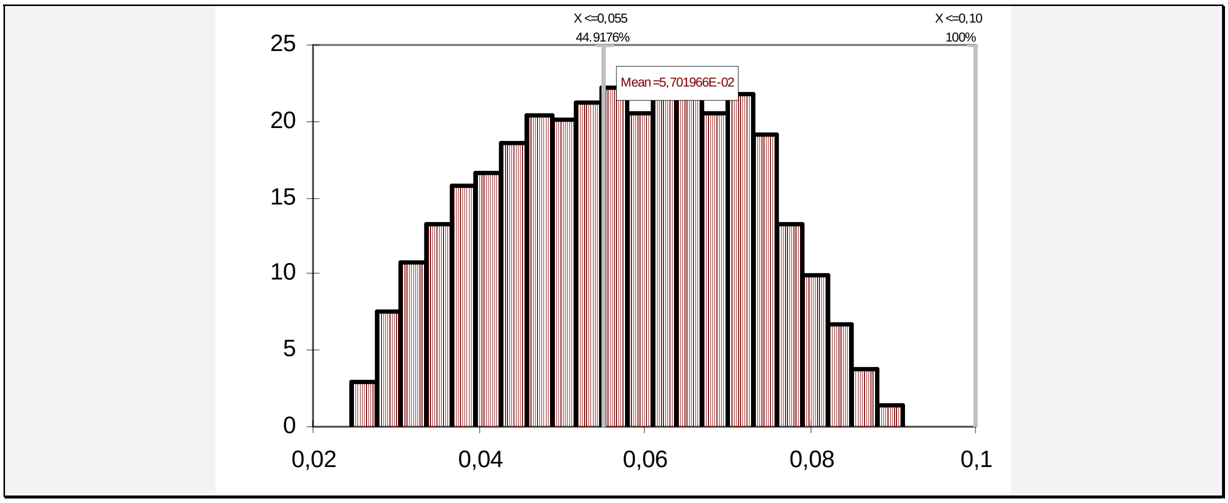
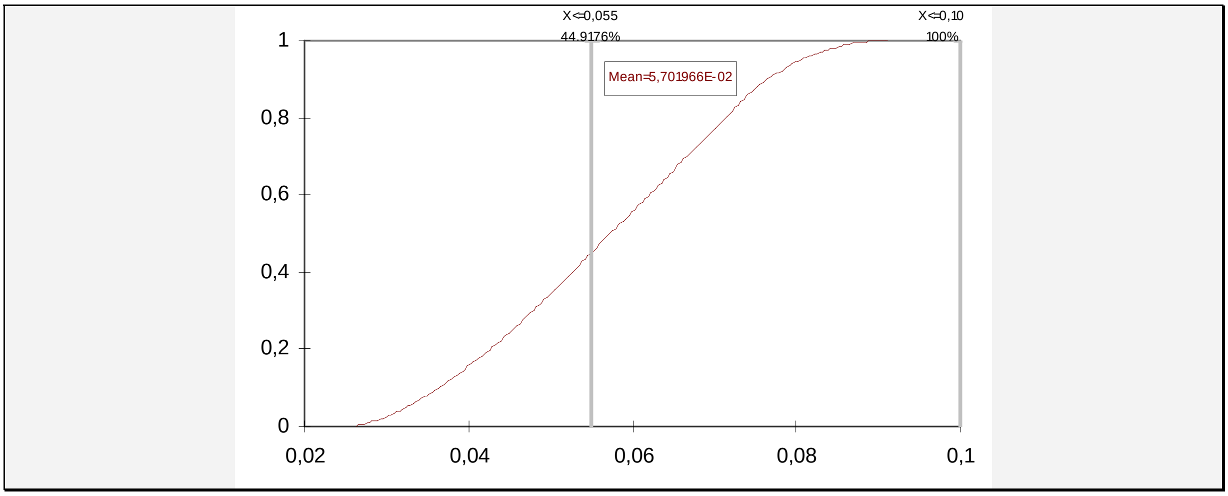


Figure 4.3 Results of the risk analysis for ERR



4.1.7 Financial analysis

The financial analysis has been conducted for the free motorway solution and has been chosen as preferable from a socio-economic point of view.

The financial resources are planned as follows:

- EU grant => €129,000,000;
- National Public Contribution => €723,000,000.

The EU Grant is calculated applying a maximum rate approved by the Operational Programme (75%) to the total eligible cost (€172,000,000), which is a minor part of the total investment costs.

The financial performance indicators are:

- Financial Net Present Value (investment)	FNPV(C)	- €755,593,000
- Financial Rate of Return (investment)	FRR(C)	- 5.0%
- Financial Net Present value (capital)	FNPV(K)	- €641,616,000
- Financial Rate of Return (capital)	FRR(K)	-4.6%

As shown by the economic analysis, the introduction of a tolling scheme would lower the socio-economic profitability of the motorway as part of the additional capacity provided by the new infrastructure would remain under-utilized. The net socio-economic loss can easily be measured: it represents the loss in consumer's surplus due to the reduction in generated traffic and the difference from external benefits of the diverted traffic. For the traffic that will remain on the motorway, there is no loss of benefits as the price they pay for the use the motorway will represent cost for the users but there will be a benefit for the motorway operator. Thus the key issue here is the divergence between economic and financial criteria.

While the answer is clear from an economic perspective, (the free of charge motorway should be preferred), it might still be interesting, from a financial point of view, to explore possible ways of having at least a partial cost recovery or a private involvement in the project financing.

On the one hand, having estimated the advantages and disadvantages from the introduction of a full cost recovery pricing scheme, it might be possible to assess whether there is an acceptable trade off, from a social point of view, between the advantages of introducing some level of tolls and the disadvantages in terms of benefits forgone. By running the demand model with different tolls it may be possible to find the tolls that generate a sum of revenues that outweigh the loss of consumers' benefits due to the reduction in diverted and generated traffic.

On the other hand, in order to guarantee a flow of private capital to the project, it would be intresting to consider a shadow tolling (see Box below). Whenever a socially costly traffic diversion due to the introduction of tolls is outweighed by the decreased social costs of public sector funding because of the private equity involved in the project, the comparison would imply a careful evaluation of the marginal cost of public funds in the country.

As a third option, the concessionaire can take risk only for the state of the asset and bear no traffic risk. The Design Build Finance and Maintain (DBFM) is one of the options considered under the overall Public Private Partnership approach. This contract design puts a strong emphasis on timely completion of the project and on improvement of overall project management processes.

FOCUS: SHADOW TOLLING
Private financing of transport infrastructure requires that a revenue stream remunerates the project promoter. In the absence of a revenue stream, the private sector may be willing to finance an infrastructure, and subsequently to operate and maintain it on the basis of a service contract. In the framework of such a contract, the private company can design, build finance and operate (DBFO) a road and will receive payments linked to the traffic using the road, the so called 'shadow tolling', over the lifetime of the concession. The shadow tolling approach may be considered as an alternative to the traditional 'pay as you go' approach. The approach transfers both construction cost and traffic risk to the concessionaire, and therefore can be treated as a Public Private Partnership (see Annex G). Road users will not be charged, but traffic volumes would be metered in order to calculate the amount of money paid to the concessionaire.

Table 4.9 Economic analysis *(Millions of Euros)* - Tolled motorway

	CF	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
BENEFITS																
Consumer's surplus		0.0	0.0	0.0	0.0	13.4	14.7	16.1	17.5	18.8	20.2	21.5	22.9	24.2	25.6	26.9
Time Benefits		0.0	0.0	0.0	0.0	37.1	38.7	40.3	42.0	43.6	45.2	46.8	48.5	50.1	51.7	53.3
Vehicle Operating Costs (perceived)		0.0	0.0	0.0	0.0	-23.7	-24.0	-24.2	-24.5	-24.8	-25.0	-25.3	-25.6	-25.9	-26.1	-26.4
Gross Producer and Road User Surplus		0.0	0.0	0.0	0.0	23.8	24.0	24.2	24.4	24.6	24.8	25.0	25.2	25.4	25.6	25.8
Tolls		0.0	0.0	0.0	0.0	28.4	28.8	29.1	29.5	29.8	30.2	30.6	30.9	31.3	31.6	32.0
Vehicle Operating Costs (not perceived)		0.0	0.0	0.0	0.0	-4.7	-4.8	-4.9	-5.1	-5.2	-5.4	-5.5	-5.7	-5.8	-6.0	-6.1
Net revenues for the State		0.0	0.0	0.0	0.0	2.4	2.5	2.6	2.6	2.7	2.8	2.9	3.0	3.1	3.1	3.2
Net Environmental Benefits		0.0	0.0	0.0	0.0	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1
Accident reduction		0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
TOTAL BENEFITS		0.0	0.0	0.0	0.0	39.5	41.2	42.8	44.5	46.1	47.8	49.4	51.1	52.8	54.4	56.1
COSTS																
Investment Costs																
Works	0.794	87.3	120.7	129.4	95.3											
Junctions	0.794	45.6	45.6	45.6	45.6											
Land acquisition	1.000	14.7	14.2	14.7	14.7											
General Expenses	0.998	10.5	10.5	10.5	10.5											
Other expenses	0.998	4.5	4.5	4.5	4.5											
Total investments costs		162.6	195.5	204.7	170.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Operating Costs (motorway operator)																
Maintenance	0.573	0.0	0.0	0.0	0.0	0.7	0.7	0.7	0.7	0.7	0.7	1.5	1.5	1.5	1.5	1.5
General Expenses	0.998	0.0	0.0	0.0	0.0	3.3	3.3	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.5	3.5
Total operating costs		0.0	0.0	0.0	0.0	4.0	4.0	4.1	4.1	4.1	4.1	4.9	4.9	4.9	5.0	5.0
TOTAL COSTS		162.6	195.5	204.7	170.6	4.0	4.0	4.1	4.1	4.1	4.1	4.9	4.9	4.9	5.0	5.0
NET BENEFITS		-162.6	-196.0	-204.7	-170.6	35.5	37.2	38.8	40.4	42.1	43.7	44.5	46.1	47.8	49.4	51.0

	CF	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
BENEFITS																
Consumer's surplus		28.3	29.6	31.0	32.3	33.6	34.8	36.1	37.3	38.6	39.8	39.8	39.8	39.8	39.8	39.8
Time Benefits		54.9	56.6	58.2	59.8	59.8	62.7	64.1	65.5	66.9	68.4	68.4	68.4	68.4	68.4	68.4
Vehicle Operating Costs (perceived)		-26.7	-26.9	-27.2	-27.5	-27.7	-27.8	-28.0	-28.2	-28.4	-28.6	-28.6	-28.6	-28.6	-28.6	-28.6
Gross Producer and Road User Surplus		26.1	26.3	26.5	26.7	26.8	27.0	27.1	27.3	27.4	27.6	27.6	27.6	27.6	27.6	27.6
Tolls		32.3	32.7	33.0	33.4	33.6	33.8	34.0	34.3	34.5	34.7	34.7	34.7	34.7	34.7	34.7
Vehicle Operating Costs (not perceived)		-6.2	-6.4	-6.5	-6.7	-6.8	-6.8	-6.9	-7.0	-7.1	-7.1	-7.1	-7.1	-7.1	-7.1	-7.1
Net revenues for the State		3.3	3.4	3.5	3.6	3.6	3.7	3.7	3.7	3.8	3.8	3.8	3.8	3.8	3.8	3.8
Net Environmental Benefits		-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1
Accident reduction		0.1	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
TOTAL BENEFITS		57.7	59.4	61.0	62.7	64.1	65.6	67.0	68.5	69.9	71.4	71.4	71.4	71.4	71.4	71.4
COSTS																
Investment Costs																
Works	0.794															
Junctions	0.794															
Land acquisition	1.000															
General Expenses	0.998															
Other expenses	0.998															
Total investments costs		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-293.5
Operating Costs (motorway operator)																
Maintenance	0.573	1.5	1.5	1.5	2.2	2.2	2.2	3.3	3.3	4.0	4.0	4.0	4.0	4.0	4.0	4.0
General Expenses	0.998	3.5	3.5	3.5	4.4	4.4	4.4	4.4	4.4	4.7	4.7	4.7	4.7	4.7	4.7	4.7
Total operating costs		5.0	5.0	5.0	6.6	6.6	6.6	7.7	7.7	8.7	8.7	8.7	8.7	8.7	8.7	8.7
TOTAL COSTS		5.0	5.0	5.0	6.6	6.6	6.6	7.7	7.7	8.7	8.7	8.7	8.7	8.7	8.7	-284.8
NET BENEFITS		52.7	54.3	56.0	56.0	57.5	58.9	59.3	60.7	61.3	62.7	62.7	62.7	62.7	62.7	356.2

Discount Rate	5.5%
ENPV	-41.3
ERR	5.0%
B/C ratio	0.9

Table 4.10 Economic analysis *(Millions of Euros)* – Free Motorway

	CF	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
BENEFITS																
Consumer's surplus		0.0	0.0	0.0	0.0	53.7	56.1	58.4	60.8	63.2	65.6	68.0	70.3	72.7	75.1	77.5
Time Benefits		0.0	0.0	0.0	0.0	59.9	62.5	65.0	67.6	70.1	72.6	75.2	77.7	80.3	82.8	85.3
Vehicle Operating Costs (perceived)		0.0	0.0	0.0	0.0	-6.3	-6.4	-6.6	-6.7	-6.9	-7.1	-7.2	-7.4	-7.6	-7.7	-7.9
Gross Producer and Road User Surplus		0.0	0.0	0.0	0.0	-10.3	-10.6	-10.8	-11.1	-11.3	-11.6	-11.8	-12.1	-12.3	-12.6	-12.8
Tolls		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Vehicle Operating Costs (not perceived)		0.0	0.0	0.0	0.0	-10.3	-10.6	-10.8	-11.1	-11.3	-11.6	-11.8	-12.1	-12.3	-12.6	-12.8
Net revenues for the State		0.0	0.0	0.0	0.0	10.3	10.5	10.8	11.0	11.3	11.6	11.8	12.1	12.3	12.6	12.8
Net Environmental Benefits		0.0	0.0	0.0	0.0	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3
Accident reduction		0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
TOTAL BENEFITS		0.0	0.0	0.0	0.0	53.4	55.8	58.2	60.6	63.0	65.4	67.7	70.1	72.5	74.9	77.3
COSTS																
Investment Costs																
Works	0.794	77.2	115.7	113.8	91.9											
Junctions	0.794	45.6	45.6	45.6	45.6											
Land acquisition	1.000	14.7	14.2	14.7	14.7											
General Expenses	0.998	10.5	10.5	10.5	10.5											
Other expenses	0.998	4.5	4.5	4.5	4.5											
Total investments costs		*152.5*	*190.5*	*189.1*	*167.2*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*
Operating Costs (motorway operator)																
Maintenance	0.573	0.0	0.0	0.0	0.0	0.7	0.7	0.7	0.7	0.7	0.7	1.5	1.5	1.5	1.5	1.5
General Expenses	0.998	0.0	0.0	0.0	0.0	3.2	3.2	3.3	3.3	3.3	3.3	3.3	3.3	3.4	3.4	3.4
Total operating costs		*0.0*	*0.0*	*0.0*	*0.0*	*3.9*	*3.9*	*4.0*	*4.0*	*4.0*	*4.0*	*4.8*	*4.8*	*4.9*	*4.9*	*4.9*
TOTAL COSTS		152.5	190.5	189.1	167.2	3.9	3.9	4.0	4.0	4.0	4.0	4.8	4.8	4.9	4.9	4.9
NET BENEFITS		-152.5	-191.0	-189.1	-167.2	49.5	51.9	54.2	56.6	59.0	61.4	62.9	65.3	67.6	70.0	72.4

	CF	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
BENEFITS																
Consumer's surplus		79.8	82.2	84.6	87.0	88.9	90.9	92.9	94.9	96.9	98.9	98.9	98.9	98.9	98.9	98.9
Time Benefits		87.9	90.4	93.0	95.5	97.6	99.7	101.7	103.8	105.9	108.0	108.0	108.0	108.0	108.0	108.0
Vehicle Operating Costs (perceived)		-8.1	-8.2	-8.4	-8.5	-8.6	-8.7	-8.8	-8.9	-9.0	-9.1	-9.1	-9.1	-9.1	-9.1	-9.1
Gross Producer and Road User Surplus		-13.1	-13.3	-13.6	-13.8	-14.0	-14.1	-14.3	-14.4	-14.6	-14.7	-14.7	-14.7	-14.7	-14.7	-14.7
Tolls		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Vehicle Operating Costs (not perceived)		-13.1	-13.3	-13.6	-13.8	-14.0	-14.1	-14.3	-14.4	-14.6	-14.7	-14.7	-14.7	-14.7	-14.7	-14.7
Net revenues for the State		13.1	13.3	13.6	13.8	14.0	14.1	14.3	14.4	14.5	14.7	14.7	14.7	14.7	14.7	14.7
Net Environmental Benefits		-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3
Accident reduction		0.1	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
TOTAL BENEFITS		-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	0.0	0.0	0.0	0.0	0.0	0.0
BENEFITS		79.7	82.1	84.5	86.8	88.8	90.8	92.8	94.8	96.8	98.8	98.8	98.8	98.8	98.8	98.8
COSTS																
Investment Costs																
Works	0.794															
Junctions	0.794															
Land acquisition	1.000															
General Expenses	0.998															
Other expenses	0.998															
Total investments costs		*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*-279.9*
Operating Costs (motorway operator)																
Maintenance	0.573	1.5	1.5	1.5	2.2	2.2	2.2	3.3	3.3	4.0	4.0	4.0	4.0	4.0	4.0	4.0
General Expenses	0.998	3.4	3.4	3.4	4.3	4.3	4.3	4.3	4.3	4.6	4.6	4.6	4.6	4.6	4.6	4.6
Total operating costs		*4.9*	*4.9*	*4.9*	*6.5*	*6.5*	*6.5*	*7.6*	*7.6*	*8.6*	*8.6*	*8.6*	*8.6*	*8.6*	*8.6*	*8.6*
TOTAL COSTS		4.9	4.9	4.9	6.5	6.5	6.5	7.6	7.6	8.6	8.6	8.6	8.6	8.6	8.6	-271.3
NET BENEFITS		74.7	77.1	79.5	80.3	82.3	84.3	85.1	87.1	88.3	90.2	90.2	90.2	90.2	90.2	370.1

Discount Rate	5.5%
ENPV	212.9
ERR	7.8%
B/C ratio	1.3

Table 4.11 Financial return on investment ***(Millions of Euros)***

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
REVENUES	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Works	97.2	145.7	143.4	115.8											
Junctions	57.5	57.5	57.5	57.5											
Land acquisition	15.0	14.5	15.0	15.0											
General Expenses	10.5	10.5	10.5	10.5											
Other expenses	4.5	4.5	4.5	4.5											
TOTAL INVESTMENTS COSTS	184.7	232.7	230.9	203.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maintenance	0.0	0.0	0.0	0.0	1.2	1.2	1.2	1.2	1.2	1.2	2.7	2.7	2.7	2.7	2.7
General expanses	0.0	0.0	0.0	0.0	3.2	3.2	3.3	3.3	3.3	3.3	3.3	3.4	3.4	3.4	3.4
TOTAL OPERATING COSTS	0.0	0.0	0.0	0.0	4.4	4.4	4.5	4.5	4.5	4.5	6.0	6.1	6.1	6.1	6.1
TOTAL OUTFLOWS	184.7	232.7	230.9	203.3	4.4	4.4	4.5	4.5	4.5	4.5	6.0	6.1	6.1	6.1	6.1
NET CASH FLOW	-184.7	-232.7	-230.9	-203.3	-4.4	-4.4	-4.5	-4.5	-4.5	-4.5	-6.0	-6.1	-6.1	-6.1	-6.1

	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
REVENUES	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	340.6
Works															
Junctions															
Land acquisition															
General Expenses															
Other expenses															
TOTAL INVESTMENTS COSTS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maintenance	2.7	2.7	2.7	3.9	3.9	3.9	5.8	5.8	7.0	7.0	7.0	7.0	7.0	7.0	7.0
General expanses	3.4	3.4	3.4	4.3	4.3	4.3	4.4	4.4	4.6	4.6	4.6	4.6	4.6	4.6	4.6
TOTAL OPERATING COSTS	6.1	6.1	6.1	8.2	8.2	8.2	10.2	10.2	11.6	11.6	11.6	11.6	11.6	11.6	11.6
TOTAL OUTFLOWS	6.1	6.1	6.1	8.2	8.2	8.2	10.2	10.2	11.6	11.6	11.6	11.6	11.6	11.6	11.6
NET CASH FLOW	-6.1	-6.1	-6.1	-8.2	-8.2	-8.2	-10.2	-10.2	-11.6	-11.6	-11.6	-11.6	-11.6	-11.6	329.0

Discount Rate	5.0%
FNPV (C)	-755.6
FRR (C)	-5.0%

Table 4.12 Financial return on capital ***(Millions of Euros)***

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Revenues	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Residual value															
TOTAL INFLOWS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Local contribution															
Regional Contribution															
National Contribution	156.8	197.5	196.0	172.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL NATIONAL PUBLIC CONTRIBUTION	156.8	197.5	196.0	172.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maintenance	0.0	0.0	0.0	0.0	1.2	1.2	1.2	1.2	1.2	1.2	2.7	2.7	2.7	2.7	2.7
General expanses	0.0	0.0	0.0	0.0	3.2	3.2	3.3	3.3	3.3	3.3	3.3	3.4	3.4	3.4	3.4
TOTAL OPERATING COSTS	0.0	0.0	0.0	0.0	4.4	4.4	4.5	4.5	4.5	4.5	6.0	6.0	6.1	6.1	6.1
TOTAL OUTFLOWS	156.8	197.5	196.0	172.6	4.4	4.4	4.5	4.5	4.5	4.5	6.0	6.0	6.1	6.1	6.1
NET CASH FLOW	-156.8	-197.5	-196.0	-172.6	-4.4	-4.4	-4.5	-4.5	-4.5	-4.5	-6.0	-6.0	-6.1	-6.1	-6.1

	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Revenues	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Residual value															340.6
TOTAL INFLOWS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	340.6
Local contribution															
Regional Contribution															
National Contribution	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL NATIONAL PUBLIC CONTRIBUTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maintenance	2.7	2.7	2.7	3.9	3.9	3.9	5.8	5.8	7.0	7.0	7.0	7.0	7.0	7.0	7.0
General expanses	3.4	3.4	3.4	4.3	4.3	4.3	4.4	4.4	4.6	4.6	4.6	4.6	4.6	4.6	4.6
TOTAL OPERATING COSTS	6.1	6.1	6.1	8.2	8.2	8.2	10.2	10.2	11.5	11.5	11.5	11.6	11.6	11.6	11.6
TOTAL OUTFLOWS	6.1	6.1	6.1	8.2	8.2	8.2	10.2	10.2	11.5	11.5	11.5	11.6	11.6	11.6	11.6
NET CASH FLOW	-6.1	-6.1	-6.1	-8.2	-8.2	-8.2	-10.2	-10.2	-11.5	-11.5	-11.5	-11.6	-11.6	-11.6	329.0

Discount Rate	5.0%
FNPV (K)	-641.6
FRR (K)	-4.6%

Table 4.13 Financial Sustainability *(Millions of Euros)*

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
EU Grant	27.9	35.2	34.9	30.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Local contribution															
Regional Contribution															
National Contribution	156.8	197.5	196.0	172.6											
Total national public contribution	156.8	197.5	196.0	172.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Operating subsidies					4.4	4.4	4.5	4.5	4.5	4.5	6.0	6.0	6.1	6.1	6.1
FINANCIAL RESOURCES	184.7	232.7	230.9	203.3	4.4	4.4	4.5	4.5	4.5	4.5	6.0	6.0	6.1	6.1	6.1
Passenger vehicles															
Goods vehicles															
TOTAL REVENUES	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL INFLOWS	184.7	232.7	230.9	203.3	4.4	4.4	4.5	4.5	4.5	4.5	6.0	6.0	6.1	6.1	6.1
Works	97.2	145.7	143.4	115.8											
Junctions	57.5	57.5	57.5	57.5											
Land acquisition	15.0	14.5	15.0	15.0											
General Expenses	10.5	10.5	10.5	10.5											
Other expenses	4.5	4.5	4.5	4.5											
Total investments costs	184.7	232.7	230.9	203.3											
Maintenance	0.0	0.0	0.0	0.0	1.2	1.2	1.2	1.2	1.2	1.2	2.7	2.7	2.7	2.7	2.7
General expanses	0.0	0.0	0.0	0.0	3.2	3.2	3.3	3.3	3.3	3.3	3.3	3.4	3.4	3.4	3.4
Total operating costs	0.0	0.0	0.0	0.0	4.4	4.4	4.5	4.5	4.5	4.5	6.0	6.0	6.1	6.1	6.1
TOTAL OUTFLOWS	184.7	232.7	230.9	203.3	4.4	4.4	4.5	4.5	4.5	4.5	6.0	6.0	6.1	6.1	6.1
NET CASH FLOW	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CUMULATED CASH FLOW	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
EU Grant	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Local contribution															
Regional Contribution															
National Contribution															
Total national public contribution	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Operating subsidies	6.1	6.1	6.1	8.2	8.2	8.2	10.2	10.2	11.5	11.5	11.5	11.6	11.6	11.6	11.6
FINANCIAL RESOURCES	6.1	6.1	6.1	8.2	8.2	8.2	10.2	10.2	11.5	11.5	11.5	11.6	11.6	11.6	11.6
Passenger vehicles															
Goods vehicles															
Residual value															
TOTAL REVENUES	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL FINANCIAL INFLOWS	6.1	6.1	6.1	8.2	8.2	8.2	10.2	10.2	11.5	11.5	11.5	11.6	11.6	11.6	11.6
Works															
Junctions															
Land acquisition															
General Expenses															
Other expenses															
Total investments costs															
Maintenance	2.7	2.7	2.7	3.9	3.9	3.9	5.8	5.8	7.0	7.0	7.0	7.0	7.0	7.0	7.0
General expanses	3.4	3.4	3.4	4.3	4.3	4.3	4.4	4.4	4.6	4.6	4.6	4.6	4.6	4.6	4.6
Total operating costs	6.1	6.1	6.1	8.2	8.2	8.2	10.2	10.2	11.5	11.5	11.5	11.6	11.6	11.6	11.6
TOTAL OUTFLOWS	6.1	6.1	6.1	8.2	8.2	8.2	10.2	10.2	11.5	11.5	11.5	11.6	11.6	11.6	11.6
NET CASH FLOW	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CUMULATED CASH FLOW	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

4.2 Case Study: investment in a railway line

4.2.1 Introduction

A government of a country eligible for Cohesion Fund assistance has planned to improve the rail connection along a corridor that runs across one of its most densely populated regions. Currently the transport supply in that area includes a relatively old single-track railway line, 215 km in length and a well developed, but congested road network. The railway line has been losing its freight traffic in favour of faster truck transportation and passenger traffic to private cars.

Road congestion particularly affects the network near the main cities and the railway line cannot offer a competitive service: train speed is low and the services provided are unreliable. The main objective of the project is to develop a high-quality rail connection for passengers and freight by improving the existing line. The improved rail link is expected to benefit the environment and to reduce the need to further increase road capacity. The shift of passengers and goods traffic from road towards the railway is one of the objectives of the National Transport Plan in order to reduce congestion and limit CO_2 emissions and air pollution the latter, particularly in densely populated areas where exposure is higher. There is also an expectation that the improved rail line will accelerate regional development. The improvement of the line is further encouraged by the introduction of the Eurovignette, which implies a taxation system for road heavy goods vehicles, foreseen for the near future.

In order to achieve these goals, the government has decided to investigate the feasibility of different investment options. The technical feasibility of the project has been confirmed since no specific barriers or other particular physical constraints have been found on the ground. A pre-screening of a number of technical development options on the basis of the preliminary assessment of investment costs and traffic potential has allowed the selection of two main options to be assessed against the BAU scenario:

- business as usual: the railway line will continue as it is and will lose further shares of its passengers and freight traffic. This implies that in the future some congestion is foreseen, particularly around the main cities due to freight traffic growth in the region. The main problem will be air pollution, that is expected to increase significantly as a consequence of the dominance of road mode in freight transport;
- 'option 1': a solution with limited investments which secures an improvement in the line reliability, although this will have only marginal benefits in terms of modal shift and reduction in environmental and social costs;
- 'option 2': a solution which reflects a more ambitious plan for the full modernisation of the existing railway line.

The existing railway services are operated by two private companies; one for passengers and the other for freight transport whilst the infrastructure is owned by the government and is managed by a state owned company.

4.2.2 Traffic analysis

The two selected options have been analysed with respect to what effect they will have on passengers and freight flows in comparison to the business as usual scenario along the whole corridor. Some sections of the existing line are presently in a very bad shape, and this is having a negative affect on the capacity of the railway infrastructure and the reliability of the services. The line is currently operating at its maximum capacity. No additional trains can be provided although there is a potential demand, particularly for freight going towards the regional port, which will shift from road to rail if further capacity is made available.

Investment in Option 1 is likely to result in a moderate increase in passenger and freight demand. It would bring to a halt the decreasing competitiveness trend of the rail and the modal share of the rail will be slightly lower than currently but will take advantage of the expected growth in the overall transport demand.

Option 2 however, will result in a further increase in demand from both passengers and freight, as the capacity will be significantly higher than in Option 1, with the rail modal share showing a limited positive trend.

The following Table shows traffic the forecast and service provided in the two options.

Table 4.14 Traffic and service forecasts

	BAU		Option 1		Option 2	
	Per day	**Per year**	**Per day**	**Per year**	**Per day**	**Per year**
Expected traffic volumes						
Tons						
Opening year	1,400	308,000	7,200	1,584,000		3,168,000
Year 15	1,400	308,000	8,113	1,784,860	16,226	3,569,720
Passengers						
Opening year	17,500	6,300,000	30,000	10,800,000	48,000	17,280,000
Year 15	17,500	6,300,000	33,805	12,169,800	54,088	19,471,680
Number of trains						
Freight						
Opening year	2	440	12	2,640	24	5,280
Year 15	2	440	14	3,080	28	6,160
Passengers						
Opening year	70	25,200	100	36,000	160	57,600
Year 15	70	25,200	112	40,320	180	64,800

4.2.3 Investment costs

The second step in the appraisal is the calculation of the financial costs of the rail upgrading. Preliminary estimates of financial investment costs have been provided by the project engineers and are shown to be compatible with the expected volume of traffic. Having checked the opportunity to further develop the technical feasibility, detailed estimates of the costs of two options have been made available.

Table 4.15 Investment Costs

	Option 1		Option 2	
	Millions	**%**	**Millions**	**%**
Works	506.0	65.2	1058.1	63.7
Equipments	126.5	16.3	293.9	17.7
Contingencies	77.6	10.0	166.9	10.1
Other expenses	66.0	8.5	141.3	8.5
Total	**776.1**	**100.0**	**1660.2**	**100.0**

Maintenance costs of the rail line include all costs for maintaining tracks, signalling, telecommunication, catenary systems and surrounding areas. The costs have been estimated on an annual basis, split into the main components (personnel, materials, freight and carriage costs) for the BAU and the two options, taking into account the expected volume of traffic in each case. The estimates reflect the costs of carrying out the necessary maintenance work that is required to ensure the specific level of service.

4.2.4 Economic analysis

The benefits of the two options are measured in terms of:

- time savings for the existing passengers rail traffic, fares being equal in all the alternatives;
- costs saving for the existing freight traffic, due to fares reduction on account of the reduced marginal costs made possible by the railway upgrading[60];
- time and operating costs savings for the passenger traffic diverted from road to rail;
- air pollution reduction as a result of the shift of freight and passenger traffic from road to rail;
- CO_2 emission reduction as a result of the shift of freight and passenger traffic from road to rail
- accident reduction owing to the shift of freight and passenger traffic from road to rail

The economic benefits of the two options can be summarized in the following categories:

- changes in consumer's surplus , represented by the changes in users generalised costs;
- changes in producer's surplus (railway operator) and in user's surplus;
- reduction of the negative externalities as a result of the diverted traffic from road to rail (air pollution, CO_2 emissions, accidents).

Table 4.16 summarises the unit generalised costs per trip for passengers and freight

Table 4.16 Costs per trip (€)

	Business as usual Scenario	Option 1	Option 2
Passangers			
Rail			
Time costs	28.6	25.0	22.3
Tariffs	16.7	16.7	16.7
Generalised costs	45.2	41.7	39.0
Road			
Time costs	25.1	24.9	24.3
Operating costs (including taxes)	17.6	17.6	17.6
Generalised costs	42.7	42.4	41.8
Freight (per ton)			
Rail Tariffs	11.6	6.5	6.5
Road Tariffs	12.9	12.9	12.9

4.2.4.1 Consumer's surplus

Passenger's consumer's surplus has been calculated according to the so-called 'rule of half' for all the rail users and for users remaining on the road network that benefit from a reduction in congestion. The following Table shows the volumes of traffic in the three options (Business as usual, 1 and 2) and the unit benefits for the different flows. The unit benefits for the existing traffic are calculated as the difference between the generalised costs (tariffs for freight) with and without the project[61]. The unit benefit for freight is the difference in rail tariffs[62], no value of time for goods has been considered given the low value of the goods and the limited time saved. For the modal shifters and the users remaining on the road, the unit benefit is half of the difference of the generalised costs of the rail and the road, respectively[63].

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[60] In this illustrative example we assume that pricing rules for the operator are given by a fixed mark-up on marginal costs. See case study motorway and Chapter 4 for an explanation of unperceived users operating costs.

[61] For instance, the unit benefit for initial users of Option 1 is (€45.2 - €41.7) = €3.6. The total benefit is 3.6 Euro * 6.3 Million passengers = 22.6 Millions of Euros.

[62] For instance, the unit benefit for rail freight service users of Option 2 is (€11.6 - €6.5) = €5.1

[63] For instance, the unit benefit for the modal shifters under Option 2 is (€45.2 - €39) = €6.2/2 = €3.1

Table 4.17 Consumer's Surplus

Passengers	Passengers (Millions)			Unit benefits (€)		Benefits (Millions of Euros)	
	BAU	Option 1	Option 2	Option 1	Option 2	Option 1	Option 2
Rail							
Initial users	6.3	6.3	6.3	3.58	6.27	22.6	39.5
Modal shifters	0.0	4.5	11.0	1.79	3.14	8.1	34.4
Total	6.3	10.8	17.3			30.6	73.9
Road							
Users	40.7	36.2	29.7	0,22	0.96	8.0	28.5
Total consumers' surplus						38.6	102.4
Freight	**Millions ton**			**Unit benefits (€)**		**Benefits (Millions of Euros)**	
	BAU	**Option 1**	**Option 2**	**Option 1**	**Option 2**	**Option 1**	**Option 2**
Rail							
Initial users	0.3	0.3	0.3	5.16	5.16	1.6	1.6
Modal shifters	0.0	1.3	2.9	2.58	2.58	3.3	7.4
Total	0.3	1.6	3.2			4.9	9.0
Road							
Users	64.7	63.4	61.8	0.04	0.17	2.7	10.4
Total						7.6	19.4

4.2.4.2 Producer's surplus and Government net revenues

The producer's surplus is calculated as the sum of the changes in the rail service operator's surplus plus the changes in the road user's surplus due to the shift of demand from road to rail (changes in freight road transport operators surplus plus the changes in unperceived costs for car users). The rail operator's surplus is calculated as the difference between the tariff revenues and the marginal costs of producing the services.

The changes in net Government revenues depend upon the changes in fuel taxes, due to the reduction in distance travelled by road and other taxes on railways.

Table 4.18 Producer's surplus

Passengers	Revenues and costs (Millions)			Benefits (Millions)	
	BAU (a)	Option 1 (b)	Option 2 (c)	Option 1 (b) – (a)	Option 2 (c) – (a)
Rail					
Operating costs	-184.7	-283.5	-470.0	-98.8	-285.3
Tariff Revenues	209.9	359.8	575.7	149.9	365.8
Total	25.3	76.4	105.7	51.2	80.5
Road					
Car users unperceived operating costs	-177.3	-157.7	-129.5	19.6	47.8
Total producers' surplus				**70.8**	**128.3**
Government					
Fuel taxes	366.1	325.6	267.3	-40.5	-98.7
Other taxes	40.6	58.1	92.9	17.4	52.2
Total Government revenues	**406.7**	**383.7**	**360.2**	**-23.0**	**-46.5**
Freight	**Revenues and costs (Millions of Euros)**			**Benefits (Millions of Euros)**	
	BAU (a)	**Option 1 (b)**	**Option 2 (c)**	**Option 1 (b) – (a)**	**Option 2 (c) – (a)**
Rail					
Operating costs	-0.8	-4.7	-9,4	-3,9	-8,6
Tariff revenues	7.2	20.4	40,9	13,3	33,7
Total	6.4	15.7	31,4	9,4	25,1
Road					
Production financial costs	-804.1	-785.5	-758.3	18.5	45.8
Tariff revenues	834.4	817.9	797.5	-16.5	-36.9
Total	30.3	32.4	39.2	2.1	8.9
Total producers' surplus				11.4	33.9
Government					
Fuel taxes	327.4	320.0	309.7	-7.3	-17.6
Other taxes	0.2	1.0	1.9	0.8	1.8
Total Government revenues	**327.5**	**321.0**	**311.7**	**6.5**	**15.8**

Financial investment costs have been adjusted for fiscal components. Personnel costs have been adjusted by deducting national insurance contributions and income taxation. The conversion factor is equal to 0.74 because the reservation wage has been taken into consideration for this area given its high unemployment.

Specific conversion factors, calculated as a weighted average of the single component conversion factors, have been applied to investments and maintenance costs as well as to tolling and residual value (see the following Table).

Table 4.19 Conversion factors for each type of cost

Type of cost	CF	Notes
Labour	0.747	Shadow wage for not-competitive labour market
Raw Materials	1.000	Traded good: Standard Conversion Factor
Carriage	0.777	44% Labour, 19.4% Diesel Oil, 36.6% Other
Works	0.867	35% Labour, 45% Raw materials, 20% Carriage
Equipments	0.918	20% Labour, 66% Raw materials, 14% Carriage
Maintenance	0.835	58% Labour, 33.9% Raw materials, 7.7% Carriage

The economic performance indicators of the two options are summarised in the following Table and detailed flows of costs and benefits are reported on (see Tables 4.21 and 4.22). The reference social discount rate is 5.5%. The results show that both investment packages are economically viable. As shown below, Option 2 gives the best results in terms of NPV while Option 1 shows a marginally higher ERR. Option 1, the upgrading of the existing line, shows a lower Net Present Value than Option 2. The difference in net present benefits between the two options is much higher then the difference in investment costs. The volume of traffic attracted by the fully upgraded railway more than justifies the higher investment costs. This result will be further enhanced in the medium term by the charging policies for road freight transport that are likely to be implemented in the forthcoming years and that will support the modal shift from road to rail with respect to freight traffic.

	Option 1	**Option 2**
- ENPV (Millions of Euros)	938.1	1,953.3
- ERR (%)	15.1	14.9
- B/C Ratio	2.5	2.4

4.2.5 Scenario analysis

The results of the economic analysis are subject to uncertainty given the preliminary definition of some investments; the variability of expected traffic and the limited knowledge of unit costs. In this case, traffic projections are particularly important as the main objective of the project is to increase the share of rail transport along the corridor and optimise the use of the existing capacity so as to reduce the negative externalities of the road transport. Therefore, to assess the robustness of the analysis, a pessimistic scenario analysis has been carried out on both alternatives with investment costs increased by 30% and transport demand decreased by 30%.

The impact of the new scenarios on the Net Present Value and Economic Rate of Return for each Option is shown in the following Table. The ranking of the two projects remains the same, but in this pessimistic scenario the performance indicators of both options become negative, highly negative for Option 1 and marginally negative for Option 2.

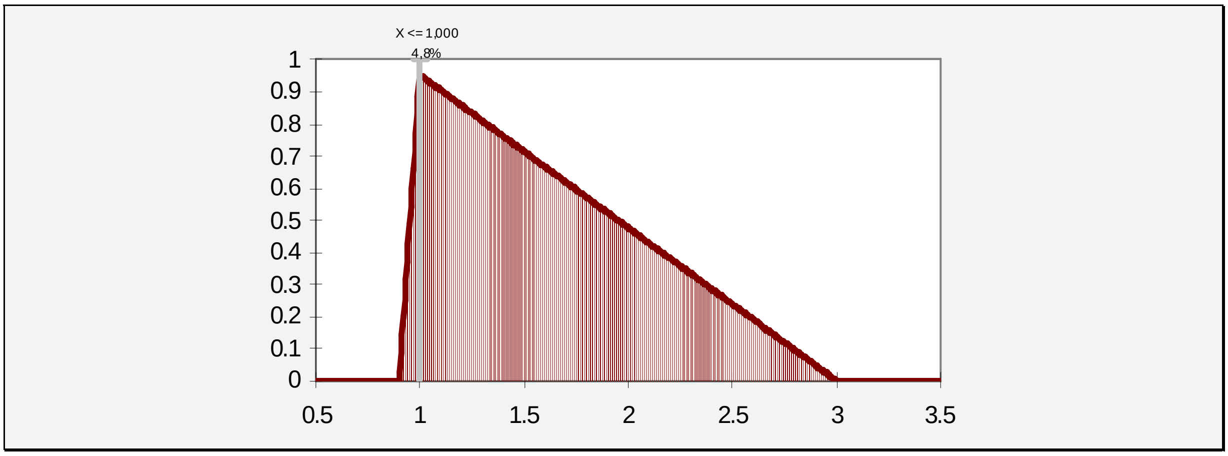
Table 4.20 Project performances in the scenario analysis

	ERR (%)	ENPV (Millions of Euros)
Option 1		
Base case	15.1	938.1
Pessimistic scenario	1.9	- 347
Option 2		
Base case	14.9	1,953.3
Pessimistic scenario	4.5	- 127

4.2.6 Risk assessment

The risk assessment is shown here on the investment costs, which emerged as one of the critical variables in the sensitivity test. The risk assessment has been carried out for the Option 2. Given the lack of reliable past data on similar investment, a three point distribution has been assumed, with the following range of values: a high estimate in which the investment costs are three times higher than the estimated 'best guess value', and a lower value in which the investment costs are 10% lower than the 'best guess value'. This highly pessimistic assumption is based on historical data, which show a tendency towards a systematic optimism bias in railway investment. Given the range of values adopted, the result is an asymmetric triangular probability distribution.

Figure 4.4 Probability distribution of investments costs. Triangular (0.9; 1; 3)



The results of the risk assessment, shown in the Figures 4.5 and 4.6, are extremely positive: the option selected is quite robust as there is just 7% probability that the ERR falls below 5.5%.

Figure 4.5 Results of the risk analysis for ERR

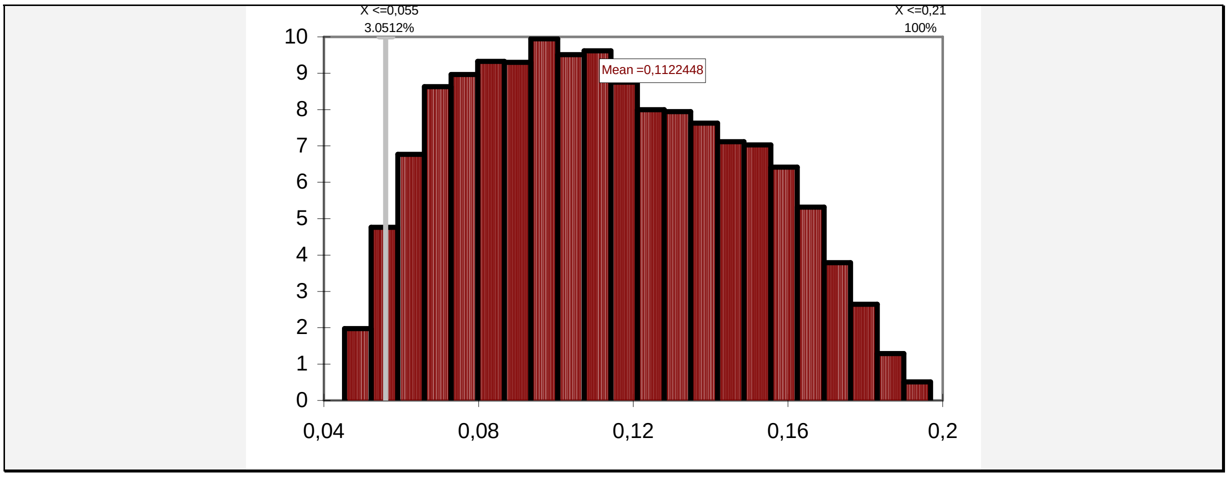
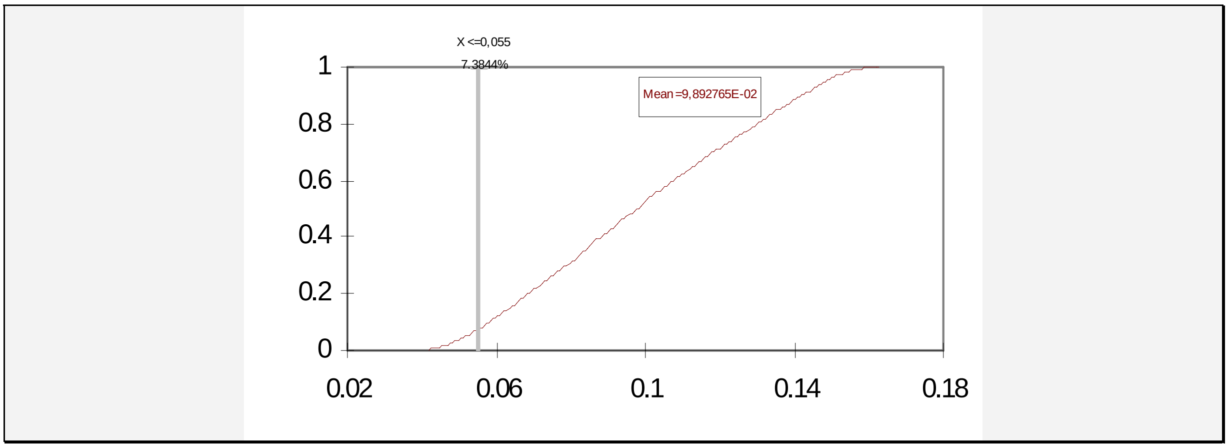


Figure 4.6 Results of the risk analysis for ERR



4.2.7 Financial analysis

The upgrading of the railway line will be completed in 3 years and the new railway is expected to be in operation after the fourth year. The upgrading of the line will be completed in both options without causing any interruption to the services already provided. The time horizon should not exceed the economically useful life of the project and in particular the lifetime of its most durable elements. In this case, the time horizon of the investment is 30 years, and given the components of the investment, the residual value beyond the evaluation period has been estimated to be 50%.

