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Guidance

The Green Book (2020)

Updated 3 December 2020

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1. Introduction

The Green Book is guidance issued by HM Treasury on how to appraise policies, programmes and projects. It also provides guidance on the design and use of monitoring and evaluation before, during and after implementation. Appraisal of alternative policy options is an inseparable part of detailed policy development and design. This guidance concerns the provision of objective advice by public servants to decision makers, which in central government means advice to ministers. In arms-length public organisations the decision makers may be appointed board members, and where local authorities are using the method,^[footnote 1] elected council members. The guidance is for all public servants concerned with proposals for the use of public resources, not just for analysts. The key specialisms involved in public policy creation and delivery, from policy at a strategic level to analysis, commercial strategy, procurement, finance, and implementation must work together from the outset to deliver best public value. The Treasury's five case model is the means of developing proposals in a holistic way that optimises the social / public value produced by the use of public resources. Similarly, there is a requirement for all organisations across government to work together, to ensure delivery of joined up public services.

The Green Book is not a mechanical or deterministic decision-making device. It provides approved thinking models and methods to support the provision of advice to clarify the social – or public – welfare costs, benefits, and trade-offs of alternative implementation options for the delivery of policy objectives.

Use of the Green Book should be informed by an understanding of other HM Treasury guidance:

- Managing Public Money (<https://www.gov.uk/government/publications/managing-public-money>) – Which provides guidance on the responsible use of public resources
- Business Case Guidance for Strategic Portfolios (<https://www.gov.uk/government/publications/the-green-book-appraisal-and-evaluation-in-central-government>) – Which provides guidance on the development of strategic portfolios for the realisation and management of policies through programmes and projects
- The Business Case Guidance for Programmes (https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/749085/Programme_Business_Case_2018.pdf) – Which provides detailed guidance on the development and approval of capital spending programmes
- The Business Case Guidance for Projects (https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/749086/Project_Business_Case_2018.pdf) – Which provides detailed guidance on the development and approval of capital spending projects
- the Aqua Book (<https://www.gov.uk/government/publications/the-aqua-book-guidance-on-producing-quality-analysis-for-government>) – Which sets out standards for analytical modelling and assurance
- the Magenta Book (<https://www.gov.uk/government/publications/the-magenta-book>) – Which provides detailed guidance on evaluation methods
- Supplementary subject guidance explains how the Green Book may be applied when dealing with particular topics, for example greenhouse gas emissions. This should be used where required. A list of topic specific supplementary guidance is given on page 127.
- Supplementary departmental guidance is produced by Departments and arms-length public organisations. It deals with the application of the Green Book in the particular context that is the organisation's area of responsibility. This supplementary guidance must be consistent with the Green Book, the Business Case guidance and supplementary guidance on specific topics. When the Green Book is updated supplementary guidance must be realigned as required to ensure consistency across government and the wider public sector.

Green Book guidance applies to all proposals that concern public spending, taxation, changes to regulations, and changes to the use of existing public assets and resources – see Box 1 below.

Box 1. Scope of Green Book Guidance

Green Book guidance covers:

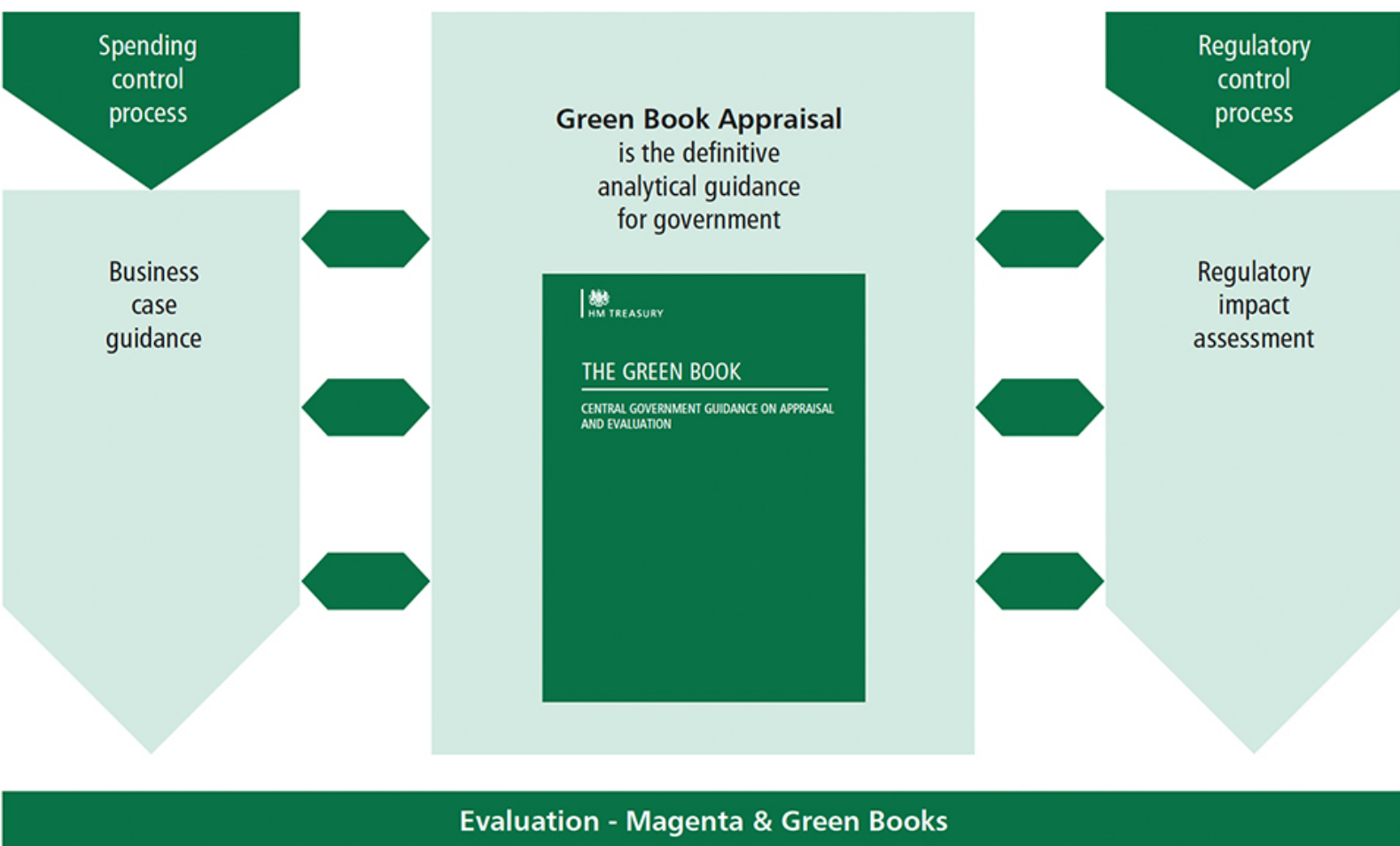
- policy and programme development
- all proposals concerning public spending
- legislative or regulatory proposals
- sale or use of existing government assets – including financial assets
- appraisal of a portfolio of programmes and projects
- structural changes in government organisations
- taxation and benefit proposals
- significant public procurement proposals
- major projects
- changes to the use of existing public assets and resources

The role of appraisal and evaluation is to provide objective analysis to support decision making. Where the use of significant new and existing public resources is required the proportionate employment of the Green book and its supplementary business case guidance is mandatory. The decision support process includes the scrutiny of business cases by approving bodies in government departments and other public organisations, Treasury Approval Processes and the Regulatory Impact Assessment process. The Five Case Model and the methods and principles of the Green Book should also support options appraisal when formal business cases and regulatory decisions are not required. The relationship between Green Book guidance and government decision making processes is shown in Figure 1.

This guidance should be applied proportionately. The resources and effort employed should be related to costs, benefits and risks involved to society and to the public sector as a result of the proposals under consideration.

Monitoring and evaluation of all proposals should be proportionately included in the budget and the management plan of all significant proposals as an integral part of all proposed interventions.

Figure 1. The Green Book and Appraisal in Context



This guidance has been designed to be accessible to a variety of users – from policy officials to analysts. Accordingly, it follows a tiered structure where:

- a high-level overview is provided in chapters 1 – 3
- detailed information for practitioners is provided in chapters 4 – 8
- technical information and shared valuations for use in appraisal are provided in annexes 1 – 6
- hyperlinks have been inserted to allow users to cross-reference within the Green Book and associated supplementary guidance
- The Green Book's chapters are as follows:

chapter 2 provides a non-technical introduction to appraisal and evaluation

- chapter 3 provides an overview of how appraisal fits within government decision making processes
- chapter 4 explains how to generate options and undertake longlist appraisal
- chapter 5 explains how to undertake detailed appraisal of a shortlist of options using social cost benefit and social cost effectiveness approaches, and distributional and sensitivity analysis and accounting for unquantifiable factors it provides the Green Book definition of public/social value for money
- chapter 6 sets out the approach to valuation of costs and benefits
- chapter 7 sets out how to present appraisal results
- chapter 8 sets out the approach to monitoring and evaluation
- annexes 1 – 7 provide further technical appraisal information and values for use in appraisal across government

1.1 Scope and relationship with other appraisal guidance

The content and boundary of all Green Book guidance is determined by HM Treasury. The content is peer reviewed by the Government Chief Economists Appraisal Group. It applies to all government departments, arm's length public bodies with responsibility derived from central government for public funds and regulatory authorities.

Departments also produce internal guidance, setting out how Green Book appraisal should be carried out for their areas of responsibility. For consistency, departmental guidance should align with the Green Book. Where departmental guidance affects other government departments, or contains significant developments in methods and approach, relevant sections should be agreed with HM Treasury and the Government Chief Economists Appraisal Group.

Throughout the guidance there are links to external supplementary guidance. These provide further detail on subjects that are relevant across government e.g. the valuation of greenhouse gas emissions. To provide background and support understanding, non-governmental research and discussion papers are referenced in the Green Book. These documents do not form part of the guidance.

2. Introduction to Appraisal and Evaluation

This chapter provides a non-technical introduction to appraisal and evaluation.

2.1 Principles of appraisal

Appraisal is the process of assessing the costs, benefits and risks of alternative ways to meet government objectives. It helps decision makers to understand the potential effects, trade-offs and overall impact of options by providing an objective evidence base for decision making.

Appraisal The appraisal of social value, also known as public value, is based on the principles and ideas of welfare economics and concerns overall social welfare efficiency, not simply economic market efficiency. Social or public value therefore includes all significant costs and benefits that affect the welfare and wellbeing of the population, not just market effects. For example, environmental, cultural, health, social care, justice and security effects are included. This welfare and wellbeing consideration applies to the entire population that is served by the government, not simply taxpayers. A summary outline of the key steps in appraisal is shown below in Box 2.

The first step in appraisal is to provide the rationale for intervention, a process covered more fully in chapters 2 to 4 and in the business case guidance. Appraisal is a two-stage process, the first stage of which is the consideration of a longlist of option choices and the selection of a rational and viable set of options for shortlist analysis. The options framework and filter process used for longlist analysis and shortlist selection is explained in Chapter 4. The second stage in appraisal is shortlist analysis using social cost benefit analysis (CBA) or social cost effectiveness analysis is explained in Chapter 5.

In government as in many large private sector organisations, major changes involve a sequence of decisions at several levels. Typically, organisations will have their high level purpose expressed in some form of mission statement and may even talk about their intentions in terms of a vision. To make these rather high level statements into implementable programmes and projects, there needs to be another level of more specific strategic policy objectives. Realisation of these strategic objectives requires the organisation and planning of programmes and projects which are best managed in related strategic portfolios. Policies provide direction and high level objectives, these enduring parameters drive and direct the required changes the organisation is working to bring about. The definitions of key terms used in this guidance are given in Box 3.

At each level of decision making, objectives are set so that the proposal being considered meets the needs placed upon it by a preceding, higher level proposal. For example, a programme to deliver signalling for a new railway line will be part of a wider programme to construct the fixed infrastructure the line requires. The signalling system will need to meet the requirements of both the rail infrastructure plan, and the operational needs of the new line, so that it enables safe running of planned train speeds and frequency. Individual projects within the signalling programme will each deliver a component of the overall system, and need to be understood in that context.

Box 2. Summary Outline of Key Appraisal Steps

- Preparing the Strategic case which includes the Strategic Assessment and Making the Case for Change,^[2] quantifies the present situation and Business as Usual (the BAU) and identifies the SMART objectives. This Rationale is the vital first step in defining what is to be appraised. Delivery of the SMART objectives must drive the rest of the process across all dimensions of the Five Case Model as explained throughout this guidance.
- Longlist analysis using the options framework filter considers how best to achieve the SMART objectives. Alternative options are viewed through the lens of public service provision to avoid bias towards preconceived solutions that have not been rigorously tested. A wide range of possibilities are considered, and a viable shortlist is selected including a preferred way forward. These are carried forward for further detailed appraisal. This process is where all complex issues are taken into account and is the key to development of optimum Value for Money proposals likely to deliver reasonably close to expectations.
- Shortlist appraisal follows and is at the heart of detailed appraisal, where expected costs and benefits are estimated, and trade-offs are considered. This analysis is intimately interconnected to the, Strategic, Commercial, Financial, and Management dimensions of the five case model, none of which can be developed or appraised in isolation. The use of Social Cost Benefit Analysis (CBA) or Social Cost Effectiveness Analysis (CEA) are the means by which cost, and benefit trade-offs, are considered.
- Identification of the preferred option is based on the detailed analysis at the shortlist appraisal stage. It involves determining which option provides the best balance of costs, benefits, risks and unmonetisable factors thus optimising value for money.
- Monitoring is the collection of data, both during and after implementation to improve current and future decision making.
- Evaluation is the systematic assessment of an intervention's design, implementation and outcomes. Both monitoring and evaluation should be considered before, during and after implementation.

Box 3. The meanings of widely used words as they are used in the Green Book

A Policy is a statement of intent that is implemented through a procedure or a protocol and a deliberate system of principles to guide decisions and achieve rational outcomes. Policy provides the enduring parameters to police change. As well as setting strategic policy objectives it consists of all the elements below.

Strategy is a plan of action designed to achieve an overall aim or objective. Derived originally from the art of planning and directing overall military operations and movements in a war or battle.

A Strategic Portfolio consists of the programmes and projects necessary to make the changes required to deliver a strategic objective or objectives that contribute to delivery of policy.

A Programme is an interrelated series of Sub-Programmes, Projects and related activities in pursuit of an organisation's longer-term objectives. Programmes deliver outcomes through changes in services

A Project is a temporary organisation designed to produce a specific predefined output at a specified time using predetermined resources.

In a similar way, the government's priorities are expressed in high level strategic objectives. To make them implementable these then drive the creation of strategic portfolios. These portfolios consist of the programmes and projects that are required to realise a strategic policy objective. Programmes identify and manage the interrelated projects and sub-programmes needed. In this example improved transportation services are a means to change economic and social outcomes. The required projects deliver changes in outputs, which when taken together support delivery of a change in rail service provision.

The changes in services in the above example are expected to result in changes in economic and social outcomes. At each level of decision making the application of appraisal takes account of the wider context of which the proposal is a part. Appraisal should be proportionate to the costs and risks involved to both the public sector and to the public i.e. to society. The levels at which decisions occur are explained in more detail in Chapter 3.

2.2 Rationale

It is necessary to set out clearly the purpose of the intervention. This is known as the rationale, and in central government overall policy objectives are determined by ministers or other decision makers. Officials should identify and design alternative options to achieve these stated objectives. Advice must be based on objective analysis and real options.

The rationale should explain how intended changes in outcomes will be produced by the recommended delivery options. The objective of the proposal may be to:

- maintain service continuity arising from the need to replace some factor in the existing delivery process or
- to improve the efficiency of service provision
- to increase the quantity or improve the quality of a service
- to provide a new service
- to comply with regulatory changes
- often a mix of all of all of these.

It is however vitally necessary to be clear that the rationale may also be to improve the welfare efficiency of existing private sector markets, for example by making polluting organisations maintain standards and meet the cost of remediation to retain standards. It may also concern achievement of ethical distributional objectives for example fair access to health or education. It might involve providing social/public goods that are not provided at a satisfactory level by the market alone, for example justice services or social services.

2.3 Generating Options and longlist appraisal

Proposals should initially be considered from the perspective of the service needed to deliver the required policy outcome and not from the perspective of a preconceived solution or asset creation. This guards against thinking too narrowly or being trapped by preconceptions into missing optimum solutions.

Longlist analysis and selection of the shortlist must use the options ^[footnote 3] in a workshop that including key experts and stakeholders as explained in more detail in Chapter 4. This method brings together the results of research, advice of experts, and knowledge of stakeholders. Provided the preparatory research has been carried out, and the right experts and stakeholders involved in the workshop, a wide variety of service scope, solution methods, service delivery methods, service implementation designs, and service funding options can be relatively rapidly appraised. Unintended collateral effects should also be considered including distributional effects that may unfairly impact particular parts of the UK, or groups within UK society. The reasons for inclusion or exclusion of option choices in the shortlist must be transparently recorded and cross referenced as a key part of longlist appraisal.

Where relevant place based effects, and the duties placed on public officials by the Equality Act 2010 and effects on families' when applying the family test (<https://www.gov.uk/government/publications/family-test-assessing-the-impact-of-policies-on-families/the-family-test>) 2010 and significant income distribution effects must be included proportionately in appraisal as set out in this guidance. Where they are not relevant a short explanation of why must be provided.

2.4 Shortlist appraisal

Shortlist appraisal is where the expected costs and benefits of an intervention are estimated, including the cost of risks and risk management, it is where the trade-off between them is considered. Where there is a clear difference in the social costs and benefits between alternative shortlisted options Social Cost Benefit Analysis

(CBA) is used. Where there is no measurable social difference between options then Social Cost-Effectiveness Analysis (CEA) is appropriate. Both of these are explained in more detail in Chapter 5.

Costs and benefits are viewed from the perspective of UK society, not just to the public sector or originating institution. That is not to say for example that a proposal to improve provision of acute care by extending an NHS building would search for UK wide effects, but simply to say that it would be considered from the perspective of the local health economy, and not confine itself to effects on the organisation making the proposal. This common sense approach to costs and benefits is not confined to thinking about branches of public services in isolation. Services provided to the public by central and local government are experienced by the public as a flow of services and there is an understandable and undeniable expectation that the various arms of government are joined up and will deliver optimum joined up public services. This understanding must inform the design of proposals in general and the choice of costs and benefits used in appraisal.

Assessing costs and benefits across all affected groups or places matters because even a proposal with a relatively low public sector cost such as a new regulation, may have significant effects on specific groups in society, places or businesses. Costs or benefits of options should be valued and monetised where possible in order to provide a common metric.

Where there is no reasonable market price a range of valuation techniques are recommended. These include societal costs and benefits such as environmental values, and they are explained further in Chapters 5 and 6 with more technical guidance in the Annexes. In some cases where there is more detailed supplementary guidance which is referred to in the text it is cross referenced with internet links. Where credible values cannot be readily calculated but it is clear they relate to a significant issue. They should then be factored in early on in preparation of a proposal, and accounted for during option design, at the longlisting stage during shortlist selection. Further guidance on dealing with unquantified and unmonetisable values is given in Chapters 4, 5 and 6 and Annex A1, and in a range of supplementary guidance referenced on page 127 and on the Green Book web pages for example the Enabling Natural Capital Approach (ENCA) guidance.

Costs and benefits should be calculated over the lifetime of the proposal. Proposals involving infrastructure such as roads, railways and new buildings are appraised over a 60 year period. Refurbishment of existing buildings is considered over 30 years. For proposals involving administrative changes a ten year period is used as a standard measure. For interventions likely to have significant costs or benefits beyond 60 years, such as vaccination programmes, or nuclear waste storage, a suitable appraisal period should be discussed with and formally agreed by the Treasury at the start of work on the proposal. Where a commercial contract is involved, and it covers a short period such as five years for an IT system for example, it is necessary to understand and plan for service delivery over the longer period applicable for the kind of proposal being considered. It is the life of the public service described above that determines the length of the appraisal period. The costs of maintain the service and of transferring to another system will need to be included and it will need to be planned for. Appraisal of the proposal must include provision of the service when the contract needs to be replaced.

Distributional analysis

Distributional analysis is important where there may be significant redistributive effects between different groups within the UK, resulting from a proposal. The level of detail and complexity devoted to this analysis should be proportionate to the likely impact on those affected. Redistribution may concern any of the groups identified by the Equality Act 2010, and should be considered when applying the Families test introduced in 2014 or where different income groups or types of businesses or geographically defined places in the UK may be affected. See also in Annex 2 and paragraphs 4.15 to 4.19 in Chapter 4. Where a form of distributional appraisal is necessary one of three possible levels of complexity may be regarded as proportionate:

- Where the level of impact on a defined group or area is very marginal it may be judged that it is sufficient to note the effect and bring it to the attention of the sponsoring Senior Responsible Owner (SRO) and the approving authority to allow judgment on possible action.
- Where the likely effect is more substantial, then a straight forward and as far as possible, quantified and monetised analysis is required to appraise the effects, and to support judgments by decision makers in considering whether adaptation of the proposal or mitigation of its effects is possible, and to provide relevant options for the decision makers to consider.

- If there is likely to be a very significant redistribution of income or related social welfare either as an objective or as a collateral consequence of a proposal, then it may be appropriate to employ an equivalised income approach as set out in Annex-3. Where such weighting is employed it must be understood that the results are sensitive to the choice of weights. The reasons for the choices made must be transparently explained. Additional sensitivity tests are required to reveal the difference made by the weighting process and in particular to reveal the impact of varying the weights to reflect the uncertainty they introduce by using the upper and lower limits of the values they can reasonably be expected to take.

Optimism bias, risk and sensitivity analysis

When conducting appraisal consideration should also be given to:

- optimism bias – this is the proven tendency for appraisers to be optimistically biased about key project parameters, including capital costs and operating costs, project duration, and resulting benefits delivery. Optimistic rather than realistic projections result in undeliverable targets and if permitted across the board create institutional failure as all proposals fall consistently far short of promised results. For this reason, specific optimism bias adjustments must be applied at the start of the process as numbers are initially identified. As proposal specific risks are identified they must be entered into the risk register explained in Chapter 5. As ways of avoiding, sharing or mitigating risks are identified and included in a proposal optimism bias can be proportionately reduced. Initial optimism bias levels recommended by the Green Book must be employed unless the organisation concerned has their own robust alternative estimates based on sufficient reliable data from similar projects. Managing, avoiding, sharing and mitigating risk is the key to successful delivery of well designed proposals, points to note are:
- risks – that are specifically related to a proposal may arise in the design, creation/building, implementation or operation of a proposal. Risk costs are either the cost of avoiding, sharing or otherwise mitigating risks, or the cost of risk materialising. An estimate of a materialised risk cost should be made using an expected likelihood approach explained in paragraph 5.51 and as set out more generally in Chapter 5 paragraphs 5.47 to 5.52. The objective is to manage risk in a socially cost effective way, not simply to build numbers into a spreadsheet. Risks should be fully understood, and realistic measures built into proposals for their management, this includes low probability but high impact events.
- sensitivity analysis – is performed to explore the sensitivity of expected outcomes to potential variations in key input variables.
- switching values can be estimated as part of sensitivity analysis where appropriate. These are the values an input would need to change to in order to make an option no longer viable.

Discounting

All values in the economic dimension are expressed in real prices relating to the first year of the proposal. This means that the average inflation rate is removed. Discounting is based on the concept of time preference, which is that generally people prefer value now rather than later. This has nothing to do with inflation, because it is true even at constant prices. Discounting converts costs and benefits into present values by allowing for society's preference for now compared with the future. It is used to allow comparison of future values in terms of their value in the present which is always assumed to be the base year of the proposal. For example if Projects A and B have identical costs and benefits but Project B delivers a year earlier, time preference gives Project B, a higher present value because it is discounted by a year less than project A.

In government appraisal costs and benefits are discounted using the social time preference rate as explained in Chapter 5 and paragraphs 5.32 to 5.39 as well as Annex 5. The reason for social discounting is to allow proposals of different lengths and with different profiles of net costs and benefits over time to be compared on a common basis. For reasons explained in Chapter 5 it does not need to be concerned with the cost of capital which is dealt with elsewhere by other means.

Selecting the preferred option and public value for money

The primary reason for implementing all proposals is not a Benefit to Cost Ratio (BCR), but it is to meet the "business need" identified early in developing the rationale for the proposal, this takes place at the start of developing the strategic dimension of the business case. All shortlisted options must be viable and meet the

requirement of delivering the SMART objectives. They will differ in timing, risk, cost and benefit delivery at or above the “Do Minimum” option.

Comparison of each shortlist option with Business As Usual, reveals the quantified differences of alternative options. The value of all benefits, less all costs, in each year when discounted can be added together because they are in present value (discounted) terms, and then represent net cost benefit (benefits minus costs). This sum is the Net Present Social/Public Value (NPSV) of a proposal. The NPSV and Benefit Cost Ratio (NPSV divided by relevant public sector implementation costs) produces an initial ranking of options.

Where there is a significant feature the benefits of which are not readily or credibly monetisable, then value for money can be revealed by preparing two alternative versions of the preferred option. One without the unmonetisable benefit and another including it and its additional costs. A comparison of each of the options with BAU enables decision makers to see the additional cost of the unmonetisable benefit and to consider if it is an acceptable price worth paying.

Significant unquantifiable risk and uncertainties are also to be considered at this stage. The choice of the preferred option on grounds of public or social value for money is wider than just the initial BCR.^[footnote 4] Optimum value for money is a considered choice starting from the initial option ranking, that also considers important unquantifiable benefits and significant unquantifiable uncertainties and known risks.

Projects do not determine the need for a programme of which they are a part, nor do programmes do so for strategy, or strategic portfolios for policy. The justification of enabling proposals is the wider policy or programme or portfolio of which they are a part. Where social costs and benefits are not sensibly calculable or where they are clearly the same for all options it is sensible to optimise on a cost efficiency basis. For example, a signalling system for railway, must deliver according to a specification provided by the overall programme of which it is a part. There is no need to imagine the signals alone have some social value in isolation from the programme that justifies their existence. Nor is it credible or useful to apportion the overall programme benefits to the signalling component.

2.5 Monitoring and Evaluation

Monitoring is the collection of data, both during and after implementation. This data can be fed back during implementation as part of managing, and it can be used during operation of a service in the same way, as well as for informing evaluation. It is important to understand and quantify Business As Usual (BAU) so that the setting of SMART objectives is realistic, proposals are founded on sufficient understanding, and performance can be monitored and evaluated.

Evaluation is the systematic assessment of an intervention’s design, implementation and outcomes. It tests:

- if or how far an intervention is working or has worked as expected
- if the costs and benefits were as anticipated
- whether there were significant unexpected consequences
- how it was implemented and if changes were made why

All proposals must as part of the proposal contain proportionate budgetary, and management provisions for their own monitoring and evaluation. This applies to monitoring and evaluation both during and after implementation. Monitoring and evaluation are an important way of identifying lessons that can be learnt to improve both the design and delivery of future interventions.

3. The Overarching Policy Framework

This chapter provides an overview of how appraisal fits within government decision making processes including the Policy Cycle, the Five Case Model and Impact Assessments.

3.1 Policy and Strategic Planning an Overview

It is vital to understand both the context within which policy objectives are being delivered and the process of change that will result from the proposed intervention and cause the desired policy objectives. This process of causation is referred to in the Green Book as the logical process of change or simply process of change. The supplementary guidance on Business Cases covers in more detail the steps needed to develop, understand and explain, the objective basis of this expectation and provide reasonable evidence. It is the foundation of the rationale for intervention in the way that is proposed.

Key issues that influence the wider debate which gives rise to policy development have been summarised in the mnemonic known as PESTLE which stands for Political, Economic, Social, Technological, Environmental and Legal issues. The translation of these issues through policy into outcomes is represented in Figure 2 below.

Figure 2. Policy and the wider context Political, Economic, Social, Technological, Environmental, Legal (PESTLE)

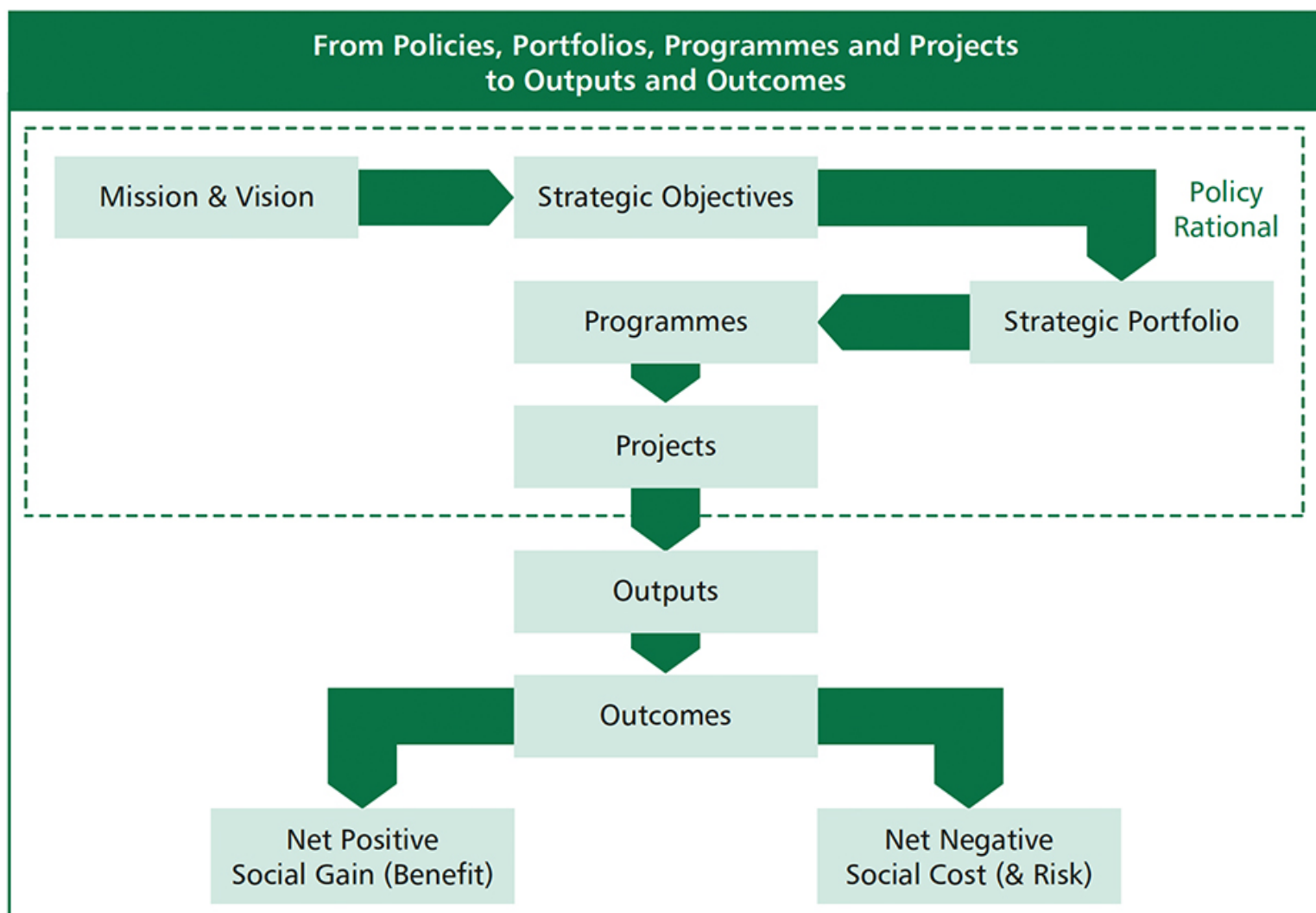


Policy development must start with development of the rationale and be based on a sound understanding of the current position. This needs to be understood in objectively quantifiable terms so that the scope and key features of the issues are understood appropriately. Parts of government may from time to time adopt policy priorities and develop policy tests for use in support of these very specific objectives. Where they exist they need to be taken into account when considering policy formation. Such tests are considered at the preliminary research stage and as part of policy design, when considering objectives, and at the longlist stage discussed in more detail in Chapter 4.

As indicated in Chapter 2, the development of policy into implementable solutions to deliver objectives, necessarily involves decisions at a number of levels of scale and delegation. Typically, progressing from high level statements of “mission” or purpose through more specific high level strategic policy objectives. Programmes are created to deliver these objectives, these Programmes contain Projects and related activities, that, taken together, are necessary to bring about the changes required to deliver the objectives. These programmes are best developed and managed through strategic portfolios which involve a common policy

theme as illustrated in Figure 3. More detailed guidance on developing strategic portfolios, programmes and projects is available on the main Green Book webpage (<https://www.gov.uk/government/publications/the-green-book-appraisal-and-evaluation-in-central-government>).

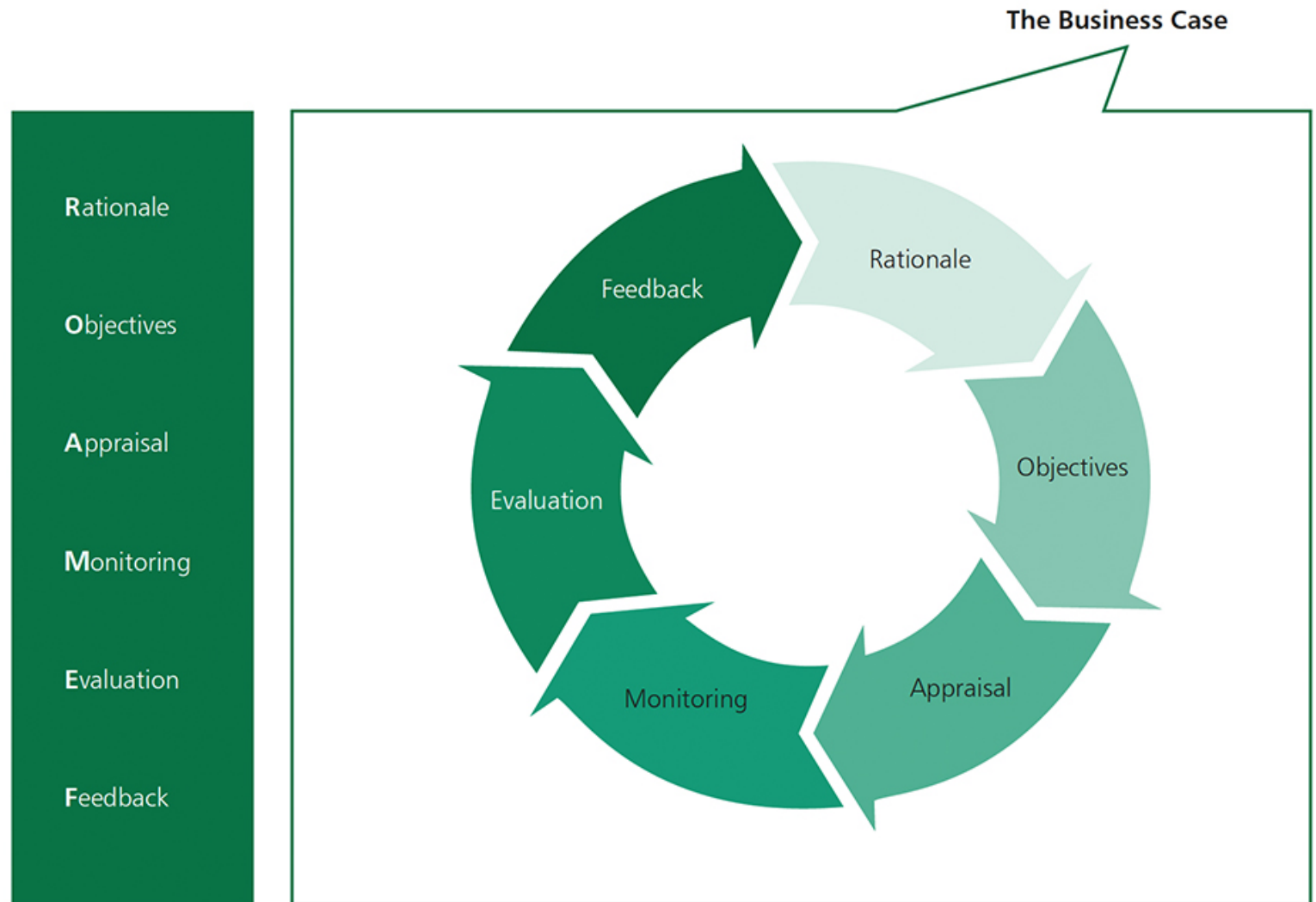
Figure 3. From Policy to Outcomes



At each of the policy development levels indicated above, the context in terms of objectives is provided by the preceding higher level. The nature of the issues being considered also changes dependent on this context and the scale of the proposal. Thus, programmes are concerned with identifying and managing projects and keeping track of the programme critical path and expected spending envelope. On the other hand, projects are concerned with delivery of specific changes in business outputs. Projects provide the detailed design of output changes and make requests for specific spending.

