Guide to Economic Appraisal of Forestry Investments and Programmes in Europe

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EFI Technical Report 94, 2014

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Publisher: European Forest Institute
Email: publications@efi.int
http://www.efi.int

Editor-in-Chief: Marc Palahí

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Preface

Forestry investments often have long time horizons. Careful and consistent assessment of the costs and benefits is important in making investment decisions. Today, the forestry sector is viewed as part of the solution to balance economic growth with conservation and ensure sustainable development. So forestry investment analysts have started to value the ecosystem services that forests provide. These can be, among others, the protection of watersheds, the preservation of biodiversity or the abatement of carbon dioxide emissions. Different programmes and instruments need to be designed for these services to be considered when assessing the costs and benefits of forestry investments.

This guide is one in a series of working papers which will be integrated in a Forest Investment Manual which analyses public and private investments in forestry. It is aimed at staff, working in institutions and companies, who prepare budgets and defend forest investments or programmes. It is intended that the Guide will be useful for analysts who carry out appraisals but it is particularly targeted at those who prepare their terms of reference. It is comprehensive, authoritative and cross-referenced.

The guide has been co-financed and prepared by the Forestry Commission in Great Britain in collaboration with the European Forest Institute's (EFI) Central European Regional Office and the Observatory for European Forests (EFICENT-OEF). It was prepared as part of the Microeconomic Programme of the Observatory for European Forests (OEF) in Nancy, France focussing on the profitability of forest investments. The two other OEF programmes, Macroeconomics and Observatory, focus respectively on Forest Sector Analysis and the communication with European citizens.

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1. Economic appraisal of forestry

1.1 Introduction

This guide provides information on preparing economic appraisals of forestry policies, programmes and projects, including setting out the essential elements of an appraisal. Economic appraisal is a tool that helps to make decisions on how best to use resources to meet policy and business objectives. It can also help in setting and defending budgets for organisations.

The guide is intended for use by forestry-related organisations in Europe, both to inform decisions on allocating resources to different investments and to clarify the types of data and analysis that are needed to carry out such work. The guide also aims to familiarise readers with the analytical methods used in economic appraisal, including ways to place values on goods and services that are not normally valued in markets (e.g. open-access recreation, landscape, biodiversity).

Economic appraisal can be applied to whole forests or to small woods or individual trees, both in rural and urban areas. The term 'forest' describes all land predominantly covered in trees, whether in large areas (generally called forests) or smaller areas (including woods and shelterbelts). In this guidance, the term 'woodland' is treated as synonymous with forest. A forest is defined by the EU as land under stands of trees with a canopy cover of at least 10%, although definitions may differ in individual countries. 'Forestry' is the science and art of planting, managing and caring for forests.

This guide should be useful for anyone in a forestry-related organisation who has to prepare or assess policy or project proposals, whether working in a policy, operational or analytical role. It will be supplemented by a more detailed manual by the Observatory of European Forests of EFI's Central European Regional Office, EFICENT-OEF, on economic appraisal for expert practitioners.

1.2 Structure of the guide

Economic appraisal is a process that has a number of distinct stages. This guide covers each stage of the process, including a short summary of the main issues that should be considered. It also contains a section on economic evaluation, a process which evaluates outcomes and which should be incorporated into project design at the outset. Finally, a set of annexes provide more detailed guidance on specific aspects of appraisal.

1.3 What is this guide based on?

This guide draws on best practice on how to carry out economic appraisal, both in the public and private sectors. It reflects current thinking on the economic framework within which forestry operates, including the ecosystem services approach (see Annex B).

2. What is appraisal?

Appraisal is the systematic analysis of the different costs and benefits of a course of action, whether economic, social, environmental or financial. It informs both the decision on whether to go ahead and the choice between different ways of carrying out an action. Appraisal is carried out before a decision is taken. It provides a structured approach for considering carefully the cost and benefits of a proposal. It is not intended to be a rigid or overly prescriptive process, nor is it intended to substitute for considering wider issues.

Appraisals may be carried out by government departments, public agencies, businesses, and non-governmental organisations. They can be applied at different levels of decision-making, ranging from international policies and projects to initiatives at a local community level. Decisions may be made affecting government or industry policy, the operation of a major organisation, the design of a regional programme or the implementation of a local project. An illustration of these different levels of decision-making is given in Table 1.

The perspective of an appraisal may differ between different types of organisation or activity. These different perspectives treat some aspects of appraisal in different ways, but the overall framework remains the same. In the private sector, appraisals tend to focus on the financial implications of a commercial project using market prices to assess costs and benefits. In the public sector, appraisals may assess the impacts of public expenditure, or take a broader approach which assesses the impacts on society including the value of costs and benefits which are not fully priced in markets.

Both financial and broader economic perspectives are often needed in order to assess whether it is sensible to proceed with a policy, programme or project. For example, it may be necessary to assess whether a proposal is commercially viable, as well as understanding the wider impacts on society and the environment.

The basis of economic appraisal is normally **cost benefit analysis**. Cost benefit analysis quantifies in monetary terms as many of the costs and benefits of a course of action as is feasible, including items for which the mar-

ket does not provide a satisfactory measure of economic value. Those costs and benefits which cannot be expressed in monetary terms are assessed in other quantitative ways or qualitatively.

An alternative to cost-benefit analysis is **cost-effectiveness analysis**. This approach if often preferred when the desired outcome is known and an assessment is needed of the comparative costs of different ways of achieving this outcome.