The total estimated financial costs of the upgrading is €1,660,000,000 and no major costs are further envisaged in the two existing railway stations. Yearly maintenance costs are €26,800,000 in the opening year and will remain constant throughout.

The financial inflows are related exclusively to the access charges paid by the service operator. Access charges are calculated by taking into account the marginal maintenance costs and scarcity. Average access charges for train km will be 1.4 Euros for passenger trains and 2.1 for goods trains, with the difference attributable to the different times of the day when the tracks are used by passenger and freight trains.

The financial resources are planned as follows:

- EU grant => €182,000,000;
- National Public Contribution => €1,478,000,000;

The EU Grant is calculated applying a maximum rate approved by the Operational Programme (70%) to the total eligible cost (€260,000,000). It should be noted that although the annual revenue exceeds the operating costs in some of the years, the project does not classify as 'revenue-generating' because the present (i.e. discounted) value of operating costs over the reference period is higher than the present value of project revenue.

The financial performance indicators are:

- Financial Net Present Value (investment)	FNPV(C)	€-1,320,810,000
- Financial Rate of Return (investment)	FRR(C)	-2.5%
- Financial Net Present Value (capital)	FNPV(K)	€-1,156,029,000
- Financial Rate of Return (capital)	FRR(K)	-1.9%

Table 4.21 Economic analysis *(Millions of Euros) - Railway Option 1*

	CF	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
BENEFITS																
Consumer's surplus																
Passengers		0.0	0.0	0.0	38.6	39.6	40.7	41.7	42.7	43.7	44.8	45.8	46.8	47.9	48.9	49.9
Freight		0.0	0.0	0.0	7.6	7.9	8.3	8.6	9.0	9.3	9.7	10.0	10.3	10.7	11.0	11.4
Producer's surplus																
Passengers		0.0	0.0	0.0	70.8	71.7	72.7	73.6	74.6	75.6	76.5	77.5	78.4	79.4	80.4	81.3
Freight		0.0	0.0	0.0	11.4	11.9	12.4	12.9	13.4	13.9	14.4	14.9	15.4	15.9	16.4	16.9
Government surplus																
Passengers		0.0	0.0	0.0	-23.0	-23.4	-23.8	-24.2	-24.6	-25.0	-25.4	-25.8	-26.2	-26.6	-26.9	-27.3
Freight		0.0	0.0	0.0	-6.5	-6.7	-6.9	-7.0	-7.2	-7.4	-7.6	-7.8	-8.0	-8.2	-8.3	-8.5
Externalities																
Passengers		0.0	0.0	0.0	12.7	13.0	13.3	13.6	13.9	14.2	14.5	14.8	15.1	15.4	15.7	16.0
Freight		0.0	0.0	0.0	1.0	1.0	1.0	1.0	1.0	1.0	1.1	1.1	1.1	1.1	1.1	1.1
TOTAL BENEFITS		0.0	0.0	0.0	112.6	115.0	117.7	120.2	122.8	125.3	128.0	130.5	132.9	135.6	138.3	140.8
COSTS																
Investment Costs																
Works	0.87	143.5	149.1	141.2												
Equipments	0.87	36.2	37.6	35.6												
General Expenses	0.87	22.0	22.9	21.7												
Other expenses	0.87	18.7	19.5	18.4												
Total investments costs		*220.4*	*229.1*	*216.9*												
Maintenance	0.835				7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7
TOTAL COSTS		220.4	229.1	216.9	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7
NET BENEFITS		-220.4	-229.1	-216.9	104.9	107.3	110.0	112.5	115.1	117.6	120.3	122.8	125.2	127.9	130.6	133.1

	CF	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
BENEFITS																
Consumer's surplus																
Passengers		50.9	50.9	50.9	50.9	50.9	50.9	50.9	50.9	50.9	50.9	50.9	50.9	50.9	50.9	50.9
Freight		11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7
Producer's surplus																
Passengers		82.3	82.3	82.3	82.3	82.3	82.3	82.3	82.3	82.3	82.3	82.3	82.3	82.3	82.3	82.3
Freight		17.4	17.4	17.4	17.4	17.4	17.4	17.4	17.4	17.4	17.4	17.4	17.4	17.4	17.4	17.4
Government surplus																
Passengers		-27.7	-27.7	-27.7	-27.7	-27.7	-27.7	-27.7	-27.7	-27.7	-27.7	-27.7	-27.7	-27.7	-27.7	-27.7
Freight		-8.7	-8.7	-8.7	-8.7	-8.7	-8.7	-8.7	-8.7	-8.7	-8.7	-8.7	-8.7	-8.7	-8.7	-8.7
Externalities																
Passengers		16.3	16.3	16.3	16.3	16.3	16.3	16.3	16.3	16.3	16.3	16.3	16.3	16.3	16.3	16.3
Freight		1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2
TOTAL BENEFITS		143.4	143.4	143.4	143.4	143.4	143.4	143.4	143.4	143.4	143.4	143.4	143.4	143.4	143.4	143.4
COSTS																
Investment Costs																
Works	0.87															
Equipments	0.87															
General Expenses	0.87															
Other expenses	0.87															
Total investments costs																*-330.6*
Maintenance	0.835	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7
TOTAL COSTS		7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	7.7	-322.9
NET BENEFITS		135.7	135.7	135.7	135.7	135.7	135.7	135.7	135.7	135.7	135.7	135.7	135.7	135.7	135.7	466.3

Discount Rate	5.5%
ENPV	938.1
ERR	15.1%
B/C ratio	2.5

Table 4.22 Economic analysis *(Millions of Euros) - Railway Option 2*

	CF	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
BENEFITS																
Consumer's surplus																
Passengers		0.0	0.0	0.0	102.4	104.0	105.5	107.0	108.6	110.1	111.6	113.1	114.7	116.2	117.7	119.3
Freight		0.0	0.0	0.0	19.4	19.9	20.4	20.9	21.3	21.8	22.3	22.8	23.2	23.7	24.2	24.7
Producer's surplus																
Passengers		0.0	0.0	0.0	128.3	129.9	131.5	133.1	134.7	136.3	137.9	139.5	141.1	142.7	144.3	145.9
Freight		0.0	0.0	0.0	33.9	34.7	35.5	36.3	37.1	37.9	38.6	39.4	40.2	41.0	41.8	42.6
Government surplus																
Passengers		0.0	0.0	0.0	-46.5	-47.1	-47.8	-48.4	-49.1	-49.7	-50.4	-51.0	-51.7	-52.3	-53.0	-53.6
Freight		0.0	0.0	0.0	-15.8	-16.2	-16.5	-16.8	-17.1	-17.4	-17.7	-18.0	-18.3	-18.6	-18.9	-19.2
Externalities																
Passengers		0.0	0.0	0.0	30.9	31.4	31.9	32.4	32.9	33.5	34.0	34.5	35.0	35.5	36.0	36.5
Freight		0.0	0.0	0.0	2.1	2.2	2.2	2.2	2.3	2.3	2.3	2.4	2.4	2.4	2.5	2.5
TOTAL BENEFITS		0.0	0.0	0.0	254.7	258.8	262.7	266.7	270.7	274.8	278.6	282.7	286.6	290.6	294.6	298.7
COSTS																
Investment Costs																
Works	0.87	306.8	306.8	306.8												
Equipments	0.87	85.2	85.2	85.2												
General Expenses	0.87	48.4	48.4	48.4												
Other expenses	0.87	41.0	41.0	41.0												
Total investments costs		*481.4*	*481.4*	*481.4*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*
Maintenance	0.835				22.4	22.4	22.4	22.4	22.4	22.4	22.4	22.4	22.4	22.4	22.4	22.4
TOTAL COSTS		481.4	481.4	481.4	22.4	22.4	22.4	22.4	22.4	22.4	22.4	22.4	22.4	22.4	22.4	22.4
NET BENEFITS		-481.4	-481.4	-481.4	232.3	236.4	240.3	244.3	248.3	252.4	256.2	260.3	264.2	268.2	272.2	276.3

	CF	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
BENEFITS																
Consumer's surplus																
Passengers		120.8	120.8	120.8	120.8	120.8	120.8	120.8	120.8	120.8	120.8	120.8	120.8	120.8	120.8	120.8
Freight		25.2	25.2	25.2	25.2	25.2	25.2	25.2	25.2	25.2	25.2	25.2	25.2	25.2	25.2	25.2
Producer's surplus																
Passengers		147.5	147.5	147.5	147.5	147.5	147.5	147.5	147.5	147.5	147.5	147.5	147.5	147.5	147.5	147.5
Freight		43.3	43.3	43.3	43.3	43.3	43.3	43.3	43.3	43.3	43.3	43.3	43.3	43.3	43.3	43.3
Government surplus																
Passengers		-54.3	-54.3	-54.3	-54.3	-54.3	-54.3	-54.3	-54.3	-54.3	-54.3	-54.3	-54.3	-54.3	-54.3	-54.3
Freight		-19.5	-19.5	-19.5	-19.5	-19.5	-19.5	-19.5	-19.5	-19.5	-19.5	-19.5	-19.5	-19.5	-19.5	-19.5
Externalities																
Passengers		37.0	37.0	37.0	37.0	37.0	37.0	37.0	37.0	37.0	37.0	37.0	37.0	37.0	37.0	37.0
Freight		2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
TOTAL BENEFITS		302.5	302.5	302.5	302.5	302.5	302.5	302.5	302.5	302.5	302.5	302.5	302.5	302.5	302.5	302.5
COSTS																
Investment Costs																
Works	0.87															
Equipments	0.87															
General Expenses	0.87															
Other expenses	0.87															
Total investments costs		*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*-722.2*
Maintenance	0.835	22.4	22.4	22.4	22.4	22.4	22.4	22.4	22.4	22.4	22.4	22.4	22.4	22.4	22.4	22.4
TOTAL COSTS		22.4	22.4	22.4	22.4	22.4	22.4	22.4	22.4	22.4	22.4	22.4	22.4	22.4	22.4	-699.8
NET BENEFITS		280.1	280.1	280.1	280.1	280.1	280.1	280.1	280.1	280.1	280.1	280.1	280.1	280.1	280.1	1,002.3

Discount Rate	5.5%
ENPV	1,953.3
ERR	14.9%
B/C ratio	2.4

Table 4.23 Financial return on investment (Millions of Euros)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Passenger trains	0.0	0.0	0.0	19.5	19.7	19.9	20.1	20.3	20.5	20.7	20.9	21.1	21.3	21.5	21.8
Goods trains	0.0	0.0	0.0	5.0	5.0	5.1	5.1	5.2	5.2	5.3	5.3	5.4	5.4	5.5	5.5
TOTAL REVENUES	0.0	0.0	0.0	24.5	24.7	25.0	25.2	25.5	25.7	26.0	26.2	26.5	26.7	27.0	27.3
Works	352.7	352.7	352.7												
Equipments	98.0	98.0	98.0												
General expensses	55.6	55.6	55.6												
Other expenses	47.1	47.1	47.1												
TOTAL INVESTMENTS COSTS	553.4	553.4	553.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maintenance	0.0	0.0	0.0	26.8	26.8	26.8	26.8	26.8	26.8	26.8	26.8	26.8	26.8	26.8	26.8
TOTAL OPERATING COSTS	0.0	0.0	0.0	26.8	26.8	26.8	26.8	26.8	26.8	26.8	26.8	26.8	26.8	26.8	26.8
TOTAL OUTFLOWS	553.4	553.4	553.4	26.8	26.8	26.8	26.8	26.8	26.8	26.8	26.8	26.8	26.8	26.8	26.8
CASH FLOW	-553.4	-553.4	-553.4	-2.3	-2.1	-1.8	-1.6	-1.3	-1.1	-0.8	-0.6	-0.3	-0.1	0.2	0.5

	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Passenger trains	21.8	21.8	21.8	21.8	21.8	21.8	21.8	21.8	21.8	21.8	21.8	21.8	21.8	21.8	21.8
Goods trains	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5
TOTAL REVENUES	27.3	27.3	27.3	27.3	27.3	27.3	27.3	27.3	27.3	27.3	27.3	27.3	27.3	27.3	27.3
Works															
Equipments															
General expensses															
Other expenses															
TOTAL INVESTMENTS COSTS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-830.1
Maintenance	26.8	26.8	26.8	26.8	26.8	26.8	26.8	26.8	26.8	26.8	26.8	26.8	26.8	26.8	26.8
TOTAL OPERATING COSTS	26.8	26.8	26.8	26.8	26.8	26.8	26.8	26.8	26.8	26.8	26.8	26.8	26.8	26.8	26.8
TOTAL COSTS	26.8	26.8	26.8	26.8	26.8	26.8	26.8	26.8	26.8	26.8	26.8	26.8	26.8	26.8	-803.3
CASH FLOW	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	830.6

Discount Rate	5.0
FNPV (C)	-1,320.8
FRR (C)	-2.5%

Table 4.24 Financial return on capital (Millions of Euros)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Passenger vehicles	0.0	0.0	0.0	19.5	19.7	19.9	19.5	20.3	20.5	20.7	20.9	21.1	21.3	21.5	21.8
Goods vehicles	0.0	0.0	0.0	5.0	5.0	5.1	5.0	5.2	5.2	5.3	5.3	5.4	5.4	5.5	5.5
TOTAL REVENUES	0.0	0.0	0.0	24.5	24.7	25.0	24.5	25.5	25.7	26.0	26.2	26.5	26.7	27.0	27.3
RESIDUAL VALUE															
TOTAL FINANCIAL INFLOWS	0.0	0.0	0.0	24.5	24.7	25.0	24.5	25.5	25.7	26.0	26.2	26.5	26.7	27.0	27.3
Local contribution															
Regional Contribution															
National Contribution	492.7	492.7	492.7												
Total national public contribution	492.7	492.7	492.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maintenance	0.0	0.0	0.0	26.8	26.8	26.8	26.8	26.8	26.8	26.8	26.8	26.8	26.8	26.8	26.8
Total Operating Costs	0.0	0.0	0.0	26.8	26.8	26.8	26.8	26.8	26.8	26.8	26.8	26.8	26.8	26.8	26.8
TOTAL FINANCIAL OUTFLOWS	492.7	492.7	492.7	26.8	26.8	26.8	26.8	26.8	26.8	26.8	26.8	26.8	26.8	26.8	26.8
CASH FLOW	-492.7	-492.7	-492.7	-2.3	-2.1	-1.8	-2.3	-1.3	-1.1	-0.8	-0.6	-0.3	-0.1	0.2	0.5

	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Passenger vehicles	21.8	21.8	21.8	21.8	21.8	21.8	21.8	21.8	21.8	21.8	21.8	21.8	21.8	21.8	21.8
Goods vehicles	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5
TOTAL REVENUES	27.3	27.3	27.3	27.3	27.3	27.3	27.3	27.3	27.3	27.3	27.3	27.3	27.3	27.3	27.3
RESIDUAL VALUE															830.0
TOTAL FINANCIAL INFLOWS	27.3	27.3	27.3	27.3	27.3	27.3	27.3	27.3	27.3	27.3	27.3	27.3	27.3	27.3	857.3
Local contribution															
Regional Contribution															
National Contribution															
Total national public contribution	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maintenance	26.8	26.8	26.8	26.8	26.8	26.8	26.8	26.8	26.8	26.8	26.8	26.8	26.8	26.8	26.8
Total Operating Costs	26.8	26.8	26.8	26.8	26.8	26.8	26.8	26.8	26.8	26.8	26.8	26.8	26.8	26.8	26.8
TOTAL FINANCIAL OUTFLOWS	26.8	26.8	26.8	26.8	26.8	26.8	26.8	26.8	26.8	26.8	26.8	26.8	26.8	26.8	26.8
CASH FLOW	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	830.5

Discount Rate	5.0%
FNPV (K)	-1,156.0
FRR (K)	-1.9%

Table 4.25 Financial sustainability (Millions of Euros)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
EU Grant	60.7	60.7	60.7												
Local contribution															
Regional Contribution															
National Contribution	492.7	492.7	492.7												
Total national public contribution	492.7	492.7	492.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Operating subsidies				2.3	2.1	1.8	2.3	1.3	1.1	0.8	0.6	0.3	0.1		
FINANCIAL RESOURCES	553.4	553.4	553.4	2.3	2.1	1.8	2.3	1.3	1.1	0.8	0.6	0.3	0.1	0.0	0.0
Passenger vehicles	0.0	0.0	0.0	19.5	19.7	19.9	19.5	20.3	20.5	20.7	20.9	21.1	21.3	21.5	21.8
Goods vehicles	0.0	0.0	0.0	5.0	5.0	5.1	5.0	5.2	5.2	5.3	5.3	5.4	5.4	5.5	5.5
TOTAL REVENUES	0.0	0.0	0.0	24.5	24.7	25.0	24.5	25.5	25.7	26.0	26.2	26.5	26.7	27.0	27.3
TOTAL INFLOWS	553.4	553.4	553.4	26.8	26.8	26.8	26.8	26.8	26.8	26.8	26.8	26.8	26.8	27.0	27.3
Works	352.7	352.7	352.7												
Equipments	98.0	98.0	98.0												
General expensses	55.6	55.6	55.6												
Other expenses	47.1	47.1	47.1												
TOTAL INVESTMENTS COSTS	553.4	553.4	553.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maintenance	0.0	0.0	0.0	26.8	26.8	26.8	26.8	26.8	26.8	26.8	26.8	26.8	26.8	26.8	26.8
TOTAL OPERATING COSTS	0.0	0.0	0.0	26.8	26.8	26.8	26.8	26.8	26.8	26.8	26.8	26.8	26.8	26.8	26.8
TAXATION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
TOTAL OUTFLOWS	553.4	553.4	553.4	26.8	26.8	26.8	26.8	26.8	26.8	26.8	26.8	26.8	26.8	26.8	26.9
NET CASH FLOW	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.4
CUMULATED CASH FLOW	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.7

	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
EU Grant															
Local contribution															
Regional Contribution															
National Contribution															
Total national public contribution	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Operating subsidies															
FINANCIAL RESOURCES	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Passenger vehicles	21.8	21.8	21.8	21.8	21.8	21.8	21.8	21.8	21.8	21.8	21.8	21.8	21.8	21.8	21.8
Goods vehicles	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5
TOTAL REVENUES	27.3	27.3	27.3	27.3	27.3	27.3	27.3	27.3	27.3	27.3	27.3	27.3	27.3	27.3	27.3
TOTAL INFLOWS	27.3	27.3	27.3	27.3	27.3	27.3	27.3	27.3	27.3	27.3	27.3	27.3	27.3	27.3	27.3
Works															
Equipments															
General expensses															
Other expenses															
TOTAL INVESTMENTS COSTS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maintenance	26.8	26.8	26.8	26.8	26.8	26.8	26.8	26.8	26.8	26.8	26.8	26.8	26.8	26.8	26.8
TOTAL OPERATING COSTS	26.8	26.8	26.8	26.8	26.8	26.8	26.8	26.8	26.8	26.8	26.8	26.8	26.8	26.8	26.8
TAXATION	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
TOTAL OUTFLOWS	26.9	26.9	26.9	26.9	26.9	26.9	26.9	26.9	26.9	26.9	26.9	26.9	26.9	26.9	26.9
NET CASH FLOW	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
CUMULATED CASH FLOW	1.1	1.4	1.8	2.2	2.6	2.9	3.3	3.7	4.1	4.4	4.8	5.2	5.6	5.9	6.3

4.3 Case Study: investment in an incinerator with energy recovery

4.3.1 Project definition and option analysis

A municipality proposes to build a new incineration plant to treat together urban and any special (not recycled) waste. The plant recovers energy in the form of electricity and heat with the latter used for industries and houses by means of an existing district heating net. Some recyclable waste components are selected and recovered in the plant before burning. The project takes place in a convergence region in a Country not eligible for the Cohesion Fund.

The service catchment area consists of an urban area of about 600,000 inhabitants. The design capacity of the furnace is fixed at 300,000 tons of total waste per year. The plant will take up a total area of 16,200 square meters.

The Municipality will choose a private partner by means of a BOT (Build-Operate-Transfer) tender. The BOT horizon is fixed at 30 years, including time for design, erection, start-up, and operating of the plant.

The urban solid waste of the town is currently disposed of in a landfill, now at the end of its operational life and without any possibility of capacity extension. So, the do-nothing scenario was discarded at the beginning of the project. An alternative to the present project, analysed during the feasibility study, is the construction of a new landfill. This infrastructure may be located at different sites, but all of these are rather distant from the collection sites for municipal solid waste. This alternative was deleted for economic reasons.

Finally, various plant locations were tested and different technological solutions for the incineration of waste and the production of energy were analysed, the best solution being the one assessed below.

4.3.2 Financial analysis

Although in this case study the owner of the infrastructure (the Municipality) is different from the operator (the private partner of BOT assignment), a consolidated financial analysis is conducted from the points of view of both owner and operator.

The horizon of the analysis is assumed to be 30 years, which also coincides with the horizon of the BOT. The financial discount rate is 5%, expressed in real terms. In the analysis, constant prices are used, and corrections are entered for changes in the relative prices. Such adjustments are undertaken by assuming an average annual inflation rate of 2.0% and also by taking into account factors of growth or marginal decrease in prices of some services and some operating costs (see below). A separate analysis will check the sensitivity of the project to relative price changes.

The production of the incinerator, assumed to be constant over the analysis horizon, is 270,000 t/y (tons per year) of urban waste plus 13,500 t/y of other waste deriving from commercial activities and/or handicrafts existing in the town. The treatment of the latter wastes is more expensive than that of the urban wastes, but their incineration produces more energy per burnt ton.

The cost of the investment, at current prices, is set at €190,809,000[64], broken-down as shown in table 3.26. The investment realization (design, licensing, erection) lasts 3 years. The start-up phase, lasting 6 months, will begin in the fourth year, when the production is assumed to be half of the regime's production.

The components with a short lifetime (50% of the equipment costs) will be replaced once in the analysis horizon, at the end of life (15 years[65]). The calculation is carried out by introducing, for simplicity's sake, the whole replacement cost of the aforementioned components in the nineteenth year[66](€72,383,000). The plant site will be cleared and decontaminated at the end of the operational period, set at the project

64 All figures are net of VAT.

65 In accordance with the technical data from literature.

66 The nineteenth year has been determined taking into account three years of plant construction plus 15 years of economic life.

horizon. These costs, allocated in the last year (30th) of the analysis period, are assumed to be €32, 697,000.

Table 4.26 Distribution of the investment cost categories in time horizon (thousand of Euros)

Investment costs (current prices)	Total	1	2	3
Feasibility study, design, work management, licensing, tender costs etc.	8,796	6,980	0	1,816
Land expropriation	2,242	1,485	757	0
Buildings	75,143	0	57,342	17,801
Equipments (furnaces, boiler, electric generator, controls…)	104,628	0	41,355	63,273
Total investment	**190,809**	**8,465**	**99,454**	**82,890**

The investment is financed[67] by public funds (ERDF and national or regional government funds) and by funds provided by the private partner. According to the maximum Community contribution (see below)[68], the requested co-financing EU grant is €58,580,000 (30.7% of total investment costs without VAT). An amount of €82,585,000 (43.3% of total investment costs without VAT) is provided by a national government fund. The private financing (€125,842,000) is given by private equity (€52,921,000) and by loan (€72,921,000). The loan has a 5% interest rate with an amortization period of 10 years.

The operation and maintenance (O&M) costs, excluding VAT (when applicable), of the infrastructure (running normally) are as follows:

- labour costs: 12 skilled employees (at 36,000 €/person per year) and 58 non-skilled employees (at 21,600 €/person per year) are assumed; an overall real growth rate of 0.4% per year is set for the labour cost;
- energy and water service costs: the gas consumed by the plant in a typical year reaches a cost of €185,000, with a real growth rate of 1.1% per year[69]; the electricity consumed in the plant reaches a net cost of €429,000, with a real growth rate of 0.9% per year; the cost of the drinking and waste water service is 6,000 €/y, with a real growth rate of 0.5% per year;
- other costs: the materials utilised by the plant have a cost of €260,000 per year; the intermediate services and goods have an annual cost of €1,299,000;
- elimination of ash and slag waste: the yearly cost is €2,697,000.

The financial inflows come from the residual value of the investment, from the price of the waste treatment and from the energy recovered (electricity and heat). They are as follows (amounts without VAT):

- residual value of the investment: the residual value, over the 27 years of life of the plant[70], is set to be 3.1% of the initial costs of the long life parts of the investment plus 1.7% of the costs of the replaced components (short life parts)[71]. This revenue (€8,990 not discounted) is allocated in the last year (30th) of the analysis period;
- waste treatment revenues: the price of treatment paid by final users is fixed at €12 per ton of urban waste and €18 per ton of other waste, an overall modest decreasing real rate of -0.5% per year is set for the prices of the waste treatments;
- energy revenues: the recovered electricity is sold with a price of 0.07 €/kWh, giving, in the operational condition of the incinerator, a revenue of €47.29 per ton of total wastes burned; a modest real growth

[67] The sum to be financed is the cost of investment at current prices without VAT, because the amount of this indirect tax will be compensated in the course of the operation period.
[68] The EU contribution in this case study is slightly less than the maximum community contribution.
[69] This should be understood as a relative price change.
[70] At the end of the horizon time, the operative life of the plant is equal to the analysis horizon minus the construction time: 30 – 3 = 27 years.
[71] The depreciation factors introduced in the calculation of residual value are founded upon an engineering estimate, based on the experience of the old incinerators and similar plants.

rate of 0.6% per year is assumed for this price; the recovered heat gives, in the operational condition of the incinerator, a revenue of €27.02 per ton of total wastes burned; a real growth rate of 0.7% per year is assumed for this price.

For simplicity's sake, the income potentially deriving from the recovered recyclable materials is not taken into account in the project analysis because this income is negligible[72].

Table 4.27 Sources of finance (current prices) over the time horizon (thousand of Euros):

Finance sources	Total	1	2	3	4 - 18	19	20 – 30
Public funds							
Investment financing							
EU grant	58,580	1,381	29,444	27,753	0	0	0
National grant	82,585	4,162	45,674	32,749	0	0	0
Total	141,165	5,545	75,118	60,502	0	0	0
Private funds							
Investment and operation financing							
Equity	16, 729	1,576	7,727	7,182	244	0	0
Loan	36,729	1,576	17,727	17,182	244	0	0
Total	53,458	3,152	25,454	24,364	488	0	0
Replacement of short life components financing							
Equity	36,192	0	0	0	0	36,192	0
Loan	36,192	0	0	0	0	36,192	0
Total	72,384	0	0	0	0	72,384	0

The financial performance indicators (before taxes) are:

- Financial Net Present Value (investment) FNPV(C) €-71,877,422
- Financial Rate of Return (investment) FRR(C) 0.7%
- Financial Net Present Value (capital) FNPV(K) €-16,059,396
- Financial Rate of Return (capital) FRR(K) 3.7%

With regard to the financial sustainability of the project the cumulative cash flow is always positive with a minimum value of about €1,066,000 in the fourth year.

The amount to which the co-financing rate of the priority axis applies is for this project equal to €78,106,666. This is determined by multiplying the project's eligible cost (in this case €184,649,330 at current price) by the funding-gap rate (42.3%). Assuming the co-financing rate for the priority axis is equal to 75%, the EU contribution is then found to be equal to €58,580,000.

4.3.3 Economic analysis

The conversion factors (CF) for the present case study are shown in Table 4.28. The notes accompanying this table outline the criteria assumed in setting or calculating the CF's.

The conversion factors allow for the calculation of the social costs due to the investments, the running costs and the replacement of 'short' life equipment (see financial analysis), the social benefits due to the residual value of the investment, and the revenues of the waste treatment and energy production. The

[72] The market for these goods (at the moment of the analysis) is not well-developed in the country in which the incinerator will operate. Cautiously, the possible market growth in the field of recycling of secondary goods, which in the future could allow for an additional gain for the plant operator, is not taken into account.

economic analysis also needs to consider the externalities (positive and/or negative) that are not accounted for in the converted financial inputs and outputs quoted above.

Table 4.28 Conversion factors adopted in economic analysis

Type of cost	CF	Notes
Standard conversion factor	0.96	SCF
Skilled labour	1.00	The labour market is assumed to be competitive
Unskilled labour	0.60	Shadow wage for not-competitive labour market[73]
Land	1.33	SCF x local market price (40% higher than prices paid for expropriation)
Building erection (constructions)	0.70	40% construction materials (CF=SCF), 5% skilled labour, 45% unskilled labour, 10% profit (CF=0)
Materials (Chemicals, reagents, etc.)	0.96	Traded good; CF=SCF
Equipment	0.60	10% construction materials (CF=SCF), 5% skilled labour, 75% unskilled labour, 10% profit (CF=0)
Energy (electricity, heat and gas)	0.96	SCF
Water services	0.96	SCF
Waste treatment service	0.96	SCF
Feasibility study, design, etc.	1.00	100% skilled labour
Engineering, geological and administrative services	1.00	100% skilled labour
Machinery, manufactured goods, carpentry, etc.	0.670	50% unskilled labour, 50% equipment
Investment (weighted)	0.705	4,7% feasibility study, design, etc., 1,2% land, 39,5% buildings, 54,6% machinery, manufactured goods, carpentry, etc.
Replacement of short life components	0.670	100% machinery, manufactured goods, carpentry, etc.
Residual value	0.705	100% investment (weighted)
Remediation and decontamination (weighted)	0.676	10% skilled labour; 79,8% unskilled labour, 10,2% materials
Intermediate services and goods	0.718	10% skilled labour; 50% unskilled labour, 30% machinery, manufactured goods, carpentry, etc., 10% materials
Elimination costs of ash and slag waste	0.673	5% skilled labour; 80% unskilled labour, 10% energy, 5% materials

First, the negative externalities are taken into account: the cost of noise, odours, aesthetic and landscape impact.

The negative external impact of the normal operation of the incinerator is valued by means of a hedonic price, assuming the real estate in the nearby area is depreciated. The hedonic price is assumed to be equal to the difference between the market value of the rent for the buildings in the area before the incinerator was built and the value of the rent after the incinerator was built, this difference then corrected by an appropriate CF. Assuming a mean building density in the impact area (an area, centred on plant, of about 700 m of radius) of 0.50 m^3/m^2 a depreciation of 30% of a yearly rent of about 52.2 €/m^2 (corrected) leads to a hedonic price of €340,000 per year.

Next, the positive externalities deriving from the waste treatment and from the energy recovery are taken into account: i) the first of these is cautiously considered to be absorbed in the re-valued revenues of the waste treatment[74]; ii) the second is assumed to be equal to the benefit due to the CO_2 avoided by burning biological wastes, excluding plastic and other petrol by-products[75], in order to generate electricity and heat.

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[73] The unskilled labour conversion factor is calculated on the basis of the shadow wage, as follows: *SW = FW (1-u) (1-t),* were *SW* is the shadow wage, *FW* in the wage assumed in the financial analysis, *u* is local (regional) unemployment rate and *t* is the rate of the social security and relevant taxes. In the case study, set *u*=12% and t=*32*%, the *CF= (SW/FW)* is equal to 0.60.

[74] Alternatively, this benefit could be directly quantified by means of the morbidity avoided, subtracting from this the revenue (corrected by the own CF) deriving from the waste collecting and treatment fares or by means of the land consumption for an alternative waste disposal in landfill avoided.

[75] Because the plastic and other recyclable wastes are selected and recovered in the plant, the burnt plastic fraction is low (not more than 25%).

The shadow price of the CO_2 avoided is set by referring to the value of the Green Certificates[76] and/or to the amount of overall incentives, which other countries have adopted[77], and which could well represent the overall environmental value of renewable energy generated. Under this assumption, a shadow price of 0.15 €/kWh is set for the electrical energy recovered from non-plastic wastes (75% of total produced electricity) and a corresponding value for the heat recovered.

The social discount rate is 3.5%. From the cash flows, the following indices are obtained:

- Economic Net Present Value ENPV €259,891,057
- Economic Rate of Return ERR 15.1%
- B/C Ratio B/C 2.0

4.3.4 Risk assessment

In order to provide a risk assessment of the incinerator project, as required by the EU regulations, the CBA includes a sensitivity analysis and a subsequent risk analysis.

The most sensitive variable is the amount of waste (tons per year) burnt in the incinerator, set as a constant in the base case. The ranges of the financial and economic indicators, due to the different assumed values for the yearly growth rate of the treated wastes, are shown in Table 4.29 (figures in thousands of Euros).

Table 4.29 Hypothesis on yearly growth rate – Thousands of Euros

Yearly production growth rate	-1%	0% (baseline)	+1%
FNPV(C)	-95,487 (-33%)	-71,877	-43,473 (+39%)
FNPV(K)	-37,096 (-131%)	-16,059	9,314 (+158%)
ENPV	193,262 (-26%)	259,891	340,507 (+31%)

As an example, Table 4.30 illustrates, with reference to the FNPV(C), the results of the sensitivity analysis for 1% of variation (positive and negative) of the other relevant variables of the CBA model, while Table 4.31 shows the results of the sensitivity analysis applied to the ENPV.

Table 4.30 Financial sensitivity analysis for FNPV(C)

Variable	±1%	Sensitivity judgement
Investment	2.8	High
Personnel (labour cost)	0.4	High
Remediation and decontamination	0.1	Low
Gas input price	0.1	Low
Electricity input price	0.1	Low
Materials	0.1	Low
Intermediate services & goods	0.3	Medium
Elimination of ash and slag waste	0.6	High
Municipal waste treatment price	0.7	High
Other waste treatment price	0.1	Low
Electricity	1.7	High
Heat	1.0	High

[76] A Green Certificate also known as Renewable Energy Certificates (RECs), or Green Tags, Renewable Energy Credits, or Tradable Renewable Certificates (TRCs) is a tradable commodity proving that certain electricity is generated using renewable energy sources. Typically one certificate represents generation of 1 Megawatthour (or 1,000 kWh) of electricity. The certificates can be traded separately from the energy produced.

[77] Among others, in Europe minimum price systems are currently being applied to a large extent; some other countries apply tax exemption credits for renewable energy; other ones a quota model.

The critical variables (see above) are: investment costs and electricity and heat selling prices, municipal waste treatment price, labour costs, costs of elimination of ash and slag waste, together with the yearly rate of growth in production.

Table 4.31 Economic sensitivity analysis for ENPV

Variable	±1%	Sensitivity judgement
Investment	0.6	High
Personnel	0.1	Low
Remediation and decontamination	0.0	Low
Gas input price	0.0	Low
Electricity input price	0.0	Low
Materials	0.0	Low
Intermediate services & goods	0.1	Low
Elimination of ash and slag waste	0.1	Low
Waste treatment income	0.2	Medium
Other waste treatment income	0.0	Low
Electricity	0.6	High
Heat	0.3	High
Local impact	0.0	Low
CO_2 avoided	0.9	High

Based on the sensitivity judgment, investment costs, electricity and heat selling price, the value given to the benefit of the CO_2 avoided, together with the yearly growth rate for production (see above), are critical variables for the social analysis.

Table 4.32, obtained by the same method used for the sensitivity analysis above, shows that the sensitivity of performance indices to the variation of the yearly rates set out for some CBA variables, is always very low.

The risk analysis for the incinerator project has been carried out by assigning an appropriate probability distribution to the critical variable, cautiously identified in this case study, with the yearly production growth rate and the other variables classified as 'High' or 'Medium' sensitivity in the above tables. Table 4.33 and Figure 4.7, below, show the hypotheses set for the probability distributions of the variables.

Table 4.32 Sensitivity analysis on the variable growth rates

	Sensitivity of the FNPV(C) ±	Sensitivity of the ENPV ±
Growth rate	1%	1%
Labour cost growth rate	0.03%	0.01%
Gas input price growth rate	0.01%	0.00%
Electricity input price growth rate	0.02%	0.01%
Waste treatment prices growth rate	0.06%	0.02%
Produced electricity price growth rate	0.16%	0.06%
Produced heat price growth rate	0.11%	0.04%

Table 4.33 Risk analysis: variable probability distributions

Variable	Range	Distribution	Notes
Yearly production growth rate	-0,5% ÷ +0,1%	Triangular	
Investment	145,6 ÷ 236,6 M€	Rectangular	See figure 3.7
Personnel (labour cost)	-5% ÷ +15%	Triangular	
Elimination of ash and slag waste	2.500 ÷ 3000 m€/y	Triangular	
Municipal waste treatment price	11 ÷ 14 €/t	Triangular	
Electricity selling revenue	32 ÷ 62 €/t	Gaussian	MV = 47,29; SD = 4,73
Heat selling revenue	18 ÷ 36 €/t	Gaussian	MV = 27,02; SD = 4,05
CO_2 avoided	0,13 ÷ 0,18 €/kWh	Triangular	

Note: MV = Mean value; SD = Standard deviation.

As a result, the probability distributions for the financial and economic performance indicators are calculated using the Monte-Carlo method and specialist software. Figure 4.8 shows, as an example, the probability distribution obtained for the ENPV. In Table 4.34, other characteristic probability parameters are given (in thousands of Euros and percentages).

Table 4.34 Risk analysis: characteristic probability parameters of the performance indicators

	FNPV(C)	ENPV
Reference value (base case)	-71,877	259,680
Mean	-74,353	259,842
Median	-71,920	260,595
Standard deviation	26,339	29,640
Minimum value	-159,475	163,406
Maximum value	-82,188	360,235
Probability of the parameters being not higher than the reference value	-71,877	259,680

Figure 4.7 Probability distribution assumed for the investment cost

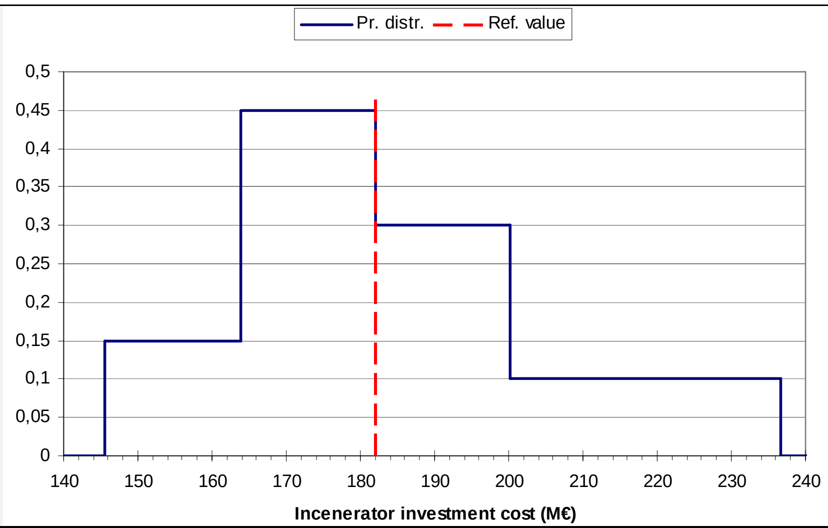

Figure 4.8 Calculated probability distribution of ENPV

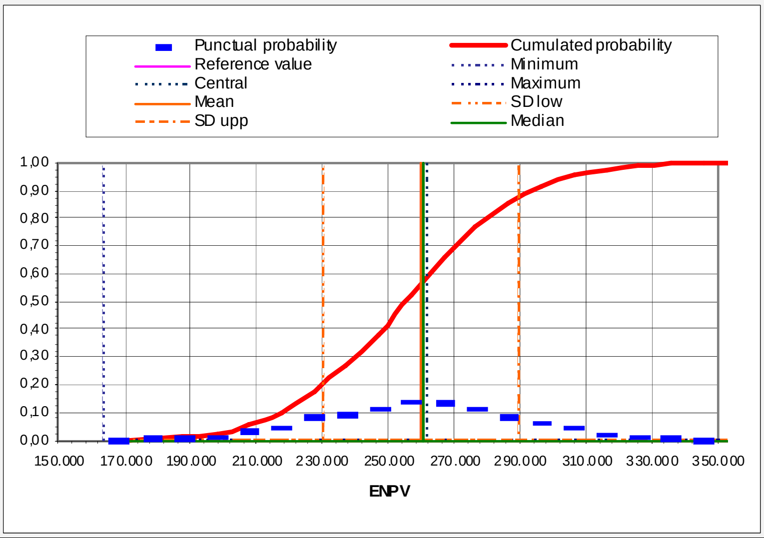

Table 4.35 Financial return on investment (thousands of Euros)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Municipal waste	0	0	0	1,719	3,489	3,541	3,593	3,647	3,701	3,756	3,812	3,869	3,927	3,985	4,045
Other waste	0	0	0	129	262	266	270	274	278	282	286	290	295	299	303
Electricity	0	0	0	3,716	7,625	7,824	8,029	8,238	8,454	8,674	8,901	9,134	9,372	9,617	9,868
Heat	0	0	0	2,132	4,379	4,498	4,620	4,745	4,874	5,006	5,142	5,282	5,425	5,572	5,724
SALES	0	0	0	7,695	15,755	16,128	16,511	16,904	17,307	17,719	18,142	18,575	19,019	19,473	19,940
Labour cost	0	0	0	1,859	1,905	1,952	2,001	2,051	2,102	2,154	2,208	2,263	2,319	2,377	2,436
Gas	0	0	0	105	216	223	229	237	244	252	259	268	276	285	293
Eectrical energy	0	0	0	241	495	510	525	540	556	572	589	606	624	642	660
Water services	0	0	0	3	7	7	7	7	8	8	8	8	8	9	9
Raw material	0	0	0	141	287	293	299	305	311	317	323	330	336	343	350
Intermediate services and goods	0	0	0	703	1,434	1,463	1,492	1,522	1,552	1,584	1,615	1,647	1,680	1,714	1,748
Elimination of ash and slag waste	0	0	0	1,460	2,978	3,037	3,098	3,160	3,223	3,288	3,353	3,420	3,489	3,559	3,630
TOTAL OPERATING COSTS	0	0	0	4,511	7,322	7,485	7,651	7,821	7,995	8,173	8,355	8,541	8,732	8,927	9,126
Feasibility study, tender costs etc.	6,980	0	1,816	0	0	0	0	0	0	0	0	0	0	0	0
Land expropriation	1,485	757	0	0	0	0	0	0	0	0	0	0	0	0	0
Buildings	0	57,342	17,801	0	0	0	0	0	0	0	0	0	0	0	0
Equipments	0	41,355	63,273	0	0	0	0	0	0	0	0	0	0	0	0
Investments costs	8,465	99,454	82,889	0	0	0	0	0	0	0	0	0	0	0	0
Replacement costs	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Remediation and decontamination costs	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Residual value	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other investment items	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL INVESTMENT COSTS	8,465	99,454	82,889	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL OUTFLOWS	8,465	99,454	82,889	4,511	7,322	7,485	7,651	7,821	7,995	8,173	8,355	8,541	8,732	8,927	9,126
NET CASH FLOW	-8,465	-99,454	-82,889	3,184	8,433	8,644	8,861	9,083	9,311	9,546	9,786	10,033	10,286	10,547	10,814

	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Municipal waste	4,105	4,166	4,228	4,291	4,355	4,420	4,486	4,553	4,621	4,690	4,759	4,830	4,902	4,975	5,049
Other waste	308	313	317	322	327	332	336	342	347	352	357	362	368	373	379
Electricity	10,126	10,390	10,662	10,940	11,226	11,519	11,820	12,129	12,446	12,771	13,104	13,447	13,798	14,158	14,528
Heat	5,879	6,038	6,202	6,371	6,544	6,721	6,904	7,091	7,283	7,481	7,684	7,893	8,107	8,327	8,553
SALES	20,418	20,907	21,409	21,924	22,451	22,992	23,546	24,114	24,696	25,293	25,905	26,532	27,175	27,833	28,509
Labour cost	2,496	2,559	2,622	2,687	2,754	2,823	2,893	2,965	3,039	3,115	3,192	3,272	3,354	3,436	3,523
Gas	303	312	322	332	342	353	364	375	387	399	411	424	438	451	465
Eectrical energy	680	700	720	741	763	785	808	831	856	881	906	933	960	988	1,017
Water services	9	9	9	10	10	10	10	11	11	11	11	12	12	12	13
Raw material	357	364	371	379	386	394	402	410	418	427	435	444	453	462	471
Intermediate services and goods	1,783	1,819	1,855	1,892	1,930	1,969	2,008	2,048	2,089	2,131	2,174	2,217	2,262	2,307	2,353
Elimination of ash and slag waste	3,702	3,777	3,852	3,929	4,008	4,088	4,170	4,253	4,338	4,425	4,513	4,604	4,696	4,790	4,885
TOTAL OPERATING COSTS	9,330	9,539	9,752	9,970	10,193	10,421	10,655	10,894	11,138	11,388	11,644	11,905	12,173	12,446	12,727
Feasibility study, tender costs etc.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Land expropriation	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Buildings	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Equipments	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Investments costs	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Replacement costs	0	0	0	72,383	0	0	0	0	0	0	0	0	0	0	0
Remediation and decontamination costs	0	0	0	0	0	0	0	0	0	0	0	0	0	0	32,967
Residual value	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-8,990
Other investment items	0	0	0	72,383	0	0	0	0	0	0	0	0	0	0	23,977
TOTAL INVESTMENT COSTS	0	0	0	72,383	0	0	0	0	0	0	0	0	0	0	23,977
TOTAL OUTFLOWS	9,330	9,539	9,752	82,353	10,193	10,421	10,655	10,894	11,138	11,388	11,644	11,905	12,173	12,446	36,704
NET CASH FLOW	11,088	11,369	11,658	-60,429	12,258	12,570	12,891	13,220	13,558	13,905	14,261	14,627	15,002	15,388	-8,195