At each level the thinking and development process follows the same high level policy development and review pattern known as the ROAMEF cycle as shown in Figure 4. The process proceeds from developing a rationale for the proposal, through identification of objectives, to options appraisal, monitoring and evaluation. More detailed supplementary guidance supporting the processes outlined above is provided by the family of business case guidance documents available from the Green Book web page.

Figure 4. The ROAMEF Policy development cycle



Monitoring and evaluation play an important role before, during and after implementation. The aim is to improve the design of policies, identify strategic objectives, to understand the mechanism of change and to support the management of implementation.

Strategic portfolios identify, scope, plan, prioritise and manage the constituent programmes needed to deliver the objectives of the portfolio. Each strategic portfolio deals with a different aspect of policy delivery known as a theme and consists of related programmes. A generic example is provided at Figure 5 below and a hypothetical case study example at Figure 6 in Chapter 4. The Green Book supplementary guidance on business cases provides more detailed information.

Figure 5. A generic example of the relationship between Strategy, Programmes and Projects

Stage	Organisational Strategy	Programme	Project
Purpose and focus	To deliver the vision, mission and long-term objectives of the organisation, typically involving transformational service change. Organisational Strategy for Transforming a Public Service	To deliver medium term objectives for change, typically involving improved quality and efficiency of service. Programme A: Service Improvement	To deliver short-term objectives, typically involving improved economy of service and enabling infrastructure. Project A: Re-procurement of ICT

Stage	Organisational Strategy	Programme	Project
Scope and content	Strategic portfolio comprising the required programmes on the critical path for delivery of required benefits. Programme A: Service Improvement Programme B: Human Resources Programme C: Estates Management	Programme portfolio comprising the required projects and activities on the critical path for delivery of anticipated outcomes. Project A1: Re-procurement of ICT Project A2: Business Process Re-engineering Project A3: Quality Management	Project comprising the inputs and activities required for delivery of the agreed output. Work streams: Replacement ICT Upgrading ICT Staff training ICT
Product	Organisational Strategy and business plans	Programme Business Case (PBC)	SOC, OBC and FBC for large projects BJC's for smaller schemes
Monitoring, evaluation and feedback	5-year strategy. Monitor during implementation. Review at least annually and update as required.	3-year programme. Monitor during implementation. Evaluate on completion of each tranche and feedback into strategy development.	1-year project. Monitor during implementation. Evaluate on completion of project and feedback to programme.

Programmes initiate, align and monitor the constituent projects and related activities needed to deliver outputs that will produce the anticipated outcomes of the programme. These outputs may consist of new products, new or improved services, or changes to business operations. It is not until the projects deliver and implement the required output changes that the outcomes that cause the benefits of the programme can be realised.

Programmes require a continuing process of review and alignment with policy objectives, to ensure that a programme and its projects remain linked to strategic objectives. This is because while they are implementing changes and improvements to business operations, they may need to respond to changes in external factors or to accommodate changes in policy objectives or strategies. The relationship between strategic portfolios, programmes and projects is illustrated by the generic Figure 5 above and the hypothetical practical example in Figure 6 in Chapter 4.

The process of policy development should be based on objective evidence. Where assumptions are needed, they should be reasonable and justified by transparent reference to the research information they are based on. Information may come from a range of possible sources including, evaluation of previous interventions and what works, background academic research, specially commissioned research or surveys, and international comparisons. Research and due diligence activity should take place early on, before the process of more detailed policy development or business case development and appraisal begins.

Box 4. Guidance and definitions and for managing successful Programmes and Projects

A Programme is an interrelated series of Sub-Programmes, Projects and related events and activities in pursuit of an organisation's long-term goals/objectives.

- Managing Successful Programmes (MSP), is an international standard originated by the UK government for programme management, it defines a programme as 'a temporary, flexible organisation created to co-ordinate, direct and oversee the implementation of a set of related projects and activities in order to deliver outcomes and benefits related to the organisation's strategic objectives'.
- Large projects are often referred to as programmes. In practice, the key differences between programmes and projects are:
- Programmes focus on the delivery of outcomes and projects on the delivery of outputs
- Programmes are comprised of enabling projects and activities

- Programmes usually have a longer lifespan than projects and usually consist of a number of tranches that take several years to deliver, and
- Programmes are usually more complex and provide an umbrella under which their enabling projects can be coordinated and delivered.
- There are different types of programmes, and the content of the supporting business case will be influenced by the nature of the change being delivered and the degree of analysis required.

A Project is a temporary organisation that is needed to produce a specific predefined output or result at a pre-specified time using predetermined resources. Managing Successful Projects with PRINCE2 guidance defines a project as 'a management environment that is created for the purpose of delivering one or more business products according to a specified business case'.

Most projects have the following characteristics:

- a defined and finite life cycle
- clear and measurable inputs and outputs
- a corresponding set of activities and plans
- a defined amount of resource, and
- an organizational structure for governance and delivery.

The potential for the proposal to have wider systemic effects across society, the economy and the environment should be considered whether or not they are intentional. Such collateral effects if significant must be taken into account at the longlist stage of the appraisal process, as explained in Chapter 4.

Proposals with long term costs and benefits must consider whether longer term structural changes may occur in the economy or society. Such external structural shifts may arise from demographic, technological, environmental, cultural, or other similar external changes. These potential effects need to be considered and taken into account at the longlisting stage of proposals.

At every level of the decision-making process, whether it concerns strategic portfolios of programmes, a programme, or a project, there is a need to set out the logical chain of cause and effect by which the SMART objectives will be produced. The need for this is widely recognised and, in some places, which lack the five-case model, and its strategic dimension, it has been catered for by approaches labelled as logic models or the theory of change.

In the five-case model, this logical model of cause and effect is necessarily different at each level of the decision-making process. Strategic portfolios are concerned with significant strategic policy objectives, and managing the programmes that will deliver the outcomes required by the policy. Whereas programmes are concerned with organising their constituent projects and related activities. Projects will be concerned with the delivery of specific outputs that enable the programme of which they are a part to change outcomes in society and the economy.

SMART objectives should as far as possible be expressed in terms of outcomes not service outputs. Projects should reflect the programme of which they are a part and they must deliver the outputs that the programme requires. A few projects may be stand alone and some projects within programmes may occasionally need to express some objectives as outcomes. Even where a proposal concerns creating or acquiring an asset, it should be appraised from the perspective of its capacity to deliver the required service levels. This helps to avoid biasing proposals towards initial solutions that may not have been sufficiently thought through.

Transformation in Green Book terms refers to a fundamental change in the structure and operation of the subject that is to be transformed. This differs from a simple change in quantity. It refers to a radical qualitative change in state, so that the subject operates in a very different way or has different properties. An analogy is the change from cold water into ice which is fundamentally different from cold water in both its structure and mechanical properties. For example, internet shopping is transforming retail shopping and consequentially the nature of many high streets.

Where proposals claim to be aiming for “transformational change” the nature of the change needs to be transparently explained. A credible explanation of the change process is required with the objective evidence on which it is based and objective support for assumptions made. Where the effects may be in practical terms irreversible, and intergenerational wealth transfers are involved, it is particularly important to take account of long-term structural changes and systemic impacts. In such cases sensitivity analysis and in many cases scenario analysis is important as explained in Chapters 4, 5 and 6.

The purpose of longlist appraisal is to narrow down possible options to identify an optimum shortlist of viable options for detailed appraisal. Shortlist appraisal can only support choice between the options offered to it. The selection of a credible and viable list of the best options for detailed appraisal is therefore vital to avoid pointless analytical work to support a choice between suboptimal options at the shortlist stage.

The primary focus of the business case process and appraisal is to identify and define the options and to support advice on prioritisation and choice. The objectives of a project are derived from the programme of which it is a part. The objectives of the programme reflect policy and are shaped by the strategic portfolio of which it is a part and the overall policy objectives determined by government. The focus is therefore on identifying the best possible options and choosing between them by identifying the optimum. Strategic policy justification is part of the high-level strategic analysis that takes place when overarching policy is being researched and options for policy at a high level are being explored. A hypothetical example showing the relationship between strategy programmes and policies is given in Figure 5 above, it is quoted from the programme business case guidance on the Green Book web page which is accessible at this link (<https://www.gov.uk/government/publications/the-green-book-appraisal-and-evaluation-in-central-government>).

3.2 The Five Case Model

The Five Case Model is the required framework for considering the use of public resources to be used proportionately to the costs and risks involved, and taking account of the context in which a decision is to be taken. The five “cases” or dimensions are different ways of viewing the same proposal, outlined in Box 5 below. The policy, analytical, commercial, financial, and delivery professions within the public service must avoid working in silos and work together on proposals from the outset. The five dimensions cannot be developed or viewed in isolation, they must be developed together in an iterative process because they are intimately interconnected.

The five case model provides a universal thinking framework that if understood and applied correctly accommodates the widely varied features of any investment or spending proposal. There is no need to invent an additional case to accommodate a special feature of a proposal, the model takes account of such features which are expressed as either objectives to be achieved or as constraints that a proposal has to work within such as a legal, regulatory, or ethical consideration.

Box 5. The Five Case Model

Strategic dimension

What is the case for change, including the rationale for intervention? What is the current situation? What is to be done? What outcomes are expected? How do these fit with wider government policies and objectives?

Economic dimension

What is the net value to society (the social value) of the intervention compared to continuing with Business As Usual? What are the risks and their costs, and how are they best managed? Which option reflects the optimal net value to society?

Commercial dimension

Can a realistic and credible commercial deal be struck? Who will manage which risks?

Financial dimension

What is the impact of the proposal on the public sector budget in terms of the total cost of both capital and revenue?

Management dimension

Are there realistic and robust delivery plans? How can the proposal be delivered?

Strategic dimension

The strategic dimension of the Five Case Model must identify “Business as Usual” (BAU) – that is the result of continuing without implementing the proposal under consideration. This must be a quantified understanding to provide a well understood benchmark, against which proposals for change can be compared. This is true even when to continue with BAU would be unthinkable.

The strategic dimension is where external constraints that a proposal must work within are considered, for example, legal, ethical, political, or technological factors. External dependencies must also be identified, such as necessary infrastructure over which the proposal has no control.

The outcome that the proposal is expected to produce is defined by a small number (up to 5 or at most 6) of SMART objectives that must be Specific Measurable Achievable Realistic and Time-limited. The SMART objectives selected in the strategic dimension must directly drive the rest of the process throughout the model. Crucially they provide the basis of option creation and the appraisal process in the economic dimension.

Programme objectives should be expressed in terms of outcomes that the expected change in service provision is expected to produce. This is a key element in understanding and refining the objective which should be expressed numerically. The objectives must directly reflect the rationale for the proposal and be able to be monitored and evaluated.

Box 6. Logical Change Process

The Strategic dimension of the Business Case requires a Strategic Assessment key steps in which are:

- A quantitative understanding of the current situation known as Business As Usual (BAU)
- Identification of SMART objectives that embody the objective of the proposal
- Identification of the changes that need to be made to the organisation’s business to bridge the gap from BAU to attainment of the SMART objectives. These are known as the business needs.
- An explanation of the logical change process i.e. the chain of cause and effect whereby meeting the business needs will bring about the SMART objectives.

This all needs to be supported by reference to appropriate objective evidence in support of the data and assumptions used including the change mechanisms involved. It should include:

- the source of the evidence;
 - explanation of the robustness of the evidence; and
 - of the relevance of the evidence to the context in which it is being used.
- This provides a clear testable proposal that can be the subject of constructive challenge and review. Single point estimates at this stage would be misleading and inaccurate and objectively based confidence ranges should be used.

The key part of all proposals, whether strategic portfolio, programme or projects, is the strategic assessment which examines the current position (Business As Usual) and compares it with the desired outcome, as summarised by the SMART objectives. The gap which needs to be bridged between Business As Usual and the attainment of the SMART objectives represents the business needs. An objectively based understanding of how meeting the business needs will result in attainment of the SMART objectives, is a basic requirement – see Box 6 and the Green Book Supplementary Guidance on Business Cases concerning strategic assessment.

From this early stage how a proposal fits with wider public policy and any potential impacts on the operations, responsibilities or budgets of other public bodies must be considered. Consultation and cooperative working between public bodies supports effective and efficient delivery of public services and avoids unnecessary waste and inefficiencies.

Research, consultation and engagement with stakeholders, should be conducted from the earliest stage. This provides greater understanding of the current situation and potential opportunities for improvement including links to relevant policies.

Economic dimension

The economic dimension is the analytical heart of a business case where detailed option development and selection through use of appraisal takes place. The economic dimension of the business case is driven by the SMART objectives and delivery of the business needs that are identified in the strategic case as explained in Chapter 4. It estimates the social value of different options at both the UK level and, where necessary on different parts of the UK or on groups of people within the UK. Where overseas development assistance is concerned the value to the recipient country is relevant. The potential for the proposal to cause significant unintended consequences should also be considered and where they are likely they must be taken into account.

Longlist appraisal and selection of the shortlist is a crucial function of the economic dimension explained more fully in Chapter 4, and in the family of Business Case Guidance documents available from the Green Book web pages. The selection of a preferred option from the shortlist requires interaction between the strategic and economic dimension and the commercial, financial and management dimensions of the case. None of these can be considered in isolation, and the supplementary guidance on Business Cases should be followed to ensure that the proposal is developed in an integrated, way bringing together all of the dimensions together with the benefit of key stakeholder input.

The selection of the preferred option from the shortlist uses social cost benefit analysis or where appropriate social cost effectiveness analysis as explained in Chapter 5. The value for money recommendation is based upon a range of factors including the net social value of the option including the costs of risk and residual optimism bias, the net whole life cost of the public resources employed, and the additional costs of including key objectives, the benefits of which are unquantifiable. The overall risk of the option to the public and the public sector is also an important consideration.

Commercial dimension

The commercial dimension concerns the commercial strategy and arrangements relating to services and assets that are required by the proposal and to the design of the procurement tender where one is required. The procurement specification comes from the strategic and economic dimensions. The commercial dimension feeds information on costs, risk management and timing back into the economic and financial dimensions as a procurement process proceeds. This is part of the iterative process of developing a proposal into a mature business case. The Cabinet Office Functional programmes can provide support and advice during appraisal e.g. the Commercial Function can support assessment of procurement decisions.^[footnote 5]

Financial dimension

The financial dimension is concerned with the net cost to the public sector of the adoption of a proposal, taking into account all financial costs and benefits that result. It covers affordability, whereas the economic dimension assesses whether the proposal delivers the best social value. The financial dimension is exclusively concerned with the financial impact on the public sector. It is calculated according to National Accounts rules.

Management dimension

The management dimension is concerned with planning the practical arrangements for implementation. It demonstrates that a preferred option can be delivered successfully. It includes the provision and management of the resources required for delivery of the proposal and arrangements for managing budgets. It identifies the organisation responsible for implementation, when agreed milestones will be achieved and when the proposal will be completed.

The management dimension should also include:

- the risk register and plans for risk management
- the benefit register
- the arrangements for monitoring and evaluation during and after implementation and any collection of data prior to implementation, including the provision of resources and who will be responsible

The management dimension is completed more fully during the middle and latter stages of a proposal's development into a full business case. The implications of the management dimension feed into the appraisal and must be reflected in the full versions of the economic, commercial and financial dimensions.

3.3 Regulatory Impact Assessments

Regulatory Impact Assessments (RIAs) are used to support the appraisal of new primary or secondary legislation, or in some cases the impact of non-legislative policy change. The Green Book should be used for the appraisal required for RIAs, in the same way as for spending proposals. It sets out the methodology for appraisal of social value and distributional effects.

RIAs follow the same logic as spending and resource appraisals and make use of the five case model in their thinking. There needs to be the same rationale with clear policy objectives, and expected process of change and SMART policy objectives. Costs, benefits and risks to the public and those affected as well as to the public sector are relevant and where new policies are concerned, consideration of a range of options. The calculation of costs and benefits, as well as the detailed evidence base which supports RIAs, should be developed in accordance with Green Book methodology. For small regulatory changes standalone RIAs may not be required, though any analysis included to support these changes should be in line with Green Book methodology.

The rules for the scrutiny and clearance processes, in England, for regulations with an impact on business above a certain value and methodology for calculating specific metrics relating to the impact on business, are set out in the Better Regulation guidance (<https://www.gov.uk/government/publications/better-regulation-framework-manual>). The Better Regulation guidance reflects ministerial decisions on statutory reporting duties and may be periodically updated to reflect policy change.

3.4 Option appraisal in government

The Green Book methodology set out in this guidance should be applied proportionately to support effective decision making across government. Some problems such as emergencies are not covered by the regular approval process. Some questions arise that do not involve the use of significant resources, the answers to which hinge on issues of social value alone. These may use only part of the process covered here, but in most cases key elements of the thinking model apply, and its use supports rapid, effective and efficient decision making, supported by objective advice.

4. Generating Options and Long-list Appraisal

This chapter sets out how to develop a rationale for intervention, generate a longlist of possible options to achieve objectives and filter them down to a shortlist suitable for detailed cost benefit or cost effectiveness analysis. These methods and principles apply when considering all significant proposals, for intervention for example regulatory options or options concerning the use of existing resources as well as new public spending and investment. As a guide to navigation a summary of the Appraisal Framework is shown throughout this guidance, below over the page in Box 7 the rationale stage is highlighted.

4.1 Rationale

In central government the objectives of policy at the highest level are determined by Ministers who are responsible to Parliament. Within the frameworks that are provided by Ministerial decisions and by the law, decision makers in other public bodies also have responsibility for setting policy objectives. The role of public officials and of this guidance is to provide objective unbiased advice to decision makers, to support choice between alternative means of realising the policy objectives that have been set.

Ideally policy objectives should be framed as social outcomes. This longlist stage of the process includes the estimation of indicative social costs and benefits including the cost of risks that result from different options. These indicative values should be expressed as ranges. As the appraisal process progresses and knowledge increases, accuracy will improve resulting in a narrowing of these ranges. While absolute certainty is not a realistic expectation, unbiased estimates within reasonable ranges accompanied by plans to manage uncertainty are a requirement.

A “rationale” explaining the desired change, and crucially the means by which it can be brought about, must be developed as outlined in Chapter 3. The rationale relates to the context of the proposal and its place in the chain of decision making,^[footnote 6] the objectives of which run like a thread from Strategy, through programmes and in to projects. The content of the rationale will relate to both the context set both by its place in the chain of decision making and the nature of the proposal concerned. A clear explanation is required of the chain of cause and effect that is expected to support attainment of the objectives. It must also explain how the proposal fits with the objectives of the stages before it in the decision chain.

Different organisations and arms of public service should act in ways that are mutually supportive and cooperative. Therefore, from the start proposals must be designed to ensure they provide a supportive strategic fit with wider public policies as described in Chapter 3. Where proposals are likely to rely on or impinge upon the policies or responsibilities of another public body, there is a duty for public organisations to work together to ensure that a positive result for the public is produced.

Box 7. Navigating the Appraisal Framework: the Rationale

Rationale for intervention

- conduct the strategic assessment, research and understand the current position – Business As Usual
- establish rationale for intervention including the Evidence based Logical Change Process
- determine whether Place Based, Equalities, and/or Distributional Appraisal is required
- ensure Strategic Fit and identify SMART objectives (outcomes and outputs) for intervention

Longlist appraisal

- identify Constraints and Dependencies
- consider Place Based, Equalities, and/or Distributional objectives
- identify Critical Success Factors (CSFs)
- consider unquantifiable and unmonetisable factors
- consider a longlist of option choices with the Options Framework-Filter
- consider Place Based, Equalities, and Distributional effects
- using the Options Framework-Filter create a viable shortlist and preferred way forward

Shortlist appraisal

- select Social Cost Benefit Analysis or Social Cost Effectiveness Analysis
- identify and value costs and benefits of all shortlisted options

- estimate the financial cost to the public sector
- ensure all values in the economic dimension are in real base year prices with inflation removed
- qualitatively assess non-monetisable costs and benefits
- apply appropriate Optimism Bias
- maintain Risk and Benefits Registers
- assess Avoidable, Transferable and Retained Risk, build in additional Risk Costs and reduce Optimism Bias accordingly
- sum the values of costs and benefits in each year
- discount the yearly sums of costs and benefits in each year to produce Net Present Social Values (NPSVs)
- add the NPSVs over time to produce The Net Present Social Value (NPSV) of each option
- calculate Benefit Cost Ratios (BCRs) if using CBA or Social Unit Costs if using CEA as appropriate

Identification of the preferred option

- identify preferred option considering NPSV, BCR, unmonetisable features risks and uncertainties
- conduct sensitivity analysis and calculate switching values, for each option

Monitoring and evaluation

- during implementation – inform implementation and operational management
- in the operational phase – inform both operational management and evaluate the outcome and lessons learned to improve future decisions.

Policies generally consist of programmes to bring about change. Programmes are best organised and managed in strategic portfolios that support particular themes within the overall policy objective, for example see Figure 6 below. Programmes are comprised of projects, which individually deliver changes in service outputs. Together the projects, through the delivery of change in their outputs, support delivery of a change in outcomes which are the objectives of the programme. The family of supplementary guidance on different types of business cases are available at this link (<https://www.gov.uk/government/publications/the-green-book-appraisal-and-evaluation-in-central-government>) and they provide the detailed guidance necessary for use when preparing spending proposals. The models and method are also applicable to other kinds of decisions such as regulatory or asset disposal issues.

Figure 6. A hypothetical applied example the relationships between Strategy, Programmes and Projects

	Organisational Strategy	Programme	Project
Purpose and focus	To deliver the vision, mission and long-term objectives of the organisation, typically involving transformational service change. National Strategy for Improving Pre-16 year old Educational Attainment	To deliver medium term objectives for change, typically involving improved quality and efficiency of service. Improving School Buildings Programme	To deliver short-term objectives, typically involving improved economy of service and enabling infrastructure. Regional School Improvement Project A

	Organisational Strategy	Programme	Project
Scope and content	Strategic portfolio comprising the required programmes on the critical path for delivery of required benefits. Improving Schools Building Programme Review of Pre-16 Curriculum Programme School Teachers Training Programme	Programme portfolio comprising the required projects and activities on the critical path for delivery of anticipated outcomes. Regional School Improvement Project A Regional School Improvement Project B Regional School Improvement Project C	Project comprising the products and activities required for delivery of the agreed output. Work streams: School building refurbishment New equipment Upgrading & Replacement IT
Product	Organisational Strategy and business plans	Programme Business Case (PBC)	SOC, OBC and FBC for large projects BJC for smaller schemes
Monitoring, evaluation and feedback	10 year strategy Review at least annually and update as required.	7 year programme Monitor and Evaluate during implementation and on completion of each tranche. Annual reviews as a minimum and feedback into strategy development.	2 year project Monitor and Evaluate during implementation and on completion of project and feedback to programme.

Proposals for change must start from a thorough objective and quantitative understanding of the current situation, this should be informed by research and consultation with experts and stakeholders. A clear quantitative understanding of “Business As Usual” (BAU) is essential to understanding the current situation, and to identifying and planning the changes that may be required. All those involved in appraisal, and in development of business cases, and in their review and approval must be trained and accredited. Details of the appropriate HM Treasury approved training and accreditation scheme are given at this link (https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/787243/Access_to_training_and_accreditation_in_best_practice_business_cases___Updated_March_2019.pdf).

Business As Usual (BAU) in Green Book terms is defined as the continuation of current arrangements, as if the proposal under consideration were not to be implemented. This is true even if such a course of action is completely unacceptable. The purpose is to provide a quantitative benchmark, as the “counterfactual” against which all proposals for change will be compared. BAU does not mean doing nothing, because continuing with current arrangements will have consequences and require action resulting in costs, in practical terms there is therefore no do-nothing option.

4.2 SMART objectives

- Clear objectives are vital for success. Identifying objectives begins at the outset or when making the case for change (part of the strategic dimension explained in more detail in Chapters 3 and 4 and in the Business Case Guidance (<https://www.gov.uk/government/publications/the-green-book-appraisal-and-evaluation-in-central-government>)). A lack of clear objectives negates effective appraisal, planning, monitoring and evaluation. Objectives must be SMART that is:
- Specific
- Measurable
- Achievable
- Realistic
- Time-limited

SMART objectives must be objectively observable and measurable, so that they are suitable for monitoring and evaluation (see Chapter 8).

The identification of “SMART” objectives is a crucial part of the rationale, whether they are for a strategic portfolio, or programme, or project. They summarise quantitatively the desired outcomes of the proposal. Taken together with the quantified BAU, the SMART objectives support a “GAP” analysis. This is used to identify the internal business changes that need to be made to move from the current BAU position to the desired outcome. The business changes required which this GAP analysis identifies are known as the core “Business Needs,” these needs must be met to achieve the core requirements of meeting the SMART objectives. At this early stage in appraisal it is expected that only indicative estimates of principle costs and benefits are available. As proposals are developed it is likely to be necessary to revise or refine early quantitative estimates and on occasion this may require resetting of quantitative objectives.

Up to 5 or 6 SMART objectives should be established. More than this and a proposed scheme is likely to lack focus and is more likely to fail or significantly exceed costs and under-deliver. The SMART objectives of portfolios and programmes are expressed as outcomes. Outcomes are the external consequences of changes in service outputs. Where projects are part of a programme, the project objectives are outputs required to enable delivery of the programme.

4.3 Important factors when considering the longlist

Constraints

Constraints are external considerations that set limits, within which a proposal must work, for example the law, ethics, social acceptability, timing, practicality and strategic fit with wider public policies and strategy. Constraints must be identified and understood at the earliest possible stage, and taken into account when considering the longlist.

Dependencies

Dependencies are external factors such as infrastructure that an option is reliant upon to be successful, but which are beyond its direct control. The successful delivery of the proposal’s objectives depends on them being present and functioning, for example a digital development proposal would be dependent on users having access to adequate internet connectivity and capacity.

Unmonetizable and Unquantifiable benefits

Where it is thought that there is a benefit to society in implementing a proposal including a feature, the benefit of which is not readily or credibly quantifiable or monetisable, it should be considered as follows: At the longlist stage when creating a shortlist, a version of the preferred way forward^[footnote 7] that includes provision of the feature with unmonetised benefits and an otherwise identical option without this provision should be produced. The costs and risks of each of these two options will naturally vary. Both should be taken forward to the shortlist stage so that in the final selection process the price of inclusion of the additional provision is revealed by comparison. The decision maker can then judge whether that additional cost is a price worth paying.

Collateral effects and unintended consequences

Collateral effects both positive and negative may result from an intervention and unintended consequences may occur as a result. These may affect particular groups in society or parts of the country. It is important to think about this when developing and appraising the longlist of options. This is especially true where proposed changes may create new opportunities, obligations or incentives. It is necessary to consider possible beneficial and adverse effects of changes in behaviour that may result from the intervention. The following paragraphs 4.15 to 4.18 are directly relevant to this consideration.

Appraising Targeted Place Based effects

Where objectives are targeted at geographically defined parts of UK, appraisal concerns the local effects produced by a flow of new and existing resources into the target areas. It is also concerned with the consequential effects on similar areas that may be adversely or favourably affected. This is, in contrast to UK policies where the effects on the UK as a whole are the subject of advice on alternative options. UK effects

remain of relevance to place based policies, as a check against serious negative consequences at a UK level. It is however, the effects on the target areas and the consequential effects on related places that may be affected, such as travel to work areas that are the main focus of advice. The point of this advice is to support the choice between the alternative options for delivering the place based policy objectives.

Appraising Collateral effects on Places and Groups within the UK

National policy objectives that may have significant favourable or adverse effects on parts of the UK, should also be appraised from the relevant place based perspective, as well as from that of the UK as a whole. Where either UK or place based policies are likely to have significant effects on groups in UK society that are specified by the Equality Act 2010, or on families under provisions of the Family test 2014, these also need to be appraised. This consideration supports advice to decision makers based on a wider view of the effects of alternative options than just reporting on a nationwide bottom line. The results of this appraisal must be made visible to decision makers – see Chapter 7.

Equality and Family Effects

Equality effects must be considered at the longlist stage and taken into account and where quantified also at the shortlist stage, as required by the Public Sector Equality Duty (PSED) (<https://www.equalityhumanrights.com/en/advice-and-guidance/public-sector-equality-duty>). This obligation was created under the Equality Act 2010 (<https://www.gov.uk/guidance/equality-act-2010-guidance>), it requires public sector bodies to “have due regard to advancing equality.” Consideration of equality issues must influence the decisions reached by public bodies. Decision makers should therefore be informed of the potential effects of intervention on groups or individuals with characteristics identified by the Act. The “Family test” (<https://www.gov.uk/government/publications/family-test-assessing-the-impact-of-policies-on-families/the-family-test>) introduced in October 2014 should also be considered where there may be significant effects on families and children. See Annex A.1 for more detailed information. This requirement for consideration also extends to long-list stage and throughout the appraisal process.

The Public Sector Equality Duty covers 9 protected characteristics as follows:

- age,
- disability,
- gender reassignment,
- pregnancy and maternity,
- race,
- religion or belief,
- sex and sexual orientation.

Income Distribution at the longlist stage

Significant income distribution effects, should be considered at the longlist stage, whether or not they are an objective of a policy, or are collateral consequence of implementing an unrelated policy. Distributional effects may apply to defined income groups, household types or types of business. At the longlist stage they may be a constraint on the feasibility of some options. Appraisal of distributional effects should be proportionate to the likely effects on those affected. Where the impact on those affected is marginal it may be sufficient to ensure that decision makers are made aware of the effect and its likely scale and possible options for avoidance or mitigation. Where it is a significant collateral effect of another policy a straightforward monetary analysis may be required. Where redistribution is a policy objective such as payments under the welfare system or if it is highly significant in terms of the impact on incomes and welfare of those affected then a weighted and equivalised income distribution analysis may be justified as set out in Annex A3.

Competition Effects and Market Imperfection

Market creation may be used to deliver some objectives. Appraisal of market creation or of changes to regulation, require an understanding of the current situation in terms of the current market or the barriers to market provision or functioning. Competition effects must also be considered, for example a proposed asset sale may require the existence of a healthy well-functioning market that is free from significant distortion. The effects of proposals on market functioning need to be thought through and the creation of unnecessary barriers to healthy markets should be avoided. Often it is necessary to introduce regulation to protect consumers and the economy from market imperfections and to support better market functioning. Where relevant these issues need to be explored at the preliminary research stage before embarking on developing the rationale as part of making the case for change. Supplementary guidance on competition issues can be found on the Competition and Markets Authority webpages (<https://www.gov.uk/government/publications/government-in-markets>). In more complex cases advice from specialist competition economists may be required.

Perfect markets, as many elementary economics textbooks note are a rarity. While some markets are closer to the perfect model than others the main value of the concept of market perfection lies in providing an abstract thinking tool used by economists to trial economic propositions under a range of market imperfections.

The Green Book is based upon the ideas of welfare economics and concerns the optimisation of social welfare. Much of its subject matter therefore concerns estimation of public, that is social, welfare values. These are values that economic markets are either unable to fully capture, or are unable to register at all. The various forms of shortfall in market welfare optimisation are characterised as “market failures.” Since the objectives of policy are set by ministers, not by officials, the main points that the Green Book needs to address concern well-functioning healthy markets and competition issues. The need to understand competition and market efficiency, arises when considering either;

- whether a public policy objective can be met by improving the social welfare efficiency of an existing market, or establishing a new market, or
- whether a proposed intervention may also result in distorting an existing market and so significantly damage welfare efficiency.

There is not always a hard and fast dividing line to identify the degree of welfare inefficiency in markets. Some decisions are informed by considerations of ethics or social preference as for example in provision of health and social care. Competition considerations are explained in more detail in the guidance published at this link on the web pages of the “Competition and Markets Authority (https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/284451/OFT1113.pdf)”.

Examples of some of causes of market failure include:

- Public goods: Many aspects of the environment can for example be described as public goods, for instance the benefits of clean air. When provided it is unavoidably available to all. It is non-excludable in supply and once provided, it matters little how many people enjoy it. It is therefore non-rivalrous in demand. These features make clean air impossible to supply on a commercial basis.
- Imperfect information: Well functioning markets require buyers and sellers to both have perfect information about what is on offer and about the other bargains being struck in the market, that is about quality and price. An imbalance in the information available known as information asymmetry confers an unfair advantage on the side that possesses it.
- Externalities: These occur when an activity imposes costs or produces benefits for economic agents not directly involved in the deal. For example, pollution not covered by regulation may be profitable for a perpetrator but impose real costs on others who are not directly involved in the market.
- Market power: This results from insufficient actual or potential competition where either sellers or buyers have an unfair advantage. It can arise from too few buyers or sellers, as occurs with monopoly and oligopoly among sellers or through collusion by sellers in anti-competitive behaviour. Problems can also arise from monopsony, i.e. where there is effectively only one dominant buyer. Barriers to market entry and exit can also cause a concentration of market power.

4.4 Longlist appraisal with Options Framework-Filter

The main steps in longlist appraisal are highlighted in Box 8 below. Use of the options framework-filter is required best practice for consideration of a longlist of possible options. The method disaggregates the design of viable options into its basic components, breaking down the choices to be made into a sequence of logical steps. This helps to avoid falling into the trap of making unconscious implicit and unconsidered assumptions. It does so by requiring the information and assumptions required at each step to be cited and explained. By their nature implicit assumptions are unconsidered and untested because they are implicit and virtually invisible. They are invariably the seeds of cost escalation, time delays, under delivery and often outright failure, because they have not been considered and tested.

The options framework-filter provides a structured process that supports a constructive engagement with stakeholders and experts, and it focusses on the choices needed to construct viable options. A workshop facilitated by an experienced accredited person is required to undertake the longlisting. The workshop or workshops bring together the knowledge and expertise of all of the professions involved in reviewing the longlist developing the shortlist, together with key stakeholders or their representative organisations. Ideally the senior responsible owner known as the SRO should also be present. As with all of this guidance this needs to be carried out in a way that is proportionate to the likely costs and risks involved to the public and the public sector. In some cases, it may be necessary to hold more than one such workshop and to take the review and shortlisting process in stages.