A further approach to considering costs and benefits is **multi-criteria analysis** (also known as weighting and scoring). In this approach, a list of criteria is set out that needs to be included in the preferred option, and a weight is given to each of these criteria. Each option is then scored in terms of how well they perform against each of these criteria. The weighted scores are summed and these scores are used to compare between options. This approach allows criteria to be included in the analysis, regardless of whether they can be quantified in money terms. Informed participation of stakeholders in the decision-making process can also help to meet the needs of multi-criteria analysis.

As well as appraisals, it is widely recommended to carry out economic evaluations. Evaluation refers to analysis of the costs and benefits of a course of action which is in progress or which has come to an end. The economic principles underpinning appraisal and evaluation are the same, and the same analytical methods (e.g. cost-benefit analysis, multi-criteria analysis) can be used. Section 6 sets out additional guidance that is needed to carry out evaluations.

Table 1. Example of different levels of application of appraisal and evaluation.

Policy goal	Achieve a steady expansion of woodland area to provide more benefits for the economy, society and the environment		
Objective	Achieve some increase in every part of the country	Achieve substantial expansion in specific localities	Provide greater access to woodlands around cities and towns
Programme	International development programme	Regional forestry initiatives	Local forestry initiatives
Project	National network of recreation sites	Regional visitor centre	Community woodland facility

3. Why is economic appraisal important in the forest sector?

Making decisions about investments in the forestry sector can be complex and uncertain for a number of reasons:

- Forests and trees deliver a diverse range of goods and services (see Annex B); providing timber and fuel, tackling climate change, regulating water quality, controlling flood risks, providing recreation facilities, enhancing biodiversity and supporting local communities. Complex choices may be faced when making decisions about a particular policy or operational practices at a forest site.
- Forests and trees affect the lives and livelihoods of many people across a wide range of economic sectors and social groups. Understanding and analysing who bears the costs and benefits of a proposal can be essential to deciding whether to proceed.
- Investments concerning forestry can have long time horizons, extending decades into the future. This generates considerable uncertainty about future costs and benefits.

Economic appraisal provides a structured and consistent approach for taking account of these issues. A good quality appraisal helps to:

- show that a proposal has been carefully planned, and that all relevant issues and options have been considered;
- ensure that action is based on a clear and robust assessment of how a policy, programme or project can maximise benefits;
- ensure that funds for investments are allocated effectively and that expenditures represent value for money;
- increase the likelihood that worthwhile projects gain funding; and,
- examine new financing options including payments for ecosystem services and other finance mechanisms.

4. How to decide on the appropriate effort for appraisal?

There are no specific guidelines on how much resource and detail should be put into an individual appraisal. The approach taken should be proportionate with the importance, scale and risks of the project, and this is generally considered to be a matter for judgement.

A number of criteria may affect this judgement, including the size of the forest or forest-related project, the magnitude of any changes that are proposed, the range and scarcity of benefits provided, the requirements of funding proposals and the perceived risks of the proposal.

In general, it is useful to estimate cost-benefit ratios for those costs and benefits which can be monetised with adequate reliability. It is often not possible to monetise all costs and benefits, particularly where these are social or environmental in nature. However, it can still be worthwhile to calculate cost-benefit ratios in these cases in order to demonstrate the impact of social and environmental considerations on monetary returns.

5. Stages in appraisal

There is a series of stages in the process of appraisal. All appraisals should address each of these stages, whether or not a specific stage is considered important to a particular proposal.

Key stages

i. Define the issue, assess the rationale for action and set out objectives
ii. Identify and set out a range of options
iii. Identify the costs and benefits of the selected options
iv. Make tax and subsidy adjustments (if necessary)
v. Adjust costs and benefits for future changes in values and prices
vi. Identify risks and uncertainty
vii. Assess distributional impacts

The following sections provide a summary of these stages, together with a checklist to help to ensure that important issues have been considered.

i. Define the issue, assess the rationale for action and set out objectives

An important first step is to define why a particular proposal is needed (the rationale), and state clearly the objectives of the proposal.

Rationales for public sector spending are normally based on aspects of market failure; for example, where intervention is required to ensure all values are considered in decisions on allocating resources. For private sector investments, rationales tend to focus on profit objectives and other strategic business aims. For both the public and private sectors, analyses of supply and demand of both timber and other goods and services can help to determine investment priorities: research such as the European Forest Sector Outlook Study provides useful information (see http://www.unece.org/efsos2).

Clear objectives are essential. These should take account of the range of social, environmental, and economic issues where relevant. The objectives should be set, as far as possible, in terms of outcomes desired.

A common approach to setting objectives is to ensure that they are "SMART". i.e. ***S**pecific, **M**easurable, **A**chievable, **R**elevant, **T**imed*). The relevant factors to consider depend on the particular proposal, but would usually include requirements for timing, scale, location and outputs.

Sometimes it is useful to identify intermediate milestones, as well as the final objectives.

Checklist

- Is the rationale for the project clear?
- Are the objectives of the project clearly stated?
- Are the objectives consistent with organisational objectives?
- Are the objectives stated in such a way that progress towards meeting them can be monitored?

ii. Identify and set out a range of options

This step involves preparing a list of options that could be taken to meet the identified objectives. Options are defined in this context as alternative ways of achieving the objectives of the proposal. Appraisals should normally consider at least two options, as well as a "do nothing" and/or a "do minimum" option. The question that the "do minimum" option should answer is which option involves doing the minimum necessary to meet the most important objectives of the project and/or maintain the status quo.