Discount Rate	5.0%
FNPV (C)	-71,877.4
FRR (C)	0.7%
Funding Gap Ratio	0.42

Table 4.36 Financial return on capital *(thousands of Euros)*

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Municipal waste	0	0	0	1,719	3,489	3,541	3,593	3,647	3,701	3,756	3,812	3,869	3,927	3,985	4,045
Other waste	0	0	0	129	262	266	270	274	278	282	286	290	295	299	303
Electricity	0	0	0	3,716	7,625	7,824	8,029	8,238	8,454	8,674	8,901	9,134	9,372	9,617	9,868
Heat	0	0	0	2,132	4,379	4,498	4,620	4,745	4,874	5,006	5,142	5,282	5,425	5,572	5,724
SALES	0	0	0	7,695	15,755	16,128	16,511	16,904	17,307	17,719	18,142	18,575	19,019	19,473	19,940
RESIDUAL VALUE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL INFLOWS	0	0	0	7,695	15,755	16,128	16,511	16,904	17,307	17,719	18,142	18,575	19,019	19,473	19,940
Labour cost	0	0	0	1,859	1,905	1,952	2,001	2,051	2,102	2,154	2,208	2,263	2,319	2,377	2,436
Gas	0	0	0	105	216	223	229	237	244	252	259	268	276	285	293
Eectrical energy	0	0	0	241	495	510	525	540	556	572	589	606	624	642	660
Water services	0	0	0	3	7	7	7	7	8	8	8	8	8	9	9
Raw material	0	0	0	141	287	293	299	305	311	317	323	330	336	343	350
Intermediate services and goods	0	0	0	703	1,434	1,463	1,492	1,522	1,552	1,584	1,615	1,647	1,680	1,714	1,748
Elimination of ash and slag waste	0	0	0	1,460	2,978	3,037	3,098	3,160	3,223	3,288	3,353	3,420	3,489	3,559	3,630
TOTAL OPERATING COSTS	0	0	0	4,511	7,322	7,485	7,651	7,821	7,995	8,173	8,355	8,541	8,732	8,927	9,126
Bonds and other financial resources	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
EIB loans	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other loans	79	965	1,824	1,836	1,653	1,469	1,286	1,102	918	735	551	367	184	0	0
INTEREST	79	965	1,824	1,836	1,653	1,469	1,286	1,102	918	735	551	367	184	0	0
Bonds and other financial resources	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
EIB loans	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other loans	0	0	0	0	3,673	3,673	3,673	3,673	3,673	3,673	3,673	3,673	3,673	3,673	0
LOANS REIMBOURSEMENT	0	0	0	0	3,673	3,673	3,673	3,673	3,673	3,673	3,673	3,673	3,673	3,673	0
PRIVATE EQUITY	1,576	7,727	7,182	244	0	0	0	0	0	0	0	0	0	0	0
TOTAL NATIONAL PUBLIC CONTRIBUTION	4,162	45,674	32,749	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL OUTFLOWS	5,817	54,366	41,755	6,591	12,648	12,627	12,609	12,596	12,586	12,581	12,579	12,582	12,589	12,600	9,126
NET CASH FLOW	-5,817	-54,366	-41,755	1,104	3,107	3,502	3,902	4,308	4,720	5,138	5,562	5,993	6,430	6,874	10,814

	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Municipal waste	4,105	4,166	4,228	4,291	4,355	4,420	4,486	4,553	4,621	4,690	4,759	4,830	4,902	4,975	5,049
Other waste	308	313	317	322	327	332	336	342	347	352	357	362	368	373	379
Electricity	10,126	10,390	10,662	10,940	11,226	11,519	11,820	12,129	12,446	12,771	13,104	13,447	13,798	14,158	14,528
Heat	5,879	6,038	6,202	6,371	6,544	6,721	6,904	7,091	7,283	7,481	7,684	7,893	8,107	8,327	8,553
SALES	20,418	20,907	21,409	21,924	22,451	22,992	23,546	24,114	24,696	25,293	25,905	26,532	27,175	27,833	28,509
RESIDUAL VALUE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8,990
TOTAL INFLOWS	20,418	20,907	21,409	21,924	22,451	22,992	23,546	24,114	24,696	25,293	25,905	26,532	27,175	27,833	37,498
Labour cost	2,496	2,559	2,622	2,687	2,754	2,823	2,893	2,965	3,039	3,115	3,192	3,272	3,354	3,436	3,523
Gas	303	312	322	332	342	353	364	375	387	399	411	424	438	451	465
Eectrical energy	680	700	720	741	763	785	808	831	856	881	906	933	960	988	1,017
Water services	9	9	9	10	10	10	10	11	11	11	11	12	12	12	13
Raw material	357	364	371	379	386	394	402	410	418	427	435	444	453	462	471
Intermediate services and goods	1,783	1,819	1,855	1,892	1,930	1,969	2,008	2,048	2,089	2,131	2,174	2,217	2,262	2,307	2,353
Elimination of ash and slag waste	3,702	3,777	3,852	3,929	4,008	4,088	4,170	4,253	4,338	4,425	4,513	4,604	4,696	4,790	4,885
TOTAL OPERATING COSTS	9,330	9,539	9,752	9,970	10,193	10,421	10,655	10,894	11,138	11,388	11,644	11,905	12,173	12,446	12,727
Bonds and other financial resources	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
EIB loans	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other loans	0	0	0	0	1,810	1,629	1,448	1,267	1,086	905	724	543	362	181	0
INTEREST	0	0	0	0	1,810	1,629	1,448	1,267	1,086	905	724	543	362	181	0
Bonds and other financial resources	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
EIB loans	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other loans	0	0	0	0	3,619	3,619	3,619	3,619	3,619	3,619	3,619	3,619	3,619	3,619	0
LOANS REIMBOURSEMENT	0	0	0	0	3,619	3,619	3,619	3,619	3,619	3,619	3,619	3,619	3,619	3,619	0
PRIVATE EQUITY	0	0	0	36,192	0	0	0	0	0	0	0	0	0	0	0
TOTAL NATIONAL PUBLIC CONTRIBUTION	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL OUTFLOWS	9,330	9,539	9,752	46,162	15,622	15,669	15,722	15,780	15,843	15,912	15,987	16,067	16,154	16,246	12,727
NET CASH FLOW	11,088	11,369	11,658	-24,238	6,829	7,323	7,824	8,334	8,853	9,381	9,918	10,464	11,021	11,587	24,772

Discount Rate	5.0%
FNPV (K)	-16,059.4
FRR (K)	3.7%

Table 4.37 Financial sustainability *(thousands of Euros)*

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
PRIVATE EQUITY	1,576	7,727	7,182	244	0	0	0	0	0	0	0	0	0	0	0
TOTAL NATIONAL PUBLIC CONTRIBUTION	4,162	45,674	32,749	0	0	0	0	0	0	0	0	0	0	0	0
EU GRANT	1,383	29,444	27,753	0	0	0	0	0	0	0	0	0	0	0	0
LOANS	1,576	17,727	17,182	244	0	0	0	0	0	0	0	0	0	0	0
TOTAL FINANCIAL RESOURCES	8,697	100,572	84,866	488	0	0	0	0	0	0	0	0	0	0	0
Municipal waste	0	0	0	1,719	3,489	3,541	3,593	3,647	3,701	3,756	3,812	3,869	3,927	3,985	4,045
Other waste	0	0	0	129	262	266	270	274	278	282	286	290	295	299	303
Electricity	0	0	0	3,716	7,625	7,824	8,029	8,238	8,454	8,674	8,901	9,134	9,372	9,617	9,868
Heat	0	0	0	2,132	4,379	4,498	4,620	4,745	4,874	5,006	5,142	5,282	5,425	5,572	5,724
SALES	0	0	0	7,695	15,755	16,128	16,511	16,904	17,307	17,719	18,142	18,575	19,019	19,473	19,940
TOTAL INFLOWS	8,697	100,572	84,866	8,183	15,755	16,128	16,511	16,904	17,307	17,719	18,142	18,575	19,019	19,473	19,940
Labour cost	0	0	0	1,859	1,905	1,952	2,001	2,051	2,102	2,154	2,208	2,263	2,319	2,377	2,436
Gas	0	0	0	105	216	223	229	237	244	252	259	268	276	285	293
Eectrical energy	0	0	0	241	495	510	525	540	556	572	589	606	624	642	660
Water services	0	0	0	3	7	7	7	7	8	8	8	8	8	9	9
Raw material	0	0	0	141	287	293	299	305	311	317	323	330	336	343	350
Intermediate services and goods	0	0	0	703	1,434	1,463	1,492	1,522	1,552	1,584	1,615	1,647	1,680	1,714	1,748
Elimination of ash and slag waste	0	0	0	1,460	2,978	3,037	3,098	3,160	3,223	3,288	3,353	3,420	3,489	3,559	3,630
TOTAL OPERATING COSTS	0	0	0	4,511	7,322	7,485	7,651	7,821	7,995	8,173	8,355	8,541	8,732	8,927	9,126
Feasibility study, tender costs etc.	6,980	0	1,816	0	0	0	0	0	0	0	0	0	0	0	0
Land expropriation	1,485	757	0	0	0	0	0	0	0	0	0	0	0	0	0
Buildings	0	57,342	17,801	0	0	0	0	0	0	0	0	0	0	0	0
Equipments	0	41,355	63,273	0	0	0	0	0	0	0	0	0	0	0	0
Investments costs	8,465	99,454	82,889	0	0	0	0	0	0	0	0	0	0	0	0
Replacement costs	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Remediation and decontamination costs	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Residual value															
Other investment items	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL INVESTMENT COSTS	8,465	99,454	82,889	0	0	0	0	0	0	0	0	0	0	0	0
Bonds and other financial resources	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
EIB loans	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other loans	79	965	1,824	1,836	1,653	1,469	1,286	1,102	918	735	551	367	184	0	0
INTEREST	79	965	1,824	1,836	1,653	1,469	1,286	1,102	918	735	551	367	184	0	0
Bonds and other financial resources	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
EIB loans	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other loans	0	0	0	0	3,673	3,673	3,673	3,673	3,673	3,673	3,673	3,673	3,673	3,673	0
LOANS REIMBOURSEMENT	0	0	0	0	3,673	3,673	3,673	3,673	3,673	3,673	3,673	3,673	3,673	3,673	0
TAXATION	153	153	153	769	1,575	1,613	1,651	1,690	1,731	1,772	1,814	1,857	1,902	1,947	1,994
TOTAL OUTFLOWS	8,697	100,572	84,866	7,117	14,223	14,239	14,260	14,286	14,317	14,353	14,393	14,439	14,490	14,547	11,120
NET CASH FLOW	0	0	0	1,066	1,531	1,889	2,251	2,618	2,990	3,366	3,748	4,136	4,528	4,926	8,820
CUMULATED TOTAL CASH FLOW	0	0	0	1,066	2,597	4,486	6,737	9,355	12,344	15,710	19,459	23,594	28,122	33,048	41,868

>>> *continues*

	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
PRIVATE EQUITY	0	0	0	36,192	0	0	0	0	0	0	0	0	0	0	0
TOTAL NATIONAL PUBLIC CONTRIBUTION	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
EU GRANT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LOANS	0	0	0	36,192	0	0	0	0	0	0	0	0	0	0	0
TOTAL FINANCIAL RESOURCES	0	0	0	72,384	0	0	0	0	0	0	0	0	0	0	0
Municipal waste	4,105	4,166	4,228	4,291	4,355	4,420	4,486	4,553	4,621	4,690	4,759	4,830	4,902	4,975	5,049
Other waste	308	313	317	322	327	332	336	342	347	352	357	362	368	373	379
Electricity	10,126	10,390	10,662	10,940	11,226	11,519	11,820	12,129	12,446	12,771	13,104	13,447	13,798	14,158	14,528
Heat	5,879	6,038	6,202	6,371	6,544	6,721	6,904	7,091	7,283	7,481	7,684	7,893	8,107	8,327	8,553
SALES	20,418	20,907	21,409	21,924	22,451	22,992	23,546	24,114	24,696	25,293	25,905	26,532	27,175	27,833	28,509
TOTAL INFLOWS	20,418	20,907	21,409	94,308	22,451	22,992	23,546	24,114	24,696	25,293	25,905	26,532	27,175	27,833	28,509
Labour cost	2,496	2,559	2,622	2,687	2,754	2,823	2,893	2,965	3,039	3,115	3,192	3,272	3,354	3,436	3,523
Gas	303	312	322	332	342	353	364	375	387	399	411	424	438	451	465
Eectrical energy	680	700	720	741	763	785	808	831	856	881	906	933	960	988	1,017
Water services	9	9	9	10	10	10	10	11	11	11	11	12	12	12	13
Raw material	357	364	371	379	386	394	402	410	418	427	435	444	453	462	471
Intermediate services and goods	1,783	1,819	1,855	1,892	1,930	1,969	2,008	2,048	2,089	2,131	2,174	2,217	2,262	2,307	2,353
Elimination of ash and slag waste	3,702	3,777	3,852	3,929	4,008	4,088	4,170	4,253	4,338	4,425	4,513	4,604	4,696	4,790	4,885
TOTAL OPERATING COSTS	9,330	9,539	9,752	9,970	10,193	10,421	10,655	10,894	11,138	11,388	11,644	11,905	12,173	12,446	12,727
Feasibility study, tender costs etc.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Land expropriation	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Buildings	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Equipments	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Investments costs	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Replacement costs	0	0	0	72,383	0	0	0	0	0	0	0	0	0	0	0
Remediation and decontamination costs	0	0	0	0	0	0	0	0	0	0	0	0	0	0	32,967
Residual value															
Other investment items	0	0	0	72,383	0	0	0	0	0	0	0	0	0	0	32,967
TOTAL INVESTMENT COSTS	0	0	0	72,383	0	0	0	0	0	0	0	0	0	0	32,967
Bonds and other financial resources	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
EIB loans	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other loans	0	0	0	0	1,810	1,629	1,448	1,267	1,086	905	724	543	362	181	
INTEREST	0	0	0	0	1,810	1,629	1,448	1,267	1,086	905	724	543	362	181	0
Bonds and other financial resources	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
EIB loans	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other loans	0	0	0	0	3,619	3,619	3,619	3,619	3,619	3,619	3,619	3,619	3,619	3,619	0
LOANS REIMBOURSEMENT	0	0	0	0	3,619	3,619	3,619	3,619	3,619	3,619	3,619	3,619	3,619	3,619	0
PROFIT TAXATION	2,042	2,091	2,141	2,192	2,245	2,299	2,355	2,411	2,470	2,529	2,590	2,653	2,717	2,783	0
TOTAL OUTFLOWS	11,372	11,629	11,893	84,545	17,867	17,968	18,076	18,191	18,313	18,441	18,577	18,720	18,871	19,029	45,694
NET CASH FLOW	9,046	9,278	9,517	9,762	4,584	5,023	5,470	5,923	6,383	6,852	7,328	7,811	8,303	8,804	-17,185
CUMULATED TOTAL CASH FLOW	50,914	60,192	69,709	79,471	84,055	89,079	94,548	100,471	106,854	113,706	121,034	128,845	137,148	145,952	128,767

Table 4.38 Economic analysis *(thousands of Euros)*

	CF	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Municipal waste	0.96	0	0	0	1,643	3,335	3,385	3,435	3,486	3,538	3,591	3,644	3,699	3,754	3,810	3,866
Other waste	0.96	0	0	0	123	250	254	258	262	265	269	273	277	282	286	290
Electricity	0.96	0	0	0	3,552	7,289	7,479	7,675	7,875	8,081	8,292	8,508	8,731	8,959	9,193	9,433
Heat	0.96	0	0	0	2,038	4,186	4,299	4,416	4,536	4,659	4,785	4,915	5,049	5,186	5,327	5,471
SALES		0	0	0	7,355	15,059	15,417	15,783	16,159	16,543	16,937	17,341	17,755	18,179	18,614	19,060
CO_2 avoided (electricity)	-	0	0	0	5,829	11,891	12,129	12,371	12,619	12,871	13,129	13,391	13,659	13,932	14,211	14,495
CO_2 avoided (heat)	-	0	0	0	5	11	11	12	12	12	12	12	13	13	13	14
POSITVE EXTERNALITIES		0	0	0	5,834	11,902	12,140	12,383	12,631	12,883	13,141	13,404	13,672	13,945	14,224	14,509
ECONOMIC BENEFITS		0	0	0	13,190	26,961	27,557	28,166	28,789	29,426	30,078	30,745	31,427	32,124	32,838	33,569
Skilled labour cost	1.00	0	0	0	481	494	507	521	535	550	565	580	596	612	629	646
Non skilled labour cost	0.60	0	0	0	827	847	867	888	909	931	954	977	1,000	1,024	1,049	1,074
Gas	0.96	0	0	0	100	206	213	219	226	233	241	248	256	264	272	280
Eectrical energy	0.96	0	0	0	230	474	487	502	516	531	547	563	579	596	613	631
Water services	0.96	0	0	0	3	7	7	7	7	7	7	8	8	8	8	8
Raw material	0.96	0	0	0	135	274	280	286	291	297	303	309	315	322	328	335
Intermediate services and goods	0.72	0	0	0	505	1,029	1,050	1,071	1,092	1,114	1,136	1,159	1,182	1,206	1,230	1,255
Elimination of ash and slag waste	0.67	0	0	0	983	2,005	2,045	2,086	2,128	2,170	2,214	2,258	2,303	2,349	2,396	2,444
TOTAL OPERATING COSTS		0	0	0	3,263	5,335	5,456	5,579	5,705	5,834	5,966	6,101	6,239	6,380	6,525	6,673
Feasibility study, tender costs etc.	1.00	6,980	0	1,816	0	0	0	0	0	0	0	0	0	0	0	0
Land expropriation	1.33	1,980	1,010	0	0	0	0	0	0	0	0	0	0	0	0	0
Buildings	0.70	0	40,140	12,461	0	0	0	0	0	0	0	0	0	0	0	0
Equipments	0.60	0	24,813	37,964	0	0	0	0	0	0	0	0	0	0	0	0
Investments costs		8,960	65,962	52,240	0	0	0	0	0	0	0	0	0	0	0	0
Replacement costs	0.67	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Remediation and decontamination costs	0.68	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Residual value	0.71	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other investment items		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL INVESTMENT COSTS		8,960	65,962	52,240	0	0	0	0	0	0	0	0	0	0	0	0
Noise, odours, etc.	-	0	0	0	184	375	383	391	398	406	415	423	431	440	449	458
NEGATIVE EXTERNALITIES		0	0	0	184	375	383	391	398	406	415	423	431	440	449	458
TOTAL ECONOMIC COSTS		8,960	65,962	52,240	3,447	5,711	5,839	5,970	6,104	6,240	6,380	6,524	6,670	6,820	6,974	7,130
NET ECONOMIC BENEFIT		-8,960	-65,962	-52,240	9,743	21,251	21,718	22,196	22,686	23,186	23,698	24,221	24,757	25,304	25,865	26,438

	CF	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Municipal waste	0.96	3,924	3,982	4,042	4,102	4,163	4,225	4,288	4,352	4,417	4,483	4,549	4,617	4,686	4,756	4,827
Other waste	0.96	294	299	303	308	312	317	322	326	331	336	341	346	351	357	362
Electricity	0.96	9,679	9,932	10,191	10,458	10,731	11,011	11,299	11,594	11,897	12,207	12,526	12,853	13,189	13,534	13,887
Heat	0.96	5,620	5,772	5,929	6,090	6,255	6,425	6,599	6,778	6,962	7,151	7,345	7,544	7,749	7,960	8,176
SALES		19,517	19,985	20,465	20,957	21,461	21,978	22,507	23,050	23,607	24,177	24,762	25,361	25,976	26,606	27,251
CO_2 avoided (electricity)	-	14,785	15,081	15,382	15,690	16,004	16,324	16,650	16,983	17,323	17,669	18,023	18,383	18,751	19,126	19,508
CO_2 avoided (heat)	-	14	14	14	15	15	15	16	16	16	16	17	17	17	18	18
POSITVE EXTERNALITIES		14,799	15,095	15,397	15,705	16,019	16,339	16,666	16,999	17,339	17,686	18,039	18,400	18,768	19,144	19,527
ECONOMIC BENEFITS		34,315	35,080	35,861	36,661	37,479	38,316	39,173	40,049	40,946	41,863	42,801	43,761	44,744	45,749	46,778
Skilled labour cost	1.00	663	681	700	719	738	758	779	800	822	844	867	890	914	939	965
Non skilled labour cost	0.60	1,100	1,126	1,154	1,181	1,210	1,239	1,269	1,299	1,331	1,363	1,395	1,429	1,464	1,499	1,535
Gas	0.96	289	298	308	317	327	337	348	359	370	381	393	406	418	431	445
Eectrical energy	0.96	650	669	688	708	729	750	772	795	818	842	866	892	918	944	972
Water services	0.96	9	9	9	9	9	10	10	10	10	11	11	11	12	12	12
Raw material	0.96	341	348	355	362	369	377	384	392	400	408	416	424	433	441	450
Intermediate services and goods	0.72	1,280	1,305	1,331	1,358	1,385	1,413	1,441	1,470	1,499	1,529	1,560	1,591	1,623	1,655	1,689
Elimination of ash and slag waste	0.67	2,493	2,543	2,594	2,646	2,699	2,753	2,808	2,864	2,921	2,980	3,039	3,100	3,162	3,225	3,290
TOTAL OPERATING COSTS		6,824	6,979	7,138	7,300	7,466	7,636	7,810	7,988	8,170	8,357	8,547	8,743	8,943	9,147	9,357
Feasibility study, tender costs etc.	1.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Land expropriation	1.33	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Buildings	0.70	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Equipments	0.60	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Investments costs		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Replacement costs	0.67	0	0	0	48,497	0	0	0	0	0	0	0	0	0	0	0
Remediation and decontamination costs	0.68	0	0	0	0	0	0	0	0	0	0	0	0	0	0	22,295
Residual value	0.71	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-6,393
Other investment items		0	0	0	48,497	0	0	0	0	0	0	0	0	0	0	15,903
TOTAL INVESTMENT COSTS		0	0	0	48,497	0	0	0	0	0	0	0	0	0	0	15,903
Local impact	-	467	476	486	495	505	515	526	536	547	558	569	580	592	604	616
NEGATIVE EXTERNALITIES		467	476	486	495	505	515	526	536	547	558	569	580	592	604	616
TOTAL ECONOMIC COSTS		7,291	7,455	7,624	56,292	7,971	8,152	8,336	8,524	8,717	8,915	9,116	9,323	9,535	9,751	25,875
NET ECONOMIC BENEFIT		27,024	27,624	28,238	-19,631	29,508	30,165	30,837	31,525	32,229	32,948	33,685	34,438	35,209	35,998	20,902

Discount Rate	3.5%
ENPV	259,891.1
ERR	15.1%
B/C	2.0

4.4 Case Study: investment in a waste water treatment plant

4.4.1 Project definition

The project is an investment in the field of waste water treatment, and for the reuse of well purified waste water for multiple purposes after an intensive tertiary treatment. It takes place in a Convergence region in a country eligible for the Cohesion Fund.

This project includes the construction of a new water purifier, in keeping with current regulations, to serve a medium-sized city (725,000 residents in the initial year, with the population growing an annual rate of 0.15%). Currently wastewater is discharged untreated into the river crossing the city.

The project includes the realisation of four modules of intensive treatment for water re-use, which will treat on average, about 70% of the flow of purified waste. Below this plant, two pumping stations and a pipe system will be erected to carry the treated water to the existing header tank in the irrigated area and the existing reservoir serving the industrial network[78]. Both the irrigation network and the water distribution network for the industrial plants already exist.

The wastewater and nearby tertiary treatment plants will take up a total area of 7,000 square meters.

The industrial area is already well developed. There are more than one hundred small and medium-size factories and many craft workshops. At present, the water supply is obtained through wells, subjecting the groundwater to an over-abstraction. For this reason, the local aquifer has been depleted, and its hydro-geological level has been considerably lowered in recent years. The territory with irrigated agriculture, not far from the city, is a new irrigated area and has a surface of 3,500 hectares, some of which are foreseen to be equipped with greenhouses in the next future.

The overall investment is realised by the Municipality, which will choose a private partner by means of a build operate transfer (BOT) tender (a form of Public Private Partnership, PPP). See Annex G for this type of PPP. The BOT horizon is fixed at 30 years and includes the time for design, erection, start-up and operation of the system.

The Municipality receives the revenues paid by the users for drainage water collection[79] and the wastewater collection and treatment services. It pays, at a stated price per unit, the operating service charge to the PPP private partner. The drainage collection and sewerage system is directly managed by the municipal staff.

The private partner receives the revenue coming from the water tariff paid by industrial and agricultural users and sustains the 'private' part of the project investment and the operation and maintenance costs.

The Municipality receives the European and national (or regional) grants and transfers them to the private operator[80], along with its own capital contribution (taken from the municipal budget). The private partner will provide the finance to cover the remaining part of the investment cost.

In the household sector, the demand for purification comes from the users of the existing urban sewer network. The industrial demand for water for process uses, or for other industrial purposes, comes from factories and craft laboratories. The water is used to irrigate the various seasonal and multi-seasonal crops and in greenhouses. The box below deals with the identification and the quantification of the water demand in the project.

In the feasibility study the BAU alternative was rejected because it involves further exploitation of groundwater, which, as previously stated, was being depleted mainly by the existing industrial use of the water.

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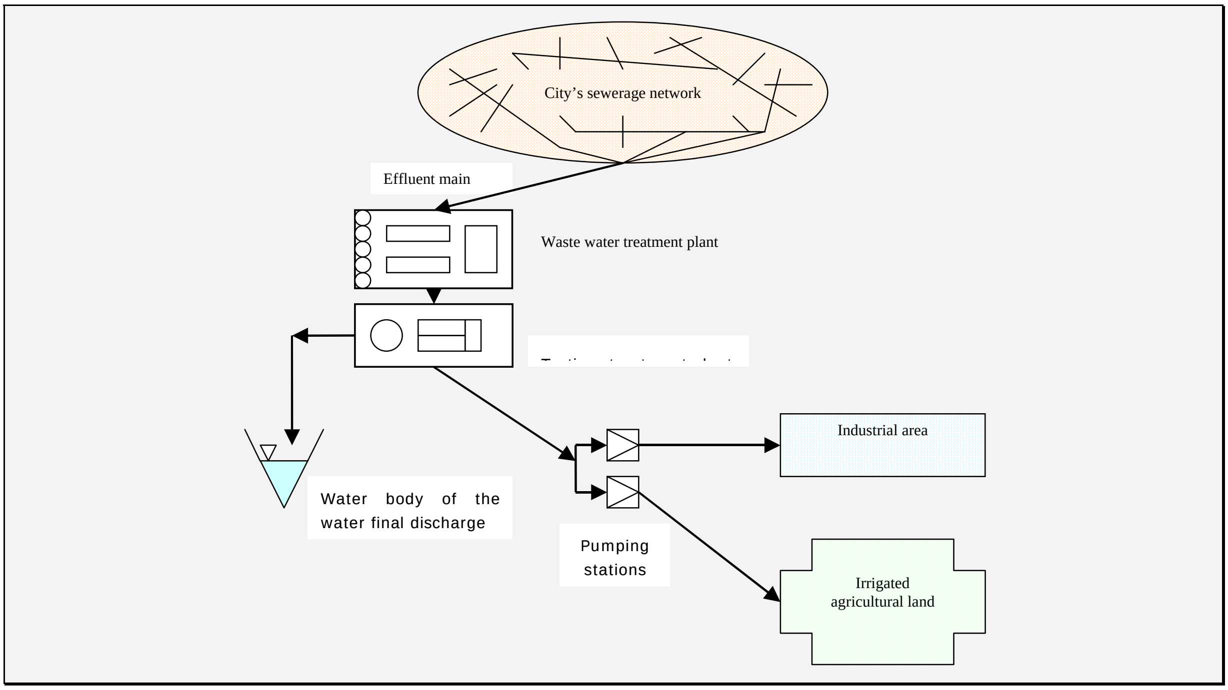
78 The recycled water is supplied to the factories for process and other industrial uses, but not for the human consumption.
79 The sewage treatment plant is designed to treat rainwater up to a scale equal to 5 times the design flow of the wastewater.
80 Proportionately for progress of the system construction.

An alternative option considered to be technically feasible, taking into account the hydrological and geo-morphological conditions of the project area, is the construction of a dam and a long aqueduct (more than 100 km long), that supplies water to the irrigation and industrial networks. This option has been rejected for economic reasons. No other alternative was considered feasible from a technical point of view.

Figure 4.9 Diagram of the overall scheme for the project infrastructures



FOCUS: THE WATER DEMAND

The volume of water to be treated has been estimated on the basis of an average daily water actual supply of 190 litres per inhabitant, taking into account a reduction factor of 0,8 for the wastewater collected by the urban sewerage system.
The size of the daily water supply was determined on the basis of a study of the needs of the civil population of areas similar to those of the project (similar social customs, similar consumption levels, same geographic area, etc.) and corrected in the light of data on historic consumption available from the Municipality[81].
For the industrial area the water demand was estimated on the basis of the specific consumption of industrial plants, taking into account a period of activity of about 11 months per year.
The water demand for irrigation, has been calculated on the basis of the expected water consumption of various specific kind of agricultural cultures, taking into account a period of activity of about 6 months per year (the dry season). For the cultivation in greenhouses the full year of activity is assumed.
The total supply is considered gross of leakages in the water network. The real consumption is calculated as follow:
real consumption = total supply – leakages

The water demand quantification

- Drinking water supplied to the urban users: 725,000 inhabitants x 190 l/inh.d. x 365 / 1,000 = 50.3 Mm^3/y
- Wastewater to be treated in the plant: 50.3 Mm^3/y x 0.80 = 40.3 Mm^3/y
- Water supplied to the urban users: 12.1 Mm^3/y
- Agricultural water demand for irrigation: 3,500 he x 4,500 m^3/ha y = 15.75 Mm^3/y

The overall recycled water is 27,9 Mm^3/y, that is about 70% of the total amount of the treated wastewater.

The dynamics of demand

The dynamics of Household demand were determined by the forecast of the population resident in the city, which has two components:

- a demographic rate of growth (the average for the region) of 0.06% per year;
- a migratory flow with a positive balance, that gives an average rate of growth of 0.09%;
- as result, an average yearly rate of growth of 0.15% has been set in the CBA model.

The industrial demand is assumed to decrease (average yearly rate = -0.3%), because of the reduction of the network leakage and because of the recovery of efficiency for the water usage inside the factories.
For similar reasons the irrigation water demand is assumed to decrease as well, with an average yearly rate = -0,5%
For simplicity, no other dynamic of demand is considered in the present case study.

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[81] As it has been mentioned, the volumes of wastewater take into account a reduction coefficient of 0.80. The contamination level (BOD Biochemical Oxygen Demand, COD, Chemical Oxygen Demand) was estimated using standard environmental engineering methods.

4.4.2 Financial analysis

Although in this project the owner of the infrastructure (the Municipality) is different from the operator (the private partner of BOT assignment), a consolidated financial analysis is carried out. The time horizon for the analysis is assumed to be 30 years, the same as for the BOT.

In the analysis constant prices are used and corrections are entered for changes in the relative prices. Such adjustments are undertaken by assuming an average annual inflation rate of 1.5% and also by taking into account growth factors, marginal decreases in the prices of some services and some operating costs (see below for details). Thus, only relative price changes are considered. The financial rate of discount is 5%, expressed in real terms.

The cost of the investment includes the construction of the effluent and discharge mains, of the waste water treatment plant, the water refining treatment plant and the aqueducts (including the pumping houses) to supply water resources to the industrial and irrigated areas. The cost of such an investment, excluding VAT, is set at €100,831,000 (at constant price)[82] and has been subdivided into homogeneous categories, whose values have been attributed to the first three periods, on the basis of the time programme for the implementation of the project.

Table 4.39 Distribution of investment cost in the time horizon

Investment costs at constant prices (Thousands of Euros)	Total	1y	2y	3y
Feasibility study, design, work management, licensing, etc.	9,259	7,363	0	1,896
Land expropriation	1,094	726	368	0
Labour	43,323	4,255	25,915	13,152
Materials for civil works	12,900	990	7,031	4,078
Rentals	3,238	26	1,607	1,604
Transports	2,681	44	1,331	1,306
Electro-mechanical components and equipment	29,138	0	11,551	17,587
Total investment	**100,831**	**13,404**	**47,804**	**39,623**

The start-up phase, lasting 5 months, will commence in the fourth year, in which the production is assumed to be at 70% of the regime production. The components of short lifetime[83] (60% of the equipment costs) will be replaced once during the investment horizon, at the end of their economic life (16 years[84]). For the sake of simplicity, the calculation is made by introducing the whole cost of the aforementioned components in the twentieth year[85].

Keeping in mind the aforementioned PPP arrangement scheme, the investment is financed[86] by grant (ERDF and national or regional funds), by the fund provided by Municipality and by funds provided by the private partner. The requested co-financing EU grant is €22,129,000 (21.9% of total investment costs at current prices without VAT). An amount of €19,029,000 (18.9% of investment costs) is provided by a national or regional fund. The Municipal fund is €10,263,000 (10.2% of investment costs). The private financing (€49,410,000, the 49.0% of investment costs) is given by equity for 50% of the amount (€24,705,000) and by loan for the other 50% (€24,705,000). The loan has a 5.00% interest rate with an amortization period of 10 years.

The financing for the replacement of the short life-time components is provided by the private partner (50% equity, 50% loan) in the 20th year (€22,652,000).

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82 The cost of the investment at current prices is € 100,831,451.

83 These are, basically, machines and other electromechanical equipment for the treatment and pumping plants.

84 In accordance with the technical data from literature.

85 The twentieth year has been determined taking into account 3 years of plant construction plus 16 years of life.

86 The sum to be financed is the cost of investment net of VAT.

Table 4.40 Sources of finance (current prices) in the time horizon (thousand of Euros)

Finance sources	Total	1	2	3	4 – 19	20	21 – 30
Public funds							
Investment financing							
EU grant	22,129	4,410	10,595	7,124	0	0	0
National grant	19,029	1,258	10,164	7,607	0	0	0
Municipal equity	10,263	1,700	4,495	4,068	0	0	0
Total	51,421	7,368	25,254	18,799	0	0	0
Private funds							
Investment and operation financing							
Equity	24,705	3,018	11,275	10,412	0	0	0
Loan	24,705	3,018	11,275	10,412	0	0	0
Total	49,410	6,036	22,550	20,824	0	0	0
Replacement of short life components financing							
Equity	11,326	0	0	0	0	11,326	0
Loan	11,326	0	0	0	0	11,326	0
Total	22,652	0	0	0	0	22,652	0

The additional running costs which are necessary to carry out the project services (the purification plant, the supply of water for industry and agriculture), include:

- labour cost: fourteen skilled employees (at 38,000 €/person per year) and thirty-two non-skilled employees (at 26,600 €/person per year) are assumed; an overall real growth rate of 0.4% per year[87] is assumed for the labour cost;
- electricity costs: the pumping stations consume 0.017 kWh per cubic metre of water raised for the end user, the plants consume 0.027 kWh per cubic metre of treated water. The electricity price is assumed to increase at an annual rate of 0.9%[88];
- materials: the materials used by the plants have a yearly cost of €0.080 per cubic metre of treated water; the real growth rate of this price is 0.9% per year;
- intermediate services and goods: the intermediate services and goods have a fixed part of the yearly cost of €1,299,000 and a variable part of €0.1 per cubic metre of treated water;
- maintenance costs: the calculation of the maintenance costs was made on the basis of prices in the local market, or, when these were not available, on prices for the region or country. This yearly cost has been set at €715,000;
- elimination of treatment sludge: the yearly cost is €0.093 per cubic metre of treated water; the marginal growth rate of this price is 0.5% per year.

The revenue accrues, in the financial consolidated analysis, from the tariff receipts for the new services provided, which are valued according to the respective tariffs applied to the metered volumes.

In fact, using a consolidated financial analysis for the determination of project performances, ensures that the aforementioned fee paid by the Municipality to the private partner (the operator) is not considered in this case. Indeed, the revenue for the operator corresponds to the cost borne by the owner, so that in the consolidated analysis the two cancel each other out and do not affect the project's net cash flows.

[87] Over the inflation rate.
[88] See note above.

THE CALCULATION OF REVENUES
Referring to a base years, the revenue predicted has been calculated as follows: - civil purification service (in the current situation 'without the intervention' no purification charge is applied): 50.3 Mm^3/year * €0.283 per m^3 * 0.950 = 13,523,000€/y[89]; - industrial supply in the reservoir: 12.1 Mm^3/year * €0.480 per m^3 * 0.995= 5,779,000€/y; - irrigation supply: 15.75 Mm^3/year * €0.030 per m^3 * 0.87 = 411,000€/y; - to take into account the certain expected level of evasion of the payment of service bills the following 'dispersion factors' have been applied cautiously before revenue calculating: municipal services: 5%, industrial water supply service: 0.5%, irrigating water supply service: 13%. - at the end, in calculating the performance indices, the values of the revenues in each year are obtained starting from the above baseline values and taking into account the growth in the water demands (see above) and the dynamics of current prices.

In addition to the above mentioned revenues, the residual value, over the 27 years of life of the infrastructures[90], is set to be 4.0% of the initial costs of the long life parts of the investment plus 3.8% of the costs of the replaced components (short life parts). The total residual value (€6,030,000, expressed at constant prices and not discounted) is allocated in the last year (30th) of the investment period.

The financial performance indicators are:

- Financial Net Present Value (investment)	FNPV(C)	€–29,083,911
- Financial Rate of Return (investment)	FRR(C)	1.9%
- Financial Net Present Value (capital)	FNPV(K)	€–8,357,812[91]
- Financial Rate of Return (capital)	FRR(K)	3.7%

As for the financial sustainability of the project, the cumulative cash flow of the project is always positive with a minimum value of about €788,000, occurring in the fifth year.

Moreover, if the service fee is set at €0.02 per cubic metre of treated water, the separate analysis of the financial profitability of the local public capital (Municipal funds, i.e.: FNPV(K_g) and FRR(K_g)) and the financial profitability of the private capital (equity and loan to finance the investment and replacement costs and the cash deficit in the early years of operation, i.e.: FNPV(K_p) and FRR(K_p)) – net of EU grant – gives the following results:

- Public partner of the PPP (municipality)	FNPV(K_g)	€3,491,008[92]
	FRR(K_g)	7.8%
- Private partner of the PPP (operator firm)	FNPV(K_p)	€5,139,536
	FRR(K_p)	6.5%

For this project, the maximum amount to which the co-financing rate of the priority axis applies is €32,467,727. This is determined by multiplying the project eligible cost (in this case €100,831,451 at current price) by the funding-gap rate (32.2%). Assuming the co-financing rate for the priority axis is equal to 80%, then the maximum EU contribution is €25,974,182.

89 Note that the rate of the purification service is applied to the volume of water delivered to users, as measured by the water meters.

90 At the end of the horizon time, the operative life of the plants and other equipments is equal to the analysis horizon minus the construction time: 30 – 3 = 27 years.

91 In the table 3.32, the functioning financial costs are financed by short-term loans with an average interest of 8%.

92 The sum of FNPV(K_g) and FNPV(K_p) is not equal to FNPV(K), because the amount of capital expenditures incurred separately by the partners does not include the national contribution, that instead is considered, in addition to above mentioned contributions, in the calculation of FNPV(K). A similar reasoning applies to the values of FRR(K).

4.4.3 Economic analysis

To convert the prices in the financial analysis, both specific conversion factors and the standard conversion factor (SCF=0.96) have been used (see table below).

Table 4.41 Conversion factors for the economic analysis

Type of cost	CF	Notes
Labour: skilled personnel	1.00	The labour market is assumed to be competitive
Labour: unskilled personnel	0.60	Shadow wage for not-competitive labour market[93]
Expropriation or land	1.34	Standard conversion factor multiplied for local price (40% higher than prices paid for expropriation)
Yard labour	0.64	10% skilled labour, 90% unskilled labour
Materials for civil works	0.83	55% machinery and manufactured goods, 45% building materials
Rentals	0.68	3% skilled personnel, 37% unskilled personnel, 30% energy, 20% maintenance, 10% profits[94] (CF = 0)
Transport	0.68	3% skilled personnel, 37% unskilled personnel, 30% energy, 20% maintenance, 10% profits (CF = 0)
Project studies, works management, trials and other general expenses	1.00	100% skilled labour
Equipment, machinery, manufactured goods, carpentry, etc.	0.82	50% local production (SCF), 40% imported goods (CF = 0.85), 10% profits (CF = 0)
Building materials	0.85	75% local materials (SCF), 15% imported goods (CF = 0.85), 10% profits (CF = 0)
Electricity, fuels, other energy prices	0.96	SCF
Maintenance	0.71	15% skilled personnel, 65% unskilled personnel, 20% materials
Reagents and other specialist materials	0.80	30% local production (SCF), 60% imported goods (CF = 0.85), 10% profits (CF = 0)
Intermediate goods and technical services	0.71	10% skilled personnel, 60% unskilled personnel, 30% manufactured goods
Elimination of treatment sludge	0.80	30% unskilled personnel, 20% transport, 50% local services (SCF)
Administrative, financial and economic services	1.00	100% skilled personnel
Resulting value of investment costs	0.76	Weighted by the types of project costs
Replacement costs	0.82	100% equipment, machinery, manufactured goods, carpentry, etc.
Agricultural product	0.85	68% various agricultural input (CF=SCF), 2% skilled labour, 30% unskilled labour

The negative externalities taken into account are: the costs of the local impact (mainly due to the wastewater treatment plants) due to the noise, odours, aesthetic and landscape impact. The overall impact of the opening of the construction sites - in an extra urban area - is considered negligible and, in any case, it is absorbed by the corrected investment costs and by the aforementioned externalities.

The impact of the normal operation of the depurator and tertiary treatment plant is valued by means of an hedonic price, assuming the real estate in the nearby area are depreciated. The hedonic price is assumed to be equal to the difference between the market value of the rent for the buildings in the area before the plant is built and the value after the plant is built; this difference is then corrected by an appropriate CF. Assuming a mean building density in the impact area (an area, centred on plant, of about 600 m radius) of

[93] The unskilled labour conversion factor is calculated on the basis of the shadow wage, as follows: SW = FW x (1-u) x (1-t), were SW is the shadow wage, SW in the wage assumed in the financial analysis, u is local (regional) unemployment rate and t is the rate of the social security and relevant taxes. In the case study, set u=12% and t=32%, the CF (SW/FW) is equal to 0.60.

[94] In the CF table, '10% profits' indicates the share of the company profits among the various costs, that contribute to the overall cost of the good.

0.15 m^3/m^2 a depreciation of 20% of a yearly rent[95] of about 63.6 €/m^2 (corrected) leads to an hedonic price of 980 Thousands of Euros per year.

For the evaluation of the economic benefits, the revenues collected by the Municipality and the operator from the services, even if corrected by means of appropriate CF's, do not, in this case, adequately represent the social benefits from the project[96]. So, in the present analysis, the financial inflows have not been included at all, in order to avoid any double-counting.

Generally, for the evaluation of the positive externalities or the benefits due to water supply services, the willingness-to-pay method could be used in order to establish accounting prices for the services that may have an alternative market. Since the accounting prices thus obtained refer to the service to the end-user, then in order to obtain the prices required for the analysis, appropriate breakdown coefficients derived from literature and experience have to be taken into account[97].

In the present case study a direct valuation approach was preferred, differentiated for various services, as follows.

- The major benefit of the new system, that will supply the water to the industrial area, is the saving of the groundwater resources, with the consequent restoration of the hydro-geological balance over time and the generation of many positive environmental effects. A possible conservative approximation of the value of this positive externality can be obtained by putting a value on the volumes of water saved. Water is no longer extracted from groundwater, but supplied by the new project system re-using the intensively treated wastewater. In this case, the volumes of industrial supplied water (equivalent to the amount of resource yearly saved from the groundwater), reduced by a coefficient of dispersion[98] (0.80), are equal to roughly 9.7 Mm^3/year, assuming a potential irrigation re-use, at an accounting price[99] of €0.81 per m^3.
- The main benefits of the new irrigation service are the significant improvements in quantity and quality and the greater diversification of products, which increases the income of farms in the area. In the situation without intervention, agricultural production was limited by the scarcity of water, almost all taken from the local groundwater (oasis-like irrigation). Conservatively, an increase of 25% of added value generated in the irrigation area (estimated to be €52,000 per hectare; see above) has been taken. To the value obtained a breakdown factor (0.65)[100] was applied in order to take account of the irrigation distribution network which is not part of the project. The method described above should be generally applied with caution. First, we must be careful not to double count the social benefit. This risk was avoided here by not taking into consideration the financial revenues from the irrigation service. Secondly, the accounting price for the supply of irrigation water, mentioned above, is not really suitable in this particular case. This price refers, in fact, to the economic benefit from new irrigated areas (practically not cultivated before). So, the accounting price might overstate the benefit due, as is the case under examination, to the replacement of a local irrigation system with a new system that is more stable and efficient. Not having a more appropriate value of the accounting price, the relative increase of the added value of the yearly crop production has been taken as the best proxy of the benefit.

