



Australian Government

**Infrastructure
Australia**

Assessment Framework

For initiatives and projects
to be included in the
Infrastructure Priority List

March 2018



THIS FRAMEWORK INCLUDES:

Infrastructure Australia is an independent statutory body that is the key source of research and advice for governments, industry and the community on nationally-significant infrastructure needs.

It leads reform on key issues including means of financing, delivering and operating infrastructure and how to better plan and utilise infrastructure networks.

Infrastructure Australia has responsibility to strategically audit Australia's nationally-significant infrastructure, and develop 15 year rolling infrastructure plans that specify national and state level priorities.

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PART A

Introduction

Introduction to Part A

Part A provides an introduction to:

- Infrastructure Australia
- The Infrastructure Priority List (IPL)
- How to make a submission to the IPL

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A1. Infrastructure Australia Assessment Framework

A1.1 About Infrastructure Australia

Infrastructure Australia is an independent statutory body with a mandate to prioritise and progress nationally significant infrastructure.

Infrastructure Australia provides independent research and advice to all levels of government, as well as investors and owners of infrastructure, on the projects and reforms Australia needs to support economic growth and quality of life, and to materially improve national productivity across infrastructure sectors.

Infrastructure Australia was established in July 2008 to provide advice to the Australian Government under the *Infrastructure Australia Act 2008* (the Act).

In 2014, the Act was amended to give Infrastructure Australia new responsibilities, and to create an independent board with the right to appoint its own Chief Executive Officer. The amended Act came into effect on 1 September 2014.

Under the Act, Infrastructure Australia has responsibility to strategically audit Australia's nationally significant infrastructure, and develop 15-year rolling Infrastructure Plans that specify national and state level priorities.

A1.2 Infrastructure Australia's role

Infrastructure Australia takes a long-term, national approach to infrastructure planning and works with states and territories and other organisations to identify nationally significant infrastructure investment priorities.

Infrastructure Australia supports the development of infrastructure investment proposals using thorough evidence-based infrastructure planning and economic assessment processes.

At a more practical level, Infrastructure Australia has a critical role in promoting best practice planning and decision-making: providing a clear national perspective, improving the linkages between jurisdictions, and shifting decisions about infrastructure from traditional bottom-up project-by-project and jurisdiction-by-jurisdiction approach to a much broader top-down focus on national objectives and priorities.

Importantly, Infrastructure Australia seeks to work in collaboration from an early stage with proponents of potential infrastructure solutions to assist them in defining infrastructure problems, and support them in developing initiatives, and ultimately business cases, that address those problems.

Box 1 What is the Infrastructure Priority List?

The IPL is the list of Initiatives and Projects which have been identified by Infrastructure Australia as potential infrastructure solutions to address nationally significant infrastructure problems and opportunities, including those identified in the 2015 Australian Infrastructure Audit (the Audit). Updates to the IPL occur periodically, as required.

The IPL represents these potential infrastructure solutions at two different stages of development: Initiatives and Projects.

Initiatives are infrastructure problems and potential solutions for which a business case has not yet been completed. Initiatives are identified through a collaborative process between proponents and Infrastructure Australia, using the Audit and other data as evidence.

Projects are potential infrastructure solutions for which a full business case has been completed and positively assessed by the Infrastructure Australia Board. Most

Projects are first identified as Initiatives, and subsequently developed into full business cases for evaluation by Infrastructure Australia.

Initiatives on the IPL will include the likely timescale in which a problem is expected to have a material impact on national productivity, based on analysis of available data, including the Audit. This allows for an understanding of when an identified Initiative should be progressed.

For projects, the timeframe provides the proponent's indication of when the project is likely to be delivered.

The timescales used for the Initiative and Project lists are:

- within 5 years (near-term)
- within 10 years (medium-term)
- within 15 years (longer-term).

Initiatives and Projects positively assessed by Infrastructure Australia are included on the IPL, which can be found at: <http://infrastructureaustralia.gov.au/projects/infrastructure-priority-list.aspx>



A1.3 Purpose of the Assessment Framework

This document sets out the assessment framework that Infrastructure Australia uses to consider initiatives and projects for inclusion on the Infrastructure Priority List (IPL). The purpose of the Infrastructure Australia Assessment Framework (the Assessment Framework) is to provide information about what Infrastructure Australia does and how initiatives and projects are assessed, to enable proponents to develop their submissions.

Further detailed guidance on specific infrastructure sectors is provided in other documents such as the jurisdictional guidelines on transport appraisals. For transport, Infrastructure Australia generally supports the use of the Australian Transport Assessment and Planning (ATAP) guidelines¹, available at www.atap.gov.au.

As with most appraisal guidelines and policy documents, this document is a live document as it incorporates development of best practice in the conduct of appraisals, and feedback from users. This document is intended to reflect most of the policy positions and advice from the ATAP guidelines of September 2016. The update of content in the ATAP guidelines is a process of continual improvement. The next update of the ATAP guidelines is due in 2018. This Assessment Framework will be updated to reflect the ATAP update.

A1.4 Structure of the Assessment Framework

This Assessment Framework consists of five parts:

- Part A: Introduction
- Part B: Stages in detail
- Part C: Templates and checklists
 - Template for Stage 1: Problem Identification and Prioritisation
 - Template for Stage 2: Initiative Identification and Options Development
 - Template for Stage 4: Business Case Assessment
 - Checklist for Stage 1: Problem Identification and Prioritisation
 - Checklist for Stage 2: Initiative Identification and Options Development
 - Checklist for Stages 3 & 4: Business Case Development and Assessment
 - Checklist for Stage 5: Post Completion Review
- Part D: Detailed Technical Notes
- Part E: Appendices

A1.5 Benefits of using the Assessment Framework

The Assessment Framework facilitates evidence-based development of infrastructure projects. The information contained in this document is essential for proponents looking to progress projects through the Infrastructure Australia assessment stages. Infrastructure Australia encourages proponents, end users and commentators to read this document, and seek advice from Infrastructure Australia when required.

¹ Transport and Infrastructure Senior Officials' Committee (2016), *Australian Transport Assessment and Planning (ATAP) Guidelines*, Transport and Infrastructure Council, Canberra, www.atap.gov.au

A2. Summary of the Assessment Framework

A2.1 Assessment Framework stages

The Assessment Framework provides a structured and objective approach to making decisions about infrastructure.

The Assessment Framework is a cumulative process divided into five stages. Following feedback from stakeholders, we have amended the Assessment Framework to differentiate between identifying the problem and identifying the initiative, and developing a business case and assessing a business case.

The five-stage assessment process is as follows:

1. Problem Identification and Prioritisation
2. Initiative Identification and Options Development
3. Business Case Development
4. Business Case Assessment
5. Post Completion Review.

The Assessment Framework sets out a process for:

- identifying problems and opportunities and assessing which of these are most important
- developing potential options (Initiatives) to solve problems or realise opportunities and assessing these options to select those with the highest net value to the Australian community
- developing in detail the preferred options in a business case. Ideally, this would include at least two options in addition to a 'do minimum' base case
- assessment of the business case by Infrastructure Australia
- review of the implemented solution to understand whether benefits have been realised as expected, whether costs estimations were accurate, and what lessons can be learnt.

Figure 1 provides an overview of each stage, the output at each stage and when Infrastructure Australia formally assesses submission for inclusion on the IPL.

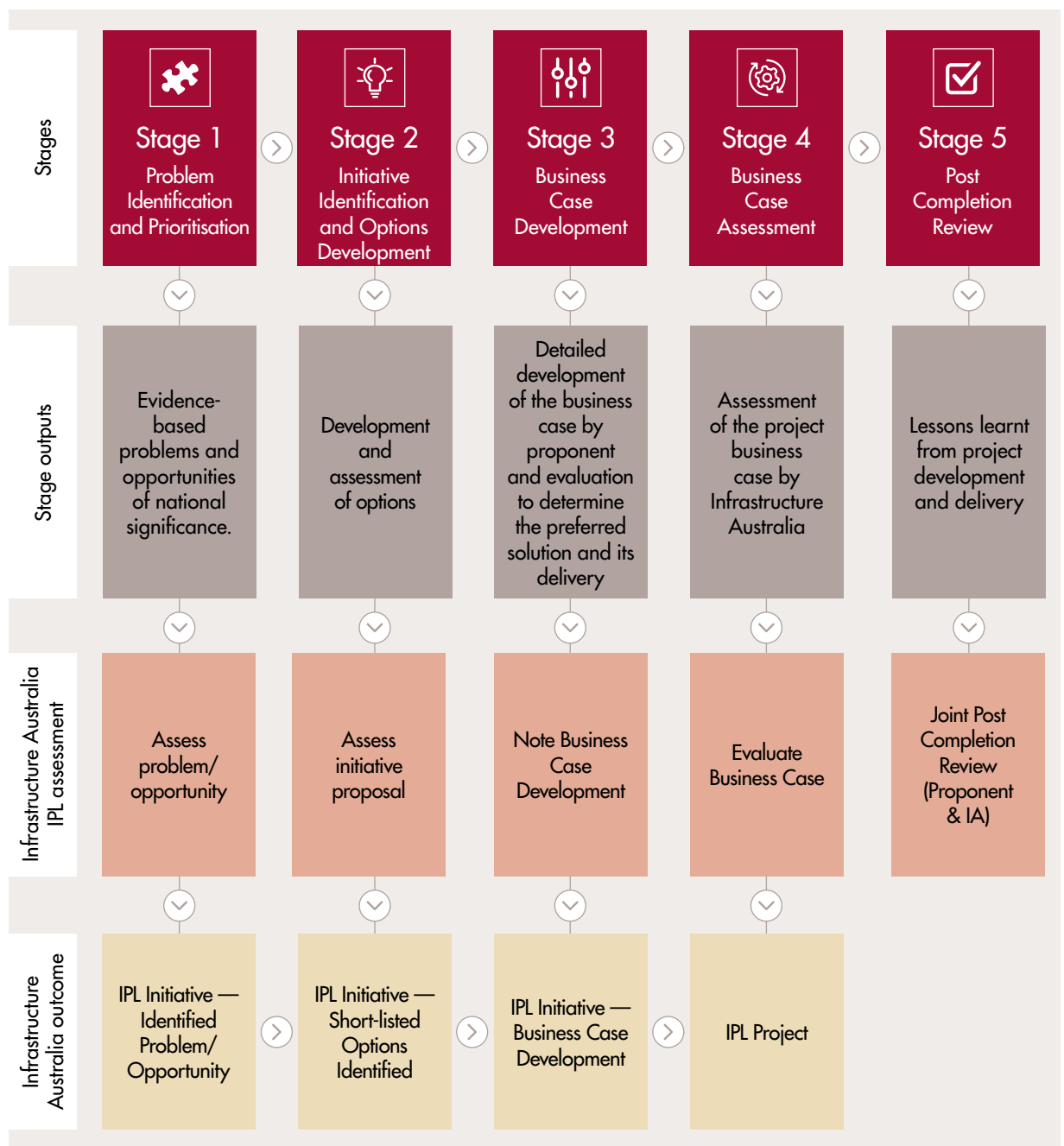
Infrastructure Australia welcomes submissions at any stage of the assessment process. However, proponents need to include the relevant information to address the preceding stages. For example, a business case submission for Stage 4 assessment will need to provide the information to address Stages 1-3, if these stages have not previously been completed.



To achieve the Assessment Framework outputs described in Figure 1, proponents are required to provide timely, quantitative and robust data and analysis that builds on previous stages.




Table 1 provides further information on the five stages, including guidance on the relevant proponent submission documents, and where proponents can find additional guidance.

Figure 1 The Assessment Framework stages, outputs and IPL assessment



Source: Infrastructure Australia.

Table 1 *The Assessment Framework stages, submission documents and further guidance*

1 Problem Identification and Prioritisation	Stage overview	<p>A collaborative process between proponents and Infrastructure Australia to identify and prioritise evidence-based problems and opportunities of national significance</p> <p>The problem is added to the IPL as an IPL Initiative — Identified Problem/ Opportunity if it is positively assessed by Infrastructure Australia after Stage 1</p>
	Submission document	<p>Template for Stage 1 at Chapter C1</p> <p>Checklist for Stage 1 at Chapter C4</p>
	Where to find further guidance in the Framework	<p>Part B (stages in detail) Chapter B1</p> <p>Part D (Detailed Technical Notes) Chapter D1</p>
2 Initiative Identification and Options Development	Stage overview	<p>Requires proponents to develop options that address the problems and opportunities identified in Stage 1, and assess these options to select those most likely to be of benefit to the Australian community</p> <p>Infrastructure Australia assesses whether the range of options is appropriate and the options assessment is robust</p> <p>The initiative is added to the IPL as an Initiative — Short-listed Options Identified if it is positively assessed by Infrastructure Australia after Stage 2</p>
	Submission document	<p>Template for Stage 2 at Chapter C2</p> <p>Checklist for Stage 2 at Chapter C5</p>
	Where to find further guidance in the Framework	<p>Part B (stages in detail) Chapter B2</p> <p>Part D (Detailed Technical Notes) Chapters D1-D2</p>
3 Business Case Development	Stage overview	<p>Requires proponents to develop a full business case that objectively considers the short-list of options available to address the problems and opportunities identified in Stage 1</p> <p>When the proponent has completed previous stages and notifies Infrastructure Australia that they are undertaking business case development, the IPL is updated to Initiative — Business Case Development</p>
	Submission document	<p>No template for this stage – see templates and checklists for Business Case Assessment for guidance.</p>
	Where to find further guidance in the Framework	<p>Part B (stages in detail) Chapter B3</p> <p>Part D (Detailed Technical Notes) Chapters D1-D4</p>

4 Business Case Assessment



Stage overview

Infrastructure Australia undertakes an assessment of the business case and works with the proponent to clarify content in the business case and seek supplementary information where required

If a business case is positively assessed by Infrastructure Australia at this stage, the project is added to the IPL

Submission document

Template for Stage 4 at Chapter C3

Checklist for Stage 4 at Chapter C6

Excel model template for Stage 4 Business Case Assessment (from Infrastructure Australia website)

Where to find further guidance in the Framework

Part B (stages in detail) Chapter B4

Part D (Detailed Technical Notes) Chapters D1-D4

5 Post Completion Review



Stage overview

Occurs after a project has been delivered and is operational

In collaboration with the proponent and other stakeholders, Infrastructure Australia will seek to understand the outcomes from the project, as well as project delivery, against the benefits described in the business case

Submission document

Checklist for Stage 5 at Chapter C7

Where to find further guidance in the Framework

Part B (stages in detail) Chapter B5

Part D (Detailed Technical Notes) Chapter D5

Source: Infrastructure Australia.

A3. Process of engaging with Infrastructure Australia and making submissions

A3.1 Overview of the Infrastructure Australia engagement process

Infrastructure Australia encourages early and staged engagement by proponents. This will ideally begin at the Problem Identification and Prioritisation stage (Stage 1) and continue throughout all five stages to facilitate a collaborative and effective review process.

Infrastructure Australia will not review earlier steps again unless there is new information that has a bearing on the previous steps. If Infrastructure Australia reviews a business case without having previously reviewed earlier steps, it will review all steps at that time. Early engagement helps proponents to consider potential issues earlier in the process, and can avoid data gaps in their business cases.

Project proponents who are not state or territory governments should also make early contact with relevant state or territory governments to discuss their submission to ensure that their proposals are deliverable.

For initiatives and projects to be included on the IPL, the process is as follows:

- the proponent submits an initiative submission or a business case and other supporting information to Infrastructure Australia for consideration on the IPL
- each submission is assessed by an Infrastructure Australia assessor
- this assessment is reviewed by the Infrastructure Australia Assessment Panel, chaired by the Infrastructure Australia Chief Executive
- the Assessment Panel, through the Chief Executive, makes a recommendation to the Infrastructure Australia Board
- the Infrastructure Australia Board makes the final decision to include an Initiative or Project on the IPL.

Infrastructure Australia will publish a summary of the project evaluations as soon as practical following a Board decision. This will include project evaluations which have not been included on the IPL.

