



UK Government

Energy Appraisal: Risk-Opportunity Analysis

Application Guidance



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A. ROA: an emerging practice

This guidance has been developed with input from HMT, Chief Economists and appraisal experts across government and academia. The ROA package of resources seeks to begin to fill a long-standing and widely recognised gap in appraisal for transformational change, a defining characteristic of many DESNZ-related policies.

Publication is an important first step to making the framework accessible to prospective users. As with any new framework, its value will be in how well it supports decision making. DESNZ welcomes collaboration with other government departments, local and central government partners and arms-length bodies to pilot ROA and evaluate its effectiveness in different contexts, and feed learnings back into guidance over time.

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Where this guidance does not raise a specific appraisal approach (e.g. additionality), users should refer to and apply techniques and principles as advised in the HMT Green Book.

Please refer to the Glossary in the ROA Technical Implementation Guidance.

Note: ROA in this package of resources refers to Risk-Opportunity Analysis (not Real Options Analysis, as in the HMT Green Book).

B. Purpose and scope of this guidance

This guidance supports the practical application of Risk-Opportunity Analysis (ROA) within the policy appraisal process set out in HM Treasury's '[Green Book](#)' (2026). It is aimed at government analysts and other decision-makers working in areas of policy where traditional cost-benefit analysis (CBA) alone may not be sufficient to appraise policy options pursuing transformational change.

This guidance should be read in conjunction with the ROA Technical Implementation Guidance.

As per the Technical Implementation Guidance, it focuses on the application of ROA to policy in the field of the low carbon transition. However, it may be applied to other domains. For use beyond DESNZ, domain-specific governance and assurance processes should be ensured.

Policy problems of transformational change often have three characteristics.

- Firstly, they involve feedbacks that can either enable self-sustaining change or maintain the status quo
- Secondly, they have widespread effects on the economy and society, so there are multiple dimensions of interest to the decision-maker
- Third, there are important uncertainties outside of the control of the decision-maker, which may impact the effectiveness of policy options

This guidance is particularly relevant to policymaking on large-scale systemic challenges centred around transformational change such as, but by no means limited to, the net zero transition.

ROA provides a structured framework for considering dynamic effects, strategic trade-offs, and wide-ranging risks and opportunities in complex systems. In doing so, ROA standardises and integrates the use of methods already used to inform decision making and brings them together into a structured framework that supports appraisal in a way that is consistent with Green Book principles, while helping analysts make dynamic effects, trade-offs and uncertainty more explicit and meets HMT's standards for economic appraisal. It builds on HMT Green Book guidance, for example by integrating analysis on feedbacks.

This Application Guidance provides practical step-by-step guidance for analysts on:

- When and how to apply ROA in economic appraisal of government spending, regulation and other policy;
- How ROA links to existing appraisal methods, including CBA and Multi-Criteria Decision Analysis (MCDA);
- How to present ROA outputs alongside monetised results to inform decisions;
- How to apply ROA proportionately and modularly based on the complexity and scale of the decision.

What is ROA?

Risk-Opportunity Analysis (ROA) is a policy appraisal framework for decisions involving **transformational change, multiple important outcome dimensions, and high uncertainty**. It enables an assessment of how options interact with **system dynamics over time**, what **trade-offs** they create across outcomes of interest, and how they perform under different plausible futures. Results are summarised in an **ROA grid and explanatory narrative**, which support a clear strategic and economic judgement.

ROA can strengthen decision-making in transformational contexts by focusing analysis on how interventions influence dynamic processes of change over time, rather than delivering static outcomes at a fixed point. By preserving outcomes in different dimensions, it makes strategic trade-offs transparent and, by focusing on risks and opportunities rather than expected values, it surfaces low-probability but high-impact outcomes which can be decisive when pursuing systemic change. Through scenario analysis, ROA helps decision-makers understand which options perform acceptably across challenging, plausible futures. The ROA grid and summary narrative bring together a holistic view of key economic and strategic considerations into a single, coherent decision-making framework.

ROA most typically will complement Green Book cost-benefit analysis (CBA), to add insight on complex, transformational decisions. It may also be used as the primary framework, where appropriate and clearly justified.

Where both frameworks are adopted, insights can be triangulated. ROA applies Green Book value for money (VfM) principles to impacts that cannot reliably be reduced to a single monetised figure. Where ROA and CBA point in different directions, the reasons are set out transparently for decision-makers.

C. Deciding when to use ROA

ROA builds on and aligns with existing HMT Green Book appraisal practice. We advise pursuing ROA when all three of the below features are strongly present and materially affect the choice between options. However, appraisers may find the technique beneficial even with fewer than three strongly present.

- **Transformational change** is intended or likely, such that policies are expected to restructure systems, not just improve marginal performance. In such situations, outcomes depend on system behaviour over time (e.g. feedbacks, lock-in, tipping points).

For example: Introducing a national hydrogen transmission network that would fundamentally reshape energy markets and industrial fuel use or reforming a city's public transport system in a way that reshapes travel behaviour, congestion patterns, land use and local economic activity over time.

- **Diverse interests** or outcome dimensions are relevant to the policy, such that accounting in a single metric (e.g. via monetisation, and/or aggregation) may diminish information important for decision-making. There may be important trade-offs that are more clearly understood when information is not reduced to a single metric.

For example: Reforming urban transport systems where objectives span congestion, air quality, regional equity, active travel, and local economic growth.

- **High uncertainty** exists around critical outcomes, such that probabilities and magnitudes cannot be confidently quantified.

For example: Supporting early-stage technologies where future costs, which may depend on global deployment pathways, are highly unpredictable.

ROA can be a powerful tool for challenges where CBA alone does not capture the full nature of the decision, which may be the case where outcomes are shaped by system dynamics over time, are multi-dimensional or highly uncertain (see Technical Implementation Guidance).

These criteria align with the Green Book's definition of transformational change and guidance on the use of systems thinking ([Chapter 4](#)) and scenarios ([Chapter 6](#)). The table below is intended to help analysts decide when ROA can add value, recognising that many appraisal issues will sit between these two stylised cases.

Figure 1: Decision Framework: When ROA is typically appropriate

Criteria	ROA less appropriate	ROA more appropriate
Intended change	Marginal. No change in relationships between economic variables.	Structural. Change in quality, type, or existence of goods and services in the economy, or in relationships between economic variables.
Diversity of interests	Low. The relative magnitude of outcomes in different dimensions is not important to the decision-maker.	High. Outcomes across different dimensions are of significant importance to the decision-maker.
Extent of uncertainty	Low. Most important policy outcomes are meaningfully quantifiable in terms of impact and probability.	High. Important policy outcomes, or factors that strongly influence them, are not meaningfully quantifiable.

For example, a clear ROA case would be choosing between pathways that may shift market structure (e.g., infrastructure + standards + consumer response), where outcomes depend on feedbacks (adoption ↔ costs ↔ confidence) and where the decision-maker cares about multiple objectives (e.g., bills, emissions, security, jobs).

A range of government interventions could reach the thresholds for using ROA listed above, including appraisal of single policy instruments or projects, or appraising different packages of policies or investments. While transformational change is often associated with larger policy packages and portfolios, it is not impossible for a single intervention to trigger structural change, such as a carbon floor price in the case of the UK coal phase-out (see [Appendix A](#)).

A full application of ROA (use of all three components and the ROA grid) and a CBA may be used together where all ROA components are applicable, and the decision-maker would like to compare the insights generated by the two appraisal frameworks. Where not all ROA components are applicable, one or two of its relevant components can be used to support traditional appraisal methods. Because ROA brings together existing techniques, many appraisers may already be doing so. See [Appendix A](#) for further explanation.

In practice, ROA will most typically complement CBA, adding insight on complex, transformational decisions. Where the characteristics set out above are strongly present, ROA is likely to add value and may be used as the primary appraisal framework, where its suitability for the context is clear and well justified; in many cases, particularly while ROA remains an emerging practice, users may wish to apply it alongside more familiar appraisal approaches to compare and triangulate insights.

D. Positioning ROA in policy appraisal

ROA is designed to be integrated within the standard Green Book appraisal framework. It should be predominantly used to inform both the Strategic and Economic Cases and sections covering similar content in Regulatory Impact Assessments.

In practice, ROA is likely to be developed iteratively across the business case lifecycle rather than completed all at once. At the Strategic Outline Business Case (SOBC) stage, the Scoping stage and Dynamic Assessment are likely to be most prominent, helping to clarify the problem, desired end-state, and key feedbacks shaping the decision context. At the Outline Business Case (OBC) stage, the Dynamic Assessment is likely to be developed further, and early Multi-dimensional Assessment may be added to explore the main trade-offs between shortlisted options. By Final Business Case (FBC) stage, where proportionate, all three ROA components may be applied in full so that the final appraisal reflects system dynamics, outcomes across dimensions, and performance under uncertainty.