Identification of options can be a substantial part of an appraisal. Consideration should be given to as wide a range of options as possible, and the larger the investment, the wider the range of options that should be considered. No option should be ruled out until it has been given due consideration. However, usually, only a small number of options (for example, 3–4) will require full analysis. The reasoning behind rejecting the other options should be recorded.

A wide range of criteria may be used to define the options. These may include the following, shown in Table 2.

Checklist

- Is the range of options being considered wide enough?
- Has a "do nothing" and/or "do minimum" option been included?
- Are the reasons for not shortlisting options for full appraisal reasonable?
- Has any potentially promising option been ruled out?

Table 2. Examples of options.

Varying time and scale	Varying quality targets
Options to rent, build or purchase	Different locations or sites
Changing the combination of capital and recurrent expenditure	Sharing facilities with other organisations
Better implementation of existing initiatives	Varying the balance between out-sourcing and providing services
Co-operation with different partners (in public, private or voluntary sectors)	Provision of service by different types of organisation (e.g. Government bodies, private companies, NGOs)

iii. Identify costs and benefits of the selected options

Identifying and estimating costs and benefits is often complex, and is likely to require input from accountants, economists, and other specialists depending on the type of appraisal.

Costs and benefits should normally be analysed over the useful lifetime of the project and the assets under consideration. If there is uncertainty about the lifetime of the project, it may be useful to run the analysis over different timescales to see if this affects the results.

It is essential to identify who bears the costs and who receives the benefits; for example, whether this is business (including specific sectors), Government or society. This will inform analysis of any distributional impacts (see p. 17, Assess distributional impacts).

Assessing the physical effects of a proposal (e.g. timber production, carbon sequestration, water quality improvement) is often an important step in estimating (i.e. valuing) costs and benefits. This can be a challenging task.

In addition to financial costs and benefits, wider economic, social and environmental impacts for which there is no market price also need to be brought into the assessment. These are described as *externalities* and can be positive (benefits) or negative (costs). They are often referred to more broadly as non-market impacts.

Valuing externalities in monetary terms is an important issue for the appraisal of forestry investments where significant environmental and social impacts are identified but do not have clear market values associated with them. Valuation techniques have been developed to enable explicit values to

be placed on such impacts (see Annex B). Further advice should be sought from economists.

Views of stakeholders can also be an important input in weighing up benefits and costs to reach an assessment of the overall value for money of the proposal. In fact, economic valuation methods involve capturing stakeholders' views and preferences.

Costs

All costs must be identified for each option, including the purchase of capital assets (or use of existing assets) and running costs (for example staff costs, purchase of materials).

Costs which have already been committed and cannot be recovered are called *sunk costs* and should be ignored.

Costs should be expressed in terms of *opportunity costs*. That is, the value of the resource in its best alternative use. In many cases, this value is reflected in its market price, but it may also be necessary to consider externalities such as pollution costs.

Negative externalities can refer to:

- impacts that can be quantified, but are difficult to value in monetary terms (for example, increased noise from timber traffic); or to,
- impacts that are difficult to quantify (for example, loss of biodiversity, soil quality and water supply).

If some costs cannot be quantified in physical or monetary terms, these should still be noted, and given some weighting which reflects their importance.

A series of typical costs and benefits is set out in Table 3.

Benefits

As far as possible, all of the benefits associated with each of the options should be identified. Benefits will usually come into one of the following categories:

- impacts which can be quantified in both physical and monetary terms (for example, cubic metres of timber, units of electricity);
- impacts which can be quantified in physical terms but not easily in monetary terms (for example, hectares of woodland open to public access for recreation); and,
- impacts which are difficult to quantify (for example, longer term effects on biodiversity or landscape from woodland creation).

The aim should be to quantify and put a monetary value on as many benefits of each option as possible, as this helps to compare options.

Research in recent years has applied methods to estimate values for the non-market benefits of forestry including recreation, biodiversity, land-

Table 3. Types of benefits and costs.

Costs	*Benefits*
The purchase of capital assets or the use of existing capital assets. (Don't leave capital assets out of an appraisal on the grounds that they have already been paid for!) [1]	The sale or use value of any capital assets at the end of the project. This is known as the residual value.
Impacts that can be quantified in physical and monetary terms; for example, staff costs, purchase of materials and supplies.	Impacts which can be quantified in physical and monetary terms; for example, units of electricity, cubic metres of timber.
Impacts which can be quantified but which are difficult to value in monetary terms; for example increased noise from timber traffic.	Impacts which can be quantified but which are difficult to value in monetary terms; for example, hectares of woodland open to public access for recreation.
Impacts which are difficult to quantify; for example, short to medium-term fall in recreation value after woodland felling.	Impacts which are difficult to quantify; for example longer term rise in landscape value after woodland creation

[1] Existing capital assets often have alternative uses. Appraisals should use the value of the asset if it was employed in its best alternative use. i.e. the opportunity cost.

scape, carbon sequestration and others. However, this can be a technical and complex area, where specialist guidance is needed to ensure that an appropriate approach is used, and that values are obtained which have a firm basis and can be justified. More detail is provided in Annex B, which describes ecosystem services and valuation methods, and in Annex C, which focuses on specific issues involved in valuing CO_2 emission abatement.