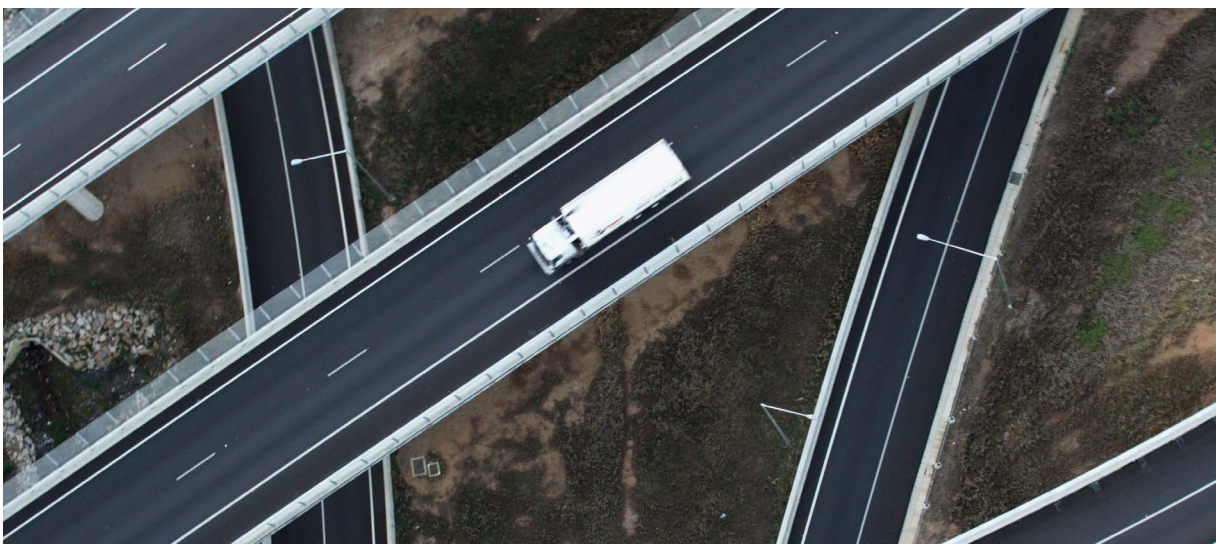
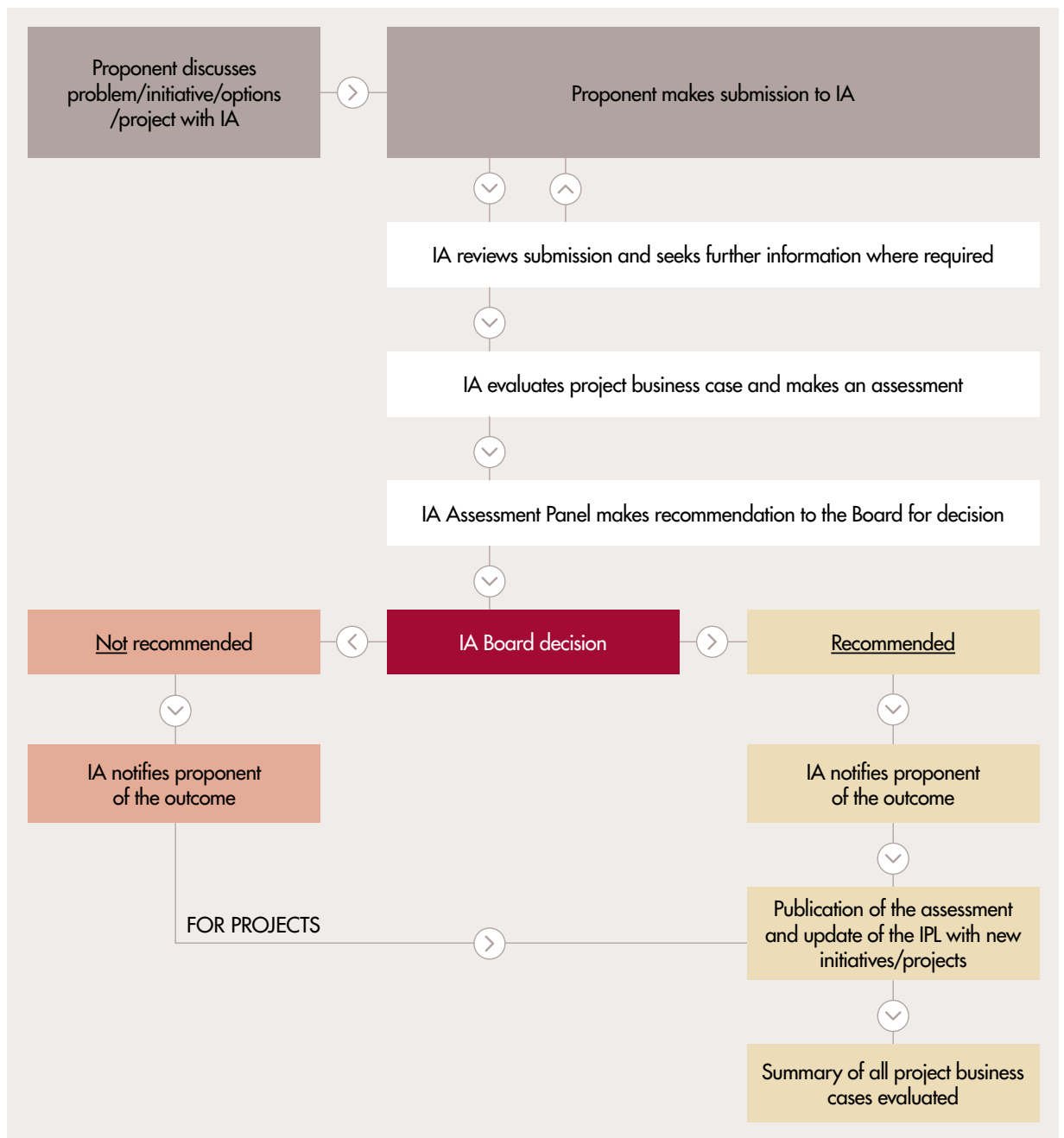


Figure 2 illustrates the Infrastructure Australia engagement process. Further details are provided thereafter.

Figure 2 Overview of the Infrastructure Australia engagement process



Source: Infrastructure Australia.

A3.2 How to make a submission for the Infrastructure Priority List (IPL)

Who can make a submission?

Infrastructure Australia welcomes initiative submissions from any individuals or organisations who would like to nominate potential infrastructure solutions for inclusion on the IPL. This can include joint submissions. These submissions can be made at any time.

Proponents for projects must have the technical and legal capacity to develop a full business case, and implement the project. Projects should be endorsed by the appropriate delegated authority of the proponent. Project submissions, including private sector submissions, are required to show support from the relevant state and/or territory governments.

For projects seeking more than \$100m of Australian Government funding, the Australian Government requires that the business case be evaluated by Infrastructure Australia.

Submission of programs

Infrastructure Australia encourages proponents to submit programs of related initiatives or projects. Such programs will be assessed against the Assessment Framework, considering the merits of the overall program. For individual proposals from the program to be recommended for funding, a detailed cost–benefit analysis (CBA) and deliverability assessment must have been completed and positively assessed by the Infrastructure Australia Board.

Maintaining confidentiality

Many of the proposals made to Infrastructure Australia have been submitted on a confidential basis. Past feedback from the jurisdictions has indicated some uncertainty as to the treatment of the material provided to Infrastructure Australia. In addition, there have been calls for Infrastructure Australia to release more details about the Initiatives it has recommended.

In order to ensure maximum transparency while protecting commercial confidences, all proponents

are asked to indicate which parts of their submission have been submitted to Infrastructure Australia on a confidential basis and to provide a brief explanation of the reasons for the request for confidentiality.

Information submitted confidentially will not be released or published by Infrastructure Australia without the written consent of the proponent.

The level of information expected in a submission

Proponents of potential infrastructure solutions should use the Infrastructure Australia checklists and templates in Part C of this document, and include all available supporting material, when making their submission. Project proponents must include the full business case for the project, as well as any related studies and reports, in their submission to Infrastructure Australia.

Proponents may wish to use the Stage 4 template for business case assessment in Part C in the absence of a jurisdictional or departmental business case template.

Infrastructure Australia publishes project evaluations on its website: <http://infrastructureaustralia.gov.au/projects/project-assessments.aspx>.

For projects in the transport sector, the ATAP Guidelines provide guidance for infrastructure planning and assessment.² Infrastructure Australia advises proponents of transport sector initiatives and projects to use the ATAP Guidelines, in conjunction with the relevant Detailed Technical Notes in Part D, in developing submissions. Project proponents which are state or territory governments should also consider the Australian Government requirements for funding submissions outlined in *Notes on Administration for Land Transport Infrastructure Projects 2014–15 to 2018–19*³ and the *National Partnership Agreement on Land Transport Infrastructure Projects*.⁴

For projects where climate risks are significant, the authoritative source of future climate risk scenarios is *Climate Change in Australia*⁵, unless an appropriate State reference is mandated.

² Transport and Infrastructure Senior Officials' Committee (2016), *Australian Transport Assessment and Planning (ATAP) Guidelines*, Transport and Infrastructure Council, Canberra, www.atap.gov.au

³ Australian Government Department of Infrastructure and Regional Development (2013), *Notes on Administration for Land Transport Infrastructure Projects 2014–15 to 2018–19*, Department of Infrastructure and Regional Development, Canberra, <http://investment.infrastructure.gov.au/funding/projects/index.aspx>

⁴ Council of Australian Governments (2014), *National Partnership Agreement on Land Transport Infrastructure Projects*, Council of Australian Governments, Canberra, http://investment.infrastructure.gov.au/publications/policies/pdf/NPA_30_October_2014.pdf

⁵ Australian Government Department of the Environment and Bureau of Meteorology (2017), *Climate Change in Australia*, Department of the Environment and Bureau of Meteorology, Canberra, <https://www.climatechangeinaustralia.gov.au/>

A3.3 Criteria used to assess and prioritise submissions

As outlined above, Infrastructure Australia formally assesses submissions as Initiatives and Projects for inclusion on the IPL. Submissions are considered against the three assessment criteria:

- Strategic fit
- Economic, social and environmental value:
 - Economic impact: This includes limiting productive capacity; reducing productivity; constraining economic capability; constraining global competitiveness; safety impacts
 - Social impact: Including problems which result in, maintain or exacerbate major issues of social exclusion and/or quality of life, such as access to services and employment and safety
 - Environmental impact: Including issues such as greenhouse gas emissions, waste creation, noise pollution, visual intrusion, heritage impacts and more
- Deliverability.

The proponent’s initiative submission should include:






- analysis of strategic fit:
 - evidence that the proposed initiative(s) addresses a problem and/or opportunity of national significance – is there a strategic case for the initiative?
 - consistency with other Government problems, opportunities or projects.
- an economic, social and environmental analysis that undertakes the following:
 - describe the problem or opportunity in terms of its economic, environmental or social impacts
 - quantifies the impacts
 - monetises the costs of a problem or value of an opportunity
 - describes qualitative impacts.

Project submissions should include:

- analysis of strategic fit – if the project was not first submitted as an initiative
- analysis of its economic, social and environmental merit:
 - evidence that the proposed project addresses a problem and/or opportunity of national significance
 - an economic, social and environmental analysis utilising the tools described in Chapter D2 that:
 - describes the problem or opportunity in terms of its economic, environmental or social impacts
 - quantifies the impacts of the project
 - monetises the costs and benefits of the project
 - describes qualitative project impacts (for unquantifiable project elements).
- deliverability analysis:
 - the proposed project is supported by the relevant state or territory government and consistent with their strategic objectives (for example, Transport Master Plans, Planning Strategies and Energy Policies)
 - an assessment of the risks inherent in delivering the project and identification of proposed measures to mitigate and manage the risks
 - procurement model analysis.

The following table provides an overview of the five Assessment Framework stages against the criteria.

Table 2 Assessment Framework summary

Core Criteria and relevant Stage	Stage and purpose
<p>Strategic fit</p> <p><i>The initiative will address problems or opportunities of national significance that constrain the achievement of stated goals.</i></p> <p><i>The problems or opportunities are identified and assessed using valid, relevant data such as the Australian Infrastructure Audit.</i></p> <p><i>The economic, social and/or environmental impacts of the problems or opportunities are assessed as being nationally significant.</i></p>	<p> Stage 1: Problem Identification and Prioritisation</p> <ul style="list-style-type: none"> Identify problems or opportunities of national significance and assess their impact on jurisdiction goals and objectives Demonstrate that problems identified are a constraint on the achievement of stated goals Demonstrate with data rich evidence that it is a priority to address the problem Analyse the extent of problems and the root causes, as well as how these are likely to change over time according to a reasonable future scenario Provide supporting evidence, such as the Australian Infrastructure Audit, that supports the assessment of the problem or opportunity of national significance. <p> Stage 2: Initiative and Options Development</p> <ul style="list-style-type: none"> Identify a wide range of options which have the potential to address a nationally significant problem or opportunity Where appropriate, develop evidence-based scenarios (e.g. of population or climate change) and use scenario analysis to ensure that options can be robust in the face of uncertainty about the future Adopt a robust methodology to short-list options on the basis of their economic, environmental and social merit.
<p><i>Not applicable – no formal submission required</i></p>	<p> Stage 3: Business Case Development</p> <ul style="list-style-type: none"> Develop a business case which assesses the short-listed options Advise Infrastructure Australia that business case development is underway.
<p>Economic, social and environmental value</p> <p><i>The proposal addresses a problem or opportunity of national significance.</i></p> <p><i>The economic, social and environmental value of the proposed solution is compelling as demonstrated by evidence-based analysis.</i></p> <p>Deliverability</p> <p><i>The delivery risk of the proposal is considered acceptable, or delivery risks can be sufficiently mitigated. A plan is in place to realise the benefits.</i></p>	<p> Stage 4: Business Case Assessment</p> <ul style="list-style-type: none"> A robust CBA has been undertaken Probabilistic risk-based cost estimates have been used in CBA and in the funding request A financial model has been developed demonstrating the viability gap and exploring options for, and impact of, different funding solutions A robust delivery plan is in place including adequate cost and risk assessments to provide assurance that the proposal will be delivered within budget Where government funding is likely to be sought, analysis of scope for private funding is completed The risk-based cost estimate, risk assessment, demand models and economic appraisal have been independently reviewed.
<p>Lesson learnt</p>	<p> Stage 5: Post Completion Review</p> <ul style="list-style-type: none"> Assessment of the delivered project to determine if the intended objectives were achieved, costs and benefits were realised, CBA assumptions were appropriate and if outcomes could have been achieved in a more effective or efficient way.

A3.4 Removal of Initiatives and Projects from the IPL

There are generally three circumstances where Initiatives are removed from the IPL. They are:

1. When construction contracts are closed.
2. The Initiative is withdrawn because the problem is no longer nationally significant
 - Evidence is required to support this assessment.
3. The Initiative is withdrawn because an alternative option to address the problem is put forward and positively assessed by the Infrastructure Australia Board.

Projects are removed from the IPL when construction contracts are closed, when the proponent withdraws the Project or when the relevant jurisdiction withdraws support for the Project.

A3.5 Improving engagement with Infrastructure Australia

After reviewing the evaluations of initiative and project submissions between April 2016 and July 2017, Infrastructure Australia has identified a number of areas which could deliver improvements in the business case development and assessment process. These are summarised in Box 2.

For questions and additional information on initiative and project submissions, Infrastructure Australia can be contacted on:

Email: mail@infrastructureaustralia.gov.au

Phone: (02) 8114 1900



Box 2 A sound basis for engagement with Infrastructure Australia

Problem identification

- Engage Infrastructure Australia at the Problem Identification and Prioritisation Stage to initiate collaborative and successful infrastructure assessment
- Use quantitative evidence to measure the magnitude and timing of the problem or opportunity, such as transport/traffic modelling, and to measure the economic cost of the problem or economic value of the opportunity
- Understand the problem properly before developing solutions
- Develop the base case as part of measuring the problem: the base case should reflect a reasonable projection of social and environmental trends. For example, trends in population, economics, climate, technology, etc., in the absence of the project.

Options assessment

- Consider a wide range of options, including non-infrastructure solutions, and narrow this range objectively using quantitative analysis
- Establish governance structures that allow for an assessment of a range of initiatives and options

- Include detailed analysis on all options considered and not just the preferred option. The business case should consider a minimum of two options in detail, in addition to the base case, to demonstrate transparency and allow comparability
- Undertake sensitivity testing of the preferred option to test the robustness of results and to provide confidence in the CBA results of the preferred option
- Provide supporting information, such as benefit and cost spreadsheets, to help Infrastructure Australia to carry out a complete assessment – this minimises the request for supplementary information after the business case has been submitted and allows Infrastructure Australia to test the results at a more granular level
- Explain all assumptions used to define the problem/opportunity and assessing options and solutions.

Project interrelationships

- Include any impacts on other problems, programs and projects, for example complementary and substitute projects which are also being pursued by the proponent.

Source: Infrastructure Australia.

PART B

Stages in detail

Introduction to Part B

Part B sets out the five-stage Assessment Framework.

- Stage 1: Problem Identification and Prioritisation
- Stage 2: Initiative Identification and Options Development
- Stage 3: Business Case Development
- Stage 4: Business Case Assessment
- Stage 5: Post Completion Review.

Note that templates/checklists are provided in Part C and Detailed Technical Notes in Part D.

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B1. Stage 1: Problem Identification and Prioritisation

B1.1 Stage overview

The purpose of Stage 1 is to:

- identify current and emerging problems and opportunities of national significance. In this context:
 - a problem is a cost to be avoided or saved
 - an opportunity is a benefit to be gained.
- demonstrate that these problems and opportunities are of national significance, and that reducing the problem or realising opportunities results in benefits. These benefits are demonstrated through providing data rich evidence of:
 - the magnitude of the problems, expressed in monetary terms where possible to allow comparison across different types of problems
 - the timing of the problems — when the costs of problems occur and how this influences the timeframe for considering investment decisions
 - the underlying causes of the problems.

One of the most common issues in infrastructure is that solutions are developed before the problem has been properly understood. Infrastructure Australia encourages proponents to undertake detailed analysis of problems before options are developed and assessed.

Proponents are encouraged to discuss their Problem Identification and Prioritisation with Infrastructure Australia after completing the Stage 1 template, but prior to formally lodging their IPL application. Problems assessed by Infrastructure Australia as nationally significant priorities will be included on the IPL as an **Initiative — Identified Problem or Opportunity**.

B1.2 Process for understanding problems and opportunities

Problems and opportunities of national significance are identified collaboratively between Infrastructure Australia and proponents, drawing on robust evidence. Infrastructure Australia will develop a consensus-based list of nationally significant problems and opportunities that will provide a basis for future Initiative identification. Proponents are encouraged to use the attached Stage 1 template to prepare material, reports and data for early engagement and discussion with Infrastructure Australia.

Nationally significant problems and opportunities are expected to emerge from a range of sources including:

- the Australian Infrastructure Audit
- strategic planning exercises undertaken by service providers, such as transport masterplans or water plans
- state infrastructure strategies.

The expectation is that nationally significant problems and opportunities will be expressed as straightforward statements that are directly linked to jurisdictional goals and objectives, such as improving Australia’s productivity.⁶ These statements should clarify how the problem (opportunity) might prevent (support) the achievement of these goals and objectives, today and in the future. Over longer time-frames, it is important to pay particular attention to the distribution of costs and benefits.

Figure 3 Problem Identification and Prioritisation stage



Source: Infrastructure Australia.

⁶ Note that productivity is considered broadly as the value to the community relative to the inputs expended, rather than a strict formal National Accounts definition limited to market outputs.



The IPL includes problem descriptions for all Initiatives and Projects. Box 3 provides some examples.