D1. ROA: an integrated Strategic and Economic Case

ROA provides a consistent method and a standardised framework to closely integrate the strategic and economic cases. Many outcome dimensions have both economic and strategic implications – such as innovation, jobs, public health and energy security. Bringing together the best available quantitative and/or qualitative evidence on each into one framework helps to create a rigorous and coherent analysis. At the component-level:

- The **Dynamic Assessment** is likely to generate insights relevant to both the strategic and economic case, as dynamic effects, feedbacks (such as learning curves, innovation spillovers, technological path-dependency), and complementarities cut across both. It can inform the theory of change, and the assessment on VfM.
- The **Multi-dimensional Assessment** generates insights on outcome dimensions that matter across economic and strategic cases, including expected values, and strategic risks and opportunities.
- The **Uncertainty Assessment** identifies the resilience of options to scenarios outside of the control of the decision-maker – which informs the strategic fit, as well as the robustness of any judgement on VfM.

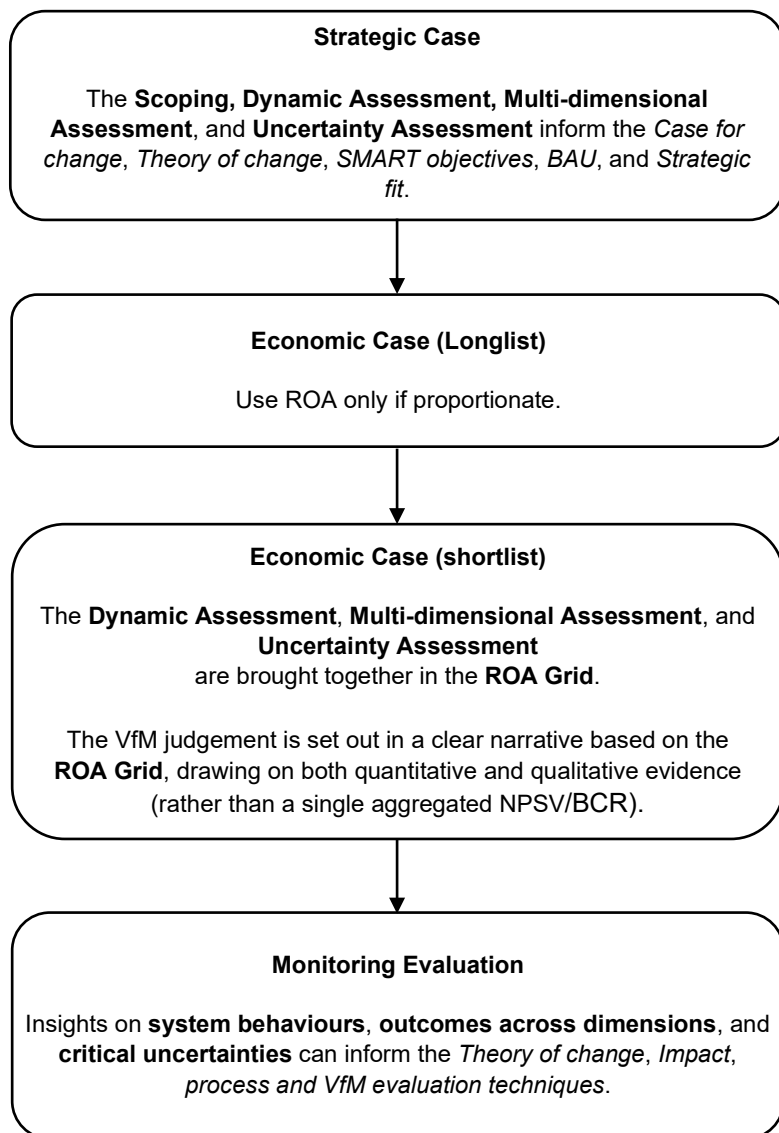
Insights from ROA therefore feed into both the Economic and Strategic cases.

ROA is particularly helpful where strategic considerations are economic in nature, they are assessed coherently and on a consistent evidence base – for example where feedbacks or deep uncertainties (such as technology learning by doing) may only be typically captured in only one case.

D2. Incorporating ROA into the appraisal process

The flow-chart below illustrates how ROA fits within the Green Book appraisal process, alongside CBA. ROA is not a separate stage of appraisal, nor a replacement for existing Green Book requirements. Instead, its insights are integrated at different points in the appraisal process to strengthen the Economic Case and the Strategic Cases, particularly where decisions involve uncertainty, multiple objectives, or system change.

Figure 2: How ROA is incorporated into the appraisal process



Where a policy's central purpose is to deliver transformational economic change (for example, place-based/regional development or the low-carbon transition), it is important that the Economic Case is supported by methods that can transparently assess transformational dynamics, multi-dimensional trade-offs, and deep uncertainty.

Figure 3 details how ROA can inform each stage of the Five Case Model. See the [HMT Green Book \(Table 2\)](#), on the Five Case Model for where each case links into other relevant guidance, including the Teal, Orange and Magenta Books.

Figure 3: ROA in the Five Case Model

5 Case Model	Step	How ROA can inform it
Strategic case	Case for change / Theory of change	Scoping: clarifies the decision context: the problem, desired end state, key outcome dimensions and critical uncertainties (to ensure subsequent analysis is decision relevant). Dynamic Assessment: use understanding of how the system operates now, and how options intervene in feedbacks, to support the theory of change.
	SMART objectives	Scoping: integrate findings on the dimensions of interest.
	Business as usual (BaU)	Dynamic Assessment: use understanding of the system, and what's driving or constraining change, to form a judgement about how it may change in future, even without intervention.
	Strategic fit	Scoping: integrate relevant findings. Multi-dimensional Assessment: highlight possible outcomes and strategic trade-offs between outcomes in different dimensions. Uncertainty Assessment: include key insights on how outcomes may vary under alternative scenarios.
Economic case	Critical success factors (CSFs)	Dynamic Assessment: Critical success Factor 1 (CSF1): Objectives and Strategic Fit may include strengthening the most helpful feedback identified. Multi-dimensional Assessment: CSF 1 may include consideration of the most important outcomes and trade-offs between them. Uncertainty Assessment: CSFs could require robustness or resilience to identified scenarios.
	Shortlist appraisal	Dynamic Assessment: include all relevant findings. Multi-dimensional Assessment: include all relevant findings. Uncertainty Assessment: include all relevant findings. Distributional analysis: use in relation to any (one or more) of the outcome dimensions of interest, as per Technical Implementation Guidance.
	Longlist appraisal	If ROA is to be used at this stage, avoid ruling out options at this stage based on expected policy effectiveness (as this will be considered at the next stage).

5 Case Model	Step	How ROA can inform it
Management case	Governance arrangements / Change management, benefits realisation and risk management arrangements / Monitoring and evaluation plan / Contingency arrangements and plans	Integrate all 3 ROA components into M&E plan (See Section H).

ROA is not designed to inform the Financial Case. The Public Sector Financial Impact (PSFI) should be carried out and included in any overall judgement on VfM, as per the [HMT Green Book](#).

D3. Presentation of ROA outputs

ROA outputs should be summarised in an ROA Grid, supported by short narrative text. The ROA Grid is a structured summary of what the analysis finds across outcome dimensions and key uncertainties. It is not a scoring tool and should not be interpreted as producing an ‘optimal’ answer. A preferred option (where appropriate) is set out in the Recommendation narrative, which explains how trade-offs are considered. ROA supports a Green Book-consistent VfM judgement by making explicit the expected outcomes, risks, opportunities, uncertainties and trade-offs that should inform the overall recommendation. The Green Book Review (2020) recognised that a single monetised number cannot, on its own, capture VfM for the most complex, transformational decisions. The ROA grid summarises evidence, and the accompanying narrative provides a clear steer on VfM (see [Figure 4](#)). Instead of a single VfM metric, the ‘value’ (expected outcomes, risks, opportunities, and resilience to uncertainty) across the different dimensions are summarised, alongside the costs to the government.

E. How to use ROA in practice

E1. Proportionality

The Green Book emphasises **proportionality**: the effort invested in appraisal should be commensurate with the likely costs, benefits, and significance of the decision. ROA follows the same principle.

On component level of **depth**: each component can be applied to three levels - basic, intermediate and advanced (as proportionate). The Technical Implementation Guidance contains specific instructions for each. ROA can be applied at these levels according to the proportionality principle, depending on analytical capacity, evidence availability, and decision criticality.