Even if some benefits cannot be quantified, either in physical or monetary terms, these should still be examined qualitatively in the appraisal. Where there are unvalued costs and benefits, multi-attribute analysis or cost-effectiveness analysis can help balance unvalued impacts against monetised ones.

Costs and Benefits Checklist

- Have all the costs and benefits been identified and profiled over time and who they accrue to, including those which are not valued in monetary terms?

- Have the costs and benefits been quantified where possible?
- Are the values of the costs and benefits based on realistic assumptions?

iv. Make tax and subsidy adjustments

Particularly for appraisals within the public sector, prices that are used in an appraisal should be adjusted to remove the tax element (that is, net of tax) if this makes a material difference to the outcome. Usually, options have similar tax structures, and so it is relatively rare that adjustments for taxation are required. Differences in tax are generally relevant when comparing private financing and public financing of the same scheme. Guidance on adjusting prices for tax, if this is necessary, should be sought from economists and/or tax specialists.

The treatment of subsidies depends on the perspective of the appraisal. Where the economy-wide impacts of a proposal are being assessed, subsidies should be removed from the analysis because they represent *transfers* between economic agents (i.e. Government to the private companies and/or individuals). If impacts on an organisation or individual are being assessed (whether a Government or a private company), subsidies should be retained in the analysis because they have an impact on that organisation/individual.

Checklist
- Has consideration been taken of whether tax adjustment is necessary?
- Have prices been adjusted, if appropriate, to remove the tax element?
- Have subsidies been accounted for correctly?

v. Adjust costs and benefits for future changes in values and prices

All costs and benefits should be presented in 'present value' terms through the application of a discount rate. It is essential not to confuse the discount rate with the entirely different concept of the inflation rate.

Presenting costs and benefits in 'present value' terms means to take account of *time preference*; that is, the value that is placed on consuming a good or service nearer in time compared to further in the future, or bearing a cost later rather than sooner. Adjustments for time preference are made by applying discount rates to costs and benefits in future years in order to estimate *present values* for them.

By estimating the 'present values' of both costs and benefits, the 'net present value' (NPV) of different options can be compared in order to identify

the option that yields the greatest net benefit. Alternatively, or in addition to the NPV, the' internal rate of return' (IRR) can be calculated. This is equivalent to the discount rate that sets the NPV to zero. The IRR has the advantage of not having to choose a discount rate.

The choice of discount rate depends on the perspective of the appraisal. Where a Government and/or societal perspective is being taken, the *social time preference* is used. This rate is based on time preference, the risk of catastrophe and the possibility that per capital consumption may grow over time (thereby lowering marginal utility). Discount rates used in the private sector often depend on best commercial practice. Where businesses are assessing commercial returns to an investment, a higher discount rate is frequently used, reflecting perceptions of the risks affecting the proposal.

Many countries specify the discount rate they wish to be used when undertaking appraisals (although not for businesses assessing commercial returns). Rates used in some European countries are set out below.

Discounting can be a difficult matter, particularly where an appraisal has inter-generational implications. Further information on discounting is provided in Annex A of this guidance.

Inflation is the process whereby the general level of prices in the economy rises over time. It means that any fixed sum of money will lose its value as prices rise because it cannot buy as many goods. The value of costs and benefits for each year should not include inflation, i.e. they should be presented in *real* rather than *nominal* terms. This is done using GDP data to adjust any nominal data to a constant price year. GDP data should be sought

Table 4. International real discount rates for cost-benefit analysis.

Region/ Country	*Agency*	*Discount rate*
European Union	European Commission	5%
France	Commissariat General du Plan	4%
Germany	Federal Finance Ministry	3%
Italy	Central Guidance to Regional Authorities	5%
Norway		3.5%
The Netherlands	Ministry of Finance	4%
United Kingdom	HM Treasury	3.5%*

* HM Treasury specifies a declining rate at intervals after 30 years. Source: Campbell (2012)

from the appropriate Government department. Projections should also allow for any expected changes in relative prices in the years covered by the proposal. For example, if any of the inputs or outputs (e.g. timber) are expected to increase in price faster than the general rate of inflation (or alternatively are expected to decline in price) in future years this should be taken into account in the presentation of costs and benefits.

Checklist
- Have the stream of costs and benefits for each option been identified and discounted?
- Have appropriate discount rates been applied?

vi. Identify risk and uncertainty

Virtually all proposals have the possibility that the outcome will vary from what is expected or desired. Effectively identifying and managing this risk helps to improve project performance and get better results.

There are three types of risk that frequently arise in appraisal:
(1) optimism bias;
(2) project specific risk; and,
(3) irreversibility.

The basic stages in addressing risk and uncertainty are:
- **Identifying** the risks;
- **Estimating** their magnitude;
- **Evaluating** the significance of the risk to the success of failure of the proposal;
- Identifying suitable **responses**, including mitigation actions to reduce risks and/or contingency arrangements to handle risks if they occur?
- Gaining **assurance** about the effectiveness of the response and its controls; and,
- Building in a **review** mechanism.

Where a set of plausible circumstances could lead to a particularly adverse outcome, further and more formal economic analysis may be worthwhile.

Optimism Bias
Optimism bias is the systematic tendency for appraisers to be over-optimistic about key project parameters, notably time and cost. For example, construction projects often overspend or suffer time delays. Standards set in

Table 5. Types of risk that frequently arise in appraisal.