B1.3 Understanding and measuring the problem or opportunity

Proponents should have a comprehensive understanding of the problem/opportunity. This will assist in developing options (initiatives) that provide the most appropriate solutions.

In order to understand and measure the problem or opportunity, the proponent should seek to address the following questions:

- What is the size of the problem or opportunity in monetary terms? For example, the cost of a traffic congestion problem could be \$20 million in 2017, increasing to \$40 million in 2026 and \$60 million in 2036. This assessment should be based on valid quantitative data and supplemented with qualitative information.
- When is the problem likely to be experienced? How does it change over time?
 - Problems that occur outside of the timeframe over which a solution could be developed are not as high a priority as problems that occur more immediately. For example, if the problem first becomes material in 2036, and a solution takes five years to develop, then it is likely to be too soon to consider this solution for construction now. However, it could be useful to put in place measures to allow lower cost future solutions, such as corridor protection.
- What are the root causes of the problem? This should clearly distinguish causes of the problem, as opposed to symptoms.
 - For example, a symptom may be crowding on trains. The underlying cause is demand growth driven by employment growth in the CBD, which cannot be met by operating additional services on the existing infrastructure.
- What are the uncertainties around future projections of the problem? Will the problem apply across a number of future scenarios?
 - For example, how is the cost of the problem impacted by higher or lower population growth, changes in employment patterns or consumption patterns, changes in the risks of extreme weather events, or the expectations of individuals and communities?
 - How will technology changes impact on the problem, such as driverless cars or increases in mobile broadband speeds and capacity?
 - How will possible changes in policy or policy trends affect the benefits and costs of the problem over time (e.g. new road user changes, shifts to electric vehicles)?
 - How might changes in trends such as population or climate affect the future demand for services, such as increasing energy demands for cooling or changing agricultural transport needs?
- How is the problem or opportunity aligned with jurisdictional priorities?
- What inter-relationships does this problem or opportunity have with other problems, programs and projects? Are there any other wider, strategic impacts that the problem creates?
- Which stakeholders are impacted by the problem?
- How has climate change risk been considered?
- What is the geographical reach of the problem?

Box 3 Examples of problem and opportunity statements from the current IPL



- Connectivity in outer Western Sydney
- Brisbane to Gold Coast public transport capacity
- Connectivity between Parramatta and Sydney CBD
- Opportunity to develop industry and agriculture in south-west Western Australia
- Constrained East Coast gas supply

Infrastructure Australia 2017, *Infrastructure Priority List 25 February 2017*, Infrastructure Australia, Sydney, viewed 31 May 2017, http://infrastructureaustralia.gov.au/projects/files/IPL_170225.pdf



The use of modelling and consideration of quantitative and qualitative information

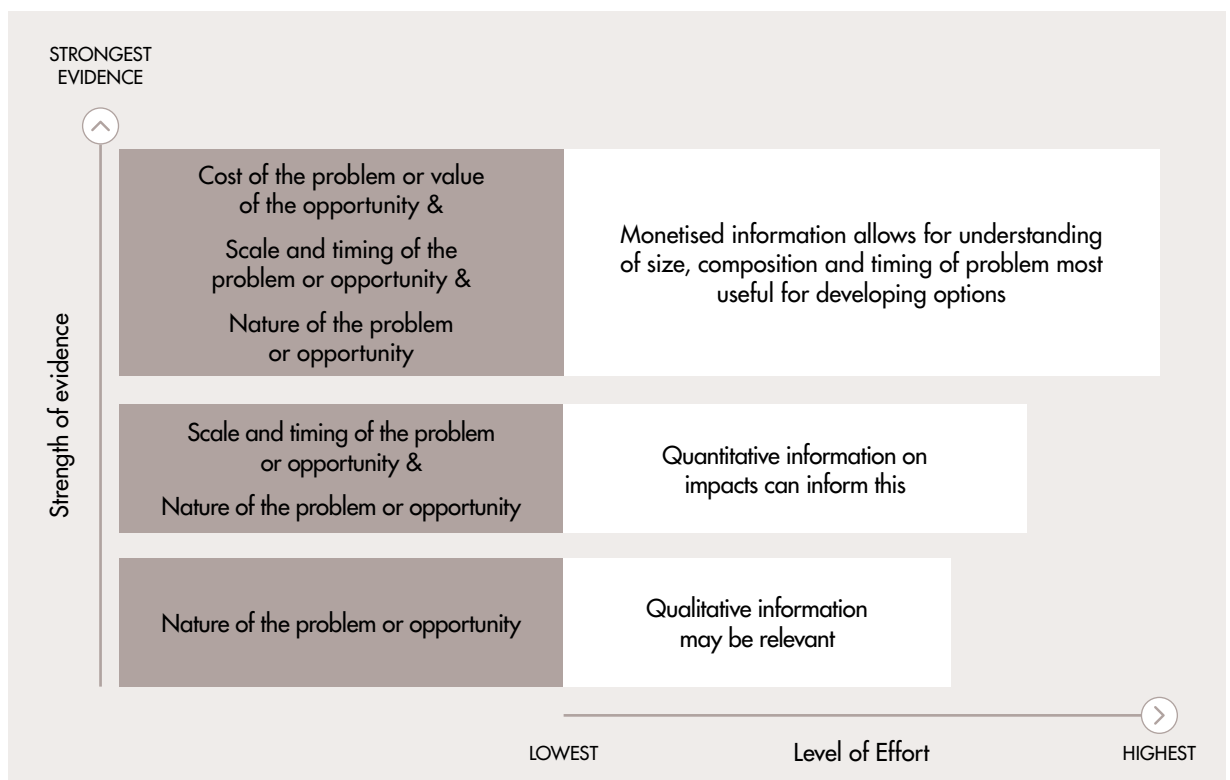
The use of quantitative evidence is a key part of the Assessment Framework, by helping to understand the problem or opportunity. There are three tiers of information:

- qualitative information on the nature, extent and timing of a problem or opportunity — for example, an observation that there are trains crowded to capacity
- quantitative information on the problem or opportunity — following the example above, this could include the number of trains and passenger hours at different levels of crowding now and expected in the future

- monetised information on the problem or opportunity — such as the cost to passengers in dollar terms associated with train crowding and reduced reliability.

Where available, Infrastructure Australia considers the value of monetised information, supported by estimated quantities and qualitative descriptions, to be the strongest, as set out in Figure 4.

Figure 4 The three tiers of evidence for a problem or opportunity



Source: Infrastructure Australia.



As outlined in Figure 4, the strongest evidence base is the scale/size and the monetary value of the cost of the problem or the value of an opportunity. That is, a dollar value associated with the problem or opportunity compared to:

- current levels of service — for example, this could measure the increase in congestion over time relative to today under the base case
- a higher level of service (for a problem) — for example, this could measure the level of congestion over time relative to free flow or uncrowded conditions.

Note that where it is difficult to measure the cost of the problem or the value of the opportunity, this will become an important issue for later assessment and should be discussed directly with Infrastructure Australia.

A qualitative, judgement-based assessment about the problem or opportunity is often of only limited value. This may be used to supplement quantitative analysis. However, we recognise that in some cases, qualitative analysis like MCA may be the only available material with which to assess the problem or opportunity. In such cases, we recommend that proponents have early discussions with Infrastructure Australia.

Defining the base case

Project appraisals compare the costs and benefits of doing something – the project case (for example, building infrastructure) – with a base case. Generally, the base case is a ‘do minimum’ base case (the “business as usual” or “keep safe and operational” situation).

In understanding and measuring the problem, a proponent should be setting up the base case for subsequent analysis of the impacts and value of possible options.

The ‘do minimum’ case is not the same as a ‘do nothing’ case as it should include any known and funded changes to the infrastructure or service that will have occurred in the absence of the project case or other investment options.

A well-established base case provides a foundation for CBA and comparison of prospective initiatives, options and projects at later stages. An incorrectly specified base

case can bias the development of options and assessment of options, and affect the results of the appraisal. Further guidance on the base case is provided in Chapter D1.

Monetising the cost of the problem or value of the opportunity over time

The reason for determining the size and timing of a problem or opportunity is that this will focus options development on appropriate cost options, and stage solutions to align to the problem. It also allows for problems to be compared more easily within and across sectors and jurisdictions. For example:

- if the cost of the problem is monetised at \$30 million per year or \$372 million in present value terms (7% real discount rate over 30 years), then solutions costing \$800 million are clearly not worth considering⁷
- if multiple problems are identified, such as flooding of a road and congestion on the road, and the economic costs of these are measured respectively at \$5 million per year and \$100 million per year, then options that are more likely to address congestion will have a higher benefit. That is, the problems do not have equal weight in their impact on the Australian community.
- However, large sources of costs or benefits should not be excluded from the analysis just because they are difficult to quantify or monetise, where ‘large’ means they might alter the decision outcome.

Proponent submissions to Infrastructure Australia are expected to include a discussion on the value of the problem or opportunity, combined with the forecast time period it is likely to occur.

Box 4 provides an example of how a problem can be expressed in monetary values.

Various analytical tools exist to help proponents to identify and measure prospective problems/opportunities. These include value management studies, investment logic mapping, benefits dependency mapping, desk-top investigations and stakeholder engagement.⁸ Further detail on measuring the problem is set out in Chapter D1.

⁷ All costs and benefits are to be expressed in constant prices of the base year and exclude taxes and subsidies from cost.

⁸ These techniques are discussed in the Transport and Infrastructure Senior Officials’ Committee 2016, *Australian Transport Assessment and Planning Guidelines F2 Problem identification & assessment and T6 Benefits Management*, Transport and Infrastructure Senior Officials’ Committee, Australian Government, Canberra, viewed 31 May 2017 <https://atap.gov.au/about/index.aspx>



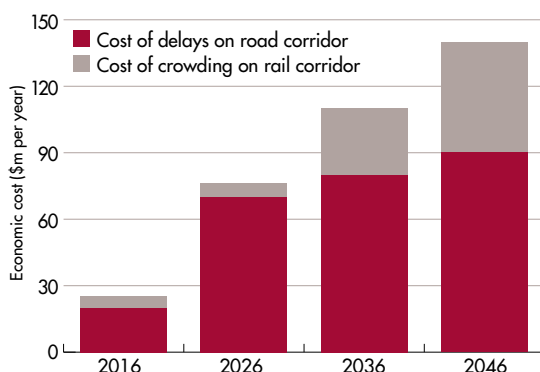
Box 4 Worked example of monetising the cost of the problem

Suppose that a strategic planning exercise has been undertaken for a major city transport system. Using this information, a proponent can show the size and pattern of costs for a particular corridor or for a number of corridors:

- to measure the cost of delays on the road network, the proponent could estimate the economic cost of additional time and vehicle operating costs for road users relative to free flow conditions
- to measure the cost of crowding on the rail network, the proponent could measure the cost to users of travelling in more crowded conditions relative to non-crowded trains and/or stations.

Considering this over time, such as in the chart below, shows the relative size of the problem and how it changes. In this example, road congestion costs increase rapidly from 2016 to 2026, while rail crowding costs are smaller but increase rapidly from 2026 to 2036.

This would then allow for comparison with other problems in terms of size and timing, and for the scope and phasing of options to be considered relative to the monetised problem. In this example, a proposed road project that costs \$1 billion to address the problem would likely cost more than the benefits it would provide, and smaller scale options should be considered.



Source: Infrastructure Australia.

The boundaries of a problem or opportunity

Defining problems or opportunities typically entails the definition of boundaries, for example:

- Geographical boundaries — a problem or opportunity could be measured for a city, a corridor or part of a corridor, a region, a state or a country
- Types of impacts — a problem or opportunity could be defined by a number of different impacts. For example, one problem may be inaccessibility because of road flooding, another may be crowding of the public transport system, while another may be delays due to road congestion.

The boundaries drawn around a problem will influence how options are developed, as different options may have varying types of impacts and geographical boundaries.

Infrastructure Australia recommends starting at the broadest level for options/initiative development and then drilling down into further detail. For example:

- at a citywide level, overall road congestion can be quantified and monetised. The types of options relevant at this level are network-wide solutions, such as pricing or governance arrangements for new transport capacity
- within the city, a transport network can be broken into transport corridors and costs can be measured at this level. The types of options relevant at this level are better use of existing infrastructure and additional network capacity
- within a corridor, the network can be split by modes.

Other infrastructure networks are less complicated. For example, water supply is a system-wide issue and therefore the problem should be considered for the entire system.

Understanding the problem at different levels allows a wider range of options to be considered. There might be options that impact on multiple corridors. Such inter-relationships between projects are also important to understand, as demonstrated by past examples of projects submitted to Infrastructure Australia (see Box 5).

As outlined in Figure 4, the strongest evidence is the quantification and monetisation of the problem cost or value of an opportunity. That is, a dollar value associated with the problem or opportunity compared to the base case. This dollar value should be supported by independent empirical data.



In some cases, it may not be feasible to directly measure the cost of the problem or opportunity, and a proxy is used instead. This is a second best solution and should be implemented after attempts are made to quantify the costs directly.

The least effective assessment information is qualitative judgements about the problem or opportunity because it does not allow measurement and comparability. Instead, qualitative information should be used to supplement quantitative analysis. In rare cases where qualitative information may be the only data available to assess the problem or opportunity, Infrastructure Australia invites the proponent for an early discussion of the problem to determine suitable qualitative analysis.

B1.4 Alignment with government priorities and other current and future programs and projects

In addition to understanding and measuring the problem, proponents are required to demonstrate how the problem or opportunity aligns with relevant jurisdictional government priorities, as well as other problems, programs and projects. For example, the proponent must explain and demonstrate how it aligns with the relevant government transport, land use, environmental and planning strategies.

B1.5 What is nationally significant?

The *Infrastructure Australia Act 2008* states nationally significant infrastructure includes:

- a. transport infrastructure
- b. energy infrastructure
- c. communications infrastructure
- d. water infrastructure.

in which investment or further investment will materially improve national productivity.

Infrastructure Australia can also consider other submissions, such as social infrastructure.

While there are no natural definitions or thresholds for what constitutes a “material improvement”, it is reasonable to categorise problems as either high priority, priority or not a priority on the basis of the monetised costs of the problem or value of the opportunity.

Infrastructure Australia’s evaluation of the initiative submission and the project business case is designed to capture all consequences of a problem (or opportunity), including environmental and social consequences. The analytical tool of CBA allows the economic, social and environmental merit of a project proposal to be identified, measured, valued and compared.

Box 5 Examples of project inter-relationships

The WestConnex project demonstrated the inter-relationships within a project’s stages and to other future infrastructure projects:

- The benefits of the WestConnex project are highly dependent on the completion of the third stage of the project, which connects the extended M4 and M5.
- WestConnex may also increase the benefits of other road expansions, such as a southern extension, because of capacity created on the core motorway network.

The Melbourne road network is another example where inter-relationships are important in the business case. For example, there are complementarities between the M80 Upgrade and a connection between the M80 at Greensborough and the Eastern Freeway.



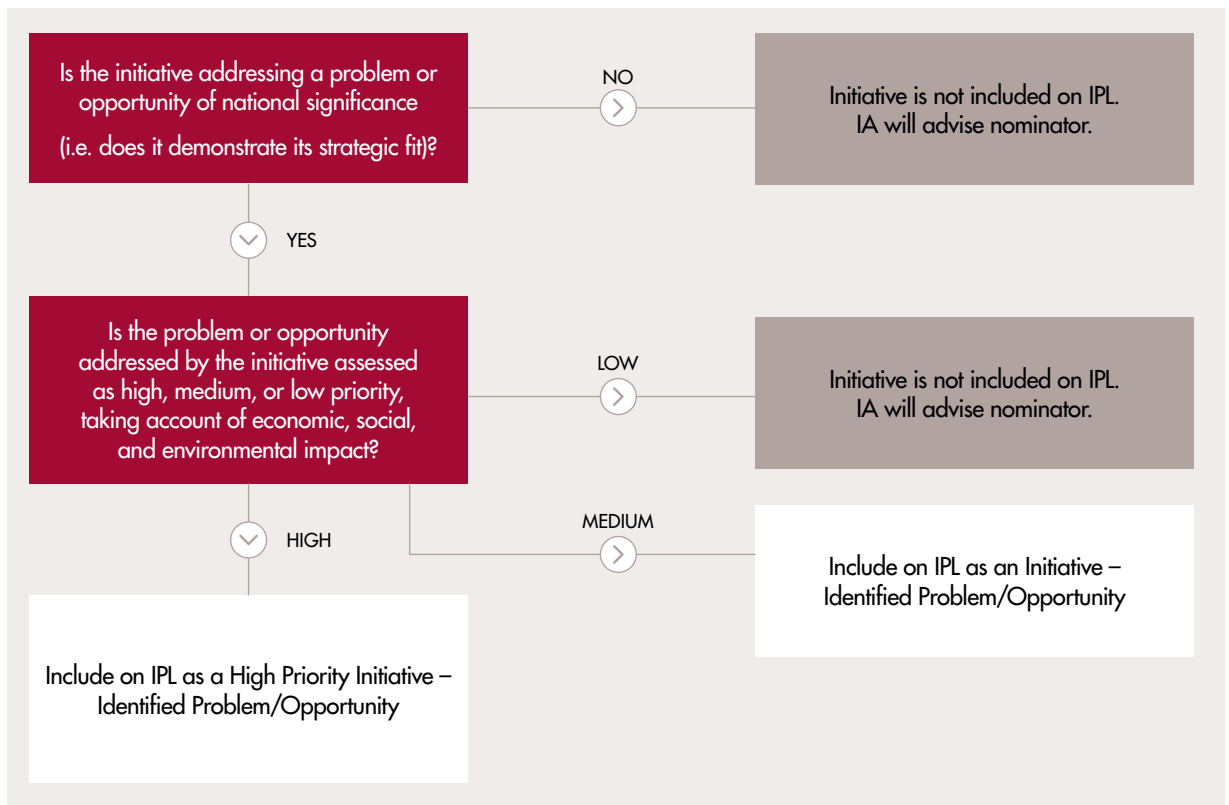
Source: Infrastructure Australia.