E2. Generating SMART objectives and options

The ROA Scoping stage and Dynamic Assessment (ROA Technical Implementation Guidance Section 4) can help ensure that the SMART objectives, the case for change, and the theory of change ([Green Book Chapter 4](#)) are informed by system dynamics. The Scoping stage involves a discussion with the responsible minister(s) and/ or Senior Civil Servants to clarify the problem to be addressed, the nature of a desirable end-state that the policy should aim to achieve, and important opportunities, risks or uncertainties to be considered. The Dynamic Assessment involves systems mapping with causal loop diagrams.

Case for change

The case for change can be informed by systems mapping with causal loop diagrams. This can help explain how feedbacks in the system contribute to the problem to be addressed (for example, market failures or lock-in), but also where helpful feedbacks or opportunities already exist and could be strengthened through intervention.

For example, originally, UK fixed bottom offshore wind was expensive, contributing to low investment and deployment. However, through a system of long term, visible support measures which brought forward significant volumes of deployment the UK Government was able to speed up deep cost reduction leveraging fixed bottom offshore wind's high learning rate. Applying this to the floating offshore wind industry shows that policy could strengthen a reinforcing feedback of cost reduction and investment, helping enable a cost-competitive industry in future.

Theory of change

A theory of change in ROA is not limited to a one-directional chain of cause-and-effect, but instead shows how interventions might weaken or break unhelpful feedbacks; or create or strengthen helpful ones.

For example, an insulation scheme would break the reinforcing feedback: poor housing stock drives fuel poverty, which reduces households' capacity to invest in upgrades, which leaves housing stock poor.

E3. Applying ROA to Longlist Appraisal

Consideration of ROA at the longlist appraisal stage should be proportionate to the amount of policy options considered and resource available. **Before** ROA is applied, longlist appraisal should follow [standard Green Book practice](#) to remove options that fail basic tests via the use of critical success factors. Where ROA is planned, avoid ruling out options at longlist appraisal stage on the basis of expected effectiveness in achieving policy objectives. Effectiveness is tested more systematically at the shortlist appraisal stage through the relevant ROA components.

If many options are shortlisted, it is likely to become clear early in an ROA dynamic and Multi-dimensional Assessment that some shortlisted options can be dropped, given their impact on feedbacks and given initial findings on likely outcomes, risks and opportunities.

E4. Applying ROA to Shortlist Appraisal

ROA at the **shortlist appraisal stage** (see [Green Book \(Chapter 6\)](#)) uses each component of ROA (Dynamic Assessment, Multi-dimensional Assessment, and Uncertainty Assessment). ROA evaluates each option in detail.

The results can be presented in the Economic Case, showing:

- **How policy options interact with dynamics of the system:** This includes how each policy option may create, break, strengthen or weaken reinforcing or balancing feedbacks, as well as how it may give rise to second- or third-order effects.

For example: Using a causal-loop diagram to explore to what extent different policy options strengthen feedbacks that increase deployment of a given technology (e.g. economies-of-scale, and learning-by-doing), while also identifying longer-term effects (e.g. supply-chain concentration, infrastructure lock-in).

- **How outcomes vary across policy-relevant dimensions:** This analysis shows how each policy option creates outcomes in different dimensions of interest to the decision-maker and reveals any trade-offs between those outcomes.

For example: For the different policy options, comparing outcomes in the dimensions that matter to the decision-maker, such as jobs likely to be created and lost, short-term costs to government, long-term impacts on industrial competitiveness, and impacts on energy bills.

- **How policy options perform under different future scenarios:** This identifies if each policy option is effective across multiple important future scenarios ('robust'), if it can be adapted to remain effective in any scenario ('resilient'), or if it can only be effective in one scenario ('contingent').

For example: For the different policy options, evaluating if each will be effective, even under low oil and gas prices, or low global deployment of a technology that the policy aims to support.

The steps in this method are described in the ROA Technical Implementation Guidance.

An **ROA Grid and narrative** is used to summarise these results, enabling clear communication of trade-offs and uncertainty to decision-makers. For more information, see [Figure 4](#).

Much like for CBA, some iteration is likely in the design of interventions throughout the appraisal process. For guidance on applying ROA alongside CBA, please see [Section G](#).

F. Presenting ROA Results to decision-makers

F1. Structuring ROA Outputs

A three-part summary narrative is suggested:

- Results of the ROA
- Additional considerations
- Recommendation

Results of the ROA:

ROA outputs should be summarised in an **ROA Grid**, supported by short narrative text. The ROA Grid is a structured summary of key findings from all components of the analysis. However, it is not a scoring tool and will not necessarily produce an 'optimal' answer. A preferred option (where appropriate) is set out in the recommendation narrative, which explains how trade-offs are considered. The structure is as follows in Figure 4:

Figure 4: ROA Summary Grid

	Dimension 1 e.g. costs	Dimension 2 e.g. solar deployment	Dimension 3 e.g. price of electricity	Dimension 4 e.g. security of supply	Dimension 5 e.g. innovation	Performance in relation to critical uncertainties
Point of interest	Expected value	Expected value	Expected value	Risk	Opportunity	
Time focus	Present and next X years (discounted)	Over next X years (cumulative)	In X years' time	In any given year	Over next Y years	
Policy A	+£Xm Neutral	+X GW Self-amplifying	-£X/MWh	+X%	Strong	Contingent Only performs well if X happens
Policy B	+£Ym Neutral	+Y GW Self-limiting	-£Y/MWh	-Y%	Unlikely	Resilient Can be adapted without difficulty to what happens with X, Y or Z
Policy C	+£Zm Neutral	+Z GW Neutral	+£Z/MWh	-Z%	Medium	Robust Performs well whatever happens with X, Y or Z

Notes: Metrics are shown here for illustrative purposes. The best available evidence should be used, whether qualitative or quantitative. Insights on feedbacks may be explained to enable understanding from the decision-maker, and may also include the strength of the feedback, and confidence in it. Where quantification is possible, a range may be more appropriate than a single number. See the Glossary in the ROA Technical Implementation Guidance for definitions of 'Contingent, Resilient and Robust'. One or more counterfactuals can be shown as additional rows in the table.

The ROA Grid or the supporting narrative text should include any key insights on how the outcomes of policy options may be distributed among different social groups and different places, where this is relevant. The PSFI of the proposal can be presented separately, but should always be included in the narrative judgement and explanation on VfM, as required by the HMT Green Book.

ROA should not monetise outcomes in non-monetary dimensions. Outcomes in dimensions that matter to the decision-maker should be retained in their original metrics. This may involve presenting results in more detail. For example, rather than presenting loss of natural capital as a single number, the actual anticipated effects should be explained – e.g. loss of pollinators, peatland carbon sinks, or wetlands that defend against flooding.

The ROA grid should not be read as a ranking; the recommendation narrative explains which outcomes were prioritised and why.

Explanation of the grid: results of the ROA

The explanation of the results of the ROA should include at least some of the following elements, with priority given to those that have emerged as most important in the comparison between the policy options:

- **Start with the scoping context:** briefly restate the problem to be solved, the desired end-state, and the outcome dimensions and critical uncertainties that matter for this decision.
- **Summarise the key dynamics:** explain the most decision-relevant feedbacks (reinforcing/balancing), the direction of change sought (strengthen/weaken/create/break), and note confidence in the key relationships (high/medium/low).
- **Draw out the main points of comparison:** interpret the dynamic and multi-dimensional findings together by summarising the most important points of comparison, across the outcome dimensions, including trade-offs between options.
- **Summarise uncertainty/scenarios:** briefly describe the scenarios used (why chosen), and the key implications for each option (e.g. robust/resilient/contingent, and what the dependencies are).

Additional considerations:

In addition to the structured ROA results, analysts should set out any **material considerations that are not well captured within the ROA framework**, or where the ROA provides only a partial representation. This may include; dependencies on decisions outside the scope of the appraisal, or emerging evidence that could not be robustly incorporated into the assessment.

This section should also be used to highlight:

- known data gaps or evidence limitations or important assumptions that drive conclusions (see '[Recording evidence quality and confidence](#)')
- issues that are highly context-specific or time-dependent
- interactions with parallel programmes, regulatory decisions, or international developments

The purpose of this section is not to reopen the ROA assessment, but to ensure that decision-makers are sighted on relevant considerations that may affect how to interpret the results.

Recommendation:

The recommendation should draw explicitly on the ROA results, supplemented by any additional considerations, to set out a **clear, reasoned judgement** on the preferred option. It should explain why the recommended option performs relatively well across the outcome dimensions that matter most, how it manages key uncertainties and system dynamics, and why it represents a credible strategic choice in the context of the decision being taken. Where appropriate, the recommendation should also:

- Make explicit how VfM has been judged, given evidence of expected outcomes, risks, opportunities and uncertainties. The recommendation paragraph should include a short statement of which outcomes were prioritised for this decision and why, to ensure the trade-offs are transparent. These should be informed by insights gained at the Scoping stage on decision-maker priorities.
- Explain how trade-offs have been balanced. For example, “We prioritised avoiding downside bill impacts over maximising upside innovation benefits at this stage; therefore, we prefer the option with lower tail risk even though its central case benefits are similar.”
- Set out any conditions, mitigations, or review points required to manage identified risks;
- Indicate where adaptive or staged approaches may be warranted given uncertainty.