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95 The figure adopted derives from a study on similar cases in the same state carried out with various methods (including: revealed preference and stated preference methods). See also: European Commission, Common Implementation Strategy for the Water Framework Directive, Guidance Document No 1 'Economics and the Environment – The Implementation Challenge of the Water Framework Directive' produced by Working Group 2.6 – WATECO, 2003.

96 The water service is a classic case of natural monopoly. Market prices generally suffer considerable distortions. As an example, the prices in the sector are based almost always on administered tariffs, which are, for many reasons, far from the equilibrium values.

97 Accounting price for the supply of industrial water: € 1.00 per m^3 x 0.70 (breakdown coefficient only for bulk water supply) = € 0.70 per m^3. Accounting price for the supply of irrigation water: € 0.24 per m^3 x 0.65 (breakdown coefficient only for bulk water supply) = € 0.16 per m^3.

98 Due to the leakage and other reasons.

99 This accounting price was applied to evaluate the benefit due to the saving in resources abstracted from natural sources and substituted, as stated, by treated waste water. For the additional volumes of water the greater added value of the additional (or improved) agricultural production due to the greater availability of water was evaluated. In this way one obtains a value of € 0.81 per m^3, used in the calculation. This last accounting price could be used to evaluate the benefits of the additional supply of resources for irrigation purposes, too.

100 Values of the breakdown factors between the adduction and distribution or between other parts of the water nets can be derived from the analysis of the data reported in the technical literature on water services.

- Civil water purification gives rise to benefits in different sectors, first and foremost the environmental protection of water and land, but also the safeguarding of human health and the integrity of the living species (see also Annex F). A possible conservative value for these positive externalities can be obtained by putting a value on the volume of purified water discharged and susceptible for re-use for different purposes. In this case, the volume of purified water not used *in situ* and thus discharged, reduced by a coefficient of dispersion[101] (0.70), are equal to roughly 9 Mm^3/year, assuming a potential irrigation re-use, at an accounting price of €0.81 per m^3, already used to evaluate the benefits of the supply of resources for industrial purposes.

The conversion factor was also applied to the benefits derived from the revenue from the residual value of the infrastructures[102].

The social discount rate is 5.5%. From the cash flows, the following performance indicator results are obtained:

- Economic Net Present Value ENPV €295,519,106
- Economic Rate of Return ERR 28.9%
- Benefit / Cost Ratio B/C 2.2

4.4.4 Risk assessment

The results of the sensitivity analysis are shown in figures 3.13, 3.14 and 3.15, with reference, respectively, to the FRR(C), the FRR(K) and the ERR. Figures 3.16 and 3.17 show, respectively, the sensitivity of the FNPV(C) and the FNPV(K) and the ENPV to variations in the inflation rate.

The following variables are identified as critical for the financial analysis (the table shows the relative variation of the FRR(C) and of FRR(K) due to changes from -1% to +1% in the critical variable):

Table 4.42 Critical variables for financial analysis

Critical variable	% of FRR(C)	% of FRR(K)
Investment cost	± 4.3	± 2.2
Yearly cost of materials	± 3.4	± 2.4
Yearly cost of the intermediate goods and services	± 5.4	± 3.8
Yearly cost of waste sludge disposal	± 4.2	± 2.9
Wastewater treatment tariff	± 13.9	± 9.8
Industrial water supply service tariff / Industrial water demand	± 5.5	± 3.9

The following variables are identified as critical for the economic analysis (the Table shows the total relative variation of the ERR due to changes from -1% to +1% in the critical variable):

Table 4.43 Critical variable for economic analysis

Critical variable	% of ERR(C)
Investment cost	± 0.8
Improvement of the crop production in the well irrigated agricultural area	± 0.8
Account price for savings in groundwater resources	± 0.4

The risk analysis of the project has been carried out by assigning appropriate probability distributions to the critical variables, identified as explained above. Table 4.44 shows the assumptions made for the probability distributions of the variables.

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101 Due to the leakage and other reasons.

102 The weighted average of the CF's applied to the categories of investment is applied to the long life investment value. The CF used for the equipment, machinery, manufactured goods, carpentry, etc. is applied to the replaced parts.

As result, the probability distributions for the financial and economic performance indicators are calculated, utilizing the Monte Carlo method.

Table 4.44 Risk analysis: variable probability distributions

Variable	Applied to	Range	Distribution	Notes
Investment	Financial and economic	78.0 ÷ 126.8 M€	Rectangular	See figure 3.18
Yearly cost of materials	Financial	0.04 ÷ 0.12 €/m³	Gaussian	MV = 0.080; SD = 0.010
Intermediate goods and services (fix plus variable)	Financial	2.67 ÷ 8.02 M€/y	Gaussian	MV = 5.35; SD = 0.80
Yearly cost of waste sludge disposal	Financial	0.08325 ÷ 0.111 €/m³	Triangular	
Wastewater treatment tariff	Financial	0.279 ÷ 0.296 €/m³	Triangular	
Industrial water service tariff	Financial	0.47 ÷ 0.49 €/m³	Triangular	
Gained added value due to new irrigation service	Economic	10% ÷ 30%	Triangular	
Account price for savings in groundwater resources	Economic	0.57 ÷ 1.05 €/m³	Gaussian	MV = 0.81; SD = 0.081

Note: MV = Mean value; SD = Standard deviation.

Figure 4.14 shows, as an example, the probability distribution obtained for the ENPV and in the following table other characteristic probability parameters are given (in thousands of Euros and%) for economic performance parameters.

Table 4.45 Probability distribution for ENPV and ERR

	ENPV	ERR
Reference value (base case)	295,519	28.9%
Mean	249,079	26.0%
Median	257,735	26.4%
Standard deviation	62,906	4.7%
Minimum value	64,176	11.9%
Maximum value	400,457	37.0%
Probability of the parameter (ENPV/ERR) being not higher than the reference value	0.74	0.7 4

The following table shows the comparison of the Community contribution determined in the base case (see the previous section 'Financial analysis') with that calculated assuming the expected values (mean values) of the parameters (Investment cost, Residual value Revenues, Operating costs), derived from the risk analysis. Given the expected values, the maximum Community contribution is higher (+5.3%) than that in the base case.

Table 4.46 Results of risk analysis on Community contribution

Parameters	Base case values (M€)	Expected values (M€)
Total Investment costs (not discounted)	100.8	101.2
Total Investment costs (discounted)	90.4	90.9
Residual value (discounted)	1.4	1.4
Revenues (discounted)	305.0	306.6
Operating and replacement costs (discounted)	245.1	247.5
Discounted net revenue (DNR)	61.3	60.5
Eligible expenditure	29.1	30.4
Funding gap rate (%)	32.2%	33.4%
Decision amount	32.5	33.8
Maximum community contribution	26.0	27.0
Maximum community contribution (%)	25.8%	26.6%

Figure 4.10 Results of the sensitivity analysis for FRR(C)

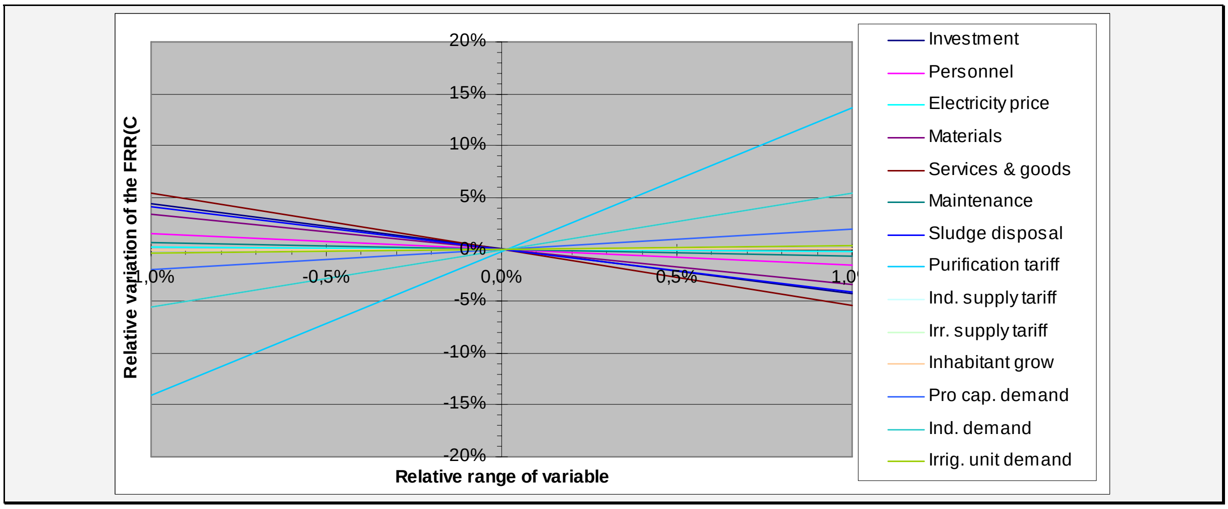


Figure 4.11 Results of the sensitivity analysis for FRR(K)

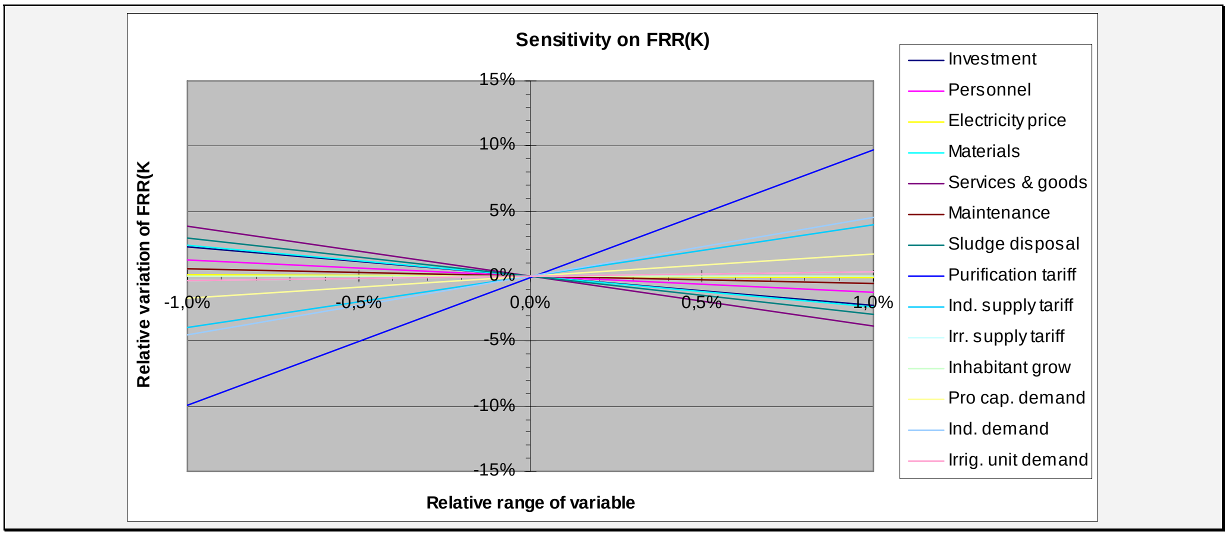


Figure 4.12 Sensitivity analysis - Inflation rate on FNPV(C) and FNPV(K)

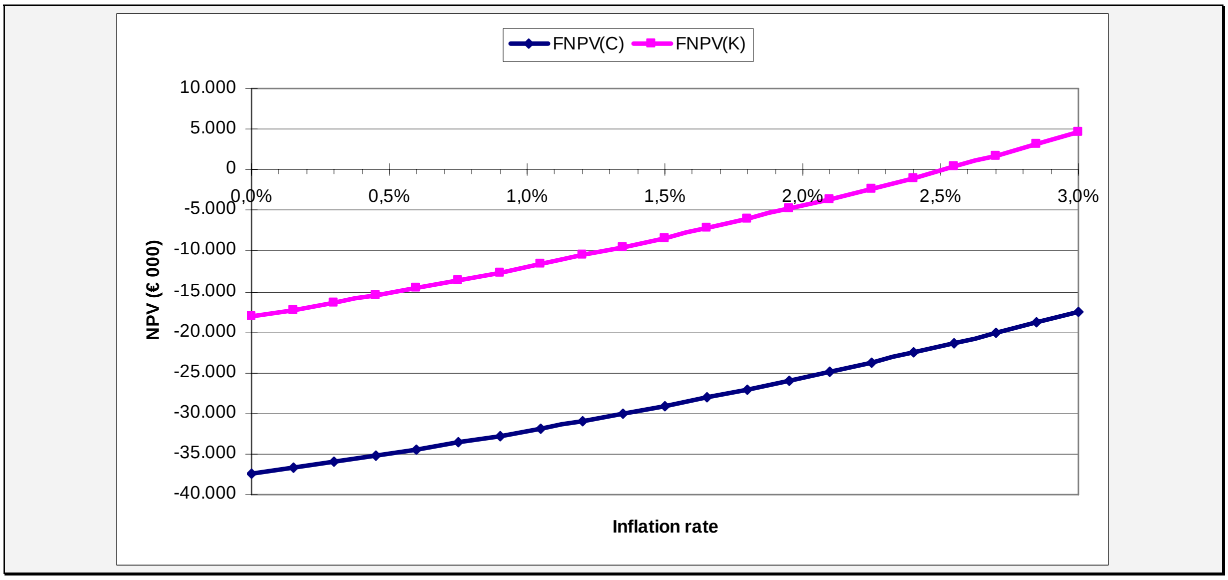


Figure 4.13 Probability distribution of the investment costs

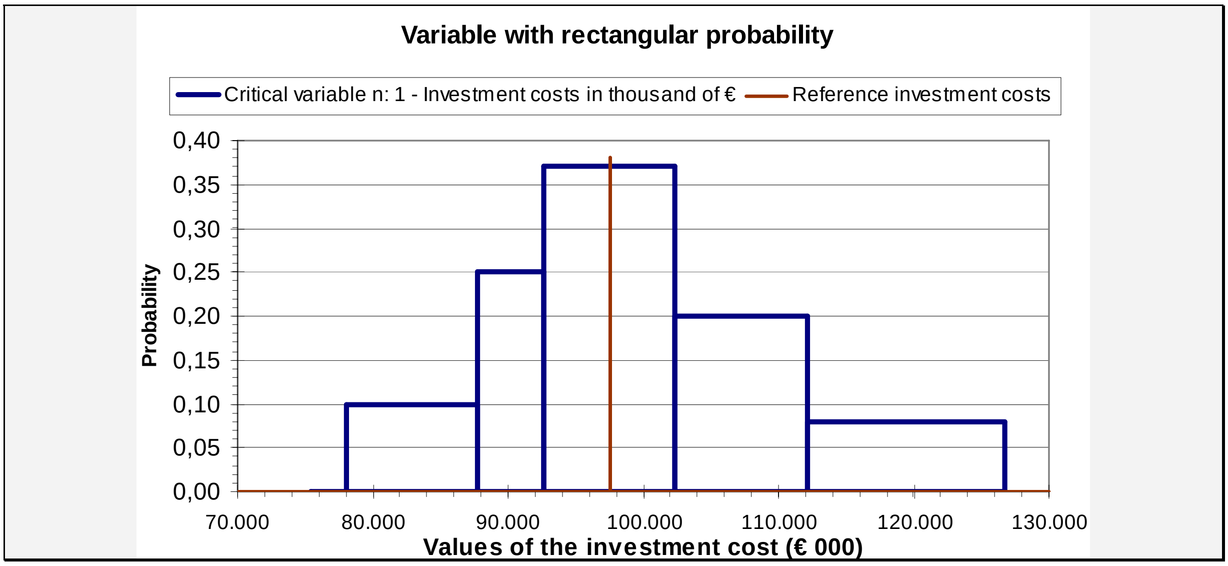


Figure 4.14 Probability distribution of the project ENPV

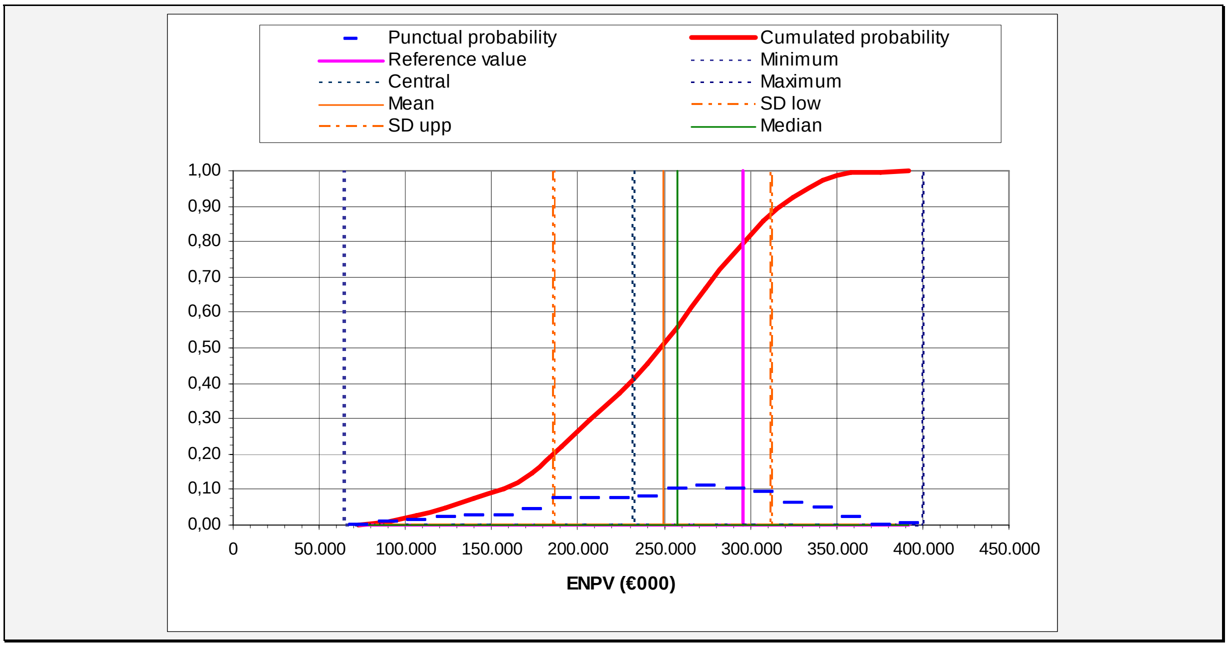


Table 4.47 Financial return on investment *(thousands of Euros)*

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Total municipal services income	0	0	0	10,096	14,662	14,904	15,150	15,401	15,655	15,914	16,177	16,444	16,716	16,992	17,273
Industrial and irrigation water supply revenue	0	0	0	4,546	6,573	6,653	6,733	6,815	6,898	6,981	7,066	7,152	7,239	7,326	7,415
SALES	0	0	0	14,642	21,235	21,557	21,884	22,216	22,553	22,895	23,243	23,596	23,954	24,318	24,688
Labour cost	0	0	0	1,494	1,523	1,553	1,583	1,614	1,645	1,677	1,710	1,743	1,777	1,811	1,847
Electrical energy	0	0	0	129	188	193	198	203	208	213	218	224	229	235	241
Materials (Chemicals, reagents, inert, etc.)	0	0	0	2,422	3,525	3,590	3,657	3,725	3,794	3,864	3,936	4,009	4,083	4,159	4,236
Intermediate services and goods	0	0	0	3,969	5,762	5,855	5,949	6,045	6,143	6,242	6,343	6,446	6,550	6,656	6,763
Maintenance	0	0	0	531	770	782	794	805	818	830	842	855	868	881	894
Elimination of treatment sludge	0	0	0	2,835	4,137	4,226	4,318	4,411	4,506	4,604	4,703	4,805	4,908	5,015	5,123
TOTAL OPERATING COSTS	0	0	0	11,380	15,905	16,199	16,498	16,803	17,113	17,430	17,752	18,080	18,415	18,756	19,104
Feasibility study, work management, etc.	7,363	0	1,896	0	0	0	0	0	0	0	0	0	0	0	0
Land expropriation	726	368	0	0	0	0	0	0	0	0	0	0	0	0	0
Labour	4,255	25,915	13,152	0	0	0	0	0	0	0	0	0	0	0	0
Materials for civil works	990	7,031	4,078	0	0	0	0	0	0	0	0	0	0	0	0
Rentals	26	1,607	1,604	0	0	0	0	0	0	0	0	0	0	0	0
Transports	44	1,331	1,306	0	0	0	0	0	0	0	0	0	0	0	0
Electro-mechanical components and equipment	0	11,551	17,587	0	0	0	0	0	0	0	0	0	0	0	0
Investments costs	13,404	47,804	39,623	0	0	0	0	0	0	0	0	0	0	0	0
Replacement costs	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Residual value	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other investment items	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL INVESTMENT COSTS	13,404	47,804	39,623	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL EXPENDITURES	13,404	47,804	39,623	11,380	15,905	16,199	16,498	16,803	17,113	17,430	17,752	18,080	18,415	18,756	19,104
NET CASH FLOW	-13,404	-47,804	-39,623	3,263	5,330	5,358	5,386	5,413	5,440	5,465	5,491	5,515	5,539	5,562	5,584

	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Total municipal services income	17,558	17,848	18,143	18,443	18,747	19,057	19,372	19,692	20,017	20,348	20,684	21,026	21,374	21,727	22,086
Industrial and irrigation water supply revenue	7,505	7,596	7,688	7,782	7,876	7,971	8,068	8,166	8,265	8,365	8,466	8,568	8,672	8,777	8,883
SALES	25,063	25,444	25,831	26,224	26,623	27,028	27,440	27,858	28,282	28,713	29,150	29,595	30,046	30,504	30,969
Labour cost	1,883	1,919	1,957	1,995	2,033	2,073	2,113	2,154	2,196	2,239	2,283	2,327	2,372	2,419	2,466
Electrical energy	247	253	259	266	272	279	286	293	301	308	316	324	332	340	349
Materials (Chemicals, reagents, inert, etc.)	4,315	4,395	4,477	4,560	4,644	4,730	4,818	4,908	4,999	5,091	5,186	5,282	5,380	5,480	5,582
Intermediate services and goods	6,872	6,983	7,096	7,211	7,327	7,446	7,566	7,688	7,813	7,939	8,067	8,198	8,330	8,465	8,601
Maintenance	907	921	935	949	963	977	992	1,007	1,022	1,037	1,053	1,069	1,085	1,101	1,118
Elimination of treatment sludge	5,234	5,347	5,462	5,580	5,701	5,824	5,950	6,078	6,210	6,344	6,481	6,621	6,764	6,910	7,059
TOTAL OPERATING COSTS	19,457	19,818	20,185	20,560	20,941	21,329	21,725	22,129	22,540	22,958	23,385	23,820	24,263	24,714	25,174
Feasibility study, work management, etc.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Land expropriation	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Labour	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Materials for civil works	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rentals	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Transports	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Electro-mechanical components and equipment	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Investments costs	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Replacement costs	0	0	0	0	22,652	0	0	0	0	0	0	0	0	0	0
Residual value	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-6,030
Other investment items	0	0	0	0	22,652	0	0	0	0	0	0	0	0	0	-6,030
TOTAL INVESTMENT COSTS	0	0	0	0	22,652	0	0	0	0	0	0	0	0	0	-6,030
TOTAL EXPENDITURES	19,457	19,818	20,185	20,560	43,593	21,329	21,725	22,129	22,540	22,958	23,385	23,820	24,263	24,714	19,144
NET CASH FLOW	5,606	5,626	5,646	5,665	-16,970	5,699	5,714	5,729	5,742	5,754	5,765	5,775	5,783	5,790	11,825

Discount Rate	5.0%
FNPV (C)	-29,083.9
FRR (C)	1.9%
Funding Gap Ratio	0.32

Table 4.48 Financial return on national capital *(thousands of Euros)*

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Total municipal services income	0	0	0	10,096	14,662	14,904	15,150	15,401	15,655	15,914	16,177	16,444	16,716	16,992	17,273
Industrial and irrigation water supply revenue	0	0	0	4,546	6,573	6,653	6,733	6,815	6,898	6,981	7,066	7,152	7,239	7,326	7,415
SALES	0	0	0	14,642	21,235	21,557	21,884	22,216	22,553	22,895	23,243	23,596	23,954	24,318	24,688
RESIDUAL VALUE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL REVENUES	0	0	0	14,642	21,235	21,557	21,884	22,216	22,553	22,895	23,243	23,596	23,954	24,318	24,688
Labour cost	0	0	0	1,494	1,523	1,553	1,583	1,614	1,645	1,677	1,710	1,743	1,777	1,811	1,847
Electrical energy	0	0	0	129	188	193	198	203	208	213	218	224	229	235	241
Materials (Chemicals, reagents, inert, etc.)	0	0	0	2,422	3,525	3,590	3,657	3,725	3,794	3,864	3,936	4,009	4,083	4,159	4,236
Intermediate services and goods	0	0	0	3,969	5,762	5,855	5,949	6,045	6,143	6,242	6,343	6,446	6,550	6,656	6,763
Maintenance	0	0	0	531	770	782	794	805	818	830	842	855	868	881	894
Elimination of treatment sludge	0	0	0	2,835	4,137	4,226	4,318	4,411	4,506	4,604	4,703	4,805	4,908	5,015	5,123
TOTAL OPERATING COSTS	0	0	0	11,380	15,905	16,199	16,498	16,803	17,113	17,430	17,752	18,080	18,415	18,756	19,104
Bonds and other financial resources	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
EIB loans	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other loans	0	0	0	1,232	1,232	1,112	988	865	741	618	494	371	247	124	0
INTEREST	0	0	0	1,232	1,232	1,112	988	865	741	618	494	371	247	124	0
Bonds and other financial resources	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
EIB loans	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other loans	0	0	0	0	2,470	2,470	2,470	2,470	2,470	2,470	2,470	2,470	2,470	2,470	0
LOANS REIMBOURSEMENT	0	0	0	0	2,470	2,470	2,470	2,470	2,470	2,470	2,470	2,470	2,470	2,470	0
PRIVATE EQUITY	3,018	11,275	10,412	0	0	0	0	0	0	0	0	0	0	0	0
National contribution	1,258	10,164	7,607	0	0	0	0	0	0	0	0	0	0	0	0
Municipal contribution	1,700	4,495	4,068	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL NATIONAL PUBLIC CONTRIBUTION	2,958	14,659	11,675	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL EXPENDITURES	5,976	25,934	22,087	12,612	19,607	19,780	19,956	20,137	20,324	20,517	20,716	20,921	21,132	21,350	19,104
NET CASH FLOW	-5,976	-25,934	-22,087	2,031	1,628	1,776	1,928	2,078	2,228	2,378	2,527	2,675	2,822	2,968	5,584

	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Total municipal services income	17,558	17,848	18,143	18,443	18,747	19,057	19,372	19,692	20,017	20,348	20,684	21,026	21,374	21,727	22,086
Industrial and irrigation water supply revenue	7,505	7,596	7,688	7,782	7,876	7,971	8,068	8,166	8,265	8,365	8,466	8,568	8,672	8,777	8,883
SALES	25,063	25,444	25,831	26,224	26,623	27,028	27,440	27,858	28,282	28,713	29,150	29,595	30,046	30,504	30,969
RESIDUAL VALUE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6,030
TOTAL REVENUES	25,063	25,444	25,831	26,224	26,623	27,028	27,440	27,858	28,282	28,713	29,150	29,595	30,046	30,504	36,999
Labour cost	1,883	1,919	1,957	1,995	2,033	2,073	2,113	2,154	2,196	2,239	2,283	2,327	2,372	2,419	2,466
Electrical energy	247	253	259	266	272	279	286	293	301	308	316	324	332	340	349
Materials (Chemicals, reagents, inert, etc.)	4,315	4,395	4,477	4,560	4,644	4,730	4,818	4,908	4,999	5,091	5,186	5,282	5,380	5,480	5,582
Intermediate services and goods	6,872	6,983	7,096	7,211	7,327	7,446	7,566	7,688	7,813	7,939	8,067	8,198	8,330	8,465	8,601
Maintenance	907	921	935	949	963	977	992	1,007	1,022	1,037	1,053	1,069	1,085	1,101	1,118
Elimination of treatment sludge	5,234	5,347	5,462	5,580	5,701	5,824	5,950	6,078	6,210	6,344	6,481	6,621	6,764	6,910	7,059
TOTAL OPERATING COSTS	19,457	19,818	20,185	20,560	20,941	21,329	21,725	22,129	22,540	22,958	23,385	23,820	24,263	24,714	25,174
Bonds and other financial resources	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
EIB loans	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other loans	0	0	0	0	0	566	510	453	396	340	283	226	170	113	56
INTEREST	0	0	0	0	0	566	510	453	396	340	283	226	170	113	56
Bonds and other financial resources	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
EIB loans	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other loans	0	0	0	0	0	1,133	1,133	1,133	1,133	1,133	1,133	1,133	1,133	1,133	1,133
LOANS REIMBOURSEMENT	0	0	0	0	0	1,133	1,133	1,133	1,133	1,133	1,133	1,133	1,133	1,133	1,133
PRIVATE EQUITY	0	0	0	0	11,326	0	0	0	0	0	0	0	0	0	0
National contribution	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Municipal contribution	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL NATIONAL PUBLIC CONTRIBUTION	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL EXPENDITURES	19,457	19,818	20,185	20,560	32,267	23,029	23,368	23,715	24,069	24,431	24,801	25,179	25,566	25,960	26,363
NET CASH FLOW	5,606	5,626	5,646	5,665	-5,644	4,000	4,072	4,143	4,213	4,281	4,349	4,416	4,480	4,543	10,636

Discount Rate	5.0%
FNPV(K)	-8,357.8
FRR(K)	3.7%

Table 4.49 Financial return on local public capital *(thousands of Euros)*

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Service fee (PPP)	0	0	0	601	872	887	902	916	932	947	963	978	995	1,011	1,028
SALES	0	0	0	601	872	887	902	916	932	947	963	978	995	1,011	1,028
RESIDUAL VALUE															
TOTAL REVENUES	0	0	0	601	872	887	902	916	932	947	963	978	995	1,011	1,028
Labour cost															
Electrical energy															
Materials (Chemicals, reagents, inert, etc.)															
Intermediate services and goods															
Maintenance															
Elimination of treatment sludge															
TOTAL OPERATING COSTS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bonds and other financial resources															
EIB loans															
Other loans															
INTEREST	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bonds and other financial resources															
EIB loans															
Other loans															
LOANS REIMBOURSEMENT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PRIVATE EQUITY															
Municipal contribution	1,700	4,495	4,068	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL NATIONAL PUBLIC CONTRIBUTION	1,700	4,495	4,068	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL EXPENDITURES	1,700	4,495	4,068	0	0	0	0	0	0	0	0	0	0	0	0
NET CASH FLOW	-1,700	-4,495	-4,068	601	872	887	902	916	932	947	963	978	995	1,011	1,028

	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Service fee (PPP)	1,045	1,062	1,080	1,097	1,116	1,134	1,153	1,172	1,191	1,211	1,231	1,251	1,272	1,293	1,314
SALES	1,045	1,062	1,080	1,097	1,116	1,134	1,153	1,172	1,191	1,211	1,231	1,251	1,272	1,293	1,314
RESIDUAL VALUE															
TOTAL REVENUES	1,045	1,062	1,080	1,097	1,116	1,134	1,153	1,172	1,191	1,211	1,231	1,251	1,272	1,293	1,314
Labour cost															
Electrical energy															
Materials (Chemicals, reagents, inert, etc.)															
Intermediate services and goods															
Maintenance															
Elimination of treatment sludge															
TOTAL OPERATING COSTS	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bonds and other financial resources															
EIB loans															
Other loans															
INTEREST	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bonds and other financial resources															
EIB loans															
Other loans															
LOANS REIMBOURSEMENT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PRIVATE EQUITY															
Municipal contribution	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL NATIONAL PUBLIC CONTRIBUTION	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL EXPENDITURES	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
NET CASH FLOW	1,045	1,062	1,080	1,097	1,116	1,134	1,153	1,172	1,191	1,211	1,231	1,251	1,272	1,293	1,314

Discount Rate	5.0%
FNPV(K_g)	3,491.0
FRR(K_g)	7.8%

Table 4.50 Financial return on private equity *(thousands of Euros)*

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Total municipal services income	0	0	0	10,096	14,662	14,904	15,150	15,401	15,655	15,914	16,177	16,444	16,716	16,992	17,273
Industrial and irrigation water supply revenue	0	0	0	4,546	6,573	6,653	6,733	6,815	6,898	6,981	7,066	7,152	7,239	7,326	7,415
SALES	0	0	0	14,642	21,235	21,557	21,884	22,216	22,553	22,895	23,243	23,596	23,954	24,318	24,688
RESIDUAL VALUE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL REVENUES	0	0	0	14,642	21,235	21,557	21,884	22,216	22,553	22,895	23,243	23,596	23,954	24,318	24,688
Labour cost	0	0	0	1,494	1,523	1,553	1,583	1,614	1,645	1,677	1,710	1,743	1,777	1,811	1,847
Electrical energy	0	0	0	129	188	193	198	203	208	213	218	224	229	235	241
Materials (Chemicals, reagents, inert, etc.)	0	0	0	2,422	3,525	3,590	3,657	3,725	3,794	3,864	3,936	4,009	4,083	4,159	4,236
Intermediate services and goods	0	0	0	3,969	5,762	5,855	5,949	6,045	6,143	6,242	6,343	6,446	6,550	6,656	6,763
Maintenance	0	0	0	531	770	782	794	805	818	830	842	855	868	881	894
Elimination of treatment sludge	0	0	0	2,835	4,137	4,226	4,318	4,411	4,506	4,604	4,703	4,805	4,908	5,015	5,123
Service fee (PPP)	0	0	0	601	872	887	902	916	932	947	963	978	995	1,011	1,028
TOTAL OPERATING COSTS	0	0	0	11,980	16,777	17,085	17,399	17,719	18,045	18,377	18,715	19,059	19,410	19,767	20,131
Bonds and other financial resources	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
EIB loans	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other loans	0	0	0	1,232	1,232	1,112	988	865	741	618	494	371	247	124	0
INTEREST	0	0	0	1,232	1,232	1,112	988	865	741	618	494	371	247	124	0
Bonds and other financial resources	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
EIB loans	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other loans	0	0	0	0	2,470	2,470	2,470	2,470	2,470	2,470	2,470	2,470	2,470	2,470	0
LOANS REIMBOURSEMENT	0	0	0	0	2,470	2,470	2,470	2,470	2,470	2,470	2,470	2,470	2,470	2,470	0
PRIVATE EQUITY	3,018	11,275	10,412	0	0	0	0	0	0	0	0	0	0	0	0
National contribution															
Municipal contribution															
TOTAL NATIONAL PUBLIC CONTRIBUTION	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL EXPENDITURES	3,018	11,275	10,412	13,212	20,479	20,667	20,857	21,054	21,256	21,464	21,679	21,899	22,127	22,361	20,131
NET CASH FLOW	-3,018	-11,275	-10,412	1,430	755	889	1,026	1,162	1,297	1,431	1,564	1,696	1,827	1,957	4,557

	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Total municipal services income	17,558	17,848	18,143	18,443	18,747	19,057	19,372	19,692	20,017	20,348	20,684	21,026	21,374	21,727	22,086
Industrial and irrigation water supply revenue	7,505	7,596	7,688	7,782	7,876	7,971	8,068	8,166	8,265	8,365	8,466	8,568	8,672	8,777	8,883
SALES	25,063	25,444	25,831	26,224	26,623	27,028	27,440	27,858	28,282	28,713	29,150	29,595	30,046	30,504	30,969
RESIDUAL VALUE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6,030
TOTAL REVENUES	25,063	25,444	25,831	26,224	26,623	27,028	27,440	27,858	28,282	28,713	29,150	29,595	30,046	30,504	36,999
Labour cost	1,883	1,919	1,957	1,995	2,033	2,073	2,113	2,154	2,196	2,239	2,283	2,327	2,372	2,419	2,466
Electrical energy	247	253	259	266	272	279	286	293	301	308	316	324	332	340	349
Materials (Chemicals, reagents, inert, etc.)	4,315	4,395	4,477	4,560	4,644	4,730	4,818	4,908	4,999	5,091	5,186	5,282	5,380	5,480	5,582
Intermediate services and goods	6,872	6,983	7,096	7,211	7,327	7,446	7,566	7,688	7,813	7,939	8,067	8,198	8,330	8,465	8,601
Maintenance	907	921	935	949	963	977	992	1,007	1,022	1,037	1,053	1,069	1,085	1,101	1,118
Elimination of treatment sludge	5,234	5,347	5,462	5,580	5,701	5,824	5,950	6,078	6,210	6,344	6,481	6,621	6,764	6,910	7,059
Service fee (PPP)	1,045	1,062	1,080	1,097	1,116	1,134	1,153	1,172	1,191	1,211	1,231	1,251	1,272	1,293	1,314
TOTAL OPERATING COSTS	20,502	20,880	21,265	21,657	22,056	22,463	22,878	23,300	23,731	24,169	24,616	25,071	25,535	26,007	26,488
Bonds and other financial resources	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
EIB loans	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other loans	0	0	0	0	0	566	510	453	396	340	283	226	170	113	56
INTEREST	0	0	0	0	0	566	510	453	396	340	283	226	170	113	56
Bonds and other financial resources	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
EIB loans	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other loans	0	0	0	0	0	1,133	1,133	1,133	1,133	1,133	1,133	1,133	1,133	1,133	1,133
LOANS REIMBOURSEMENT	0	0	0	0	0	1,133	1,133	1,133	1,133	1,133	1,133	1,133	1,133	1,133	1,133
PRIVATE EQUITY	0	0	0	0	11,326	0	0	0	0	0	0	0	0	0	0
National contribution															
Municipal contribution															
TOTAL NATIONAL PUBLIC CONTRIBUTION	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL EXPENDITURES	20,502	20,880	21,265	21,657	33,382	24,163	24,521	24,886	25,260	25,642	26,032	26,430	26,837	27,253	27,677
NET CASH FLOW	4,561	4,564	4,566	4,567	-6,759	2,866	2,919	2,971	3,022	3,070	3,118	3,165	3,208	3,251	9,322

Discount Rate	5.0%
FNPV(K_p)	5,139.5
FRR(K_p)	6.5%

Table 4.51 Financial sustainability (*thousands of Euros*)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
PRIVATE EQUITY	3,018	11,275	10,412	0	0	0	0	0	0	0	0	0	0	0	0
National contribution	1,258	10,164	7,607	0	0	0	0	0	0	0	0	0	0	0	0
Municipal contribution	1,700	4,495	4,068	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL NATIONAL PUBLIC CONTRIBUTION	2,958	14,659	11,675	0	0	0	0	0	0	0	0	0	0	0	0
EU GRANT	4,410	10,595	7,124	0	0	0	0	0	0	0	0	0	0	0	0
LOANS	3,018	11,275	10,412	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL FINANCIAL RESOURCES	13,404	47,804	39,623	0	0	0	0	0	0	0	0	0	0	0	0
Total municipal services income	0	0	0	10,096	14,662	14,904	15,150	15,401	15,655	15,914	16,177	16,444	16,716	16,992	17,273
Industrial and irrigation water supply revenue	0	0	0	4,546	6,573	6,653	6,733	6,815	6,898	6,981	7,066	7,152	7,239	7,326	7,415
SALES	0	0	0	14,642	21,235	21,557	21,884	22,216	22,553	22,895	23,243	23,596	23,954	24,318	24,688
TOTAL INFLOWS	13,404	47,804	39,623	14,642	21,235	21,557	21,884	22,216	22,553	22,895	23,243	23,596	23,954	24,318	24,688
Labour cost	0	0	0	1,494	1,523	1,553	1,583	1,614	1,645	1,677	1,710	1,743	1,777	1,811	1,847
Electrical energy	0	0	0	129	188	193	198	203	208	213	218	224	229	235	241
Materials (Chemicals, reagents, inert, etc.)	0	0	0	2,422	3,525	3,590	3,657	3,725	3,794	3,864	3,936	4,009	4,083	4,159	4,236
Intermediate services and goods	0	0	0	3,969	5,762	5,855	5,949	6,045	6,143	6,242	6,343	6,446	6,550	6,656	6,763
Maintenance	0	0	0	531	770	782	794	805	818	830	842	855	868	881	894
Elimination of treatment sludge	0	0	0	2,835	4,137	4,226	4,318	4,411	4,506	4,604	4,703	4,805	4,908	5,015	5,123
TOTAL OPERATING COSTS	0	0	0	11,380	15,905	16,199	16,498	16,803	17,113	17,430	17,752	18,080	18,415	18,756	19,104
Feasibility study, work management, etc.	7,363	0	1,896	0	0	0	0	0	0	0	0	0	0	0	0
Land expropriation	726	368	0	0	0	0	0	0	0	0	0	0	0	0	0
Labour	4,255	25,915	13,152	0	0	0	0	0	0	0	0	0	0	0	0
Materials for civil works	990	7,031	4,078	0	0	0	0	0	0	0	0	0	0	0	0
Rentals	26	1,607	1,604	0	0	0	0	0	0	0	0	0	0	0	0
Transports	44	1,331	1,306	0	0	0	0	0	0	0	0	0	0	0	0
Electro-mechanical components and equipment	0	11,551	17,587	0	0	0	0	0	0	0	0	0	0	0	0
Investments costs	13,404	47,804	39,623	0	0	0	0	0	0	0	0	0	0	0	0
Replacement costs	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Residual value															
Other investment items	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL INVESTMENT COSTS	13,404	47,804	39,623	0	0	0	0	0	0	0	0	0	0	0	0
Bonds and other financial resources	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
EIB loans	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other loans	0	0	0	1,232	1,232	1,112	988	865	741	618	494	371	247	124	0
INTEREST	0	0	0	1,232	1,232	1,112	988	865	741	618	494	371	247	124	0
Bonds and other financial resources	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
EIB loans	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other loans	0	0	0	0	2,470	2,470	2,470	2,470	2,470	2,470	2,470	2,470	2,470	2,470	0
LOANS REIMBOURSEMENT	0	0	0	0	2,470	2,470	2,470	2,470	2,470	2,470	2,470	2,470	2,470	2,470	0
PROFIT TAXATION	0	0	0	1,171	1,699	1,725	1,751	1,777	1,804	1,832	1,859	1,888	1,916	1,945	1,975
TOTAL OUTFOLWS	13,404	47,804	39,623	13,783	21,306	21,505	21,706	21,915	22,129	22,349	22,576	22,809	23,049	23,295	21,079
NET CASH FLOW	0	0	0	859	-71	52	177	301	424	546	667	787	905	1,023	3,609
CUMULATED TOTAL CASH FLOW	0	0	0	859	788	839	1,017	1,318	1,742	2,288	2,955	3,742	4,647	5,670	9,279

>>> *continues*

	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
PRIVATE EQUITY	0	0	0	0	11,326	0	0	0	0	0	0	0	0	0	0
National contribution	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Municipal contribution	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL NATIONAL PUBLIC CONTRIBUTION	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
EU GRANT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
LOANS	0	0	0	0	11,326	0	0	0	0	0	0	0	0	0	0
TOTAL FINANCIAL RESOURCES	0	0	0	0	22,652	0	0	0	0	0	0	0	0	0	0
Total municipal services income	17,558	17,848	18,143	18,443	18,747	19,057	19,372	19,692	20,017	20,348	20,684	21,026	21,374	21,727	22,086
Industrial and irrigation water supply revenue	7,505	7,596	7,688	7,782	7,876	7,971	8,068	8,166	8,265	8,365	8,466	8,568	8,672	8,777	8,883
SALES	25,063	25,444	25,831	26,224	26,623	27,028	27,440	27,858	28,282	28,713	29,150	29,595	30,046	30,504	30,969
TOTAL INFLOWS	25,063	25,444	25,831	26,224	49,275	27,028	27,440	27,858	28,282	28,713	29,150	29,595	30,046	30,504	30,969
Labour cost	1,883	1,919	1,957	1,995	2,033	2,073	2,113	2,154	2,196	2,239	2,283	2,327	2,372	2,419	2,466
Electrical energy	247	253	259	266	272	279	286	293	301	308	316	324	332	340	349
Materials (Chemicals, reagents, inert, etc.)	4,315	4,395	4,477	4,560	4,644	4,730	4,818	4,908	4,999	5,091	5,186	5,282	5,380	5,480	5,582
Intermediate services and goods	6,872	6,983	7,096	7,211	7,327	7,446	7,566	7,688	7,813	7,939	8,067	8,198	8,330	8,465	8,601
Maintenance	907	921	935	949	963	977	992	1,007	1,022	1,037	1,053	1,069	1,085	1,101	1,118
Elimination of treatment sludge	5,234	5,347	5,462	5,580	5,701	5,824	5,950	6,078	6,210	6,344	6,481	6,621	6,764	6,910	7,059
TOTAL OPERATING COSTS	19,457	19,818	20,185	20,560	20,941	21,329	21,725	22,129	22,540	22,958	23,385	23,820	24,263	24,714	25,174
Feasibility study, work management, etc.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Land expropriation	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Labour	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Materials for civil works	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rentals	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Transports	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Electro-mechanical components and equipment	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Investments costs	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Replacement costs	0	0	0	0	22,652	0	0	0	0	0	0	0	0	0	0
Residual value															
Other investment items	0	0	0	0	22,652	0	0	0	0	0	0	0	0	0	0
TOTAL INVESTMENT COSTS	0	0	0	0	22,652	0	0	0	0	0	0	0	0	0	0
Bonds and other financial resources	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
EIB loans	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other loans	0	0	0	0	0	566	510	453	396	340	283	226	170	113	56
INTEREST	0	0	0	0	0	566	510	453	396	340	283	226	170	113	56
Bonds and other financial resources	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
EIB loans	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other loans	0	0	0	0	0	1,133	1,133	1,133	1,133	1,133	1,133	1,133	1,133	1,133	1,133
LOANS REIMBOURSEMENT	0	0	0	0	0	1,133	1,133	1,133	1,133	1,133	1,133	1,133	1,133	1,133	1,133
PROFIT TAXATION	2,005	2,036	2,066	2,098	2,130	2,162	2,195	2,229	2,263	2,297	2,332	2,368	2,404	2,440	2,478
TOTAL OUTFOLWS	21,462	21,853	22,252	22,657	45,723	25,191	25,563	25,943	26,332	26,728	27,133	27,546	27,969	28,400	28,841
NET CASH FLOW	3,601	3,591	3,579	3,567	3,552	1,837	1,877	1,914	1,950	1,984	2,017	2,048	2,076	2,103	2,128
CUMULATED TOTAL CASH FLOW	12,880	16,471	20,050	23,617	27,169	29,006	30,883	32,797	34,747	36,732	38,749	40,797	42,873	44,976	47,104