B1.6 Problem Identification and Prioritisation process

The flowchart below sets out the Problem Identification and Prioritisation process.

Figure 5 Problem Identification and Prioritisation process



Source: Infrastructure Australia.



B2. Stage 2: Initiative Identification and Options Development

B2.1 Stage overview

The purpose of this stage is to:

- identify initiatives (options) which address the problems or opportunities identified in Stage 1
- assess these options to narrow or ‘short-list’ the range of preferred options.

Options should represent a range of reasonable alternatives to solve the problems, with capital investment being one of those options. Further, consideration should be given to how individual initiatives and options can be packaged together — or better coordinated — for a more efficient and effective outcome, and how such options can handle future uncertainty if necessary.

The process of assessing options will reduce the initial long-list of potential options. This should be achieved utilising a structured approach to considering the costs and value of options, and removing options which are not expected to produce solutions with the highest net benefit to the Australian community.

Infrastructure Australia recommends the following process:

1. *Step one:* A quantitative multi-criteria analysis (MCA) of the long-list of initiatives/options, showing, at a high level, each option’s impact on the goals, objectives and problems identified in Stage 1 of the overall Assessment Framework. Proponents should select appropriate criteria to conduct the MCA, and should recognise that the MCA should act as a guide to support common-sense decision making, rather than being relied upon as a “standalone” final output. Poorer-performing options should be excluded (the

documentation should capture the rationale for their exclusion) with the best performing options progressing to Step two.

2. *Step two:* A rapid CBA on the short-list of options from step one. If required, a more detailed MCA could be conducted to identify any impacts not captured in the rapid CBA.
3. *Step three:* The final short-list of the best performing options informs the development of the detailed CBA in the final business case in Stage 3.

Chapter D2 provides more information on the tools which could be used to short-list options during options assessment.

Proponents are encouraged to engage with Infrastructure Australia during this Stage. This will ensure that Infrastructure Australia understands how proponents have narrowed their range of options for the final CBA, and ensure that issues are not raised by Infrastructure Australia after detailed development of preferred options by the proponent. The template for Stage 2 is provided at Chapter C2 in Part C.

Where a proponent submits a Stage 2 template to Infrastructure Australia that is accepted by the Board, then the potential solution(s) will be included on the IPL as an Initiative — Short-listed Options.

It should be noted that it is preferable to review the assessment of the options at this stage, before the business case is developed and submitted. This allows both the proponent and Infrastructure Australia to be confident that the best options are being taken forward in business case development.

Figure 6 Initiative Identification and Options Development stage



Source: Infrastructure Australia.

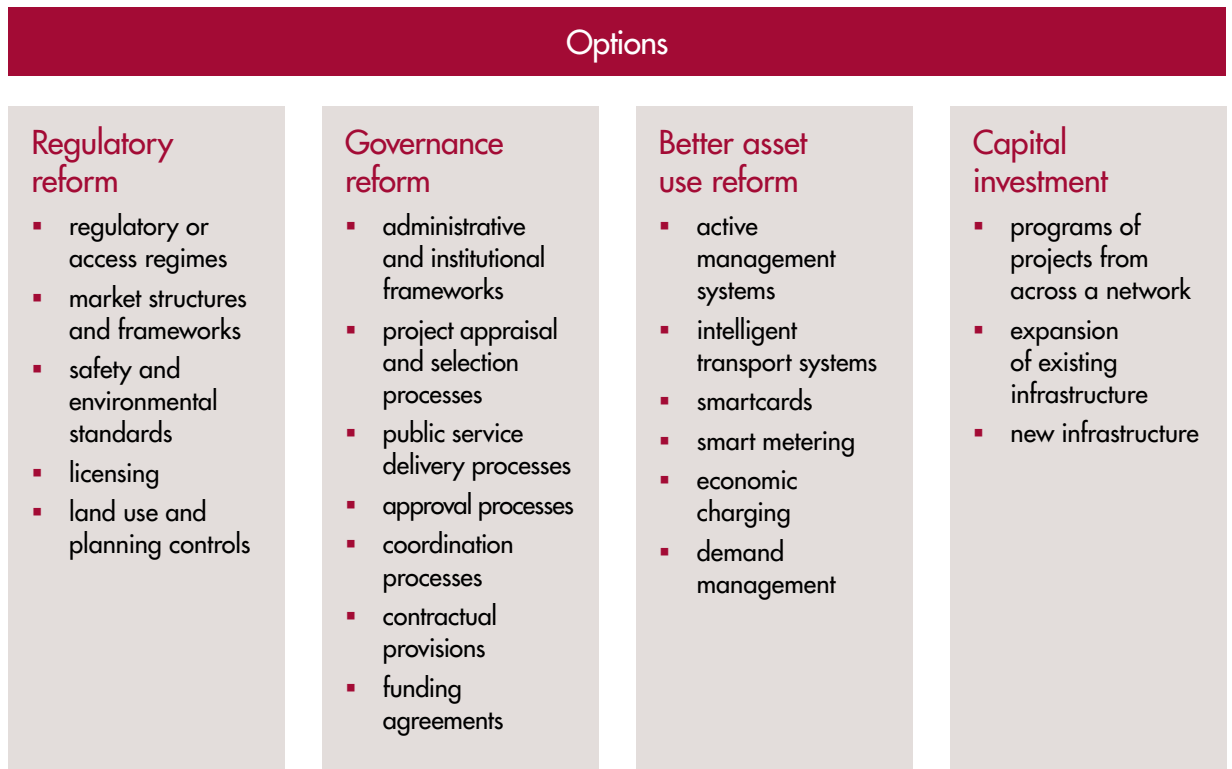


B2.2 Range of options that should be considered

Infrastructure Australia supports the consideration of innovative, deliverable options that include capital and non-capital solutions, as well as supply- and demand-side solutions. These include:

- Regulatory reform:
 - Changes to the way both infrastructure and infrastructure service markets are regulated from a competition perspective, for example, changes to regulatory regimes, access regimes, market structures and frameworks
 - Changes to the regulations surrounding markets: safety, environmental, technical standards, licensing requirements
 - Changes to land use and development planning and control to provide a land use solution to infrastructure issues.
- Governance reform:
 - Changes to administrative and institutional frameworks, such as project appraisal and selection processes, public service delivery processes, approval processes, coordination and cooperation processes, assurance processes, contractual provisions, and funding agreements.
- Better use of assets reform:
 - Technological innovations: intelligent active management systems (e.g. intelligent transport systems, predictive asset condition monitoring systems, smartcards, smart metering) and product technical standards (e.g. energy efficiency standards)
 - Influencing behaviours through information: workplace practices, workplace travel planning, information labelling for energy and water intensive products

Figure 7 Range of options to address a problem



Source: Infrastructure Australia.



- Economic pricing and charging – the introduction of full economic pricing of energy and water sectors; for instance, time of day pricing for transport and energy; full cost-recovery pricing for water.
- Capital investment:
 - Expansion of existing infrastructure and service
 - Building new infrastructure and providing additional services.

Figure 7 summarises the range of investment options which could be generated to address a problem.

B2.3 Developing options to address a problem

When developing initiatives to address a problem or take advantage of an opportunity, it is important to create a comprehensive list of potential options that are drawn from the regulatory, governance, better asset use reform and capital investment range described in Figure 7. The benefit of this approach is that proponents are able to demonstrate that a comprehensive initiative development process occurred with prospective options including:

- capital and non-capital solutions
- demand and supply side solutions.

Proponents are also required to provide the environmental context of each identified initiative. This includes regulatory, governance/ownership and operational arrangements. For example, Box 6 provides an overview of the regulatory, governance, ownership and operational arrangements applicable to the electricity distribution and transmission sector.

An ‘option’ may also cover multiple solutions or a sequence of actions. This can be termed as a program of works, rather than individual projects.

- A program of works comprises multiple projects or solutions, which may be at differing levels of planning and design maturity. For example:
 - A set of options to address a water supply problem could include water restrictions and the development of a new desalination plant.
 - A highway corridor upgrade may have developed detailed design for the southern section, and high level concepts for the northern section.
 - A sequenced set of actions for an irrigation area could be to enhance the storage behind a series of weirs, where decisions about subsequent project stages depend on future changes to water supply and demand.

Box 6 *Example of regulatory, governance, ownership and operational environments – electricity distribution and transmission*



The natural monopoly infrastructure used in the electricity distribution and transmission sector is economically regulated by independent economic regulators, such as the Australian Energy Regulator or a state-based equivalent. In addition, electricity service providers are granted operating licences by their respective jurisdictions that also impose service, reliability and other regulatory requirements that must be met. The asset owner’s performance against the operating licence is measured annually by an appointed independent assessor.

Further, electricity assets operated in Queensland, NSW, Victoria, Tasmania and South Australia are physically linked by interstate connectors and collectively form the National Electricity Market (NEM). The day to day operation of the NEM is

undertaken by the Australian Energy Market Operator, while policy review and assessment is undertaken by the Australian Energy Market Commission, which provides advice and analysis to the Council of Australian Governments Energy Council.

Electricity distribution and transmission assets are owned and operated utilising various arrangements across the NEM. These include full government ownership by state governments, partnership arrangements between state governments and private firms and full private ownership.

Operational arrangements across the NEM also vary and range from state owned corporations, which have independent boards appointed by the government shareholders, to executive management teams accountable to domestic and international shareholders.



- Projects should be grouped into a program for Infrastructure Australia's process based on whether the problems that they are addressing are inter-related, as per the discussion in Chapter B1.

Proponents should identify whether or not uncertainty about future scenarios needs consideration in terms of climate change mitigation and resilience with respect to climate change hazard (see Section D4.6) and, if so, whether the uncertainty suggests additional robust options that perform reasonably well across plausible futures rather than performing well in one future but failing in others.

B2.4 Level of detail required for development of options

Sufficient detail is required in the development of options to be able to assess these options. This means that options are developed enough to be able to consider:

- their costs, at a high level
- their impacts, in terms of social, environmental, cultural and financial implications imposed on or gained by stakeholders by the possible initiatives.

B2.5 Options assessment process

In options assessment, the guiding principle is to progress options that maximise the welfare of the Australian community. Options assessment is a structured, objective, and evidence-based method to estimate the costs and benefits of feasible options.

Options assessment begins with a long-list of initiatives identified in Stage 2, which are progressively discarded when the proponent is confident that the option has net costs higher than another option and/or has lower net benefits than another option. The proponent undertakes this 'filtering' process using CBA and MCA. In very rare cases, cost-effectiveness analysis (CEA) might be applied.

Chapters D1 and D2 provide detailed guidance on how and when to use the CBA and MCA project appraisal

tools. Infrastructure Australia expects proponents to review the Chapter D1 and D2 guidance before undertaking the options assessment and lodging the Stage 2 template.

Proponents should be careful not to discard options prior to analysing their costs and benefits simply because they do not fully meet objectives. That is, options should not be ruled out on the basis of personal preferences, perceived political difficulties or in any way that precludes genuine consideration of certain options. Instead, options should be judged on their merits and ruled out only on the basis that they do not address the problem in a way that will maximise the welfare of the Australian community.

As options are narrowed, more detailed analysis is required in the subsequent CBA to differentiate which of the options has the highest net benefit

As with initiatives, options should be considered from a system wide perspective. Infrastructure Australia encourages inter-related options to be combined into a program of works to take advantage of initiative synergies and economies of scope and scale.

B2.6 Output of options assessment

The options assessment should result in a small set of options to take forward to Business Case Development and the final CBA. In practice, Infrastructure Australia requests a minimum of two options, in addition to the base case.

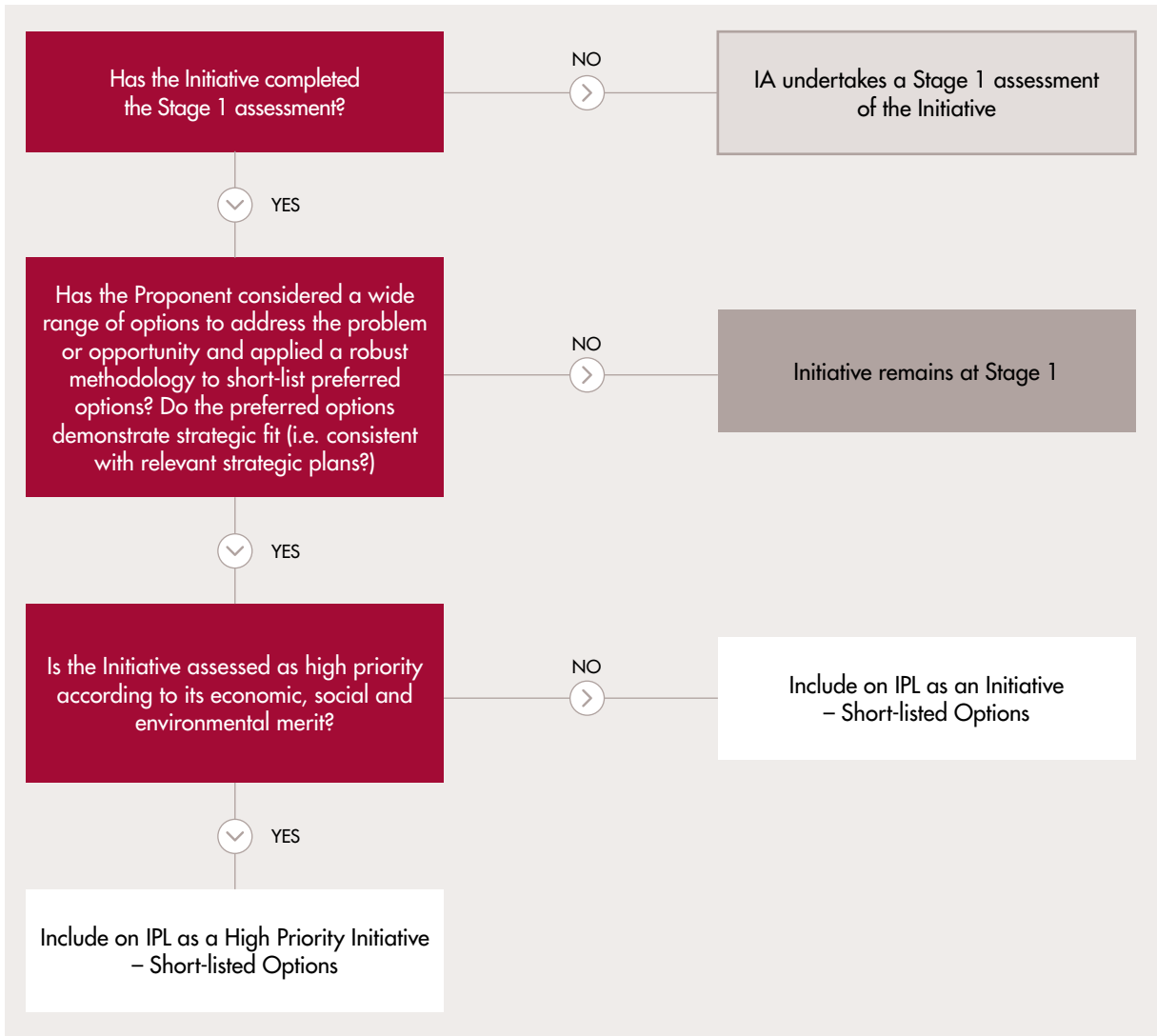
In addition, the outputs from the options assessment stage for all options must be documented and provided to Infrastructure Australia to understand why the respective options were chosen for Business Case Development.

B2.7 Initiative Identification and Options Development process

The flowchart in Figure 8 sets out the Initiative Identification and Options Development process.



Figure 8 Initiative Identification and Options Development process



Source: Infrastructure Australia.



B3. Stage 3: Business Case Development

B3.1 Stage overview

The purpose of Stage 3 is for the proponent to develop a business case that examines in detail alternative options, recommends a preferred solution and sets out the governance, approach to risk and delivery approach that will ensure benefits are realised.

Engagement with Infrastructure Australia during this stage can be undertaken at the proponent's discretion. No formal assessment is undertaken by Infrastructure Australia, as the assessment occurs in Stage 4: Business Case Assessment. The guidance for Stage 3 should be read in conjunction with the guidance for Stage 4.

Business Case Development is a major stage for the project proponent, as this involves:

- developing options in greater detail to understand their costs, benefits, delivery and risks
- refining options as greater analysis is undertaken, such as refining route alignments, interchanges or building design standards

- ensuring that factors relevant to the success of an option are comprehensively addressed, such as operations, land use planning and governance structures. Where a proponent indicates that business case development is underway, and an Options Assessment has been approved by Infrastructure Australia, the IPL will be revised to **IPL Initiative — Business Case Development**.

Note that there is no template for the Business Case Development stage. As the proponent would submit information on the business case as part of the next stage only, and there is no formal assessment by Infrastructure Australia, a template is provided for the Business Case Assessment stage.

B3.2 Economic appraisal

A central part of the Business Case Development process is the economic appraisal, also known as CBA. The key steps of the CBA process are provided in Figure 10, with further detail in Chapter D3.