This narrative is critical to linking the ROA to the **Strategic and Economic Cases**, ensuring that the analytical findings directly inform the policy recommendation.

F2. Communicating to decision-makers

ROA should be presented as a policy appraisal framework that:

- Is appropriate for situations of uncertainty, diverse interests, and structural change (or ‘transformational change’);
- Makes system behaviour explicit and assesses the dynamic effects of policy options;
- Addresses the limitations of monetised analysis, presenting an assessment of possible outcomes of interest to policy (and trade-offs between them) with maximum transparency;
- Considers uncertainties relevant to policy options in a systematic way;
- Generates a VfM assessment: a balanced judgement about the best way to use public resources to achieve the objectives of a proposal. This is achieved through the ROA Grid and accompanying narrative.

As with CBA, ROA outputs should be accompanied by a clear narrative explaining evidence quality, uncertainty, and the basis for key judgements.

F3. Communicating Evidence Quality, Uncertainty and Judgement

Recording evidence quality and confidence

When applying ROA, analysts should explicitly consider the **quality of evidence** underpinning their assessments and record their **confidence in key judgements**, particularly where analysis relies on qualitative reasoning or expert judgement.

This is especially important in the **Dynamic Assessment**, where conclusions about system behaviour may depend on assumptions about causal relationships, feedback loops, or behavioural responses. Analysts should record their level of confidence in these relationships (for example, high, medium, or low), drawing on available empirical evidence, theory, stakeholder insight, or precedent from comparable contexts. This approach is explained in more detail in the ROA Technical Implementation Guidance and helps distinguish well-evidenced dynamics from more contested assumptions. When presenting ROA outputs, uncertainty should be communicated clearly as an inherent feature of the decision context, not merely as a limitation in the analysis.

As with CBA, underlying assumptions and quality assurance should be logged and outlined in the supporting document, for example an analytical annex accompanying a business case. For further information please consult the [HMG AQuA Book](#). Uncertainties and assumptions that meaningfully shape the results should always be clear to the decision-maker (see below).

Communicating Uncertainty and Judgement

Key principles include:

- **Emphasise transparency:** uncertainty is something to be managed within the analysis, not eliminated
- **Focus on performance across futures, not prediction:** explain how options behave under different plausible scenarios
- **Use plain language:** avoid technical terms unless they materially aid understanding
- **Draw out implications for robustness and adaptability:** rather than presenting deterministic conclusions

Illustrative phrasing:

“The analysis suggests Option A performs more strongly under central assumptions but is more exposed to future demand volatility. Option B performs less strongly under central assumptions but appears more resilient across a wider range of plausible futures.”

Highlighting uncertainty and evidence strength in ROA outputs

The narrative accompanying the ROA grid should be used to clearly explain:

- the **key sources of uncertainty** affecting the analysis
- the **strength and limitations of the evidence base**
- where conclusions are most **sensitive to assumptions or data gaps**

This mirrors good practice in CBA, where explanations are given for data limitations, modelling assumptions, and uncertainty alongside monetised results. ROA provides a structured way to do this for impacts that cannot be meaningfully quantified, ensuring that uncertainty and evidence quality are explicit rather than implicit.

Where evidence is weak or mixed, this should be stated clearly, along with any implications for confidence in the results and for future monitoring, evaluation, or adaptive policy design.

Illustrative phrasing:

“The analysis assumes that cost reductions from early deployment increase over time. If learning effects are stronger than assumed, the long-term benefits of Options A and B would be greater. This uncertainty does not change the direction of impact, but it affects the speed and scale at which benefits are realised.”

Using ROA to support transparent professional judgement

ROA does not remove the need for professional judgement; rather, it provides a framework for making that judgement transparent. By recording confidence levels, evidential strengths, and key uncertainties, analysts can support more informed decision-making and clearer accountability. This is particularly important in contexts of transformational change, where uncertainty is inherent and decisions must often be taken before full evidence is available.

F4. Tailoring to different audiences

ROA outputs should be tailored to the needs of different audiences, recognising that ROA is typically developed through close collaboration between analysts and policy teams. Finding best available evidence may also require involving subject-matter experts, academia, industry, delivery or commercial colleagues, or other specialist functions – both to strengthen the evidence base and to ensure that the narrative reflects the practical and strategic implications of the analysis.

- **Analysts** should engage closely with the **narrative and implications** of the results, not solely with the mechanics of the method. ROA is an integrated, ‘one-team’ exercise, requiring analysts and policy professionals to together interpret dynamic effects, trade-offs, and uncertainty in a way that clearly informs the policy recommendation and supports the Strategic and Economic Cases.
- **For Policy teams and Senior Responsible Owners (SROs)**, ROA provides a structured narrative that explains why certain options are more viable, effective, robust, or strategically aligned than others. The emphasis should be on how the ROA findings shape the recommended option, highlight key dependencies or risks, and inform delivery considerations over time.
- **For ministers and senior decision-makers such as governance boards**, the focus of the ROA outputs will typically be on the **outcomes and implications**. The ROA grid and accompanying narrative should provide a clear line of sight between policy choices and the outcomes decision-makers care about, explaining how different options are expected to perform across dimensions and under uncertainty. The narrative should be framed explicitly around the recommendation:

“This is how the proposed policy is expected to affect the outcomes of most importance, and why it represents a credible strategic choice.”

G. Doing ROA and Cost-Benefit Analysis together

This section explains how ROA, in full or partial applications, may be presented alongside CBA in the Economic Case and Impact Assessments.

G1. Relationship Between ROA and CBA

CBA and ROA are different ways of organising evidence about the same policy options. They mainly differ not in what they consider, but in how impacts are assessed and how results are presented.

Both CBA and ROA seek to consider quantifiable and unquantifiable impacts across a range of potential options, and present these to decision-makers in a structured framework. Indeed, the steps taken to estimate quantified impacts presented under ROA can be the same steps taken to develop an appraisal under a CBA framework, up to a point. Both have the capacity to consider the following:

- **Dynamic effects:** Both frameworks may use methods to identify systemic impacts of interventions on processes of change, including qualitative systems mapping with causal loop diagrams, and quantitative systems modelling. In ROA it is a core component of the analysis, reflecting the importance of feedback effects to achieve transformational change. While such analysis can be incorporated into CBA, it is not yet common practice, and its implications cannot be fully encapsulated within a benefit-cost ratio (BCR) or a net present social value (NPSV).
- **Outcomes across multiple dimensions:** Here we see the biggest departure between the two. Both encourage comprehensive analysis of outcomes in different dimensions, using best available evidence. CBA takes this a step further to monetise and aggregate expected impacts into a single NPSV / BCR/ return on public sector cost (RPSC) net present unit cost (NPUC) where possible, while presenting unmonetisable impacts in a remaining category. ROA preserves analysis on outcomes in their most natural metrics instead of monetising and aggregating and requires greater focus on risks and opportunities rather than expected outcomes, where relevant. For ROA, the distributional analysis is specific to each outcome dimension.
- **High uncertainty:** Both frameworks can use sensitivity analysis where uncertainty is low enough for a range of plausible outcomes to be meaningfully quantified, and scenario analysis where uncertainty is deeper. The key difference is that CBA scenario analysis tends to focus on the quantified, and in some cases only monetised impacts, whereas ROA considers the performance of an option in a consistent way more holistically across both quantifiable and unquantifiable outcomes and also uses qualitative scenario analysis as a core method. The latter is particularly appropriate for situations of deep uncertainty. Qualitative scenario analysis can also be used with CBA, but this is not common and is not a requirement.

- **Clear presentation of outputs:** The Green Book recommends Appraisal Summary Tables (ASTs) to present options, headline social value metrics as per [Green Book \(Table 10\)](#) (e.g. NPSV, BCR), unmonetisable impacts, public sector costs, and distributional effects. By contrast, the ROA grid does not separate monetisable and unmonetisable impacts, instead summarising risks, opportunities and/or expected impacts for each outcome dimension explicitly (e.g. gigawatts for installed energy capacity, jobs created for employment), using the best available qualitative and quantitative evidence. It requires a conclusion on the resilience of each option to plausible scenarios, which the AST does not. **ROA's design - which requires explicit consideration of dynamic effects, risks and opportunities in different dimensions, and high uncertainty - makes it a particularly powerful tool with which to understand nuanced information on complex challenges.**

ROA is particularly well suited to complex, transformational challenges where dynamic effects, a range of outcomes across multiple dimensions, and high uncertainty are central to the decision. Its requirement for systems mapping encourages a shift from assessing whether an intervention delivers a static outcome by a fixed point in time, to understanding how it may strengthen or weaken dynamics that amplify or constrain change.