This process makes use of indicative cost and likely benefit estimates. While not accurate enough to define the final option, they should be good enough to support selection of a viable shortlist. An option that only meets the core “Business Needs” previously identified as the internal changes needed to meet the core requirement of achieving the SMART objectives, is known as the “Do Minimum” option. The do minimum does not take advantage of any opportunities for additional changes that may occur. It may or may not, be the option eventually chosen, but it is essential because it provides a second important benchmark that can reveal the real value of additional changes. Comparison with the “Do Minimum” option reveals whether options that take advantage of additional opportunities to make changes are worthwhile or not. If comparison with the “Do Minimum” reveals that they add more cost and risk than they add value, they are regarded as likely to be pointless “gold plating”. However, this may not be the case where there is a widely recognised benefit that is not readily or credibly quantifiable or monetisable. Paragraph 4.14 above on choices with unquantifiable and unmonetizable benefits explains this.

Box 8. Navigating the Appraisal Framework and the Longlist -

Rationale for intervention

- conduct the strategic assessment, research and understand the current position – Business As Usual
- establish rationale for intervention including the Evidence based Logical Change Process
- determine whether Place Based, Equalities, and/or Distributional Appraisal is required
- ensure Strategic Fit and identify SMART objectives (outcomes and outputs) for intervention

Longlist appraisal

- identify Constraints and Dependencies
- consider Place Based, Equalities, and/or Distributional objectives
- identify Critical Success Factors (CSFs)
- consider unquantifiable and unmonetisable factors
- consider a longlist of option choices with the Options Framework-Filter
- consider Place Based, Equalities, and Distributional effects
- using the Options Framework-Filter create a viable shortlist and preferred way forward

Shortlist appraisal

- select Social Cost Benefit Analysis or Social Cost Effectiveness Analysis
- identify and value costs and benefits of all shortlisted options
- estimate the financial cost to the public sector
- ensure all values in the economic dimension are in real base year prices with inflation removed
- qualitatively assess non-monetisable costs and benefits
- apply appropriate Optimism Bias
- maintain Risk and Benefits Registers
- assess Avoidable, Transferable and Retained Risk, build in additional Risk Costs and reduce Optimism Bias accordingly
- sum the values of costs and benefits in each year
- discount the yearly sums of costs and benefits in each year to produce Net Present Social Values (NPSVs)
- add the NPSVs over time to produce The Net Present Social Value (NPSV) of each option
- calculate BCRs if using CBA or Social Unit Costs if using CEA as appropriate

Identification of the preferred option

- identify preferred option considering NPSV, BCR, unmonetisable features risks and uncertainties
- conduct sensitivity analysis and calculate switching values, for each option

Monitoring and evaluation

- during implementation – inform implementation and operational management
- in the operational phase – inform both operational management and evaluate the outcome and lessons learned to improve future decisions.

“Critical Success Factors” (CSFs) are the attributes that any successful proposal must have, if it is to achieve successful delivery of its objectives. A table of five basic CSFs that apply to all proposals is given in Box 9. In some cases, one or at most two addition factors may be added, but if a proposal’s objectives, constraints and dependencies are correctly understood this is rarely the case, at most the number should not exceed seven.

Box 9. Critical Success Factors

Key Critical Success Factors	Description
Strategic fit and meets business needs	How well the option: - meets the agreed spending objectives, related business needs and service requirements - provides holistic fit and synergy with other strategies, programmes and projects
Potential Value for Money	How well the option: - optimises social value (social, economic and environmental), in terms of the potential costs, benefits and risks
Supplier capacity and capability	How well the option: - matches the ability of potential suppliers to deliver the required services - appeals to the supply side
Potential affordability	How well the option: - can be financed from available funds - aligns with sourcing constraints

Key Critical Success Factors	Description
Potential achievability	How well the option: - is likely to be delivered given an organisation's ability to respond to the changes required - matches the level of available skills required for successful delivery

4.5 Option choices and the options framework-filter

When used as set out here, and covered in more detail in the Treasury's family of supplementary guidance documents on development of Business Cases (<https://www.gov.uk/government/publications/the-green-book-appraisal-and-evaluation-in-central-government>), the Five Case Model employs structured facilitated workshops, using the options framework-filter. It can support a rapid and clear consideration of a wide range of options. These must be based on evidence from research and the inclusion of input from experts and stakeholders. The workshops enable selection of an optimum viable shortlist, capturing a clear rationale for the inclusion and exclusion of alternative option choices. It has been used widely in the UK and internationally, to efficiently and effectively support the development of policies, strategic portfolios, programmes and projects.

When constructing the longlist a predetermined or complete final option should be avoided. Instead the method will support the building of a number of alternative viable options by considering the logical sequence of option choices set out in Box 10. The identification of options for delivery and the identification of a viable shortlist is driven by the SMART objectives. Choices between options are viewed through the lens of the public service that the scheme is intended to deliver.

Box 10. Choices in the Strategic Options Framework-Filter

Option choices - broad description	
1 Scope	- coverage of the service to be delivered
2 Solution	- how this may be done
3 Delivery	- who is best placed to do this
4 Implementation	- when and in what form can it be implemented
5 Funding	- what this will cost and how it shall be paid for

These option choices are about:

- “Service Scope” – what is the coverage of the service to be delivered, defined by one or several parameters including geographic, demographic, quality, time limits and any other relevant factors.
- “Service Solution” – how the scoped outcomes preferred above can be delivered, considering available technologies and best practice. In addition to direct service provision by a new or existing public sector organisation, alternatives may also include outsourcing, insourcing, the creation of new markets, new or revised regulations, grants and subsidies, public information initiatives, or the use of so called “nudge techniques” based on insights from behavioural psychology and economics.
- Service Delivery – who in organisational terms is best placed to deliver the scope, and choices preferred above, for example:
 - Direct public sector provision

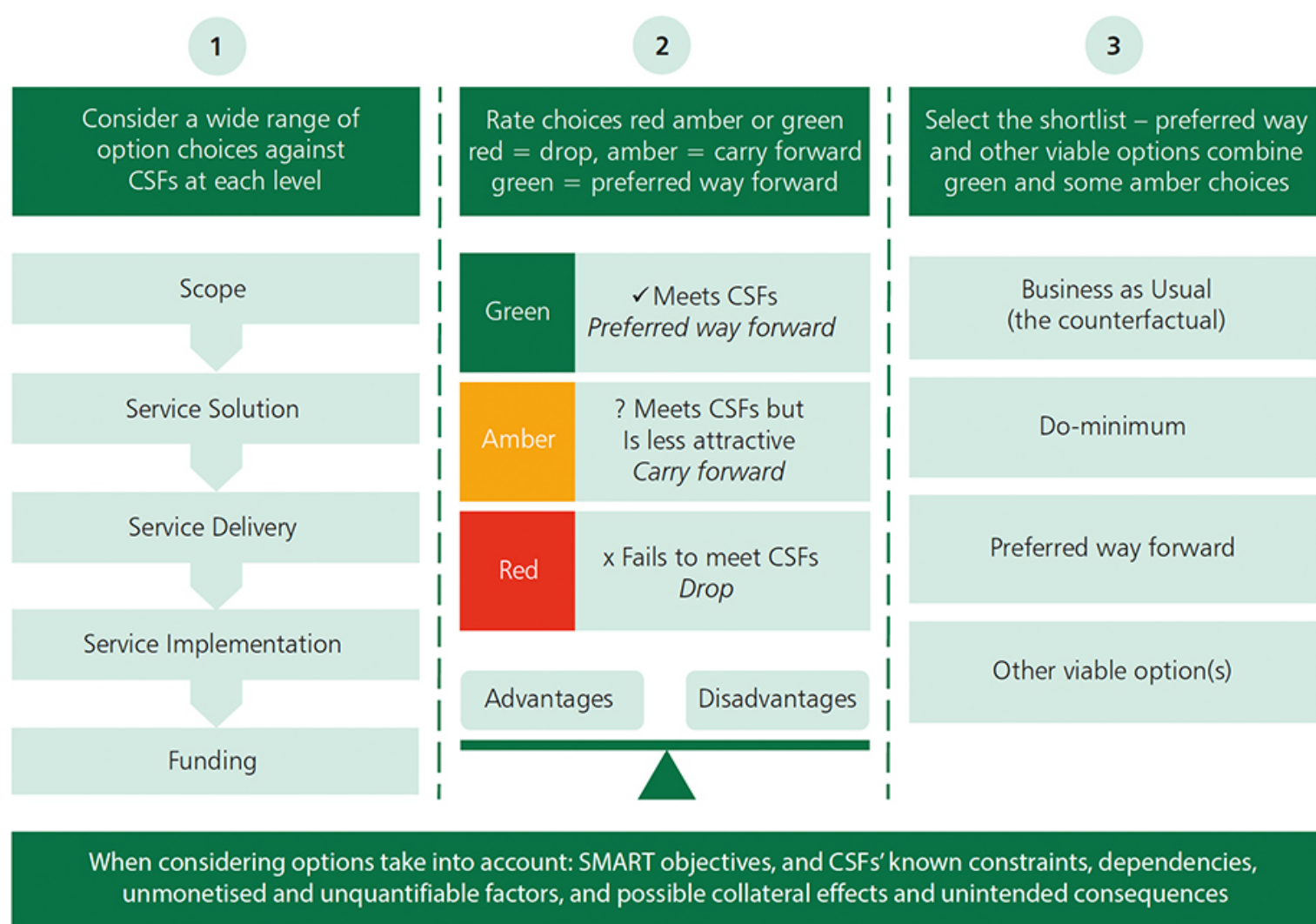
- Public Private Partnerships (PPP)
- Not-for-profit providers
- Private sector providers
- Service Implementation – how the proposal is to be delivered, for example will it be an initial pilot with provisions to learn “what works” and to adapt, a phased implementation or a ‘big bang’ approach? Or would a roll out dependent on geography, age, expiry of existing arrangements or other factors be more appropriate?
- Service Funding – an initial indicative cost estimate in light of the preferences for scope, solution, delivery and implementation, and how will it be funded.

The method supports the building of a number of alternative viable options, by considering the logical sequence of option choices set out in Box 10, by going through an iterative process explained below.

How SWOT analysis identifies options with the Options Framework-Filter

Consideration of the longlist and selection of the shortlist is an iterative process that is explained in the following paragraphs. The identification of options for delivery and the identification of a viable shortlist is driven by the SMART objectives. Choices between options are viewed through the lens of the public service that the scheme is intended to deliver. This avoids limiting option selection, that would be caused by considering only a predetermined solution that may run foul of the implicit assumptions problem outlined above. That approach is also likely to ignore potentially better alternatives by taking too narrow a view.

Figure 7. Overview of Longlisting with the Options Framework-Filter process



The way in which options are broken down into a series of choices is shown in Box 10. How these are appraised, and acceptable choices are built back up into full options is explained below. This is an iterative process and in the initial pass through the framework minima, maxima and a provisional preferred way forward are identified. Variations around the preferred way forward, which at this stage is not a preferred option, are

considered in the light of the choices made at the preceding levels of choice. The individual choices are considered sequentially by analysing the strengths, weaknesses, opportunities, and threats associated with each of the possible choices, (this is known as a SWOT analysis). This analysis will be based on the need for all, shortlisted options to meet the SMART objectives, and on how well each option choice meets the critical success factors identified in Box 9. Option choices that do not at least meet the “Do Minimum” requirement of meeting the core objectives fail to meet the SMART objectives, they must therefore be rejected at this stage. The reasoning must be recorded as set out below.

Consideration of the options choices takes place in a workshop setting, that brings together all of the public service professions involved with key stakeholders and experts. It should be facilitated by a competent independent facilitator accredited in the Treasury methodology. Longlist consideration begins with the choice of service scope. The maximum and minimum potential scope should be identified. The minimum must, by definition be the scope required to just meet the business needs, so it therefore meets the SMART objectives. The maximum may or may not be viable. Between these two extremes, examination in a workshop setting will generate valuable insights into viable possibilities. Several alternative option choices for scope between the maximum and minimum should be examined to test the effect on viability through considering the CSFs. Each choice should either be rejected or carried forward as possible. During this initial pass through the framework a favourite option choice for scope should be identified as the preferred way forward. This is not yet the preferred option because it may not be the final selection at shortlist stage, but at this early stage it is identified as “front runner”. The reason for rejecting, selecting, or carrying forward each choice must be recorded in a brief paragraph describing the advantages and disadvantages and the conclusion reached. Evidence, and assumptions and their sources must be cited. For summary purposes a colour coded matrix using red for reject, amber for possible, and green for the initially preferred option choices should be used. A hypothetical example is shown in Figure 8 below and the method is set out in more detail in the Business Case Guidance under options framework in Chapter 5 of both Project and the Programme guidance.

The next choice concerns the service solution choice which is about how the required changes will be realised. On this first iteration of the framework filter this choice is made assuming that the preferred scope identified above is used. As above the SWOT analysis based on SMART objectives and the CSFs is applied to consideration of service solution. The minimum required to meet the “Do Minimum” and so meet the “Business Needs” is identified. A sensible maximum which may not necessarily be viable is also identified to understand the range of possibilities. Rational points in between these two extremes are considered and the same procedure that was used for scope is followed. This uses the CSFs in a SWOT analysis to reject some and carry forward other possible choices and to identify a choice of preferred way forward. The reasoning together with evidence and citation of sources of evidence and assumptions is concisely recorded.

The next stage concerns service delivery choice, in light of the preferred way forward identified for scope and solution it considers the appropriate delivery agent, in other words who will deliver the required changes. It is not necessary to consider maximum and minimum levels of ambition for this choice but to look at the range of reasonable alternatives available. The same SWOT analysis method and criteria for selection are used and a preferred option together with other alternative options are identified. The reasons for decisions including rejection of possibilities must be recorded as described above.

Service implementation choice are the next set of choices to consider in relation to the preferred way forwards for scope, solution and delivery. This concerns the way that the service change will be delivered as explained above. For example is a, “big bang approach” desirable or possible, or would a phased roll out be more appropriate? Does uncertainty on key effects require the use of a piloting and a “phased learning development roll out process,” with adaptation and building on what works between each phase? Alternative option choices are considered through a SWOT analysis in the same way as earlier choices, and the decisions for each are clearly recorded.

Funding option choices are the final set of choices to be considered. In the same way as above the initial iteration of the framework filter process considers this option in the light of the preferred way forward chosen above. Note that because “funding” is considered at the end of the sequence, this does not mean that finance has been ignored up until now. On the contrary the use of the same critical success factors in the SWOT analysis when appraising every set of choices means that the five case model is used to consider possibilities in the round for every decision. Use of the CSF’s in the SWOT analysis is the means by which this holistic consideration is carried out.

Assembling the shortlist

The initial pass through the options framework rejects option choices that do not meet the SMART objectives, or which are judged unacceptable by a failure to satisfy the CSFs to a satisfactory degree. The reasons for rejecting, preferring or for carrying forward as a possibility must be recorded as part of the SWOT analysis, along with the evidence and assumptions on which decisions are based. The inside knowledge of stakeholders and experts is captured during this process. If well done, it should ensure that there are no untested implicit assumptions included in choices carried forward for further consideration. For each option choice there is a clear favourite which may, or may not, be the selected option after detailed analysis at the shortlist stage.

It is now possible, to assemble a rational viable set of shortlist options from among the possibilities identified at the first iteration, in addition to a quantified BAU for use as a benchmark counterfactual. This must include a:

- Do minimum option (that just meets the business needs required by the SMART objectives)
- Preferred Way Forward (that may or may not be the Do Minimum)
- A more ambitious preferred way forward (this may be more expensive, deliver more value, but at higher costs with increased risks)
- A less ambitious preferred way forward – unless the preferred option is a do minimum (this option may take longer, deliver less value but cost less and / or carry less risk)

Figure 8 contains a hypothetical example of an options summary matrix^[footnote 8] illustrating how the choices should be graphically summarised. Business as Usual is also shown on the left. The hypothetical example refers to a small imaginary developing country which is seeking assistance from international development bodies to support investment in a road improvement programme, as part of its wider economic and transport development strategy. There are four cities labelled A, B, C, and D the size and importance of which declines from A to D. Research at strategic level has indicated that improved road service improvements are vital for economic development. In this case the service level changes are represented by improved interconnections that the road developments provide.

The preferred option choices are shown by the green cells in the matrix. The red choices have been rejected because they do not deliver the SMART objectives, and other viable choices are carried forward and are represented by the amber choices. A do minimum option can be assembled using the minimum options carried forward or the green if no other option is available for that choice. This example illustrates how options that are more or less ambitious versions of the preferred way forward, are also possible, by substituting reasonable alternative option choices coded amber, for some of the preferred way forward choices coded green, to vary the costs benefits and risks involved.

Figure 8. The Options Framework-Filter summary matrix

Business As Usual (BAU)	Project	Do Minimum	Intermediate Option	Intermediate Option	Do Maximum
1.0 All Cities.	1.Service scope - as outlined in strategic case	1.1Linking Cities A and B.	1.2. Linking Cities A, B and C.	1.3 Linking Cities A, B, C and D.	1.4 Linking All Cities, A, B, C, D and E.
Carried forward		Carried forward	Preferred Way Forward	Carried forward	Discounted
2.0 Current services: for road maintenance etc.	2. Service Solution - in relation to the preferred scope	2.1 Core: Refurbish existing highways.	2.2 Core & Desirable: Combination of refurbish & new highways.	2.3 Core & Desirable: Completely new highways.	2.4 Core, Desirable and Optional: New highway & facilities.

Business As Usual (BAU)	Project	Do Minimum	Intermediate Option	Intermediate Option	Do Maximum
Carried forward		Carried forward	Preferred Way Forward	Carried forward	Discount
3.0 Current arrangements.	3. Service Delivery - in relation to preferred scope and solution	3.1 Local Contractor.	3.2 National Contractor.	3.3 International Contractor.	
Carried forward		Discount	Carried forward	Preferred Way Forward	
	4.Implementation - in relation to preferred scope, solution and method of service delivery	4.1 Phased over 3 years.	4.2 Phased over 2 years.	4.3 Big bang over 1 year.	
		Carried forward	Preferred Way Forward	Discount	
	5.Funding - in relation to preferred scope, solution, method of service delivery and implementation	5.1.Public funding.	5.2 Mixed public and private funding.	5.3 Private finance - service charge.	5.4 Private finance - toll.
		Discount	Preferred Way Forward	Discount	Discount

This summary matrix provides an overview, it is not a substitute for recording the decisions and the reasons /evidence used in the SWOT analysis. These must be recorded along with the indicative estimates of costs and benefits as explained above. Longlist appraisal must be based on evidence and rational assumptions with objective support. Simple weighting and scoring lacks an objective basis and detracts from transparency, it must not be substituted for this transparent evidence based analysis as part of the decision process.

In some cases complex technical trade-offs at the longlist stage, concerning choices of service scope and service solution, may be assisted by the use of expertly facilitated Multi-Criteria Decision Analysis making use of swing weighting, referred to here as MCDA. Swing weighting techniques objectively weigh the balance of informed expert and stakeholder opinion, in a high-level expert workshop. The inferior form of multi criteria analysis or MCA is not suitable for Green Book appraisal. It involves simple subjective weighting and scoring is not a recognised method due to its lack of transparency and objectivity. More guidance on swing weighted MCDA is given in Annex 1 and the referenced supplementary Green book guidance.

In this way an evidence based set of viable options can be developed that capture input from experts and stakeholders, which includes option choices that facilitate comparison of options with unquantifiable benefits as explained above. This shortlist can then provide a reasonable basis for social cost benefit or social cost effectiveness analysis at the shortlist stage. The shortlist is based on indicative estimates, it should be compared with the Business As Usual benchmark, and include; the preferred way forward (which appears most likely to deliver the SMART objectives), a viable do-minimum option (that meets minimum core business requirements to achieve the SMART objectives), and at least two alternative viable options that explore more and less ambitious and risky options than the preferred way forward.

5. Shortlist Options Appraisal

Chapter 5 sets out how to appraise shortlist options. It covers assessment of costs and benefits, the treatment of equalities, place based appraisal, distributional analysis and adjustments for discounting, inflation, risk and uncertainty (including optimism bias) and distributional analysis. The main steps are highlighted in Box 11 below.

Box 11. Navigating the Appraisal Framework and the Shortlist

Rationale for intervention

- conduct the strategic assessment, research and understand the current position – Business As Usual
- establish rationale for intervention including the Evidence based Logical Change Process
- determine whether Place Based, Equalities, and/or Distributional Appraisal is required
- ensure Strategic Fit and identify SMART objectives (outcomes and outputs) for intervention

Longlist appraisal

- identify Constraints and Dependencies
- consider Place Based, Equalities, and/or Distributional objectives
- identify Critical Success Factors (CSFs)
- consider unquantifiable and unmonetisable factors
- consider a longlist of option choices with the Options Framework-Filter
- consider Place Based, Equalities, and Distributional effects
- using the Options Framework-Filter create a viable shortlist and preferred way forward

Shortlist appraisal

- select Social Cost Benefit Analysis or Social Cost Effectiveness Analysis
- identify and value costs and benefits of all shortlisted options
- estimate the financial cost to the public sector
- ensure all values in the economic dimension are in real base year prices with inflation removed
- qualitatively assess non-monetisable costs and benefits
- apply appropriate Optimism Bias
- maintain Risk and Benefits Registers
- assess Avoidable, Transferable and Retained Risk, build in additional Risk Costs and reduce Optimism Bias accordingly
- sum the values of costs and benefits in each year
- discount the yearly sums of costs and benefits in each year to produce Net Present Social Values (NPSVs)
- add the NPSVs over time to produce The Net Present Social Value (NPSV) of each option
- calculate BCRs if using CBA or Social Unit Costs if using CEA as appropriate

Identification of the preferred option

- identify preferred option considering NPSV, BCR, unmonetisable features risks and uncertainties
- conduct sensitivity analysis and calculate switching values, for each option

Monitoring and evaluation

- during implementation – inform implementation and operational management
- in the operational phase – inform both operational management and evaluate the outcome and lessons learned to improve future decisions.

5.1 Social Cost Benefit and Cost Effectiveness Analysis

Social Cost Benefit Analysis (CBA) assesses the impact of different options on social welfare. All relevant costs and benefits are valued in monetary terms, unless it is not proportionate or possible to do so.^[footnote 9] Social CBA is the recommended approach for detailed comparison of the shortlist of options. Social Cost-Effectiveness Analysis (CEA) is a variant of Social CBA which compares the costs of alternative ways of producing the same or similar outputs. Social CEA may sometimes be appropriate where:

- wider social costs or benefits will remain broadly unchanged or for the delivery of a public good, such as defence
- output may not be proportionately quantified

Where wider social outcomes are not affected by the decision being appraised, Social CBA and Social CEA are in effect equivalent. The assumption that there will be no change in output or welfare needs to be objectively validated before choosing the appropriate technique.

Social CBA and Social CEA techniques are “marginal analysis” principally employed to consider changes between alternative options, and compare alternative options based on a static model of the world. Significant non-marginal issues involving fundamental changes in the relationships on which models, estimates, and forecasts are based must be analysed during the research phase in advance of the longlist stage. They are taken into account there, as is consideration of whether place based appraisal, or consideration of equalities or income distribution effects is required. The outcome of that analysis is fed into shortlist selection. At shortlist stage it may therefore be necessary to undertake appraisal from several perspectives in order to produce balanced advice.

5.2 Social costs and benefits

Identification and valuation of relevant costs and benefits is at the heart of economic appraisal. The principles outlined here are complemented by in-depth discussion of valuation techniques in Chapter 6 and Annex 1.

Scope of costs and benefits

When considering proposals from a UK perspective the relevant values are viewed from the perspective of UK society as a whole. Where appraising a place based policy or a UK wide proposal with place based effects the relevant values include effects in the place of interest and similar nearby travel to work areas. The relevant costs and benefits which may arise from an intervention should be valued and included in Social CBA unless it is not proportionate to do so. The priority costs and benefits to quantify are those likely to be decisive in determining the differences between alternative options. The appraisal of social value involves the calculation of Net Present Social Value (NPSV) and Benefits Cost Ratios (BCRs) the ratio of benefits to costs.

UK society generally includes UK residents and not potential residents or visitors. It is sometimes reasonable to include the costs and benefits for people living outside the UK e.g. service personnel posted overseas. Appraisal of Official Development Assistance (ODA) should include the costs and benefits to the recipient countries. The financial cost of ODA should be assessed in the same way as other public spending.

Appraisal of individual spending decisions is largely undertaken in the context of pre-determined budgets. Decisions concerning the overall level of public spending are macro-level decisions made separately from, and in advance of, individual spending decisions. The cost of raising public funds e.g. the cost of issuing debt or the impact of taxes, is therefore not considered in shortlist appraisal.

A categorisation of potential costs and benefits that may be part of appraising social value is given in Box 12. Not all appraisals involve every category.

Costs in the appraisal of social value

- total direct public costs (to originating organisation):
 - capital
 - revenue
- total indirect public costs (to other public sector organisations):
 - capital
 - revenue
- wider costs to UK society:
 - monetisable including cash costs
 - quantifiable but unmonetisable costs
 - qualitative unquantifiable costs
- total risk costs (the costs of mitigating or managing risks):
 - optimism bias (decreased as estimated risk costs are included)
 - estimated or measured risk cost

Benefits in the appraisal of social value

- direct public sector benefits (to originating organisation):
 - cash releasing benefits
 - monetisable non cash releasing benefits
 - quantifiable but not monetisable benefits
 - qualitative unquantifiable benefits
- indirect public sector benefits (to other public sector organisations):
 - cash releasing benefits
 - monetisable but non cash releasing benefits
 - quantifiable but unmonetisable benefits
 - qualitative unquantifiable benefits
- wider benefits to UK society (e.g. households, individuals, businesses):
 - monetisable including cash benefits
 - quantifiable but not monetisable benefits
 - qualitative unquantifiable costs and benefits

5.3 Adjustments for inflation

Costs and benefits in appraisal of social value should be estimated in ‘real’ base year prices (i.e. the first year of the proposal). This means the effects of general inflation should be removed. The effects of converting values from nominal to real terms are shown in Table 1 using a GDP deflator of 2%.

The following should be used to adjust prices from nominal to real terms:

- for short time horizons, whole economy inflation (the “GDP deflator”) from the most recent forecasts by the Office for Budget Responsibility (OBR)
- for long time horizons, forecasts of the GDP deflator published in the OBR Fiscal Sustainability Report (<http://budgetresponsibility.org.uk/fsr/fiscal-sustainability-report-january-2017/>) (FSR)

- for longer time horizons, beyond the end of the OBR’s FSR, the GDP deflator should be extrapolated using the growth rate in the final year of the OBR’s projection

Table 1. Adjusting for the Effects of Inflation (Using a 2% Gdp Deflator)

Year	0	1	2	3	4	5
Nominal terms	£1,000	£1,000	£1,000	£1,000	£1,000	£1,000
Real terms (year 0 prices)	£1,000	£980	£961	£942	£924	£906

For some goods or services there may be a relative price effect i.e. the movement of a specific price index (e.g. construction) may differ significantly from the general inflation (such as the GDP deflator). Where there is historical evidence and an expectation this will continue in the future, different rates of inflation can be used to reflect the relative difference. For example, Information Technology has become relatively less expensive over time and land used for development relatively more expensive. How prices change in relation to real incomes will affect this. Similarly, if supply is limited the price of the good may increase relative to inflation.

Time horizon

Costs and benefits should be calculated over the lifetime of an intervention. As a guideline, a time horizon of 10 years is a suitable working assumption for many interventions. In some cases up to 60 years may be suitable, for example for buildings and infrastructure. In all cases, the maintenance and renewal costs associated with the servicing of these assets should be included. An asset’s residual value or liability at the end of the appraisal period should also be included.

A longer appraisal period may be suitable where intervention is likely to have significant social costs or benefits beyond 60 years. This should be agreed with the approving authority. Possible examples include immunisation programmes, the safe treatment and storage of nuclear waste or interventions that reduce climate change risks.

Estimating costs

The costs of using assets and resources are defined by the value which reflects the best alternative use a good or service could be put to – its opportunity cost. Market prices are usually the starting point for estimating opportunity costs. Where market prices are not suitable or available non-market valuation techniques can be used.

Sunk costs refer to expenditure or payments already incurred and should be excluded from the appraisal of social value. What matters are costs and benefits affected by decisions still to be made. The costs of continuing to use resources that are already paid for (e.g. assets or buildings) are relevant and should be included as opportunity costs.

Private sector costs (including capital and revenue for spending proposals) should be valued on an opportunity cost basis and included in the appraisal. This is particularly important for regulatory options where the costs of regulation would fall largely on private companies.^[footnote 10] Relevant prices and costs for public and private sector options should be done on a comparable basis.

Cost and benefit estimation will normally involve input from accountants, economists or other specialists. Consultation with stakeholders, particularly those who will potentially incur costs, is an important part of this.

Distinguishing between fixed, variable and other costs can be helpful to aid sensitivity analysis (see Box 13). A step change in the cost of one input factor may not apply to others. Costs and cost drivers need to be fully understood and each cost requires its own relevant set of governing assumptions.

Box 13. Definitions of Costs

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Costs can be defined as:

- fixed costs or overheads remain constant over wide ranges of activity for a specified time period (e.g. a building)
- variable costs vary according to the volume of activity (e.g. external training costs vary with the number of trainees)
- semi-variable costs include both a fixed and variable component (e.g. maintenance where there is usually a planned programme and a responsive regime such as call-outs, where costs vary with activity)
- semi-fixed, or step costs, are fixed for a given level of activity and eventually increase at a critical point (e.g. after telephone call volumes reach a certain level, a new call centre may be required)

Other ways of categorising costs may be relevant to support full consideration of opportunity costs and sensitivity analysis:

- capital and resource costs should be accounted for separately, and built up from their fixed, variable, semi-variable and stepped elements
- direct values relate to the originating public sector organisation, while indirect values fall to the wider public sector

Public sector financial cost

Public sector financial costs are the estimated resource and capital costs for a spending proposal over its expected lifetime. They include all costs and receipts to the public sector but do not include wider social costs. As set out in the HM Treasury Business Case Guidance (<https://www.gov.uk/government/publications/the-green-book-appraisal-and-evaluation-in-central-government>), public sector costs and benefits appear differently in economic and financial cases. In economic analysis they are recorded in real terms whereas in financial analysis they are recorded in current, nominal terms (on the same basis as organisational budgets) and adhere to different accounting rules. Discounting is applied in the economic dimension of the business case, but not to numbers in the financial dimension of the business case.

Public sector financial costs should be calculated using the international National Accounts statistical framework produced for the UK by the Office of National Statistics. Public sector financial costs are recorded on an accruals basis consistent with departmental budgets, as per the Consolidated Budgeting Guidance. (<http://www.gov.uk/government/collections/consolidated-budgeting-guidance>) These distinctions apply to any intervention with financial impacts on the public sector.

For new public spending proposals the financial dimension of a business case would usually require 3 major financial statements, which are the source of public sector financial costs when calculating NPSV:

- a budget statement based on accounting principles as per the Consolidated Budgeting Guidance. (<https://www.gov.uk/government/collections/consolidated-budgeting-guidance>) This shows the resource and capital costs over the lifetime of the proposal. For strategic initiatives, the budget will often include forecast financial statements of a whole organisation over a number of years.
- a cashflow statement showing the costs that will be spent on the preferred option if it goes ahead.
- a funding statement showing the sources of funds and other resources required i.e. which internal departments, partners and external organisations would provide the resources and funding required.

Contingency is an allowance made for the cost of residual known risks in case they occur. These are risks that cannot be avoided, shared or managed; they are added to residual optimism bias (OB), which is what remains of OB after the risk costs that can be avoided, shared or otherwise managed have been deducted. This remaining OB is an allowance for uncertainty which by its nature is unknown (see Uncertainty, Risk and Optimism Bias, paragraphs 5.41 to 5.52 below). In the financial case this residual sum is converted into real

prices and is used to estimate the contribution to the reserves required to allow the approving authority to provide for its risk liabilities. This is required because government is effectively self-insured. This contingency sum should not therefore be allocated to the programme or project.

Monitoring of costs and benefits during and after implementation is necessary for management, control and transparent accountability. Longer running programmes and larger projects over several years should maintain regular monitoring against and updates of original projections. This is vital to managing the delivery of social value through benefit realisation and cost control, providing information that supports the design of future interventions.

Public sector organisations responsible for public expenditure need to undertake cost monitoring, cost modelling and risk monitoring. Forecasting error and associated risks can be reduced by maintaining active cost monitoring systems and improving unit cost estimates by employing cost modelling techniques.

Estimating benefits

Estimating benefits means they can be compared with costs and net benefit can be calculated i.e. benefits once costs have been taken into account or netted off.

Real or estimated market prices provide a first point of reference for estimating the value of benefits. As with cost estimation, where no market price or market exists non-market valuation techniques should be used.

Expected benefits of an intervention and how these will be measured and realised should be set out in a benefits register. This is a key strand of implementation, operational management and a key part of the management dimension of a business case. A benefits register can be used to support the assurance of benefits realisation (<https://www.gov.uk/government/publications/assurance-of-benefits-realisation-in-major-projects>) as a project or programme is implemented. Box 14 below provides a template for the benefits register.

Box 14. Benefits Register Template

Benefit number	Unique within the register
Benefit category & class	Categories e.g. public sector benefits (direct/indirect), wider social benefits. Classes such as: cash/non cash releasing, quantitative/qualitative etc. (see Box 7)
Description	Including enabling programme, project or activity
Service feature	What aspect of the proposal will give rise to the benefit - to facilitate monitoring
Potential costs	Incurred during delivery
Activities required	To secure benefit
Responsible officer	Senior responsible officer for project or programme
Performance measure	Key performance indicators (KPIs) and relationship to SMART objectives

Benefit number	Unique within the register
Target improvement	Expected level of change
Full-year value	Value of benefits (£m)
Timescale	Number of years

Unquantified costs and benefits

It may be disproportionate to quantify some costs and benefits or there may be insufficient evidence to provide reliable estimates. Where this is the case, these effects should be clearly described and visible as part of the results of the appraisal (see Chapter 7 and Annex 2).

5.4 Discounting and Social Time Preference

Discounting is a technique used to compare costs and benefits occurring over different periods of time on a consistent basis. Discounting should be applied to all future costs and benefits. Discounting in appraisal of social value is based on the concept of time preference – that generally people prefer to receive goods and services now rather than later.

For individuals, time preference can be measured by the real interest rate on money lent or borrowed. Amongst other investments, people invest at fixed, low risk rates, hoping to receive more in the future to compensate for the deferral of consumption now. These real rates of return give some indication of their individual pure time preference rate. Society as a whole, also prefers to receive goods and services sooner rather than later. This is known as ‘social time preference’. The discount rate used in the Green Book is known as the ‘social time preference rate’ (STPR). It is the rate at which society values the present compared to the future.

The STPR has two components:^[footnote 11]

- ‘time preference’ – the rate at which consumption and public spending are discounted over time, assuming no change in per capita consumption. This captures the preference for value now rather than later.
- ‘wealth effect’ – this reflects expected growth in per capita consumption over time, where future consumption will be higher relative to current consumption and is expected to have a lower utility.

The STPR used in the Green Book is set at 3.5% in real terms, with exception for risk to life values which use a lower rate of 1.5%. The derivation of the discount rate can be found in Annex 6. Table 2 shows the present value of £1,000 declines in future years with a discount rate of 3.5%.