Table 4.52 Economic analysis (thousands of Euros)

	CF	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
SALES		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Wastewater treatment external benefits	-	0	0	0	3,680	5,378	5,501	5,627	5,756	5,888	6,022	6,159	6,299	6,442	6,588	6,737
Benefit due to improvement of the production in the well irrigated area	-	0	0	0	18,677	27,082	27,488	27,900	28,319	28,743	29,175	29,612	30,056	30,507	30,965	31,429
Savings in groundwater resources	-	0	0	0	5,756	8,321	8,420	8,521	8,623	8,726	8,830	8,936	9,043	9,151	9,260	9,371
POSITVE EXTERNALITIES		0	0	0	28,112	40,780	41,409	42,048	42,697	43,357	44,027	44,707	45,398	46,100	46,813	47,537
TOTAL ECONOMIC BENEFITS		0	0	0	28,112	40,780	41,409	42,048	42,697	43,357	44,027	44,707	45,398	46,100	46,813	47,537
Skilled personnel labour cost	1.00	0	0	0	576	588	599	611	624	636	649	662	675	689	703	717
Not-skilled personnel labour cost	0.60	0	0	0	551	561	572	583	594	605	617	629	641	653	665	678
Electrical energy	0.96	0	0	0	123	180	185	190	194	199	204	209	214	220	225	231
Materials (Chemicals, reagents, inert, etc.)	0.80	0	0	0	1,932	2,812	2,864	2,917	2,971	3,026	3,082	3,140	3,198	3,257	3,318	3,379
Intermediate services and goods	0.71	0	0	0	2,802	4,067	4,132	4,199	4,267	4,336	4,406	4,477	4,550	4,623	4,698	4,774
Maintenance	0.71	0	0	0	375	544	552	560	569	577	586	595	604	613	622	631
Elimination of treatment sludge	0.80	0	0	0	2,255	3,291	3,363	3,435	3,509	3,585	3,663	3,742	3,823	3,905	3,990	4,076
TOTAL OPERATING COSTS		0	0	0	8,614	12,043	12,267	12,495	12,728	12,965	13,207	13,453	13,704	13,959	14,220	14,485
Feasibility study, work management, etc.	1.00	7,363	0	1,896	0	0	0	0	0	0	0	0	0	0	0	0
Land expropriation	0.60	435	221	0	0	0	0	0	0	0	0	0	0	0	0	0
Labour	0.64	2,723	16,586	8,417	0	0	0	0	0	0	0	0	0	0	0	0
Materials for civil works	0.83	821	5,836	3,385	0	0	0	0	0	0	0	0	0	0	0	0
Rentals	0.68	18	1,094	1,092	0	0	0	0	0	0	0	0	0	0	0	0
Transports	0.68	30	906	889	0	0	0	0	0	0	0	0	0	0	0	0
Electro-mechanical components and equipment	0.82	0	9,466	14,412	0	0	0	0	0	0	0	0	0	0	0	0
Investments costs		11,391	34,109	30,092	0	0	0	0	0	0	0	0	0	0	0	0
Replacement costs	0.82	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Residual value	0.76	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other investment items		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL INVESTMENT COSTS		11,391	34,109	30,092	0	0	0	0	0	0	0	0	0	0	0	0
Noise, odours, etc.	-	0	0	0	617	894	908	921	935	949	963	978	992	1,007	1,022	1,038
NEGATIVE EXTERNALITIES		0	0	0	617	894	908	921	935	949	963	978	992	1,007	1,022	1,038
TOTAL ECONOMIC COSTS		11,391	34,109	30,092	9,231	12,937	13,175	13,417	13,663	13,914	14,170	14,431	14,696	14,967	15,242	15,523
NET ECONOMIC BENEFITS		-11,391	-34,109	-30,092	18,882	27,843	28,235	28,632	29,034	29,443	29,856	30,276	30,702	31,133	31,571	32,014

	CF	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
SALES		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Wastewater treatment external benefits	-	6,889	7,045	7,204	7,366	7,532	7,701	7,874	8,050	8,231	8,415	8,604	8,796	8,993	9,194	9,400
Benefit due to improvement of the production in the well irrigated area	-	31,901	32,379	32,865	33,358	33,858	34,366	34,882	35,405	35,936	36,475	37,022	37,577	38,141	38,713	39,294
Savings in groundwater resources	-	9,483	9,596	9,711	9,827	9,945	10,063	10,184	10,306	10,429	10,553	10,680	10,807	10,936	11,067	11,199
POSITVE EXTERNALITIES		48,273	49,020	49,779	50,551	51,334	52,130	52,939	53,761	54,596	55,444	56,305	57,181	58,071	58,975	59,893
TOTAL ECONOMIC BENEFITS		48,273	49,020	49,779	50,551	51,334	52,130	52,939	53,761	54,596	55,444	56,305	57,181	58,071	58,975	59,893
Skilled personnel labour cost	1.00	731	746	761	776	792	808	824	840	857	874	892	910	928	947	966
Not-skilled personnel labour cost	0.60	691	704	717	731	745	759	774	789	804	819	834	850	867	883	900
Electrical energy	0.96	237	243	249	255	261	268	274	281	288	296	303	311	318	326	334
Materials (Chemicals, reagents, inert, etc.)	0.80	3,442	3,506	3,571	3,637	3,705	3,773	3,843	3,915	3,987	4,061	4,137	4,213	4,292	4,371	4,452
Intermediate services and goods	0.71	4,851	4,929	5,009	5,090	5,172	5,256	5,340	5,427	5,514	5,604	5,694	5,786	5,880	5,975	6,071
Maintenance	0.71	641	650	660	670	680	690	700	711	722	732	743	755	766	777	789
Elimination of treatment sludge	0.80	4,164	4,254	4,346	4,440	4,536	4,634	4,734	4,836	4,940	5,047	5,156	5,268	5,381	5,498	5,617
TOTAL OPERATING COSTS		14,756	15,031	15,312	15,598	15,890	16,187	16,490	16,798	17,113	17,433	17,760	18,092	18,431	18,777	19,129
Feasibility study, work management, etc.	1.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Land expropriation	0.60	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Labour	0.64	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Materials for civil works	0.83	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rentals	0.68	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Transports	0.68	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Electro-mechanical components and equipment	0.82	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Investments costs		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Replacement costs	0.82	0	0	0	0	18,563	0	0	0	0	0	0	0	0	0	0
Residual value	0.76	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-4,590
Other investment items		0	0	0	0	18,563	0	0	0	0	0	0	0	0	0	-4,590
TOTAL INVESTMENT COSTS		0	0	0	0	18,563	0	0	0	0	0	0	0	0	0	-4,590
Noise, odours, etc.		1,053	1,069	1,085	1,101	1,118	1,135	1,152	1,169	1,187	1,204	1,222	1,241	1,259	1,278	1,297
NEGATIVE EXTERNALITIES	-	1,053	1,069	1,085	1,101	1,118	1,135	1,152	1,169	1,187	1,204	1,222	1,241	1,259	1,278	1,297
TOTAL ECONOMIC COSTS		15,809	16,101	16,397	16,700	35,570	17,322	17,641	17,967	18,299	18,637	18,982	19,333	19,691	20,055	15,836
NET ECONOMIC BENEFITS		32,464	32,920	33,382	33,851	15,764	34,809	35,298	35,793	36,296	36,806	37,324	37,848	38,380	38,920	44,057

Discount Rate	5.5%
ENPV	295,519.1
ERR	28.9%
B/C	2.2

4.5 Case Study: industrial investment

4.5.1 Project objectives

In order to assist a Convergence Region development strategy in a Cohesion Country, the government decided to co-finance an industrial investment project.

The objective of the project support is to pursue the productive base of the region in the manufacturing sector as a growth catalyst for economic development.

Consequently, the project is expected to improve the regional competitiveness on national and international markets and to increase, directly or indirectly, the income level of the region.

In order to limit the support to the private sector and to avoid strong displacement effects, the government decided to keep financing under an acceptable threshold, in line with the priorities stated its Operational Programme and in compliance with EU legislation on State Aid.

4.5.2 Project identification

The government identified an investment in the automotive supply-chain sector. This industry guarantees a reasonably safe financial return and at the same time it assures an improvement in the technological level of the regional industrial structure.

Point B.5.1. of Annex XXII of Regulation (EC) 1828/2006 (Application Form for major projects/productive investments) requires an indication of 'the extent to which the region(s) is/are at present endowed with the type of production facilities or activities covered by this application': the region in which the investment is expected to be realised, even with a low industrialization level, has a majority of companies operating in traditional industrial sectors; thus, this investment integrates well into the existing economic environment and would increase business for local firms.

The automotive components market has experienced a reasonably stable growth pattern in the last decade, confirming itself as a mature and relatively safe sector. The company currently has a 5% share of the European market, compared to the 3% share of ten years ago, recording a better performance than its competitors. The market structure is expected to remain stable, partly due to the high entry barriers characterising the sector.

The legislation on pollutant emissions calls for a series of standards that require the continuous innovation of some automotive components, a circumstance that guarantees a good outlook for the sector.

Preliminary studies showed the project to be feasible from the technical, managerial and profitability points of view.

4.5.3 Feasibility and option analysis

4.5.3.1 Financial-economic reliability

The private actor who proposed the project to be co-financed is a multinational company active in the automotive industry with production plants in many countries. The company has a long history of successful achievements in this sector and has demonstrated a reliable financial structure and strong economic performance in recent years.

Point B.1.3 of the Application Form requests the definition of enterprise size. The company is not classifiable as an SME (Small Medium Enterprise) according to the definition of Recommendation 2003/361/EC because it has more than 250 employees and a turnover higher than €50,000,000. An in-depth financial analysis of the balance-sheets of the last three years was conducted by expert auditors.

4.5.3.2 Technical features of the project

The project implies the purchase of the land, the construction of two main buildings, the acquisition of tools, machinery, software and hardware. Moreover, the company will be responsible for establishing road connections between the plant site and the city's road network.

4.5.3.3 Options analysis

The government considered two alternative options:

- 'Business as usual': the region would carry on with its limited economic growth and in particular with a high unemployment rate.
- Supporting a productive investment in a highly-innovative sector: an alternative investment in nanotechnologies was proposed. Such an investment could be highly profitable and also a good growth-driver, but the uncertainties associated with the sector and the absence of an industrial environment sustaining the project make it too risky.

In the end the government preferred the project in a more traditional sector, one that promises an increase in social welfare and fits the present local industrial structure.

4.5.3.4 Type of financing

The government can support the private investment promoter by co-financing the project in different ways:

- A subsidy to cover interest
- Capital grant
- Tax exemption.

Assuming a fixed amount of public disbursement, the main selective criterion is the time profile. For the private actor the preferred option would be a capital grant in order to cover the large cash outflows of the early years due to fixed investments. The least preferred type of contribution would be tax exemption because it implies no immediate cash inflows and a delayed saving of cash outflows. The subsidy for the interest account allows the company to borrow money from the credit system to start investments at a very low interest rate and it facilitates the spreading of financial outflows over many years, thus resulting in a lower burden on the yearly budget.

4.5.4 Financial analysis

The financial analysis was conducted using the main elements and parameters referred to in Point E.1. of the Application Form.

The time horizon for evaluating the project is 10 years. The reference financial discount rate is 5%.

The analysis is at constant prices, with changes in relative prices[103].

The investment is expected to take three years for full realization. However, production activities will start in the second year, albeit at an initially slow rate. Indeed, in the first couple of years following full realization of the investment, the growth rate of production is very high, while from the sixth year onwards it is expected to stabilise at a lower level.

The following paragraphs illustrate the main categories of financial flows.

[103] An analysis at current prices with a discount rate that includes inflation will be carried out as well (not reported here).

4.5.4.1 Investment costs

The total investment costs of the project amount to €64.5 Million (€62 Million of fixed assets, €1 Million of pre-production expenses, and €1.5 Million of variation in working capital). More specifically:

- The land to be bought costs €50 per m^2 and the company needs 60,000 m^2, for a total cost of €3 Million.
- The project includes the construction of two new plants, the first of 2,000 m^2 and the second of 5,000 m^2, for a total cost of €17 Million.
- The acquisition of tools, machinery, software and hardware from the best suppliers is expected to cost €42 Million.
- Licences and Patents expenses are estimated at €1 Million.

All the costs are considered net of Value Added Tax.

4.5.4.2 Operating costs

Operations will require different inputs. Assumptions are made about their dynamics depending on the expected market growth (prices and demand).

Table 4.53 Main costs as a percentage of sales

COST ITEMS	Value as% of sales	Average annual increase/decrease (%)
Raw materials	51	0.00
Electricity	4	0.10
Fuel	5	0.30
Maintenance	3	0.00
General industrial costs	3	-0.15
Administrative variable costs	3	-0.10
Sales expenditures A	3	0.00
Sales expenditures B	4	0.00
Sales expenditures C	2	0.00

With regard to the cost of labour, the required number of workers and the cost per worker in future years, the assumptions are shown in Table 4.54. To simplify the calculation it was assumed that labour costs included some other minor fixed costs (e.g. administrative costs).

Table 4.54 Cost of labour / Main consumption

Type of worker	Number needed	Baseline salary (*000/€*)	Increase in base salary (%)
Unskilled workers	50	13	1.00
Skilled workers	25	15	1.20
White collars	20	18	1.50

4.5.4.3 Operating revenues

The company will produce three outputs, in particular two for specific customers and one for the market. Detailed forecasts were made for the output and the price of each of them (not reported here).

The three financial performance indicators were calculated:

- the project's return on investment (FNPV(C) and FRR(C))
- the project's return on national capital (FNPV(K) and FRR(K))
- the project's return on private equity (FNPV(K_p) and FRR(K_p))

The financial performance of the investment is modest (FRR(C) is 3.3%), while the returns on national capital and private equity are high (respectively 9.3% and 11.8%). In fact the investment itself would probably not have been implemented because of the fairly low expected financial return and the relatively high risk of investing in the area. Nevertheless, thanks to the contribution of EU funds, the company has a strong incentive to implement the investment, because it is guaranteed a satisfactory return on its equity.

The project performance in terms of return on private equity is computed by including in the outflows only the private equity (plus loan reimbursement and interest), thus disregarding both the contribution of the national public sector and the EU as financial outflows. The return in this case is higher, since it is intended to remunerate the risk of the private investor (see below, Risk Assessment).

The financial performance indicators are:

- Financial Net Present Value (investment)	FNPV(C)	-€5,472,500
- Financial Rate of Return (investment)	FRR(C)	3.3%
- Financial Net Present Value (capital)	FNPV(K)	€10,458,180
- Financial Rate of Return (capital)	FRR(K)	9.3%
- Financial Net Present Value (private equity)	FNPV(K_p)	€14,958,180
- Financial Rate of Return (private equity)	FRR(K_p)	11.8%

4.5.4.4 Financial sustainability

One of the most relevant issues to be checked is the financial sustainability of the project, which implies that, for each year, the cumulated sum of the net inflows must be higher than the outflows of that year. The financial resources must be organised in order to satisfy this condition.

The financial resources planned are as follows:

- EU grant => €14,170,000
- Total national public contribution => €4,725,000
- Loans from credit system => €10,000,000
- Private equity => €33,608,0000

The EU grant is equal to the eligible costs (€63,000,000) * 30% (State Aid plafond) * 75% (co-financing rate). In the case of productive investment projects the funding-gap method is not applicable on the basis of Article 55(6) of Regulation 1083/2006. Therefore the national contribution is equal to 63,000,000 * 30% * 25%.

The real interest rate on loans was assumed to be 5%.

In order to guarantee the financial sustainability and capacity to minimise interest expenditure, the company will input its own capital in the first three years and will obtain the financial inflows from loans in the third year. The projected loan reimbursement is shown in the financial sustainability table.

4.5.5 Economic analysis

The starting point for the economic analysis is the financial analysis. Specific conversion factors and standard conversion factors were used to convert market prices into prices adjusted for market imperfections.

The Value Added Tax on raw materials was eliminated. In a similar way, the energy costs were considered net of taxation. The labour cost was considered net of insurance contributions and income taxes because the reservation wage was to be taken as the shadow wage, due to high unemployment in the area. Sales were to be accounted net of Value Added Tax.

Land is provided by the local government at a concession price that is below the market price; for this reason a conversion factor of 1.235 was applied.

Finally, a residual value was estimated of €28 Million in year 10. The conversion factors applied to the buildings, the replacement of short-life equipment and the residual value were calculated as a weighted average of the single components' conversion factors.

A standard conversion factor of 0.95 was used to account for generic price distortions in the country.

Table 4.55 Conversion factors per type of cost

Type of cost	CF	Notes
Skilled labour	0.600	Shadow wage for non-competitive labour market
Land	1.235	Concession price below market price
Buildings	0.715	50% construction materials (CF=SCF), 40% labour, 10% profit (CF=0)
Raw Materials	0.950	Traded goods; CF=0.95
Equipment	0.990	Set like CF of machinery aggregate sector (0.99)
Electricity	0.970	As in the public utilities sector
Fuel	0.970	As in the public utilities sector
Replacement of short-life equipment	0.756	60% labour, 40% equipment
Investment (weighted)	0.928	4.8% land, 27% buildings, 66.7% equipment, 1.6% patents and licenses
Residual value	0.928	100% investment (weighted)

The real discount rate was 5.5%, as indicated in Working Document No 4 for Cohesion Countries.

Even though there will be some beneficial externalities (e.g. for other users of the roads to be built) and some displacement effects, they were not estimated, because they were assumed to be modest. The negative effects deriving from the traffic congestion due to the new industrial plant will be compensated by the new roads that the company has to build. As a negative externality, the pollutant emissions were taken into account.

It is not easy to estimate the economic value of the overall environmental damage because of the variety of pollutant emissions and because of the lack of reliable data about the volume of emissions for industry sectors other than those subject to emission limitation regulation. The company will provide an environmental impact assessment carried out by external experts from which it may be possible to identify the volume of each pollutant produced during the industrial process.

An average emission of 0.5 ton of CO_2 per unit of production was assumed. A prudential economic value of €8 was applied to 1 ton of CO_2.

The economic performance is better than the financial return on investment (see Table 4.62) mainly thanks to the socio-economic valuation of the costs. In fact the economic analysis gave these performance indicators:

- Economic Net Present value	ENPV	€3,537,540
- Economic Internal Rate of Return	ERR	6.7%
- Benefit Cost Ratio	BCR	1.02

4.5.6 Risk assessment

In order to assess the project risk, a sensitivity analysis was carried out as a first step. Moreover, as stated in Regulation (EC) 1086/2006, a complete risk assessment was also conducted.

For industrial investment projects the two most critical variables are the sales and the investment costs. Operating costs are also critical, but in this case they have been calculated as a function of sales, therefore they are directly correlated to them.

Consequently, a sensitivity analysis that considers possible variations in operating costs and items of investment costs must be carried out.

4.5.6.1 Sales

It is possible to consider a worse dynamic for the sales of product C (the one not designed for a specific customer). In this case, with a reduction of 5% in annual growth and of 5% in initial output, the performance of the project would decrease in a remarkable way. In this case, assumptions showed in the table were made.

Table 4.56 Sales of product C - Assumption

		1	2	3	4	5	6	7	8	9	10
Baseline Assumption											
Initial output= 2,000	+% of the output			60	80	200	30	2	2	2	2
Sensitivity test											
Initial output =1,900	+% of the output			57	76	190	28.5	1.9	1.9	1.9	1.9

4.5.6.2 Investment costs

The other possibility is to consider a worse situation for the dynamics of some investment cost items, as shown in the following tables.

An investigation into the impact of the single components of investment costs was conducted and has underlined the importance of building and new equipment costs.

Also in this case the results of financial and economic analyses for the two items are presented for a 5% variation in the yearly absolute value.

Table 4.57 Building costs – Assumption – Thousands of Euros

	1	2	3	4	5	6	7	8	9	10
Baseline Assumption	6,000	6,000	5,000							
Sensitivity test (+5%)	6,300	6,300	5,250							

Table 4.58 New equipment costs – Assumption – Thousands of Euros

	1	2	3	4	5	6	7	8	9	10
Baseline Assumption	10,000	14,000	18,000							
Sensitivity test (+5%)	10,500	14,700	18,900							

As requested by Point E.1. of the Application Form, the impact of parameter variation in terms of modification of the main performance indicators is summarised in the table below.

Table 4.59 Results of the sensitivity test

Performance Indicators	Baseline Case	Sensitivity Test		
		Sales of product C (-5%)	Operating Costs	
			Buildings (+5%)	New Equipment (+5%)
FNPV(C) – M Euro	-5.47	- 9.77	-6.24	-7.35
FRR(C)	3.3%	1.9%	3.0%	2.8%
FNPV(K) – M Euro	10.45	6.15	10.45*	10.45*
FRR(K)	9.3%	7.6%	9.3%*	9.3%*
ENPV- M Euro	3.53	-1.16	2.82	1.52
ERR	6.7%	5.1%	6.4%	6.0%

** Buildings and new equipment costs do not affect the FNPV(K) and FRR(K)*

With regard to the investment costs, the analysis points out that the most critical item is new equipment costs. A similar variation in land cost only has a slight effect on both financial and economic profitability.

This analysis shows the need to pay great attention to the forecasts of investment costs and sales. An over-optimistic provision for sales can turn an unprofitable investment project into a profitable one: so, it is important to analyse the market dynamics and the company's capacity to compete successfully.

In order to properly assess the project risk, the risk analysis was based on an appropriate probability distribution for the critical variables. In the sensitivity analysis the most critical variables identified were 'Sales of product C' and 'New equipment costs'.

Table 4.60 Assumed probability distributions of the project variables, Monte Carlo method

Variable	Applied to	Range	Kind of distribution	Notes
Sales of product C	Financial and economic	1,400–2,600 units	Gaussian	MV[104] = 2,000; SD = 180
New equipment costs	Financial and economic	38,000–46,000 Euro	Triangular	

Figure 4.15 Probability distribution of sales of product C in Units – Normal distribution

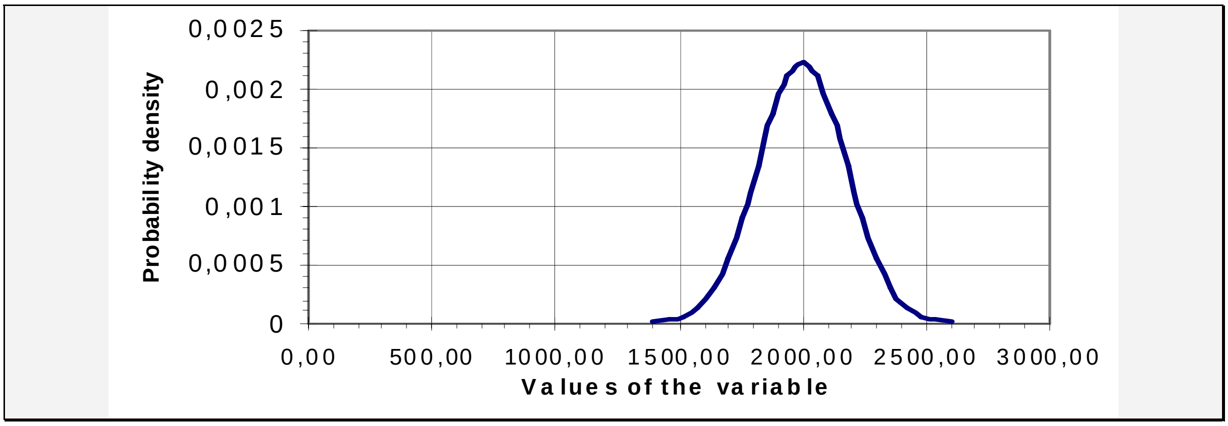
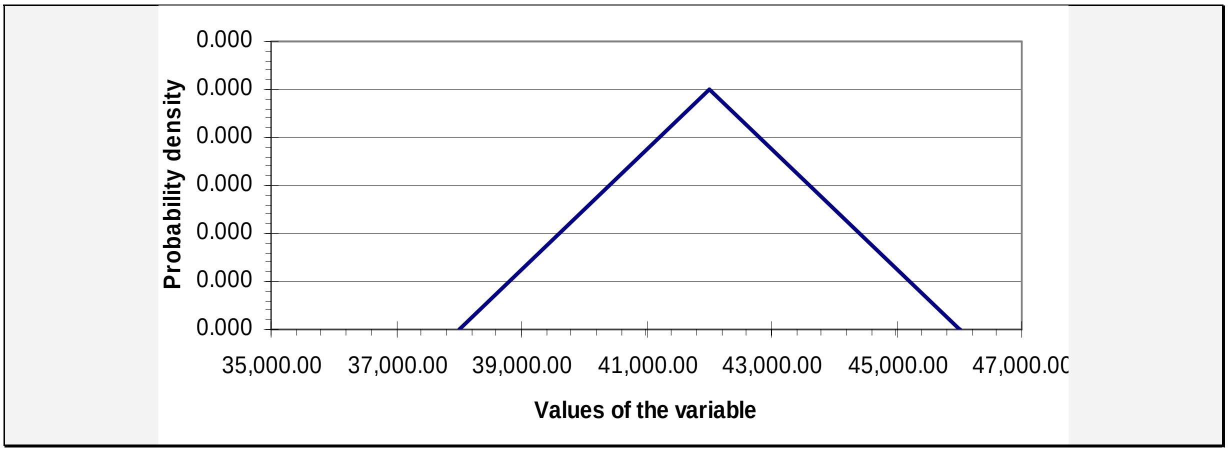


Figure 4.16 Probability distribution of new equipment costs in Euro – Triangular distribution



The results of the risk analysis (see Figure 4.17 below) show that the project is highly risky (more than 40% probability of a negative ENPV). Given the modest financial return on investment and the high risk for the economic return[105], the project should be reconsidered and risk mitigation measures adopted.

[104] MV = Mean value; SD = Standard deviation.

[105] The risk is also relatively high for the private investor (the analysis is not reported here).

Table 4.61 Probability parameters

	ENPV (Millions of Euros)	ERR%
Reference value (baseline case)	3.53	6.68
Mean	3.42	6.50
Median	3.64	6.71
Standard deviation	10.66	3.55
Minimum value	-29.29	-5.62
Central value Mode	2.90	5.35
Maximum value	35.16	16.31

Figure 4.17 Probability distribution of ENPV

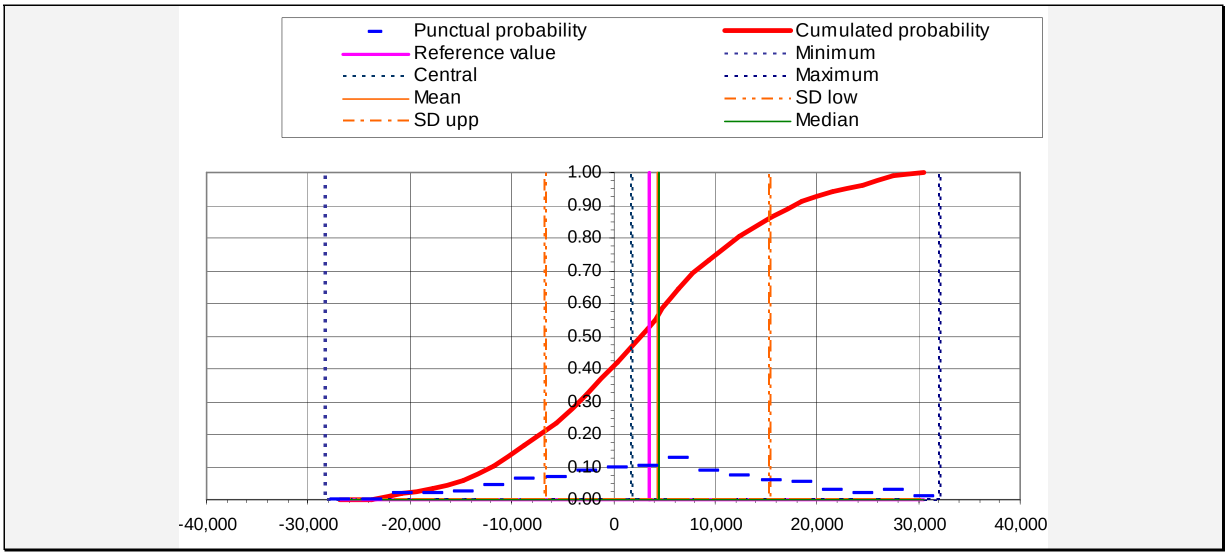


Figure 4.18 Probability distribution of ERR

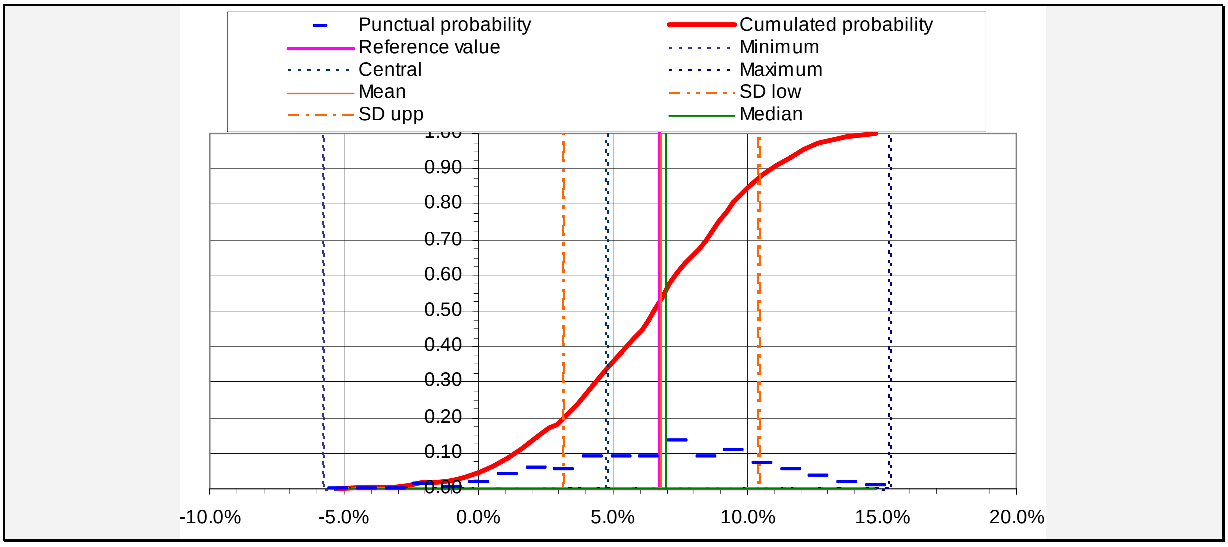


Table 4.62 Financial return on investment (thousands of Euros)

	1	2	3	4	5	6	7	8	9	10
Product A	0	1,200	1,800	3,060	4,766	4,934	5,108	5,287	5,473	5,665
Product B	0	750	1,050	1,680	2,206	2,272	2,341	2,412	2,485	2,534
Product C	0	2,400	3,840	6,912	20,798	27,119	27,744	28,384	29,038	29,708
SALES	0	4,350	6,690	11,652	27,770	34,325	35,193	36,083	36,996	37,907
Raw materials	0	2,219	3,412	5,943	14,163	17,506	17,948	18,402	18,868	19,333
Labour	0	295	820	1,418	1,435	1,452	1,469	1,486	1,504	1,522
Electricity	0	178	281	501	1,222	1,545	1,619	1,696	1,776	1,857
Fuel	0	231	375	687	1,722	2,231	2,393	2,562	2,738	2,919
Maintenance	0	131	201	350	833	1,030	1,056	1,082	1,110	1,137
General industrial costs	0	124	181	297	666	772	739	704	666	625
Administrative costs	0	126	187	315	722	858	845	830	814	796
Sales expenditure	0	114	173	297	647	781	802	823	844	865
TOTAL OPERATING COSTS	0	3,418	5,630	9,808	21,410	26,175	26,871	27,585	28,320	29,054
RETIREMENT BONUS	0	0	0	0	0	0	0	0	0	0
Land	3,000	0	0	0	0	0	0	0	0	0
Buildings	6,000	6,000	5,000	0	0	0	0	0	0	0
New Equipment	10,000	14,000	18,000	0	0	0	0	0	0	0
Used Equipment	0	0	0	0	0	0	0	0	0	0
Extraordinary Maintenance	0	0	0	0	0	0	0	0	0	0
FIXED ASSETS	19,000	20,000	23,000	0	0	0	0	0	0	0
Licenses	0	0	500	0	0	0	0	0	0	0
Patents	0	0	500	0	0	0	0	0	0	0
Other pre-production expenses	0	0	0	0	0	0	0	0	0	0
PRE-PRODUCTION EXPENDITURE	0	0	1,000	0	0	0	0	0	0	0
Investments costs	19,000	20,000	24,000	0	0	0	0	0	0	0
Cash	50	125	90	90	90	90	90	90	90	90
Client	110	460	600	600	600	600	600	600	600	600
Stock	1,400	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000
Current Liabilities	1,060	1,185	1,190	1,190	1,190	1,190	1,190	1,190	1,190	1,190
Net working capital	500	1,400	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500
Variations in working capital	500	900	100	0	0	0	0	0	0	0
Replacement of short-life equipment	0	0	0	0	0	240	420	540	296	518
Residual value	0	0	0	0	0	0	0	0	0	-28,000
Other investment items	0	0	0	0	0	240	420	540	296	-27,482
TOTAL INVESTMENT COSTS	19,500	20,900	24,100	0	0	240	420	540	296	-27,482
TOTAL EXPENDITURE	19,500	24,318	29,730	9,808	21,410	26,415	27,291	28,125	28,616	1,572
NET CASH FLOW	-19,500	-19,968	-23,040	1,844	6,360	7,910	7,902	7,958	8,380	36,335

Discount Rate	5.0%
FNPV (C)	-5,472.5
FRR (C)	3.3%

Table 4.63 Financial return on national capital (thousands of Euros)

	1	2	3	4	5	6	7	8	9	10
Product A	0	1,200	1,800	3,060	4,766	4,934	5,108	5,287	5,473	5665
Product B	0	750	1,050	1,680	2,206	2,272	2,341	2,412	2,485	2534
Product C	0	2,400	3,840	6,912	20,798	27,119	27,744	28,384	29,038	29,708
SALES	0	4,350	6,690	11,652	27,770	34,325	35,193	36,083	36,996	37,907
RESIDUAL VALUE	0	0	0	0	0	0	0	0	0	28,000
TOTAL REVENUES	0	4,350	6,690	11,652	27,770	34,325	35,193	36,083	36,996	65,907
Raw materials	0	2,219	3,412	5,943	14,163	17,506	17,948	18,402	18,868	19,333
Labour	0	295	820	1,418	1,435	1,452	1,469	1,486	1,504	1,522
Electricity	0	178	281	501	1,222	1,545	1,619	1,696	1,776	1,857
Fuel	0	231	375	687	1,722	2,231	2,393	2,562	2,738	2,919
Maintenance	0	131	201	350	833	1,030	1,056	1,082	1,110	1,137
General industrial costs	0	124	181	297	666	772	739	704	666	625
Administrative costs	0	126	187	315	722	858	845	830	814	796
Sales expenditure	0	114	173	297	647	781	802	823	844	865
TOTAL OPERATING COSTS	0	3418	5630	9808	21410	26175	26871	27585	28320	29054
Bonds and other financial resources	o	0	0	0	0	0	0	0	0	0
EIB loans	0	0	0	0	0	0	0	0	0	0
Other loans	0	0	0	500	500	250	200	150	100	50
INTEREST	0	0	0	500	500	250	200	150	100	50
RETIREMENT BONUS	0	0	0	0	0	0	0	0	0	0
Bonds and other financial resources		0	0	0	0	0	0	0	0	0
EIB loans		0	0	0	0	0	0	0	0	0
Other loans		0	0	0	5,000	1,000	1,000	1,000	1,000	1,000
LOANS REIMBURSEMENT		0	0	0	5,000	1,000	1,000	1,000	1,000	1,000
PRIVATE EQUITY	10,500	15,468	7,640	0	0	0	0	0	0	0
TOTAL NATIONAL PUBLIC CONTRIBUTION	4,725			0	0	0	0	0	0	0
TOTAL EXPENDITURE	15,225	18,886	13,270	10,308	26,910	27,425	28,071	28,735	29,420	30,104
NET CASH FLOW	-15,225	-14,536	-6,580	1,344	860	6,900	7,122	7,348	7,576	35,803

Discount Rate	5.0%
FNPV (K)	10,458.2
FRR (K)	9.3%

Table 4.64 Return on private equity (thousands of Euros)

	1	2	3	4	5	6	7	8	9	10
Product A	0	1,200	1,800	3,060	4,766	4,934	5,108	5,287	5,473	5665
Product B	0	750	1,050	1,680	2,206	2,272	2,341	2,412	2,485	2534
Product C	0	2,400	3,840	6,912	20,798	27,119	27,744	28,384	29,038	29,708
SALES	0	4,350	6,690	11,652	27,770	34,325	35,193	36,083	36,996	37,907
RESIDUAL VALUE	0	0	0	0	0	0	0	0	0	28,000
TOTAL REVENUES	0	4,350	6,690	11,652	27,770	34,325	35,193	36,083	36,996	65,907
Raw materials	0	2,219	3,412	5,943	14,163	17,506	17,948	18,402	18,868	19,333
Labour	0	295	820	1,418	1,435	1,452	1,469	1,486	1,504	1,522
Electricity	0	178	281	501	1,222	1,545	1,619	1,696	1,776	1,857
Fuel	0	231	375	687	1,722	2,231	2,393	2,562	2,738	2,919
Maintenance	0	131	201	350	833	1,030	1,056	1,082	1,110	1,137
General industrial costs	0	124	181	297	666	772	739	704	666	625
Administrative costs	0	126	187	315	722	858	845	830	814	796
Sales expenditure	0	114	173	297	647	781	802	823	844	865
TOTAL OPERATING COSTS	0	3418	5630	9808	21410	26175	26871	27585	28320	29054
Bonds and other financial resources	0	0	0	0	0	0	0	0	0	0
EIB loans	0	0	0	0	0	0	0	0	0	0
Other loans	0	0	0	500	500	250	200	150	100	50
INTEREST	0	0	0	500	500	250	200	150	100	50
RETIREMENT BONUS	0	0	0	0	0	0	0	0	0	0
Bonds and other financial resources	0	0	0	0	0	0	0	0	0	0
EIB loans	0	0	0	0	0	0	0	0	0	0
Other loans	0	0	0	0	5,000	1,000	1,000	1,000	1,000	1,000
LOAN REIMBURSEMENT	0	0	0	0	5,000	1,000	1,000	1,000	1,000	1,000
PRIVATE EQUITY	10,500	15,468	7,640	0	0	0	0	0	0	0
TOTAL NATIONAL PUBLIC CONTRIBUTION										
TOTAL EXPENDITURE	10,500	18,886	13,270	10,308	26,910	27,425	28,071	28,735	29,420	30,104
NET CASH FLOW	-10,500	-14,536	-6,580	1,344	860	6,900	7,122	7,348	7,576	35,803

Discount Rate	5.0%
FNPV (K_p)	14,958.2
FRR (K_p)	11.8%

Table 4.65 Financial sustainability (thousands of Euros)

	1	2	3	4	5	6	7	8	9	10
PRIVATE EQUITY	10,500	15,468	7,640	0	0	0	0	0	0	0
TOTAL NATIONAL PUBLIC CONTRIBUTION	4,725			0	0	0	0	0	0	0
EU GRANT	4,275	4,500	5,400	0	0	0	0	0	0	0
Bonds and other financial resources	0	0	0	0	0	0	0	0	0	0
EIB loans	0	0	0	0	0	0	0	0	0	0
Other loans	0	0	10,000	0	0	0	0	0	0	0
OTHER FINANCIAL RESOURCES	0	0	10,000	0	0	0	0	0	0	0
TOTAL FINANCIAL RESOURCES	19,500	19,968	23,040	0	0	0	0	0	0	0
Product A	0	1,200	1,800	3,060	4,767	4,934	5,108	5,287	5,473	5,665
Product B	0	750	1,050	1,680	2,206	2,272	2,341	2,412	2,485	2,534
Product C	0	2,400	3,840	6,912	20,798	27,119	27,744	28,384	29,038	29,708
SALES	0	4,350	6,690	11,652	27,771	34,325	35,193	36,083	36,996	37,907
TOTAL INFLOWS	19,500	24,318	29,730	11,652	27,771	34,326	35,193	36,083	36,996	37,907
Raw materials	0	2,219	3,412	5,943	14,163	17,506	17,948	18,402	18,868	19,333
Labour	0	295	820	1,418	1,435	1,452	1,469	1,486	1,504	1,522
Electricity	0	178	281	501	1,222	1,545	1,619	1,696	1,776	1,857
Fuel	0	231	375	687	1,722	2,231	2,393	2,562	2,738	2,919
Maintenance	0	131	201	350	833	1,030	1,056	1,082	1,110	1,137
General industrial costs	0	124	181	297	666	772	739	704	666	625
Administrative costs	0	126	187	315	722	858	845	830	814	796
Sales expenditure	0	114	173	297	647	781	802	823	844	865
TOTAL OPERATING COSTS	0	3,418	5,630	9,808	21,410	26,175	26,871	27,585	28,320	29,054
RETIREMENT BONUS	0	0	0	0	0	0	0	0	0	0
Land	3,000	0	0	0	0	0	0	0	0	0
Buildings	6,000	6,000	5,000	0	0	0	0	0	0	0
New Equipment	10,000	14,000	18,000	0	0	0	0	0	0	0
Used Equipment	0	0	0	0	0	0	0	0	0	0
Extraordinary Maintenance	0	0	0	0	0	0	0	0	0	0
FIXED ASSETS	19,000	20,000	23,000	0	0	0	0	0	0	0
Licenses	0	0	500	0	0	0	0	0	0	0
Patents	0	0	500	0	0	0	0	0	0	0
Other pre-production expenses	0	0	0	0	0	0	0	0	0	0
PRE-PRODUCTION EXPENDITURE	0	0	1,000	0	0	0	0	0	0	0
Investments costs	19,000	20,000	24,000	0	0	0	0	0	0	0
Cash	50	125	90	90	90	90	90	90	90	90
Client	110	460	600	600	600	600	600	600	600	600
Stock	1,400	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000
Current Liabilities	1,060	1,185	1,190	1,190	1,190	1,190	1,190	1,190	1,190	1,190
NET WORKING CAPITAL	500	1,400	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500
Variations in working capital	500	900	100	0	0	0	0	0	0	0
Replacement of short-life equipment	0	0	0	0	0	240	420	540	296	518
Residual value	0	0	0	0	0	0	0	0	0	0
Other investment items	0	0	0	0	0	240	420	540	296	518
TOTAL INVESTMENT COSTS	19,500	20,900	24,100	0	0	240	420	540	296	518
Bonds and other financial resources		0	0	0	0	0	0	0	0	0
EIB loans		0	0	0	0	0	0	0	0	0
Other loans		0	0	500	500	250	200	150	100	50
INTEREST		0	0	500	500	250	200	150	100	50
Bonds and other financial resources		0	0	0	0	0	0	0	0	0
EIB loans		0	0	0	0	0	0	0	0	0
Other loans		0	0	0	5,000	1,000	1,000	1,000	1,000	1,000
LOAN REIMBOURSEMENT		0	0	0	5,000	1,000	1,000	1,000	1,000	1,000
TAXES	0	0	0	0	461	1,590	1,978	1,976	1,989	2,095
TOTAL OUTFLOWS	19,500	24,318	29,730	10,308	27,371	29,255	30,469	31,251	31,705	32,717
NET CASH FLOW	0	0	0	1,344	399	5,070	4,725	4,832	5,291	5,189
CUMULATED TOTAL CASH FLOW	0	0	0	1,344	1,744	6,814	11,539	16,371	21,662	26,851

Table 4.66 Economic analysis (thousands of Euros)

	CF	1	2	3	4	5	6	7	8	9	10
Product A	1.000	0	1,200	1,800	3,060	4,766	4,934	5,108	5,287	5,473	5,665
Product B	1.000	0	750	1,050	1,680	2,206	2,272	2,341	2,412	2,485	2,534
Product C	1.000	0	2,400	3,840	6,912	20,798	27,119	27,744	28,384	29,038	29,708
SALES		0	4,350	6,690	11,652	27,770	34,325	35,193	36,083	36,996	37,907
Raw materials	0.950	0	2,108	3,241	5,646	13,455	16,631	17,051	17,482	17,925	18,366
Labour	0.600	0	177	492	851	861	871	881	892	902	913
Electricity	0.970	0	173	273	486	1,185	1,499	1,570	1,645	1,723	1,801
Fuel	0.970	0	224	364	666	1,670	2,164	2,321	2,485	2,656	2,831
Maintenance	1.000	0	131	201	350	833	1,030	1,056	1,082	1,110	1,137
General industrial costs	1.000	0	124	181	297	666	772	739	704	666	625
Administrative costs	1.000	0	126	187	315	722	858	845	830	814	796
Sales expenditure	1.000	0	114	173	297	647	781	802	823	844	865
TOTAL OPERATING COSTS		0	3,177	5,112	8,908	20,040	24,606	25,266	25,943	26,640	27,335
RETIREMENT BONUS	1,000	0	0	0	0	0	0	0	0	0	0
Land	1,235	3,705	0	0	0	0	0	0	0	0	0
Buildings	0.715	4,290	4,290	3,575	0	0	0	0	0	0	0
New Equipment	0.990	9,900	13,860	17,820	0	0	0	0	0	0	0
Used Equipment	0,990	0	0	0	0	0	0	0	0	0	0
Extraordinary Maintenance	0,756	0	0	0	0	0	0	0	0	0	0
Fixed Assets		17,895	18,150	21,395	0	0	0	0	0	0	0
Licenses	1.000	0	0	500	0	0	0	0	0	0	0
Patents	1.000	0	0	500	0	0	0	0	0	0	0
Other pre-prod. expenses	1.000	0	0	0	0	0	0	0	0	0	0
Pre-production expenditure		0	0	1,000	0	0	0	0	0	0	0
Investments costs		17,895	18,150	22,395	0	0	0	0	0	0	0
Cash	1.000	50	125	90	90	90	90	90	90	90	90
Client	1.000	110	460	600	600	600	600	600	600	600	600
Stock	1.000	1,400	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000
Current Liabilities	1.000	1,060	1,185	1,190	1,190	1,190	1,190	1,190	1,190	1,190	1,190
NET WORKING CAPITAL		500	1,400	1,500	1,500	1,500	1,500	1,500	1,500	1,500	1,500
Variations in working capital		500	900	100	0	0	0	0	0	0	0
Repl. of short-life equipment	0.756	0	0	0	0	0	181	318	408	224	392
Residual value	0.928	0	0	0	0	0	0	0	0	0	-25,984
Other investment items		0	0	0	0	0	181	318	408	224	-25,984
TOTAL INVESTMENT COSTS		18,395	19,050	22,495	0	0	181	318	408	224	-25,424
TOTAL EXPENDITURE		18,395	22,227	27,607	8,908	20,040	24,787	25,584	26,351	26,864	1,911
NEGATIVE EXTERNALITIES		0	18	27	47	102	124	127	129	132	135
TOTAL ECONOMIC EXPENDITURES		18,395	22,245	27,634	8,955	20,142	24,911	25,710	26,480	26,996	1,878
NET ECONOMIC FLOW		-18,395	-17,895	-20,944	2,697	7,629	9,414	9,483	9,603	10,000	36,029

Discount Rate	5.5%
ENPV	3,537.5
ERR	6.7%
B/C	1.02

ANNEXES

ANNEX A
DEMAND ANALYSIS

Demand forecasting is an important step in the feasibility study of a project, as it allows us to assess how much of a good or a service will be requested in the future, as well as the revenues that can be expected from the sale of that good or service.