Type of risk	*Description*	
Optimism bias	Tendency for appraisals to underestimate the costs and time of projects, and to overstate benefits	Must be considered in all appraisals and evaluations, and adjustments made if needed
Project-specific risk	Risks relating to a specific proposal e.g. operating risks, performance risk, risk of obsolescence	Depends on availability of suitable data for the specific project
Irreversibility	Applies when an option would rule out later investments, or use resources that might be preferred for an alternative use later	Likely to apply in a number of forestry related contexts

regulations may not be properly applied. The specifications of a project may not be fully met, requiring follow-up action.

The recommended way to account for optimism bias is to examine past experience of similar projects, review how their outcome differed from expectations, and apply adjustments to the estimates for the current project based on this evidence. However, particular attention to optimism bias may be necessary for project types in which project developers and managers have less experience.

In some countries, guidance is available to apply pre-set adjustments to expected project outcomes to counter optimism bias for different types of project (for example, see Supplementary Guidance to Green Book published by the UK Treasury) although specific adjustments for forestry projects are not available.

vii. Assess distributional impacts

Options should be analysed to determine whether impacts of a proposal would differ between socio-economic groups. For example, economic theory shows that an extra pound to somebody who has a higher income will

give less benefit than to somebody on a lower income. Distributional impacts may differ across groups depending on: income, gender, ethnic group, age, geographical location, or disability.

Forests and woodlands are enjoyed by a broad range of population groups, covering different socio-economic groups in widely different localities. For example, projects that concern peri-urban forestry, community forests and the development of visitor facilities may affect a range of socio-economic groups. The depth of the analysis should be proportional to the importance of the project to distributional issues, and these factors should guide whether a formal distributional analysis is required.

Checklist

- Does the analysis identify if there are any significant distributional issues?
- Is possible action identified to deal with them?

6. Evaluation

The following section briefly outlines the main considerations in conducting an evaluation. An evaluation should be planned as much as possible at the start of a project. Otherwise, processes such as data gathering may not be in place during a project to enable a subsequent evaluation to be carried out.

Evaluation usually follows four main steps:

- decide the scope of the evaluation;
- decide what information is needed and how to obtain it;
- analyse the information in order to compare the outcome of the policy or programme with its objective; and,
- present the results.

Decide the scope of the evaluation

The scope of most evaluations can usually be defined in the following way:

- find out whether the outcome of the project or programme is different from that foreseen in the appraisal and if so why;
- determine how effective and efficient the activity was in achieving the objectives set for it; and,
- determine what the results mean for the future of the project or programme (e.g. continue with the programme with modifications or discontinue the programme) and for future decisions on relevant projects or programmes more generally.

Decide what information is needed and how to obtain it

As well as actual quantities and values of costs and benefits, information will also be needed about possible reasons for these being different from the projections in the original appraisal. To determine effectiveness and efficiency will require information about the *counterfactual*, i.e. what the outcome might have been in the absence of the programme or if a different delivery mechanism had been used.

Analyse the information

Is the outcome of the project or programme different from that foreseen in the appraisal and if so why?
The outcome of any activity is never exactly as projected in advance. The reasons for the outcomes being better or worse than expected may be attributable to actions within the control of the organisation involved or to factors beyond its control.

How effective and efficient was the activity in achieving the objectives set for it?
The evaluation should assess the effectiveness and efficiency of the project or programme in achieving its objectives. It should include an assessment of the impact of changes in factors outside the project's control and of actions within the project's control on the actual outcome, and a comparative assessment of one or more outcomes that would have occurred if the project had taken a different decision following the original appraisal and different decisions during the life of the project or programme. Where possible the comparative assessment should include a control group to whom the project or programme was not applied.

As with appraisal, evaluation considers streams of inputs and outputs over a period of time and discounting is required in the same way.

What do the results imply for the future of the project or programme and for future decisions on such projects or programmes more generally?
The results obtained should lead to recommendations for the future. These might include, for example, the continuation, modification or replacement of a programme.

The results and recommendations should be deployed in such a way that the lessons learnt feed into future decision making.

7. Presentation of results

The output of an economic appraisal may form part of a business case, or part of an impact assessment or policy assessment. The reason for carrying out an appraisal is to inform the decision whether or not to proceed with a proposal.

Presentation is very important. Appraisals should be set out clearly and comprehensively. Each of the sections that are described in this guidance should be addressed, even if they are of limited importance to a specific proposal, to show that they have been considered. If technical terms are used, they should be explained.

Transparency is vital. Sufficient evidence should be provided to support the conclusions and recommendations. It should be straightforward for the reader to check calculations, supporting evidence and assumptions.

Sensitivity analysis should be included in the results, whereby the impacts are assessed of changing the assumptions and values that are used in the appraisal. This helps to ascertain whether the results are sensitive to such assumptions and values and, therefore, how reliable the results of the appraisal are likely to be.

A typical layout for an appraisal report may be as follows:

- overview of the subject of the appraisal and its objectives;
- description of the options;
- description of the main assumptions;
- list of the main costs and benefits, and their timing;
- summary of the results including the main components of net present value, costs and benefits that cannot easily be valued, and any relevant adjustments to costs and benefits;
- summary of the analysis of risk and uncertainty, and of distributional impacts; and,
- summary of what the results imply for the management decision.