Table 2. Present Values and Discount Rate

Year	0	1	2	3	4	5	6	7	8	9	10
Value	£1,000	£966	£934	£902	£871	£842	£814	£786	£759	£734	£709

The main role of discounting is to put interventions with different time spans and benefit cost profiles on to a common “present value” basis. In the longer term (over 30 years), the STPR declines in a series of steps to allow for future uncertainty in the value of its constituent parts, as explained in Annex 6. The approach to discounting where there are inter-generational wealth transfers is also described in Annex 6. The accompanying

tables in Annex 6 and associated tables on the Green Book web pages (<https://www.gov.uk/government/publications/the-green-book-appraisal-and-evaluation-in-central-government>) show both the discount rate and discount factors that can be used to calculate a present value.

Discounting is solely concerned with adjusting for social time preference and is separate from adjusting for inflation. The recommended Green Book discount rate applies to real values, with the effects of general inflation already removed. To promote transparency the best practice approach is to first convert costs or benefits to a real price basis, and then perform the discounting adjustment. The inflation rate and discount rate should not be added and applied to costs and benefits.^[footnote 12]

In appraisal, discounting should never be applied retrospectively to costs and benefits that have already occurred. Values do not increase simply because activities took place in the past (although of course the value of some assets may tend to increase over time). Discounting and the calculation of NPSV are illustrated further in Box 15.

Costs to government of raising funds (either through taxation or borrowing) are not a decision variable because the planned level of public spending is decided in advance when the budget is decided. It is at this macroeconomic stage that borrowing costs are considered. The decisions that are the concern of the Green Book are about the allocation of the given funds to meet government objectives in way that optimises social (that is public) value for money. The STPR is therefore not linked to the costs of raising funds (either through taxes or borrowing).

Box 15. Npsv and Discounting Worked Example

Alternative options, A and B, are both expected to improve the quality of a department's work and reduce staff costs.

Option A requires £10 million in initial capital expenditure to realise benefits of £2.5 million per annum for the following four years (£2 million in reduced staff costs and £0.5 million in quality improvements).

Option B requires £5 million in initial capital expenditure to realise benefits of £1.5 million per annum for the following four years (£1 million reduced staff costs and £0.5 million in quality improvements).

Year	0	1	2	3	4
Option A (£m)					
Costs	-10.00	0	0	0	0
Benefits	0	2.50	2.50	2.50	2.50
Net Benefit	-10.00	2.50	2.50	2.50	2.50
Discounted net benefits	-10.00	2.42	2.33	2.25	2.18
Net Present Social Value -0.82					
Option B (£m)					
Costs	-5.00	0	0	0	0
Benefits	0	1.50	1.50	1.50	1.50
Net Benefit	-5.00	1.50	1.50	1.50	1.50

Year	0	1	2	3	4
Discounted net benefits	-5.00	1.45	1.40	1.35	1.31
Net Present Social Value 0.51					
Discount factor	1	0.9662	0.9335	0.9019	0.8714

Option B has positive NPSV of £0.51m compared to -£0.82m for Option A.

5.5 Unintended consequences

Appraisal of the shortlist should consider any likely beneficial or adverse collateral effects and unintended consequences. This may include:

- effects on particular groups in society
- possible changes in behaviour as a result of an intervention
- claims made for efficiency gains from payment-by-results, performance targets or bonus systems, which should be supported by robust evidence ideally from a similar setting, rather than simple assumptions.
- the potential for gaming and unexpected results

5.6 Uncertainty, risk, optimism bias

There is a wide range of uncertainty that affects interventions, but in appraisal it is often due to lack of evidence or understanding of the likely impact of new interventions. Research and evidence from evaluations of previous interventions, pilot studies and experience of “what works” can help to reduce this uncertainty. The following paragraphs set out a range of techniques for dealing with uncertainty in appraisal.

As used in the Green Book, risk and optimism bias are closely linked but distinct concepts, for more detail on methods see Annex 5.

Optimism bias

Optimism bias is the demonstrated systematic tendency for appraisers to be over-optimistic about key project parameters, including capital costs, operating costs, project duration and benefits delivery. Over-optimistic estimates can lock in undeliverable targets.

To reduce this tendency appraisals should make explicit adjustment for optimism bias. The Green Book recommends applying overall percentage adjustments at the outset of an appraisal. The initial optimism bias estimate should not be “locked in” but can be reduced as an appraisal develops and the cost of specific risks are identified.

Ideally adjustments should be based on an organisation’s own evidence base for historic levels of optimism bias. In the absence of robust organisation-specific estimates generic values are provided in Annex 5. There are currently no generic values available to be applied to benefits, however an adjustment should be applied based on an organisation’s own evidence base.^[footnote 13]

Optimism bias is a form of reference class forecasting which predicts future outcomes based on the outcomes for a group of similar past projects. It is important to note that adjustments for optimism bias are not the same as financial contingency (a concept explained above).

Risk

Risk management is defined as a structured approach to managing risks that are identified and assessed when designing an intervention or that materialise later in its lifecycle.

The public sector's risk exposure arises as a consequence of public policy decisions. Public sector organisations responsible for an intervention cannot opt out of certain risks and achieve risk reduction through 'cherry picking' (as insurance companies may choose to do when refusing cover). The option of managing a balanced risk portfolio is also not usually available (as investment funds may do).

To optimise social value, risk must consciously and proportionately be managed. Good risk-management practice in appraisal, monitoring and evaluation involves:

- identifying possible risks in advance and putting mechanisms in place to minimise the likelihood they materialise with adverse effects. The appraisal should include an assessment of how specific risks may be avoided, minimised or managed.
- including the costs of risk avoidance, transfer and mitigation. A risk register should be created during the development of an intervention (see Annex 5) and maintained through implementation. It should be owned by those responsible for operational delivery.
- considering how and by whom key risks might be managed. This is this an important part of assessing the longlist and provides important inputs into the design of a procurement process, risk allocation and risk sharing in commercial contractual arrangements. If a procurement process is involved this should be re-examined as a proposal develops, including when contract bids are assessed.
- ensuring risk is borne by the organisation that is best placed to monitor and manage it, and that this responsibility is clearly agreed with appropriate controls to mitigate adverse consequences if risks materialise.
- monitoring of risk and optimism bias which should be undertaken by all public bodies as part of their monitoring and evaluation processes.
- having decision making processes supported by a framework of risk analysis and evaluation, ensuring they are underpinned by good oversight and accountability.

As the shortlist appraisal is developed, risks and risk costs should be identified and the optimism bias allowance included at the outset of the appraisal should be reduced in accordance with the Green Book guidance (see Annex 5). Box 16 shows an example of applying optimism bias.

Risk costs are the costs incurred if a risks materialises, they are calculated on an expected value basis. Expected values result from multiplying the expected cost if it occurs by the expected likelihood of it materialising. This requires objectively based estimates of the percentage likelihood of a risk occurring. Low probability high impact risks should be noted in the risk register to make the decision maker aware. Effective risk costing will be supported if organisations put in place well designed risk assessment processes supported by effective routine data recording.

Risks with low probability but high impact need to be considered seriously by policy makers. In addition to ensuring these risks are part of the risk register, Senior Responsible Owners (SROs) must ensure that the proposal realistically and efficiently manages risk down, placing it where it can be effectively managed, both before and during implementation. Real options analysis (see Annex 5 for a worked example) provides a technique to explore whether additional flexibility can be added in the project design phase and utilised later when further information becomes available. It is particularly useful for projects that exhibit significant uncertainty or are difficult to reverse following initial investment (eg. where future climate change impacts are uncertain).

Box 16. Optimism Bias Case Study

The capital costs of a non-standard civil engineering project within a major change programme are estimated to be £50 million on a present value basis. No detailed risk analysis work has taken place at this stage, although significant costing work has been undertaken.

The project team applies an optimism bias adjustment of 66% showing that, for the scope of the work required, the total cost may increase to £83m. This adjustment was based on evidence and experience from comparable civil engineering projects at a similar stage in the appraisal process.

As the project progresses, more accurate costs and quantified risks are identified. The adjustment for optimism bias can then be reduced to reflect this. When reduced, there will only be a general contingency left for unspecified risks.

Without applying optimism bias adjustments, a false expectation would have been created that a larger project could be delivered at a lower cost.

5.7 Preferred option selection

Preferred option selection starts from a comparison of the alternative options in the shortlist relative to Business As Usual (BAU). The shortlist should include at least BAU, the preferred way forward, a do-minimum option and at least one other viable alternative.

Box 17. Navigating the Appraisal Framework the Option Selection and VfM

Rationale for intervention

- conduct the strategic assessment, research and understand the current position – Business As Usual
- establish rationale for intervention including the Evidence based Logical Change Process
- determine whether Place Based, Equalities, and/or Distributional Appraisal is required
- ensure Strategic Fit and identify SMART objectives (outcomes and outputs) for intervention

Longlist appraisal

- identify Constraints and Dependencies
- consider Place Based, Equalities, and/or Distributional objectives
- identify Critical Success Factors (CSFs)
- consider unquantifiable and unmonetisable factors
- consider a longlist of option choices with the Options Framework-Filter
- consider Place Based, Equalities, and Distributional effects
- using the Options Framework-Filter create a viable shortlist and preferred way forward

Shortlist appraisal

- select Social Cost Benefit Analysis or Social Cost Effectiveness Analysis
- identify and value costs and benefits of all shortlisted options
- estimate the financial cost to the public sector
- ensure all values in the economic dimension are in real base year prices with inflation removed
- qualitatively assess non-monetisable costs and benefits
- apply appropriate Optimism Bias
- maintain Risk and Benefits Registers
- assess Avoidable, Transferable and Retained Risk, build in additional Risk Costs and reduce Optimism Bias accordingly
- sum the values of costs and benefits in each year

- discount the yearly sums of costs and benefits in each year to produce Net Present Social Values (NPSVs)
- add the NPSVs over time to produce The Net Present Social Value (NPSV) of each option
- calculate BCRs if using CBA or Social Unit Costs if using CEA as appropriate

Identification of the preferred option

- identify preferred option considering NPSV, BCR, unmonetisable features risks and uncertainties
- conduct sensitivity analysis and calculate switching values, for each option

Monitoring and evaluation

- during implementation – inform implementation and operational management
- in the operational phase – inform both operational management and evaluate the outcome and lessons learned to improve future decisions.

Summary measures of social welfare

A variety of measures can be used to summarise Social CBA. Estimates of Net Present Social Value (NPSV) and Benefit Cost Ratios (BCR) are commonly used:

- NPSV is defined as the present value of benefits less the present value of costs. It provides a measure of the overall impact of an option.
- BCR is defined as the ratio of the present value of benefits to the present value of costs. It provides a measure of the benefits relative to costs.

When calculating the NPSV or BCR:

- future costs and benefits should be adjusted for inflation to ‘real’ base year prices. The base year should be the first year of the proposal.
- future costs and benefits should be discounted by the Social Time Preference Rate (STPR) to provide the present value.

The most appropriate summary measures and their construction will depend on the context in which the decision is being made:

- Where optimising over a constrained budget, as is usually the case for government spending, the BCR can be constructed as a measure of social value divided by the relevant public spending constraint (e.g. NPSV/£ or the Present Value of Benefits/£). This assesses the benefits bought per £ of public spending. It can be used to allocate across a portfolio of spending to maximise Value for Money.^[footnote 14]
- For Regulatory Impact Assessments, where the constraint is based on cost targets for business regulation, an indicator of the cost to business (or deregulatory benefits) of options will be relevant.
- Where departments or types of spend with a constrained budget operate on thresholds, the relevant measures may be framed accordingly. For example ‘cost per QALY measure’ is commonly used in the health sector to assess Value for Money with a pre-defined threshold that should be met to be considered Value for Money.
- When comparing a range of options a consistent formulation should be used to calculate the BCR of all options. Ideally organisations should use a consistent approach to formulating BCRs for similar types of decision and across time.

Where non-monetised costs or benefits are significant summary measures alone will not capture the full impact of an option. Similarly, a single measure may fail to adequately reflect the full range of potential costs and benefits to society if there are significant risks attached to an option that have proved challenging to quantify. It may be unrealistic to produce a single number that adequately captures the full impact of an option.

Appraisal is iterative and involves checks and reworking of steps in the analysis and planning stages of an intervention. If additional evidence is identified at a late stage it may be necessary to reconsider:

- the selection of the shortlist, repeating Social CBA and Social CEA
- the preferred way forward (i.e. the option identified at the longlist stage which is most likely to deliver SMART objectives)
- the choice of preferred option (the chosen option at the shortlist stage)

Box 18. A Definition of Value for Money

Value for Money as mentioned in chapters 2, 3, 4, 6 and 8 is a judgment about the optional use of public resources to achieve stated objectives embodied in the SMART objectives of a proposal (be it a policy, a portfolio, a programme, or a project), based on consideration of the following factors:

- Performance against SMART objectives. Each shortlisted option must achieve the SMART objectives, options which do not deliver against SMART objectives cannot be included in a shortlist, or represent value for money for the proposal being considered
- Net present value to society of all social, economic and environmental benefits – these may be qualitative or quantitative
- Net present public resource costs as measured by whole life costs, including capital and operating costs and the opportunity cost of existing assets employed
- Risk costs associated with managing and mitigating risks that are associated with a proposed option

For each shortlisted option a quantified net present social value and the relevant cost to the public sector are estimated as set out in chapters 4, 5 and 6 and combined in a benefit cost ratio (BCR) to support an initial first ranking of options or proposals based on quantifiable factors. As set out above all shortlisted options must meet the SMART objectives to be considering public/social value for money. Additional features with benefits which are not readily or credibly quantifiable or monetisable, but which are considered decisively important enough to be taken into account must be dealt with at the longlisting stage as follows:

- If they are regarded as essential to provision of the objectives', then they are a constraint and they must be incorporated into all of the options.
- If they are regarded as desirable but not essential, then two versions of the option with the most favourable BCR should be prepared, one with and one without the inclusion of the features concerned. The resulting disparity in costs will enable decision makers to consider if the increase in cost associated with the inclusion of this desirable feature is a price worth paying in terms of public value for money.

Residual hard to quantify risk and uncertainty where it is likely to be significant should also be considered as part of the value for money judgment.

Proposals that are part of a larger programme need to be understood and appraised for public value and value for money in the light of their role in the overarching programme. If such an enabling or supporting proposal has high levels of risk and uncertainty the issue must be referred upwards to the overarching programme for assessment. This may result in the need to consider the effects of delay on the programme or a reassessment of the projects initial SMART objectives and specification.

5.8 Sensitivity analysis

Sensitivity analysis explores the sensitivity of the expected outcomes of an intervention to potential variations in key input variables. It can demonstrate, for example, the changes in key assumptions required to change the preferred option on an NPSV or BCR basis or to turn the NPSV of an option positive.

A switching value refers to the value a key input variable would need to take for a proposed intervention to switch from a recommended option to another option or for a proposal not to receive funding approval (see Box 19 for a worked example).

At a minimum sensitivity analysis and the identification of switching values should be carried out on the preferred option from the shortlist appraisal. These results must form part of the presentation of results. If the costs and benefits of the preferred option are highly sensitive to certain values or input variables, sensitivity analysis will probably be required for other options in the shortlist.

Box 19. Switching Values – Worked Example

Officials are appraising the remediation (treatment) of a 39 acre contaminated land site, to be funded by a public sector grant. The remediation of the land would enable new businesses to move close to an existing cluster of businesses in a highly productive sector. The benefits of the intervention can be estimated by the change in the land value of the site (land value uplift). There is data on the current value and likely value of the land post remediation. For simplicity, it is assumed all values are already appropriately discounted.

Variable	Value
Site area	39 acre
Existing use land value estimate	£30,659 per acre
Future use land value estimate	£200,000 per acre
Land value uplift per acre	£169,341 per acre
Total land value uplift	£6.6m
Wider social benefits	£1.4m
Present Value Benefits (PVB) - including land uplift, health and environmental effects)	£8m
Present Value Cost (PVC)	£10m
Benefit Cost Ratio (BCR = PVB / PVC)	0.8
Net Present Social Value (NPSV)	-£2m

The total benefits are £8m when wider social benefits are added to the increase in land value as a result of the remediation. The costs of the remediation exceed the benefits so the BCR is less than 1 and the NPSV is negative. The switching value to turn the NPSV positive, so benefits outweigh costs, would be an approximate future land use value of £251,000 per acre equal to a land value uplift of approximately £221,000 per acre.

Source: Ministry of Housing, Communities and Local Government

Scenario analysis is a form of ‘what if’ analysis that is useful where there are significant future uncertainties. Scenarios may be chosen to explore significant technical, economic and political uncertainties which will affect the success of an intervention. Scenario analysis must always be proportionate to the costs and risks involved.

Low cost, low risk proposals may look at simple ‘what if’ questions. Major policies and more expensive, higher risk options may require modelling exercises which test the impact of different states of the world on expected costs and benefits.

Monte Carlo analysis is a simulation-based risk modelling technique that can be used when there are a number of variables with significant uncertainty. Further explanation can be found in Annex 5.

Decision trees and real options analysis are alternative approaches to dealing with uncertainty in appraisal. They illustrate more complex alternative options and risks over time, especially when decisions are sequential. They can be used to illustrate alternative scenarios where key external risks are likely. They can also be used to clarify alternatives where decisions taken are either irrevocable or expensive to reverse. More detail can be found in Annex 5 along with an example of real options analysis.

5.9 Equalities analysis at the shortlist stage

As outlined in Chapter 4 the Public Sector Equality Duty (PSED) requires that public sector bodies have due regard to advancing equality, for groups of individuals with protected characteristics identified in the Equality Act. The need for equalities analysis will apply when considering a shortlist of options and the results must be visible to decision makers. Public Sector Equality Duty Guidance (<https://www.equalityhumanrights.com/en/advice-and-guidance/public-sector-equality-duty>) is available from the Equality and Human Rights Commission. Separately there is a need to consider effects on Families (<https://www.gov.uk/government/publications/family-test-assessing-the-impact-of-policies-on-families>).

It is important to consider the likelihood and extent to which average impacts will differ across groups and places, including where several distributional factors might apply in combination. Where this is likely to be significant, the possibility of avoiding, or mitigate adverse effects needs to be understood. Where there are significant uncertainties or gaps in the evidence concerning such effects, further consultation and research should be undertaken to inform a proportionate judgement. Consideration should be also given to capturing evidence as part of the evaluation plan. Where suitable, implementation options should be considered, such as piloting to test what works and to understand distributional risks and to adapt the scheme as required.

5.10 Distributional analysis at the shortlist stage

Where distributional effects (e.g. on income) are relevant, they should be appraised. Assessment of distributional impacts could range from a simple quantitative or descriptive approach where the scale of the effect is relatively low, to an in-depth appraisal and detailed calculation of distributional effects where the scale is relatively high. Depending on the scope and type of intervention distributional analysis may involve considering the impact on businesses of different size, for example focussing on small and micro businesses.

Where effects are significant for a group concerned, a clearly presented analysis identifying gaining and losing groups and estimating the effects on their welfare should be carried out. Presentation alongside the overall UK effects improves visibility and transparency of distributional impacts, so that the effects of decisions are properly understood and, where necessary, options for mitigation may be considered.

Distributional weights are factors that increase the monetary value of benefits or costs that accrue to lower income individuals or households. They are based on the principle that the value of an additional pound of income may be higher for a low-income recipient than a high-income recipient.

Distributional weights can be used as part of the distributional analysis where there is understood to be a social value that differs from simple additionality due to who gains or loses. To account for the uncertainties, sensitivity analysis is recommended and it may be useful to estimate switching values i.e. the distributional weights required to change the preferred option. This provides an estimate of the certainty of the results based on the weights used.

In practice the use of distributional weighting is challenging. This is due to uncertainty in the assumptions relating to the groups between whom redistribution is measured and uncertainty in estimation of distributional weights.

Distributional results should be presented transparently. For example, if distributional weightings are used to adjust estimated costs or benefits depending on which groups in society they fall on, the analysis with weightings should be presented alongside the analysis without weightings.

It may be necessary to undertake additional distributional analysis for interventions with sub-national or regional distributional effects (e.g. those that involve redistribution of welfare to different parts of the UK), those which are targeted at one or more types of geographic area (e.g. rural areas) or those which are targeted at one or more geographic area (e.g. a specific city or town). Results should be shown separately alongside the calculation of UK-wide NPSV, which allows the local effects to be clearly identified. It may also be necessary to assess the differential impact of new interventions in devolved administrations, due to differences in existing policies.

This type of appraisal must include, as far as possible, the effects on other areas affected by the proposal. It cannot be assumed that resources are diverted from other parts of the UK 'on average'. Interventions will often divert resources from areas that are nearby and/or have very similar characteristics to the areas receiving an intervention. The effects of deadweight, displacement, transfers, substitution and leakage must be estimated based on credible, objective evidence that relates to the areas or issues of concern (See Annex 3 for more detail).

Distributional issues should also be considered when conducting research to calculate generic reference values for appraisal. For example, the income distribution of a sample population may be taken into account in order to adjust a generic value to represent the total population.

5.11 Appraising projects and programmes

Programmes usually form part of a wider organisational strategy and contribute to organisational objectives. The key differences between projects and programmes which should be reflected in the way they are appraised are:^[footnote 15]

- programmes focus on the delivery of outcomes and projects usually focus on the delivery of outputs
- programmes are usually made up of enabling projects and activities
- programmes usually have a longer life span, involving a series of projects or stages and take a number of years to deliver
- programmes are usually more complex, with a wider scope and provide an umbrella for enabling projects to be co-ordinated and delivered

Individual projects within a programme are subject to the usual approval, development and processes set out in the HM Treasury Business Case guidance (<https://www.gov.uk/government/publications/the-green-book-appraisal-and-evaluation-in-central-government>) available at the link shown. The existence of a programme business case should shorten and simplify the business case for the constituent projects. In some cases the business case process can be shortened with agreement of the approving authority. Guidance is available to support planning and approval of Agile (<https://www.gov.uk/government/publications/the-green-book-appraisal-and-evaluation-in-central-government/agile-digital-and-it-projects-clarification-of-business-case-guidance>) digital and IT projects.

5.12 Portfolio appraisal

Portfolio appraisal involves the optimisation of a portfolio of programmes and projects within a limited budget. The objective is to optimise the social value of the portfolio taking account of total whole life cost of projects, when subject to a budget constraint.

An example of portfolio appraisal is the capital allocation process at a Spending Review. Public capital spending is a readily controlled form of expenditure. This is because proposals that are not yet started or fully implemented can be more easily delayed, reduced in scope, re-phased or abandoned. When a decision is made to go ahead with capital expenditure it creates substantial whole of life costs e.g. maintenance and

running costs for infrastructure or service provision for schools or hospitals. As a result, public sector capital spending is usually a relatively small percentage of the total cost of project. When ranking a set of projects with substantial capital spending, the BCR including whole life costs should be used. However, the cut off or budget constraint for considering which options are affordable should be the capital budget.

All capital spending proposals should be assessed on the basis of contribution to Government priorities as well as their BCR including whole life costs. Account may also be taken of unquantifiable and unmonetised factors and risks, and consideration may be given to the overall balance of the portfolio in terms of factors such as risk, uncertainty or the distribution of impacts. Future spending commitments should be taken into account in approval of individual spending decisions and when strategically reviewing a portfolio.

5.13 Competitive bids

In some cases, public expenditure will be allocated via competitive bidding, rather than through the standard business case process. In such cases the challenge is to design and construct a process that optimises the social efficiency of the final allocation at a strategic level. To achieve such an efficient use of public resources the allocating authority should define, in consultation with potential bidders, the overarching objectives that the bidding process is designed to support. To allow for variations between the needs of different bidders the overarching objectives may be supported by a number of SMART criteria developed in discussion with potential bidders. The bidding organisations should then prepare proposals based on their objectives using the business case methodology, and bids should be initially completed up to conclusion of the outline business case stage. Allocation of funds should initially be provisional and be based on the social value for money criteria. That is focusing on the agreed objectives, taking account of costs, benefits, unquantifiable features, risks and uncertainty. Final allocation of funds should be conditional on a satisfactory full business case in which costs are tied down. An agreed margin of error needs to be agreed at the outset beyond which further funding is not necessarily supported. In developing competitive processes, organisations should weigh the benefit of competitive process against the administrative costs and potential impacts on the ability of bidding organisations to plan strategically. Consideration should also be given to:

- the appropriate size and scope of the competition
- alignment with wider government objectives
- ensuring that the assessment criteria cover all relevant considerations, including strategic fit
- ensuring fairness in the assessment process

6. Valuation of Costs and Benefits

Chapter 6 sets out the approach to the valuation of costs and benefits in more detail. This includes further explanation of opportunity costs, which costs and benefits to include and approaches to non-market valuation. It covers land use valuation, assets and infrastructure, valuation of risks to life and health, natural capital and travel time.

6.1 Opportunity cost

The costs of using assets and resources are defined by the value which reflects the best alternative use a good or service could be put to, or opportunity cost. The starting point for estimating opportunity costs is usually market prices. It is important to understand the best alternative use of an asset being valued, since better alternatives may exist. The opportunity cost of labour should include the total value of the output produced by employees. This is the cost of employees' time, based on Full Time Equivalent (FTE) costs and includes pension costs, National Insurance, allowances, benefits and basic salary.

6.2 Employment and productivity effects

Productivity effects should be included in the calculation of UK costs and benefits where they can be objectively demonstrated. Productivity effects may arise from movement to more or less productive jobs, changes in the structure of the economy, benefits from dynamic clustering or agglomeration (benefits that arise through close

location of businesses and/or people), private investment, product market competition or the generation and flow of ideas. Productivity effects will typically lead to higher wages, rather than higher employment. The benefits can be calculated from the different levels of total employment costs under different options.

Interventions which increase human capital, job-search activity or provide better access to jobs can have positive labour supply and macroeconomic effects. Provided they can be supported by clear, objective evidence labour supply effects can be included in appraisal.

Green Book appraisal is not concerned with the macroeconomic effects of spending which is the concern of government when it makes macro spending decisions on the overall level of spending and taxation. Green Book appraisal concerns effects on welfare and wellbeing at a micro level. It may be used to inform public resource allocation as when used in a spending review. Its principle focus and function is most frequently to support the development and selection of optimised spending proposals in the development of business cases. It is not generally possible to estimate objectively based, credible and statistically significant differences in macroeconomic variables arising from alternative options within a business case.

Therefore, changes to Gross Domestic Product (GDP), or Gross Value Added (GVA) or the use of Keynesian^[footnote 16] type multipliers arising from different options cannot provide useful information for choosing between options within a scheme and are therefore not part of the Green Book appraisal process. However, macro variables may well form part of the higher level analytical research that informs identification of policy, and policy priorities.

6.3 Economic transfers

Transfers of resources between people (e.g. gifts, taxes, grants, subsidies or social security payments) should be excluded from the overall estimate of Net Present Social Value (NPSV). Transfers pass purchasing power from one person to another and do not involve the consumption of resources. Transfers benefit the recipient and are a cost to the donor and therefore do not make society as a whole better or worse off.

Where transfers may have a distributional impact it may be appropriate to quantify and show these effects alongside the estimate of UK NPSV. This could involve showing the transfer of equivalent costs or benefits from one group in society to another, particularly when relevant to distributional objectives. It may be appropriate in those circumstances to undertake distributional analysis as set out in Annex 3.

Redundancy payments are a transfer payment and should not be part of the estimate of UK NPSV. Redundancy costs (or potential costs) should be included in the calculation of the financial costs to the public sector. In addition, where there are significant wider social effects of redundancy these should be calculated and included.

Payments of tax and national insurance made from an employee's gross earnings are part of the output or value produced by the workforce. They are therefore not a transfer payment and should be included where relevant in calculations of social value. HM Treasury should be contacted if there is uncertainty about whether costs or benefits in appraisal represent a transfer payment.

6.4 Residual values and other adjustments

An asset's residual value or liability at the end of the appraisal period should be included to reflect its opportunity cost. Residual values do not depend on the actual sale of an asset. The market price at the end of the asset's lifetime – the best value obtainable from its sale, lease or alternative use – is part of the value created as a result of the cost to the public sector of creating the asset.

Contingent liabilities – potential future expenditure if certain events occur – should be appraised and included as part of the expected cost of risk. They sometimes result from decisions that do not involve direct public expenditure. One example of a contingent liability is the cancellation costs if a public sector organisation terminates a contract prematurely. The HM Treasury contingent liability approval framework (<https://www.gov.uk/government/publications/contingent-liability-approval-framework>) provides further discussion on calculating expected costs.

Depreciation is not included in the estimate of NPSV, although it is included in the estimate of public sector costs in financial analysis. Depreciation is used in accounting to spread an allowance for loss in value of an asset over its lifetime. In calculating NPSV, costs are not spread over time but register when total costs are reflected in the accounts.

6.5 Non-market valuation

When there is no market price for costs and benefits to society they need to be estimated and are known as shadow prices. This is particularly important for environmental, social and health effects. Some have generic values generated, for example, through surveys of a sample of the population. These are included, with information on how to use them, in Annex 1 and the Green Book webpages (<https://www.gov.uk/government/publications/the-green-book-appraisal-and-evaluation-in-central-government>). To ensure appropriate use it is important to understand the difference between the characteristics of the sample population and an intervention's intended target population. The advice of professional economists is required when dealing with non-market valuation.

Non-market price calculation and estimation

Social costs and benefits without a market price can be estimated using a range of techniques. Box 20 summarises a hierarchy of the main techniques that can be used. These approaches have strengths and weaknesses that need to be considered when they are used for Social CBA.^[footnote 17]

Box 20. Valuation Methods for Non-Market Prices

Market prices

Prices from the relevant market (excluding taxes and subsidies). In some cases a closely comparable market can be used where a direct market price is unavailable.

Generic prices

Use of a Green Book approved transferable price applicable to the proposal.

Revealed preference

Techniques which involve inferring the implicit price placed on a good by consumers by examining their behaviour in a similar or related market. Hedonic pricing is an example of this where econometric techniques are used to estimate values from existing data.

Stated preference willingness to pay

Research study by professionally designed questionnaire eliciting willingness to pay to receive or avoid an outcome.

Stated preference willingness to accept

Research study by professionally designed questionnaire eliciting compensation to accept a loss.

Wellbeing

Use of direct wellbeing based responses (in existing data or from research by questionnaire) to estimate relative prices of non-market goods.

Estimation of a central reference value and a range

Market prices will not represent total costs and benefits where a market is distorted because of restricted competition, such as a monopoly in supply (only one seller), or monopsony in purchasing (only one buyer). If this is the case valuation may be required and discussion is advised between the responsible organisation and their approving authority, or HM Treasury in the case of major expenditure.

For non-market valuation in general, research studies may be commissioned where there are no reliable values and it is justified by the size of the cost, benefit or risks. Where a research study is not feasible and transferable values are not available, desk-based research and other data sources may shed light on the likely range of values. In these cases a range of estimates should be used. The basis should be made clear, and they must be included in the sensitivity analysis, to test whether the benefit valuation is critical to the decision to be made.

Sometimes it is possible to identify the implied value of non-market goods from other decisions people make where prices are available. This gives a revealed preference – the value revealed as a result of people's actions. Hedonic pricing is an example of this approach. For example, the relationship between house prices and levels of environmental amenity, such as peace and quiet, may be analysed in order to assign a monetary value to the environmental benefit. Another example is the travel cost method, which involves estimating the costs people incur in order to consume a non-market good such as a recreational site.

If robust revealed preference data is not available, surveys that use willingness to pay and willingness to accept are an established alternative method known as stated preference techniques.

Revealed and stated preference techniques are commonly used to elicit estimates of what individuals are willing to pay or accept for a specific outcome. They underpin many of the valuation techniques outlined in Annex 1, for example stated preference techniques are used to value health outcomes using Quality Adjusted Life Years (QALYs).

Subjective wellbeing approaches

Subjective wellbeing evidence aims to capture the direct impact of a policy on wellbeing. The evidence can challenge decision makers to think carefully about the full range of an intervention's impacts and to consider a wider range of interventions. The evidence can also help challenge implicit values placed on impacts by providing a better idea of the relative value of non-market goods.

The use of subjective wellbeing approaches in assessing the longlist of options is explained in Chapter 4. For use in shortlist appraisal it may be appropriate to use subjective wellbeing as the outcome variable for Social CEA in certain circumstances.^[footnote 18] It is recognised that the methodology continues to evolve^[footnote 19] and it may be particularly useful in certain policy areas, for example community cohesion, children and families. Where valuations are considered robust enough for inclusion in Social CBA, benefits or costs must not be double counted, which could occur if a benefit or cost arising from a policy were counted by different valuation methods.

6.6 Specific approaches to valuation

Land use values

The value of land is determined by factors such as use, location, nearby infrastructure and the cost of development for an alternative use. The potential net benefits of new land used can be assessed using values arising from a change. The change in value is defined as the value of the land in its new use (e.g. commercial or residential) minus the value of the land in its existing use.

Any increase in land value as a result of a change in its use reflects the economic benefits of conversion to a more productive use. The value to society of a development can therefore be derived from the land value. This estimate should be adjusted for any change likely without the development, displacement from the original land use and wider effects of the resulting development, e.g. any change in amenity value, environmental or health outcomes. Any double counting should be adjusted for. See Annex 1 for more detail.

Asset maintenance

Asset maintenance costs may be substantial, occur over long time periods and need to be accounted for over an asset's likely lifetime. These estimates should be based on an organisation's asset maintenance policies. In the absence of policy any assumption should be based on maintaining the service level and quality at the outset for the asset's lifetime.

Asset sales

The design of an asset sale is subject to the Green Book and HM Treasury Business Case Guidance (https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/469317/green_book_guidance_public_sector_business_cases_2015_update.pdf). Estimates of social value should include wider social costs and benefits that may be affected by a sale.

The value of existing assets is their opportunity cost. For asset sales this is usually the value in the market and must be estimated where no comparable market value exists. Where there is a known stream of income arising from an asset's ownership (e.g. interest, repayment of a debt, or rental/lease income) the value should be estimated based on a discounted value of the future income stream (using Social Time Preference Rate, STPR). Where there is no income stream, market value can be estimated using comparable sale values or comparable potential income streams. The asset value used should inform the estimate of social value and public sector income.

Where an asset is unused, there may still be positive benefit of an alternative use if transferred to the private sector or a wider social cost of disposal. These costs and benefits may be affected by the method and timing of the sale and any provisions attached. There may also be public sector or social costs associated with ongoing ownership of an asset which will need to be considered as part of any assessment to hold or dispose of an asset.

Social CBA and Social CEA are not relevant when the benefit of an asset sale is only public sector revenue, with no change in public service output. If there is no change in the output of public or other services, there is simply a saving in the overall public sector. The focus should then be on ensuring an efficient sale to deliver best value to public sector finances and should be registered in the financial dimension of a business case.

Valuation of financial asset sales is covered by the Green Book, except for the sale of government debt which is exempt. Financial assets are generally priced according to a valuation of their discounted income stream, using the STPR. The composition of the STPR means it excludes project or programme specific risks, so the cost of risks should be explicitly included in an intervention's cost.

A market risk premium must be estimated to price a financial asset for sale and should be added to the risk-free component of the STPR, which is 2.5%. The STPR is 3.5% and includes a 1 percentage point allowance for catastrophic risk which is excluded to give the risk-free component of 2.5% (Annex 6 provides a breakdown of the STPR). A projection of the future stream of income from the asset is also required. The variability of this income stream and the reliability of the projections will directly affect the size of the risk premium.

Potential purchasers may have other reasons for finding a financial asset attractive, such as its risk profile. This can be irrelevant to the public sector but of material value to a financial institution seeking to balance risk in a portfolio. This may increase the price that potential purchasers are willing to pay. More information on valuing financial assets can be found in Green Book supplementary guidance: asset valuation (<https://www.gov.uk/government/publications/green-book-supplementary-guidance-asset-valuation>).