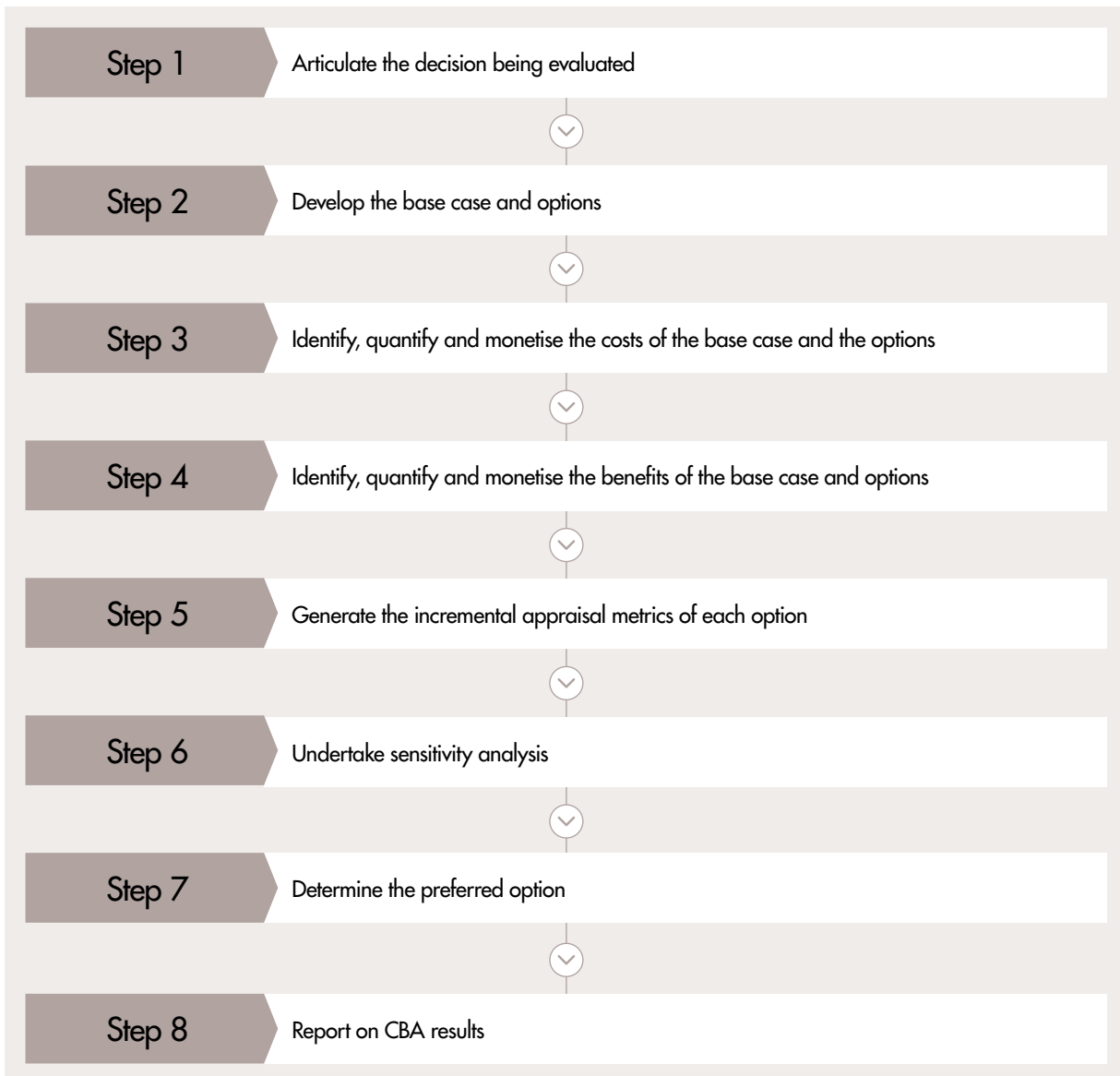
Figure 9 Business Case Development stage



Source: Infrastructure Australia.



Figure 10 Key steps in a cost–benefit analysis (CBA)



Source: Infrastructure Australia.



B3.3 Summary of detailed CBA requirements

All proposals should include a thorough and detailed CBA. This analysis should be of sufficient quality that it can be used to allow Infrastructure Australia to describe the productivity gains that may be anticipated from the proposal.

In preparing and presenting results of the detail economic appraisal, proponents must:

- 1. Submit robust and objective CBA which is supported by strong evidence.** Full transparency of the assumptions, parameters and values which are used in each CBA is required. For key input data that underpins the CBA (e.g. demand or price forecasts, and capital and operational costs), supporting evidence is also required. Independent verification of costs and benefits is required to provide confidence that the data is robust.
- 2. Consider as many monetised economic benefits and costs as possible.** Infrastructure Australia requires proponents to monetise impacts whenever possible and to consider impacts on as many stakeholders as practicable to gain an accurate community-wide perspective on the costs and benefits. Infrastructure Australia is particularly interested to understand the magnitude and longevity of benefits. Examples include:
 - Productivity and economic impacts (e.g. reliability and travel time impacts, and vehicle operating cost savings).
 - Individual user benefits (e.g. accessibility and connectivity benefits; travel time impacts).
 - Service improvement benefits.
 - Health, safety and security benefits
 - Land use impacts (e.g. higher or lower value of land use, public infrastructure cost changes, and second round transport benefits and costs).
 - Wider economic benefits (WEBs) should also be considered, where relevant. ATAP is currently undertaking original research and analysis to develop local parameters and values for estimating WEBs in Australia. The guidance from ATAP on WEBs should be available in 2018. In the interim, proponents should refer to the Transport Analysis Guidance (WebTAG) approach developed by the UK Government⁹, taking into account local circumstances. The final analysis and the appraisal metrics such as net present value (NPV) and benefit-cost ratio (BCR) should be presented with and without WEBs.
- 3. Consider non-monetised benefits and costs.** Where impacts cannot be robustly expressed in monetary units, Infrastructure Australia will nevertheless incorporate them in the review process and request proponents provide information on the scale of these impacts. This includes community and network impacts. The community impacts include social and environmental costs and benefits. The network impacts include the wider network implications of the project, including unquantified journey time reliability and network resilience benefits.
- 4. Both the overall efficiency of the proposal (the combined scale of benefits and costs), as well as its equity and distributional impacts.** Efficiency is determined by comparing the benefits and costs of a proposal – it specifically addresses the question “When all the benefits and costs are combined, will the proposal deliver **net benefits** (i.e. benefits in excess of costs)?” Equity and distributional impacts relate to who bears the benefits and costs. Thus, to aid its decision making, Infrastructure Australia not only requires the benefit cost ratio as a measure of net benefits, but also a breakdown of who is likely to bear the benefits and the costs, and when.
- 5. Consider the issues of risk and uncertainty.** Infrastructure Australia is fully aware that economic growth, individuals’ behaviour, oil prices, carbon prices, climate risks and so on may vary over time with some level of uncertainty. To ensure that

⁹ United Kingdom Department for Transport (2013), *Transport analysis guidance: WebTAG*, Department of Transport, London, <https://www.gov.uk/guidance/transport-analysis-guidance-webtag>



the CBA process is robust to potential changes, Infrastructure Australia requests a series of sensitivity tests of the demand and cost modelling and the CBA results, including testing for robustness across a range of future scenarios, where appropriate.

transparency of data, assumptions, and methodologies used; comprehensive supporting evidence to justify assumptions, including independent verification of demand forecasts and costings where possible; and a detailed picture of the results of the appraisal.

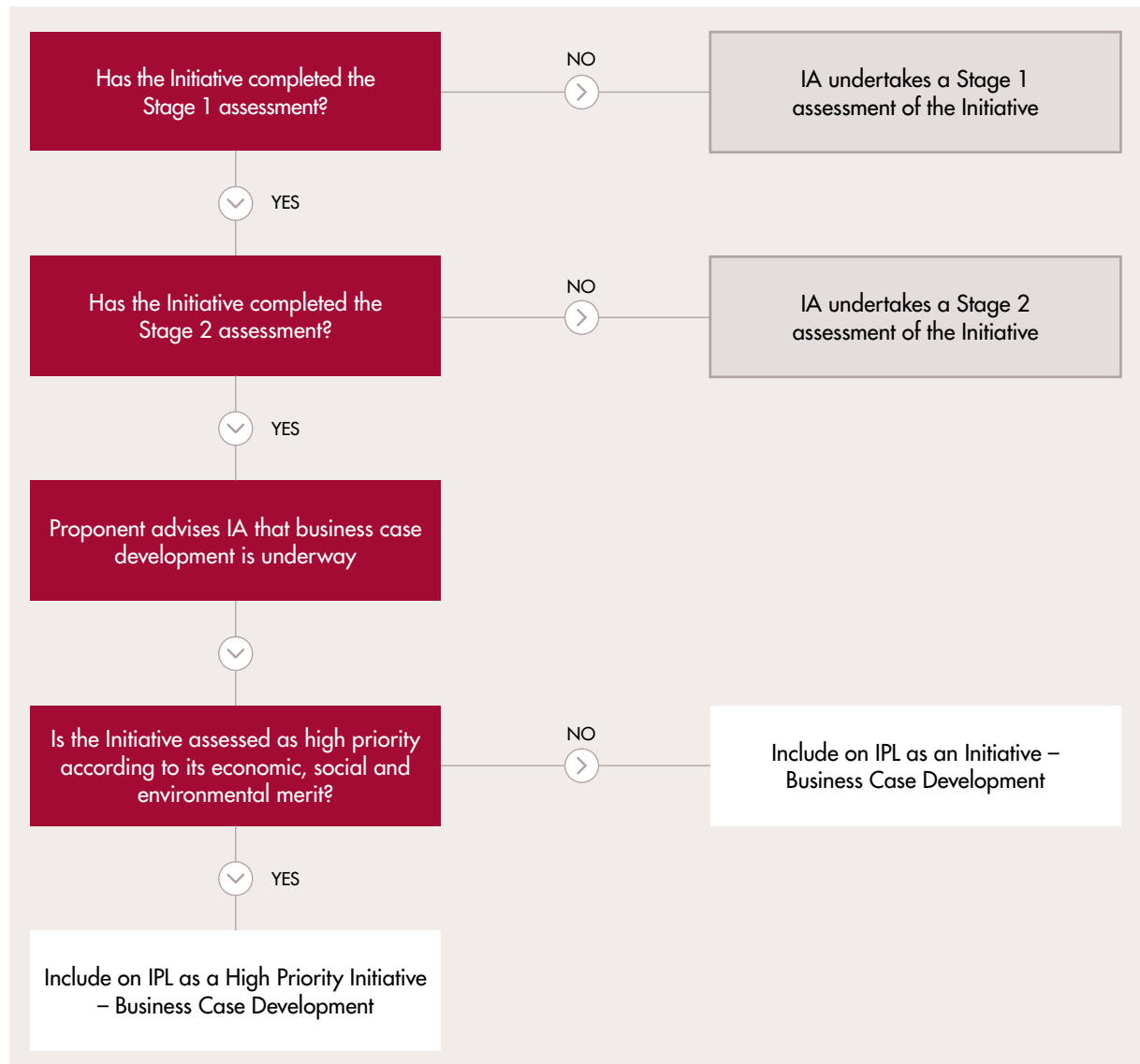
Infrastructure Australia requires all proponents to submit detailed appraisal information in support of all proposals. This should provide complete

Further advice and guidance on the various aspects of the CBA requirements are given in Part D (Detailed Technical Notes).

B3.4 Business Case Development process

The flowchart below sets out the Business Case Development process.

Figure 11 Business Case Development process



Source: Infrastructure Australia.



B4. Stage 4: Business Case Assessment

B4.1 Stage overview

The purpose of this stage is for Infrastructure Australia to review and assess the project business case from the proponent.

The proponent’s business case should have sufficient information and details for Infrastructure Australia to understand and assess the following key criteria:

1. The strategic fit (the basis for which will already have been considered in Stages 1, 2 and 3).
2. Economic, social and environmental value – the proposal’s lifetime benefits should outweigh its lifetime costs (in discounted terms or in present values).
3. Deliverability – the proposal must have a clear and robust delivery and risk management plan to ensure its successful realisation.

The business case submission at the end of Stage 3 should help Infrastructure Australia to determine:

- the productivity gains that may be anticipated from the proposal
- any complementary infrastructure required to maximise the productivity gains from the proposal
- the timeframe for delivering the proposal.

When considering a project for inclusion on the IPL, Infrastructure Australia must be confident that:

- the project will demonstratively address a problem of national significance
- the project business case is compelling and evidence-based, and that the forecast benefits and costs are based on a methodology that is consistent with best practice

- the net benefits of the project outweigh the costs as measured in constant dollars.

In addition, Infrastructure Australia considers the following highly desirable for consideration of a project on the IPL:

- options that include best practice infrastructure development and/or Infrastructure Australia’s policy principles have been actively considered
- the proponent has considered the funding and financing model and, if possible, elements of this model are in place
- the business case outlines appropriate governance and processes in place to manage risks
- benefits realisation has been actively considered, and an appropriate benefits measurement strategy proposed (see Chapter B5 for more details).

Infrastructure Australia will determine if the preferred option is to be included on the IPL and if it should be categorised as a Project or High Priority Project.

Proponents are strongly encouraged to engage with Infrastructure Australia during Stage 4. This will facilitate a robust and transparent Business Case Assessment process.

Note that where Infrastructure Australia has previously assessed that the problem is nationally significant and that the options assessment is complete, then it will not revisit these assessments unless there has been a substantial change in information available.

Figure 12 Business Case Assessment stage



Source: Infrastructure Australia.



B4.2 Infrastructure Australia process for assessing a business case

An overview of the Business Case Assessment process is provided in Box 7.

Part D (Detailed Technical Notes) provides guidance on specific aspects of the CBA in the proponent's business case:

- Chapter D1 – developing the base case and measuring the problem
- Chapter D2 – selecting appraisals and evaluation methods
- Chapter D3 – conducting economic appraisal
- Chapter D4 – risk, uncertainty and sensitivity analysis
- Chapter D5 – undertaking post completion reviews.

Box 7 Business Case Assessment process

Steps in the assessment process undertaken by Infrastructure Australia:

1. National significance

The proponent demonstrates that the project addresses a problem or an opportunity of national significance.

2. Options assessment

The proponent demonstrates that an appropriate range of options have been considered and robustly assessed to determine the short-list of preferred options.

3. Relevant government support

The proponent demonstrates that the project is supported by relevant state or territory governments.

4. Economic appraisal

Infrastructure Australia assesses the proponent's economic appraisal to ensure:

- a robust CBA has been undertaken
- best practice methods have been followed in the CBA, such as probabilistic risk-based cost estimates
- the net benefits of the project outweigh the costs as measured in real present dollars
- equity and distributional impacts of the project have been considered, with identified impacts properly accounted for on relevant social groups
 - the risk-based cost estimate, risk assessment, demand models and economic appraisal have been independently reviewed.

5. Benefit realisation

Infrastructure Australia assesses the proponent's benefits realisation approach, including the Benefits Realisation Plan.

6. Deliverability

Infrastructure Australia assesses the deliverability, funding and other risks associated with the project, with a focus on how this could impact on the costs and benefits.

7. Supporting material

Infrastructure Australia assesses the proponent's supporting material to ensure:

- a robust delivery plan is in place including adequate cost and risk assessments to provide assurance that the proposal will be delivered within budget
- a financial model has been developed demonstrating the viability gap and exploring options for, and impact of, different funding solutions
- where government funding is likely to be sought, analysis of scope for private funding has been completed.

Infrastructure Australia will also assess the problem and options development and assessment processes where they have not previously been involved in earlier stages.





Infrastructure Australia will engage with proponents before and after the submission of the business case (or Stage 4 template) and supporting information. This can be done through:

- interviews with the proponent
- question and answer sessions with the proponent, their advisors and their independent reviewer(s)
- workshops with Infrastructure Australia assessors and the proponent.

B4.3 IPL project prioritisation listing

A project business case provided to Infrastructure Australia is categorised as either:

- a High Priority Project for the IPL
- a Project for the IPL
- not suitable for the IPL.

Infrastructure Australia makes a project assessment taking account of:

- the national significance of the project
- the support of relevant state or territory governments
- the project's net benefits.

Infrastructure Australia will publish a summary of the project business case evaluation as soon as practical following a Board decision. This will include the business case evaluation of project proposals which are not included on the IPL.

B4.4 Information required to be submitted to Infrastructure Australia

Proponents are required to ensure the information set out within the Infrastructure Australia Stage 4 template found in Part C of this document is provided in their submission. This information can be provided directly within the template, or the Stage 4 checklist can be used to ensure relevant information is contained within models provided and business case documents and appendices. This includes:

- details on the assumptions applicable to forecast costs and benefits
- economic appraisal spreadsheets, showing individual benefit and cost flows over the evaluation period, clearly differentiating between the outcomes for the base case and the respective options and the derived incremental results between them
- funding and financial models
- governance structures
- risk mitigation strategies
- evidence of independent business case review
- a Benefits Realisation Plan, indicating how benefits and costs will be measured as the project proceeds.