Annex A. Guide to Discounting

Comparing the streams of those costs and benefits that can be valued

Discounting is designed to get over the problem that arises when costs and benefits appear in different time periods. For instance, how would one compare € 0.5 million worth of benefits in 10 years time, with € 0.5 million of costs in 2 years time?

The recommended approach for considering this type of trade-off is to discount costs and benefits over time. Discounting is used to convert costs and benefits arising at different times in the future to a "present value". Effectively it benchmarks future costs and benefits against the present to enable comparison. It is based on the principle that, generally, people prefer to receive goods and services now rather than later, and to defer costs.

The discounted value of costs or benefits is determined by reducing its value by the current *discount rate* (conventionally expressed as an annual rate) for each unit of time between the time when the cashflow is to be valued to the time of the cash flow.

Discounting is used to estimate the Net Present Value (NPV) of a proposal. NPV is estimated by discounting all costs and benefits for the proposal, and then subtracting the sum of discounted costs from the sum of discounted benefits.

Level of the discount rate

Appraisals and evaluations should use the appropriate government discount rate (for example, see Table 4 in the main text), or a rate that is accepted in the industry.

For time periods of more than 30 years, a lower discount rate may be applied, as has been recommended by the UK Government, according to the stepped schedule shown in Table A1.

The stepped schedule of lower discount rates over the long term increases NPVs of proposals that provide net benefits far into the future (i.e. the lower the discount rate the higher the current value of benefits (and costs) encountered in the future). Therefore, it is likely that NPVs of forestry projects will often be higher when long-term declining discount rates are applied.

Table A1. The declining long term discount rate.

Period of Years	0–30	31–75	76–125	126–200	201–30	301 +
Discount Rate	3.5%	3.0%	2.5%	2.0%	1.5%	1.0%

Discount factors and present values

The sum of the discounted benefits of an option less the sum of the discounted costs is the net present value (NPV) of the option. The discount factor to apply can also be calculated from the following formula:

$$D_n = \frac{1}{(1 + r)^n}$$

where r is the discount rate D is the discount factor, and n is the year in the which the value to discounted arises (e.g. year 1). For example, a discount rate of 3.5% implies that € 1 today is worth the same as € 1.035 in one year's time. (The discount factor applied to the € 1.035 received in one year.s time is (1/1.035) or 0.0966183.) The discounted value of a future Euro is called the present value of that euro.

The choice of base year for discounting

Although it does not usually matter in principle which year is chosen as the base or reference year for discounting, normally the starting year of the programme or project is used. The same base date should be used throughout the analysis and clearly noted when presenting the results. It is usually sufficiently accurate to treat all sums accruing during the course of a year as falling at mid-year and to assume that the programme or project starts in the middle of the base year.

Calculating Net Present Values

The simplest way of calculating net present values is to set out the costs and benefits year by year in a spreadsheet such as Microsoft Excel and apply the Excel formula for the discount factor or equivalent annual value. An advantage of using a spreadsheet is that it is easy to vary the values of costs and benefits in order to conduct a sensitivity analysis[1].

The alternative approach involves applying discount factors (shown on the Present Value spreadsheet) to the costs and benefits. This calculates an NPV for each year which is then aggregated to a cumulative figure. This method relies on each discount factor being input into the sheet which means if you need to change the percentage rate it is a time consuming process.

The stages to calculating NPV are as follows.

- Set out the schedule of costs and benefits in a spreadsheet, showing the year of the project in which they occur (year 0, 1, 2, 3 etc.).
- Apply the appropriate discount factor to each cost and benefit (using the Excel function or appropriate discount factors).
- Add all discounted costs and benefits for the project together. Costs should have a negative sign, and benefits a positive sign.
- The resulting sum is the net present value of the proposal.

It should be noted that NPV by itself may not indicate which project should be chosen. It may also be necessary to consider the IRR or the benefit:cost ratio. It also does not provide information on different levels of risk associated with different projects.

[1] A feature in Excel allows you to automatically calculate an NPV for a series of cash flows (click on Σ *fx* and choose NPV). All you have to do is specify the interest rate and highlight the cash flows to be included.

Annex B. Ecosystem services

This annex gives more detail on the concept of ecosystem services, the types of ecosystem services provided by forests, and how ecosystem services can be valued in cases where such value is not fully reflected in market prices.

What are Ecosystem Services?

Ecosystem services are defined as the social, economic and environmental goods and services provided by the natural environment that benefit people. Ecosystem services have been the subject of major analyses both at international (e.g. the Millennium Ecosystem Assessment, see http://www.unep.org/maweb/) and national (e.g. the UK National Ecosystem Assessment, see http://uknea.unep-wcmc.org/) levels.

Europe's forests and woodlands are an integral part of our ecosystem and generate a wide range of ecosystem services. The way that woodlands are managed can have major effects on ecosystems and the benefits that ecosystems provide.

Although many aspects of our environment (e.g. air, landscape, water, habitats and species) are protected under regulations (e.g. the EU Habitats Directive), pressures on ecosystems and the resulting feedbacks on the economy and society mean that we need to consider the environment as a functioning ecosystem that provides essential services that underpin economic and social well-being.

Apart from goods that can be sold (e.g. timber and woodfuel), the value of forest ecosystems is largely unrecognised in markets. Economists refer to this as an externality, or a non-market good or service. Such goods and services may be ignored or unvalued in decision-making and, therefore, may be vulnerable to loss or degradation.