Infrastructure

Infrastructure interventions should be appraised and valued in the same way as all other interventions. Infrastructure is a broad term relating to the assets, networks and systems that support the operation of a modern society and economy. In the UK, the term economic infrastructure refers to businesses and their assets that are concerned with transportation, water and sewage, waste management, energy, communications, and flood and coastal erosion. Economic infrastructure has particular characteristics that need to be recognised and taken into account.

Economic infrastructure can be geographically extensive and involve significant investment in physical assets. Many of these assets have grown organically over time and are often highly interdependent. Because of their size, and in certain cases complexity, some decisions may have effects on future flexibility of an organisation or industry affected and other infrastructure service providers. Productivity benefits should be considered as part of appraisal, including agglomeration effects or changes in the structure of the economy that may result from infrastructure investment.

Infrastructure, long term planning and high interdependence levels need to be taken into account at the longlisting stage and when selecting the optimum shortlist (Chapter 4). It is vital that this is supported by sufficient good quality research and evidence, for example on previous similar interventions.

Valuing risks to life and health

Changes in risks to life or health as a result of government interventions should be valued as part of appraisal and will usually require non-market valuation techniques. The choice of technique will depend on the nature of the specific intervention being appraised.

The Value of a Prevented Fatality (VPF) measures the social value of changes in risk to life. It is used to value small changes in fatality risks, where levels of human safety vary between options. This is not the value of a life, it is the value of a small change in the risk or probability of losing a statistical life. Not to value this in appraisal would effectively value human safety at zero.

In cases where alternative levels of fatality risk are involved in option design, VPF allows this to be taken into account. The value concerned is known as the value of the risk of “a statistically prevented fatality.” It has been widely used for many years, particularly in transport. The current value and how it may be applied is discussed in Annex 1.

Valuation can also involve estimating the impact of risks to the length of life, measured using Statistical Life Years (SLYs), and risks to health related quality of life (QoL) measured using Quality-Adjusted Life Years (QALYs). In practice, particularly in the health sector, QoL can be thought of as different dimensions of health (e.g. the capacities for mobility, self-care, usual activities, pain or discomfort and anxiety or depression).^[footnote 20] Observations used will be based on self-reported health and provide equal weight to whatever full health means to each respondent.

The value of a SLY is derived from the social value of a small change in the probability (the risk) of losing or gaining a year of life expectancy. This value can be of use when appraising options that involve different changes to life expectancy. These risks may involve regulation or provision of goods and services that affect or directly relate to human life and health.

The gain or loss of a QALY can represent the social value of an improvement in life expectancy and QoL in a way that is comparable to the gain or loss of a SLY. The QALY is two dimensional, combining both longevity and level of health in a single measure. This is useful when appraising options that result in different effects on both longevity and QoL. The current values of a SLY and a QALY, how they can be applied, and background information is contained in Annex 1.

On grounds of equity in appraisal, the VPF, QALY and SLY values are based on average values from representative samples of the population. For the avoidance of doubt VPF, QALYs and SLYs are used when analysing and planning the provision of assets, goods and services at a population or sub-population level. They are not designed for contexts such as situations of emergency or rescue.

Greenhouse gas emissions and energy efficiency values

Greenhouse gas (GHG) emissions occur as a result of many decisions to create assets or provide public services, particularly where direct energy consumption is required. They may also result from the energy required to produce basic input materials used in construction. The creation of GHGs has a social cost based on its contribution to climate change.

To estimate the social cost of an intervention it is necessary to include the costs of emitting GHGs. Energy efficiency has a direct social value, in addition to the value of a reduction in GHGs, as the energy saved itself has a direct benefit to society (similarly, activities that create extra demand for energy have a direct energy cost). The approach and values to quantify GHGs and energy efficiency can be found in Annex 1.

Assessing and valuing effects on the natural environment

Natural capital includes certain stocks of the elements of nature that have value to society, such as forests, fisheries, rivers, biodiversity, land and minerals. Natural capital includes both the living and non-living aspects of ecosystems.

Stocks of natural capital provide flows of environmental or 'ecosystem' services over time. These services, often in combination with other forms of capital (human, produced and social) produce a wide range of benefits. These include use values that involve interaction with the resource and which can have a market value (e.g. minerals, timber, fresh water) or non-market value (e.g. outdoor recreation, landscape amenity). They also include non-use values, such as the value people place on the existence of particular habitats or species. Where service flows are not marketed, or market prices do not include their full value to society, non-market values may be estimated using the range of non-market valuation techniques or tools.

Understanding natural capital provides a framework for improved appraisal of a range of environmental effects alongside potentially harmful externalities such as air pollution, noise, waste and GHGs.

Natural capital stock levels should be systematically measured and monitored for the social costs and benefits of their use to be understood and controlled (see report to the Natural Capital Committee (<https://www.gov.uk/government/publications/natural-capital-committee-research-improving-cost-benefit-analysis-guidance>)). A focus solely on the marginal valuation of a loss in services may overlook the potential for large reductions in stocks. This could then lead to dramatic reductions in present or future services. Similarly, the cumulative effects of multiple decisions on natural capital stocks need to be considered. Where appropriate therefore, and particularly for major impacts, assessments should consider whether affected natural assets are being used sustainably.

Figure 9. The Natural Capital Framework

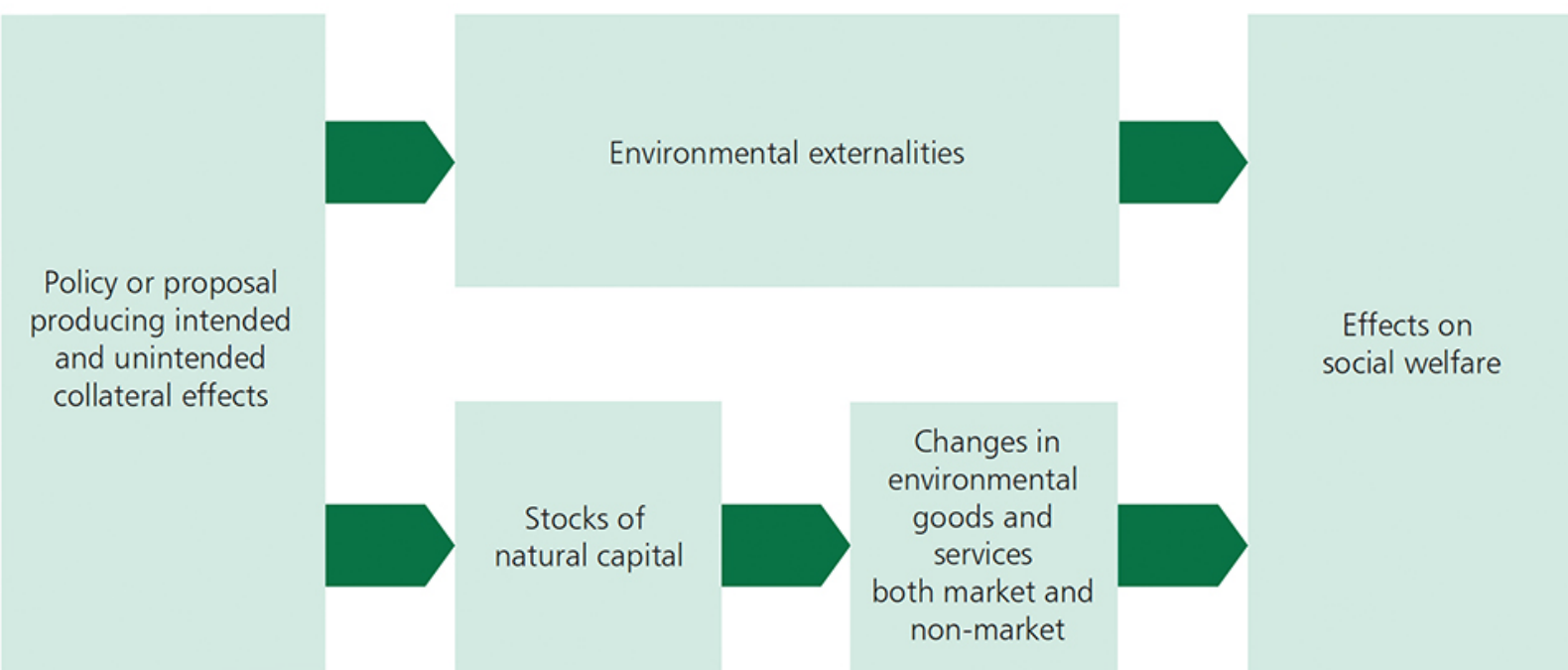


Figure 9 shows the natural capital framework. This does not replace existing approaches to appraising and valuing environmental effects. Rather, by providing a more comprehensive framework within which to develop and appraise policy, it suggests additional options to meet policy goals and enables all options to be assessed more accurately for potential improvements and/or damage to the environment.

- As a first step, the following questions can be used to consider the impact on natural capital. Is the option likely to affect, directly or indirectly:
- the use or management of land, or landscape?
- the atmosphere, including air quality, GHG emissions, noise levels or tranquillity?
- an inland, coastal or marine water body?^[footnote 21]
- wildlife and/or wild vegetation, which are indicators of biodiversity?^[footnote 22]
- the supply of natural raw materials, renewable and non-renewable, or the natural environment from which they are extracted?
- opportunities for recreation in the natural environment, including in urban areas?

If the answer to one or more of these questions is “yes” or “maybe”, further assessment is recommended as outlined in Annex 1.

Travel time

The value of a change in travel time is the change in welfare expressed in monetary terms. The values of travel time savings represent the opportunity costs of time spent by travellers during their journeys. For example, the opportunity cost of travel time for a visiting care worker during working hours is the social value of the time which would otherwise be spent caring for service users. More detail on travel time valuation can be found in Annex 1.

6.7 PPP, tax and other adjustments

Comparison of Public Private Partnerships (PPP) options with a comparable public sector option is required. A suitable public sector option should be created to provide a benchmark for comparison of direct public provision and partnership options, costs and value on a level playing field. This requires the comparable public sector option to be based on the same provision of services in terms of quantity and quality and provide the same level and length of asset maintenance as the partnership option. It is therefore necessary for adjustments to be made for tax (see Annex 4).

A choice involving PPP options should not be reduced to a binary choice between public and private. Having a partnership option and public sector comparator on the shortlist does not rule out other options. There may be more than one partnership option and where this is the case each one requires its own public sector comparator. There may also be other directly provided public sector options not comparable to the PPP options (e.g. different in terms of scope or benefits offered) in addition to the public sector comparator.

Payments of tax on foreign procurements are included in market prices in the social value calculations, in the same way as they are for UK purchases. Manufacturing and supply chains are generally global in nature, meaning all procurements on average are likely to have elements of foreign origin, manufacture and taxation applied to their production. It would not be proportionate, or likely to add value to the decision process, to attempt an analysis of each procurement's degree of embedded foreign taxation and then to make an adjustment.

The existence of a UK supply chain or the location of companies involved in maintenance and repair may be important for policy or wider social objectives. When this is the case this should be considered at the longlist stage and in selection of the shortlist. Such priorities should be used when developing the economic dimension of a business case, and should feed through into the specification of the procurement process in the commercial dimension.

If competition effects resulting from a proposal are deemed likely during consideration at the longlisting stage (Chapter 4), further in-depth assessment of these impacts should be undertaken and incorporated into any Social CBA or Social CEA. Guidance on quantifying competition effects can be found at the CMA webpages (<https://www.gov.uk/government/publications/competition-impact-assessment-guidelines-for-policy-makers>).

6.8 Unmonetisable and unquantifiable costs and benefits

If there are significant unmonetisable effects associated with an intervention, efforts should be made (where it is possible and meaningful) to quantify them in some other way. Significant benefits and risks that are beyond direct monetisation should be considered at the longlist stage and in selection of the shortlist. Options with and without their inclusion provide alternative scenarios, which can be used to reveal their costs. This informs choice by considering whether these cost differences are a price worth paying. For example, Bateman et al. (2013) ^[footnote 23] apply this when examining the costs of changing policy on land use when faced with unmonetisable impacts on biodiversity.

The focus of appraisal should be on benefits and costs important to the decision being considered. The treatment of unmonetisable and unquantifiable benefits is discussed further in Annex 1.

7. Presentation of Results

Chapter 7 outlines how to present appraisal results.

The role of appraisal and evaluation is to provide objective evidence and analysis that feeds information into the design, scrutiny and approval processes that support government decision making. Accordingly appraisal results should be presented transparently to show clearly the social value of alternative options in a consistent way.

The presentation of appraisal results is at the heart of the recommendation of the preferred option. Results should be clearly and transparently reported in summary form with clear cross references to more detailed tables and graphical presentation where appropriate, as well as sources for assumptions and data. Results should be supported by an executive summary that summarises the objective evidence, analysis and any recommendations. All tables and data including the appraisal summary table and key figures in the executive

summary should be cross referenced to their sources in the main body of the business case, key data and assumptions should be identified and cross referenced to the original evidence and sources from which they are derived.

The executive summary should refer to:

- the strategic dimension of the case, and explain the strategic fit of the proposal with wider public policy and other proposals to which it is directly related, and should be revisited as part of the advice on a recommendation
- constraints and dependencies where relevant, and significant residual risks and uncertainties explained
- the logical change process to demonstrate how delivery of the SMART objectives will be produced by making the changes proposed
- distributional issues where relevant, and evidence provided including for place based issues, equalities effects or income distribution
- key parameters and assumptions that have a significant effect on selection of the recommended option
- a clear explanation of the sensitivity analysis and switching values as part of an explanation of residual risks, their management, likelihood and costs
- a clear discussion of the recommended option and the reasons for the recommendation and the balance in judgment between the benefit to cost ratio, the costs of including any key features that have been included the benefits of which are not monetisable and the overall level of risk, as well as a description of the contingency plan.

7.1 Appraisal Summary Tables

The generic core appraisal summary table shown below is intended as a template that can be extended within reason so as not to obscure the key points that are the basis of advice on the preferred option. A set of summary table templates is provided on the Green Book web page and should be used. Where a place based appraisal is involved an appraisal summary table showing place based results and a table showing UK results are needed, multiple places will require a table each as will travel to work areas if a place based proposal results in significant effects there. The relationships between them should be covered in the single executive summary.

Figures are to be presented in absolute terms not as incremental differences from “BAU” or the “Do Minimum.” This makes each option more transparent and allows clear straightforward comparisons between options in a variety of ways. Relative differences can be explained where they are relevant to the advice contained in the executive summary.

Assumptions which have a significant effect on the decision must be clearly indicated in the summary and the objective basis on which all assumptions are based must be explained with links to sources of data and assumptions provided. The quantified Business As Usual must be shown.

A generic, core Appraisal Summary Table (AST) is shown in Figure 10. It can be used as a starting point for summarising results, and it represents the minimum set of core information to be used in presenting results. Some government departments already use standard ASTs to bring together key information that is tailored to their needs, these should include the generic table as an overview.

The AST is a template intended to be spread horizontally across two facing A4 pages to provide an at a glance summary of the key factors in a public spending and non-regulatory decisions.

This approach to presentation of results and the AST template applies to Place Based Appraisal in the same way as for UK wide appraisal results. In such cases two or more ASTs will be appropriate one for the UK wide results and one for the place of interest with a single unified executive summary.

If income distribution or equalities effects have been appraised, then clear simple supplementary summary tables on the results should be provided for presentation with the ASTs.

The AST should also record any significant unmonetisable and unquantifiable effects that are important for a decision. Extensions to this template and supporting tables setting out costs and benefits over time are downloadable from the Green Book web pages (<https://www.gov.uk/government/publications/the-green-book-appraisal-and-evaluation-in-central-government>).

Regulatory decisions with impacts on business are subject to the Better Regulation Framework (https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/872342/better-regulation-guidance.pdf) issued by the Better Regulation Executive. In some circumstances specific requirements may apply (e.g. use of an IA toolkit and template). The AST here does not replace the summary sheet on the front of the IA template (<https://www.gov.uk/government/publications/impact-assessment-template-for-government-policies>) but it should be proportionately used to support the presenting results within the evidence base section of the IA template.

Where proposals are not conventional and higher levels of uncertainty on costs and benefits are involved then the confidence interval should be agreed with the Treasury at the start of the process. This higher degree of uncertainty should be explained, and the confidence level justified from the outset. Care must be taken to explore sensitivity and switching values as part of the sensitivity exercise and these values clearly shown in the summary table. Optimism bias must be fully included as set out in the guidance and the cost risks should be as far as possible realistically reduced through option selection, risk management, and sharing. Additional useful templates can be found in the supplementary guidance on Business Cases (<https://www.gov.uk/government/publications/the-green-book-appraisal-and-evaluation-in-central-government>).

Figure 10. Generic Core Appraisal Summary table template

BAU and alternative options at least 4				
Option label	1. Business As Usual BAU	2. Do Minimum Option	3. Preferred Option if not Do Min	4. More and less Ambitious Options 4-to-N → as needed
NPSV for CBA or Net Present Unit Cost, NPUC for CEA	90% Confidence* Interval and expected value	→	→	→
Relevant present vale public sector cost	90% Confidence* Interval and expected value	→	→	→
Appropriate BCR or NPUC	90% Confidence* Interval and expected value	→	→	→
Significant Quantified but unmonetisable benefits	Brief description* Who benefits 90% Confidence range & expected.	→	→	→
Significant Unquantifiable benefits	Brief description if included	→	→	→
Residual risk and optimism bias allowances	90% Confidence Interval and expected value	→	→	→
Switching values of key variables	90% Confidence Interval and expected value	→	→	→
Life span of the option	Months and /or Years	→	→	→

The 90% level may need to be wider for exceptional non-standard costs where this is significant a wider confidence interval must be agreed with the Treasury at the start of the process, see paragraph 7.13 above.

8. Monitoring and Evaluation

Chapter 8 sets out the approach to monitoring and evaluation including different types of evaluation and uses before, during and after implementation.

Monitoring and evaluation should be part of the development and planning of an intervention from the start. They are important to ensure successful implementation and the responsible, transparent management of public resources. Guidance on conducting evaluation is contained in the Magenta Book (<https://www.gov.uk/government/publications/the-magenta-book>).

Evaluation is a systematic assessment of an intervention's design, implementation and outcomes. It involves:

- understanding how an intervention is being or has been implemented, what effects it had, for whom and why
- comparing what happens with what was expected under Business As Usual (the appropriate counterfactual)
- identifying what can be improved, estimating overall impacts and cost-effectiveness.

When used properly, evaluation can inform thinking before, during and after implementation as set out in Box 21.

It is important to incorporate consideration of monitoring and evaluation into the development, design and appraisal stage of a policy, programme or project. Pilots can be used to test policy effectiveness of what works. Policies can also be designed with inbuilt variation to test the effectiveness of different approaches in real time. And some implementations are able to benefit from use of controlled experimental methods or the use of phased pilot roll outs in which adaptation and learning about what works are part of a programme.

Box 21. Uses of Evaluation

During Implementation

Monitoring allowing improved management and adaptation of implementation in response to evidence based on live data collection and analysis and inform subsequent operational delivery.

- Is the intervention being delivered as intended?
- Is the intervention working as intended?

After Implementation

Evaluation provides an assessment of the outcome of the intervention and a summative assessment of the lessons learned throughout design and delivery.

- How well did the intervention meet its SMART objectives?
- Were there unexpected outputs and outcomes?
- Were costs benefits and delivery times as predicted at approval?
- Was delivery achieved as expected and were any changes needed?
- What can be learnt for future interventions

Evaluation is often broken down as follows:

- **Process Evaluation** – involves assessing whether an intervention is being implemented as intended within its cost envelope, whether the design is working, what is working more or less well and why. It supports understanding of internal processes used to deliver outputs, alongside what was actually delivered and when.
- **Impact Evaluation** – involves an objective test of what changes have occurred, the extent of those changes, an assessment of whether they can be attributed to the intervention and a comparison of benefits to costs. It supports understanding of the intended and unintended effects of outputs, as well as how well SMART objectives were achieved.

Regulations may require post-implementation reviews (PIRs) which are closely related to policy evaluations. The aim is to review regulations at timely intervals to assess whether they are still necessary, whether they are having the intended effects and what the costs to business are. PIRs will generally focus on measures with significant impacts on business and should be conducted proportionately, supported by appropriate monitoring and evaluation. Better Regulation guidance (<https://www.gov.uk/government/publications/better-regulation-framework-manual>) provides more information on conducting PIRs.

The planning of monitoring and evaluation for spending proposals should follow the HM Treasury Business Case guidance for both programmes and projects available at this link (<https://www.gov.uk/government/publications/the-green-book-appraisal-and-evaluation-in-central-government>). This allows a wide range of analytical and logical thinking tools to be used when initially considering the objectives and potential solutions. Planning and provision of resources for monitoring and evaluation should be proportionate when judged against the costs, benefits and risks of a proposal both to society and the public sector.

Monitoring and evaluation typically use a mixture of qualitative and quantitative methodologies to gather evidence and understand different aspects of an intervention's operation. Surveys, and interviews may be needed to understand effects on a wide range of stakeholders. At each stage questions should reflect the need to manage and assess an intervention. Evaluation is important because:

- it can be used to improve current interventions
- it supports transparency, accountability
- it adds to the evidence base available for future decision making
- importantly by improving understanding of change and how it is caused, it improves understanding of the logical change processes informing future proposals about what works and why.

Monitoring and evaluation typically use a mixture of qualitative and quantitative methodologies to gather evidence and understand different aspects of an intervention's operation. Surveys, interviews and focus groups may be needed to understand the views of a wide range of stakeholders, evaluation questions should reflect immediate needs to manage and assess the success an intervention. Evaluation is important as:

- it facilitates transparency, accountability and development of the evidence base
- it can be used to improve current interventions
- it expands learning of 'what works and why' to inform the design and planning of future interventions.

Building monitoring and evaluation into the design of a proposal, and building resources into a proposal, supports provision of timely, accurate and comprehensive data. Data collection should be done alongside the monitoring of costs; either within the intervention itself, or as part of the organisation's wider cost monitoring. Well designed data collection:

- ensures monitoring and evaluation can take place
- allows for relatively minor adjustments to be made to the implementation design which can greatly improve the delivery of benefits
- supports provision of high-quality evaluation evidence and reduces the likelihood of retrospectively attempting the collection of data.
- where creation of a natural comparison group is possible as part of the implementation it allows valuable insights into what works and why
- informs management during implementation enabling identification of threats to delivery.

Monitoring and evaluation objectives should be aligned with the proposal's intended outputs, outcomes and the internal processes, although they may also be wider. Policies and programmes that involve a series of related sub-programmes must also be subject to monitoring and evaluation in programme terms during and after implementation.

SMART objectives should be objectively observable and measurable. Their design should take into account monitoring and evaluation processes. Their suitability for use in monitoring and evaluation is a necessary condition for inclusion as SMART objectives (Chapter 4). Without verifiable and measurable objectives success cannot be measured, proposals will lack focus and be less likely to achieve Value for Money.

Data on Business As Usual, along with continuing data collection, is vital to manage delivery and monitor the intervention during and after implementation. Monitoring and evaluation should examine what happens compared to:

- the objectives expected at the outset, in the business case or impact assessment if available
- the BAU situation at the start of implementation.

In terms of the Five Case Model, a core set of questions to consider are set out in Box 22. A more detailed set of evaluation questions can be found in the Magenta Book (<https://www.gov.uk/government/publications/the-magenta-book>).

Box 22. Core Evaluation Questions

To what extent were the SMART objectives achieved and by when, in particular:

- to what extent were outputs delivered and when?
- to what extent were the anticipated outcomes produced and by when?
- what continuing change is expected as a result of the above?
- how well did the process of delivering the outputs and outcomes work?
- were there significant unintended effects?
- what social value was created as defined in the economic dimension?
- what level of confidence can be attributed to the estimates of impact, including social value?
- what was the cost to the public sector as defined in the financial dimension?

Monitoring and evaluation evidence and reports should be actively owned by the Senior Responsible Officer and the team responsible for an intervention's delivery. Data and findings should be reported regularly, and reports should be timed to correspond to decision points where they can be of maximum use. Major findings should also be reported to the organisation's Accounting Officer and to the relevant external approving organisation.

Evaluation reports, and the research that informs them, should be placed in the public domain in line with government transparency standards and Government Social Research: Publication Protocol (<https://www.gov.uk/government/publications/government-social-research-publication-protocols>), subject to appropriate exemptions.

9. A1. Non-market Valuation and Unmonetisable Values

This Annex provides detail on specific approaches to non-market valuation techniques and generic values for use in appraisal. It covers:

- a range of environmental techniques
- land values

- energy efficiency and Greenhouse Gases
- life and health
- travel time

Environmental and natural capital

Where potential effects on natural capital are identified by the screening questions in Chapter 6, the 4-step approach in Box 23 can be used to identify whether and how an intervention may affect stocks of natural capital and the benefits they provide. Further guidance by Department for Environment Food and Rural Affairs (DEFRA) called “Enabling a Natural Capital Approach (ENCA) is available at this link (<https://www.gov.uk/guidance/enabling-a-natural-capital-approach-enca>).

In addition to the process in Box 23, further points relevant to the natural capital approach include:

- an understanding of biological and physical changes in natural assets is the starting point of the appraisal and associated economic valuation (for example, understanding the impacts of a woodland creation and carbon sequestration project).
- environmental effects and associated values are often geographically specific. The recreational value of new or destroyed woodlands, publicly accessible green space or changes in air quality may be greater in or near densely populated locations than more remote areas. Recreational values may be greater where there are fewer alternative sites.
- the sustainable use of natural assets should also be considered. In addition to the marginal valuation of a loss in services, the degradation of a renewable asset should be assessed, such as the exploitation of a fishery or a loss in condition of the underlying biodiversity. Non-marginal effects such as reaching ecological tipping points might lead to dramatic or irreversible loss in the asset under consideration. This would result in a loss of environmental services and welfare. Cumulative effects of multiple investment decisions upon the underpinning stocks of natural capital should also be considered.
- future scarcity values for goods and services are likely to rise over time. This is due to the rising demand for goods and services which depend on natural capital and the services it provides, combined with limited, and in some cases diminishing, underlying stocks. This is not a problem easily addressed through the appraisal of individual project level interventions, as diminishing underlying stocks and potential tipping points in complex systems may well involve non-marginal effects. In addition, if assumptions about future prices exceed the long term growth of per-capita real income, this must be agreed with HM Treasury.

Box 23. Identifying whether an intervention may affect Natural Capital

The four steps to consider whether and how an intervention may affect stocks of natural capital are:

Step 1 – identify the environmental context of the proposal (“what and where?”):

- identify scale, location, outputs and spatial reach of the intervention.
- what types of land cover and natural system will the proposal affect, directly or indirectly (e.g. farmland, urban green space, woodland, freshwaters, moorland, coastal margins)?

Step 2 – consider bio-physical effects on natural assets (“how?”):

- which natural assets (such as land use, water bodies, species, wildlife habitats and soils) are specifically likely to be affected?
- this step facilitates the assessment of relevant welfare effects in Step 3, as well as informing on the physical sustainability of natural stocks.
- Step 3 – consider the social welfare implications of the bio-physical effects identified in Step 2 (“what consequences?”):

- how are environmental goods and services to society affected by the changes to the assets? These goods and services may be classified as: i “provisioning” services such as supply of food, fuel, fibre and water which typically have market values. ii “regulating” services such as water quality and quantity regulation, climate regulation, pollination, air quality regulation. iii “cultural” services such as landscape and environmental spaces for recreation amenity, and cultural heritage.
- “regulating” and “cultural” services do not typically have direct market values. The effects should be identified as far as possible and proportionately quantified and monetised. Unmonetised factors should be treated as recommended for all interventions.

Step 4 – consider uncertainties and implementation:

- environmental effects may be uncertain. Therefore, consideration needs to be given to quantifying these uncertainties as risks that must be costed and managed, so that they can be minimised, mitigated or where possible avoided.
- critical factors should be identified and arrangements for monitoring included as part of intervention proposals in order to manage risks and optimise outcomes. See Annex 5 on risk management.
- identification of mitigating measures is particularly important so that risks to natural assets can be minimised and benefits maximised.

Multiple impacts may need to be measured and valued. For example, the costs of a proposal that would destroy woodland could include the loss of the following: timber value, carbon sequestration, recreational value, biodiversity and “non-use” values, as well as direct externalities such as noise and air quality. Care should be taken to avoid double-counting where impacts overlap.

Approaches to environmental valuation

For initial estimates of environmental impacts, or valuing secondary impacts, Defra’s Enabling a Natural Capital Approach guidance known as (ENCA) (<https://www.gov.uk/government/publications/enabling-a-natural-capital-approach-enca-guidance>) provides access to environmental valuation evidence. These indicative values should be combined with changes in the physical quantity of the environmental good or impact under consideration.

ENCA provides a starting point for scoping the requirements for more robust valuation, and access to a number of Value Transfer methods or commissioning bespoke economic valuation studies. Value Transfer refers to the use of existing economic valuation evidence in a new appraisal context.^[footnote 24]

Other sources for Value Transfer include:

- the international Environmental Valuation Reference Inventory (<http://evri.ca/en>) which contains over 400 UK environmental valuation studies
- the Forestry Commission’s searchable Woodland Valuation Tool (<https://forestry.gov.scot/publications/680-woodland-valuation-tool>) now published by Scottish Forestry collates all valuation studies relevant to the various services provided by woodland

The following sections summarise valuation approaches and provide indicative estimates for specific environmental services and effects. A primary valuation study may be justified where there is no relevant valuation evidence and environmental benefits are critical to decision making.

Effects on air quality

Atmospheric pollution can have significant effects on health, quality of life, economic activity and the functioning of ecosystems. Three approaches can be used for valuation:^[footnote 25]

1. if impacts are likely to be less than £50 million and do not affect compliance with legal limits then a “damage cost” approach is appropriate. This involves multiplying emissions changes by pre-calculated unit costs, described further below. This is often used to value the consequences of changes in pollution e.g. on

health, crops and buildings.

2. if impacts are greater than £50 million then the “impact pathway” approach should be considered. This involves bespoke modelling specific to the intervention.
3. an “abatement cost” approach should be used in the limited instances where a proposal could affect compliance with legal limits. This involves estimating the least costly way of mitigating the impact of the proposal to ensure continued compliance with legal obligations.

Damage costs are a relatively simple way to value changes in air pollution, as full modelling can be resource intensive. Damage costs are estimates of the societal cost of a change in emissions of different pollutants. This approach is appropriate for small air quality impacts (below £50 million) provided the proposal does not affect areas likely to breach legal air quality limits. Damage costs are calculated per year and should be multiplied by the number of years to which they apply. Full guidance and the latest damage cost estimates are available from Defra (<https://www.gov.uk/government/publications/assess-the-impact-of-air-quality>).

Noise

Noise has a social cost. It can affect health, wellbeing, productivity and the natural environment. Generic appraisal values are shown in Table 3 and Table 4. These are marginal annual values for changes in total road, rail and aircraft noise exposure. These values can be added for changes of more than one decibel and should be multiplied by the number of years and households to which they apply. Where the effect of noise is likely to be a substantial or a decisive factor for an intervention, a detailed assessment may be justified. Full tables, more information on how the values in the table below are calculated and further guidance can be found on the DEFRA webpages (<https://www.gov.uk/guidance/noise-pollution-economic-analysis>).

Table 3. Change in Noise Metric by Decibel (dba) – Daytime per Household per Decibel Change, Central Values (2014 Prices)

Change in noise metric by decibel (dBA) – daytime		Road	Rail	Aircraft
45.0	46.0	£11.28	£3.90	£15.61
55.0	56.0	£51.22	£16.98	£49.01
65.0	66.0	£103.96	£46.34	£79.82
75.0	76.0	£175.04	£93.31	£114.75

Table 4. Change in Noise Metric by Decibel (dba) – Night Time per Household per Decibel Change, Central Values (2014 Prices)

Change in noise metric by decibel (dBA) – night time		Road	Rail	Aircraft
45.0	46.0	£29.20	£13.59	£37.93
55.0	56.0	£57.91	£28.25	£66.56
65.0	66.0	£86.62	£42.92	£95.19
75.0	76.0	£86.62	£42.92	£95.19

Waste

Where a proposal affects the flow of materials or waste it may be possible to access data on environmental externalities from Life Cycle Assessment (LCA) studies.^[footnote 26] LCA is the compilation and evaluation of the inputs, outputs and the potential environmental impacts of a product system throughout its life cycle. LCA studies and databases cover air pollution, greenhouse gas emissions, resource depletion, aquatic eco-toxicity, human toxicity and other issues. These are expressed either as mid-point indicators (e.g. tonnes of CO₂ equivalent emissions) or end-point indicators (e.g. human health measured in Disability Adjusted Life Years).

European data to feed into LCAs are publicised via the EU, although a range of other databases are in common use. When using published studies, it is important to ensure that the study is representative of the situation to which the data is being applied.

Recreation

The recreational value of the natural environment varies with the type of habitat, location, population density and the availability of substitute recreational opportunities. The University of Exeter has developed a map-based web interface which captures these complexities. The Outdoor Recreation Valuation (ORVal) Tool (<http://leep.exeter.ac.uk/orval/>) uses a range of spatial data layers to model the visitation rates and recreational welfare benefits that are provided by accessible green space in England and Wales. The ORVal Tool allows users to explore existing recreational values of individual or multiple sites as well as the welfare effects of creating or altering sites. It is relevant for national and local appraisals where outdoor recreational opportunities are likely to be affected.

Effects on amenity value

Activities such as waste disposal and quarrying of minerals and aggregates have social costs such as noise, congestion, dust, odours and visual intrusion. These can undermine public enjoyment of an area and generate adverse health impacts. Land contaminated from past industrial activity and pollution can also result in costs to society. Interventions that address these problems can generate benefits to residents, visitors and businesses.

Hedonic pricing studies use econometric techniques to estimate a value for a good or service from a related market. The technique has been used to estimate the value of a wide range of environmental costs and benefits as they are reflected in local property prices. For example, analysis of house prices suggests that proximity to habitats, designated areas, heritage sites, domestic gardens and other natural amenities can add as much as £68,000 to the price of a £200,000 house in the UK, a premium of one-third.^[footnote 27]

Hedonic valuation techniques using property price data help estimate relevant amenity values.^[footnote 28]

Research for Defra ([http://randd.defra.gov.uk/Default.aspx?](http://randd.defra.gov.uk/Default.aspx?Menu=Menu&Module=More&Location=None&ProjectID=17468&FromSearch=Y&Publisher=1&SearchText=contaminated&GridPage=3&SortString=ProjectCode&SortOrder=Asc&Paging=10)

[Menu=Menu&Module=More&Location=None&ProjectID=17468&FromSearch=Y&Publisher=1&SearchText=contaminated&GridPage=3&SortString=ProjectCode&SortOrder=Asc&Paging=10](http://randd.defra.gov.uk/Default.aspx?Menu=Menu&Module=More&Location=None&ProjectID=17468&FromSearch=Y&Publisher=1&SearchText=contaminated&GridPage=3&SortString=ProjectCode&SortOrder=Asc&Paging=10)) on the value of remediating contaminated land identified statistically significant differences in local property prices from remediation in a number of case study sites. More generally, changes in amenity value will depend on many factors including local circumstances, population density and the environmental change in question. Therefore, care needs to be taken in using or transferring values from existing studies. Amenity value can potentially overlap with local recreational values so where both are being used, care should be taken not to double count. In addition, property value effects reflect capitalised rather than annual changes in value.