By preserving outcomes across dimensions in their original metrics and focusing on risks and opportunities where relevant, ROA provides insight into low-probability, high-impact outcomes that may be decisive for decision-makers – such as avoiding worst-case risks or enabling strategic upside. Through scenario analysis, ROA supports judgements about which options perform acceptably across a range of plausible futures.

In many cases those adopting an ROA framework, particularly early adopters, may wish to do so alongside a CBA appraisal (though ROA may also be used as the primary appraisal framework, where its suitability for the context is clear and well justified). If ROA and CBA are used for one appraisal, they should have the same or similar scope and can be used to triangulate insights. **ROA should not be used alongside CBA solely to capture non-monetised / non-quantified impacts.** If ROA is used, it should capture analysis on all outcome dimensions of interest: if CBA monetises emissions, for example, it does not mean that emissions should be left out of the ROA grid. If emissions are relevant to the decision-maker, then outcomes in this dimension should be presented in a column in the ROA grid, using the metric of tCO₂.

G2. Presenting and Interpreting ROA and CBA together

This section provides guidance on how to present a full ROA (all three components) alongside a CBA.

Where ROA and CBA are both used, they should be presented and interpreted as two distinct but related views of the same policy options. Where possible, both should draw on the same underlying evidence base and assumptions, but they differ in how impacts are assessed and presented. CBA summarises monetised impacts, alongside non-monetised and distributional impacts, in line with the HMT Green Book appraisal summary table ([Table 12 in the HMT Green Book](#)); ROA, by contrast, presents outcomes in their natural metrics and makes system dynamics, trade-offs, and performance under uncertainty explicit (Figure 5).

The ROA Grid and the Green Book appraisal summary table should therefore be presented in a way that keeps the two analytically distinct but easy to read together. The ROA Grid should not be used simply to capture non-monetised impacts left out of the CBA; if ROA is used, it should reflect all outcome dimensions relevant to the decision. Used together, the two frameworks should allow decision-makers to see both the CBA results and the wider strategic, dynamic and uncertainty-related implications of each option at a glance.

The two frameworks should then be interpreted together to triangulate insights, not as competing assessments of different parts of the problem. CBA helps quantify monetised costs and benefits, while ROA explains how options are expected to perform across the outcome dimensions of interest, including their dynamic effects and resilience under uncertainty. The accompanying narrative should explain how the monetised results of CBA relate to the ROA assessment in which outcomes are not monetised, and how uncertainty or system dynamics affect the overall judgement.

As an illustrative example of the framework:

"Option C has the highest central NPSV, but the ROA shows this depends on a behavioural feedback that does not hold under the 'low trust' scenario, leaving it exposed to significant downside risk. Option B has a marginally lower central NPSV but performs robustly across scenarios. On a risk adjusted basis — consistent with the Green Book's treatment of risk and uncertainty — Option B represents better VfM."

The reason for divergence must be explained transparently.

Where the two analytical frameworks produce results that point in the same direction, this can strengthen confidence in the conclusion; where they diverge, the reason for that divergence should be made explicit. For example, an option may perform best on central CBA metrics, while another may be preferred because it is more resilient across a wider range of plausible futures or better supports the feedbacks needed for transformational change. ROA results should not be monetised for consistency with CBA; instead, they should be used to clarify where a monetised appraisal may be incomplete or have significant limitations for the decision at hand.

For example:

"The CBA does not capture the potential impact of these options on UK competitiveness in industry X. The ROA evidence suggests Option A could support the development of a competitive domestic industry over time, whereas Option B does not, despite its lower short-term costs. This wider economic potential is weighed alongside, not in place of, the monetised costs and benefits".

ROA findings may also help inform how risks are treated within the CBA narrative, including where relevant in sensitivity analysis or switching values.

For example:

“A key risk of pursuing Option B is potential competition for land between energy, food production and carbon sequestration. While CBA has costed this risk at £X, this estimate does not capture the wider implications of food inflation and supply shortages if Y external events unfold simultaneously.”

Figure 5: Full ROA alongside a CBA

When ROA and CBA are used together, the summary of the findings should be presented in the following sequence.

Appraisal Evidence	Purpose	Presentation Format
CBA results	Summarises metrics of social value as per Table 10 of the HMT Green Book .	Standard HMT Green Book Appraisal Summary Table 12
CBA limitations	Summarises limitations of CBA in the context, justifies why each ROA component is applicable.	Short narrative.
ROA grid	Captures wider range of impacts including systemic and uncertain impacts; does not monetise or aggregate.	One-page summary showing: (1) Dynamic Assessment, (2) multi-dimensional outcomes, and (3) uncertainty classification (robust / resilient / contingent).
Combined summary	Integrates both analyses to support overall recommendation.	Summary narrative explaining strengths and limitations of each, and triangulates evidence to reach coherent recommendation

Treatment of uncertainty: CBA mainly explores uncertainty through sensitivity analysis around central estimates and can be complemented with scenario analysis.

H. Monitoring and Evaluation

H1. Using ROA for Monitoring and Evaluation

DESNZ explicitly encourages new and innovative monitoring and evaluation (M&E) approaches.¹ ROA can support M&E of interventions seeking transformational change, where it was used for initial appraisal, or as a first application. In this application, analysis can be split into the three components: the Dynamic Assessment, the Multi-dimensional Assessment, and the Uncertainty Assessment. Because **ROA requires careful, transparent documentation of decisions and judgements**, it lends itself to monitoring and evaluation: small but important decisions (such as the relationship between two variables) can easily be revisited and re-evaluated if needed.

For each component, the evaluation should aim to explore if the rationale for outcomes is accurate in a proportionate manner. For example:

- Is the core feedback identified in the Dynamic Assessment the main driver of change? Are the relationships between variables correct in direction and strength?
- Are the expected outcomes, risks and opportunities identified in the Multi-dimensional Assessment emerging as expected?
- How are the policy interventions performing in the scenario that is unfolding? Do they seem to be resilient to the critical uncertainties identified in the initial analysis, and any other emerging threats?

The below steps can be followed, for each component:

- **Dynamic Assessment:** M&E should aim to identify if the intervention is changing the system as expected. At the basic level, it would involve monitoring if the core reinforcing feedback expected to drive structural change in an intended direction, is operating as expected. This might include:
 - looking for evidence that the relationships between each of its variables are operating as expected; and/or
 - looking at whether the outcomes it most directly affects are changing in the desired way
 - if not, investigating the reasons why

A more advanced assessment could take the same approach, but expand the scope of analysis beyond the single core feedback. The analyst may also choose to focus on links or feedbacks where there is lower confidence, or evaluate links back through the systems map from where unintended consequences emerge.

¹ DESNZ (2024) [‘DESNZ monitoring and evaluation framework’, Section 4.6.](#)

- **Multi-dimensional Assessment:** the focus here is to understand if the intervention is producing outcomes as intended, in the dimensions that matter most. Outcomes should be monitored in the multiple dimensions of interest to the decision-maker, rather than just one. A basic level assessment might include:
 - identifying whether outcomes in any dimensions are far outside the range of, or directionally different, to what was expected
 - investigating the reasons why

A more advanced assessment might also aim to identify and understand smaller differences in expected and actual outcomes.

- **Uncertainty Assessment:** this component should aim to monitor how critical uncertainties are behaving in the real world. Observing trends can signal whether the world (the 'contextual environment') is moving closer to one scenario or another. Monitoring this contextual environment, through qualitative or quantitative research, can help provide early warning of whether a policy that was judged to be 'resilient' may need to be adapted, or whether a policy judged to be 'contingent' may need to be abandoned. If the policy being implemented was judged to be 'robust', then there should be less need for it to be adapted. However, it may still be helpful to:
 - review whether any previously unconsidered factors have emerged that now challenge the policy's effectiveness, or
 - review whether the policy is proving as robust as expected – i.e., is it performing well in the conditions that have materialised

A basic or advanced assessment would differ only in depth of research and the extent of participation used to triangulate perspectives.