Ecosystem Services provided by Forests

Economic ecosystem services of forests include the income generated through sales of timber and woodfuel, through forest-related tourist visits and through other woodland initiatives that support urban regeneration and rural development.

Forests also deliver social benefits, including employment and the provision of recreation and amenity. Woodlands can contribute to facilitating social inclusion through local community projects. In addition, forests can

contribute important cultural benefits, including the protection of archaeological artefacts and providing inspiration for art, folklore and architecture.

Forests provide environmental ecosystem services, including landscape benefits, the protection of biodiversity, control of water supply and improvement of water quality, flood prevention, soil formation and soil erosion control. Moreover, the role that trees play in absorbing carbon dioxide from the atmosphere is of major importance, given concerns about climate change.

The ecosystem services provided by forests and trees can support urban regeneration and rural development.

Ecosystem Services of Green Infrastructure

In recent years, research has examined the role of green infrastructure in providing ecosystem services. Green infrastructure is defined as the green spaces that exist within and between urban areas.

Green infrastructure can affect wide-ranging economic, social and environmental factors, including economic growth and investment, land and property values, labour productivity, health and wellbeing, tourism and leisure quality of place, land and biodiversity, flood alleviation, water quality, and climate change adaptation and mitigation. The quality of the green infrastructure will determine the value of these services.

Categories of Ecosystem Services

Ecosystem services are sometimes categorised according to the type of benefit they provide (see Table B1).

- *Provisioning Services* are goods that people obtain from ecosystems, such as timber and woodfuel.
- *Cultural Services* are non-material benefits that people obtain from ecosystems, including recreation and health.
- *Regulating Services* are benefits derived through the regulation of ecosystems, such as flood and soil protection and climate regulation.
- *Supporting Services* are services that are necessary for the production of all other ecosystem services, including soil formation, pollution sink and nutrient cycling.

Biodiversity is shown in both the 'cultural service' section and under 'regulating services'. Biodiversity is a cultural benefit in the sense that people derive value from knowing that different types of wildlife exist. It is a reg-

Table B1. Categories of ecosystem services.

Forest Ecosystem Services	*Examples of Delivery*
Provisioning Services	
• Timber	Provision of raw timber material for use in commercial and domestic enterprises
• Fuel Wood	Timber products as firewood, and as raw material for processed hydrocarbon fuels and chemicals
• Non-Wood Forest Products	Meat, berries, fungi and medicinal drugs
Cultural Services	
• Recreation, Amenity, Health, Tourism	Many forests are open to the public for the enjoyment of outdoor pursuits and recreational activities. Their access facilitates exercise and benefits human health. Tourists who spend money in the region boost local income and employment
• Landscape	Trees and woodlands increase the diversity of landscape character
• Education	Forests are a valuable educational resource.
• Social Inclusion	Trees and woodlands are valuable for personal enlightenment and as places or catalysts for social activity and cohesion
• Protection of Archaeological Artefacts	Forests reduce the need for cultivation, a significant cause of archaeological destruction.
• Inspiration for Art, Folklore and Architecture	Forests and woodlands offer a rich source of inspiration for art, folklore, architecture and advertising
• Conservation of Biodiversity	Forests provide habitats for flora and fauna. Individuals obtain value from seeing wildlife and from simply knowing it exists

ulating service in that biodiversity supports the resilience of ecosystems to current and future shocks.

Economists sometimes refer to 'use' and 'non-use' value, which can be another means of categorising ecosystem services. 'Use' value is when individuals make actual use of a good or service provided by ecosystems. 'Non-use'

Table B1. Continued.

Forest Ecosystem Services	*Examples of Delivery*
Regulating Services	
• Forests for Flood, Soil and Water Protection	Forests moderate rainfall and water flows, delaying and reducing floods. Tree cover can also provide protection from soil erosion and slope failure and can offer benefits in terms of water quality
• Air Quality Maintenance	Capture of atmospheric pollutants in tree canopies and consequent reduced exposure for humans, crops, buildings etc.
• Climate Regulation	Forests and their soils are major reserves of carbon. Trees can also protect soils, animals and humans from extremes of temperature and UV light
• Conservation of Biodiversity	Biodiversity supports the resilience of forests to shocks, such as low rainfall or drought, for example
Supporting Services	
• Soil Formation, Nutrient Cycling, Water Cycling	Forests facilitate soil formation, absorption of pollutants and other processes essential to life

value is when individuals benefit from the natural resource without actually using it. This includes deriving value from knowing that the resource can be passed on to future generations (bequest value), that it can be used by others in current generations (altruistic value) and that it simply exists even if the individual does not and never will use it (existence value).

Valuing Ecosystem Services

The Case for Valuation

Numerous studies in recent years have estimated economic values for some of the 'non-market' benefits of forests. Providing such values is an important step in decision-making by policy-makers, businesses and individuals.

For instance, failure to recognise the non-market value of forests can lead to inefficient forest management, whereby forests are managed solely for profit-driven opportunities rather than for a wider set of social and environmental outputs which can be of higher value to society.

Economists have devised techniques for estimating the monetary value of these benefits. Estimating values for non-market benefits is of increasing importance given current concerns about climate change and biodiversity loss. A description of economic valuation techniques is provided below.