Theoretical background

According to standard microeconomics each consumer has a utility function *U*, which is an increasing function of the quantity of each good consumed.

The behaviour of the consumer can be symbolized by the following constrained maximization

$$Max\ U(x_1, x_2 \ldots x_n)$$

with

$$\Sigma p_i x_i \leq r$$

Where *r* is the budget (disposable income) of the consumer.

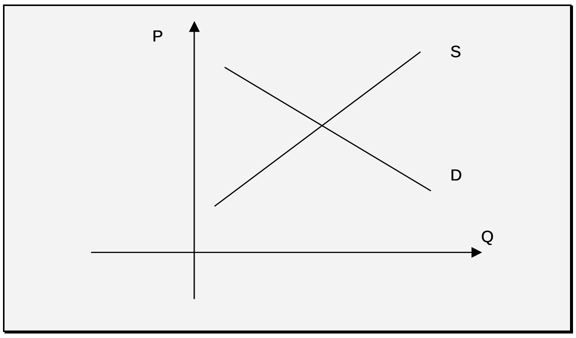
So it is assumed that the consumer will try to maximise her or his utility under the constraint that expenditure cannot exceed income. The solution of this problem leads to the demand curve.

The demand curve is defined as the relationship between the price of the good and the amount or quantity the consumer is willing and able to purchase in a specified time period.

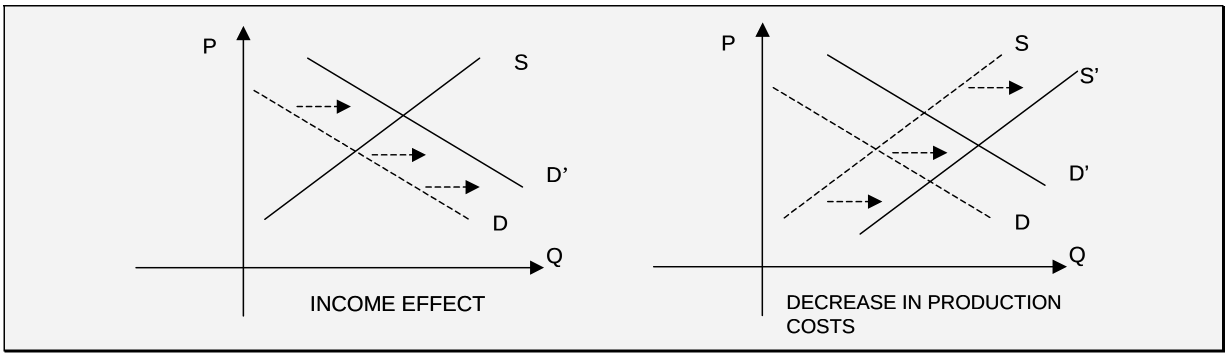
The consumers' willingness and ability to purchase the good is influenced not only by the price of the good but also by income, the prices of related goods, and tastes.

In the diagram, *D* is the demand curve, *P* is the price, *Q* is the quantity (number of product units), and *S* is the supply curve. As the price *P* on the vertical axis decreases, so the quantity demanded *Q* increases.

Figure A.1 Demand and Supply Curves



Forecasting demand requires estimating the changes in the conditions that determine the equilibrium between demand and supply (special models are required for rationed markets). Such conditions include: consumer income, tastes, supply costs, additional demand induced by the new project, etc. For instance, when the price of the good changes and other demand determinants are constant, the outcome is given by a new equilibrium on the same demand curve. Instead, if a non-price determinant changes in such a way as to increase demand, this is a 'shift' or simply 'change' in the demand curve, as shown in the following diagram.



A shift in the supply curve leading to a price decrease is expected to increase the quantity demanded.

In practical terms the problem of forecasting demand is solved using specific methodologies, which are based on the assumptions above. In the following sections the main relevant concepts and approaches are outlined.

Demand elasticities

Given the need to estimate future demand for a specific service or good whose availability and price will change due to the intervention, demand elasticities are relevant aspects to be addressed in the forecasting exercise.

The price elasticity of demand is the ratio of relative variations in the quantity Q of good or service demanded to the relative variation in price. Price elasticity can be expressed as:

$$E_p = \frac{Q_1 - Q_0}{Q} \times \frac{P}{P_1 - P_0}$$

where E_P is the price elasticity coefficient, Q_1 is the demand with price P_1, and Q_0 is the demand at the present price P_0. As in many cases the project will affect prices, price elasticity plays an important role in demand projections.

Demand for a good or service is determined not only by its own price, but also by the price of complementary or substitute products, what is called cross elasticity. The cross price elasticity of demand for product A compared to product B is given by:

$$C_{AB} = \frac{Q_{2A} - Q_{1A}}{Q_A} / \frac{P_{2B} - P_{1B}}{P_B}$$

If $C_{AB} > 0$, product B is a substitute for A;

If $C_{AB} < 0$, product B is a complement to A;

If $C_{AB} = 0$, no cross elasticity exists between A and B.

Price elasticity differs between products and also, for a given product, between different income groups, as well as in accordance with the social characteristics of the areas. Therefore, whenever possible the analysis should not be limited to the average per capita income in the whole national economy, but should separately consider different socio-economic groups.

Income is not only relevant for the size of price elasticities. Income elasticities exist as well, i.e. demand for different products and services is expected to increase or decrease when income changes. For most industrial goods and services income elasticities are positive, as demand is higher when household income increases. However, for primary products negative elasticities can be observed. An example is demand for local public transport services that may fall when income growth leads to a higher motorisation rate.

Demand elasticities are relatively simple parameters that may be used to estimate impacts of new projects. In many cases, however, more complex methodologies are required. This is justified also with the evidence that elasticities are very context-dependent. Therefore, even if literature values provide a valid reference example, the demand elasticity in principle should be estimated case by case.

Demand forecasting techniques

Several techniques can be used for demand forecasting, depending on the data available, the resources that can be dedicated to the estimates, and the sector involved. The selection of the most appropriate techniques for estimating the actual demand and forecasting the future ones with and without the project will depend on the nature of the good or service, the characteristics of the market and the reliability of the available data.

Transparency in the main assumptions and in the parameters and values, as well as the trends and coefficients used in the forecasting exercise, are matters of considerable importance for the accuracy of the estimates. Furthermore, any uncertainty in the prediction of future demand must be clearly stated (see also Annex D).

Assumptions concerning the evolution of the policy and regulatory framework, including norms and standards, should also be clearly expressed.

The method applied for the forecasting must be clearly explained and details on how the forecasts were prepared may help in understanding the consistency and realism of forecasts.

Interviewing experts

Whenever, for budget or time reasons, a quantitative methodology for demand forecasting cannot be applied, interviewing experts can provide independent external estimations of the expected impact of a project. The advantages of this approach are low cost and speed. Of course, this kind of estimation can be only qualitative or, if quantitative, very approximate. Indeed, this approach can be recommended only for a very preliminary stage of the forecasting procedure.

Trend extrapolation

Extrapolation of past trends involves fitting a trend to data points from the past, usually with regression analysis. Various mathematical relationships are available that link time to the variable being forecasted (e.g. expected demand). The simplest assumption is a linear relationship, i.e.:

$$Y = a + bT$$

where Y is the variable being forecasted and T is time.

Another common model assumes *constant growth rate*, i.e.:

$$Y = a(1+g)^t$$

where Y is the variable being forecasted, a is a constant, g is the growth rate and t is time.

The choice of the best model depends mainly on data. Whenever data is available for different times (e.g. years) statistical techniques can be used to find the best fitted model. When data is available only twice any model can be fitted in principle (i.e. for each functional form parameters will always exist such as the two points lie on the curve). In such cases, additional information (e.g. trends observed in other contexts, different countries, etc.) should be used. Often, the Occam's razor principle is applied: the simplest form is assumed unless specific information suggests a different choice. Therefore, a linear trend or a constant growth rate is applied in most cases.

Extending an observed past trend is a commonly used approach, although one should be aware of its limitations. First, trend extrapolation does not explain demand, it just assumes that an observed past behaviour will continue in the future. This may be quite a naïve assumption however. This is particularly true when new big projects are under study; significant changes on the supply side can give rise to a break in past trends. Induced transport demand is a common example.

Multiple regression models

In the regression technique, forecasts are made on the basis of a linear relationship estimated between the forecast (or dependent) variable and the explanatory (or independent) variables. Different combinations of independent variables can be tested with data, until an accurate forecasting equation is derived. The nature of the independent variables depends on the specific variable to be forecasted.

Some specific models have been developed to correlate demand to some relevant variables. For instance, the consumption-level method considers the level of consumption, using standards and defined coefficients, and can be usefully adopted for consumer products. A major determinant of consumption level is consumer income, influencing, inter alia, the household budget allocations that consumers are willing to make for a given product. With few exceptions, product consumption levels demonstrate a high degree of positive correlation with the income levels of consumers.

Regression models are widely used and can have a strong forecasting power. The main drawbacks of this technique are the need for a large amount of data (as one should explore the role of several independent variables and, for each one, a large set of values is required, across time or space) and the need for projections for the independent variables, which may be difficult. For instance, once we assume that consumption is income-dependent, the issue is then to forecast future income levels.

A generalisation of the regression models is the econometric analysis where more sophisticated mathematical forms are used in which the variable being forecasted is determined by explanatory variables such as population, income, GDP, etc. As in the regression models, the coefficients are obtained from a statistical analysis and the forecasts depend on projections of the explanatory variables.

The simplest example of a relationship is a static, linear expression of the kind:

$$Y_t = a + b_1x_{1t} + b_2x_{2t} + e_t$$

According to this equation, the variable Y_t (for instance, consumption in quarter t) depends on the variables Xi_t (for instance, income and price during the same period). The last, random-error, term e_t denotes the variation in Y_t, which cannot be explained by the model.

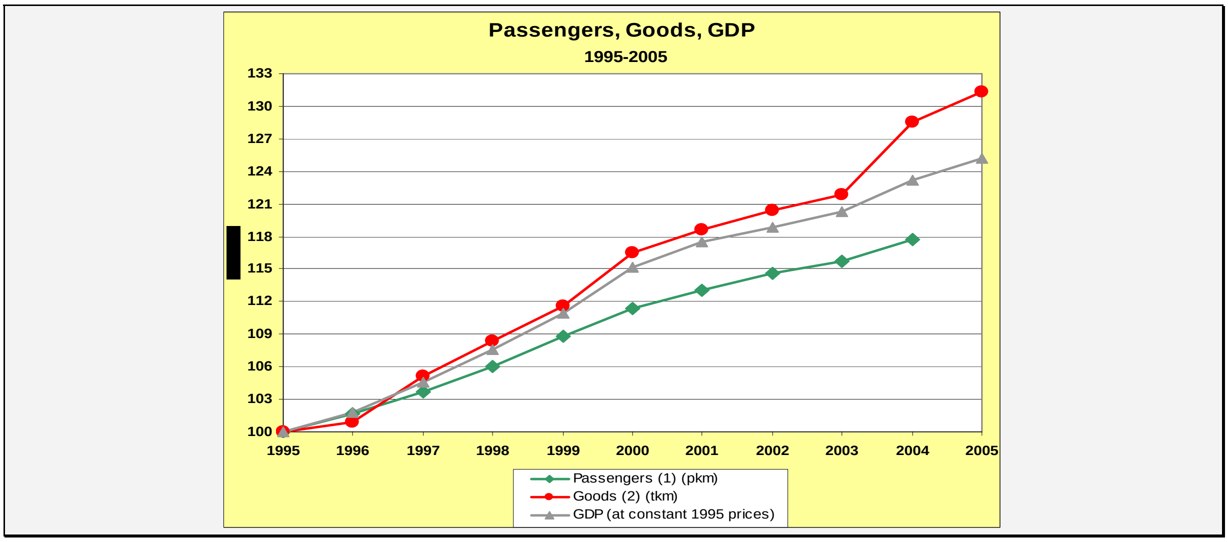
When estimating relationships and making forecasts, researchers frequently use data in the form of time series (i.e. data concerning the same context in different periods) or alternatively cross sections (i.e. data concerning different contexts over the same period). The role of time in the analysis is not trivial, especially when the objective is forecasting. Many time series are non-stationary: that is a variable, such as GDP, follows a long-run trend, where temporary disturbances affect its long-term level. In contrast to stationary time series, non-stationary series do not exhibit any clear-cut tendency to return on a constant value or a given trend. Estimates of relationships between non-stationary variables could yield nonsensical results by erroneously indicating significant relationships between wholly unrelated variables. So, when estimating regression models using time series data it is necessary to know whether the variables are stationary or not (either around a level or a deterministic linear trend) in order to avoid spurious regression relations.

An example: transport demand

Estimates of the financial viability of transport projects are heavily dependent on the accuracy of transport demand forecasts. Future demand is also the basis for economic and environmental appraisal of transportation infrastructure projects. The accuracy and reliability of data regarding traffic volumes, spatial traffic distribution and distribution between transport modes is crucial for assessing project performances.

As shown by the graph below, there is a strong positive correlation between GDP and the distance travelled by passengers and goods: goods transport tends to grow faster than GDP while, at least recently, passenger demand has tended to grow at a slower rate. In terms of elasticity, goods elasticity to GDP is above 1 while for passengers it is below 1.

Figure A.2 Passengers, Goods, GDP, 1990 – 2002



Source: EU, Energy and Transport in Figures 2006

Notes: (1): passengers travelling by car, powered two-wheeler, bus, coach, tram, metro, rail, air and sea;
(2): road, sea, rail, inland waterways, pipelines, air;

Travel is almost always a derived demand: travel occurs and goods are shipped because people want to undertake specific activities at different locations in an area, at different times of the day, or periods of the year, or because goods and commodities are required at different locations from where they were produced or stored. Estimating future travel demand entails forecasting not only the key macro drivers influencing the total demand (population, personal income and GDP) but also sectoral developments, since each sector contributes to the total demand according to its specific characteristics.

Furthermore, travel demand depends on the locations of activities and families, and therefore trends in the distribution of economic activities by sector and population should also be considered. Location patterns affect not only the distance travelled, but also the frequency of trips and thus the total demand. Accessibility is one factor affecting the choices of firms and families about where to locate, and as a consequence of these choices the 'with project' and 'without project' demand may not be the same.

The price of the service provided is not the only determinant of travel demand. The choice of how much travel to consume or how far to ship a good depends on the travel cost and the time spent in travelling. Elasticity to travel time is a further determinant to be introduced in travel demand predictions. As for price elasticity, also in the case of travel time, direct and cross-elasticity are relevant. Demand for a specific mode of transport can be influenced by an increase in the speed of that mode, but also by an increase/decrease in the speed of the competing mode(s).

Demand characteristics, price, income and cross elasticity, value of time, value attributable to comfort for passengers and damage for freight will vary with the different segments of the market, as will the transport costs, type of service demanded etc. It is therefore extremely useful to disaggregate travel demand into homogeneous segments. The characteristics of the different type of commodities, the income group to which the individuals belong as well as the purpose of the trip are important determinants in predicting travel demand[106].

[106] Despite the considerable experience and the wide range of techniques available, forecasting transport demand remains a challenging task. Recent studies (Flyvberg et al., 2006) found considerable deviations between forecast and actual traffic volumes in more than 200 large-scale transport projects. Forecast inaccuracy is often higher in rail than in road projects. This is not to say that road forecasts are always accurate; in fact, the rate of inaccuracy in road projects is significant, but it is more balanced between over- and underestimation. For rail travel the inaccuracies are systematically higher and overestimates are the rule. Many factors contribute to making rail travel forecasts less accurate than road travel forecasts: railway projects are, in general, bigger in size (but a study on aviation showed no correlation between size and demand forecast inaccuracy), and have a longer implementation phase. However, overestimation of rail traffic seems to be linked to an overoptimistic expectation of modal shift.

ANNEX B
THE CHOICE OF THE DISCOUNT RATE

The financial discount rate

As a general, and quite uncontroversial, definition, the financial discount rate (FDR) is the opportunity cost of capital. Opportunity cost means that when we use capital in one project we sacrifice a return on another project. Thus, we have an implicit cost when we sink capital into an investment project: the loss of income from an alternative project.

In academic literature and in practice we can find, however, differing views regarding the discount rate that should be used in the financial analysis of investment projects.

There are at least three approaches:

- the first one estimates the actual (weighted average) cost of capital. The benchmark for a public project may be the real return on Government bonds (the marginal direct cost of public funds), or the long-term real interest rate on commercial loans (if the project needs private finance), or a weighted average of the two rates. This approach is very simple, but it may be misleading: the best alternative project could earn much more than the actual interest rate on public or private loans;
- the second approach establishes a maximum limit value for the discount rate as it considers the return lost from the best investment alternative. In other words, the alternative to the project income is not the buying back of public or private debt, but it is the return on an appropriate financial portfolio;
- the third approach is to determine a cut-off rate as a planning parameter. This implies using a simple rule-of-thumb approach, i.e. a specific interest rate or a rate of return from a well-established issuer of securities in a widely traded currency, and then to apply a multiplier to this minimum benchmark.

Table B.1 shows some estimates for real rates of return on financial assets as a starting point for the choice of the financial discount rate. We can then think that non-marginal investors and experienced professionals are able to obtain higher than average returns. Supposing project proposers are experienced investors, then a rate of return marginally higher than the mean of the values in the table will better fit our requirements.

Table B.1 Indicative estimates for the long-term annual financial rate of return on securities

Asset Class	Nominal Annual Return Estimates%	Real Annual Return Estimates*%
Large Stocks	9,0	6,4
Mid/Small Stocks	10,7	8,1
International Stocks	9,1	6,5
Bonds	4,8	2,2
Cash Equivalent	3,2	0,6
Inflation	2,6	-
Simple average[107]		4,76

A 20-year horizon is used and asset classes correspond to indexes. 'Large stocks' to S&P 500, 'Mid/Small' to Russell 2000 index, 'International stocks' to MSCI AEFE, 'Bonds' to Lehman Aggregate Bond Index and 'Cash equivalent' to the 3 month T-Bill Index.

** The Fisher formula was used because of low inflation;* $r = i - \pi$ *where r is the real rate i the nominal rate and inflation is π. The more general rule is*

$$r = \frac{1+i}{1+\pi} - 1$$

Table B.1 suggests that a 5% financial discount rate is marginally higher than the average value of a portfolio of different securities.

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[107] A weighted average of these rates, according to the relative significance of the various assets in a 'typical portfolio', might be more appropriate than a simple un-weighted average. This should be estimated country by country.

This Guide supports a unique reference FDR value based on the assumption that the funds are drawn from the EU median taxpayer. This means that even if the project is region- or beneficiary-specific, the relevant opportunity cost of capital should be based on a European portfolio. Moreover, the integration of financial markets should lead to a unique value as long as convergence of both inflation and interest rates across EU countries is expected in the long-term. This may not, however, be true of IPA countries and, under specific circumstances, of some EU Member States.

It should be noted that as long as the FDR is taken as a real discount rate, the analysis should be carried out at constant prices. If current prices are used throughout the financial analysis, a nominal discount rate (which includes inflation) must be employed.

The social discount rate

The discount rate in the economic analysis of investment projects - the social discount rate (SDR) – should reflect the social view on how future benefits and costs are to be valued against present ones. It may differ from the financial rate of return because of market failures in financial markets.

The main theoretical approaches are the following:

- a traditional view proposes that marginal public investment should have the same return as the private one, as public projects can displace private projects;
- another approach is to derive the social discount rate from the predicted long-term growth in the economy, as further explained below in the social time preference approach;
- a third, more recent approach, and one that is especially relevant in the appraisal of very long-term projects, is based on the application of variable rates over time. This approach involves decreasing marginal discount rates over time and is designed to give more weight to project impacts on future generations. These decreasing rates help mitigate the so-called 'exponential effect' from the structure of discount factors, which almost cancels more distant economic flows when discounted in a standard way.

In practice a shortcut solution is to consider a standard cut-off benchmark rate. The aim here is to set a required rate of return that broadly reflects the social planner's objectives.

Still, consensus is growing around the social time preference rate (STPR) approach. This approach is based on the long term rate of growth in the economy and considers the preference for benefits over time, taking into account the expectation of increased income, or consumption, or public expenditure. An approximate and generally used formula for estimating the social discount rate from the growth rate can be expressed as follows:

$$r = eg + p$$

where r is the real social discount rate of public funds expressed in an appropriate currency (e.g. Euro); g is the growth rate of public expenditure; e is the elasticity of marginal social welfare with respect to public expenditure, and p is a rate of pure time preference.

On the basis of social time preference, France set a 4% real discount rate in 2005 (formerly fixed at 8%); in 2004 Germany reduced its social discount rate from 4% to 3%. The HM Treasury Green Book of 2003 was actually the precursor of these reductions: the real discount rate in the UK was reduced from 6% to 3.5%[108].

The EC, DG Regio, has suggested a 5.5% SDR for the Cohesion countries and 3.5% for the others (EC Working Document 4)[109]. Every Member State should assess its country-specific social discount rate. In any case, there may be good arguments in favour of using these two benchmark values for broad macro-areas in terms of their potential for economic growth (see below).

For our practical purposes, it may be useful to reinterpret the STRP formula in terms of consumption. Let us suppose g is the growth rate of consumption, e is the elasticity of marginal utility with respect to consumption, and p is the inter-temporal preference rate.

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108 The application of declining discount rates, and the associated hyperbolic path for the present value weights or discount factors attached to future benefits and costs, merits a fuller consideration, especially as some of the projects considered in the Guide have investment horizons exceeding 50 years. The HM Treasury Green Book (2003) includes a schedule of declining long-term discount rates for very long-term projects based on a starting STPR of 3.5% (the standard discount rate for normal long-term projects with investment horizons of up to 30 years). The Green Book also includes a table showing the marginal discount factors up to 500 years ahead. The Stern Report (2006) on Climate Change uses a 0.1% per year, and discusses declining social discount rates.

109 See also Florio (2006) for a non-technical discussion

The first component of the STPR formula is a utilitarian preference; the second one (*p*) is a pure time preference. The pure inter-temporal preference reflects consumer's impatience or, more generally, the present value attributed to a future marginal utility. The utilitarian part measures the utility reduction of a marginal Euro caused by increases in real income. This means that in a developing economy where future consumption will be plentiful compared to the present level, individuals will require more compensation for postponing consumption. The social rate of time preference represents, in fact, the minimum return that individuals demand for giving up some of their current consumption in exchange for additional consumption in the future.

All the values in the formula are country specific, especially those of consumption growth (*g*) that depend directly on GDP, which is quite different across the 27 Member States. Social and individual preferences affect the marginal utility parameter (*e*); life expectancy and other individual characteristics influence the time preference parameter (*p*).

If we consider mortality-based statistics, a consistent proxy for the utility discount rate (*p*), we can observe a death rate very close to 1% for the majority of countries.

Estimation of the elasticity of the marginal utility of consumption, *e*, is less direct and proves to be less homogeneous. A range of values between 1 and 2 is consistent with the evidence provided by behavioural approaches and revealed social preferences based on tax-based data.[110]

Assuming that income tax structures are at least loosely based on the principle of equal absolute sacrifice of satisfaction, then the extent of progressiveness in the tax structure provides a measure of *e*.[111] The more progressive the tax structure, and thus the greater the extent of social aversion to income inequality, then the larger the value of *e*.

For the real annual per capita growth rate the best approach would be to estimate a long-term development path for each economy, based on an appropriate growth model. Our estimates are based, however, on past annual growth rates.

In Table B.2, where all these values are summarized, we show a purely indicative SDR for some countries.

The presence of two different groups clearly emerges. As suggested before, the discriminating factor is the growth rate. It alone justifies the presence of different social discount rates for at least two macro-areas: the mature economies, on one hand, and the fast-growing ones, on the other. In the EU context this difference can be expressed in terms of eligibility or non-eligibility for the Cohesion Fund.

Table B.2 Indicative social discount rates for selected EU Countries based on the STPR approach

Non CF countries	G	e	P	SDR
Austria	1.9	1.63	1.0	4.1
Denmark	1.9	1.28	1.1	3.5
France	2.0	1.26	0.9	3.4
Italy	1.3	1.79	1.0	3.3
Germany	1.3	1.61	1.0	3.1
Netherlands	1.3	1.44	0.9	2.8
Sweden	2.5	1.20	1.1	4.1
CF countries	**G**	**E**	**P**	**SDR**
Czech Rep.	3.5	1.31	1.1	5.7
Hungary	4.0	1.68	1.4	8.1
Poland	3.8	1.12	1.0	5.3
Slovakia	4.5	1.48	1.0	7.7

Source: Our estimates based on World Bank, European Commission and OECD data[112]

[110] Evans (2007) fully develops the STPR method and he studies in detail every parameter of the formula and the ways of estimating them; a method that was also mainly used for our assessments.

[111] The formula is the following: $e = Log(1-t) / Log(1-T/Y)$
where *t* is the marginal rate of income tax; *T* is the total income tax liability and *Y* the total taxable income.

[112] Data from 2000 to 2006 are mainly taken from the 2005 spring economic forecast of the European Commission (DG ECFIN (2005). 'European Economy', No 2/2005). Where the OECD Economic Outlook 77 database reported different values from those of the European Commission, they have been replaced. Forecasts for the period 2007-2008 (2009-2010) are taken from the Stability or Convergence Programme of member countries, respectively for former European countries and for 2004 entrants. Data for elasticities (*e*) are taken from the OECD Tax

A higher discount rate for countries and regions lagging behind will also reflect the need to invest in projects that are more socially profitable in order to achieve a higher growth rate. This reflects a real convergence objective and we can then consider the discount rate as a standard benchmark for the rate of return.

For the reasons outlined above, EC Working Document No 4 suggested a reference social discount rate for 2007-2013 of 3.5% for the countries not eligible for the Cohesion Fund (CF) and 5.5% for the CF countries. As mentioned, in recent years, France, Germany and the UK have autonomously adopted values for their national projects that are broadly consistent with this SDR framework. The regions for which the 'Convergence' objective is relevant may consider adopting the 5.5% rate that reflects the faster growth requirement. This would imply greater selectivity in project appraisal.

In special circumstances, country or region-specific SDRs may be utilized, and proposers would justify their assessments based on specific empirical estimates.

Database (Taxation of Wage Income, 2004) and refer to personal income taxation. The tax rate includes central government and sub-central taxation, plus employees' social security contributions for single persons without dependants.

ANNEX C
PROJECT PERFORMANCE INDICATORS

This annex explains how to calculate and use the main project performance indicators for CBA analysis: Net Present Value (NPV), Internal Rate of Return (IRR) and the Benefit-Cost Ratio (B/C).

The indicators provide concise information about project performance and are the basis for ranking projects. The preferred indicator is the NPV.

The Net Present Value

The Net Present Value of a project is the sum of the discounted net flows of a project. The NPV is a very concise performance indicator of an investment project: it represents the present amount of the net benefits (i.e. benefits less costs) flow generated by the investment expressed in one single value with the same unit of measurement used in the accounting tables.

Financial and economic tables are defined by inflows (I_1, I_2, I_3, …), outflows (O_1, O_2, O_3, …) and balances (S_1, S_2, S_3, … for time 1, 2, 3, …). Inflows and outflows are distributed over a number of years and this could generate problems if we want to sum S at time 1 and S at time 2 and so on. These problems are due to the fact that the marginal utility of one Euro today is higher than the marginal utility of one Euro in year 2. There are two basic interrelated reasons for this:

- there exists a positive opportunity cost of numeraire: a unit benefit is worth less the further it occurs in the future;
- individuals have positive time preferences, because of risk aversion for future events, because income is a function that increases with time, while marginal utility for consumption decreases, and because of pure preferences for present utility compared to future utility.

The aggregation of costs and benefits occurring in different years can be carried out by weighting them. This boils down to applying appropriate coefficients, decreasing with time in order to measure the loss of value of the *numeraire.*

Such a coefficient is discounting factor $a_t = (1+i)^{-t}$, where *t* is the time, *i* is the rate of discount and a_t is the coefficient for discounting a value in year *t* to obtain its present value.

The Net Present Value of a project is defined as:

$$NPV = \sum_{t=0}^{n} a_t S_t = \frac{S_0}{(1+i)^0} + \frac{S_1}{(1+i)^1} + ... + \frac{S_n}{(1+i)^n}$$

Where S_t is the balance of cash flow at time *t* and a_t is the financial discount factor chosen for discounting at time *t*.

It is important to notice that the balance of costs and benefits in the early years of a project is usually negative and it only becomes positive after some years. As a_t decreases with time, negative values in the early years are weighted more than the positive ones occurring in the later years of a project's life. The value of the discount rate and the choice of the time horizon are crucial for the determination of the NPV of a project.

NPV is a very simple and precise performance indicator. A positive NPV, NPV>0, means that the project generates a net benefit (because the sum of the weighted flows of costs and benefits is positive) and it is generally desirable either in financial terms or in economic terms. When different options are considered, the ranking of the NPVs of the alternatives indicates the best one. For instance in Figure C.1 project 1 is more desirable than project 2 because it shows a higher NPV for all the discount rates (*i*) applied.

Figure C.1 Project ranking by NPV values

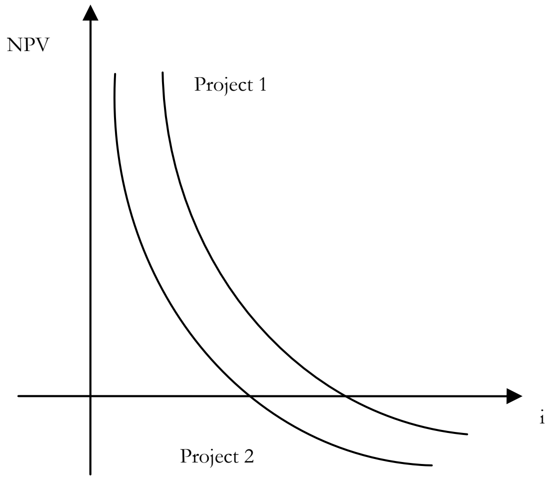
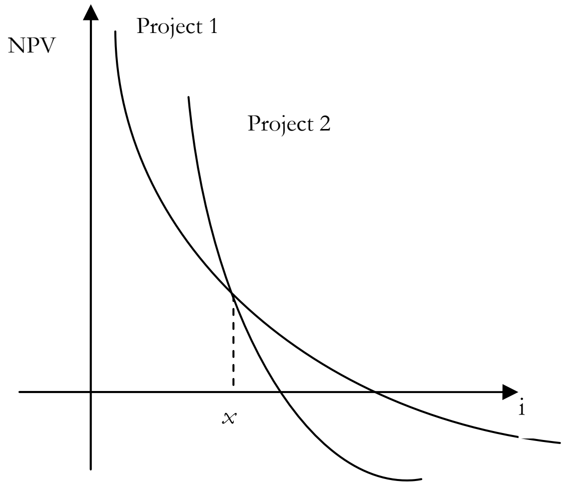


Figure C.2 A case of switching



There are cases in which the NPV of one alternative is not greater than the other or for every *i* value. This is due to a phenomenon referred to as 'switching'. Switching occurs when the NPV curves of two projects intersect one another as in Figure C.2. With a discount rate above *x* project 1 has a higher NPV, with a discount rate below *x* project 2 will perform better. In order to select the best option the definition of the discount rate is crucial for the selection of the best option (and IRR cannot be used as a decision rule).

The Internal Rate of Return

The Internal Rate of Return (IRR) is defined as the discount rate that zeroes out the net present value of flows of costs and benefits of an investment, that is to say the discount rate of the equation below:

$$NPV\ (S) = \sum [S_t \ / \ (1 + IRR^t)] = 0$$

The Internal Rate of Return is an indicator of the relative efficiency of an investment, and should be used with caution. The relationship between NPV and IRR is shown in the graph below.

Figure C.3 The internal rate of return

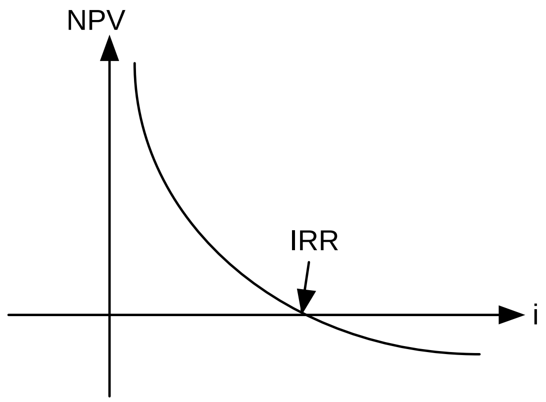
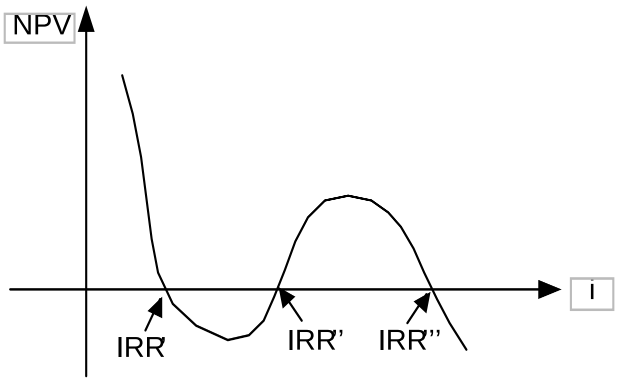


Figure C.4 Multiple IRRs

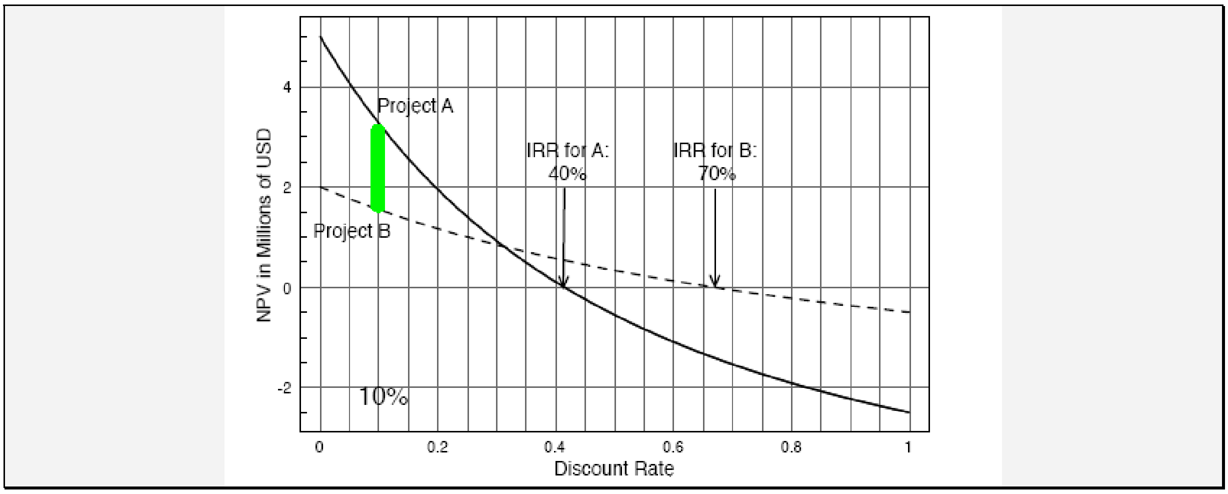


If the sign of the net benefits, benefits minus costs, changes in the different years of the project's lifespan (for example - + - + -) there may be multiple IRRs for a single project. In these cases the IRR decision rule is impossible to implement. Examples of this type of project are mines and nuclear power plants, where there is usually a large cash outflow at the end of the project because of decommissioning costs.

As IRR rankings can be misleading, and given that the informational requirements for computing a proper NPV and IRR are the same except for the discount rate, it is always worth calculating the NPV of a project. There are many reasons in favour of the NPV decision rule (see Ley, 2007).

The IRR contains no useful information about the overall economic value of a project. This can be illustrated by graphing the NPV as a function of the discount rate (*r*). Consider Figure C.5 that displays the NPV schedule for two alternative projects. Project A has a substantially higher NPV for any discount rate in the economically relevant range (i.e. for any *r* less than 30%), yet it crosses the axis to the left of project B, and consequently has a lower IRR—i.e. $IRR_A = 40\% < IRR_B = 70\%$.

Figure C.5 IRR and NPV of two mutually exclusive alternatives



Source: Ley, E., 2007, On the Improper use of the Internal Rate of Return in Cost-Benefit Analysis

Since welfare depends on NPV, not IRR, it is apparent that project A dominates B. For instance NPVA(*r*) exceeds NPVB(*r*) by about US$ 1.6 million for a discount rate in the neighbourhood of 10%.

Other shortcomings of the Internal Rate of Return are:

- the sensitivity to economic life: when projects with different economic lives are to be compared, the IRR approach inflates the deliverability of a short-life project because IRR is a function both of the time period and of the size of capital outlay;
- the sensitivity to the timing of benefits: when there are projects that fail to yield benefits for many years, the IRR tends to be lower compared to projects with a fairly even distribution of benefits over time, even though the Net Present Value of the former may be higher;
- the IRR indicator cannot deal with cases in which time-varying discount rates are used. In these cases, the Net Present Value rule allows discount rate changes to be incorporated easily into the calculation.

One advantage of the IRR (under reasonable assumptions) is that it is a pure number and this makes it easier to compare projects that are similar, apart from their size.

Benefit-cost ratio (B/C)

The benefit-cost ratio is the present value of project benefits divided by the present value of project costs:

$$BCR = PV\ (I)/PV\ (O)$$

where *I* are the inflows and O the outflows. If *BCR* >1 the project is suitable because the benefits, measured by the Present Value of the total inflows, are greater than the costs, measured by the Present Value of the total outflows.

Like the IRR, this ratio is independent of the size of the investment, but in contrast to IRR it does not generate ambiguous cases and for this reason it can complement the NPV in ranking projects where budget constraints apply. In these cases the B/C ratio can be used to assess a project's efficiency.

The main problems with this indicator are:

- it is sensitive to the classification of the project effects as benefits rather than costs. It is relatively common to have project effects that can be treated both as benefits and as cost reductions and vice versa. Since the Benefit-Cost ratio rewards projects with low costs, considering a positive effect as a cost-reduction rather than a benefit would only result in an artificial improvement of the indicator;
- it is not appropriate for mutually exclusive projects. Being a ratio, the indicator does not consider the total amount of net benefits and therefore the ranking can reward more projects that contribute less to the overall increase in public welfare.

The appropriate case for using the BCR is under capital budget constraints. The following table provides an example of project ranking given a budget constraint of 100.

Table C.1 Benefit-Cost Ratio under budget constraints

	PV (O)	PV (I)	NPV	PV(I) / PV(O)
Project A	100	200	100	2
Project B	50	110	60	2.2
Project C	50	120	70	2.4

Looking at NPV, the preferred project is A and the ranking is A, C, B. But looking at the ratios between PV(I) and PV(O), C is the favourite project. Since the budget constraint is 100 and the PV(O) of project C is 50, project B, the second in the ranking, could also be undertaken. The resulting NPV (NPV(B)+NPV(C)) is 130, which is higher than the NPV of project A.

ANNEX D
THE PROJECT'S IMPACT ON EMPLOYMENT AND THE OPPORTUNITY COST OF LABOUR

Labour, like all other project inputs, is valued in the financial analysis with the price to be paid for its use, i.e. the wage. In the economic analysis, however, we should consider the social opportunity cost of labour. The difference between the two values lies in the specificity of the labour market that may overrate (less frequently underrate) the opportunity cost of labour, because of specific market features: legal minimum wage, real wage rigidity, taxes and social contributions, subsidies, monopsony, unionisation, etc. The use of shadow wages accounts for the social cost of using labour, net of all the benefits derived from additional employment and, in principle, no further assessment is necessary of effects in secondary markets.

The social opportunity cost of labour is its alternative use without the project. This means valuing the substitute use of labour time in a particular region. According to the state of the labour market, job seekers and employees will react differently (leave previous employment, take leisure, work on the black market, etc.) and consequently the social opportunity cost will change.

Choosing the appropriate shadow wage then means understanding the social opportunity cost of labour, which depends upon the peculiarity of the local labour market. This is why different types of unemployment imply different formulas for estimating shadow wage rates (SWR).

Competitive labour markets

Even under full employment and in competitive labour markets, shadow wages may differ from market wages because of the social cost of displacing workers from one activity to another. These costs also lead to 'frictional' unemployment. For example, in the Lombardy region, the unemployment rate is 3% and typically it is short-term unemployment. The latter comes mostly from the time needed to find the desired post. The labour market functions relatively well and only small corrections are necessary due to project-specific transport, training, relocation and other costs not captured by the wage. Even if these data are project-specific, an average can be inferred from the observation of past projects in the same region. In the case of skilled worker or unskilled worker displacement (i.e. new and former activities are similar), the shadow wage can even be assumed equal to the financial wage. The conversion factor used in Lombardy will be a figure very close to one (e.g. 0.95).

SHADOW WAGES IN IRELAND

In 1999 the Community Support Framework Evaluation Unit (CSF Evaluation Unit, 1999) suggested the use of a shadow price for labour in cost-benefit analysis in Ireland equal to the market wage. Even when a different approach is advisable, the minimum shadow wage applicable is 80% of the market wage. This decision is supported by literature (e.g. Honohan 1996, Honohan 1998) and conditions of full employment (low unemployment and immigration as labour supply). Even if several years have passed, these guidelines are still relevant and, in fact, the Irish labour market now fits even better the conditions necessary for a conversion factor equal or near to one.

Markets with informal activities

In some regions there is both a formal and an informal labour market, often related to urban and rural markets. Informal labour markets can exist also in an urban context with activities in construction or self-employment in micro-business and some illegal jobs. Self-employment in the informal market comes from a lack of opportunities in the formal sector. In these sectors, there are often no formal labour contracts, and unionisation and legal protection of labour are weak. Public projects, in contrast, need to comply with regulations about safety, minimum wage, social contributions, etc. This is the reason why the formal sector usually pays higher salaries.

The lost annual output m of hiring a new employee in a public project can be assessed from the average daily income and number of workers per day in the previous informal occupation. A conversion factor c is then necessary, especially in the rural sector. In fact, CAP (Common Agricultural Policy) keeps domestic prices for some agricultural goods higher than EU border prices. Hence, this conversion factor will be smaller than one. Additional costs of transferring workers (training, relocation, etc.) z are subjected to conversion factor d, which will probably be based on a standard conversion factor. A very simple formula is:

$$SWR = mc + zd$$

It is important to remember that informal activities often hide unemployment, particularly in the rural areas.

EXAMPLE OF SHADOW WAGE IN DUAL MARKET
In the high unemployment Slovak region of Východné, rural workers earned about €6,000 p.a. in 2005. In the formal sector, wages reached €7,300. Suppose the conversion factor to account for agricultural price distortion is 0.8 and the standard factor for the 800 additional costs of employment (e.g. for additional training) is 0.9. The shadow wage will be €5,520 and the conversion factor for wages is 0.69 (i.e. 5,520/8,000).