If no ROA was undertaken during the initial appraisal, it may still be useful for M&E. For example:

- a Dynamic Assessment of feedbacks may help to explain why a theory of change is, or is not, unfolding as expected
- the Multi-dimensional Assessment may help explain why outcomes are unfolding in greater extremes than expected (given its focus on risks and opportunities, rather than solely expected outcomes)
- the Uncertainty Assessment may be used to inform the intervention's resilience to the unfolding scenario, as well as to emerging threats

H2. Relationship between ROA and Evaluation Approaches

Where M&E is undertaken, ROA should be understood as complementary to, rather than a substitute for, established evaluation approaches such as: impact, process, and VfM evaluation as outlined in the [HMT Magenta Book](#), and [DESNZ Monitoring and Evaluation Framework](#).

- **ROA** can be used to structure evidence on how an intervention is influencing system dynamics, outcomes across multiple dimensions, and key uncertainties over time
- **Impact Evaluation** focuses on estimating the causal effect of the intervention
- **Process Evaluation** examines how and why implementation is working as intended
- **Value-for-money Evaluation** assesses whether realised benefits justify costs

Where ROA is applied to policy choices that were originally appraised using CBA, or where formal impact or process evaluations are planned, these approaches should be treated as analytically distinct but mutually reinforcing. ROA can help interpret evaluation findings in context, highlight emerging risks or opportunities, and inform adaptation, but should not be used to replace causal or VfM evaluation where these are required. Analysts should therefore be clear which framework is being used for a VfM evaluation and how any ROA insights are being used as inputs, to avoid duplicating analysis.

Appendices

Appendix A: Summary Guide to the ROA Components

ROA consists of three main analytical components – a Dynamic Assessment, a Multi-dimensional Assessment, and an Uncertainty Assessment – preceded by a scoping stage. Iteration between these components is often beneficial. The level of depth should follow the proportionality principle outlined in the Green Book.

The method steps summarised below are explained in greater detail in the ROA Technical Implementation Guidance.

A1. Scoping

Purpose:

To establish clarity on the problem, desired end state, and relevant opportunities, risks, and uncertainties before undertaking analysis. This complements [HMT Green Book, Chapter 5 – Generating Options](#) and aligns with Strategic Case development.

Approach:

Engage ministers and senior policy officials early.

Define the:

- **Rationale for intervention:** the problem to be addressed
- **Objectives:** a vision of a desirable future state
- **Dimensions of interest:** such as growth, emissions, jobs, public health
- **Opportunities and risks** to be considered
- **Best and worst-case scenarios**
- **Range of policy options** for consideration

A2. Dynamic Assessment

Purpose:

To assess how policies affect processes of change within the economic or policy system.

The Dynamic Assessment focuses on identifying and understanding feedback mechanisms within the system – particularly reinforcing and balancing loops – that can amplify, dampen, or redirect policy impacts over time, giving rise to higher-order effects that influence future choices, incentives, and system structure.

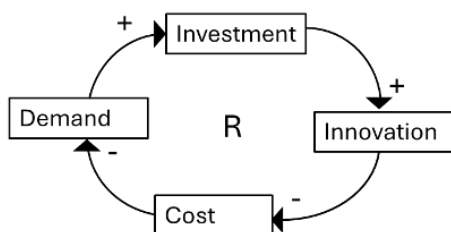
Approach:

- Determine an appropriate system boundary to focus analysis
- Identify variables that are important to the problem of interest and assign directions to the relationships between pairs of variables, recording the evidence used
- Use systems mapping with causal loop diagrams to identify:
 - Reinforcing feedbacks (self-amplifying change)
 - Balancing feedbacks (stabilising, self-limiting change)
- Determine the relevance of feedbacks to policy objectives. Identify at least one helpful reinforcing feedback aligned to the policy's aims
- Assess the dynamic efficiency of policy options (self-amplifying, self-limiting, neutral) by considering how they interact with feedbacks

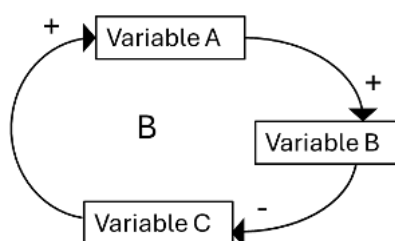
Key output:

A dynamic efficiency rating for each of the policy options, identifying the policy's dynamic effect (self-amplifying, self-limiting, or neutral) on relevant outcomes, the strength of these effects, and the level of confidence in these judgments.

Figure 6: Illustrative Causal Loop Diagrams



Reinforcing (self-amplifying)



Balancing (self-limiting)

Please refer to the 'Dynamic Assessment' section of the technical implementation guidance for more detail. There is also further guidance on causal loop mapping, and wider systems thinking tools, in the systems thinking toolkit for civil servants '[An introductory systems thinking toolkit for civil servants](#)'. See sections on causal loop diagrams (Tool 6), stock and flow diagrams (Tool 9) and agent-based modelling (Further tools and reading).

There is also a cross-Government Systems Thinking Interest Group (STIG) and a departmental systems thinking lead who can provide resources and/or training to equip analysts to deliver the Dynamic Assessment at any level. The central government Systems Insight Team can also provide access and support to systems mapping expertise and interactive systems mapping tools.

Levels of Application:

- **Basic:** Focus on a single central feedback loop
- **Intermediate:** Map key variables, feedbacks, and policy interactions
- **Advanced:** Use participatory mapping or quantitative simulation models

Analysts should record their level of confidence in key dynamic relationships identified, drawing on the available evidence base. For more information, please see '[Recording evidence quality and confidence](#)' in Section F3.

A3. Multi-dimensional Assessment

Note: while similar, this is not the same as MCA nor MCDA. It (i) requires analytical focus on expected values, risks or opportunities as appropriate and (ii) does not involve scores, weightings, or swing-weightings.

Purpose:

To present possible outcomes across all relevant dimensions with maximum transparency, without aggregating into a single metric.

Approach:

- **Identify the outcome dimensions of significant importance to the policy problem:** These should reflect the full range of factors that matter for the decision, including strategic objectives, distributional impacts, delivery considerations, and wider social or environmental effects.

Example: A skills policy may be assessed across productivity, regional equity, employer engagement, and fiscal cost.

- **Determine which part of the probability distribution (tail risks, expected outcomes, upside opportunity) is most relevant for each dimension, and the most relevant timeframe:** Depending on the nature of the policy and decision context, it may be more appropriate to focus on expected outcomes, downside risks, or upside potential.

Example: For critical infrastructure resilience, worst-case performance may be more relevant than expected value.

- **Assess expected, or worst-case/best-case outcomes of policy options in each dimension by drawing on the best available information, which may be quantitative or qualitative:** Keep outcomes in their natural metrics (e.g. GBP for costs, tCO₂e for emissions avoided), not monetised. To avoid hidden weightings or implicit trade-offs, no aggregation of outcomes across different dimensions is carried out. Each option should be assessed using the same set of dimensions and assumptions to allow transparent comparison. Where evidence is uncertain or mixed, this should be clearly indicated.

Example: estimates of cost savings to bill payers might be in GBP saved per annum, emissions avoided might be in tonnes CO₂e, and impacts on industrial competitiveness might include qualitative and quantitative metrics.

- **Combine results with findings from the Dynamic Assessment:** Where system dynamics materially affect outcomes in a given dimension, this should be noted explicitly.

Example: employment impacts may depend on whether reinforcing innovation feedbacks emerge.

Key output:

A table showing expected/worst/best-case outcomes by dimension, with indicators of dynamic effects, accompanied by short narrative text explaining evidence quality, uncertainties, and key trade-offs. Please refer to the 'Multi-dimensional Assessment' section of the technical implementation guidance for more detail.

Figure 7: Outcomes of each policy option by dimension

	Dimension 1 e.g. costs	Dimension 2 e.g. solar PV deployment	Dimension 3 e.g. price of electricity	Dimension 4 e.g. security of supply	Dimension 5 e.g. innovation
Point of interest	Expected value	Expected value	Expected value	Tail risk (of system stress event)	Opportunity (of tech improvement)
Time focus	Present and next X years (discounted)	Over next X years (cumulative)	In X years' time	In any given year	Over next Y years
Policy A	+£Xm Neutral	+X GW Self-amplifying	-£X/MWh Self-amplifying	+X% probability Self-amplifying	Strong chance Self-amplifying
Policy B	+£Ym Neutral	+Y GW Self-limiting	-£Y/MWh Self-limiting	-Y% probability Self-limiting	Unlikely Neutral
Policy C	+£Zm Neutral	+Z GW Neutral	+£Z/MWh Neutral	-Z% probability Neutral	Medium likelihood Self-amplifying

Levels of Application:

There is no difference in method between a basic, intermediate, or advanced level of analysis for this component of analysis. The differences are only of breadth and depth: the number of dimensions that are considered, and the depth of analysis undertaken within each one.

ROA shares with MCDA the consideration of outcomes in different dimensions, and the use of participatory approaches. The difference is that in ROA there is no weighting or aggregation process: instead, the relative importance of outcomes in different dimensions is considered explicitly by the decision-maker.