Landscape

Landscape provides the setting for people's day-to-day lives. It does not only refer to special or designated landscapes or the countryside. In the context of appraisal of environmental impacts, landscape benefits can relate to opportunities for recreational activities including nature viewing (e.g. bird watching), hiking, and the opportunities to experience views, sounds and scents. It can include aesthetic experience and visual amenity. Since landscape incorporates values for recreation, aesthetic values and cultural heritage, care is needed in order not to double count impacts.

Water quality and water resources

Water use, water quality and flood risk are likely to be affected where land use is changed, development or infrastructure is promoted or certain technological change is facilitated. For example, transport schemes may lead to social costs where polluted water runs off from new roads into local watercourses, a housing development may place pressure on local water supplies and new types of power station may increase freshwater abstraction to the detriment of local natural assets. Water or flooding impacts should be considered and valued as part of options appraisal.

Valuation of water resources

Valuation evidence is publicly available from Water Resources Management Plans developed by water companies in England and Wales. These include marginal costs (known as “average incremental social costs”) of providing extra water output which may be used as a proxy for the economic value of water resource impacts. In the 2014 round of Management Plans, the industry average incremental social cost of provision of an additional million litres (a marginal mega litre) per day was around £1.5 million. This can be interpreted as the typical economic cost of replacing a marginal mega litre of water and may be suitable for high-level assessment of the value of water resource impacts. However regional variation can be significant, because options to augment resources are constrained to varying degrees, in part reflecting wider water scarcity. Care should therefore be taken in using these figures. For significant interventions, the relevant local Water Resource Management Plan should be consulted and Defra can advise at watereconomics@defra.gsi.gov.uk.

The quality of water in the environment has an effect on biodiversity, amenity and recreation and was the subject of a major study in 2007, updated in 2013, called the National Water Environment Benefits Survey. ^[footnote 29] Estimates ^[footnote 30] of the average benefits of improvements in the quality of water in rivers, lakes, canals & coastal waters are:

- £17,400/km/year – value of improving water quality from bad to poor
- £20,100/km/year – value of improving water quality from poor to moderate
- £23,300/km/year – value of improving water quality from moderate to good

For river basins with higher population densities, benefits are above these averages. Economic valuation of ecosystem services provided by the water environment, particularly in urban areas, is an active area of research. For additional information Defra can be contacted at watereconomics@defra.gsi.gov.uk.

Flood risk and coastal erosion

Flooding and coastal erosion can lead to social costs (e.g. harm to people and damage to property, infrastructure and the environment). Typical damage per property, per flood event varies from around £7,000 to £10,000 for a flood of less than 0.1 metres in depth, to between £37,000 and £42,000 for a flood in excess of 1.2 metres in depth.

To estimate the changing risk of flooding and coastal erosion over time, risk is generally measured in terms of changes to Annual Average Damages (AAD). This is the probability-weighted resource cost of flood damage to property and infrastructure, plus adverse health impacts and the resource costs of disruption. Estimating AADs for large scale flood and coastal erosion requires complex hydraulic modelling to estimate the probability and severity of flooding and/or coastal erosion, and its likely impact on people and assets in a defined spatial area.

Generic national Weighted Annual Average Damage (WAAD) estimates are available for broader-scale, high-level scoping analysis. These are national average, per property, annual damage estimates and have been developed for residential properties across flood events with different probabilities and levels of flood warning service. The estimates for an average house in 2017 prices range from the following:

- a property with no flood protection and no flood warning service – £5,054 per property, per annum
- a property with existing protection against a “1 in 200 chance” (0.5% annual probability) and a flood warning service of more than 8 hours – £39 per property, per annum

Local economic output and employment impacts of flooding can be material, though as with other local impacts, the potential for displacement at the national level should be recognised. Defra provides a toolkit for assessing such impacts. ^[footnote 31]

For further guidance see the Environment Agency's Flood and Coastal Erosion Risk Management Appraisal Guidance (Environment Agency 2010) (<https://www.gov.uk/guidance/flood-and-coastal-defence-appraisal-of-projects>) and the online Flood and Coastal Erosion Risk Management Handbook and Data for Economic Appraisal 2017 (<https://www.mcm-online.co.uk/handbook/>).

Vulnerability to climate change

The Climate Change Risk Assessment (CCRA) (<https://www.gov.uk/government/publications/uk-climate-change-risk-assessment-2017>) should be used to consider current and potential future climate risks and vulnerability to risks of an intervention. The CCRA provides a framework that quantifies interactions with climate risk. It enables a consideration of the role of climate in altering the scale and distribution of costs and benefits over the lifetime of the proposal. Supplementary guidance, Accounting for the effects of Climate Change (<https://www.gov.uk/government/publications/green-book-supplementary-guidance-environment>) provides steps to determine whether climate risks are relevant in relation to the appraisal of an intervention.

Biodiversity

Biodiversity can be thought of as a core component of natural capital that supports the provision of environmental goods and services to people. It is defined by the Convention on Biological Diversity (<https://www.cbd.int/convention/articles/default.shtml?a=cbd-02>) as 'the variability among living organisms from all sources including terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and ecosystems'.

Valuation is typically estimated per hectare or per household, using stated preference methods. Biodiversity may be reflected by, or associated with other benefits e.g. recreation, pollination, water quality and amenity. To avoid double counting, biodiversity should only be valued where it directly impacts human wellbeing and where it is additional to other benefits. For example, non-use value for biodiversity represents a legitimate additional category of value that can be added to direct and indirect use values for final goods and services.

Defra have published a discussion paper (http://sciencesearch.defra.gov.uk/Document.aspx?Document=13670_ValuingBiodiversityDiscussionPaper_eftec_November2015v2.pdf) which presents a broad discussion on valuing diversity in the appraisal context and specific guidance on biodiversity values. In cases where available stated preference estimates of biodiversity value are insufficiently robust for use, an alternative is to use quantitative metrics of biodiversity change as objectives and calculate the costs of delivering those objectives.^[footnote 32]

9.1 Land values

Land value changes arising from a change in land use may be used to derive a social value for use in appraisal. This can provide a convenient way of estimating the impact of an intervention rather than valuing the underlying factors that caused the value to change.

- Land prices reflect different attributes of the land's use including planning permission, amenity value, proximity to urban centres and transport connectivity. Land values increased by transport improvements may rise due both to the change in planning status that facilitates development and the benefits from the transport scheme.

The value of an intervention that enables a change in use and subsequent new development may include:

- the private benefit associated with the change in land use, as represented by the uplift in land value due to a more productive use. This is defined as the value of the land in its new use (e.g. commercial or residential) minus the value of the land in its existing use and it typically accrues to landowners.
- the net external effects of the resulting development on society, such as loss or gain in amenity value, transport costs, health or environmental effects and land use value changes etc.

To understand how land values can help in the appraisal of a potential development, it is important to understand the factors that determine the land's price. The private benefit or Gross Development Value (GDV) is the estimated total revenue that could be obtained from a development, for housing it would be:

$$\text{GDV} = \text{house prices} \times \text{number of dwellings}$$

The residual method of land valuation stipulates the maximum price that will be paid for the land (commercially) after accounting for development costs and a minimum level of profit:

$$\text{Land price} = \text{GDV} - (\text{development costs} + \text{fees} + \text{profit})$$

Therefore the land price reflects the value of the land in its new use (the GDV) less the expected development costs and minimum required profit. In a well-functioning market, competition for the right to develop the land drives the price of land up to a point where a normal level of profit is achieved, where the change is equal to the economic rent extracted from the land.

In appraisal terms, the difference between this new land value and its previous land value represents the net private benefits of the development. This is the final value of the site, less development costs, less the value of the land in its "old" use. Any increase as a result of a change in use reflects the economic efficiency benefits of converting this land into a more productive use.

To estimate the full value to society of the change in use wider effects need to be accounted for. The Net Present Social Value (NPSV) of a development is the discounted sum of the land value uplift and the net value of wider effects, taking into account potential deadweight and displacement. The range of wider effects associated with a development includes the amenity cost or benefit associated with a development, potential health effects and any transportation effects arising from the development. Further details of potential external effects and appraisal values are given in the MHCLG Appraisal Guide (<https://www.gov.uk/government/publications/department-for-communities-and-local-government-appraisal-guide>). When considering the wide range of positive and negative effects, double counting of benefits needs to be avoided. For transport appraisal the Department for Transport's (DfT) Web-Tag guidance (<https://www.gov.uk/guidance/transport-analysis-guidance-webtag>) should be used.

Land value data is derived from market data which is dependent on individuals' and firms' valuation of a specific piece of land. Where local land value data is available, this information can be used to appraise the net impact of a development. However, where this data is not readily available, illustrative land value data from the Valuation Office Agency (VOA) is available. This is included in the MHCLG Appraisal Guide (<https://www.gov.uk/government/publications/department-for-communities-and-local-government-appraisal-guide>) and the MHCLG publication Land value estimates for policy appraisal (<https://www.gov.uk/government/publications/land-value-estimates-for-policy-appraisal>). It provides estimates for the average prices of residential, greenfield and brownfield land in England from 2014, with residential land split by local authority. Further guidance on the appraisal of transport dependent land developments can be found in WebTAG Unit A2.3 (<https://www.gov.uk/government/publications/webtag-tag-unit-a2-3-transport-appraisal-in-the-context-of-dependent-development-july-2016>).

9.2 Energy efficiency and Greenhouse Gas (GHG) values

This is a high-level guide to valuing Greenhouse Gas (GHG) emissions and energy use for appraisal purposes. BEIS publish (<https://www.gov.uk/government/publications/valuation-of-energy-use-and-greenhouse-gas-emissions-for-appraisal>) more extensive guidance, background, rationale and relevant data tables that should be used.

The steps given below are based on a change in fuel or energy use. Most interventions will have other objectives and will involve energy use as part of a wider effect. In both cases, total energy use and total GHG emissions should be quantified and costed, using the data tables referred to above and included with other costs.

Multiplying the fuel use in each year by the Long Run Variable Cost (LRVC) for that fuel will give the societal value in fuel usage for that period (excluding GHG emissions, which are calculated separately):

$$\text{Social cost of energy} = \text{fuel consumption} \times \text{Long Run Variable Cost (LRVC)}$$

- Step 1 – quantify energy use or efficiency. Identify the fuel or electricity consumption for each year, distinguished by type of fuel and the sector in which the changes are incurred (e.g. residential, commercial, industry). Changes should be measured in megawatt hours (MWh).^[footnote 33]
- Step 2 – value energy or fuel use. The LRVC reflects the production and supply costs of energy which vary according to the amount of energy supplied. They will vary according to the type of fuel, sector being supplied and prevailing fuel prices. Low, central and high LRVC assumptions for different fuels and sectors are published on the BEIS webpages in data tables (<https://www.gov.uk/government/publications/valuation-of-energy-use-and-greenhouse-gas-emissions-for-appraisal>).
- Step 3 – convert energy use into GHG emissions. The formula below shows how to quantify GHG emissions for a given energy use. This uses the energy changes estimated in ‘Step 1’, converted into a GHG measure. An emission factor is used to estimate the amount of GHG emissions from burning a unit of fuel. These vary by fuel type and reflect the mix of fuels required for electricity. The global warming potential of GHG emissions is measured as the equivalent amount of carbon dioxide (CO₂) that would give this warming. The standard unit of account is equivalent tonnes (tCO₂e) or kilograms (kgCO₂e) of carbon dioxide. Various emission factors can be found in the data tables (<https://www.gov.uk/government/publications/valuation-of-energy-use-and-greenhouse-gas-emissions-for-appraisal>). For electricity, the consumption-based long-run marginal emission factor should be used for changes in energy demand. The generation-based emission factors are only used for energy production rather than energy demand. Energy production is generally greater than energy demand to account for losses during the transport of energy to final consumers.

$\text{GHG} = \text{fuel use} \times \text{emissions factor}$

$\text{Cost of GHG} = \text{GHG (kgCO}_2\text{e)} \times \text{value of carbon}$

- Step 4 – value to society of emissions. GHG values are based on the economic cost of mitigating a unit of carbon. The carbon value will vary depending on the sector from which the emissions occur:
- the traded sector is defined as those activities covered by the EU Emissions Trading System (EU ETS) which sets a market price for carbon. It generally covers all power generation, many energy-intensive industries, and intra-EU aviation. Therefore, all electricity consumption is covered by the EU ETS and is in the traded sector.
- the non-traded sector – includes all other energy consumption, including all household and non-aviation transport fuel use (excluding electricity).

Carbon value assumptions for the traded and non-traded sectors are available for 3 different scenarios (low, central, and high) to enable sensitivity analysis. The values can be found in the data tables (<https://www.gov.uk/government/publications/valuation-of-energy-use-and-greenhouse-gas-emissions-for-appraisal>). Further detail on how to map energy use to the traded and non-traded sectors is available in the BEIS online guidance (<https://www.gov.uk/government/publications/valuation-of-energy-use-and-greenhouse-gas-emissions-for-appraisal>).

9.3 Life and health

Risks to life and health

This section outlines some approaches to the measurement and valuation of risks to life and health. In addition to valuing changes to the risk of a statistically prevented fatality, other methods most often used in appraisal are statistical life-years (SLYs), quality-adjusted life-years (QALYs) and sometimes disability-adjusted life-years (DALYs) which are explained further below. The choice will depend on the appraisal and should be agreed with the approving authority.

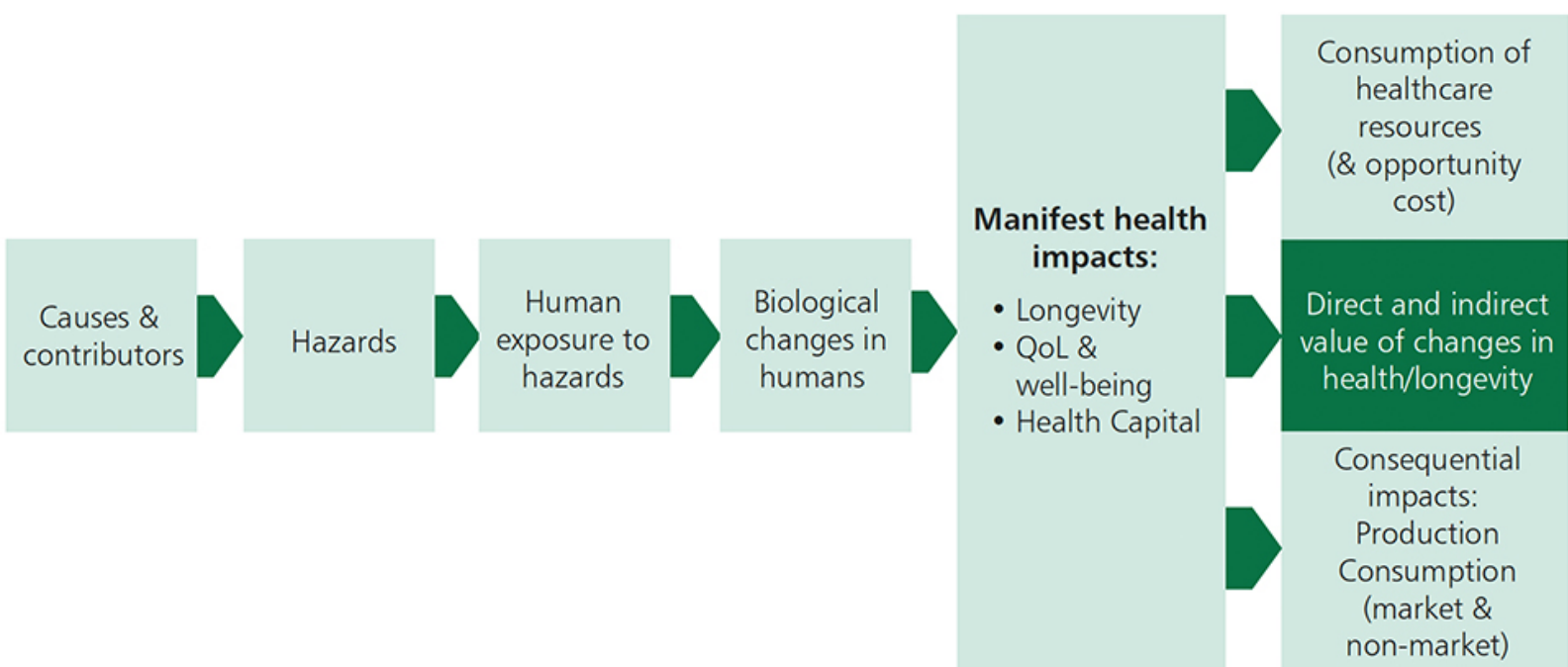
Measurement of health impact may be expressed in the two dimensions of length of life (longevity), and health-related quality of life (QoL). Different risks, and interventions to reduce those risks, may affect different dimensions. Some risks entail significant loss of longevity, some QoL rather than longevity and some both. Measurements using numbers of fatalities or SLYs reflect the longevity dimension only, while QALYs reflect both longevity and QoL dimensions.

On grounds of equity in appraisal QALY values, SLY values and the valuation of a statistically prevented fatality (VPF) are based on average values from representative samples of the population (who differ in their incomes, preferences, age, states of health and other circumstances). These values are used when analysing and planning the provision of assets, goods and services at a population or sub-population level. They are not designed for use in contexts such as situations of emergency or rescue.

Life and health effects

Health affects the ability to produce and consume goods or services and the ability to derive welfare and well-being directly. The impact pathway approach is a way of structuring analysis of the effects of external factors from causes to consequences for health and life. A general model which, is used to structure this approach, is shown in Figure 5.

Figure 11. The Impact Pathway Approach



An example of a biological change could be hypertension (high blood pressure). This can be caused by human exposure to hazards such as lead in petrol, sustained environmental noise, salty food, high consumption of alcohol, smoking, and lack of exercise. Hypertension is a cause of angina, heart attacks and stroke, typically affecting life expectancy, QoL and the consumption of healthcare resources. These then affect participation in paid and unpaid production, paid for consumption and not paid for consumption (such as informal care), and the health or welfare of others (e.g. family members). Interventions at any point in the pathway may have health and longevity consequences. At whatever stage the intervention occurs, consequential impacts along the pathway should be considered, including:

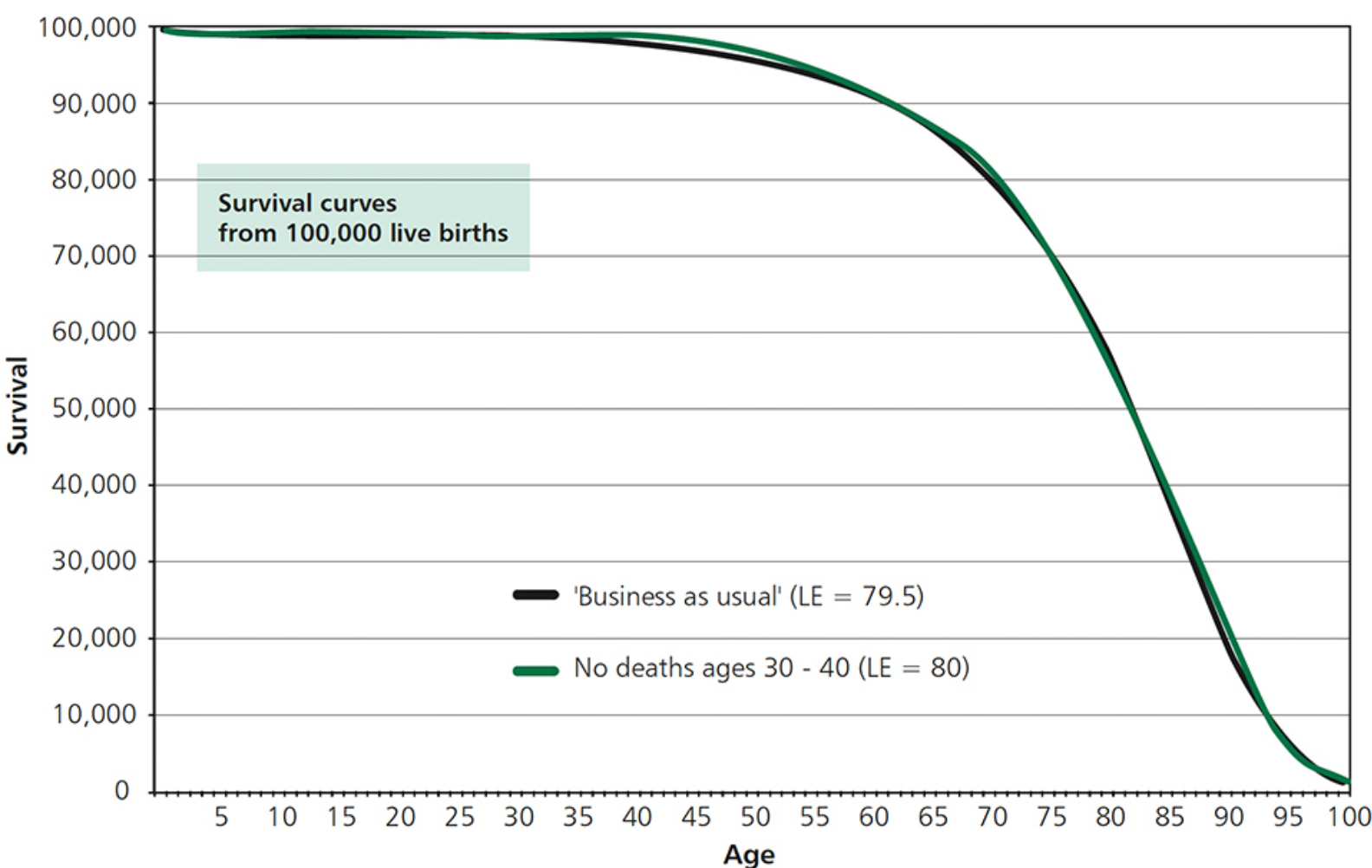
- the opportunity cost (or benefit) of shifts in the consumption of healthcare resources alongside other costs of the intervention
- the direct value of the change in health or longevity
- indirect and consequential impacts

Measuring and valuing risks to longevity

For Social Cost Benefit Analysis involving risks to longevity, clarity is required concerning how length of life is affected by the risk or intervention. Longevity can be measured as life expectancy. This can be expressed as the area under a survival curve, which shows the likelihood of surviving to any given age, as illustrated in Figure 12. Life expectancy is a statistical expectation of the risk of dying at any given age, rather than a specific number of years. If for example a cohort of 100,000 people faced a 1% risk of dying aged 30 to 40, and an intervention could eliminate this risk, the intervention could be described as preventing 1,000 fatalities.

The black line in Figure 12 represents the survival profile without the intervention and the green line with elimination of all 1,000 deaths between the ages of 30 and 40. The cohort collectively would live an extra 45,000 statistical life-years (SLYs), compared with Business As Usual. The cohort's life expectancy would increase by 0.45 years per person; and the unknown 1,000 people whose early deaths are prevented would each gain, on average, 45 years of life expectancy. They are not certain to live an extra 45 years, this is their average statistical expectation of life. This valuation method does not relate to "life-or-death" circumstances affecting specific individuals. It is unknown which members of the cohort would be the prevented fatalities.

Figure 12. Illustration of longevity effects



Monetary valuations of a VPF have been used in transport appraisals for several decades. They derive from research conducted on behalf of DfT. The current value and references to the research on which it is based can be found on the DfT webpages (<https://www.gov.uk/guidance/transport-analysis-guidance-webtag#webtag-data-book>).

The value of a SLY is derived from the same empirical evidence as a VPF. SLYs help with the appraisal of options where the number of years of life expectancy at risk differs between options; valuing impacts in terms of SLYs offers a way of allowing for this difference. The current monetary value for a SLY is £60,000 and is updated annually (see DfT web pages (<https://www.gov.uk/guidance/transport-analysis-guidance-webtag#webtag-data-book>) for further information).

Measuring health-related quality of life and QALYs

QoL is the other key dimension used in health-related appraisal. The two dimensions of longevity and QoL are aggregated in the concept of a QALY. As risks, and interventions to reduce them, can affect QoL as well as longevity, QALYs can reflect this additional dimension. QALYs are calculated by multiplying the change in QoL by the duration (in years) – for example a reduction in QoL from 1.0 to 0.5 for 6 months equals the loss of 0.25 QALYs. While not necessarily as straightforward as measuring length of life, measuring QoL can be undertaken with simple instruments such as questionnaires. The most widely used of these in the UK is the EQ-5D. This measures QoL in 5 dimensions:

- mobility
- ability to self-care
- ability to carry out usual activities
- pain/discomfort
- anxiety/depression

Each dimension is rated at one of 5 levels: no problems / slight problems / moderate problems / severe problems / extreme problems or unable. With 5 levels on 5 dimensions, EQ-5D is able to describe 3,125 (i.e. 5⁵) “health states”. Cardinal ratings for these health states – on a scale where 1 is equivalent to the best of health, and 0 to being dead – are available for the UK, based on the preferences of the population.

- Ratings between 0 and 1 for different health states described by the EQ-5D tool are available from the EuroQol website (<https://euroqol.org/eq-5d-instruments/eq-5d-3l-about/valuation/>)
- ideally the QoL ratings under the options being considered should, if possible, be sourced from people like those who would be affected (as commonly happens in clinical trials). However, if that is not feasible, QoL ratings for some common health states are available.^[footnote 34]
- monetary valuations of QALYs are available for the UK. The current monetary WTP value for a QALY is £60,000. Further information on the basis for the value of a QALY can be obtained by contacting the Department of Health and Social Care.

Discounting of resources relating to health and life issues is carried out using the appropriate standard discount rate of 3.5% declining after 30 years. The value of VPFs, SLYs and QALY effects should be discounted at the health rate of 1.5%, declining after 30 years. See Annex 6 for further information on the discount rate.

DALYs are a measure of life-years adjusted for loss of quality of life and loss of life expectancy for people living with a health condition or its consequences. Unlike life expectancy, which is measured by the area below profiles such as the survival curves illustrated above, DALYs measure a loss of longevity aggregated with loss of quality of life (the area above a curve). Appraisal of an intervention is concerned with estimating the difference that it makes – hence the intervention’s impacts could be described in terms of QALYs gained or DALYs prevented. However, in practice, DALYs differ in some subtler ways and are used less often in the UK.

9.4 Travel Time

Values of Travel Time Savings (VTTS) vary according to journey purposes, the characteristics of the journeys being made and the preferences of individual travellers. In the context of transport appraisal, it is standard practice to disaggregate VTTS by 3 journey purpose types:

- commuting – often to/from a usual place of work
- employer’s business – journeys made in the course of work
- other non-work – all other trips (such as shopping, leisure and personal trips)

The VTTS for employer’s business trips represents the opportunity cost to the employer of time spent travelling by their employee. Businesses benefit from reduced travel times include improved access to suppliers or customers, which increase productivity by lowering the cost or raising the quality of inputs and widening the market a business can serve. It is these benefits that form the basis of values of employer’s business VTTS.

For non-work (commuting and other non-work trips) the VTTS represents the value travellers place on the preferable activities they can undertake in the saved time. For instance, in response to a quicker commute a traveller could choose to spend more time at home with their families or move to a bigger house further away from work.

VTTS differs by travelling conditions, for example:

- a higher value is placed on saving walking or waiting time than on saving time spent in a vehicle
- time spent in overcrowded conditions on public transport also carries a higher weight, the value being determined by the severity of the overcrowding
- reliability can also carry a premium and is commonly measured in terms of the standard deviation of journey time or average lateness in the case of public transport

Values for use in VTTS are available in the WebTAG data book (<https://www.gov.uk/guidance/transport-analysis-guidance-webtag#webtag-data-book>) which is maintained and updated annually by DfT. Further, more detailed guidance on the use of VTTS in transport appraisal and information on the derivation of DfT's recommended VTTS can be found on the DfT webpages (<https://www.gov.uk/government/publications/webtag-tag-unit-a1-3-user-and-provider-impacts-march-2017>).

Value transfer considerations for VTTS

The DfT's published VTTS represent the typical values of time savings resulting from transport interventions. Therefore, the recommended standard VTTS may not be appropriate if the characteristics of the affected group are not similar transport users, or differ significantly from those of a typical transport scheme. In these circumstances the DfT values may still be used as an indication of the order of magnitude of impacts.

9.5 Unmonetisable values

As part of shortlist appraisal proportionate effort should be made to monetise the significant costs and benefits of each option (as set out in Chapter 5). The resources and effort should be related to the scale of the proposals under consideration. The scale may be judged in terms of financial costs or savings, social welfare costs or benefits and risks involved to society and the public sector.

Where it is not possible to monetise certain costs or benefits they should be recorded and presented as part of the appraisal. Where possible these unmonetisable values should be assessed in another way, providing an understanding of their magnitude.

Straightforward unmonetisable values

Significant unmonetisable values that are important enough to affect key choices about options should be considered at the longlist stage. Strategic examination of the longlist of options can deal with many factors that are likely to be unmonetisable when framing the analysis (as set out in Chapter 4). If valuing social benefits is likely to be difficult, it may still be possible to have an idea of potential costs. As part of indicative costing at the longlist stage this could involve estimating the additional costs of an option which delivers these greater benefits and considering whether the additional costs are worthwhile.

At the shortlist stage unmonetisable values should form part of the consideration for determining the preferred option. This will involve presenting an assessment of unmonetisable effects alongside estimates of NPSV and describing the potential impacts on a decision.

Complex unmonetisable values

Complex, unmonetisable trade-offs occur where there are a number of important unmonetisable costs or benefits in different options that need to be balanced. Such trade-offs are often strategic in nature and involve the design of solutions based around alternative benefits against a limited budget.

Multi-Criteria Decision Analysis (MCDA) using swing weighting is a technique that can be employed at the longlisting stage to consider unmonetised trade-offs. Where there are a number of competing often complex technical trade offs to be made, it can helpfully be applied to the choices for service scope and service delivery. This occurs during longlisting and selection of the shortlist. MCDA should not be confused with simple weighting and scoring, sometimes referred to as Multi Criteria Analysis (MCA). This latter is not a recognised Green Book approach because of its lack of transparent objectivity. MCDA should not be used as a substitute for cost benefit analysis in appraising the shortlist. To work effectively MCDA requires top level decision makers, senior experts and stakeholders to be assembled in a workshop, facilitated by an independent expert facilitator experienced in MCDA, and the use of swing weighting. They should also be accredited at least to foundation level in understanding the Green Book five case model. To justify this level of involvement by senior decision makers experts and stakeholders it is likely to be employed on proposals with very significant associated costs and, or risks, as well as the complexities outlined above. Supplementary Green Book guidance available from the Green Book web pages provides detailed guidance on how to undertake MCDA in accordance with the Green Book.

Users of MCDA must:

- ensure the MCDA facilitator is independent and experienced and understands the limitations of the method
- involve stakeholders representing the interests of those affected by and implementing the options under consideration
- explore the problem under consideration in advance to ensure that all key criteria which influence social value are included
- ensure that bias is eliminated through requiring justification of preferences captured including their impact on social value and employment of other techniques by the facilitator
- ensure the independence of criteria used where a linear weighted-sum model is used
- use swing a weighting method, in which the weights represent the relative value attached to the swing in preference between least and most preferred option in each of the criteria
- ensure an independent reviewer oversee the analysis.

10. A2. Place Based Analysis

10.1 Definition

Place based analysis concerns appraisal applied to geographically defined areas within the UK. This definition includes a wide range of obvious categories such as, villages, towns, cities, counties and regions and the home countries that make up the UK, it also includes other geographically based definitions such as “rural areas” or “areas of urban deprivation.”

Place based analysis is be required for two broad categories of proposal:

- proposals with an objective that is specific to a particular place or area or type of area;
- proposals which do not have geographically defined objectives but which appear likely to have different implications either positive or negative for parts of the UK that decision makers will need to understand and may need to take into account.

Where a proposal has geographically defined objectives, then the principle frame of reference relating to the analysis of costs, benefits and value concerns the area in question. There should also be proportionate analysis of the whole home country effects or the whole UK effects. The choice will depend on the legislative reach or the proposal being considered. As always in the Green Book proportionality relates to the costs, benefits and risks involved to society and to the public sector.

10.2 When to employ place based analysis

As outlined above, where proposals have a focus on a specific part of the UK, place based analysis should be performed and be central to appraisal advice. Where proposals are not principally focused on a specific part of the UK, the potential for significant differential place based impacts should be considered, and a decision taken

about whether to undertake more detailed analysis. This decision should balance the cost and feasibility of such analysis against the likelihood of significant positive or negative consequences for parts of the UK that decision makers need to understand and may wish to take in to account. Where place based analysis is not undertaken then the decision not to do so should be explained and justified.

- The relevance and extent of place based analysis will be context specific and a matter of judgement for those developing, appraising and scrutinising business cases. The research and analysis that takes place before the start of a business case should consider whether a place based analysis is likely to be required. The decision criteria should be based on the likely significance of consequential effects in areas of particular concern. The analysis should be proportionate to the scale of the effects on the affected areas in relation to their existing situation, and a list of questions to consider is provided in ^[footnote 4]

below. Consideration should be given to both positive and negative effects:

Box 24. Place Based analysis for projects without a specific spatial focus

Where proposals are not principally focused on a specific part of the UK, the potential for place based impacts should be considered, and a decision taken about whether place-based analysis is required. The following questions should be considered as part of this analysis.

Differential spatial impacts

- Do you expect impacts to be differ significantly in different areas, or types of area (at any spatial scale)?
- Where data is available at a spatial area level can this be presented graphically (i.e. on a map)?
- Where data is not available, can improvements be made to data collection to ensure that it can be provided in future?
- If effects are significant what is a proportionate level of analysis and can this be built into monitoring and evaluation arrangements?
- In areas experiencing significantly different effects will any of the protected groups identified by the Equality Act or Families Act be significantly affected by the proposal? If so, there is a duty to proportionately consider these effects and determine whether action is required as a result.

Alignment with local plans and strategies

- Where impacts are significant, to what extent does the intervention align with wider strategic objectives for the relevant area/s?
- Where impacts are significant, is the VFM of the intervention dependent on the successful delivery of other interventions in the relevant area/s?

Box 25. Place Based analysis for projects with a specific spatial focus

Where the objectives of proposals have a specific spatial focus then place based analysis should be central to appraisal and the advice it supports. The following questions may be considered as part of this analysis.

- Is the proposal part of a wider programme that has been agreed in principle, if not are there external dependencies that significantly effect its viability?
- What are the expected effects in the target area/s?
- Are there likely to be unintended negative or positive collateral effects in the target area or within wider spatial area such as nearby travel to work areas?

- Within the identified areas will any of the protected groups identified by the Equality Act or will Families be significantly adversely affected by the proposal, proportionately consider these effects and determine whether action is required as a result.
- Will there be significantly different impacts by income group? All significant gaining and losing groups of a policy should be identified.
- Where relevant data is unsatisfactory or unavailable can improvements be made to produce it in the future?

Alignment with local plans and strategies

- What are the views of local stakeholders?
- To what extent does the proposal align with wider public policy in the relevant area/s and the UK as a whole/s

Interdependencies with other local or national interventions

- Is achievement of the proposal's SMART objectives dependent on the successful delivery of other proposals, if so, are they part of the same programme? If not, how is this risk being managed.

10.3 Inclusion of employment and productivity effects

An explanation of when and how productivity, labour supply and demand effects may be included in the estimation of social value at the UK level is given in Chapter 6. New employment may not be included in UK level appraisal where the relevant focus of advice is the aggregate UK effect and it is not possible to reliably and credibly calculate the effects to a level of accuracy required to support differentiation between alternative options. The choice to target interventions to specific employment sectors or geographical areas should be set at the level of strategy, guided by appropriate research. If a place based competitive bidding process is employed, then the approach recommended at paragraph 5.82 must be followed.