Markets with involuntary unemployment

From economic theory and empirical observation, we know that people may prefer not to work instead of receiving too low a wage, and they shift to some form of public or private assistance. Under Keynesian unemployment, moreover, people willing to work do not find adequate remuneration on the market and they are involuntarily unemployed. This situation is frequently associated with high urban unemployment.

The shadow wage here will be usually higher or at least equivalent to the reservation wage, which will be approximately equal to the unemployment benefit.

A simple formula for the shadow wage is:

$$SWR = n(\Delta u/\Delta L) + zd$$

Where ΔL is the project labour input, Δu the decrease in unemployment (number of units), n is the reservation wage and z is again the relocation costs. Usually the reservation wage is assumed equal to unemployment benefits, but in the 'black' economy it could be thought of as wages net of tax and contributions: this is probably near to the minimum compensation required to enter the labour market. This insight clarifies the link between the informal sector and involuntary unemployment, and the fact that they often coexist. With a correction to the former c we obtain the following formula that merges the two situations.

$$SWR = n(\Delta u/\Delta L) + m(\Delta e/\Delta L) + zd$$

m is the opportunity cost of output forgone (measured by the wage) in the prior activity, Δe the decrease in employment. c becomes $(\Delta e/\Delta L)$ which is a weight for the loss of employment in displaced activities. Further correction d can be added for relocation costs z.

Where detailed statistical information on the local labour market is not available, unemployment is sizeable, and unemployment benefits are not available or extremely low, a shortcut formula can be used to determine the conversion factor for the labour cost:

$$SWR = W(1-u)(1-t)$$

where W is the market wage, u is the regional unemployment rate, t is the rate of social security payments and relevant taxes. The conversion factor here is $(1-u)(1-t)$. The meaning is that some people would accept cuts to their wage below the nominal wage net of tax, in direct proportion to how severe the unemployment in the area is (but usually not below the unemployment benefit or private support if available to them when unemployed). However, this formula probably understates the shadow wage unless used in conditions of very high involuntary unemployment (e.g. more than 15-20%). In fact, if worker (and output) displacement and relocation costs are omitted, the CF will be underrated.

Table D.1 Illustrative definition of different market conditions and corresponding shadow wages

	Unemployment rate (indicative)	Informal sector	Shadow wage
Competitive market	0 – 3%	Absent	Near to market wage
Dualistic market	> 3%	Present	Added value in informal sector
Involuntary unemployment	> 3%	Nearly absent	Near the unemployment benefit

In fact, the most appropriate shadow wage formula often comes from a weighted average calculation reflecting the proportion of labour drawn from each of the three situations described above. It should be calculated for the relevant NUTS 2 or NUTS 1 region, according to country guidelines.

ANNEX E
AFFORDABILITY AND EVALUATION OF DISTRIBUTIVE IMPACT

A key aspect of the financial sustainability of public services is tariff setting. Under a 'full-cost recovery' approach[113], not only direct costs but also the relevant portion of overheads is included, such as premises, office costs, governance and direction costs, finance, human resources, IT, etc.

Full cost recovery avoids chronic underinvestment in an organisation's capacity, avoids funding gaps and allows an overall improvement in cost management. This approach is advantageous also for funders as long as it provides enhanced accuracy, transparency and efficiency.

In some countries, however, a cost-reflective tariff reform in industries such as water, electricity or waste disposal may determine sizeable regressive redistribution effects. In fact, tariff setting must also consider social affordability. Obviously, the concern for equity is greater where the local circumstances reveal serious social imbalances, which may be exacerbated by some project features.

Broadly speaking there are three possible methods of analysing distributional issues.

- a more general formula for shadow prices could be used, plugging in the welfare weights in the shadow prices, and thus avoiding further distribution calculations;
- explicit welfare weights derived from social inequality aversion estimates can be attached to the project winners and losers, when shadow prices do not include welfare weights;
- the last approach is to focus on the impact of the projects on the poor, and particularly on the share of income necessary to pay for the service.

In principle, the general shadow pricing formula already includes a social welfare weight called 'distributional characteristic' and so it combines efficiency gain and equity loss. In principle it could be properly used as an ex-ante weight of the net benefits of the public project, but this approach is relatively demanding in terms of information requirements. In order to give the reader an idea of the structure of such distributional characteristics, the box below shows relevant values for some goods in two countries.

DISTRIBUTIONAL CHARACTERISTIC FOR SHADOW PRICES

Shadow prices are inversely related to the distributional characteristic *r*, which is defined as the weighted average of the distribution weights (the share of expenditure on good *x* in total consumption *X* by the specific household *i*).

$$r = \sum_i \left(\frac{x_i}{X_i} \right) a_i$$

The weight used to calculate the average (*a*) is the social marginal utility of income, and under some conditions becomes simply the inverse of income.
Here are some examples of distribution characteristics (*r*) for various products in the UK:

Phone	Rail	Bus	Electricity	Gas	Water	Coal
0.875	0.573	0.756	0.893	0.9	0.938	0.992

Source: Brau and Florio (2004)

Brau and Florio (2004) discuss realistic assumptions for price elasticities and the average of distribution weights in order to allow for simple empirical estimation.

113 Defined as: Operational & Management Costs + Depreciation + Return on capital

Another exhaustive way to include distributive effects and concerns in the economic analysis is to adopt a set of 'explicit welfare weights'.

When there is socially undesirable income distribution, one Euro at the margin does not have the same value for individuals with different incomes. Public redistributive preferences in this case are expressed by weighting the aggregated per-capita consumption for the various consumer groups. To define the welfare weights we can refer to the declining marginal utility of income or consumption: utility increases with a rise in consumption but increments get smaller the more we consume[114]. The elasticity of marginal utility of income, which we have already dealt with in appendix B in relation to the social discount rate, measures this particular effect.

Under some assumptions[115] the welfare weights normalized to the average household are structured as follows:

$$W = \left(\frac{\overline{C}}{C_i} \right)^e$$

where $\overline{C}$ is the average consumption level, C_i is the per capita consumption in the group, and e is the constant elasticity of marginal utility of income[116].

Table E.1 Example of welfare weights

Classes	Consumption	$(\overline{C} / C_i)$	e=0	e=0.3	e=0.7	e=1.2
High income	3,000	0.75	1	0.9173	0.8176	0.7081
Medium income	2,500	0.90	1	0.9689	0.9289	0.8812
Low income	1,250	1.80	1	1.1928	1.5090	2.0245
Average	2,250	1	1	1	1	1

Thus, expressing the effect of adopting welfare weights with an example, let us suppose there are in a region the following per capita income groups: 3,000, 2,500 and 1,250 with an average of 2,250, see Table E.1.

From the tax schedule we can obtain an estimate of the elasticity of marginal utility of income with the same method used for the SDR. We can easily see from Table E1 that from the same revenue distribution, weights differ greatly depending on the value of *e*.

The elasticity parameter is a planning signal that in principle should be given to the project analyst by the managing authority at a national level. Roughly speaking, we can say that zero elasticity implies unitary welfare weights; hence, one Euro is one Euro in welfare terms whoever the 'winner' or 'loser' of the project adoption. Values between zero and one will fit with moderate inequality-aversion; *e* above one will be adopted by more egalitarian social planners.

Table E.2 Example of weights for the distributional impact

Classes	Net benefits	Elasticity 0.7	Distributional impact
High income	60	0.8176	49.06
Medium income	100	0.9289	92.89
Low income	140	1.5090	211.26
Total	300		353.21

Let us suppose, as in Table E.2, that the marginal utility of income is equal to 0.7 and the total net benefits of a project reach ENPV=300. These benefits would mainly be for the disadvantaged households and the use of welfare weights allows us to give more importance to these benefits. In particular, the amount of net benefits (140) obtained by the low income class is, with our weights, worth 211.26 and the entire project is worth 353.21.

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114 In the case of the commonly assumed iso-elastic social utility function, the expression for marginal utility is as follows: $MUy = Y^{-e}$.
If *e* were to take a unitary value, for which there is some empirical support, then we have: $MUy = Y^{-1} = 1/Y$.

115 The most important assumption is that an iso-elastic social utility function applies and is relevant over the complete range of incomes, so that the same value of *e* holds for all income classes.

116 See Evans, Kula and Sezer (2005) for further elaboration and the measurement of welfare weights in a regional context.

In our example considering distributional effects, the project increased its social value by 53.21. In other situations, as in Table E.3, welfare weights may reduce the social value of the project as a consequence of regressive benefits distribution.

Table E.3 Example of weights for regressive distributional impact

Classes	Net benefits	Elasticity 0.7	Distributional impact
High income	150	0.8176	122.64
Medium income	100	0.9289	92.89
Low income	50	1.5090	75.45
Total	300		290.98

A final shortcut for including distribution considerations is to focus solely on the impact of the project on the most disadvantaged groups. In fact, an additional analysis, along with the financial and economic analyses, will focus on the impact of the project on the welfare of specific target groups (the poor, ethnic minorities, the disabled, etc.).

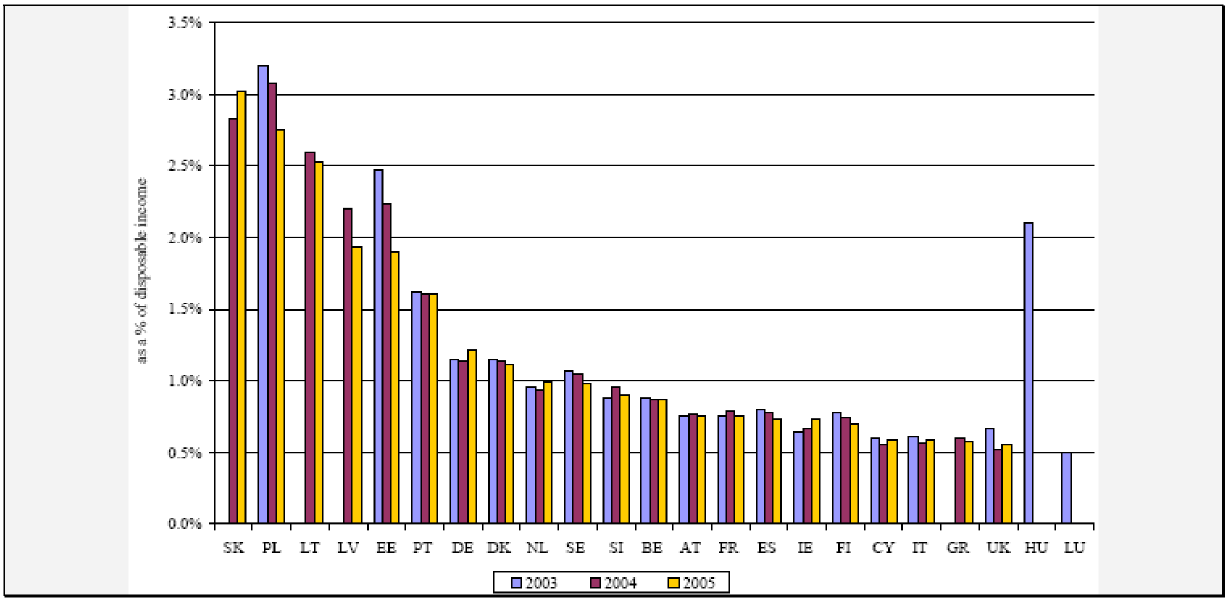
The simplest solution is to establish some affordability benchmarks. For example, the share of water or other essential services expenditure should not exceed a given threshold share of income of the target group (e.g. the bottom quintile).

Study on affordability shares for gas and electricity services

In an EC study[117] the shares of income spent on gas and electricity services in EU25 countries was shown. The affordability was assessed for incomes below the risk-of-poverty threshold, which corresponded to 60% of the median national equivalised disposable income.

For these low-income users between 2003 and 2005 the average share of electricity expenditure for the old Member States was 0.9% and for the 10 new Member States it was 1.9%. The 2005 figures for gas were 0.76% for EU15 and 1.36% for new Member States.

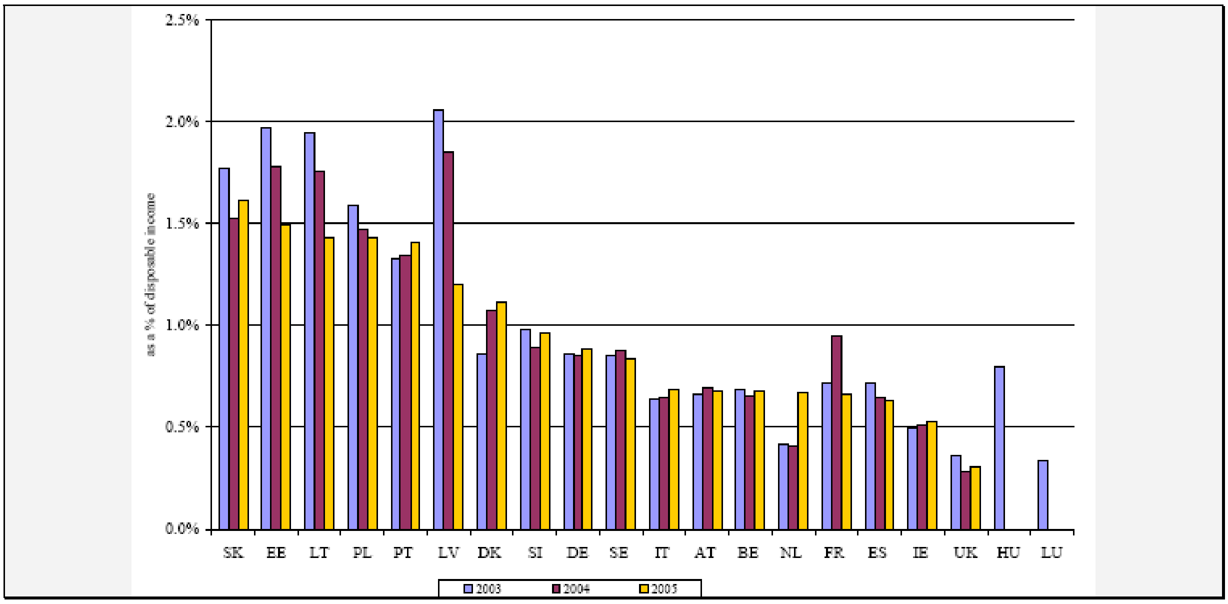
Figure E.1 Percentage of low income spent on electricity services by low-income consumers



Source: DG ECFIN (2007)

117 DG ECFIN (2007) - Evaluation of the Performance of Network Industries Providing Services of General Economic Interest - European Economy 1/2007

Figure E.2 Percentage of low income spent on gas services by low-income consumers



Source: DG ECFIN (2007)

When focusing on the bottom quintile, the shares can be much higher than in this study as long as average income in that group is considerably lower.

In fact, project implementation could be affected when the 'losers', because of the redistribution effects, are low-income households, left without any compensation. Extremely poor households could have no other choice than to stop paying for the service or avoid using it, with consequences for the project's financial sustainability and social unrest. Project proposers should consider appropriate remedies (e.g. progressive tariffs, vouchers or subsidies for avoiding serious social tensions due to the project).

Table E.4 shows some critical ratios from empirical observation: the share of persons who avoid using the service (replacing it when possible) or that do not pay for it, and the ratio of expenditure to total income they face.

Table E.4 Share of expenditure and service exclusion, self-disconnection, or non-payment in some sectors and countries for the bottom quintile

	ELECTRICITY SECTOR		GAS SECTOR		WATER SECTOR	
BOTTOM QUINTILE	**Share of income on electricity%**	**% of no expenditure***	**Share of income on gas**	**% of no expenditure***	**Share of income on water**	**% of no expenditure***
Bulgaria	10	1	3	0	5	14
Hungary	7	3	11	8	5	22
Poland	10	41	7	48	4	51
Romania	6	34	7	32	6	42
Turkey	10	50	29	56	5	59

Source: Lampietti, Benerjee and Branczik (2007)
** Households may report zero payment for a variety of reasons, including lack of connection, self-disconnection free riding, poor service quality, billing cycles and arrears.*

Table E.4 suggests as an empirical rule, that if the bottom quintile has to bear expenditure equal to or higher than a certain share of its revenues for utilities, then strong interventions are necessary because a substantial percentage of users will stop paying for the service or will disconnect.

UTILITY POVERTY IN THE UK AND IN ITALY

UK Fuel Poverty Strategy November 2001 defines a household in fuel poverty if it needs to spend more than 10% of its income on fuel for a satisfactory heating regime (i.e. generally 21 degrees in the main living area, and 18 in the other occupied rooms).

Fuel poverty mainly depends on the energy efficiency status of the property, the cost of energy and the household income.

To tackle fuel poverty the UK Government and Devolved Administrations put in place a range of specific programmes and measures including programmes to improve energy efficiency, maintaining the downward pressure on fuel bills, ensuring fair treatment for the less well-off, and supporting industry initiatives to combat fuel poverty.

Periodical progress reports and fuel poverty datasets are available at: http://www.berr.gov.uk/energy/fuel-poverty/index.html

One study[118] investigates the effects of the implementation of public utility reforms in Italy between 1998 and 2005 and takes territorial heterogeneity into account to find evidence of no aggravation of affordability issues. With the help of a counterfactual exercise, positive welfare effects of the reforms even emerged, but affordability concerns persisted.

From the statistical national database an affordability index was built on a 'reference basket' considering the consumption of utility services by the poorest section of the population. The figures obtained were:

	Water	**Electricity**	**Heating**	**Total utilities**
Threshold potential budget shares%	1.44	3.09	3.15	7.86

According to this definition the paper reports that in 2005, 5.2% of Italian households were in water poverty and 4.7% in electricity poverty, while 11.9% had affordability problems with heating. In fact, 3.4 million households were facing affordability problems with at least one utility (representing 14.7% of households in Italy).

[118] Miniaci, Scarpa and Valbonesi (2007) - Distributional effects of price reforms in the Italian utility markets

ANNEX F
EVALUATION OF HEALTH & ENVIRONMENTAL IMPACTS

Why do we value the environment?

The economic evaluation of the environment helps decision-makers to integrate into the decision-making process the value of environmental services provided by ecosystems. Direct and external environmental effects are expressed in monetary term[119] in order to integrate them into the calculation of homogenous aggregate CBA indicators of net benefits.

When face with strong uncertainty and irreversibility in the future availability of the environmental resources or for ethical reasons, other evaluation methods can be applied, such as Environmental Impact Assessments, multi-criteria analyses or public referenda. These methods avoid the need to express all the environmental impacts and individuals' preferences in a single numeraire, but are often less consistent and open to manipulation of the information.

Evaluating environmental impacts in investment projects

Most public infrastructure projects have negative or positive impacts on the local and global environment. Typical environmental impacts are associated with local air quality, climate change, water quality, soil and groundwater quality, biodiversity and landscape degradation, technological and natural risks. A decrease or increase in the quality or the quantity of environmental goods and services will produce some changes, gains or losses in social benefits associated with their consumption.

For example, a road infrastructure will be expected to reduce the availability of useful rural land, will change rural landscape, will increase pressures on biodiversity and negatively affect air quality due to increased traffic flows. Each of these impacts will reduce the provision of environmental services by the ecosystems and will lower economic benefits. In contrast, investments in waste treatment facilities will decrease environmental negative impacts on soil and water and will increase economic benefits related to the provision of high quality environmental services to economic agents (consumers and producers).

Not taking into account environmental impacts will result in an over- or underestimation of the social benefits of the project and will lead to bad economic decisions.

[119] A direct effect can be observed on markets (through the variation of price and quantity) or in the decision-making process, while external effects arise when the economic behaviour of an individual (or a firm) affects the behaviour of another (individual or firm), without any economic compensation or transaction from the former to the latter. In economics, pollution or resource depletions are often analysed with the help of the externality concept.

TOTAL ECONOMIC VALUE

The monetary measure of a change in an individual's well being due to a change in environmental quality is called the total economic value of the change. The total economic value of a resource can be divided into use values and non-use values:

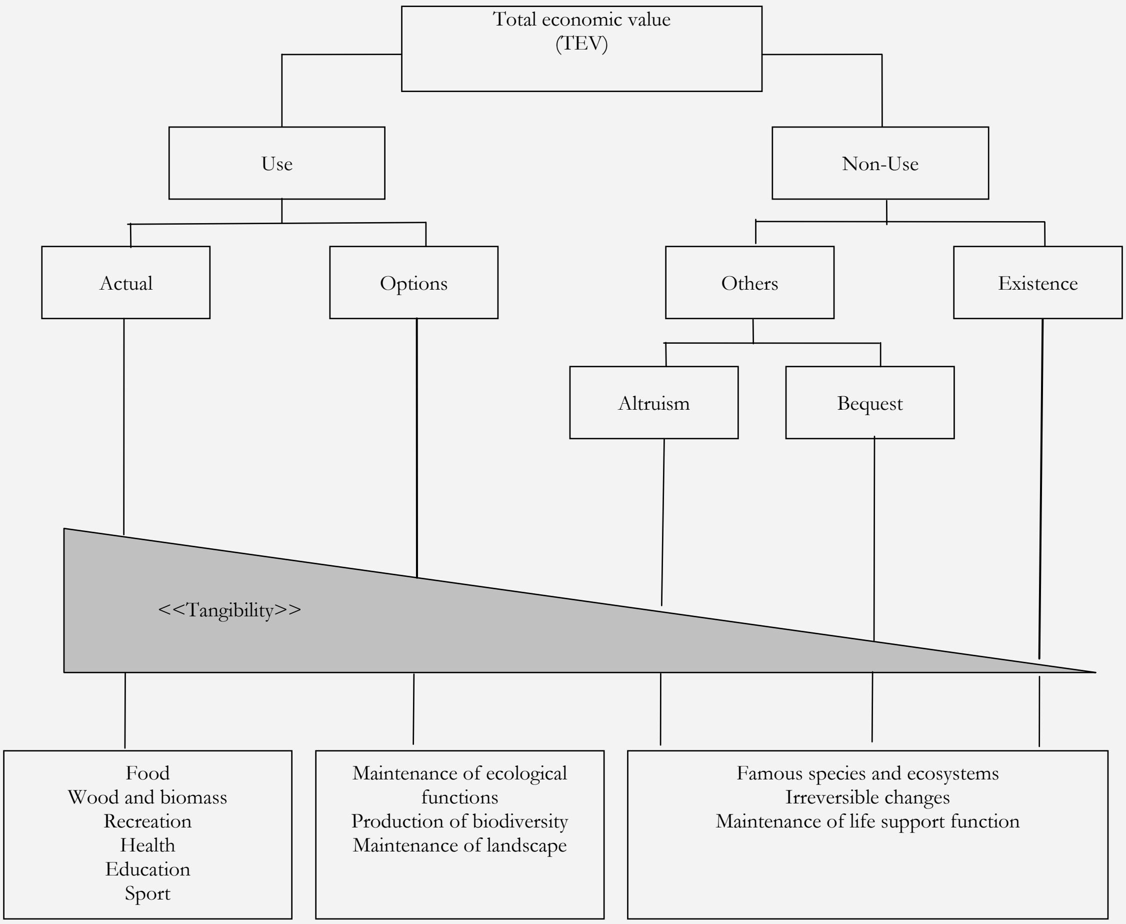
Total economic value = use values + non-use values.

Use values include benefits from the physical use of environmental resources, such as a recreational activity (sport fishing) or productive activities (agriculture and forestry). In this context stems from a combination of the individual's uncertainty about future demand for the resource and uncertainty about its future availability. Non-use values refer to the benefits individuals may obtain from environmental resources without directly using them. For example, many people value tropical ecological systems without directly consuming or visiting them. The components of non-use values are existence value and bequest value. Existence value measures willingness-to-pay for a resource for some 'moral', altruistic or other reason and is unrelated to current or future uses. Bequest value is the value that the current generation obtains from preserving the environment for future generations.

Non-use values are less tangible than use values since they often do not refer to a physical consumption of goods and services.

Values are directly linked to the ecological services produced by the ecosystems, which support them. For example, fishery depends on the ecological productivity of the water ecosystem as wetlands. Water availability is linked to the entire hydro-geological cycle and groundwater quality depends on the filtering capacity of soils. A reduction in the provision of ecological services (by a pollution for example) is be likely to depreciate the values expressed by people on environmental quality with, as a final result, a decrease in social benefits associated with it.

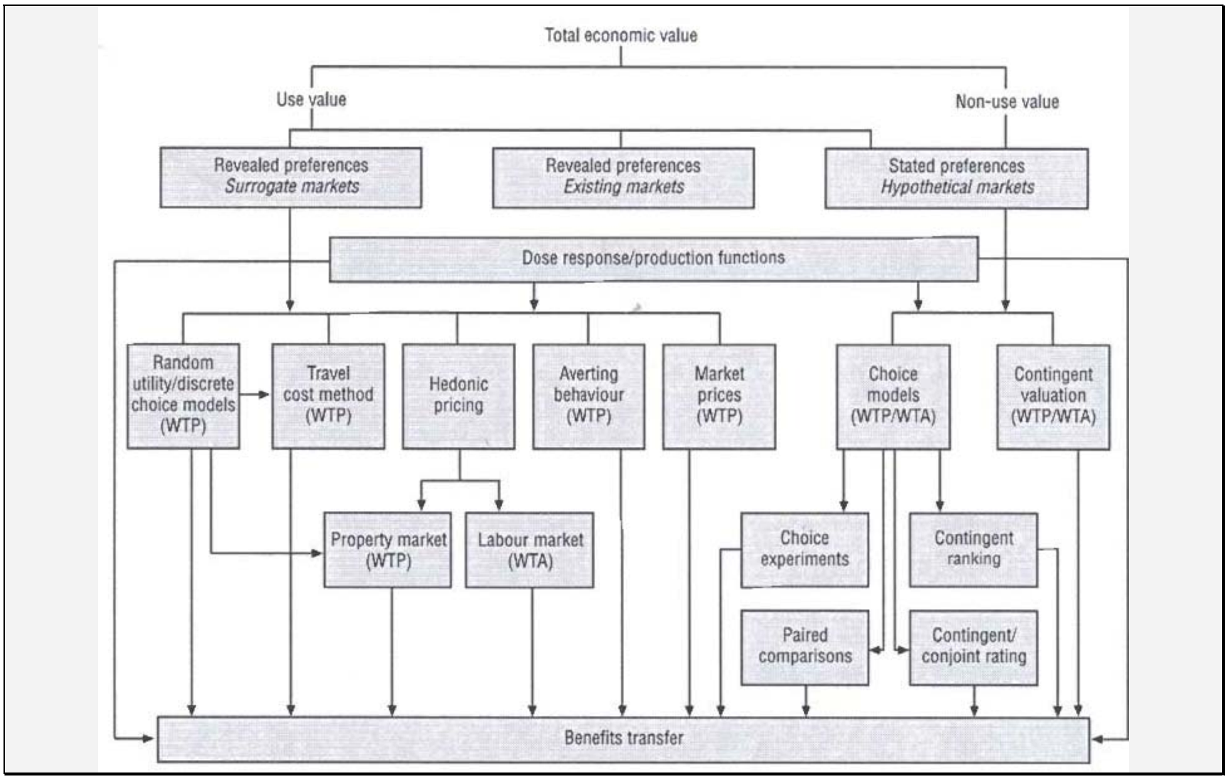
It is important to understand that economic value does not measure environmental quality per se; rather it reflects people's preferences for that quality. Evaluation is 'anthropocentric' in that it relates to preferences held by people.



How to measure environmental benefits

Since the environmental impacts may represent an important outcome of the projects it is necessary to include them in the economic appraisal framework.

Figure F.1 Main evaluation methods



Source: Pearce, D., Atkinson, G., Mourato, S., 2006, Cost-Benefit Analysis and the Environment, OECD, Paris

When environmental service markets are available, the easiest way to measure economic value is to use the actual related market price. For example, when marine pollution reduces fish catches, market values for the lost harvest are easily observed in the fish market. When there is no market, the price can be derived through non-market evaluation procedures. This is the case, for example, of air pollution since no market value can be associated with clean air.

When the goods to be evaluated are not traded in a real market, their value should be estimated using other approaches. The starting point of the evaluation, as for all costs and benefits, is looking at the individual preferences. A benefit is measured by the individual willingness-to-pay to secure it, and a cost is measured by the willingness to accept a compensation for the loss. In particular:

Negative Environmental Impacts	Positive Environmental Impacts
WTP to avoid a deterioration	WTP for an improvement
WTA compensation for a deterioration	WTA compensation to forgo an improvement

Three main methodologies can be applied for estimating the monetary value of changes in non-market goods:

- Revealed Preference Methods
- Stated Preference Methods
- Benefit Transfer Method.

Revealed Preference Methods

This approach implies that the valuation of non-market impacts is based on the observation of the actual behaviour and, especially, on the purchases made in actual markets. Consequently, the focus is on real choices and implied willingness-to-pay.

The strength of these approaches is that they are based on actual decisions made by individuals. The main weakness is the difficulty of testing the behavioural assumptions upon which the methods rely.

The main specific methods are:

- hedonic pricing method
- travel cost method
- averting or defensive behaviour method
- cost of illness method

Hedonic pricing method

The focus of this method is in the observation of behaviour in markets for goods related to the ones the analyst is evaluating. The starting point is the fact that the prices of many market goods are functions of a bundle of characteristics. For example, the price of a washing machine usually depends on the variety of washing programmes, its energy efficiency and its reliability. Through statistical techniques the method tries to isolate the implicit price of each of these characteristics.

In non-market evaluation the method uses two types of markets:

- property market
- labour market

With regard to the property market it is possible to describe any house e.g. by the number of rooms, location, structure, age, etc. The Hedonic pricing method should identify the contribution of each significant determinant of house prices in order to estimate the marginal willingness-to-pay for each characteristic.

Hedonic studies of the property market have been used to identify the value of non-market goods such as traffic noise, aircraft noise, air pollution, water quality and proximity to landfill sites. A house near an airport, for example, will be purchased at a lower price than a house located in a quiet area. The difference in values can be viewed as the value attached to noise.

In the labour markets the observation of wage differentials between jobs with different exposure to physical risk has been used in order to estimate the value of avoiding risk of death or injury.

Specific problems with this approach could be:

- lack of information on households and a partly irrational behaviour;
- multicollinearity: due to the fact that market characteristics tend to move in tandem, it is often hard to 'tease out' the independent effect of the single characteristic.

EXAMPLE OF THE USE OF A HEDONIC PRICE FOR THE ECONOMIC EVALUATION OF NOISE
Due to the extention of an airport, the decibel B in the neighbouring area increases by 10 (so ΔB is assumed to equal to 10). The social cost of the noise increase can be calculated with the following formula: $C = \Delta B \text{ x } e \text{ x } V \text{ x } L$ where L are the houses located in the area, V the average value and e as the value differential

Travel Cost method

The travel cost approach seeks to put a value on the individuals' willingness-to-pay for an environmental good or service, like for instance a nature park or an archaeological area, by the costs incurred to consume it.

The basis of the method is the observation that travel and nature parks, or archaeological areas, are complements such that the value of the nature park or archaeological area can be measured with reference to values expressed in the markets for trips to those areas. For zones located far from the nature park the number of visits is zero because the cost of the trip exceeds the benefit derived from the trip.

Therefore it is important to know:

- the number of trips to the nature park over a given time period;
- the costs of the trips to the nature park, from different zones split into the different components:
    - ♦ The monetary costs; in particular
      - travel costs,
      - admission price (if relevant),
      - on-site expenditures

- expenditure on capital equipment necessary for consumption;
- ♦ the time spent travelling and its value

Specific problems with this approach are related to 'multiple purpose trips'; because many trips have more than one destination, it is difficult to identify which part of the total travel cost is related to one specific destination.

Since only the benefits of the direct consumption of the environmental services are considered in this approach, non-use values (option value and existence value) cannot be considered.

Averting or defensive behaviour method

The main assumption of the averting evaluation method is that individuals can insulate themselves from a non-market bad by adopting more costly behaviours to avoid it. The cost these behaviours require can be represented by extra-time or by the restrictions they impose on what individuals would otherwise wish to do.

Another way to avoid exposure to specific non-market goods is the purchase of a market-good to 'defend' the consumer from the 'bad' (defensive expenditures). The value of each of these purchases can be considered the implicit price for the non-market good that individuals want to avoid.

An example could be the installation of double-glazed windows to decrease exposure to road traffic noise. Double-glazing is a market good that can be seen as a substitute for a non-market good (absence of road traffic noise) and so the cost of purchasing it can be considered as the price of the non-market good.

Specific problems with these approaches could be:

- defensive expenditures often represent a partial estimate of the value of the non-market good individuals want to avoid;
- many averting behaviours or defensive expenditures are related to joint products (e.g. heating and insulation from noise);
- individuals or firms may undertake more than one form of averting behaviour in response to any environmental change.

Cost of illness method

Like the defensive expenditures method, this one focuses on expenditures on medical services and products made in response to the health effects of non-market impacts.

The difference between the two methods is that usually the decision concerning health care expenditure is not made by individuals alone, but involves social administrators, politicians and taxpayers. This circumstance introduces a complex evaluation issue because the decisions of public administrators and politicians reflect not only the assessment of the negative impacts of the non-market good, but also other types of considerations (politics and ethics).

An additional problem with this approach is that changes in expenditure on treatments of health impacts are usually not easily directly observed, due to the stochastic link between health and non-market goods (for example air pollution).

Stated Preference Methods

Stated preference approaches are survey-based and elicit people's intended future behaviour in the markets. Through an appropriately designed questionnaire, a hypothetical market is described where the good in question can be traded. A random sample of people is then asked to express their maximum willingness-to-pay for (or willingness to accept) a supposed change in the good's provision level. Consequently, the focus is on real choices and implied willingness-to-pay.

The main strength of the methods based on this approach is represented by the flexibility they can assure. Indeed, they allow the evaluation of almost all non-market goods, both from an ex-ante and from an ex-post point of view. Moreover, this methodology is able to capture all types of benefits from a non-market good or service, including the so-called non-use values.

The main specific methods are:

- contingent valuation method
- choice modelling method

Contingent Valuation Method

The aim of the method is to elicit individual preferences, in monetary terms, for changes in the quantity or quality of a non-market good or service.

The key element in any contingent evaluation study is a properly designed questionnaire. The questionnaire aims to determine individuals' estimates of how much having or avoiding the change in question is worth to them.

In order to conduct a contingent valuation it is worthwhile:

- investigating the attitudes and behaviour related to the goods to be valued in preparation for answering the valuation question and in order to reveal the most important underlying factors driving respondents' attitude towards the public good;
- presenting respondents with a contingent scenario providing for a description of the commodity and the terms under which it is to be hypothetically offered. The final questions should aim to determine how much they would value the good if confronted with the opportunity to obtain it under the specified terms and conditions;
- asking questions about the socio-economic and demographic characteristics of the respondents in order to check the extent to which the survey sample is representative of the population involved.

At the end of the survey process, analysts use appropriate econometric techniques to derive welfare measures such as mean or median willingness-to-pay and also to identify the most important determinants of willingness-to-pay. With regard to the statistical indicators to be used, the median could be the best predictor of what the majority of people would actually be willing to pay because, unlike the mean, it does not give much weight to outliers

Choice Modelling Method

Choice Modelling is a survey-based method for modelling preferences for goods, when goods are described in terms of their attributes and of the level of these attributes. Respondents have various alternative descriptions of a good, differentiated by their attributes and levels, and are requested to rank the alternatives, to rate them or to choose their preferred option. By including price/cost as one of the attributes of the good, willingness-to-pay can be directly recovered from people's rankings, ratings or choices. Also, in this case, the method allows the measurement of non-use values.

The main variants proposed in specialist literature are described in the following table:

Main variants of CM method	Tasks
Choice experiments	Choose between two or more alternatives (where one is the *status quo*)
Contingent ranking	Rank a series of alternatives
Contingent rating	Score alternative scenarios on a scale of 1-10
Paired comparison	Score pairs of scenarios on a similar scale

The main strengths of the method are:

- the capacity to deal with situations where changes are multi-dimensional, thanks to its ability to separately identify the value of the specific attributes of a good;
- the possibility for respondents to use multiple choices (for example variants in Choice experiments), to express their preference for a valued good over a range of payment amounts;
- by relying on ratings, rankings and choices and deriving indirectly the willingness-to-pay of respondents, the method overcomes some problems associated with the Contingent Valuation Method.

The main problems are:

- the difficulties respondents experience in dealing with multiple complex choices or rankings;
- the inefficiency in deriving values for a sequence of elements implemented by a policy or project. For these types of evaluations Contingent Methods should be preferred;
- the willingness-to-pay estimate is sensitive to study design. For example, the choice of attributes and levels to present to the respondents and the way in which choices are relayed to respondents (use of photographs, text description etc.) may impact on the values of estimates;
- one indirect method of evaluating non-market goods is related to dose-response functions.

Dose-response functions

The dose-response technique aims to establish a relationship between environmental impacts (the response) and physical environmental impacts such as pollution (the dose). The technique is used when the dose-response relationship between the cause of environmental damage, such as air or water pollution, and the impacts, morbidity due to air pollution or water contamination by chemical products for example, is well known. The technique takes natural science information on the physical effects of pollution and uses this in an economic model of evaluation. The economic evaluation will be performed by estimation, through a production or a utility function of the profit variations of firms or the revenue gains or losses of individuals.

The two steps of the method are:
- the calculation of the pollutant dose and receptor function, and;
- the economic evaluation by the choice of an economic model.

To assess the monetary gain or loss of benefits due to the variation in environmental quality requires the analysis of biological and physical processes, their interactions with economic agents' decisions (consumer or producer) and the final effect on welfare.

The major fields of application of the methodology are the evaluation of losses (in crops, for example) due to pollution, the pollution effects on ecosystems, vegetation and soil erosion, and the impacts of urban air pollution on health, materials and buildings. The approach cannot estimate the non-use value.

Benefit Transfer

Recent developments in policy behaviour have stressed the relevance of the so-called Benefit-Transfer Approach in the appraisal of non-market goods, specifically environmental goods and services (Pearce, Atkinson and Mourato, 2006). This method consists of taking a unit value for a non-market good estimated in an original study and using this estimate, after some adjustments, to value benefits (or costs) that arise when a policy or project is implemented elsewhere.

The Benefit Transfer method can be defined as the use of a good estimate in one site, the 'study site' as a proxy for values of the same good in another site, the 'policy site' (Desvousges, Johnson and Banzhaf, 1998). For example, the provision of a non-market good at a policy site could refer to a lake at a particular geographical location. If sufficient data are not available for that country, analysts can use values for similar conditions in data-rich countries.

The interest shown in this approach is due to the opportunity to reduce the need for costly and time–consuming original studies of non-market goods values. Moreover Benefit Transfer could be used to assess whether or not a more in-depth analysis is worthwhile.

Clearly, the main obstacle in using this approach is that Benefit Transfer can give rise to seriously biased estimates.

Obviously judgement and insight are required for all the basic steps entailed in undertaking a BT exercise. For example, information needs to be obtained on baseline environmental quality, changes and relevant socio-economic data.

Benefit transfer is usually performed in three steps:
- the compilation of the existing literature on the subject under investigation (recreational activity, human health, air and water pollution…);
- the assessment of the selected studies for their comparability (similarity of the environmental services valued, difference in revenue, education, age and other socio-economic characteristics which can affect the evaluation);
- the calculation of values and their transfer in the new context of evaluation.

The most crucial stage is where existing estimates or models are selected and estimated effects are obtained for the policy site. In addition, the population at the relevant policy site has to be determined.

Adjustments are usually advisable in order to reflect differences at the original study sites and the new policy sites.

The analyst may choose from three main types of adjustment of increasing sophistication:
- unadjusted Willingness-to-pay Transfer => this procedure implies a simple 'borrowing' of the estimates made in the study site and the use of those estimates in the policy site, with an obvious advantage in terms of simplicity;
- willingness-to-pay Transfer with Adjustment (value transfer) => it could be useful to modify the values from the study site data to reflect the difference in a particular variable that characterizes the sites. For example, the values can be adjusted through multiplication using the ratio between the income level of the study case and the income level of the policy case.
- willingness-to-pay Function Transfer => a more sophisticated approach is to transfer the benefit or value function from the study site to the policy site. Thus, if it is known that Willingness-to-pay for a good at the study site is a function of, first, a range of physical features on the site, second, of its use, and third, of a set of socio-economic characteristics of the population at the site, then this information itself can be used as part of the transfer process.

VALUE TRANSFER
Value transfer encompasses the adjustment of WTP in order to take into account the differences between the study and policy sites. The most commonly used adjustment is based on income, because it is thought that it is the most important factor resulting in changes in WTP. Thus if the WTP for an environmental good is X in a region when income per capita is Y, it may be X*f(Z/Y) in a different region where per capita income is Z.
Other determinants might systematically differ between study and project sites, the main ones include:
- the socio-economic and demographic characteristics of the population
- the specific physical characteristics of the area
- the extent of the change involved (values derived for small improvements may not apply to large changes)
- the market conditions (availability of substitutes)
- the changes of valuation over time

For all types of adjustments the quality of the original study is of paramount importance for the validity of the method.

Some databases have been set up to facilitate benefit transfer. This is the case with the EVRI database[120] developed by Environment Canada and the US Environment Protection Agency. More than 700 studies are currently available in the database, but only a minority are of European origin and this fact reduces the usability of the database in a European context. GEVAD is an online European database, which was co-funded by the European Social Fund and Greek government resources. The aim of the project was to create a free online environmental valuation database, by gathering a critical mass of European valuation studies. About 1,400 studies were reviewed, focusing on the ones that were spatially more relevant to Europe. Emphasis was also placed on the most recent research results. So far, more than 310 studies have been included in the GEVAD database. These studies are classified according to the environmental asset, good or service, which is valued (e.g. amenities, water and air quality, land contamination, etc.), the valuation method used, the main author and the country of the 'study site'.[121]

Recent Estimate of the VOSL (Value of Statistical Life) in the UK

WTP for mortality risk reductions is normally expressed in terms of the value of statistical life (VOSL). This entails dividing the WTP for a given risk reduction by that risk reduction in order to obtain the VOSL. The following table has a variety of estimates of the VOSL, mostly for the UK. There is some unease about using the value of statistical life in contexts where remaining years may be few for the affected individuals and this has led to the use of 'life year' valuations derived from VOSL. For example, the concern is that estimates of VOSL from studies of workplace accidents (which tend to affect healthy, middle-aged adults), and road accidents (which tend to affect median age individuals) are 'too high' when transferred to environmental contexts where mortality-related air pollution impacts tend to mostly affect the very elderly or those with serious respiratory problems.

Study	Type of study	Risk Context	VOSL $Million (year prices)
Markandya et al. 2004	Contingent valuation	Context-free reduction in mortality risk between ages of 70 and 80	1.2 - 2.8 0.7 – 0.8 0.9 – 1.9 (2002)[3]
Chilton et al. 2004	Contingent valuation	Mortality impacts from air pollution	0.3 – 1.5 (2002)[3,4]
Chilton et al. 2002	Contingent valuation	Roads (R), Rail (Ra)	Ratios: Ra/R=1.003[6]
Beattie et al.1998	Contingent valuation	Roads (R) and domestic fires (F)	5.7[3]
Carthy et al. 1999	Contingent valuation/standard gamble	Roads	1.4 – 2.3 (2002)[3,5]
Siebert and Wie 1994	Wage risk	Occupational risk	13.5 (2002)[3]
Elliott and Sandy 1996	Wage risk	Occupational risk	1996: 1.2 (2000)[3]
Arabsheibani and Marin 2000	Wage risk	Occupational risk	1994: 10.7 (2000)[3]

Source: Adapted from Pearce, D.W., G. Atkinson and S. Mourato (2006)

Note: 1: median of the studies reviewed; 2: range varies with risk reduction level, lower VOSLs for larger risk reductions. 3: UK £ converted to US$ using PPP GNP per capita ratio between UK and US. Range reflects different risk reductions. 4: based on WTP to extend life by one month assuming 40 years of remaining life. 5: based on trimmed means. 6: this study sought respondents' relative valuations of a risk relative to a risk of death from a road accident. Numbers reported here are for the 2000 sample rather than the 1998 sample. Between the two sample periods there was a major rail crash in London

120 The database is accessible through the following link: <http://www.evri.ca/>

121 The database is accessible through the following link: <http://www.gevad.minetech.metal.ntua.gr/>

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Climate change

Climate change costs have a high level of complexity due to the fact that they are long-term and global and because risk patterns are very difficult to anticipate. As a result there are difficulties in valuing the damage caused. Therefore, a differentiated approach (looking both at the damage and the avoidance strategy) is necessary. In addition long-term risks should be included.

The climate change or global warming impacts on production and consumption activities are mainly caused by emissions of greenhouse gases carbon dioxide (CO_2), nitrous oxide (N_2O) and methane (CH_4). To a smaller extent, emissions of refrigerants (hydro fluorocarbons) from Mobile Air Conditioners (MAC) also contribute to global warming.

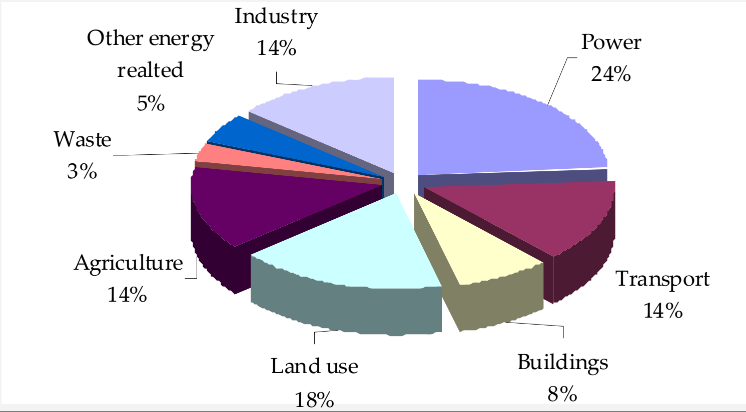
Climate change impacts have a special position in external cost assessment:

- climate change is a global issue, so the impact of emissions is not dependent on the location of the emissions;
- greenhouse gases, especially CO_2, have a long lifetime in the atmosphere so that present emissions contribute to impacts in the distant future;
- the long-term impacts of continued emissions of greenhouse gases are especially difficult to predict but potentially catastrophic.