A4. Uncertainty Assessment

Purpose:

To consider how factors outside government control could affect policy performance. This approach uses scenario analysis to explore alternative plausible futures.

Approach:

Use scenario analysis to explore alternative plausible futures. This involves developing a small set of internally consistent narratives that reflect different ways the external environment might evolve—such as the international trade environment, fossil fuel prices, or technology preferences in the global market.

For example, the outcomes of a low-carbon heat deployment policy may depend on whether other countries are choosing to deploy large quantities of heat pumps, and whether that is helping to bring down the costs of heat pumps, or whether it is leading to scarcity in supply of their components.

The ROA Uncertainty Assessment is intended to complement, not replace, existing Green Book uncertainty practice (including sensitivity testing and scenario analysis where used in departmental guidance). Where probabilities and magnitudes can be credibly quantified, analysts should continue to use standard quantitative approaches (e.g. sensitivity analysis around central estimates). ROA's scenario approach is most useful where uncertainties are deep (i.e., not meaningfully expressible as probabilities), where change could be qualitative as well as quantitative, where relationships between variables and outcomes of interest are not fully known or quantifiable, or where the decision hinges on whether options remain viable across a small set of distinct, plausible futures. In policy areas with extensive sector-specific appraisal and uncertainty guidance, ROA can be applied selectively—for example, to structure portfolio interactions, key dependencies and deep uncertainty scenarios—rather than duplicating established quantitative uncertainty analysis.

Steps:

- **Identify critical uncertainties:** These are factors that strongly influence policy outcomes, that are highly uncertain, and that are largely outside government control, (typically, their likelihood cannot be reliably expressed in probabilities). Examples include breakthrough innovations, public attitudes, or changes in global markets arising from the actions of other countries. For instance, hydrogen infrastructure decisions may hinge on uncertain future industrial demand.
- **Select 3–4 relevant and challenging scenarios, by clustering the critical uncertainties:** Scenarios should stretch thinking by covering a spectrum of diverse and challenging plausible futures, including downside and upside risks, rather than simply varying assumptions around a central forecast. For example, a digital identity programme may be tested under scenarios of high trust, low trust, and divergent international standards. A narrative should be developed to describe each scenario.
- **Assess each policy option’s performance under each scenario:** This helps reveal whether an option only performs well under a narrow set of conditions or is resilient across most plausible futures. For example, whether a policy intended to deploy electric vehicles may underperform in scenarios with disruption of global supply chains.
- **Classify options as robust, resilient, or contingent:**
 - Robust options perform well across a wide range of futures
 - Resilient options may require adjustment under certain conditions but remain viable
 - Contingent options are highly sensitive to specific conditions and may only be successful if certain futures materialise.

For example, a targeted R&D subsidy could be contingent on global technology pathways, while an energy efficiency programme may be robust across most futures.

Key output:

The scenario impact matrix, a table summarising the performance of each policy option under each scenario, along with any adaptation of the policy that may be necessary for it to succeed.

Please refer to the ‘Uncertainty Assessment’ section of the Technical Implementation Guidance for more detail.

Levels of Application:

- **Basic:** Identify a single most critical uncertainty for each policy option, and assess its implications
- **Intermediate:** Full scenario development and stress testing
- **Advanced:** Participatory scenario workshops; may integrate quantitative “robust decision-making” models. See signposted resources in Appendices A2/E.

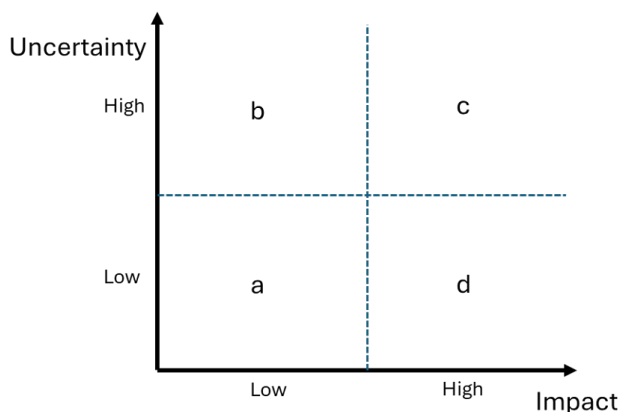
Appendix B: Note on participation

For ROA, the participation of different stakeholders is relevant for the first component, Dynamic Assessment with systems mapping, and the last component, Uncertainty Assessment with scenarios, at the stages where professional judgement is important. Participatory approaches are less necessary for the Multi-dimensional Assessment, because there is no weighting or aggregation process of outcomes in different dimensions, which requires significant professional judgement (unlike for MCDA).

The proportionality principle should be considered when planning participation. For the Dynamic Assessment, a participatory approach to systems mapping (in which a group of analysts and experts in the system of interest construct the system map together through a series of interactive workshops) may be useful when there is a high level of complexity in the economic system of interest, and a high degree of uncertainty around the causal relationships that exist and the feedbacks that are important. The use of a participatory approach sits in the **Advanced level** of application. [‘An introductory systems thinking toolkit for civil servants’](#) provides specific guidance on participation in systems mapping.

For the Uncertainty Assessment, participation is valuable even at the **Intermediate level**, to consider how policy outcomes may be affected by factors outside the control of the decision-maker. The Uncertainty Assessment requires the analyst to plot factors on a grid of uncertainty and impact (below).

Figure 8: Grid of uncertainty and impact



Because this positioning is a matter of judgement, it should reflect the consensus of more than a single analyst. The extent of participation should be proportional. At the intermediate level including at least several analysts and policy officials with a strong understanding of the problem at hand. For the **Advanced level**, there should be more extensive consultation including facilitated workshops, which can also be supplemented with interviews and a verification process.

The Technical Implementation Guidance provides more in-depth guidance for both components. [‘An introductory systems thinking toolkit for policymakers’](#) also provides practical advice on participatory systems mapping.

Appendix C: Incorporating a partial ROA application into the appraisal process

Often, the qualities of structural change, high diversity of interests and high uncertainty come together, making a full ROA application appropriate. However, ROA should be applied proportionately, and individual components may be used in isolation where this is sufficient to inform the decision. In such cases, the analyst may decide to apply just one or two components of ROA, in combination with traditional appraisal tools, rather than applying all three components. Analysis should explain which components were used and why, ensuring the approach remains **transparent and proportionate**.

Figure 9: Modular use of ROA Components

ROA component	When it may be used in isolation	Illustrative example
Dynamic Assessment	Where system interactions are poorly understood.	Mapping how different heat decarbonisation options interact with electricity networks, consumer behaviour, supply chains, and skills constraints to identify potential lock-in or bottlenecks.
Uncertainty Assessment	Where outcomes are highly sensitive to future conditions and robustness across scenarios is the key decision criterion.	Testing how alternative hydrogen support schemes perform under different global energy price and technology cost scenarios.
Multi-dimensional Assessment	Where outcomes are not amenable to monetisation and decision-makers need to see trade-offs explicitly across several objectives.	Comparing carbon capture deployment options across emissions reduction, regional employment, energy security, and fiscal exposure, using natural metrics rather than monetised values.
Combined Dynamic and Uncertainty Assessment	Where future system behaviour is uncertain and policy choices may alter system trajectories.	Exploring how measures to increase investment in electric vehicle charging infrastructure can help assess how far these options may accelerate adoption of EVs, and how they perform under different scenarios, such as low fuel prices or high electricity costs.