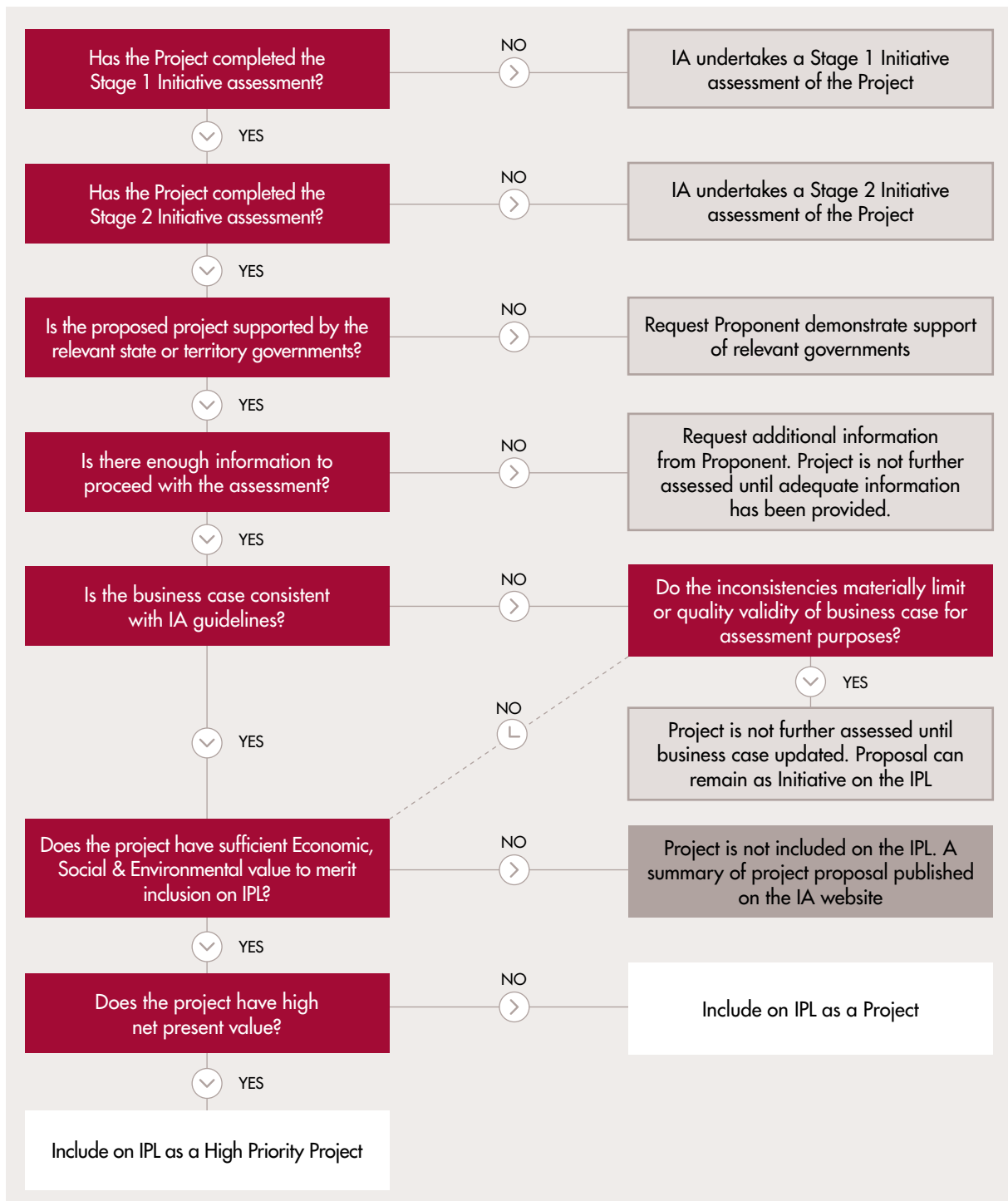
Where Infrastructure Australia has not assessed previous stages for a particular project submission, then it will also require the necessary information to assess these stages.



B4.5 Business Case Assessment process

The flowchart below sets out the Business Case Assessment process.

Figure 13 Business Case Assessment process



Source: Infrastructure Australia.



B5. Stage 5: Post Completion Review

B5.1 Stage overview

The purpose of Stage 5 is to undertake a Post Completion Review (PCR) of the delivered project to determine if the:

- project achieved its intended objectives
- project’s net benefits have been realised as per the business case
- assumptions adopted in the CBA of the business case were appropriate
- outcomes could have been achieved in a more effective and efficient way.

Infrastructure Australia recommends proponents review the delivered project using the three evaluation areas used on the initial project evaluation and to capture other lessons, as follows:

- **Strategic Fit:** Whether the project achieved its intended strategic objectives
- **Economic Merit:** An ex-post review of the economic merit and performance of the project (including a review of project options developed)
- **Delivery Efficiency:** An analysis of how efficiently the project was delivered against forecast capital costs, and if delivery objectives were achieved

The PCR should also capture other lessons to improve project planning, delivery and risk mitigation.

A well-executed PCR should lead to better infrastructure decisions by identifying project issues and successes that proponents of new projects or programs can incorporate into future business cases. It should provide lessons on how to improve the delivery of projects in the future.

In accordance with the Australian Infrastructure Plan, Infrastructure Australia recommends that proponents undertake PCRs on all projects seeking Commonwealth’s capital contribution in excess of \$100 million. PCRs should be undertaken periodically throughout the operational life of the asset. Proponents could prioritise PCRs in accordance with their resources availability and, for more complex and transformative projects that are of a significant scale, the proponents are likely to require more than one PCR to be completed.

To this end, Infrastructure Australia expects proponents to include a PCR Plan (which could include a Benefits Realisation Plan) in their business case submission.

In accordance with the Australian Infrastructure Plan, jurisdictions or proponent organisations should publish the findings from the PCRs, so that others can learn from their experience. Jurisdictions or proponent organisations should publish the PCR report in full for each project.

Infrastructure Australia’s role is to assist proponents to undertake and complete PCRs. Proponent organisations contemplating a PCR can contact Infrastructure Australia to nominate staff member(s) to assist with completing the review. Infrastructure Australia’s intention is that findings from PCRs will assist delivery agencies and proponent organisations to learn about how to develop better business cases for future projects.

Figure 14 Post Completion Review stage



Source: Infrastructure Australia.



B5.2 Best practice Post Completion Review

The objective of a PCR is to promote better decision making, which should result in more robust business cases and better use of public funds. To achieve this objective, the focus of PCRs should be to understand and learn from experience to improve future decisions, project delivery and project performance. Importantly, the focus of a PCR should not be on allocating blame or be of a punitive nature where problems have emerged. Delivery agencies and project sponsors should foster a 'no blame culture' in undertaking PCRs. Similarly, the positive findings of PCRs should be used to recognise proponent organisations for their success and achievements.

The PCR requirements need to balance a rigorous review process while also ensuring the process is not too burdensome and costly. Proponents should tailor the PCR to suit different asset classes and projects with different complexities.

For this to occur, costs and benefits, or drivers of costs and benefits should be:

- measurable
- recorded by the proponent
- aligned to ex-ante expectations (from the final business case).

The project's forecasts should be compared with actual outputs and outcomes, for example:

- the expected demand for the infrastructure should be compared with the actual demand after the project was commissioned
- the expected travel times for key trips should be compared to actual observed travel times
- the expected land use and wider economic benefits should be compared to actual benefits attributable to the project
- the expected capital, operational and maintenance costs should be compared with actual construction, operational and ongoing costs with variations due to project scope changes identified and accounted for separately.

The forecasts should be contained in the business cases, benefits management plans/reports, project status reporting and modelling data. Further, the use of questionnaires, surveys, stakeholder interviews and analysis of usage data should also be employed to generate the actual information required for the PCR.

It is Infrastructure Australia's expectation that proponents will adopt best practice and undertake PCRs a short period after the infrastructure has been commissioned or become operational (to assess forecast construction costs against actuals and initial infrastructure performance) and as data becomes available for a longer term review.



B5.3 Post Completion Review approach

To enhance the integrity and objectivity of these reviews, strategic, engineering and economic expertise will be required. Expertise will be required to analyse and form conclusions on how well the projects were delivered, whether the business case forecasts were met and whether the right options were selected during the assessment phase.

The flowchart, in Figure 15, sets out the recommended five-step process for completing PCRs.

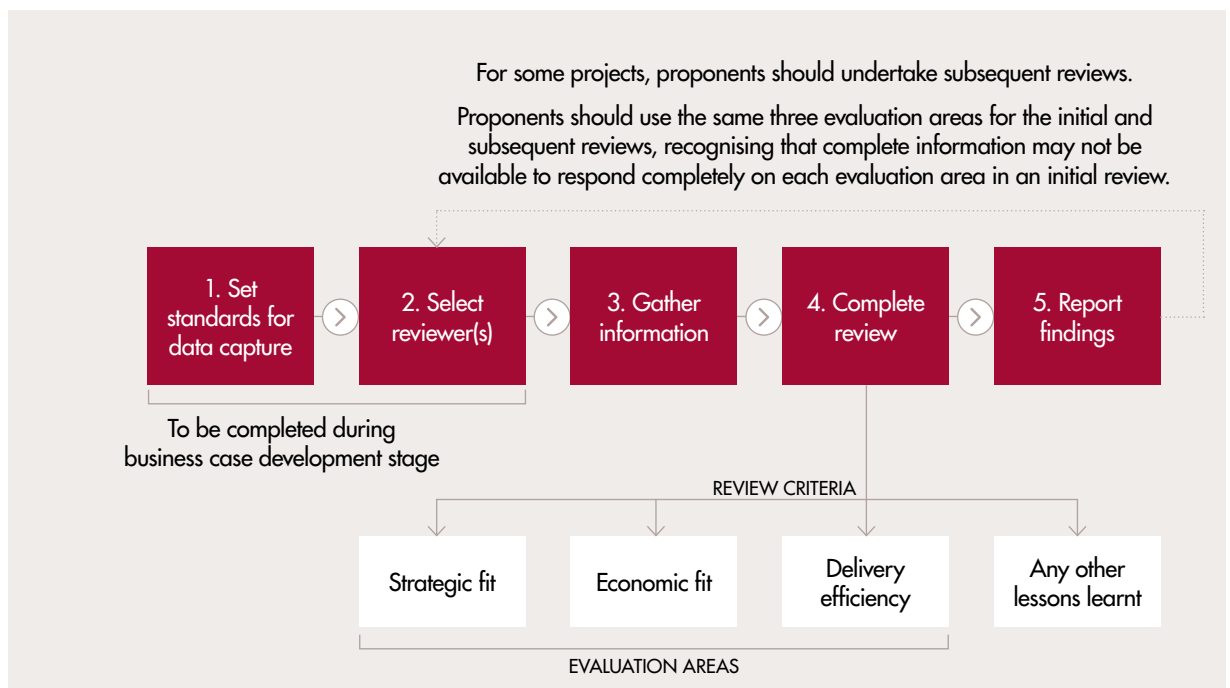
To be effective, the decision on the first two steps (i.e. what, when and how to review, and what format and what information will be required) should be made during the business case development stage. This will help to ensure that those preparing the business case documents, including external consultants (if engaged), understand the data organisation, capture and storage requirements and capture and store the data appropriately for the purposes of the PCRs. This, in turn, will make it easier for subsequent reviewers to retrieve and examine this information.

The final three steps of the process will occur post project completion as part of the review itself.

Infrastructure Australia recommends that proponents undertake at least two separate PCRs at different stages to assess comprehensively the project’s strategic fit, economic merit and delivery efficiency as well as any other lessons. Proponents should undertake the initial PCR a year after the project has been delivered. The timing of the subsequent review should depend on the nature of the asset. Projects where the benefits are expected to be realised sooner (e.g. ICT projects) should have the subsequent review undertaken approximately two years after delivery, whereas projects where it takes longer to realise benefits (e.g. transport and water infrastructure) should have the subsequent review undertaken approximately five years after delivery. By this time, the project or program of works would be in ‘steady state’ operational phase and demand would have ramped up sufficiently.

For some projects, subsequent reviews may be completed at the asset’s half-life or end of life. Proponents should undertake a mid life or an end-of-life review for very large projects (over \$1 billion in delivery costs), or where there are a large number of beneficiaries, or for types of projects that involve a recurring investment (e.g. rolling stock fleet procurement).

Figure 15 Post Completion Review methodology



The initial review and the subsequent review(s) should all cover the three evaluation areas (strategic fit, economic merit, and delivery efficiency) and other lessons learned. Reviewers may not have sufficient detail at the time of the initial review to address fully all aspects of the evaluation areas. The reviewer should discuss where more information is required and recommend that the proponent collect this information prior to the subsequent review(s).

The PCR allows the proponent and Infrastructure Australia to understand the deviations from outcomes of the estimates contained in the business cases. Proponents should compare forecasts contained in the business cases, benefits management plans/reports, project status reporting and modelling data against actual outcomes using questionnaires, surveys, stakeholder interviews and analysis of usage data. Proponents should identify the information required to complete a PCR during the business case development stage and collect the data required as the project proceeds.

Further guidance on undertaking PCRs is provided in Section D5 of the Detailed Technical Notes.

Box 8 Examples of forecasts that can be compared with actual outputs and outcomes

- Lifecycle costs of the new or upgraded asset
 - Capital costs
 - Routine operational and maintenance costs
 - Planned periodic refurbishment costs
- Costs of decommissioning life-expired assets
- Demand levels for the new infrastructure or asset (including where relevant, demand ramp-up profile)
- Key metrics and benefit drivers for different asset classes, including:
 - Transport infrastructure:
 - Travel times for key trips
 - Crowding and congestion
 - Service frequency
 - Journey time reliability
 - Implications for land use and wider economic benefits
 - Health assets:
 - Separations
 - Savings in operational costs per separation
 - Rate of avoided preventable deaths
 - Staffing levels
 - Bed occupancy days
 - Emergency response times
 - Water utilities and infrastructure:
 - Storage capacity
 - Release volumes
 - Education assets:
 - Student enrolments

PART C

Templates and checklists

Introduction to Part C

Part C provides the templates that proponents can use to make submissions to Infrastructure Australia.

It also provides checklists for proponents to determine if they have supplied the required information for Infrastructure Australia's assessment at different stages of the process.

The templates and checklists are related to the Infrastructure Australia Assessment Stages:

- **Template** for Stage 1:
Problem Identification and Prioritisation
- **Template** for Stage 2:
Initiative Identification and Options Development
- **Template** for Stage 4:
Business Case Assessment
- **Excel template** for Stage 4:
Business Case Assessment (refer to the Infrastructure Australia website)
- **Checklist** for Stage 1:
Problem Identification and Prioritisation
- **Checklist** for Stage 2:
Initiative Identification and Options Development

- **Checklist** for Stages 3 & 4:
Business Case Development and Business Case Assessment
- **Checklist** for Stage 5:
Post Completion Review.

Please note that there are no templates for Stage 3, as no formal submission to Infrastructure Australia is required. Instead, proponents should advise Infrastructure Australia that business case development is underway.

Proponents are welcomed to use their own business case templates for developing their business case in Stage 3. In the absence of their own business case templates, they are encouraged to use the Infrastructure Australia Stage 4 Template.

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C1. Template for Stage 1: Problem Identification and Prioritisation

This template is to be used by proponents to lodge a Stage 1 (Problem Identification and Prioritisation) submission to Infrastructure Australia and should be read in conjunction with the Detailed Technical Notes in Part D.

Proponents are encouraged to contact Infrastructure Australia for clarification on any part of this template, or for additional guidance in preparing a submission.

The remainder of this chapter provides guidance on how to use the Stage 1 template.

Infrastructure Australia can be contacted via email on mail@infrastructureaustralia.gov.au, or by telephone on (02) 8114 1900.



DOWNLOAD TEMPLATE

Example pages

Infrastructure Australia
Australian Government

Assessment Framework

TEMPLATES AND CHECKLISTS

Template for Stage 1: Problem Identification and Prioritisation

1. Overview

1.1 Document control details

PROJECT NAME: PROPONENT:
 VERSION: DATE COMPLETED:
 CHANGES FROM PREVIOUS VERSION:

1.2 Prepared by

NAME: JOB TITLE: ORGANISATION:
 CONTACT DETAILS: PHONE: MOBILE: EMAIL:
 DATE:

1.3 Approved by

NAME: JOB TITLE: ORGANISATION:
 CONTACT DETAILS: PHONE: MOBILE: EMAIL:
 DATE:

1 CONTINUED >>

Infrastructure Australia Assessment Framework
TEMPLATES AND CHECKLISTS

Template for Stage 1: Problem Identification and Prioritisation (continued)

2. Problem Opportunity description

2.1 Nationally significant problem - opportunity statement

2.2 Problem/Opportunity location

2.3 Problem / Opportunity root causes and future state profile

Problem	Opportunity	Time Period
1		
2		
3		
4		

2 CONTINUED >>

Infrastructure Australia Assessment Framework
TEMPLATES AND CHECKLISTS

Template for Stage 1: Problem Identification and Prioritisation (continued)

2.4 Information about the problem and opportunity

Problem	Opportunity description	Opportunity outcome	Relevant and
			to, and 2015
Problem 1	High opportunity in western	Real growth of 200 bn to 400 bn peak, compared to base level of 100 bn	2015-2025
Problem 2	High opportunity in southern	400 bn peak, 200 bn regional, 200 bn 2015-2025 base level	2015-2025
Problem 3	High opportunity in central	400 bn peak, 200 bn regional, 200 bn 2015-2025 base level	2015-2025
Problem 4	High opportunity in north	400 bn peak, 200 bn regional, 200 bn 2015-2025 base level	2015-2025

2.5 Stakeholder impact

Stakeholder:

2 CONTINUED >>



The following section provides guidance on how to complete the Stage 1 template.

1 C1.1 Overview

Proponent details

The proponent should provide document control and contact details.

Infrastructure Australia
 Assessment Framework
 TEMPLATES AND CHECKLISTS
**Template for Stage 1:
 Problem Identification and Prioritisation**

1. Overview

1.1 Document control details

PROJECT NAME: _____ PROponent: _____
 VERSION: _____ DATE COMPLETED: _____
 CHANGES FROM PREVIOUS VERSION:

1.2 Prepared by

NAME: _____ JOB TITLE: _____ ORGANISATION: _____
 CONTACT DETAILS: _____
 DATE: _____

1.3 Approved by

NAME: _____ JOB TITLE: _____ ORGANISATION: _____
 CONTACT DETAILS: _____
 DATE: _____

1 CONTINUED →

Page 1

2 C1.2 Problem/opportunity description

A What is the problem or opportunity to be addressed?

Describe the problem/opportunity as a succinct statement that clearly identifies a nationally significant issue to be improved or built upon.

B What is the location of the problem/opportunity?

Describe and provide supporting material such as maps, coordinates etc. to provide an accurate description of the entire problem/opportunity area.

C What is the root cause(s) of the problem/opportunity?

Explain the underlying cause(s) of the problem/opportunity and when they are forecast to eventuate.

Infrastructure Australia **Assessment Framework**
TEMPLATES AND CHECKLISTS

Template for Stage 1: Problem Identification and Prioritisation (continued)

2. Problem/Opportunity description

2.1. Nationally significant problem / opportunity statement

Please describe the problem/opportunity as a succinct statement that clearly identifies a nationally significant issue to be improved or built upon.

2.2. Problem/Opportunity location

Please describe and provide supporting materials such as maps, coordinates, etc. to provide an accurate description of the entire problem/opportunity area.