Valuation Techniques

Economic valuation attempts to assign monetary values to goods and services where market prices are not available. The monetary value is measured in terms of what individuals would be willing to pay to obtain a certain level of the good, or willing to accept in payment to 'lose' a certain level of good. A number of techniques have been developed for estimating willingness to pay. These tend to be based either on observed behaviour towards some marketed good that is connected to the non-market good (revealed preference) or on responses to hypothetical questions in surveys regarding the non-market good (stated preference).

Revealed preference techniques elicit willingness to pay values from observed behaviour. These methods comprise market prices; averting behaviour; travel cost method; hedonic pricing and random utility modelling.

Market prices can be used as a proxy for the value of environmental goods that are traded in markets, such as food and timber. Market prices give a good signal of the value society places on a good or service as they show the minimum value that people would be willing to pay to obtain it. However, for many ecosystem services, markets do not exist. It is therefore necessary to identify other approaches to valuing these services.

Averting behaviour is the price people would be willing to pay to avoid environmental damage costs. For example, the cost of water filtration could be used as a proxy for the value of clean water.

Travel cost method takes the costs incurred by people visiting a recreation site (such as travel costs and entry fees) as a proxy for the value of the site. Costs are identified through the use of surveys.

Hedonic pricing considers the impact that environmental attributes, such as landscape and amenity, have on house prices. The basic premise is that the price of a house reflects all of the individual properties of the house, including environmental attributes, such as landscape and amenity. It is, therefore, possible to value the environmental aspects by looking at how

much people would be willing to pay for the house changes when these attributes change.

Random utility modelling is an extension of the travel cost method. This approach considers how willingness to pay to visit a recreational site changes as the quality or quantity of an environmental attribute at that site is altered.

Stated Preference techniques elicit willingness to pay value by asking hypothetical questions in surveys. These approaches include contingent valuation and choice modelling.

Contingent valuation typically asks individuals, through the use of surveys, to state their willingness to pay to maintain an environmental good or service, thus revealing the value they place on the good.

Choice modelling is another survey-based technique. Individuals are presented with various combinations of environmental attributes and are asked to choose their favourite combination or to rank the combinations in order of preference. The attributes have prices associated with them, so by ranking the combinations, participants reveal their willingness to pay for different attributes.

Benefits transfer

An alternative to collecting data to estimate willingness to pay values for non-market goods and services is to use values from existing studies. For example, average willingness to pay for recreation at a particular forest site could be estimated by transferring a value from a different forest setting. This can be achieved by transferring the value directly from one setting to another, by adjusting the value in some way before transfer to account for differences between the two sites or by using a mathematical function to predict values at different sites.

Benefits transfer is a cost-effective alternative to data collection but it does introduce issues with accuracy.

Annex C. Valuing CO_2 emissions abatement

The benefits (costs) of reduced (increased) greenhouse gas emissions of a policy option should be taken into account when conducting an appraisal. To do this, it is necessary to assign a monetary value to the change in emissions. This is achieved by quantifying the change in emissions in terms of carbon dioxide equivalent (CO_2e) and then applying a value for a tonne of carbon dioxide.

Valuing CO_2 enables potential climate change impacts to be accounted for in economic appraisal. The effect of including a value for CO_2 will be to raise the Net Present Value (NPV) of options with low CO_2 emissions relative to those with larger CO_2 emissions. The higher the value of a tonne of CO_2, the greater the benefit from reducing emissions. This information can inform decisions on how to minimise CO_2 emissions associated with a policy or project.

Different approaches may be taken to estimating the value of CO_2. Some estimates are based on the social cost of CO_2 (i.e. the damage caused by emitting a tonne of CO_2). A target-consistent approach may also be used which incorporates the cost of achieving GHG mitigation targets; the aim behind this approach is that the value assigned to CO_2 will drive the appropriate level of behaviour change and technological take-up to meet a given emissions reduction target.

Different estimates exist for the value of CO_2. For example, the UK Government has estimated values until 2050 and beyond. Where a target-consistent approach is taken, different values may be used depending on whether the abatement technology falls within the traded (e.g. power stations and energy-intensive industrial installations) or non-traded carbon sectors (e.g. forestry).

Ideally, observed market prices for CO_2 would be used to value CO_2 in the traded sector in future. However, there is considerable uncertainty about these prices and, arguably, the *market failure* that remains within the EU ETS means that prices remain too low to drive the necessary abatement. A similar situation exists in the non-traded sector where CO_2 prices remain too low to incentivise abatement to meet targets.

The following steps are recommended when valuing GHG emissions in an appraisal:

Step 1: Quantifying the Policy Impact on Greenhouse Gas Emissions

The first step to valuing the GHG effects of a policy or project is to set out the quantity of CO_2 (or CO_2e) that the policy will prevent or emit. This should be the net change from the baseline emissions. The baseline is what

would occur if no policy was implemented. To convert from carbon to CO_2e, the conversion factor of 44/12 should be used (1 tonne of carbon equals 1 x (44/12) = 3.67 CO_2e).

Step 2: Choosing the Appropriate Target-Consistent Price of CO_2

The price that should be applied per tonne of CO_2e depends on the year in which the emission/abatement occurs and on whether the emission/abatement takes place in the traded or non-traded sector.

In the UK, the Department for Energy and Climate Change has developed a Carbon and Energy Valuation Toolkit, to calculate the value of changes in emissions associated with changes in energy use, accessible at http://www.decc.gov.uk/en/content/cms/statistics/analysts_group/analysts_group.aspx.