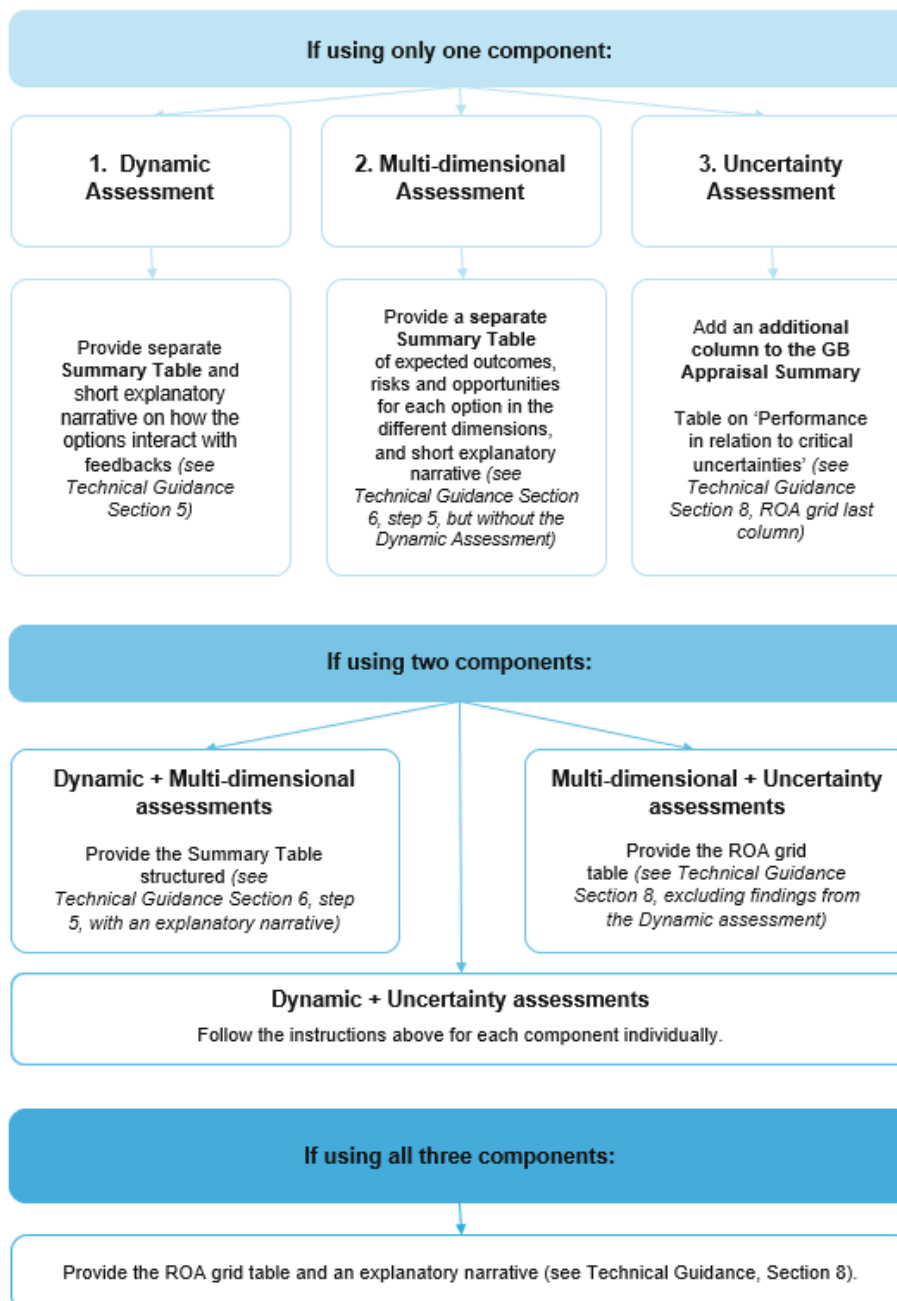
Where ROA is applied partially, analysts should be clear about the **scope and limitations** of the analysis, and about which questions are being addressed through ROA components, and which are being addressed through other appraisal or evaluation methods.

Analysts should also consider the availability of evidence, time, and analytical capability, ensuring that ROA adds value. The key test is **whether the chosen level of ROA improves decision quality in a transparent and proportionate manner**.

Presenting a Partial and a Full ROA

Below is a figure summarising how to present partial and full applications of ROA, to align with the Green Book. Partial application should be clearly positioned within the Green Book appraisal structure and treated as **complementary to standard appraisal outputs**, including CBA.

Figure 10: Applying one or more components of ROA



Appendix D: Integration with other appraisal techniques

ROA complements, and should not duplicate, existing Green Book and other HMG appraisal tools. It can be used alongside:

- [CBA for monetisable impacts](#)
- [Real options analysis](#) to inform potential value in delaying decisions where knowledge is increasing, and indicate value of making more flexible but higher cost interventions

The following may be useful inputs into ROA:

- **Horizon scanning** to identify possible challenging scenarios which policies should be tested for their resilience to.
- **Existing whole systems modelling tools** which may output systems mapping rather than starting from scratch
- [Monte Carlo \(simulation-based risk modelling\)](#) to support scenario analysis, when there are many uncertainties

Note that Real options analysis and Monte Carlo analysis require the important values and probabilities to be quantifiable, so are less well suited to situations where important outcomes are fundamentally uncertain.

ROA should not be used alongside Cost-Effectiveness Analysis (CEA) or Multi-Criteria Decision Analysis (MCDA):

- **ROA performs a role similar to Cost-Effectiveness Analysis (CEA)**, but across multiple outcome dimensions simultaneously. Like CEA, it retains outcomes in their natural metrics rather than converting them into monetary values; however, ROA extends this approach by considering effectiveness across several dimensions at once, alongside system dynamics and uncertainty. Where a problem is suitable for ROA, undertaking a separate CEA is unlikely to add additional insight.
- **Multi-Criteria Decision Analysis (MCDA)** should not be used alongside ROA, because MCDA is applicable in specific circumstances in which weighting and aggregations is considered appropriate. For guidance on MCDA, refer to [Green Book Section 5.14](#) and accompanying [supplementary guidance on MCDA](#).
- Analysts should therefore **select the most appropriate framework** for the policy context rather than combining multiple methods. ROA does not invalidate the use of CEA or MCDA in other circumstances, but where ROA is applied in full, additional use of these frameworks should be carefully justified.

Appendix E: Further resources

Figure 11: Further resources

Topic	Source / Link
Scenario analysis and futures methods	The Futures Toolkit (GO-Science)
Systems mapping guidance	Defra Systems Thinking Handbook and GO-Science Systems Thinking Toolkit
Risk and uncertainty analysis	Green Book Chapter 6
Dynamic efficiency and adaptive policy	GO-Science Dynamic Systems Toolkit

Appendix F: Glossary

This is the same glossary as in the ROA Technical Implementation Guidance.

Allocative efficiency: The extent to which good use is made of a fixed set of resources at a fixed moment in time.

Balancing feedback: A closed loop of causal relationships that limits change in a given direction, tending to stabilise the system or a variable within it around a constant state. Also known as a negative feedback.

Causal loop diagram: A diagram showing one or more feedbacks, in a system of interest.

Contextual environment: The field containing actors and factors outside the government's influence but relevant to its interests.

Contingent: Performs well only if one particular scenario is realised (i.e., represents a strategic bet on that future).

Dimensions: Qualitatively different fields in which a policy may have some outcomes; for example: costs, jobs, security, technology innovation, public health, carbon emissions.

Dynamic assessment: The component of ROA that assesses the likely effect of policy options on processes of change in the economic system of interest.

Dynamic efficiency: The efficiency with which new resources (such as technologies) are created, or structural change is achieved, over the course of time.

Factors: Forces or events that influence a policy's outcomes.

Feedback: A closed loop of causal relationships. See: reinforcing feedback and balancing feedback.

Marginal change: Incremental change that does not qualitatively change the system within which it occurs. Also defined as 'where the broader environment (e.g. the price of goods and services in the economy) can be assumed to be unchanged by the policy, and there are no changes in relationships between economic variables.'

Multi-dimensional assessment: The component of ROA that assesses the possible outcomes of policy options in different dimensions.

Opportunity: The effect of uncertainty on objectives, in a positive sense. A possible good outcome of a policy, or a factor that could positively affect a policy's outcomes.

Outcomes: The results or consequences of a policy's implementation, whether intended or unintended.

Probability distribution: A mathematical function that describes the probability of different possible values of a variable. The concept of a probability distribution is used in ROA even when probabilities are not known: policy objectives in a given dimension are identified as primarily concerned with either the expected or most likely, best-case, or worst-case outcome.

Reinforcing feedback: A closed loop of causal relationships that amplifies change in a given direction. Also known as a positive feedback.

Resilient: Is relatively easy to adapt as scenario uncertainties become resolved (i.e., remains viable with adjustment as the future becomes clearer).

Robust: Performs well in all scenarios considered.

Risk: The effect of uncertainty on objectives, in a negative sense. A possible bad outcome of a policy, or a factor that could negatively affect a policy's outcomes.

ROA grid: A table that presents the summary findings of the three components of the ROA.

System boundary: The boundary containing variables important to the problem that policy aims to address, and excluding variables that are less important.

System map: A diagram showing the relationships between variables in a system. In ROA, the method of systems mapping used is systems mapping with causal loop diagrams.

Tipping point: A point at which a small change in one variable can lead to a large change in the state and behaviour of a system.

Transactional environment: The field containing actors and variables that the government can influence.

Transformational change: A radical, permanent and qualitative change in a particular subject, such that the subject has very different properties and behaves in a different way.

Uncertainty: Not knowing. Uncertain factors or outcomes are those whose magnitude and/or probability cannot be quantified with any reasonable degree of confidence.

Uncertainty assessment: The component of ROA that considers how policy outcomes may be affected by factors outside the control of the decision-maker.

Variable: An element of a system that can increase or decrease; for example: investment, employment, cost, risk of supply shortage.

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