2.3. Problem / Opportunity root causes and forecast time period

Root cause	Time Period
1. _____	_____
2. _____	_____
3. _____	_____
4. _____	_____

2 CONTINUED →

Page 2



D When is the problem/opportunity forecast to eventuate and what is the quantified impact?

Please complete the table which seeks information from proponents to identify the year(s) the problem/opportunity is forecast to eventuate and the estimated cost of this impact over the identified time period. An example is shown within the table. For longer term problems/opportunities (>10 years), indicate what assumptions form a baseline future scenario of trends in population, economic development, climate, technology, etc., as appropriate.

E What stakeholders are impacted by the problem/opportunity

Include information about all stakeholders that are affected by the problem/opportunity.

F How does the identified problem/opportunity align with relevant government policy objectives, strategies as well as other problems/projects/programs

Provide details and evidence describing how the identified problem/opportunity is consistent with relevant government policy objectives and other projects. This includes, but is not limited to:

- transport plans
- land use plans
- disaster resilience or critical infrastructure strategies
- other announced problems/opportunities and projects that may be complements or substitutes to the identified problem/opportunity.

3 C1.3 Confidentiality

Please identify if any of the information provided to Infrastructure Australia in this template is confidential. Please provide a brief explanation of the reasons for the request of confidentiality.

Information submitted confidentially will not be released or published by Infrastructure Australia without the written consent of the proponent.

Infrastructure Australia Assessment Framework
TEMPLATES AND CHECKLISTS

Template for Stage 1: Problem Identification and Prioritisation (continued)

2.4 Information about the problem and opportunity

Problem	Qualitative description	Quantitative evidence	Monetised cost \$m, real 2000
Current			
Problem 1	e.g. Congestion on corridor	Travel speed of 40 km/hr in AM peak, compared to Free flow of 80km/hr 80,000 trips per day impacted, of which 10,000 are heavy vehicles	\$60 million
Problem 2	e.g. reliability compromised	Average AM trip time of 20 minutes, 20% of AM trips longer than 45 minutes	\$10 million
Problem 3	e.g. resilience to major incidents	Major incidents occur twice per year, and leads to delays of over 2 hours for 20,000 trips	\$4 million
Medium term (e.g. 2026)			
Problem 1	e.g. Congestion on corridor	Travel speed of 30 km/hr in AM peak, compared to Free flow of 80km/hr 100,000 trips per day impacted, of which 15,000 are heavy vehicles	\$90 million
Problem 2	e.g. reliability compromised	NA	
Problem 3	e.g. resilience to major incidents	NA	
Longer term (e.g. 2036)			
Problem 1	e.g. Congestion on corridor	Travel speed of 20 km/hr in AM peak, compared to Free flow of 80km/hr 120,000 trips per day impacted, of which 15,000 are heavy vehicles	\$120 million
Problem 2	e.g. reliability compromised	NA	
Problem 3	e.g. resilience to major incidents	NA	

2.5 Stakeholder impact

Stakeholder	Impact

3

CONTINUED →

Page 3

Infrastructure Australia Assessment Framework
TEMPLATES AND CHECKLISTS

Template for Stage 1: Problem Identification and Prioritisation (continued)

2.6 Problem / Opportunity alignment with relevant Government policy objectives, strategies and other Problems/ Opportunities/Programs

Please provide details and evidence describing how the identified problem/opportunity is consistent with relevant Government policy objectives and other Programs.

3. Confidentiality

Please identify if any of the information provided to Infrastructure Australia in this template is confidential. Please provide a brief explanation of the reasons for the request of confidentiality.

Information submitted confidentially will not be released or published by IA without the written consent of the proponent.

4

Page 4



C2. Template for Stage 2: Initiative Identification and Options Development

This template is to be used by proponents to lodge a Stage 2 (Initiative Identification and Options Development) submission to Infrastructure Australia and should be read in conjunction with the Detailed Technical Notes in Part D.

Proponents are encouraged to contact Infrastructure Australia for clarification on any part of this template, or for additional guidance in preparing a submission, via the contact details provided in the Assessment Framework publication.

The remainder of this chapter provides guidance on how to use the Stage 2 template.

Infrastructure Australia can be contacted via email on mail@infrastructureaustralia.gov.au, or telephone on (02) 8114 1900.



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Example pages

Infrastructure Australia
Australian Government

Assessment Framework

TEMPLATES AND CHECKLISTS

Template for Stage 2: Initiative Identification and Options Development

1. Overview

1.1 Document control details

PROJECT NAME: PROPONENT:
 VERSION: DATE COMPLETED:
 CHANGES FROM PREVIOUS VERSION:

1.2 Prepared by

NAME: JOB TITLE: ORGANISATION:
 CONTACT DETAILS: PHONE: ADDRESS: EMAIL:
 DATE:

1.3 Approved by

NAME: JOB TITLE: ORGANISATION:
 CONTACT DETAILS: PHONE: ADDRESS: EMAIL:
 DATE:

1 CONTINUED →

Infrastructure Australia Assessment Framework
TEMPLATES AND CHECKLISTS

Template for Stage 1: Problem Identification and Prioritisation (continued)

2. Problem/Opportunity description

2.1. Nationally significant problem / opportunity statement

2.2. Problem/Opportunity location

2.3. Problem / Opportunity root causes and relevant time period

Time Period:

1.
 2.
 3.
 4.

2 CONTINUED →

Infrastructure Australia Assessment Framework
TEMPLATES AND CHECKLISTS

Template for Stage 1: Problem Identification and Prioritisation (continued)

2.4. Information about the problem and opportunity

Problem	Qualitative description	Quantitative evidence	Relevant and Significant
Problem 1	High congestion on roads	Annual growth of 20% in road growth, compared to the 10% of 2010-2015	2015 million
Problem 2	High accessibility improvement	Annual growth of 10% in accessibility, compared to the 5% of 2010-2015	2015 million
Problem 3	High accessibility improvement	Annual growth of 10% in accessibility, compared to the 5% of 2010-2015	2015 million
Problem 4	High accessibility improvement	Annual growth of 10% in accessibility, compared to the 5% of 2010-2015	2015 million

2.5. Stakeholder impact

Stakeholder: Impact:

3 CONTINUED →



The following section provides guidance on how to complete the Stage 2 template.

1

C2.1 Overview

The proponent should provide document control and contact details.

1

Infrastructure Australia
Assessment Framework
TEMPLATES AND CHECKLISTS

**Template for Stage 2:
Initiative Identification and Options Development**

1. Overview

1.1 Document control details

PROJECT NAME: _____ PROPONENT: _____
 VERSION: _____ DATE COMPLETED: _____
 CHANGES FROM PREVIOUS VERSION: _____

1.2 Prepared by

NAME: _____ JOB TITLE: _____ ORGANISATION: _____
 CONTACT DETAILS: PHONE: _____ FACSIMILE: _____ EMAIL: _____
 DATE: _____

1.3 Approved by

NAME: _____ JOB TITLE: _____ ORGANISATION: _____
 CONTACT DETAILS: PHONE: _____ FACSIMILE: _____ EMAIL: _____
 DATE: _____

1 CONTINUED →

Page 1

2

C2.2 Initiative Identification and Options Development

A

Initiative Identification and Options Development process

The proponent should describe the process used to develop a long-list of initiatives, and the stakeholders that were involved.

The long-list of initiatives that were identified should be provided.

2

A

Infrastructure Australia **Assessment Framework**
TEMPLATES AND CHECKLISTS

Template for Stage 2: Initiative Identification and Options Development (continued)

2. Problem/Opportunity description

2.1 Initiative identification and options development process

Initiative long-listing and options development process

Describe the process used to develop a long list of initiatives (e.g. options development workshop)

Stakeholder input

Describe the stakeholders involved in the long listing process and their relevance to the problem/opportunity.

Long list of initiatives identified

Please provide a summary list of the initiatives identified in per the example below:

- Adjust existing water licences
- Adjust existing water allocations
- Water pipeline from neighbouring region
- Upgrade to existing dam
- New dam development

2 CONTINUED →

Page 2



B Long-listed initiative descriptions

The proponent should copy and complete the table for each long-listed initiative. While different initiatives will have varying levels of information and analysis, each section should be completed using the best possible information.

2
B

Page 3

C Capital and non-capital solutions

The proponent should describe how wide a range of capital and non-capital solutions have been considered. This includes:

- Regulatory reform
- Governance reform
- Better asset use reform
- Capital investment solutions.

Please provide justification where options are not considered for any of these reform categories.

D Initiative coordination

The proponent should describe how individual initiatives could be packaged together, better coordinated, or sequenced over time.

2
C
2
D

Page 4



3

C2.3 Initiative short-listing

A

Initiative short-listing process

The proponent should describe the process used to refine the long-list of initiatives to a short-list of options. This could be through:

- Rapid cost-benefit analysis
- Cost-effectiveness analysis
- Multi-criteria analysis.

The proponent should also describe the stakeholders involved in the short-listing process.

The short-list of options should be provided.

B

Short-listed options descriptions

The proponent should copy and complete the table for each short-listed option. Information should be provided which describes:

- the current status of the option
- the next development steps
- the ability of the option to address a nationally significant problem or opportunity
- the economic, social and environmental impact of the option.

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TEMPLATES AND CHECKLISTS

Template for Stage 2: Initiative Identification and Options Development (continued)

2.3 Capital and non-capital solutions
*Please describe how wide a range of capital and non-capital solutions have been considered (including regulatory reform, governance reform, better use reform and capital investment solutions)
Please provide justification where options are not considered for any of these reform categories.*

2.4 Initiative coordination
Describe how individual initiatives could be packaged together or better coordinated.

3 Initiative short listing

3.1 Initiative short listing process

Initiative short listing process
Describe the process used to refine the long list of initiatives to a short list of options (e.g. rapid cost benefit analysis, cost effectiveness analysis, multi-criteria analysis, etc.)

Stakeholder input
Describe the stakeholders involved in the short listing process.

4 CONTINUED →

3

A

Page 4

Infrastructure Australia | Assessment Framework
TEMPLATES AND CHECKLISTS

Template for Stage 2: Initiative Identification and Options Development (continued)

Short list of options identified
Please provide a summary list of the short listed initiatives identified as per the example below:

- Adjust existing water allocations
- Upgrade to existing dam
- New dam development

3.2 Shortlisted options descriptions

Option	Next option name
Category	Description
Option Status	This includes, but is not limited to, work completed such as: <ul style="list-style-type: none"> • Planning studies • Feasibility studies • Preliminary business case • Environmental assessment or and Gateway review/approval • Economic appraisal studies • Gateway review • Approval • Detail/realisation plan development
Next development steps	Describe the next activities planned to progress the option. This should include what activities are due to commence and when they are due to be completed.
Ability to address a nationally significant problem or opportunity	Please describe or provide evidence of the option's ability to address a nationally significant problem or opportunity. This includes: <ul style="list-style-type: none"> • Effectiveness (value for money) • Timeliness (how soon and for how long) • Adaptability (flexibility to change and uncertainty)
Economic, social and environmental impact of the option	Please provide evidence on available: <ul style="list-style-type: none"> • Identification of costs of a problem or value of an opportunity • Quantification of impacts in terms of economic, social and environmental • Qualitative discussion of impacts in terms of economic, social and environment <i>This should include any project externalities (positive and negative)</i>

5 CONTINUED →

3

B

Page 5




4 C2.4 Confidentiality

Please identify if any of the information provided to Infrastructure Australia in this template is confidential. Please provide a brief explanation of the reasons for the request of confidentiality.

Information submitted confidentially will not be released or published by Infrastructure Australia without the written consent of the proponent.

4



Assessment Framework
TEMPLATES AND CHECKLISTS

Template for Stage 2: Initiative Identification and Options Development (continued)

4. Confidentiality
Please identify if any of the information provided to Infrastructure Australia in this template is confidential. Please provide a brief explanation of the reasons for the request of confidentiality.
Information submitted confidentially will not be released or published by IA without the written consent of the proponent.

Page 6



C3. Template for Stage 4: Business Case Assessment

This template is to be used by proponents to lodge a Stage 4 (business case) submission to Infrastructure Australia and should be read in conjunction with the Detailed Technical Notes in Part D.

Infrastructure Australia also notes that proponents should also complete the Excel Stage 4 template, or equivalent, where a CBA has not previously been undertaken.

Proponents are encouraged to contact Infrastructure Australia for clarification on any part of this template, or for additional guidance in preparing a submission, via the contact details provided in the Assessment Framework publication.

The remainder of this chapter provides guidance on how to use the Stage 4 template.

Infrastructure Australia can be contacted via email on mail@infrastructureaustralia.gov.au, or telephone on (02) 8114 1900.



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TEMPLATES AND CHECKLISTS

Template for Stage 4: Business Case Assessment

1. Project Overview and Strategic Alignment

1.1 Document control details

PROJECT NAME PROPONENT
 VERSION COMPLETED
 CHANGES FROM PREVIOUS VERSION

1.2 Prepared by

NAME JOB TITLE ORGANISATION
 CONTACT DETAILS PHONE MOBILE EMAIL
 DATE

1.3 Approved by

NAME JOB TITLE ORGANISATION
 CONTACT DETAILS PHONE MOBILE EMAIL
 DATE

1.4 State/Territory Government approval

State/territory government impacted
 NSW ACT VIC QLD WA NT TAS

1 CONTINUED →

Infrastructure Australia Assessment Framework
TEMPLATES AND CHECKLISTS

Template for Stage 4: Business Case Assessment (continued)

Summary of project description

Outline level of support

State/territory government approval

NAME PHONE MOBILE EMAIL

1.1 Project Overview

Project Name

Public Description

1 CONTINUED →

Infrastructure Australia Assessment Framework
TEMPLATES AND CHECKLISTS

Template for Stage 4: Business Case Assessment (continued)

Project Options

1.4 'No additional' base case description

1.7 Project case options description (identify and describe each shortlisted project option)

Project Option 1

Project Option 2

Add additional options, if necessary

1 CONTINUED →



Guidance Overview

Proponents wishing to make a submission to Infrastructure Australia for a project to be included on the IPL should have completed a full business case, or should complete the Stage 4 Business Case Assessment template if they do not have a full business case template.

Proponents should have already completed the Stage 1 and Stage 2 templates, and submitted these to Infrastructure Australia.

Amendments to the template formatting is acceptable, provided the order of questions within the template is maintained. In providing responses, proponents may provide references to the appropriate page or section of the business case or other reports.

Proponents should also include any relevant supporting information in their submission to Infrastructure Australia. This should include as a minimum:

- The full business case
- Infrastructure Australia's Stage 4 Excel template, or equivalent, that captures key quantitative data
- Delivery options analysis (if it is not in the full business case)
- High-level delivery schedule (if it is not in the full business case)
- Risk assessment (if it is not in the full business case)
- Full references to appropriate studies or reports that justify any parameters or assumptions used.

In addition, proponents should include other relevant additional information such as:

- Detailed modelling
- Any early-stage (e.g. scoping or concept design) plans or drawings
- Benefits realisation plans
- Intended project and program governance.

Throughout this process, Infrastructure Australia seeks to be pragmatic and collaborative, in order to make fair and objective assessments. If proponents have any issues or questions about their submission, they should contact Infrastructure Australia. The process might benefit from discussions between Infrastructure Australia and the proponent before the Stage 4 template is completed and submitted.

In completing the Stage 4 template, proponents may provide page references to the appropriate pages in the business case, rather than copying out sections of the business case into the template.

Proponents should highlight any information they wish to remain confidential.





The following section provides guidance on how to use the Stage 4 Template.

1 C3.1 Project overview and strategic alignment

A Document control

The proponent should provide document control and contact details.

B State/territory government approval

The proponent should provide a brief description of the potential project impacts on the state or territory governments identified.

For private sector proposals, evidence is required to demonstrate support of the impacted state/territory government(s). Note, public sector proponents are not required to complete the table outlining level of support.

Assessment Framework
TEMPLATES AND CHECKLISTS

Template for Stage 4: Business Case Assessment

1. Project Overview and Strategic Alignment

1.1 Document control details

PROJECT NAME: _____ PROPOSER: _____
 VERSION: _____ COMPLETED: _____
 CHANGES FROM PREVIOUS VERSION: _____

1.2 Prepared by

NAME: _____ JOB TITLE: _____ ORGANISATION: _____
 CONTACT DETAILS: PHONE: _____ EMAIL: _____
 DATE: _____

1.3 Approved by

NAME: _____ JOB TITLE: _____ ORGANISATION: _____
 CONTACT DETAILS: PHONE: _____ EMAIL: _____
 DATE: _____

1.4 State/Territory Government approval

State/territory government impacted
 NSW ACT VIC QLD WA NT TAS

1 CONTINUED →

Page 1

C Project overview

Please provide a brief overview of the business case in terms of the proposed project, the problem/opportunity it seeks to address and the overall objective of the project.

Assessment Framework
TEMPLATES AND CHECKLISTS

Template for Stage 4: Business Case Assessment (continued)

Summary of impact description

Please provide a brief description of the potential project impacts on the State or Territory Governments, classified.

Outline level of support

Please provide evidence to demonstrate the support of the Impact State or Territory Governments. Note that this is only required for private sector proposals.

State/territory government official

NAME: _____ PHONE: _____ EMAIL: _____

1.5 Project Overview

Proposed Project

Problem Description

2 CONTINUED →

Page 2



D

Define the base case

Describe the ‘do minimum’ base case, including but not limited to a:

- description of how the ‘do minimum’ base case results in, or impacts, on a problem/opportunity of national significance
- summary of the infrastructure network which provides this service, including level of service etc.
- description of the service constraint identified in Stage 1. This may be the volume/capacity, reliability, speed or quality of services delivered to customers
- summary of the root causes of these problems; proponents should reference or update information provided during Stage 2 of the Infrastructure Australia Assessment Framework
- description of the costs of the current infrastructure network faced by infrastructure owners (‘do minimum’ capex and operating costs), customers (user charges) and government (taxes and subsidies)
- description of how the base case changes over time.