Scientific evidence on the causes and future paths of climate change is becoming increasingly consolidated. In particular, scientists are now able to attach probabilities to the temperature outcomes and impacts on the natural environment associated with different levels of stabilisation of greenhouse gases in the atmosphere.

The proportion of greenhouse gases in the atmosphere is increasing as a result of human activity; the sources are summarised in this figure:

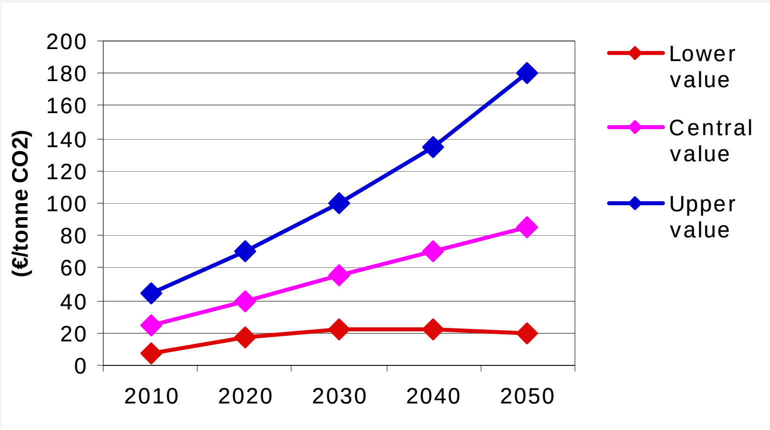
Figure F.2 Greenhouse-gas emissions in 2000



Source: Stern Review 2006

As we all know, there is great uncertainty attached to climate change projections based on anthropogenic emissions and to the associated expected environmental damage and external costs. The available figures range from the €20/tonne estimate for the CO_2 permit trading price to the higher values estimated in literature (€140 and €170, respectively, in INFRAS-IWW (2002) and ETSAP-Sweden (1996). Recently the Stern Review[122] suggested an average damage value of €75/tonne CO_2. The following diagram shows the recommended values estimated by the Impact Study[123].

Figure F.3 Recommended values for the external costs of climate change



122 'The Economics of Climate Change', www.sternreview.org.uk, 2006
123 Impact Handbook of Estimation of External Costs in the Transport Sector, December 2007

ANNEX G
EVALUATION OF PPP PROJECTS

It is possible to define as PPP any project in which the investment (or part thereof) is contributed by the private sector and where there is a regulatory contract between the private and public sectors in terms of risk allocation for the provision of the infrastructure and/or the services. The level of PPP complexity will differ according to the sector, the type of project and country, as a function of the risk mitigation mechanisms and the use of project finance to fund the project. The participation of the private sector in the provision of public assets and services assumes that, whatever the contractual arrangement between the two parties, adequate returns on investment - from a strictly financial perspective - must be allowed to occur.

Definition of PPP

Acknowledging the growing importance of the PPP solution at the Community level, the European Commission is progressively working towards the clarification of the PPP concept, the specification of the policies to be adopted in this domain as well as promoting the dissemination of good practices[124].

The 2003 EC Guidelines for successful Public–Private Partnerships[125], defines PPP as 'a partnership between the public sector and the private sector for the purpose of delivering a project or a service traditionally provided by the public sector…By allowing each sector to do what it does best, public services and infrastructure can be provided in the most economically efficient manner'.

The Green Paper on Public-Private Partnerships[126] refers to PPPs as 'forms of cooperation between public authorities and the world of business, which aim to ensure the funding, construction, renovation, management or maintenance of an infrastructure or the provision of a service'. The Green Paper singles out the following elements that normally characterize PPPs:

- the relatively long duration of the relationship, involving cooperation between the public partner and the private partner on different aspects of a planned project;
- the method of funding the project, in part from the private sector, sometimes by means of complex arrangements between the various players. Nonetheless, public funds - in some cases rather substantial - may be added to the private funds;
- the important role of the economic operator, who participates in different stages of the project (design, completion, implementation, funding). The public partner concentrates primarily on defining the objectives to be attained in terms of public interest, quality of services provided and pricing policy, and it takes responsibility for monitoring compliance with these objectives;
- the distribution of risks between the public partner and the private partner, with the risks generally borne by the public sector transferred to the latter. However, a PPP does not necessarily mean that the private partner assumes all the risks, or even the majority of the risks linked to the project. The precise distribution of risk is determined case by case, according to the respective abilities of the parties concerned to assess, control and cope with this risk.

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124 The main documents reflecting initiatives taken by the EC in this specific domain are: Commission Interpretative Communication on Concessions under Community Law (Official Journal C 121 of 29/04/20009); Guidelines for Successful Public – Private Partnerships; Directives 2004/17/EC and 2004/18/EC of the European Parliament and of the Council Coordinating the Procedures for the Award of Public Contracts; Green Paper on Public-Private Partnerships; Communication from the Commission on Public-Private Partnerships and Community Law on Public Procurement and Concessions (COM (2005) 569 final, issued on 15.11.2005).

125 EC DG Regional Policy, Guidelines for Successful Public–Private Partnerships, January 2003

126 EC Green Paper on Public-Private Partnerships and Community Law on Public Contracts and Concessions (COM (2004) 327 final).

CLASSIFICATION OF PPPS
There are many possible ways of classifying PPPs. According to the World Bank [127] it is possible to group them into the following four categories.
- Divestitures or asset sales, contracts are used to transfer ownership of the firm to the private sector, leading to the 'privatisation' of all risks. This type of PPP can take many forms, such as initial public offerings of shares, or private sales of the assets themselves;
- Greenfield Projects, projects that are awarded to the private sector. Design-Build-Finance-Operate-Transfer (DBFOT), Operate-Build-Operate and Transfer or Own (BOT or BOO) (see below) are among the most common contractual forms. The associated commercial risks tend to be assumed by the private constructor, while other risks such as exchange rate or political risks can be shared to varying degrees with the public sector through various types of legal instruments such as guarantees or explicit subsidies;
- Brownfield Projects are contracts that give the private operator the right to manage (i.e. operate and maintain) the service but do not include major investment obligations. These contracts are typically of short to medium duration (2-5 years) and generally the government continues to take on all risks involved in the project except for the management risks;
- Concessions/licenses/franchises are typically long term contracts of 10-30 years, which pass on the responsibility for O&M (operation and maintenance) to a private operator and include detailed lists of investment and service obligations. There is no transfer of public asset ownership to the private sector, and the operator takes the commercial risks.

Risk

According to the European System of Accounts (ESA 95)[128] the assets involved in a public-private partnership should be classified as non-government assets, and therefore recorded off-balance sheet for the government if:

- the private partner bears the construction risk and;
- the private partner bears at least one of either availability or demand risk.

Thus, the type of risk borne by the contractual parties is the core element for the accounting of the impact on the government deficit of public-private partnerships.

According to the ESA manual, if the construction risk is borne by government, or if the private partner bears only the construction risk and no other risks, the assets should be classified as government assets. This decision on the accounting treatment also specifies the main categories of 'generic' risks[129].

Risk distribution among the different project phases is likely to vary depending on the nature of the project. How risk is priced is closely related to what extent the party that bears the risk is able to control it. If a party has to bear a risk, which it is not able to control, it will then ask for a compensation price (high risk premium). On the other hand, if the partner considers the risk manageable, it will not require a high risk premium. Through the financial instruments that are used in PPPs, risks are distributed and priced. This then influences interest rates, financial terms and insurances and also how the financing model is built up for each project in terms of types of loans and lenders.

Public Sector Comparator PSC

As mentioned before, one of the principal arguments in favour of private sector involvement is that the profit motive increases cost-effectiveness and market awareness. Companies will do their best to ensure that their capital at risk is used effectively and produces adequate returns. Although the cost of private capital is greater then the cost of finance raised by the public sector, it is thought that this is offset by the greater efficiency of the private sector.

In order to check the advantages of having the private sector provide an infrastructure, private bids should be assessed objectively against a publicly managed and financed benchmark to demonstrate value for money. One way of assessing the Value for Money is through the Public Sector Comparator (PSC), which estimates the hypothetical risk-adjusted cost if a project were to be financed, owned and operated by the government. It therefore represents the most efficient public procurement cost (including all capital and operating costs and share of overheads) after

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127 Estache, A. and Serebrisky, T. 2004: Where do we stand on transport infrastructure deregulation and public-private partnership? in Policy Research Working Paper Series 3356. The World Bank. Available online at: [http://ideas.repec.org/p/wbk/wbrwps/3356.html]

128 ESA95 Manual on Government Debt and Deficit – Long term contracts between government units and non-governmental partners (Public-Private Partnerships) (Part IV), 30 August 2004. Available online at [http://epp.eurostat.cec.eu.int/cacheITY_OFFPUB/KS-BE-04-004/ENKS-BE-04-004-EN.PDF].

129 Three categories were selected: a) construction risk - covering events such as late delivery, non-respect of specified standards, additional costs, technical deficiency, and external negative effects; b) availability risk - the partner may not be in a position to deliver the volume that was contractually agreed or to meet safety or public certification standards relating to the provision of services to final users, as specified in the contract and c) Demand risk - bearing the variability of demand (higher or lower than expected when the contract was signed) irrespective of the behaviour (management) of the private partner. This risk should only cover a shift of demand not resulting from inadequate or low quality of the services provided by the partner or any action that changes the quantity/quality of services provided.

adjustments for Competitive Neutrality, Retained Risk and Transferable Risk to achieve the required service delivery outcomes, and is used as a benchmark for assessing the potential value for money of private party bids.

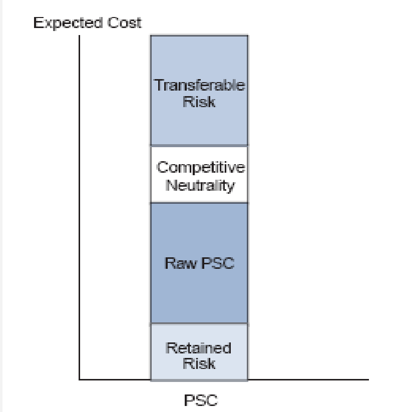
The PSC should:

- be expressed as the Net Present Cost of a projected cash-flow based on the specified government discount rate over the required life of the contract;
- be based on the most recent or efficient form of public sector delivery for similar infrastructure or related services;
- include Competitive Neutrality adjustments so that there is no net financial advantage between public and private sector ownership;
- contain realistic assessments of the value of all material and quantifiable risks that would reasonably be expected to be transferred to the bidders;
- include an assessment of the value of the material risks that are reasonably expected to be retained by the government.

The assessment requires a number of steps:

Raw PSC. First of all a raw PSC has to be estimated, which provides a base costing under the public procurement method where the underlying asset or service is owned by the public sector. This includes all capital and operating costs, both direct and indirect, associated with building, owning, maintaining and delivering the service (or underlying asset) over the same period as the term under the Public Private Partnership, and to a defined performance standard as required under the output specification. One of the keys to constructing a PSC is the identification of the Reference Project. The Reference Project is the most likely and efficient form of public sector delivery that could be employed to satisfy all elements of the output specification.

Figure G.1 Public Sector Comparator



Competitive Neutrality adjustments remove any net advantages (or disadvantages) that accrue to a government business simply by virtue of being owned by the government. This allows a fair and equitable assessment between a PSC and the bidders.

Transferable risk Estimate of the value of those risks (from the government's perspective) that are likely to be allocated to the private party.

Retained risk Estimate of the value of those risks or parts of a risk that the government proposes to bear itself.

Risk adjustment bids may propose different levels of risk transfer. Before the PSC can be compared against the accepted variant bids, the level of risk transfer proposed in each bid should be analysed to reflect the level of risk transfer proposed by the government.

This is achieved by adjusting the relevant bids through the following method:

- where a bid offers a greater level of risk transfer to the private sector than proposed by the government, the adjustment to the bid cost will be negative (reduce the total bid cost); or

- where a bid offers a lower level of risk transfer to the private sector than proposed by the government, the adjustment will be positive (increase the total bid cost).

The amount of the adjustment should be calculated in the same manner as Retained Risk.

Implications for financial analysis

Under a PPP, there is private equity involved in the project and the transfer of funds from the public sector, including the grants given by the Structural Funds, should not be excessive. A straightforward way to check this is to split the standard NPV(K) or FRR(K) in the components accruing respectively to the national public sector NPV(Kg) and to the private sector NPV(Kp). The latter is simply the net present value of the operating flows less the private equity, loan reimbursement and interest. It is the return for the private investor when both the EU grant and the national public sector transfer are excluded from the performance calculation. For an example, see Case Study Water in Chapter 3.

ANNEX H
RISK ASSESSMENT

In *ex-ante* project analysis it is necessary to forecast the future value of variables, with an unavoidable degree of uncertainty. Uncertainty arises either because of factors internal to the project (as, for example, the value of time savings, the timing of the completion of the investment etc.) or because of factors external to the project (for example, the future prices of inputs and outputs of the project).

Risk assessment, in the broad sense, requires:
- sensitivity analysis;
- probability distribution of critical variables;
- risk analysis;
- assessment of acceptable levels of risk;
- risk prevention.

Sensitivity analysis

Sensitivity analysis can be helpful in identifying the most critical variables of a specific project. See Chapter 2 for the suggested approach.

Probability distribution of critical variables

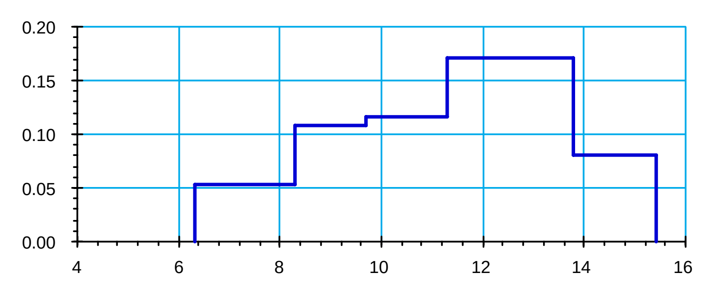
Once the critical variables have been identified, then, in order to determine the nature of their uncertainty, probability distributions should be defined for each variable. A distribution describes the likelihood of occurrence of values of a given variable within a range of possible values.

There are two main categories of probability distribution in literature:
- 'Discrete probability distribution': when only a finite number of values can occur;
- 'Continuous probability distribution': when any value within the range can occur.

Discrete distributions

If a variable can assume a set of discrete values, each of them associated to a probability, then it is defined as discrete distribution. This kind of distribution may be used when the analyst has enough information about the variable to be studied, to believe that it can assume only some specific values.

Figure H.1 Discrete distribution

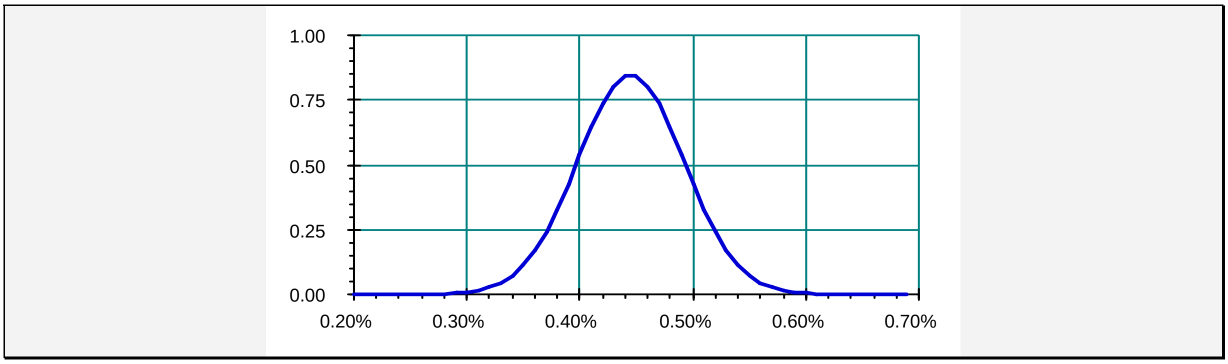


Continuous distribution

Gaussian (or Normal) distribution is perhaps the most important and the most frequently used probability distribution. This distribution is completely defined by two parameters:
- the mean (μ),
- the standard deviation (σ).

The degree of dispersion of the possible values around the mean is measured by the standard deviation[130]

Figure H.2 Gaussian distribution

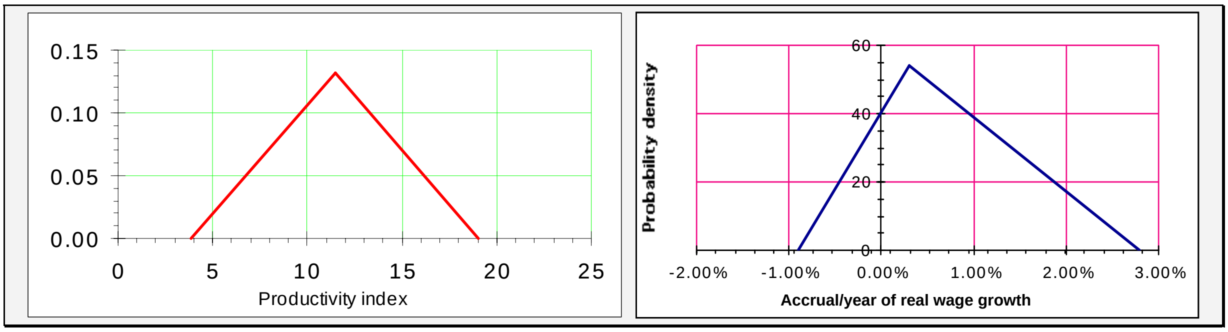


Normal distributions occur in a lot of different situations. When there is reason to suspect the presence of a large number of small effects acting additively and independently, it is reasonable to assume that observations will be normally distributed.

Triangular or three-point distributions are often used when there is no detailed information on the variable's past behaviour. This simple distribution is completely described by a 'High Value', a 'Low Value' and the 'Best-Guess Value', which, respectively, provide the maximum, the minimum and the modal values of the probability distribution.

Triangular Distribution is typically used as a subjective description of a population for which there is only limited sample data, and especially in cases where the relationship between variables is known but data is scarce (possibly because of the high cost of collection). The precise analytical and graphical specification of a triangular distribution varies a lot, depending on the weight given to the modal value in relation to the extreme point values.

Figure H.3 Symmetric and asymmetric triangular distributions



The diagrams in figure H. 3 show two types of triangular distributions:

- the first one is symmetric, with the high value as likely as the low ones and with the same range between the modal value and the low value and between the modal value and the high value;
- the second one is asymmetric, with the high value more likely than the low ones and with a larger range between the modal value and the high value than the range between the modal value and the low value (or vice-versa).

If there is no reason to believe that within a range a given value is more likely to materialise than others, the distribution obtained is called Uniform, i.e. a distribution for which all intervals of the same length on the distribution's support are equally probable.

130 $f(x) = \frac{1}{\sigma\sqrt{2\pi}} e^{-\frac{(t-\bar{t})^2}{2\sigma^2}} \qquad with -\infty < x < \infty$

Reference Forecasting

The question of where to look for relevant distributions arises. One possible approach is 'Reference Forecasting'. i.e. taking an 'outside view' of the project by placing it in a statistical distribution of outcomes from a class of similar projects. It requires the following three steps:

- the identification of a relevant reference class of past projects, sufficiently broad to be statistically meaningful without becoming too generic;
- the determination of a probability distribution of the outcomes for the selected reference class of project;
- a comparison of the specific project with the reference class distribution and a derivation of the 'most likely' outcome.

According to Flyvberg (2005) 'The comparative advantage of the outside view is most pronounced for non routine projects. It is in planning such new efforts that the biases toward optimism and strategic misrepresentation are likely to be largest.'

Systematic Risk

In financial and economic literature there is a distinction between variability that is random and, at least in principle, diversifiable, and variability that is correlated with overall market trends and economic growth. Non-diversifiable variability is usually described as systematic or market risk.

Risk that is diversifiable, or non-systematic, is regarded for most practical purposes as costless in the public and private sectors. Public sector risks are generally spread across taxpayers, again reducing the variability faced by any individual to a small fraction of individual income.

In welfare economics the cost (or benefit) of systematic variability is conventionally estimated from first principles, using a utility function in which the marginal utility of extra income declines as the individual's income increases. This can materially affect the estimated value of the benefits of schemes that produce the highest benefits in years when incomes would otherwise have been very low. Such a utility function usually assumes a constant but plausible value for the income elasticity of marginal utility with respect to income (normally abbreviated to the 'elasticity of marginal utility').

Risk analysis

Having established the probability distributions for the critical variables, it is possible to proceed with the calculation of the probability distribution of the project's NPV (or the IRR or the BCR). The following table shows a simple calculation procedure that uses a tree development of the independent variables. In the sample reported in the table, given the underlying assumptions, there is 95% probability that the NPV is positive. The more general approach to the calculation of the conditional probability of project performance by the Monte Carlo method was presented in Chapter 2. See also references in the bibliography.

Table H.1 Probability calculation for NPV conditional to the distribution of critical variables *(€ million)*

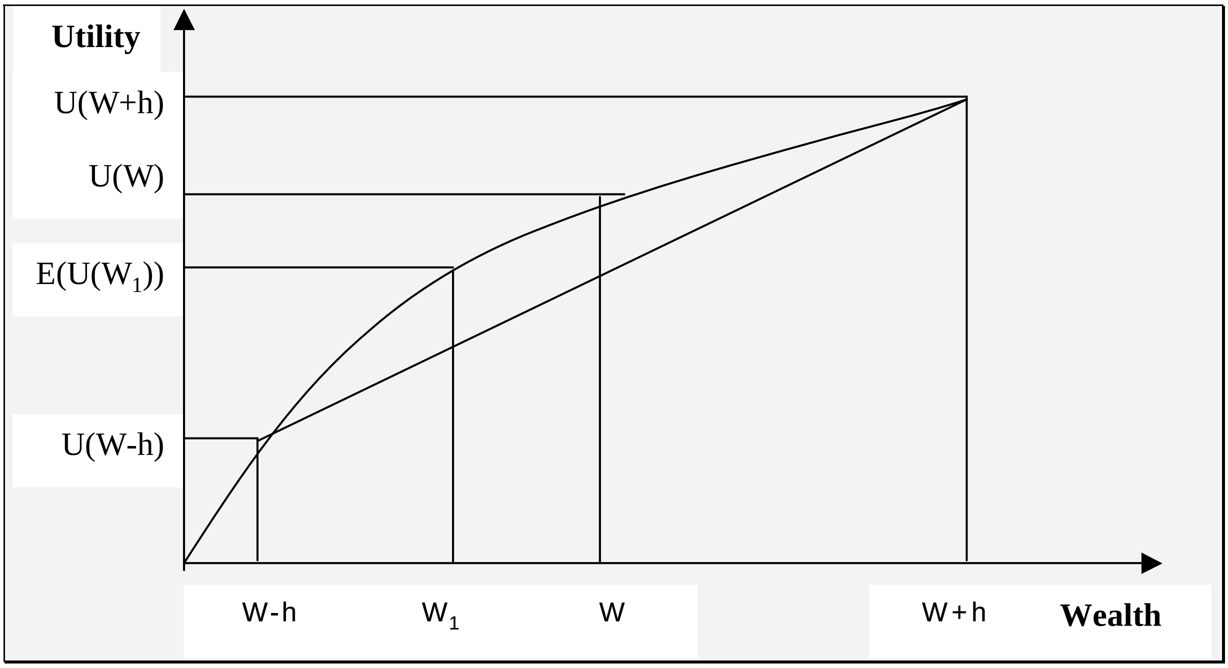
Critical variables					Result	
Investment	Other costs		Benefit		NPV	
Value	Value	Probability	Value	Probability	Value	Probability
-56.0	-13.0	0.20	74.0	0.15	5.0	0.03
			77.7	0.30	8.7	0.06
			81.6	0.40	12.6	0.08
			85.7	0.15	16.7	0.03
	-15.6	0.50	74.0	0.15	2.4	0.08
			77.7	0.30	6.1	0.15
			81.6	0.40	10.0	0.20
			85.7	0.15	14.1	0.08
	-18.7	0.30	74.0	0.15	-0.7	0.05
			77.7	0.30	3.0	0.09
			81.6	0.40	6.9	0.12
			85.7	0.15	10.9	0.05

Assessment of acceptable levels of risk

When individuals attach greater importance to the possibility of losing a sum of money than to the possibility of gaining the same sum, with a 50% probability of each outcome occurring, there is 'Risk Averse Behaviour'.

Risk aversion follows from the proposition that the utility derived from wealth rises as wealth rises, but at a decreasing rate. This, in turn, comes from the theory of diminishing marginal utility of wealth. In microeconomic theory it is generally assumed that the utility of the marginal quantity of a good is lower than the utility of the same quantity obtained before the marginal one.

Figure H.4 Relationship between Utility and Wealth for a risk averse society

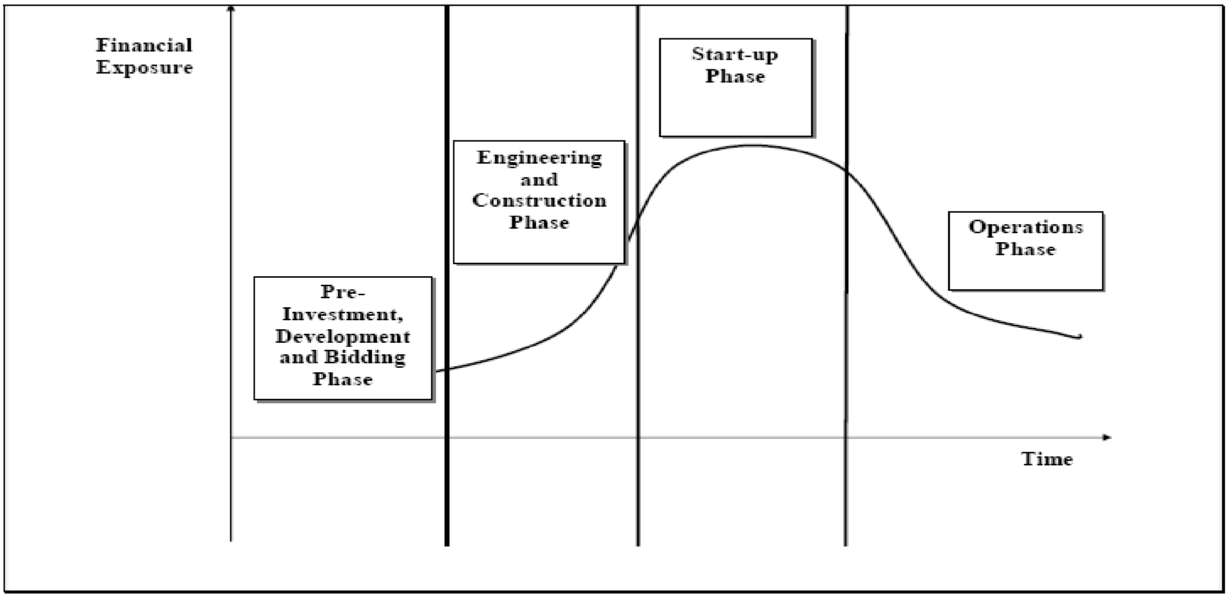


In figure D.4 the utilities associated with the wealth levels W+h, W and W-h are indicated on the vertical axis. The expected utility of wealth for the society if the investment is realised is indicated on the vertical axis as well *(E(U(W1))*. Since there is a 50% chance of gaining and a 50% chance of losing, the value is exactly in the middle between *(U(W+h)* and *U(W-h)*. But, because of the shape of the utility function (deriving from diminishing marginal utility of wealth assumption), the expected utility of wealth *E(U(W1))* will be lower than the expected value of wealth *(E(U(W1)) < U(W))*. Consequently, the risk averse decision-maker will decide to reject the project. However, for the public sector, risk neutrality is to be assumed in general for a risk pooling (and spreading) argument. Under risk neutrality the expected value of the NPV (the mean of probabilities) replaces the baseline or modal estimate of the NPV as a performance indicator. This may also have a substantial impact on the determination of the EU Grant (see an example in Chapter 4, Case Study Water).

Risk prevention

The degree of risk is not always the same over the time horizon of the project realization. It has been demonstrated by past experience, and it is generally accepted in literature, that the riskiest phase of a project is the Start-up. At that time most of the investment costs have been incurred but there may not yet be any feedback from an operational point of view. When the investment enters into the operations phase, the risk involved diminishes because the feedback becomes increasingly evident.

Figure H.5 Levels of risks in different phases of a given infrastructure project



Source: OECD TI/1, 2007

Moreover 'there is a demonstrated, systematic tendency for project appraisers to be overly optimistic. To reduce this tendency, appraisers should make explicit, empirically-based adjustments to the estimates of a project's costs, benefits and duration. It is recommended that these adjustments be based on data from past projects or similar projects elsewhere, and adjusted for the unique characteristics of the project in hand. In the absence of a more specific evidence base, departments are encouraged to collect data to inform future estimates of optimism, and in the meantime use the best available data'[131].

According to Flyvbjerg and Cowi (2004) cost overruns and/or benefit shortfalls, i.e. optimism bias, are the results of a number of different factors:

- multi-actor decision-making and planning;
- non-standard technologies;
- long planning horizons and complex interfaces;
- changes in project scope and ambition;
- unplanned events.

As a result, cost overruns and benefit shortfalls lead to an inefficient allocation of resources, delays and further cost overruns and benefit shortfalls.

In addition to carrying out a full risk assessment, which represents a major step ahead in mitigating inaccuracy and bias, other measures recommended in order to reduce optimism are:

- better forecasting methods through the use of 'Reference class' forecasting;
- changed incentives in order to reward better projects;
- transparency and public control to improve accountability;
- involvement of private risk capital;

Table H.2 provides some examples of mitigation measures of identified risks extrapolated from the World Bank Project Appraisal Documents (PADs) for different countries.

[131] The Supplementary Green Book Guidance on Optimism Bias (HM Treasury 2003)

Table H.2 Risk mitigation measures

Country	Project	Risk	Rating	Risk mitigation measure
Azerbaijan	Power transmission	Project implementation delays due to lack of local financing and poor project management	S	Local financing requirement minimised. Project Implementation Unit to be assisted by technical assistance for project management during implementation.
Kyrgyz	Water management improvement	Counterpart funds are not available in timely manner	N	Project design minimises the need for counterpart funds, except for taxes. The Ministry of Economy and Finance has developed a satisfactory track record of support to ongoing IDA-funded irrigation projects.
Russia	Municipal heating	Potential corruption may erode project benefits	M	Commercial and Financial Management systems for the project will provide more transparency and improve possibilities for adequate audit and control.
Turkey	Railway reconstruction	Social resistance to change	H	Close cooperation between the Government, General Directorate of State Railways Administration (TCDD) management and the trade unions, early definition of an appropriate social plan, expeditious payment of the severance benefits and assistance to staff.

Note: Risk rating: H (High risk), S (Substantial risk), M (Modest risk), N (Negligible or Low risk)
Source: World Bank Project Appraisal Documents

ANNEX I
DETERMINATION OF THE EU GRANT

The EU contribution is generally determined by multiplying the project's eligible expenditure by the co-financing rate of the relevant operational programme's priority axis. The eligible expenditure is the part of the investment cost that may be eligible for EU co-financing. It should be noted that in the 2000-2006 period common eligibility rules for the Structural Cohesion Fund were determined at Community level, while for the 2007-2013 period the rules are established at national level, apart from some exceptions set out in the regulations relating to each fund.

For revenue-generating projects, the methodology used for the determination of the EU grant is the funding-gap approach.

In order to modulate the contribution from the Funds, the maximum eligible expenditure is identified by Article 55(2) Regulation 1083/2006 as the amount '*that shall not exceed the current value of the investment cost less the current value of the net revenue from the investment over a specific reference period*'. Such identification of the eligible expenditure aims at ensuring enough financial resources for project implementation, avoiding, at the same time, the granting of an undue advantage to the recipient of the aid (over-financing)[132]

The funding-gap approach applies to all investment operations (not just major ones) which generate net revenues through charges borne directly by users. It does not apply to the following cases:

- projects that do not generate revenues (funding-gap rate equals 100%);
- projects whose revenues do not fully cover the operating costs (funding-gap rate equals 100%);
- projects subject to State-aid rules.

According to the funding-gap approach, three steps have to be followed in order to determine the EU grant:

- the first step involves the calculation of the funding-gap rate, which is the share of the discounted cost of the initial investment not covered by the discounted net revenue of the project. In other words, the funding-gap rate is the complement to 100% of the gross self-financing margin. The funding-gap rate (*R*) is given by the ratio between the maximum eligible expenditure (*Max EE*) and the discounted investment cost (*DIC*):

$$R = Max\ EE\ /\ DIC = (DIC - DNR)\ /\ DIC$$

  where:

  - *DNR* (Discounted Net Revenue): discounted revenue - discounted operating costs + discounted residual value
  - Cash flows used in this calculation are the ones included in the calculation of the profitability of investment - FNPV(C). In particular:
  - financial revenues generated by the projects, and not all the sources of financing, are used for the calculation of net revenues;
  - re-investments are not included in the investment cost but in the operational costs;

- the second step is the identification of the '*the amount to which the co-financing rate for the priority axis applies*'[134]. This 'decision amount' (*DA*) is defined as the eligible cost (*EC*) multiplied by the funding-gap rate (*R*):

$$DA = EC * R$$

- the third step is the identification of the maximum EU grant, that is equal to the decision amount (*DA*) multiplied by the maximum co-funding rate (*Max CRpa*) fixed for the priority axis in the Commission's decision adopting the operational programme.

$$EU\ grant = DA * Max\ CRpa$$

  It gives the amount of financial resources provided by the EU.

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[132] It should be noted that in the 2000-2006 period the co-financing rate was modulated and not the eligible expenditure.

[133] Art. 55.6 ' This Article shall not apply projects to the rules on State aid within the meaning of Article 87 of the Treaty'.

[134] Art. 41.2 'The Commission shall adopt a decision…(that) defines the physical object, the amount to which the co-financing rate for the priority axis applies, and the annual plan of financial contribution from the ERDF or the Cohesion Fund'.

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GLOSSARY

Accounting period: the interval between successive entries in an account. In project analysis, the accounting period is generally one year, but it could be any other convenient time period.

Accounting prices: the opportunity cost of goods, sometimes different from actual market prices and from regulated tariffs. They are used in the economic analysis to better reflect the real costs of inputs to society, and the real benefits of the outputs. Often used as a synonym for shadow prices.

Accounting unit: the unit of account that makes it possible to add and subtract unlike items. Euro is the unit of account for the appraisal of EU financed projects.

Appraisal: the ex-ante analysis of a proposed investment project to determine its merit and acceptability in accordance with established decision-making criteria.

Benefit-cost ratio: the net present value of project benefits divided by the net present value of project costs. A project is accepted if the benefit-cost ratio is equal to or greater than one. It is used to accept independent projects, but it may give incorrect rankings and often cannot be used for choosing among mutually exclusive alternatives.

Benefits transfer: the benefits transfer method can be defined as the use of a good value estimate in one site, the 'study site', as a proxy for values of the same good in another site, the 'policy site'.

Border price: the unit price of a traded good at the country's economic border. For exports, it is the f.o.b. (free on board) price, and for imports, it is the c.i.f. (cost, insurance, and freight) price. The economic border for a Member State of the EU can be with non-EU members or wherever there are substantial differences in observed prices because of market distortions.

Business as usual scenario: a reference scenario which assumes that future evolution is an extension of the current trends. See also 'do nothing scenario'.

Constant prices: Prices that have been deflated by an appropriate price index based on prices prevailing in a given base year. They should be distinguished from current or nominal prices.

Consumer's surplus: the value consumers receive over and above what they actually have to pay.

Conversion factor: the factor that converts the domestic market price or value of a good or production factor to an accounting price.

Cost-Benefit analysis: conceptual framework applied to any systematic, quantitative appraisal of a public or private project to determine whether, or to what extent, that project is worthwhile from a social perspective. Cost-benefit analysis differs from a straightforward financial appraisal in that it considers all gains (benefits) and losses (costs) to social agents. CBA usually implies the use of accounting prices.

Cost/effectiveness analysis: CEA is an appraisal and monitoring technique used when benefits cannot be reasonably measured in money terms. It is usually carried out by calculating the cost per unit of 'non monetised' benefit and is required to quantify benefits but not to attach a monetary price or economic value to the benefits.

Current prices: (Nominal prices) prices as actually observed at a given time. They refer to prices that include the effects of general inflation and should be contrasted with constant prices.

Cut-off rate: the rate below which a project is considered unacceptable. It is often taken to be the opportunity cost of capital. The cut-off rate would be the minimum acceptable internal rate of return for a project or the discount rate used to calculate the net present value, the net-benefit investment ratio, or the benefit-cost ratio.

Discount rate: the rate at which future values are discounted to the present. The financial discount rate and economic discount rate may differ, in the same way that market prices may differ from accounting prices.

Discounting: the process of adjusting the future values of project inflows and outflows to present values using a discount rate, i.e. by multiplying the future value by a coefficient that decreases with time.

Do-minimum: the project option that includes all the necessary realistic level of maintenance costs and a minimum amount of investment costs or necessary improvements, in order to avoid or delay serious deterioration or to comply with safety standards.

Do nothing: the baseline scenario, 'business as usual', against which the additional benefits and costs of the 'with project scenario' can be measured (often a synonym for the 'without project' scenario).

Do-something: the scenario(s) in which investment projects are considered, different from 'do nothing' and 'do-minimum', see above.

Economic analysis: analysis that is undertaken using economic values, reflecting the values that society would be willing to pay for a good or service. In general, economic analysis values all items at their value in use or their opportunity cost to society (often a border price for tradable items). It has the same meaning as social cost-benefit analysis.

Economic impact analysis: the analysis of the total effects on the level of economic activity (output, income, employment) associated with the intervention. This kind of analysis focuses on macroeconomic indicators and forecasts the influence of the project on these indicators. It goes beyond CBA when very large projects are considered in relatively small economies.

Economic rate of return: ERR, the internal rate of return (see definition below) calculated using the economic values and expressing the socio-economic profitability of a project.

Environmental impact analysis: the statement of the environmental impact of a project that identifies its physical or biological effects on the environment in a broad sense. This would include the forecasting of potential pollution emissions, loss of visual amenity, and so on.

Externality: an externality is said to exist when the production or consumption of a good in one market affects the welfare of a third party without any payment or compensation being made. In project analysis, an externality is an effect of a project not reflected in its financial accounts and consequently not included in the valuation. Externalities may be positive or negative.

Ex-ante evaluation: the evaluation carried out in order to take the investment decision. It serves to select the best option from the socio economic and financial point of view. It provides the necessary base for the monitoring and subsequent evaluations ensuring that, wherever possible, the objectives are quantified.

Ex-post evaluation: an evaluation carried out a certain length of time after the conclusion of the initiative. It consists of describing the impact achieved by the initiative compared to the overall objectives and project purpose (ex-ante).

Feasibility study: a study of a proposed project to indicate whether the proposal is attractive enough to justify more detailed preparation. It contains the detailed technical information necessary for the financial and economic evaluation.

Financial analysis: the analysis carried out from the point of view of the project operator. It allows one to 1) verify and guarantee cash balance (verify the financial sustainability), 2) calculate the indices of financial return on the investment project based on the net time-discounted cash flows, related exclusively to the economic entity that activates the project (firm, managing agency).

Financial rate of return: the FRR measures the financial profitability of a project with a pure number. In some cases it cannot be calculated in a meaningful way and can be misleading.

Financial sustainability analysis: analysis carried out in order to verify that financial resources are sufficient to cover all financial outflows, year after year, for the whole time horizon of the project. Financial sustainability is verified if the cumulated net cash flow is never negative during all the years considered.

Impact: a generic term for describing the changes or the long term effects on society that can be attributed to the project. Impacts should be expressed in the units of measurement adopted to deal with the objectives to be addressed by the project.

Internal rate of return: the discount rate at which a stream of costs and benefits has a net present value of zero. The internal rate of return is compared with a benchmark in order to evaluate the performance of the proposed project. Financial Rate of Return is calculated using financial values, Economic rate of Return is calculated using economic values.

Independent projects: projects that in principle can all be undertaken at the same time. These should be distinguished from mutually exclusive projects.

In itinere evaluation (on-going evaluation): an evaluation carried out at a certain point during the project implementation in order to allow a re-orientation of the activity in case the first results suggest the need of a re-adjustment of the project.

Long run: the time period in the production process during which all factors of production can be varied, except the basic technological processes being used.

Market price: the price at which a good or service is actually exchanged for another good or service or for money, in which case it is the price relevant for financial analysis.

Monitoring: the systematic examination of the state of advancement of an activity according to a pre-determined calendar and on the basis of significant and representative indicators.

Multi-criteria analysis: MCA is an evaluation methodology that considers many objectives by the attribution of a weight to each measurable objective. In contrast to CBA, that focuses on a unique criterion (the maximisation of social welfare), Multi Criteria Analysis is a tool for dealing with a set of different objectives that cannot be aggregated through shadow prices and welfare weights, as in standard CBA.

Mutually exclusive projects: projects that, by their nature, are such that if one is chosen the other one cannot be undertaken.

Net Present Value (NPV): the sum that results when the discounted value of the expected costs of an investment are deducted from the discounted value of the expected revenues. Financial net present value (FNPV). Economic net present value (ENPV).

Net revenues: the amount remaining after all outflows have been subtracted from all inflows. Discounting the incremental net revenues before financing gives a measure of the project worth of all resources engaged; discounting the incremental net revenues after financing gives a measure of the project worth of the entity's own resources or equity.

Non-tradable goods: goods that cannot be exported or imported, e.g. local services, unskilled labour and land. In economic analysis, non-traded items are often valued at their long-run marginal cost if they are intermediate goods or services, or according to the willingness-to-pay criterion if they are final goods or services.

Opportunity cost: the value of a resource in its best alternative use. For the financial analysis the opportunity cost of a purchased input is always its market price. In economic analysis the opportunity cost of a purchased input is its marginal social value in its best non-project alternative use for intermediate goods and services, or its value in use (as measured by willingness-to-pay) if it is a final good or service.

Optimism bias: the tendency to be over-optimistic in project appraisal by under-estimating costs and over-estimating benefits.

Producer's surplus: the value a producer receives over and above his actual costs of production.

Programme: a co-ordinated series of different projects where the policy framework project purpose, the budget and the deadlines are clearly defined.

Project: a discrete on-off form of expenditure. Used in this Guide to define an investment activity upon which resources (costs) are expended to create capital assets that will produce benefits over an extended period of time. A project is thus a specific activity, with a specific starting point and a specific ending point, that is intended to accomplish a specific objective. It can also be thought of as the smallest operational element prepared and implemented as a separate entity in a national plan or program.

Project analysis: the analytical framework for the evaluation of a project's feasibility and performance. It includes the analysis of the context, the objectives, technical aspects, demand forecasts, financial and economic costs and benefits project analysis is needed to determine if, given the alternatives, a proposed project will sufficiently advance the objectives of the entity from whose standpoint the analysis is being undertaken to justify the project.

Project cycle: a sequence of the series of necessary and pre-defined activities carried out for each project. Typically it is separated into the following phases: programming, identification, formulation, ex-ante evaluation, financing, implementation and ex-post evaluation.

Project evaluation: the last phase of the project cycle. It is carried out to identify the success factors and the critical areas in order to understand and diffuse the lessons learnt for the future.

Public Private Partnership: a partnership between the public sector and the private sector for the purpose of delivering a project or a service traditionally provided by the public sector.

Public Sector Comparator: this represents the least public procurement cost (including all capital and operating costs and share of overheads) to achieve the required service delivery outcomes, and is used as a benchmark for assessing the potential value for money of private party bids.

Risk analysis: a study of the odds of the project's earning a satisfactory rate of return and the most likely degree of variability from the best estimate of the rate of return. Although risk analysis provides a better basis than sensitivity analysis for judging the riskiness of an individual project or the relative riskiness of alternative projects, it does nothing to diminish the risks themselves. It helps, however to identify risk prevention and management measures.

Real rates: rates deflated to exclude the change in the general or consumption price level (for example real interest rates are nominal rates less the rate of inflation).

Relative prices: the exchange value of two goods, given by the ratio between the quantity exchanged and their nominal prices.

Residual value: the net present value of assets at the end of the final year of the period selected for evaluation analysis (project horizon).

Scenario analysis: a variant of sensitivity analysis that studies the combined impact of determined sets of values assumed by the critical variables. It does not substitute the item-by-item sensitivity analysis.

Sensitivity analysis: the analytical technique to test systematically what happens to a project's earning capacity if events differ from the estimates made in planning. It is a rather crude means of dealing with uncertainty about future events and values. It is carried out by varying one item and then determining the impact of that change on the outcome.

Shadow prices see accounting prices.

Short-run: the time period in the production process during which certain factors of production cannot be changed, although the level of utilisation of variable factors can be altered.

Social discount rate: to be contrasted with the financial discount rate. It attempts to reflect the social view on how the future should be valued against the present.

Socio-economic costs and benefits: opportunity costs or benefits for the economy as a whole. They may differ from private costs and benefits to the extent that actual prices differ from accounting prices.

Tradable goods: goods that can be traded internationally in the absence of restrictive trade policies.

Willingness-to-pay: the amount consumers are prepared to pay for a final good or service. If a consumer’s willingness-to-pay for a good exceeds its price, the consumer enjoys a rent (consumer’s surplus).

Without project scenario: the baseline scenario against which the additional benefits and costs of the with project scenario can be measured (e.g. business as usual).

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