There are some differences in the approach permitted for place based appraisal where the primary objective is to analyse the impact on the place or places in question. The effects on the relevant travel to work areas should also be included if they are liable to be affected. Box 26 summarises the differences. Larger effects of a strategic nature should be taken into account within a programme of which the project under consideration is a part. Project decisions should take place within a programme's overall context.

In addition to the effects considered for UK level appraisal, place based appraisal may also include employment changes in the area under consideration. Where the proposal has geographically targeted objectives, appraisers should clearly specify whether the employment objectives relate to employment located in the area (including those taken by in-commuters), or to employment of residents of the local area (including in jobs outside the target area). Employment effects should be adjusted for leakage, substitution and displacement as set out below, noting that treatment of these effects depends on the employment objective above. Where appropriate, employment multipliers can also be applied.

10.4 Leakage, displacement, and substitution

Place based effects should be adjusted for:

- substitution where firms substitute one type of labour for another to benefit from an intervention but do not increase employment or output.
- leakage which is the extent to which effects "leak out" of a target area into others. For an intervention designed to increase employment in a particular area, leakage could take the form of increased employment in neighbouring areas. For the example in Box 27, some of the employment creation occurs in the surrounding area. This leakage of employment effects into neighbouring areas reduces employment

- effects in the target areas. However, leakage is not always a ‘zero sum’ game. For example, a place-based crime intervention might decrease crime in neighbouring areas (leakage) without reducing the effect in the target area.
- displacement which is the extent to which an increase in economic activity or other desired outcome is offset by reductions in economic activity or other desired outcome in the area under consideration or in areas close by. For example, where a supported business takes market share from an unsupported business.

The above adjustments needed to be based upon objective evidence. Public bodies that routinely engage in place based interventions should collect data to develop an objectively based, well researched evidence base to support decision making. From the outset, research and use of previous evaluation evidence is vital, made more important by the relative scarcity of well supported objective data. Data provided by the prospective beneficiaries of an intervention should be independently verified. Ranges should be presented and variability in data should be clearly shown and used in sensitivity analysis to test the results. This uncertainty should be allowed for when setting SMART objectives by using ranges and expected values and the evaluation of results. Application of assumptions with no basis on objective data is not a satisfactory approach.

Place Based Employment Multipliers

Where appropriate, employment multipliers can be applied following the adjustment for leakage, displacement and substitution. The recommended values in Box 26 are based on empirical research and provide estimates of the additional jobs that will be generated in the area via both supply and demand linkages. These multipliers apply only where an intervention creates jobs in ‘tradable’ sectors, i.e. those the output of which is sold mostly outside the local area. Conversely non tradable applies to occupations the output of which is mostly only deliverable within the local area. Care must be taken to apply the appropriate multiplier and to use ranges to indicate low and high estimates. The appropriate multipliers to use will depend on the functioning of the local labour market. Where the employment rate is at or above the national average and/or projected local employment numbers are large relative to the local unemployment rate, multipliers at the lower end of the range would be expected as the likely level of displacement will be greater. An illustrative example is provided in Box 27 to illustrate how the analysis can be applied.

Deadweight refers to allowing for outcomes that would have taken place without the intervention under consideration. It applies to any proposed intervention and it will be revealed when the total outcome of an option for intervention is compared with business as usual, the (BAU), since comparison with the BAU reveals what would have occurred without intervention.

Box 26. Place Based (i.e. Sub-UK) Employment multipliers^[footnote 35]

Direct employment category	Tradable	Tradable	High tech tradable	High skilled tradable	Public sector
Effect on employment sectors:	Non-tradable	Tradable	Non-tradable	Non-tradable	Private sector
Central	0.9	0.4	1.9	2.6	0.25
Low	0.1	0.3	0.7	2.5	−0.7
High	1.6	0.6	4.9	3.0	1.3

A proposed intervention aimed at improving levels of youth unemployment among residents would create 200 new apprentice jobs in Loweville, a central borough within a wider travel to work area, Highton. The place based appraisal should estimate the net employment effects in both areas. The proposed jobs are in

the tradable sector (i.e. that sell mostly outside the local area), so the relevant multipliers are 0.9 and 0.4 (i.e. every 10 new net jobs generates a further 9 jobs in the non-tradeable sector and 4 in the tradable sector).

Research suggests that 80% of all jobs, across all sectors, in Loweville are filled by Loweville residents, with the remainder commuting from the surrounding TTWA. Conversely, 20% of Highton jobs are filled by Loweville residents.

Box 27. Hypothetical Illustration: Calculating place based employment effects

Job creation, loss and displacement			
	Loweville	Highton TTWA (excludes Loweville)	Total TTWA
CREATION 200 new apprentice places	200	0	200
SUBSTITUTION 50 employees lose their jobs in the same firms	-50	0	-50
DISPLACEMENT 20 jobs are lost in other Loweville firms and a further 20 are lost in other Highton firms	-20	-20	-40
Net ‘direct’ job creation	130	-20	110
Direct employment effects			
	Loweville	Highton TTWA (excludes Loweville)	Total TTWA
LEAKAGE Direct employment in each area as a result of job creation	$(0.8 \times 130) = 104$ $(0.2 \times -20) = -4$	$(0.8 \times -20) = -16$ $(0.2 \times 130) = 26$	110
Net ‘direct’ employment effects	100	10	110
Indirect employment effects			
	Loweville	Highton TTWA (excludes Loweville)	Total TTWA
MULTIPLIER Indirect employment creation in the non-tradable sector	$(0.9 \times 100) = 90$	$(0.9 \times 10) = 9$	99
Indirect employment creation in the tradable sector	$(0.4 \times 100) = 40$	$(0.4 \times 10) = 4$	44
Net ‘indirect’ employment effects	130	13	143

Job creation, loss and displacement			
	Loweville	Highton TTWA (excludes Loweville)	Total TTWA
Total net employment in each area	230	23	253

Employment effects should be translated into monetised value of employment to represent the welfare effect. In this example, the multiplier effects are applied based on the residence of the worker, rather than the location of the job. The choice of which is most appropriate is dependent on the objective of the calculation in each case.

Income and Welfare distribution considerations and calculations apply in place based proposals in the same way as for UK wide appraisal as set out in Chapter 4 paragraphs 4.18 - 4.19 and Chapter 5 paragraphs 5.66 - 5.76 and in Annex 3.

Equalities considerations and calculations apply in place based appraisal in the same way as in UK wide proposals.

When calculating place based values other social costs and benefits should be treated in the same way as for UK wide appraisal and proportionality should be judged in the same way.

11. A3. Distributional Appraisal

Distributional analysis is a term used to describe the assessment of the impact of interventions on different groups in society. Interventions may have different effects on individuals according to their characteristics (e.g. income level or geographical location). These effects could be a deliberate government objective or the unintended consequences of an intervention. These concepts are introduced in Chapter 4 paragraphs 4.18 - 4.19 and Chapter 5 paragraphs 5.66 - 5.76.

It is not proportionate to calculate all distributional effects. The appraisal method employed for considering distributional effects should be proportionate to the likely consequences for those affected and may be judged based on:

- Where the impact on those affected is minor it may be sufficient to ensure that decision makers are made aware of the effect and its likely scale, and possible options for avoidance or mitigation.
- Where it is a significant collateral effect of another policy a straightforward monetary analysis may be required.
- Where redistribution is a policy objective such as payments under the welfare system or if it is highly significant in terms of the impact on incomes and welfare of those affected then a weighted and equivalised income distribution analysis may be justified

When considering how to apply a weighted analysis consider the following:

- is the analysis targeted at individuals or a mixture of households of different size and composition? If the latter then equivalisation may be required, prior to applying weights
- is the income of the group affected by the intervention known? If known and a welfare weighting approach is proportionate it should be used to calculate the welfare weight. If not, then the HBAI income groups (<https://www.gov.uk/government/collections/households-below-average-income-hbai--2>) can be used.

Distributional weighting

When assessing costs and benefits of different options it may be necessary or desirable to “weight” these costs and benefits, depending on which groups in society they fall on. This is in addition to estimating the “unweighted” costs and benefits, which is the minimum requirement of Social CBA. In weighted analysis, financial benefits for lower income households are given a higher social value than the equivalent benefits for higher income households. Weighted estimates should be presented alongside unweighted estimates to demonstrate the impact of the weighting process.

The basis for distributional weights is the economic principle of the diminishing marginal utility of income. It states that the value of an additional pound of income is higher for a low-income recipient and lower for a high-income recipient. Broadly a value of 1 for the marginal utility of income would indicate that the utility of an additional pound is inversely proportional to the income of the recipient. An additional £1 of consumption received by someone earning £20,000 per year would be worth twice as much than to a person earning £40,000. Higher estimates of the marginal utility of income will mean the value of an additional pound declines more quickly relative to increases in income.

A review of international evidence provides an estimate of the marginal utility of income at 1.3.^[footnote 36]

This is used by DWP in distributional analysis. The estimate of the marginal utility of income can be used to calculate welfare weights to adjust costs and benefits.

Equivalisation

Where distributional effects are quantified by applying weights, it may also be necessary to apply “equivalisation” techniques. Often the distributional impact of policy will be estimated by household, however households can have different structures.

Equivalisation applies a scaling factor to household income to adjust for composition (factors such as age, income and size) to standardise the welfare impact. This allows a consistent comparison in welfare terms between households of different structures. For example, where a single person would have a higher standard of living than a couple with the same household income, equivalisation produces a higher “equivalised income” for the single person to reflect this.

An example of equivalisation is set out in Figure 13, which DWP use in the annual statistical publication on poverty at the UK level, entitled Households Below Average Income (HBAI) (<https://www.gov.uk/government/collections/households-below-average-income-hbai--2>). The government commonly bases analyses on the household as this is the level at which budgeting decisions and benefit incomes are considered. In some circumstances, however, it may be appropriate to consider relative incomes at an individual level.

Figure 13. Methodology for Income Equivalisation

Income data undergoes equivalisation

Equivalisation allows comparisons to be made of individuals of different ages from different sized **households**.

Each household member is given a standard weighting which is summed together

Weekly net income before equivalisation

Weekly net income after equivalisation

$$0.67 + 0.33 = 1$$



£300

÷ 1



£300

A couple with no children is the reference point

$$0.2 + 0.67 + 0.33 + 0.2 = 1.4$$



£300

÷ 1.4



£214

Income has decreased as a couple with children need a higher income to enjoy the same living standard

$$0.67$$



£300

÷ 0.67



£448

Income has increased as a single person needs a lower income to enjoy the same living standard

Score value

First adult 0.67

Other adult 0.33

Children 14 yrs & over 0.33

Children under 14 yrs 0.2

If specific data is not available for an intervention's target population, then data on incomes by quintile may be used. This is provided by the ONS and HBAI and summarised in Table 5 below. HBAI (2017)

(<https://www.gov.uk/government/statistics/households-below-average-income-199495-to-201516>) presents weekly equivalised income (£) by quintile in 2015/16 prices and is updated annually. Ensuring this is representative of the income for the group concerned in a particular proposal is important and affects the accuracy of any estimates produced.

Table 5. Quintile Groups of all Households Ranked by Equivalised Disposable Income (Based on Weekly Income Before Housing Costs 2015/16)

	Bottom	2nd	3rd (Median)	4th	Top	Mean of All Households
Final income (£)	244	363	481	638	946	593

Calculating welfare weights: practical steps

To appraise the impact of policies using distributional weights, the equivalised income for two groups is estimated:

- taxpayers as funders of policies (group t) – who are assumed to have an average income (using median equivalised income)
- programme participants who benefit from the policies (group p) – who are assumed to be in the lowest equivalised income group, given DWP's overall objectives. For other departments applying this approach, interventions may be targeted at groups with higher incomes. If that is the case a higher income estimate should be used.

Using the "taxpayer" and "programme participant" approach welfare weights can be estimated as follows:

- divide median equivalised income of average taxpayers (proxied by median of all households) by the median equivalised income of programme participants (proxied by the quintile that matches the target for distributive effects)
- raise this number by the power of 1.3 (the estimate of elasticity of marginal utility of income as set out above)
- the result is the redistributive effect for an individual member of the group being affected by a policy change
- Fujiwara (2010) (<https://www.gov.uk/government/publications/the-dwp-social-cost-benefit-analysis-framework-wp86>) uses this methodology to estimate a welfare weight of 2.5, based on income figures from the Office for National Statistics. Using more recent 2015 data (<https://www.gov.uk/government/statistics/households-below-average-income-19941995-to-20132014>)^[footnote 37] yields a slightly lower welfare weight of 2.4.

The weighted impact resulting from any redistribution is as follows:

impact on society = change in income, group p * welfare + change in income, group t

There is uncertainty in both weighting and equivalisation methods. Presenting unweighted and weighted costs and benefits side-by-side shows the impact of the weightings. Testing the estimated weights through sensitivity analysis, including switching values where appropriate, is recommended. Switching values estimate the value that a key input variable (in this case the income weights) would need to take for a proposed intervention to be not worth pursuing (see Chapter 5).

12. A4. Public Private Partnerships

This Annex provides further detail on how Public Private Partnership (PPP) options should be considered in appraisal. More detail is available in the HM Treasury Business Case Guidance (<https://www.gov.uk/government/publications/the-green-book-appraisal-and-evaluation-in-central-government>).

A variety of PPP options may be relevant to consider in options appraisal alongside other options as part of public service provision. These include different possibilities for purchase or outsourcing of service delivery covering construction, operation, delivery and risk sharing. All of these have potentially different costs, benefits and degrees of complexity relative to public sector provision or funding. There are also different commercial and contractual issues for example, the costs of flexibility and risks, to consider in an assessment of specific PPP options.

12.1 Overview of PPP options

PPPs can be included as an option in longlist appraisal (set out in Chapter 4) alongside delivery alternatives such as direct public provision, outsourcing, market creation, not-for-profit solutions, changes to regulation, the use of nudge techniques and grant giving. The choice for how an option is delivered should be closely linked to the nature of the intervention and some interventions will be more amenable to PPP options than others.

PPP appraisal at the longlist stage

When considering PPP at the longlist stage, qualitative questions help to identify whether PPP should be the “preferred way forward” or form part of the shortlist. In addition to assessing a PPP option against critical success factors set out in Chapter 4, the issues in Box 28 should also be considered.

- Public sector organisations putting forward PPP proposals (the responsible organisation) will need to secure as much evidence as possible against the questions in Box 28 as part of the long-list process. In particular, they need to consider the lifetime costs and risks involved in the project, including those arising from early termination. The risk assessment should also consider any major financial and operational risks that could affect the private partner over the life of the project.

Box 28. Qualitative Issues when Considering Ppp Options

Issues to Consider

Ability of the public sector to define and measure objectives and outputs

- Is the responsible organisation satisfied that long term contracts could be constructed for projects in the sector and that any contractual outputs could be objectively measured and assessed?

Risk allocation and management of risk by the private sector

- Is the responsible organisation sure that optimal risk allocation and service delivery is achieved through a PPP delivery model (including practical risk transfer to the private sector for better management)?
- Is the private sector able to manage the risks associated with the programme more effectively than the responsible organisation?
- Have service demand and income risks been fully assessed in the context of proposed contract length for the PPP option?

Operational flexibility

- Is the responsible organisation sure that there is an appropriate balance between the degree of operational flexibility desired and long term contracting based on up-front capital investment?
- The responsible organisation should assess the likelihood and nature of variations during the life of the contract.
- Can the service be implemented without unacceptably constraining the responsible organisation in Value for Money delivery of future operational objectives?

Equity, efficiency and accountability

- Is the responsible organisation sure there are no factors that mean direct service delivery is required, rather than a PPP contract?

Innovation by the private sector

- Is there scope for innovation in the design of the solution or the provision of services, including the need for removal of constraints by the public sector organisation?

Contract duration and residual value

- Is the responsible organisation sure that the advantages and disadvantages of the proposed contract length are understood?
- This consideration should include how far into the future service demand can reasonably be predicted, the expected life of any assets, what the expected use of any asset or service could be post-contract, the residual value of any assets and the affordability of the contract.

Incentives and monitoring

- Can the contracts be drafted to avoid perverse incentives for the private sector? Are private sector partners actively able to manage the risks they will hold and be held accountable for doing so?
- The responsible organisation should assess whether incentives for delivery or service levels can be enhanced through the proposed PPP payment mechanism. They should also be satisfied that the service can be independently assessed against an agreed standard.

The Market

- Is the private sector capable of delivering the required outcome?
- The responsible organisation should assess whether a significant market with sufficient capacity for these services exists in the private sector.
- They should also assess whether there is sufficient market appetite and whether other similar projects have been tendered to market.
- Do potential private partners have the financial and managerial resources to manage the risks it is taking on?

Timescale

- The responsible organisation should ensure that the procurement is feasible within the required timescale and that there is enough time for the resolution of key procurement issues.

Skills and resources

- The responsible organisation should ensure that it has the management expertise and capacity to define, deliver and support the service throughout the procurement and the subsequent delivery period.

PPP appraisal at the shortlist stage

Shortlist appraisal of PPP options should take place in the same way as other options. This includes calculation of social value, valuation of wider social costs and benefits, consideration of unmonetisable benefits, application of optimism bias, risk costing and sensitivity analysis.

The Green Book recommends that, Business As Usual, a do-minimum option, the preferred way forward and at least one other viable alternative option are included in the shortlist. At least two viable options other than the preferred way forward are required. At the longlist stage, if any form of Public Private Partnership (PPP) option including an outsourcing or insourcing change, is selected as a preferred way forward, then at least one of the viable alternative options must be for comparable direct public provision. This is required option is the “Public Sector Comparator,” it provides a benchmark as a fair counterfactual that is used to test the social value for money of the preferred way forwards. This is referred to in some documents as a “should cost model.”

The public sector comparator should be comparable to the PPP option, in terms of service quality and output and also levels and quality of asset maintenance. There should also be an additional PPP version of the do-minimum to check for gold plating of the PPP option. Public sector comparators must be adjusted to remove distortions caused by differences in effective tax rates between the public and the private sector. This is to enable a true comparison of costs and value to be made. Adjustments for tax treatment should reflect as far as possible estimates of the effective tax rate based on tax paid rather than a theoretical maximum.

When part of a business case changes through the process which alters cost, distribution of risk across different points in time or the transfer of risk between participants, this should be included and updated as part of Net Present Social Value (NPSV) and budget calculations. Changes to costs and risk which occur during contract negotiations, should be fed into the NPSV and public sector cost calculations. This means the appraisal of the preferred option is properly informed before a final contract is agreed.

12.2 Benefits and risks of PPP options

In PPP contracts the quality of service provided and performance of the contractor are central to the delivery of VfM. Complexity and change hinder effective risk management. To be successful partnership arrangements need to be thoughtfully designed. Principal-agent theory explains that if the interests of an agent (in this case a private partner) employed by a principal (in this case a public sector organisation) are not aligned, then the agent is likely to act in their own interest. Therefore, from the principal’s viewpoint, unintended and undesirable results may occur.^[footnote 38]

The need to align the interests of agents and principals with minimum complexity means shared objectives need to be high level rather than minutely complex. The need to build in flexibility for future change should be considered. In the longer term, unforeseen changes in the wider environment are likely e.g. the demand or funding for a service may change. Being committed to an inflexible long term contract, that cannot be altered at a realistic cost, should be avoided. It is important to take account of previous evidence and the value of flexibility in longer term commercial arrangements.

PPP options are about more than financial issues, although these are important. For example PPPs are cited as potentially offering higher levels of specialist and operational management expertise, greater management flexibility and focus and improved risk management. These issues should be considered on a case-by-case basis to produce realistic and objective estimates of costs and benefits arising from an option involving PPP, to compare against alternative options. The bundling of design, build and maintenance activities can create better value in the right circumstances, by creating an incentive for high quality design and build.

12.3 Treatment of costs in PPP options

A PPP option will still register as part of total public sector debt, but in certain circumstances may make capital available at an earlier date than other options. Costs may be brought forward in time and will also impact on future spending. The costs should be counted at the point at which they will accrue to the accounts of the organisation responsible. To reflect the true cost of the PPP option, appropriate provision for the full cost of the additional capital should be included in Cost Benefit calculations. This involves including private finance charges as a cost to the public sector. Additional costs of privately financed options need to be fully offset by additional benefits before a PPP option demonstrates a favourable Benefit Cost Ratio comparable with a directly financed option.

National Accounts treatment of PPP should not be a reason for project approval. However, as recording in departmental budgets follows the National Accounts then it is necessary to ensure the correct treatment of costs. The classification of PPP projects and other procurement options in the National Accounts have different budgeting implications and this should be reflected in the methodology used to assess affordability.

It is the responsibility of the organisation to come to a view on the expected classification of a proposal in the National Accounts. It should take an informed view on classification from the outset, keep this under review as the proposal and contract negotiation develops and reflect this in any business case. The features of the proposal may change during its development, which could change its classification. The responsible organisation should retain the budget flexibility necessary to deal with any such change. If the organisation requires advice contact HM Treasury as per the Consolidated Budgeting Guidance (<https://www.gov.uk/government/collections/consolidated-budgeting-guidance>).

The UK National Accounting rules are set by the Office of National Statistics. (ONS). The Manual on Government Deficit and Debt (MGDD) sets out the rules that classification of a programme or project depends upon. A project may be classified to the public sector in the National Accounts for various reasons, even where significant risk transfer is involved. The value of risk transferred should be included in the calculation of public sector costs and benefits and be included in the calculation of NPSV and sensitivity analysis.

Treatment of PPP options classified to the private sector

For PPP options where costs are classified to the private sector in the National Accounts, the financial costs of the proposal are spread over the course of the contract. This is because they are part of the unitary payments made by the public sector to the private sector and public sector costs are charged to the year in which they accrue in accounts. See Chapter 5 of the main Green Book text for the treatment of costs in economic analysis (estimates of social value) and financial analysis (estimates of public sector financial costs).

Treatment of PPP options classified to the public sector

For PPP options where costs are classified to the public sector, capital costs are not spread over a scheme's lifetime. They instead occur relatively early in its implementation. As is the case for all other public capital spending, the costs accrue to the National Accounts (and therefore to the procuring public body's accounts) during the creation of the asset.

The overall fiscal envelope is centrally determined in the Budget, as are departmental and other public sector bodies' budget allocations. Capital used should therefore be accounted for in the spending body's capital budgets in accordance with accounting rules. Payments that account for provision of services as part of a scheme and other costs to the PPP partner, including their cost of capital required to fund the scheme, are accrued to the accounts as they are charged during the life of the scheme.

13. A5. Uncertainty, Optimism Bias and Risk

This Annex covers the Green Book approach to uncertainty, optimism bias and risk, covering:

- definitions
- adjusting for optimism bias
- risk quantification
- risk management and categories of risk
- the interaction between risk and optimism bias
- reducing optimism bias
- project or programme contingency and optimism bias
- presentation of optimism bias in appraisal results

The focus is on the application of optimism bias and quantification of risk, in the context of uncertainty about costs, benefits and time taken to deliver interventions. See also Chapter 5 paragraphs 5.25 and 5.41 to 5.49. The approach set out here primarily applies to the appraisal and management of projects and programmes, usually associated with new public spending, but the principles are applicable to government appraisal more widely. When considering infrastructure values further information is provided by the Green Book supplementary guidance (<https://www.gov.uk/government/publications/green-book-supplementary-guidance-valuing-infrastructure-spend/early-financial-cost-estimates-of-infrastructure-programmes-and-projects-and-the-treatment-of-uncertainty-and-risk>) on infrastructure costing.

13.1 Definitions

In appraisal, uncertainty is often due to lack of evidence or understanding of the likely impact of new interventions. Research and previous evaluation evidence, pilot studies and evidence of what works can help to reduce this uncertainty.

Optimism bias is the demonstrated systematic tendency for appraisers to be over-optimistic about key project parameters, including capital costs, operating costs, project duration and benefits delivery. The Green Book recommends applying specific adjustments for this at the outset of an appraisal. Optimism bias estimates are a form of reference class forecasting, which predicts future outcomes based on the outcomes for a group of similar past projects.

Risks are specific uncertainties that arise from activities such as forecasting or implementation, the costs of which have been estimated. They are specific to an intervention and may be quantified and managed.

13.2 Adjusting for optimism bias

The aim of adjusting for optimism bias is to provide a more realistic assessment of the initial estimates of costs, benefits and time taken to implement a project. As the appraisal develops, more accurate costing of project or programme specific risk management should be undertaken. Accordingly, adjustments for optimism bias may be reduced as more reliable estimates of specific risks are made. Any reductions should be presented transparently and tested with sensitivity analysis where appropriate.

Supplementary guidance on the application of optimism bias and risk together with appropriate spending categories and values is provided on HM Treasury's Green Book web page. In the absence of systematic data collected and made transparently available at an organisation level this guidance and the values it contains must be followed. The identification of ways in which exposure can be reduced including risk avoidance, risk sharing and mitigation through contingency are important management issues covered by this guidance.

Optimism bias adjustment should be reduced in proportion to risk avoidance or risk mitigation measures taken. Objective and transparent evidence of the mitigation of contributory factors should be observed and verified independently before reductions are made. Procedures for this include the Gateway Review process. Further information can be found on the Infrastructure and Projects Authority’s assurance review toolkit webpages (<https://www.gov.uk/government/collections/infrastructure-and-projects-authority-assurance-review-toolkit>).

Closer to implementation the optimism bias adjustment for a project can be reduced to its lower bound provided mitigating evidence is robust. This assumes that the cost of mitigation is less than the cost of managing any residual risks. The costs of risk avoidance should be built into the proposal in their entirety since they will be incurred irrespective of whether the risks materialise. The costs of mitigation are included as expected costs, which is cost of mitigation multiplied by likelihood of the risk occurring.

Optimism bias should be applied to operating costs and benefits, as well as capital costs. Where there is no appropriate measurement of typical bias, the confidence intervals of key input variables can be used.

13.3 Monitoring and Sensitivity Analysis

The time taken to complete policies, programmes or projects and the benefits achieved relative to expectations should be monitored and recorded. Monitoring costs in public organisations is an important factor in delivering Value for Money. Quantitative evaluation of schemes after implementation is vital for producing realistic estimates of optimism bias to be used in future. Monitoring and evaluation will also support improvements in costs, benefits and timing for use in appraisal.

Switching values should also be checked to explore the following questions:

- by how much can benefits fall short of expectations if a proposal is to remain Value for Money? How likely is this?
- by how much can costs increase if the proposal is to remain worthwhile? How likely is this to happen?
- what will be the impact on benefits if costs are constrained?

13.4 Risk quantification

Risk should be quantified and costed in a proportionate way. Where relevant this should include the costs of mitigation and the expected costs if risks materialise. The extent to which risk is identified allows the initial estimates of optimism bias to be reduced (as set out in Step 4 above). As an appraisal develops the cost of risk should be estimated and included in the estimated costs of an intervention. This is not a mechanistic relationship and will be a judgement of the extent to which relevant risks have been identified and quantified. There are various techniques set out in the next sections that can be used to calculate risk costs.

Single point probability analysis

An ‘expected value’ can be calculated by multiplying the probability of a risk occurring by the costs associated with a risk materialising – see Box 29 below.

Box 29. Example of Single Point Probability

Case study: Single point analysis	
Annual cost of service	£2 million
Estimated additional cost of project overrun	£200,000
Estimated probability of risk occurring	10%

Case study: Single point analysis

Estimated value of risk = £200,000 x 10%

£20,000

Multi-point probability analysis

There are a range of possible values for any risk. A probability distribution recognises some are more likely than others. An example is given below in Box 30. While some risks have low probability, they may have significant impacts on project outcomes and need to be closely managed by Senior Responsible Officers (SROs).

Box 30. Example of Multi-Point Probability

Case study: Expected costs of a construction project using multi-point analysis

A facility is estimated to cost £50m to build. The expected costs associated with construction uncertainties are:

Possible cost (£m)	Difference from estimated cost (£m)	Estimated probability of the event occurring	Risk value (£m)
45	-5	0.1	-0.5
50	0	0.6	0
55	+5	0.3	+1.5

The most likely result is no extra cost (probability 60%). However, the expected additional cost (the sum of each possible result multiplied by its probability) is £1 million.

Decision trees and real options analysis

Decision trees and real options analysis illustrate more complex alternative options and risks over time, especially when decisions are sequential. They can be used to illustrate alternative scenarios where key external risks are likely. They can also be used to clarify alternatives where decisions taken are either irrevocable or expensive to reverse. Where information is likely to increase over time this can illustrate the value of delaying decisions or leaving options open by making smaller decisions now that allow for larger decisions later.

Decision trees provide a structure for calculating expected values in complex situations. They can be used to map out and understand the sequence of actions, decision points and events along an activity's path. Decision trees require that probabilities are either known or can be reasonably estimated. They can also be populated with information on costs and benefits.

Real Options Analysis

A 'real option' is a choice that becomes available through an action or an investment opportunity. Real options analysis recognises information about uncertainty can change over time through research and learning, and initial decisions can be changed as a result. If the value of this flexibility is not accounted for, the social value of an option will be systematically underestimated.

Real options analysis is particularly applicable to proposals that exhibit significant uncertainty following initial investment, but where learning opportunities and flexibility in future decisions can help mitigate this. It is most useful where knowledge that is relevant to the choice of options is growing. If there is limited flexibility in the future, the benefits of new information are unlikely to be realised.

Decisions should be taken with the best available information, recognising that this may change in future and flexibility to respond should not be used to justify delay. In addition to considering the range of options available, describing how information is likely to be acquired through monitoring and evaluation should be incorporated into appraisal. In practice, a decision will only have value if it can be enforced. The length of time before exercising a decision will also affect its value. The greater the time for useful information to become available, the greater the scope for the value of a decision to vary.

- An example of real options analysis can be found in Box 31 below.

Box 31. Example of Real Options Analysis

Case Study: Appraisal using a real options approach

Consider a proposal for investing in infrastructure protecting against the impacts of river flooding due to climate change. Because of time required to build the infrastructure, this is best done in advance but there is uncertainty about future impacts.

There are two options: invest in a wall, or invest in groundworks for a wall which has the option to be fully upgraded quickly in the future. There is an equal probability of high or low climate change impacts in the future.

The standard wall costs 100, and has benefits of 170 from avoided flooding if high climate change impacts occur (zero otherwise). The groundworks for the upgradeable wall cost 60, the future upgrade costs 50 and the benefit is also 170 if high climate change impacts occur. The upgrade can however be put off until there is more certainty about climate change.

The information can be set out in a decision tree:

Invest in wall (Cost now = 100)

- 0.5 High climate change impacts. Payoff $170 - 100 = 70$
- 0.5 Low climate change impacts. Payoff $0 - 100 = -100$

Invest in upgradeable wall (Cost now = 60, later = 50)

- 0.5 High climate change impacts. (Upgrade carried out). Payoff $170 - 60 - (0.8 \times 50) = 70$
- 0.5 Low climate change impacts. (Upgrade not carried out). Payoff $0 - 60 = -60$

Simplifying assumptions: residual damages under the “do not invest” strategies have been ignored; the discount factor for the future decision to upgrade or not is 0.8.

The expected value of investing in the standard wall is a simple net present calculation, calculating the expected costs and benefits of the investment. The NPV is $(0.5 \times 70) + (0.5 \times -100) = -15$. This suggests the investment should not proceed.

Flexibility over the investment decision allows the possibility to upgrade in the future if the impacts of climate change are observed to be high. The expected value of this option can be calculated.

If the impacts of climate change turn out to be high enough to warrant upgrading, then the value of the investment is 70 in net present value terms. If the impacts are low, no upgrade is carried out but the earlier groundworks are sunk costs, totalling 60. However, these sunk costs are lower than in the case of the “standard” wall and overall, the expected value of investing now with the option to upgrade in the future is $(0.5 \times 70) + (0.5 \times -60) = +5$.

Comparing the two approaches shows an NPV of -15 for the standard approach, and +5 for the Real Options approach. The Real Options approach also has an unmonetised benefit in allowing better views of the river for longer. Flexibility to upgrade in the future is reflected in the higher NPV, and switches the investment decision.

Source: Department for Environment, Food and Rural Affairs

Monte Carlo Analysis

Monte Carlo analysis can be used to understand the impact of uncertainty in key evidence or assumptions that are inputs into estimates of cost, benefits or risks as part of an appraisal.

Monte Carlo analysis is a simulation-based risk modelling technique that produces expected values and confidence intervals. The outputs are the result of many simulations that model the collective impact of a number of uncertainties. It is useful when there are a number of variables with significant uncertainties, which have known, or reasonably estimated, independent probability distributions. It requires a well estimated model of the likely impacts of an intervention and expert professional input from an operational researcher, statistician, econometrician, or other experienced practitioner.

The technique is useful where variations in key inputs are expected and where they are associated with significant levels of risk mitigation costs, such as flood prevention. This can be used to determine what level of investment might be required to deal with extreme events such as rainfall events, which will have a statistical likelihood.

13.5 Risk management and categories of risk

Risk management is defined as a structured approach to identifying, assessing and managing risks that are identified when designing an intervention or that materialise during its later lifecycle.

Effective risk management helps the achievement of wider aims, such as change management, the efficient use of resources, better project management, minimising waste and fraud and supporting innovation.

Options for risk mitigation and management

The public sector's risk exposure arises as a result of public policy decisions. Therefore, to optimise social value, risk must be consciously and proportionately managed. Good practice involves:

- identifying possible risks in advance
- putting mechanisms in place to minimise the likelihood risks materialise with adverse effects
- having processes in place to monitor risks and access reliable, up-to-date information
- having the right balance of control in place to mitigate the adverse consequences of risks if they materialise
- having decision making processes supported by a framework of risk analysis and evaluation
- early consultation with stakeholders – experience suggests costs tend to increase as more requirements to mitigate risk are identified. Early consultation will help to identify what those requirements are and how they may be addressed
- avoidance of irreversible decisions and a full assessment of costs, including the potential to delay decisions, allowing more time for the investigation of risks or alternative options
- pilot studies – acquiring more information about risks affecting a project through pilots allows steps to be taken to mitigate risk or increase the benefits
- design flexibility – where future demand and relative prices are uncertain, it may be worth choosing a flexible design. Breaking a project into stages, with reviews at points when it could be stopped or changed, can increase flexibility

- precautionary principle – precautionary action can be taken to mitigate risk. The precautionary principle states that because some outcomes are so undesirable, even though they may be very unlikely, precautionary action is justified. In cases where such risks have been identified, they should be drawn to the attention of senior management and expert advice sought
- procurement contractual risk – that can be contractually transferred to other parties and maintained through good contractual relationships e.g. insurance
- use of proven, rather than leading edge, technology – should be preferred if it reduces risk significantly while providing a proportion of the benefits of higher risk alternatives
- reinstating or developing different options – following the risk analysis, it may be desirable to reinstate options, or develop alternatives that are either less inherently risky or which deal with the risks more efficiently
- abandoning the proposal – finally, the proposal may be so risky that, whatever option is considered, it has to be abandoned

Additional guidance on risk management can be obtained from The Orange Book Management of Risk – Principles and Concepts (<https://www.gov.uk/government/publications/orange-book>) and further background information can be found in Risk Analysis and Management for Projects (RAMP) (<http://www.icevirtuallibrary.com/doi/book/10.1680/ramp.41578>).

Types of risk

Risks can be assigned to 3 main categories which are not mutually exclusive – business, service and external risks.

Business risks (Box 32) remain with the public sector and cannot be transferred. These include the loss of opportunity and poor Value for Money that occurs when schemes under-deliver or fail completely.

Box 32. Business Risks

Risk

Non-transferable risks of failure to the organisation.

Business risk

The risk an organisation fails to deliver its commitments and cannot meet its business objectives.

Reputational risk

The risk confidence in an organisation's ability to fulfil its business objectives will be undermined.

Service related risks may be shared between the public and private sectors. These are listed in Box 33.

Box 33. Service Risks

Service risks

The risk a service is not fit for purpose.

Design risk

The risk a design cannot deliver services to required quality standards.

Planning risk

The risk implementation of a project fails to meet planning permission conditions, planning permission cannot be obtained or if obtained, can only be implemented at costs greater than in the original budget.

Build risk

The risk the construction of physical assets is not completed on time, to budget and specification.

Decant risk

The risk in accommodation projects of needing to decant staff/clients from one site to another.

Environmental risk

The risk the nature of the project has a major impact on an adjacent area and there is a strong likelihood of objection from the public.

Contractual risk

The risk from the contractual arrangements between two parties.

Operational risk

The risk operating costs vary from budget and that performance standards slip, or a service cannot be provided.

Availability and performance risk

The risk the amount of service provided is less than required under the contract.

Demand risk

The risk the demand for a service does not match the levels planned, projected or assumed. As the demand for a service may be partially controllable by the public body concerned, the risk to the public sector may be less than perceived by the private sector.

Volume risk

The risk actual usage of the service varies from the levels forecast.

Maintenance risk

The risk that the costs of keeping the assets in good condition vary from budget.

Technology risk

The risk that changes in technology result in services being provided using old technology.

Funding risk

The risk that the availability of funding leads to delays and reductions in scope.

Residual value risk

The risk due to the uncertainty of the physical asset at the end of the contract period.

External risks (Box 34 below) arise from the wider environment, not the intervention being appraised.

Box 34. External Risks

External Risk

The risks that are not connected to the proposal being considered.

Catastrophe risks

These unpredictable risks, which may be related to changes in economic growth, are allowed for in the social discount rate and do not have to be costed separately e.g. technological disruption, natural disasters, unexpected policy changes and other unforeseeable occurrences.

Regulatory risk

The risk a change in law or regulations will affect the costs or benefits of a project.

Transferring risk

The responsibility for management of risk should be allocated to the organisation best placed to manage it whether in the public or private sector. The objective is optimal allocation of risk, not maximum transfer, and this is important to deliver Value for Money. Not all risks can be transferred.

Successful risk transfer from the public sector to the private sector requires a clear understanding of risks, the likely impact they may have on the suppliers' incentives and financing costs and the limits of risk transfer which are possible. Commercial arrangements should reflect where the private sector has clear ownership, responsibility and control of certain risks it can manage more effectively.

Public Private Partnership (PPP) arrangements may provide cost-effective and efficient risk management through risk transfer and sharing. Generally PPP schemes should transfer risks to the private sector when a supplier is better able to manage or influence the outcome. For example, the bundling of design, build and maintenance into a commercial agreement may affect the way they are planned, implemented and managed, and can lead to a higher quality outcome at the operational stage. Risks to be considered include:

- design and construction risk (to cost and/or time)
- technology and obsolescence risks
- commissioning and operating risks (including maintenance)
- regulation and similar risks (including taxation, planning permission)
- demand (or volume/usage), funding or income risks
- residual value risk
- project financing risk

Policy, programme and project level risk management

Risk management strategies should be adopted in a way that is appropriate to their scale. A risk register is required to identify, quantify and value risk. It should identify who owns each risk, provide an assessment of the likelihood and an estimate of the impact on project outcomes. The purpose of the risk register is to provide

oversight of risks and their management. Information on the status of each risk is also included and the register should be updated, maintained and reviewed. A basic risk register template is provided in Box 35. A risk allocation table is also recommended, an example is set out in Box 36.

Box 35. Risk Register

<ul style="list-style-type: none"> • Risk number (unique within register) • Risk type • Author (who raised it) • Date identified • Date last updated • Description • Likelihood • Interdependencies with other sources of risk • Expected impact • Bearer of risk • Countermeasures • Risk status and risk action status
--

Box 36. Example of Risk Allocation Table

Risk	Scale	Bearer		Key Issues
		Purchaser	Provider	
Obsolescence	Low		✓	Assets require low levels of technology
Demand Risk	Med	✓		...
Design Risk	High		✓	...
Residual Value	Low	✓		...
3rd Party Revenues	Low		✓	...
Regulatory Change	High	✓		...
Etc.

13.6 The interaction between risk, optimism bias and contingency

As set out previously, as an appraisal is developed, risks and risk costs should be identified and the optimism bias allowance included at the outset should be reduced.

The contributory factors leading to the need for optimism bias should be reviewed by appraisers. The main strategies for reducing the adjustment are:

- full identification of stakeholder requirements (including consultation)
- realistic scoping when selecting the shortlisted options
- accurate costing
- risk mitigation and management

Only those measures where the costs of avoidance, sharing or mitigation are lower than the cost of bearing the risk should have been adopted. The contingency provision in the financial case (at nominal prices) should be estimated on conversion to nominal prices of data in the economic case which is the sum of residual optimism bias adjustment and residual risk costs (which in the economic case are all in real base year prices), calculated as:

- the value of the residual optimism bias adjustment (that is the original OB adjustment less the values of identified risks.
- plus residual measured risk (that is the all of the identified risk values less the risk values- of risks avoided, shared and/or otherwise mitigated – all estimated on an expected likelihood basis (which is cost times probability)

Contingency provision in the financial dimension of the case should be used to inform the approving authority of its potential liabilities. Government is self-insured and contingency should not be credited to the approved proposal. It should be used to support estimation of the approving organisations potential risk liabilities and hence the reserves required by the approving body. Note that the costs of avoiding sharing and mitigating risks have been built into firm costs.

14. A6. Discounting

This Annex sets out the role of discounting in appraisal and how the 3.5% discount rate is derived. It also provides guidance on long term discounting and the treatment of intergenerational wealth transfers. Discounting and its role in appraisal are introduced in Chapter 2 paragraphs 2.22 - 2.23 and Chapter 5 Paragraphs 5.32 - 5.38 and Box 15.

14.1 Role of discounting

Discounting in the public sector allows costs and benefits with different time spans to be compared on a common “present value” basis. The public sector discount rate adjusts for social time preference, defined as the value society attaches to present, as opposed to future, consumption. It is based on comparisons of utility across different points in time or different generations.

The Green Book discount rate, known as the Social Time Preference Rate (STPR), for use in UK government appraisal is set at 3.5% in real terms. This rate has been used in the UK since 2003. Exceptions to the use of the standard STPR are outlined below.

The use of the STPR in public sector appraisal differs from private sector discounting. Decisions about the overall size of public spending and allocation of budgets are taken on a top down basis. The costs associated with raising funds (i.e. through taxes or debt issuance) are not used when appraising individual projects, programmes or policies. The cost of borrowing is not included as a decision variable on whether to go ahead with an individual project or not. In addition, there is no allowance for project specific risk in the STPR as risks should be identified and costed explicitly in appraisal. This approach to the STPR contrasts with private sector discounting which incorporates allowances for the cost of raising capital and compensation for risk.

14.2 Breakdown of the discount rate

The STPR has two components:^[footnote 39]

- ‘time preference’ – the rate at which consumption and public spending are discounted over time, assuming no change in per capita consumption. This captures the preference for value now rather than later.
- ‘wealth effect’ – this reflects expected growth in per capita consumption over time, where future consumption will be higher relative to current consumption and is expected to have a lower utility.

The STPR is expressed as:

- $r = \rho + \mu g$

where:

- r is the STPR
- ρ (rho) is time preference comprising pure time preference (δ , delta) and catastrophic risk (L)
- μg is the wealth effect. The marginal utility of consumption (μ , mu), multiplied by expected growth rate of future real per capita consumption g

As recognised in the 2003 Green Book there are a range of estimates of the individual components of the discount rate.^[footnote 40]

Research continues to illustrate a range of plausible estimates but concludes that the overall discount rate of 3.5% remains within that range and is justifiable.^[footnote 41]

The way in which the STPR is applied in the Green Book requires each component to be specified. This facilitates sensitivity analysis and clarifies treatment where individual components of the discount rate should be adjusted (e.g. for health discounting). The overall values ascribed to specific components of the STPR are retained from the 2003 edition as set out below. The calculation of the STPR is shown in Box 37.

Estimates of ρ

The estimate of ρ (rho) is the sum of:

- an allowance for time preference (δ)
- an allowance for unpredictable risks not normally included in appraisal, known as ‘catastrophic’ and ‘systemic’ risk (L)

The risks contained in L could, for example, be disruptions due to unforeseeable and rapid technological advances that lead to obsolescence, or natural disasters that are not directly connected to the appraisal. L also includes a small premium for ‘systemic risk’ because costs and benefits are usually positively correlated to real income per capita. With regard to time preference, δ , Freeman, Groom and Spackman (2018)^[footnote 42] survey the evidence and show that plausible values range from 0% to 1%. Coupled with an estimate of 1% for the risk component, L , this is compatible with a value of 1.5% for the overall value of ρ .

For the purposes of the STPR the estimate of δ is retained at 0.5% and the estimate of L is retained at 1%. The estimate of ρ is therefore 1.5%.

Estimates of μ and g

Available evidence suggests a range of plausible values of μ (mu). The 2003 edition of the Green Book set a value of 1. As set out in Annex 3, the estimate used by DWP for distributional weighting is 1.3 (based on Layard et al. 2008^[footnote 43]), while Groom and Maddison (2018)^[footnote 44] use a number of techniques to estimate a pooled value of 1.5.

Historic growth rates in consumption per capita depend on the time period considered and the extent to which more recent growth rates or projections are considered to be representative of long term trends. The 2003 Green Book set g at 2%. Freeman, Groom and Spackman (2018)^[footnote 45] reference average real annual per capita consumption growth for the UK for the period 1949 – 2016 of 2.2% per year. Estimates based on ONS data from the recent past, for example 1996 to 2016, are lower at 1.7% per year.^[footnote 46]

Future projected growth rates are also relevant. Long-run forecasts of GDP growth (rather than consumption) from the Office of Budget Responsibility are for growth of 2.2% per year in real terms. This implies an annual projected growth rate of GDP per capita of 1.9%.^[footnote 47]

Taken together, the range of estimates of μ and g suggest 2% remains plausible as an estimate of the overall wealth effect. For the purposes of the STPR the estimate of μ is retained at 1 and g at 2%.

Box 37. Calculation Of Stpr

$$r = \rho + \mu g$$

Where $\rho = 1.5\%$; $\mu = 1.0$; and $g = 2\%$

$$0.015 + 1 \times 0.02 = 3.5\%$$

14.3 Exceptions to the standard STPR

The recommended discount rate for risk to health and life values is 1.5%. This is because the ‘wealth effect’, or real per capita consumption growth element of the discount rate, is excluded. As set out in Annex 2, health and life effects are expressed using welfare or utility values, such as Quality Adjusted Life Years (QALYs), as opposed to monetary values. The diminishing marginal utility associated with higher incomes does not apply as the welfare or utility associated with additional years of life will not decline as real incomes rise.

The standard UK discount rate may not be appropriate for appraisal of Official Development Assistance (ODA) expenditure. For example, long term growth rates, the probability of catastrophic risk and the macro-economic effects associated with expenditure may differ. An appropriate estimate of the STPR for the recipient country should be used. Government departments should contact Department for International Development if they require further information.

14.4 Long term discounting

Policies or projects which involve long term effects may require a different approach. This can be particularly important for policies expected to have significant environmental effects. Where long term effects are expected to occur, the appraisal of proposals may involve longer timescales. Generally, the maximum life span of an intervention is assumed to be up to 60 years. This may be extended where there is evidence a longer time period is required for the full effects of an intervention to materialise.

The standard STPR of 3.5% applied in appraisal should decline over the long term due to uncertainty about future values of its components. To support practical application in appraisal, standard declining discount rates and discount factors by year can be found in Table 7 and the corresponding values for the reduced health rate are given in Table 8.

14.5 Intergenerational effects

Where the possible effects of an intervention being examined as part of an appraisal are long term and involve very substantial or irreversible wealth transfers between generations further sensitivity analysis is appropriate. This could include irreversible changes to the natural environment. This involves applying both the standard Green Book discount rate and a reduced discount rate (excluding pure social time preference, δ) to costs and benefits.

When applying this approach the Net Present Social Value (NPSV) using the standard STPR and the reduced rate STPR should both be included in the results of the appraisal and explained clearly. The difference between these two estimates of NPSV provides an estimate of the intergenerational wealth transfer attributable to pure social time preference which should be part of the explanation of the approach. The basis for the approach to long-term discounting set out here can be found in supplementary guidance on intergenerational wealth transfers and social discounting (<https://www.gov.uk/government/publications/green-book-supplementary-guidance-discounting>).

Table 6. Declining Long Term Discount Rate

Year	0 – 30	31 – 75	76 – 125
STPR (standard)	3.50%	3.00%	2.50%
STPR (reduced rate where pure STP = 0)	3.00%	2.57%	2.14%
Health	1.50%	1.29%	1.07%
Health (reduced rate where pure STP = 0)	1.00%	0.86%	0.71%

In addition to declining values for the standard STPR and a reduced rate STPR further sensitivity analysis to increase transparency and visibility of long term effects can be undertaken. This involves presenting:

- the average discounted annual cost of the effect over the first 30 years, alongside the calculation of UK welfare
- an indication of how long the effect is expected to persist
- an indication of the level of accuracy indicated by a range of reasonable values
- an explanation of how the value may be expected to change in the future

Further information on the basis for this approach to intergenerational effects can be found in supplementary guidance on intergenerational wealth transfers and social discounting (<https://www.gov.uk/government/publications/green-book-supplementary-guidance-discounting>).

14.6 Discounting and inflation

- Discounting is solely concerned with adjusting for social time preference and has nothing to do with adjusting for inflation. The recommended Green Book discount rate applies to real values, with the effects of general inflation already removed. To promote transparency the best practice approach is to first convert costs or benefits to a real price basis, and then perform the discounting adjustment. The inflation rate and discount rate should not be added and applied to costs and benefits, as it gives an arithmetically incorrect result.

Table 7. Standard Discount Rates and Associated Discount Factors

Year	Discount Rate	Discount Factor	Year	Discount Rate	Discount Factor
0		1	31	3.000%	0.3459
1	3.500%	0.9662	32	3.000%	0.3358
2	3.500%	0.9335	33	3.000%	0.3260
3	3.500%	0.9019	34	3.000%	0.3165
4	3.500%	0.8714	35	3.000%	0.3073
5	3.500%	0.8420	36	3.000%	0.2984
6	3.500%	0.8135	37	3.000%	0.2897
7	3.500%	0.7860	38	3.000%	0.2812

Year	Discount Rate	Discount Factor	Year	Discount Rate	Discount Factor
8	3.500%	0.7594	39	3.000%	0.2731
9	3.500%	0.7337	40	3.000%	0.2651
10	3.500%	0.7089	41	3.000%	0.2574
11	3.500%	0.6849	42	3.000%	0.2499
12	3.500%	0.6618	43	3.000%	0.2426
13	3.500%	0.6394	44	3.000%	0.2355
14	3.500%	0.6178	45	3.000%	0.2287
15	3.500%	0.5969	46	3.000%	0.2220
16	3.500%	0.5767	47	3.000%	0.2156
17	3.500%	0.5572	48	3.000%	0.2093
18	3.500%	0.5384	49	3.000%	0.2032
19	3.500%	0.5202	50	3.000%	0.1973
20	3.500%	0.5026	51	3.000%	0.1915
21	3.500%	0.4856	52	3.000%	0.1859
22	3.500%	0.4692	53	3.000%	0.1805
23	3.500%	0.4533	54	3.000%	0.1753
24	3.500%	0.4380	55	3.000%	0.1702
25	3.500%	0.4231	56	3.000%	0.1652
26	3.500%	0.4088	57	3.000%	0.1604
27	3.500%	0.3950	58	3.000%	0.1557
28	3.500%	0.3817	59	3.000%	0.1512
29	3.500%	0.3687	60	3.000%	0.1468
30	3.500%	0.3563	61	3.000%	0.1425

Table 8. Health Discount Rates and Associated Discount Factors

Year	Health Discount Rate	Health Discount Factor	Year	Health Discount Rate	Health Discount Factor
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Year	Health Discount Rate	Health Discount Factor	Year	Health Discount Rate	Health Discount Factor
0		1	31	1.286%	0.6316
1	1.500%	0.9852	32	1.286%	0.6236
2	1.500%	0.9707	33	1.286%	0.6157
3	1.500%	0.9563	34	1.286%	0.6079
4	1.500%	0.9422	35	1.286%	0.6002
5	1.500%	0.9283	36	1.286%	0.5926
6	1.500%	0.9145	37	1.286%	0.5850
7	1.500%	0.9010	38	1.286%	0.5776
8	1.500%	0.8877	39	1.286%	0.5703
9	1.500%	0.8746	40	1.286%	0.5630
10	1.500%	0.8617	41	1.286%	0.5559
11	1.500%	0.8489	42	1.286%	0.5488
12	1.500%	0.8364	43	1.286%	0.5419
13	1.500%	0.8240	44	1.286%	0.5350
14	1.500%	0.8118	45	1.286%	0.5282
15	1.500%	0.7999	46	1.286%	0.5215
16	1.500%	0.7880	47	1.286%	0.5149
17	1.500%	0.7764	48	1.286%	0.5083
18	1.500%	0.7649	49	1.286%	0.5019
19	1.500%	0.7536	50	1.286%	0.4955
20	1.500%	0.7425	51	1.286%	0.4892
21	1.500%	0.7315	52	1.286%	0.4830
22	1.500%	0.7207	53	1.286%	0.4769
23	1.500%	0.7100	54	1.286%	0.4708
24	1.500%	0.6995	55	1.286%	0.4649

Year	Health Discount Rate	Health Discount Factor	Year	Health Discount Rate	Health Discount Factor
25	1.500%	0.6892	56	1.286%	0.4590
26	1.500%	0.6790	57	1.286%	0.4531
27	1.500%	0.6690	58	1.286%	0.4474
28	1.500%	0.6591	59	1.286%	0.4417
29	1.500%	0.6494	60	1.286%	0.4361
30	1.500%	0.6398	61	1.286%	0.4306

15. List of Green Book Supplementary Guidance

Supplementary Guidance Collection (<https://www.gov.uk/government/collections/the-green-book-supplementary-guidance>)

Assessing the competition: effects of subsidies (<https://www.gov.uk/government/publications/green-book-supplementary-guidance-competition>)

Completing competition assessments in impact assessments (<https://www.gov.uk/government/publications/green-book-supplementary-guidance-competition>)

Economic valuation with stated preference techniques (<https://www.gov.uk/government/publications/green-book-supplementary-guidance-stated-preference-techniques>)

Intergenerational wealth transfers and social discounting (<https://www.gov.uk/government/publications/green-book-supplementary-guidance-discounting>)

Accounting for environmental impacts in policy appraisal (<https://www.gov.uk/government/publications/green-book-supplementary-guidance-environment>)

Optimism Bias (<https://www.gov.uk/government/publications/green-book-supplementary-guidance-optimism-bias>)

Policy appraisal and health (<https://www.gov.uk/government/publications/green-book-supplementary-guidance-health>)

Procedures for dealing with optimism bias in transport (<https://www.gov.uk/government/publications/green-book-supplementary-guidance-transport>)

Regeneration, renewal and regional developmen (<https://www.gov.uk/government/publications/green-book-supplementary-guidance-regeneration-and-the-regions>)t

The economic and social costs of crime
(https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/191497/Green_book_supplementary_guidance_e_economic_social_costs_of_crime.pdf)

The Orange Book (risk) (<https://www.gov.uk/government/publications/green-book-supplementary-guidance-risk>)

Valuation of energy use and greenhouse gas emissions for appraisal
(<https://www.gov.uk/government/publications/valuation-of-energy-use-and-greenhouse-gas-emissions-for-appraisal>)

Value for money and the valuation of public sector assets (<https://www.gov.uk/government/publications/green-book-supplementary-guidance-asset-valuation>)

Valuing impacts on air quality (<https://www.gov.uk/government/publications/green-book-supplementary-guidance-air-quality>)

Valuing Infrastructure spend (<https://www.gov.uk/government/publications/green-book-supplementary-guidance-valuing-infrastructure-spend>)

16. A7. Transformation, Systems and Dynamic Change

This Annex provides more detail on the Green Book definitions and use of the terms “Transformation, Systems, and Dynamic Analysis”, including how they can be taken into account in Green Book appraisal within the framework outlined in Chapters 3 and 4. It covers:

- the definition of transformation and important characteristics of the transformational change processes
- the interrelationship with Systems and Dynamic methods, in both the analytical research that precedes a business case and when developing a business case
- risk and uncertainty and appraising transformational outcomes
- Where in the policy process transformation, systems and dynamic change should be considered
- Value for Money assessment of transformational outcomes

16.1 Definition of Transformation and roles of Systems and Dynamic considerations

While Transformation has a range of meanings in general use, it is defined more precisely for the purposes of Green Book analysis.

In Green Book terms transformational change refers to a radical permanent qualitative change in the subject being transformed, so that the subject when transformed has very different properties and behaves or operates in a different way.

In this definition permanence refers to a “practically irreversible change in a system” that causes self-sustaining internal feedback effects that result in continuing change, or a new stable state, but not reversion to the original state. This transformation persists after the initial stimulus is withdrawn. This definition excludes the less specific use of the term as sometimes applied to projects that are simply significant in terms of their costs and/or impact. A very clear statement of the logical process of change that will cause the transformation is required and it must be supported by objective evidence that recognises the uncertainties inherent in the proposition. Examples of transformation are given in the Oxford dictionary as “photochemical reactions transform the light into electrical impulses” And “London’s Docklands have been radically transformed over the last 20 years.” This goes much further than just a change in quantity, although changes in quantity can have transformational consequences. Transformation is not always a necessary result of quantitative change but on occasion where a system is close to a tipping point, small changes may cause it pass that point and to change qualitatively.

There are three main contexts in which transformational change may be of concern in an understanding of the analysis and appraisal of policies, strategic portfolios, programmes and projects. These are where:

- creating or supporting a transformation change is a specific policy objective
- transformational change is not the specific policy objective but may result as a collateral unintended effect
- transformational change is taking place externally in the operational environment that the proposal is concerned with.

Dynamic Changes and Systems Effects

In each of these contexts, transformational changes can bring about change that may have widespread effects across complex systems such as the economy and society. Changes in the fundamental properties of a system and the way it behaves have important implications for analysis and the estimation or forecasting of future outcomes. Simple extrapolation from past experience will fail to foresee the way that a system may behave after it has been transformed or once the process of change has started. For these reasons research and analysis which considers transformational possibilities needs to consider wider systemic effects and do so with an awareness of dynamic changes in the ways that parts of the system behave in relation to each other. Such

analytical work should precede the use of longlist or shortlist analysis which uses a form of comparative statics based on marginal changes to select preferred option choices. Such analysis relies on high quality input that accounts for non-marginal effects such as dynamic changes in relationships and wide systems effects.

Uncertainty and Risk in the context of Transformation

Changes in complex systems can sometimes involve tipping points when a build-up in a quantitative input variable reaches a critical level and the system tips over fairly quickly into a different state, e.g. when water becomes steam or ice as a result of heat energy being added or removed. While in physical sciences the properties of materials and their tipping points are largely well understood and quantified, the tipping points of very complex systems are often more challenging with high levels of uncertainty. For example climate change science faces significant uncertainty in prediction of meteorological tipping points. The social sciences are similarly challenged in dealing with the complex problems of predicting dynamic and systems outcomes.

Systems in general usually involve feedback effects, as opposed to simple linear processes and in complex systems there can be many such effects all interacting across the system. This leads to the possible presence of tipping points that result in the entire system tipping over into an altered – transformed – state when a certain point is reached. As a result, relatively modest interventions in a system at certain points may possibly produce very large transformational effects. Systems can also form nodes where feedback effects converge. These are leverage points where the effects of an intervention are amplified and can cause increased system wide effects, intended or otherwise. Within systems there will also be barriers to change either active or passive. Where significant transformational change is an objective it is important to map the key systems effects and research the likelihood, magnitude and location of tipping and leverage points.

Irreversibility or virtual irreversibility due to cost and timescale are a feature of many changes. Irreversibility or its virtual equivalent arise where the scale of a change is very large compared to the resources required to reverse it, or where a system passes a tipping point and begins behaving differently which causes self-sustaining feedback effects, making it impractical to reverse. The possibility of irreversible change is a feature of how a system functions, in other words, what happens when the system tips into a new and altered state. See also Annex 5 section on Decision trees and Real Options Analysis concerning analysis of uncertainty in situations where knowledge is increasing. Where relevant, research should therefore seek to understand how the system is likely to function at and after a tipping point.

The less objective data and experimental evidence there is, the higher will be the uncertainty around changes driven by tipping points. In cases where the likelihood of the resulting change or the scale of the change is unknown, uncertainty is different from quantifiable risk. Analysis of such situations must take care not to give a spurious impression of accuracy. To support informed decisions appraisers should clearly identify the unknowns and their potential scale in terms of outcomes. The use of scenario analysis together with real options analysis^[footnote 48]

of alternative scenarios can shed light on the potential value of delaying decisions, particularly where knowledge is increasing over time. It can also indicate the value of making more flexible higher cost interventions. This is an operations research problem and the proportionate use of expert operations research analysts' is recommended. For an example of scenarios used with real options analysis in conditions of uncertainty see the paper "Modelling the risk–benefit impact of H1N1 influenza vaccines"^[footnote 49]

Transformation, Systems and Dynamic change in the policy process

Transformational changes are hardly ever brought about by individual projects or programmes. They require strategic portfolios of programmes grouped into related subjects. These portfolios of programmes are focussed on shared SMART objectives and aim to change a range of related outcomes. Bringing about a fundamental transformational change will require changes across many fronts, for example the attainment of a zero carbon emissions economy, in which increased output does not automatically bring about increased emissions. This will apply across the extractive industries, the manufacture of products, and the delivery of services, as well as changes in which goods and services are produced and consumed, and in what proportions. To make this self-sustaining will require changes across supply and logistical chains and changes in public taste and habits.

Significant transformational changes need to be researched, appraised, designed, approved and evaluated in the context of the strategic level of the decision hierarchy outlined in chapter 3. Individual projects and programmes will have their SMART objectives set by requirements of the strategy and its strategic portfolios. It is not sensible to attempt appraisal of the social value of projects and programmes in isolation from their role in implementing a policy or strategic objective they enable. It is also unhelpful and unrealistic to attempt to divide the social value of the whole programme into its constituent enabling components. The solution in such cases where the social value is not amenable to direct valuation in isolation from the wider strategy, is to use social cost effectiveness as the criteria for optimum option selection within the enabling projects.

1. Local authorities are asked to use the method when preparing proposals based on an allocation of central government funding, but many also find it useful when considering other capital allocation.
2. The options framework and filter is outlined in Chapter 4 and explained in greater detail in the Green Book supplementary guidance on Business Cases for projects programmes and Strategic Portfolios available on the main Green Book web page.
3. Where cost effectiveness is employed, the unit costs of options, is used in the same way as a BCR in initial option ranking and uses the same approach as for a BCR when considering unquantifiable benefits risks and uncertainties at both the long and the shortlist appraisal stages.
4. <https://www.gov.uk/government/organisations/government-commercial-function>
(<https://www.gov.uk/government/organisations/government-commercial-function>)
5. For examples of the decision chain from strategy to projects see Figure 5 in Chapter 3 and a hypothetical example in Figure 6 below. Guidance on each level of decision is provided by the family of Business Case publications available from the Green Book web pages.
6. The preferred way forwards as explained in later in this chapter is the favoured option at this stage before shortlist analysis, see Chapter 5 for explanation of the choice of the preferred option and dealing with unmonetizable and unquantifiable option choices.
7. The example quoted is from the project business case guidance
8. Costs to society are given a negative value and benefits a positive value. After adjusting for inflation and discounting, costs and benefits can be added together to calculate the Net Present Social Value (NPSV) for each option.
9. Such additional costs should be recorded at the point they will be incurred and should be discounted by the Social Time Preference rate (STPR).
10. Based on Ramsey F.P. (1928) "A Mathematical Theory of Saving" Economic Journal, Vol. 38, No 152, pp. 543 559.
11. Some automated systems to calculate costs and benefits are not set up in line with this approach. As long as the calculation provides the same result this is acceptable on grounds of proportionality for this to continue until established data systems are redeveloped.
12. An example of adjusting benefits for optimism bias at a local level can be found in Supporting public service transformation: cost benefit analysis for local partnerships
(<https://www.gov.uk/government/publications/supporting-public-service-transformation-cost-benefit-analysis-guidance-for-local-partnerships>).
13. Public sector budgets are nearly always constrained so it is generally impossible to undertake all projects that would provide benefits that exceed their public-sector costs. This means public spending has an opportunity cost that needs to be considered when assessing options. Considering options in terms of the benefits per £ of the relevant budget constraint allows the opportunity cost to be taken into account.
14. The differences affect the way they are appraised, approved and evaluated as further explained in HM Treasury Business Case Guidance
(https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/749085/Programme_Business_Case_2018.pdf) and the Treasury Approvals Process
(<https://www.gov.uk/government/publications/treasury-approvals-process-for-programmes-and-projects>).
15. Keynesian multipliers consider an increase in demand arising from an increase in employment leading to subsequent further increased employment leading to further demand, continuing on a diminishing scale due to savings and any other leakage from the spending and employment cycle.

16. Fujiwara and Campbell (2011) (<https://www.gov.uk/government/publications/valuation-techniques-for-social-cost-benefit-analysis>) discuss the strengths and weaknesses of revealed and stated preference techniques and use of subjective wellbeing evidence.
17. Where there is evidence that wellbeing fully captures all the outcomes affected by a proposal and there is sufficient evidence available for different options being considered.
18. The What Works Centre for Wellbeing have published a guide on the use of wellbeing evidence in cost-effectiveness analysis, available on the analyst web page: <https://www.whatworkswellbeing.org/appraisal> (<https://www.whatworkswellbeing.org/appraisal>).
19. These are dimensions of health as measured using the EQ-5D (<https://euroqol.org/>) instrument. This is a tool that individuals complete to show changes in self-reported health over time or before/after receiving health care treatment.
20. The water cycle cuts across natural assets, and includes non-tidal rivers, lakes, ponds, wetlands, floodplains as well as groundwater, coastal estuaries, the marine environment.
21. Wildlife can be affected by direct changes to protected sites and by disrupting or creating connections between sites.
22. Bateman et al. (2013) "Bringing ecosystem services into economic decision making: Land use in the UK" *Science*, Vol 341, No. 6141: 45-50, 5th July 2013. DOI: 10.1126/science.1234379.
23. Further information on Value Transfer methods is available on the DEFRA web pages (https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/182380/vt-guidelines-steps.pdf).
24. Please contact IGCB@defra.gsi.gov.uk to discuss the most appropriate approach.
25. Government analysis on carbon emissions for multiple sectors, including material use and waste disposal, are based on multiple LCA studies that estimate greenhouse gas reporting conversion factors. The latest data are available online on the Department for Business, Energy and Industrial Strategy web pages (<https://www.gov.uk/government/publications/greenhouse-gas-reporting-conversion-factors-2017>).
26. Gibbons et al. (2014) "The amenity value of English nature: a hedonic price approach" *Environmental Resource Economics*, 57: pp. 175-196.
27. For example, see Ham et al. (2013) "The valuation of landfill disamenities in Birmingham" *Ecological Economics*, 85: pp. 116-129.
28. For a summary of values see the Environment Agency web pages (<https://www.gov.uk/government/publications/updating-the-national-water-environment-benefit-survey-values-summary-of-the-peer-review>). In addition, the water companies run customer surveys ahead of each five-yearly business planning round (most recently in 2013) which include stated preference elements to determine customers' local willingness to pay for various improvements in water services, often including the quality of the local water environment.
29. Based on estimates for each river basin and catchment in England and Wales.
30. "Flood and Coastal Erosion Risk Management (FCERM) and the Wider Economy" Frontier Economics for Defra, 2014. Available at <http://randd.defra.gov.uk> (<http://randd.defra.gov.uk>) by searching on "FD2662".
31. For an example see Bateman et al (2013) "Bringing ecosystem services into economic decision making: Land use in the UK" *Science*, Vol 341, No. 6141: 45-50, 5th July 2013. DOI: 10.1126/science.1234379.
32. Conversion factors for converting between calorific units of measurement (i.e. tonnes of oil equivalent, calories, therms, joules, or watt hours) are available in Annex B of the online guidance "Valuation of energy use and greenhouse gas emissions for appraisal" available on the Business, Energy and Industrial Strategy webpages (<https://www.gov.uk/government/publications/valuation-of-energy-use-and-greenhouse-gas-emissions-for-appraisal>). Conversion factors for converting volume-based or weight-based measurements into calorific units of measurement (which will vary according to the fuel) can be found in Table A1, Annex A, of the Digest of UK Energy Statistics.
33. See for example Stouthard, M. E. A., et al (1997) "Disability weights for diseases in the Netherlands" Amsterdam: Inst. Sociale Geneeskunde.
34. Source: What Works Centre for Local Growth Toolkit: Local Multipliers (<https://whatworksgrowth.org/resources/toolkit-local-multipliers/>) based on 18 studies meeting their evidence standards. Multipliers are for use on place based studies within the UK only, not for use on UK wide appraisals.
35. Layard et al. (2008) "The marginal utility of income" *Journal of Public Economics*, Vol. 92, pp. 1846-1857.

36. With median equivalised income per week for the bottom and middle quintile, respectively £244 and £481.
37. Principal-agent theory here refers to the economic and organisational theory only and not to the concept of a principal or an agent in legal terms.
38. Based on Ramsey F.P. (1928) "A Mathematical Theory of Saving" Economic Journal, Vol. 38, No. 152, pp. 543-559.
39. See discussion paper: Spackman, M. (2016) "Appropriate time discounting in the public sector" GRI Working Paper No. 182. Grantham Research Institute on Climate Change and Environment. London School of Economics.
40. See Freeman, Groom and Spackman (2018) "Social Discount Rates for Cost-Benefit Analysis: A Report for HM Treasury" published on the HMT Green Book web page (<https://www.gov.uk/government/publications/the-green-book-appraisal-and-evaluation-in-central-government>).
41. *ibid*.
42. Layard et al. (2008) "The marginal utility of income" Journal of Public Economics, Vol. 92, pp. 1846-1857.
43. Groom and Maddison (2018) "New Estimates of the Elasticity of Marginal Utility for the UK" forthcoming in Environmental and Resource Economics. Working paper version (2013) Centre for Climate Change Economics and Policy Working Paper No. 141.
44. See Freeman, Groom and Spackman (2018) "Social Discount Rates for Cost-Benefit Analysis: A Report for HM Treasury" published on the HMT Green Book web page (<https://www.gov.uk/government/publications/the-green-book-appraisal-and-evaluation-in-central-government>).
45. The ONS quarterly national accounts publication provides historic consumption data. Based on analysis in December 2017 the approximate compound annual growth rate in consumptions per capita between 1996 and 2016 was 1.7%. Freeman, Groom and Spackman (2018) provide a range of estimates for different historical horizons.
46. Long-run forecast of GDP growth from the Office for Budget Responsibility – Long-term economic determinants – November 2017 Economic and fiscal outlook – supplementary documents published on 24th of January 2018. Estimate of average long-term GDP per capita growth consistent with OBR's long term economic determinants.
47. See Annex 5 from paragraph A5.15 onwards for real options analysis with an example.
48. By L.D. Phillips Et al.- published by the European Journal of Public Health February 2013.

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