Infrastructure Australia encourages proponents to use the guidance provided in Chapter D1 when describing the base case as it forms an integral part of an unbiased assessment of the proposed solutions. Proponents should also refer to sector specific guidance, such as ATAP,¹⁰ for further guidance.

Particular attention should be given to specifying the base case and the need to avoid including significant, unfunded infrastructure in the base case.

E

Project options

This should be consistent with information provided to Infrastructure Australia during the previous assessment stages. Information should include a:

- list and description of at least two short-listed project options identified and explored in the business case
- description of how the short-listed project options were identified, assessed and short-listed
- capital and operating cost for each option, where relevant
- description of the options’ expected impact in terms of efficiency, equity and productivity, imposed on or gained by stakeholders by the possible initiatives.

Page 3

¹⁰ Transport and Infrastructure Senior Officials’ Committee (2016), *Australian Transport Assessment and Planning (ATAP) Guidelines*, Transport and Infrastructure Council, Canberra, www.atap.gov.au



F

Strategic alignment of the project options

Proponents should copy and complete the table for each project option, addressing at least the following:

- Please describe why the option is nationally significant and provide quantitative and qualitative evidence, where relevant
- How does the option align with infrastructure plans?
- How does the option align with relevant land use plans?
- How does the option align with jurisdictional strategic initiatives/economic objectives?
- How does the option align with projects which are being planned, constructed or have been recently completed that may be complements or substitutes to the project (i.e. potential complements and substitutes)?

2

C3.2 Economic, social and environmental appraisal

A

Demand modelling

Describe the demand model, which has been used to measure demand (e.g. name of the model, behaviour included in the model, model inputs, performance of model compared to history, years for which demand was modelled and time periods modelled).

Where demand is measured for only part of the year, or part of the day, what expansion factor has been used? What is the basis for this expansion factor?

Has an independent review of the model been conducted? If so, provide findings.

How has the model taken into account interdependencies and wider economic impacts, such as induced and diverted demand?

Please provide the excel demand model as an attachment to the submission.

Infrastructure Australia | Assessment Framework
TEMPLATES AND CHECKLISTS

Template for Stage 4: Business Case Assessment (continued)

1.8 Strategic alignment of the Project options

Project case strategic alignment	ASSESS PROJECT VALUE
Strategic alignment categories	Supporting evidence
Description of national significance	Quantitative and qualitative evidence
Alignment with infrastructure plans	Such as transport master plans or similar
Alignment with land use plans	Such as regional land use plans or similar
Alignment with jurisdictional strategic initiatives/economic objectives	Such as policy documents or similar
Alignment with potential complements and substitutes	For example, projects which are being planned, constructed or recently completed

(Add and complete for each option assessed in the Business Case)

2. Economic, Social and Environmental Appraisal

2.1 Demand modelling for the Base Case

Please describe the demand model, which has been used to measure demand, model inputs, model performance and for which years or time periods demand was modelled in the Base Case.

4 CONTINUED →

1

F

2

A

Page 4

Infrastructure Australia | Assessment Framework
TEMPLATES AND CHECKLISTS

Template for Stage 4: Business Case Assessment (continued)

2.2 Demand modelling for each option

Demand modelling for each Option	ASSESS PROJECT VALUE
<i>Please describe the demand model, which has been used to measure demand, model inputs, model performance and for which years or time periods demand was modelled in the option.</i>	

(Add and complete for each option assessed in the Business Case)

2.3 Land use, population and employment forecasts description

Please describe the land use projections and assumptions used in the demand modelling.

2.4 Forecast costs for the Base Case

Please provide a breakdown of capital and maintenance costs.

5 CONTINUED →

2

A

Page 5



B Land use, population and employment forecasts

What land use projections have been used in the demand modelling? This should be supported by planning documents or other evidence. Where these documents are not publicly available, they must be provided as an attachment to the submission.

What population and employment projections have been used in demand modelling? How has uncertainty in these future drivers of demand (e.g. population, economic growth, climate) been accounted for (e.g. by testing multiple scenarios of future trends)? Where these projections are not publicly available, they must be provided as an attachment to the submission.

Have specific land use forecasts been undertaken for this project? If so, what approaches or tools have been used to develop these? What is the difference in terms of number of jobs and residents compared to the base case land use in the last year the forecasts are produced for? What level of segmentation (e.g. demographics/ industry sectors) has been used? Has there been any redistribution of jobs and residents and if so, what are the assumptions underpinning this redistribution?

2
B
2
C

Infrastructure Australia | Assessment Framework
TEMPLATES AND CHECKLISTS

Template for Stage 4: Business Case Assessment (continued)

2.2 Demand modelling for each option

Demand modelling for each Option (COMP PROJECT READ)

Please describe the demand model which has been used to measure demand, model inputs, model performance and for which years or time periods demand was modelled in the option.

(add and complete for each option assessed in the Business Case)

2.3 Land use, population and employment forecasts description

Please describe the land use projections and assumptions used in the demand modelling.

2.4 Forecast costs for the Base Case

Please provide a breakdown of capital and maintenance costs.

5 CONTINUED →

Page 5

C Forecast costs

Proponents should provide the results of the quantity surveyors report, which will normally be in the cost estimate. Infrastructure Australia requires the following information for each project option and base case, if applicable:

- Who were the capital cost estimates prepared by and have they been independently verified? If they have been reviewed, a copy of the report must be provided to Infrastructure Australia
- A description of the approach to estimate the project contingency
- A description of the methodology for estimating capital costs
- The confidence level of capital cost estimates (i.e. are estimates expected values, P50 or P90 estimates?)
- The timing of construction, the timing of costs over the evaluation period
- The project's real costs in each year during construction (\$m, real, undiscounted)
- The project's outturn costs (\$m, nominal, undiscounted)
- The assumed escalation rate
- Provide supporting documentation (quantity surveyor's report, cost peer reviews) as an attachment to the submission.

2
C

Infrastructure Australia | Assessment Framework
TEMPLATES AND CHECKLISTS

Template for Stage 4: Business Case Assessment (continued)

2.5 Forecast costs for each option

Forecast costs of project option (COMP PROJECT READ)

Please provide a breakdown of capital and maintenance costs.

(add and complete for each option assessed in the Business Case)

2.6 Forecast benefits for each option, incremental to the Base Case

Forecast costs of project option (COMP PROJECT READ)

Please provide a breakdown of benefits for the option, incremental to the Base Case.

(add and complete for each option assessed in the Business Case)

6 CONTINUED →

Page 6



C

Forecast costs (continued)

Proponents should provide details on the ongoing costs associated with each option, including maintenance and operating costs. This information should include:

- Maintenance costs – Describe the basis for estimating all maintenance costs, including growth rates over time (for both base and project cases). Are the maintenance costs P50, P90, P95? What is the basis for this estimate and who were the maintenance cost estimates prepared by?
- Replacement – Is there a need to replace or refurbish major components of the infrastructure / rolling stock during the appraisal period? If so, how are these replacement or refurbishment costs captured?
- Operating costs – Describe the basis for estimating all operating costs, including growth rates over time (for both base and project cases). Who were the operating cost estimates prepared by? Have they been independently verified?

Please note that for transport infrastructure submissions for which Australian Government funding may subsequently be sought, Infrastructure Australia strongly recommends that proponents follow the capital cost breakdown and escalation approach outlined in the Department of Infrastructure and Regional Development’s *Guidance Note 2: Base Cost Estimation*¹¹. This can potentially avoid any unnecessary subsequent re-categorisation of costs.

2
C

Infrastructure Australia | Assessment Framework
TEMPLATES AND CHECKLISTS

Template for Stage 4: Business Case Assessment (continued)

2.5 Forecast costs for each option

Forecast costs of project option

Please provide a breakdown of capital and maintenance costs

(add and complete for each option assessed in the Business Case)

2.6 Forecast benefits for each option, incremental to the Base Case

Forecast costs of project option

Please provide a breakdown of benefits for the option, incremental to the Base Case

(add and complete for each option assessed in the Business Case)

4 CONTINUED →

Page 6

¹¹ Australian Government Department of Infrastructure and Regional Development (2017), *Guidance Note 2: Base Cost Estimation*, Department of Infrastructure and Regional Development, Canberra, http://investment.infrastructure.gov.au/publications/administration/pdf/Guidance_Note_2_Base_Cost_Estimation.pdf



C

Forecast benefits

Proponents should provide the cost–benefit model in Excel as an attachment to the submission, as well as the time stream for each benefit and cost component (\$m, real, undiscounted). This may be required for multiple scenarios of the future where key trends are uncertain.

For each benefit component, proponents should describe:

- who receives the benefit (e.g. public vs. private benefits)
- how benefits were estimated, including the ramp up
- the approach used to estimate the benefit
- how benefits were interpolated for non-modelled years.
- whether any resource cost corrections are appropriate.

Proponents should also provide information on external costs and benefits (for both the base and project cases). This includes an explanation of:

- the basis for estimating all costs imposed/costs avoided by external parties (e.g. environmental harm)
- the source of parameters/proxies used to generate these estimates
- how parameters align with current industry practice.

Further, proponents should also provide information on whether the benefits and costs are closely related to, dependent upon or potentially influenced by other initiatives or projects and how that has been accounted for in the benefit–cost ratio.

Some benefits may not be able to be quantified. Where this is the case, proponents should provide a qualitative description of the potential project benefits.

D

Cost–benefit analysis (CBA)

Proponents are required to provide the CBA results for each option (incremental to the base case).

E

Proponents are required to provide the ranking of project options on the basis of the benefit–cost ratio estimated in the cost-benefit analysis.

2
C

Assessment Framework
TEMPLATES AND CHECKLISTS

Template for Stage 4: Business Case Assessment (continued)

2.5 Forecast costs for each option

Forecast costs of project option (\$m, real, undiscounted)

Please provide a breakdown of capital and maintenance costs

(add and complete for each option assessed in the Business Case)

2.6 Forecast benefits for each option, incremental to the Base Case

Forecast costs of project option (\$m, real, undiscounted)

Please provide a breakdown of benefits for the option, incremental to the Base Case

(add and complete for each option assessed in the Business Case)

4
CONTINUED →

Page 6

2
D

Assessment Framework
TEMPLATES AND CHECKLISTS

Template for Stage 4: Business Case Assessment (continued)

2.7 Cost-benefit analysis summary results by option (incremental to the Base Case)

	Present value (4 per cent)	Present value (7 per cent)	Present value (10 per cent)
	\$ million	\$ million	\$ million
Benefit 1			
Benefit 2			
Benefit 3			
Benefit 4			
Benefit n			
Total benefits			
Capital costs			
Operating costs			
Total costs			
Net present value (NPV)			
Benefit-cost ratio (BCR)			

(add and complete for each option assessed in the Business Case)

2.8 Project option rankings

Rank	Time Period	Benefit-Cost Ratio
1.		
2.		
3.		
4.		
5.		

7
CONTINUED →

Page 7



F Proponents should describe the underlying characteristics of the cost-benefit analysis used to assess each option. This includes:

- what discount rates have been used
- what the base year is
- what the length of the evaluation period is and why was this chosen
- what the length of the principal asset's economic life is.

If the economic appraisal has been independently verified through a peer review, provide a description of the key findings and attach a copy of the peer review to the submission.

2
F

Infrastructure Australia | **Assessment Framework**
TEMPLATES AND CHECKLISTS

Template for Stage 4: Business Case Assessment (continued)

2.9 Underlying cost-benefit analysis characteristics
Cost-benefit analysis characteristics and assumptions
This includes, but is not limited to:

- What discount rates have been used?
- What is the base year?
- What is the length of the evaluation period and why was this chosen?
- What is the length of the principal asset's economic life?

Please submit if a peer review has been completed for the economic analysis. If possible, this should be included in the submission.

2.10 Sensitivity analysis
This includes, but is not limited to:

- A description of the assumptions/parameters that have tested and reasons for testing these assumptions/parameters
- How are the net present value and benefit-cost ratio results affected if different estimates and assumptions are used?
- What happens when discount rates are varied?
- What happens when a "worst-case" scenario (i.e. a 20% increase in capital costs and a 20% decrease in benefits) is tested?

1 CONTINUED →

Page 7

G **Sensitivity analysis**

What sensitivity analysis has been undertaken?
This section should describe, but is not limited to:

- the assumptions that have been tested and reasons for testing these parameters
- how are the net present value and benefit-cost ratio results affected if different estimates and assumptions are used?
- what happens when discount rates are varied?

2
G

Infrastructure Australia | **Assessment Framework**
TEMPLATES AND CHECKLISTS

Template for Stage 4: Business Case Assessment (continued)

2.9 Underlying cost-benefit analysis characteristics
Cost-benefit analysis characteristics and assumptions
This includes, but is not limited to:

- What discount rates have been used?
- What is the base year?
- What is the length of the evaluation period and why was this chosen?
- What is the length of the principal asset's economic life?

Please submit if a peer review has been completed for the economic analysis. If possible, this should be included in the submission.

2.10 Sensitivity analysis
This includes, but is not limited to:

- A description of the assumptions/parameters that have tested and reasons for testing these assumptions/parameters
- How are the net present value and benefit-cost ratio results affected if different estimates and assumptions are used?
- What happens when discount rates are varied?
- What happens when a "worst-case" scenario (i.e. a 20% increase in capital costs and a 20% decrease in benefits) is tested?

1 CONTINUED →

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3 C3.3 Deliverability

A Proponents should describe and provide supporting material that demonstrates how each option would be delivered, financed and risk managed.

B Benefit Realisation Plan

Proponents should describe and provide supporting material that demonstrates how the Project Post Completion Review will be undertaken. Proponents are required to provide Infrastructure Australia with the Benefits Realisation Plan when the business case submission is lodged.

3 A

3 B

Infrastructure Australia

Assessment Framework
TEMPLATES AND CHECKLISTS

Template for Stage 4: Business Case Assessment (continued)

3. Deliverability

3.1 Option deliverability

Option Deliverability

Delivery component **Details**

Delivery strategy *What is the Delivery Strategy and Operations Strategy?
Describe whether the feasibility of recovery of full or partial costs from users through mechanisms such as tolling or those who benefit from the project through mechanisms such as value capture.
Provide a delivery options analysis and high level delivery schedule.
Explain who will own operate and maintain the infrastructure.*

Funding and Financing *How will the project be funded and financed?
Does the project include user funding?
If not, provide a justification for user funding not being included in the funding mix of the project.
If a mix of private and public funding or full public funding is proposed, what are the market failures that require that? What is the viability gap for the project?
Outline how the market failures could be remedied through reforms or regulation.
Describe the required funding sources: private sector, Commonwealth, State and local government, and the proposed split of funding. Describe why this funding split has been proposed.*

Unmitigated project risks *What are the unmitigated project risks?
Describe the risk reduction approach used to identify and manage risks.
Provide a risk matrix that outlines the relevant risks identified for the project, the severity of the risk and how risks will be managed.
Outline the governance structures, accountability and responsibilities for the risk management for the project.*

(Add and complete for each option assessed in the Business Case)

3.2 Benefit Realisation Plan

Describe the base line against which 50% will be measured and governance structure as per Stage 2 guidance.

CONTINUED →

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4 C3.4 Confidentiality

Please identify if any of the information provided to Infrastructure Australia in this template is confidential. Please provide a brief explanation of the reasons for the request of confidentiality.

Information submitted confidentially will not be released or published by Infrastructure Australia without the written consent of the proponent.

4

Infrastructure Australia

Assessment Framework
TEMPLATES AND CHECKLISTS

Template for Stage 4: Business Case Assessment (continued)

4. Confidentiality

*Please identify if any of the information provided to Infrastructure Australia in this template is confidential. Please provide a brief explanation of the reasons for the request of confidentiality.
Information submitted confidentially will not be released or published by IA without the written consent of the proponent.*

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C4. Checklist for Stage 1: Problem Identification and Prioritisation

The following provides a checklist for proponents to use at the end of Stage 1.

Proponents are encouraged to contact Infrastructure Australia for clarification on any part of this checklist, or for additional guidance in preparing a submission.



Infrastructure Australia can be contacted via email on mail@infrastructureaustralia.gov.au, or telephone on (02) 8114 1900.

Table 3 Checklist

Key questions	Complete?
Is the problem/opportunity expressed as a straightforward statement?	
Is there an explanation of how and why the problem/opportunity is nationally significant?	
Is the problem/opportunity to link to jurisdictional goals and objectives, as well as other problems, programs and projects?	
Is the problem/opportunity measured by quantitative and/or qualitative data?	
Is the problem/opportunity articulated in the base case?	
Has the problem/opportunity been monetised over time?	
What are the assumptions about future trends in drivers (e.g. population, economic growth, technology, climate trends)?	
Have the project/opportunity interrelationships been described?	



C5. Checklist for Stage 2: Initiative Identification and Options Development

The following provides a checklist for proponents to use at the end of Stage 2.

Proponents are encouraged to contact Infrastructure Australia for clarification on any part of this checklist, or for additional guidance in preparing a submission.

Infrastructure Australia can be contacted via email on mail@infrastructureaustralia.gov.au, or telephone on (02) 8114 1900.



C5.1 Step 1: Initiative description

Table 4 Describe each initiative being considered

Key questions	Complete?
What is the expected stakeholder impact (these should be quantified where possible)?	
What is (are) the location(s) of all associated benefits and costs?	
What are the infrastructure outputs, changes or enablers that will achieve these outcomes?	
What non-infrastructure outputs, changes or enablers have been considered that will achieve these outcomes?	
What are the costs for each initiative (including capital expenditure and operating expenditure, where relevant), and how are these expected to vary over time?	
Is it important to consider alternative future scenarios of key drivers, and, if so, which have been considered?	
What are the key initiative dependencies (including complements and substitutes)?	
How does each initiative align with jurisdictional plans or strategies, including any references where relevant?	
How can individual initiatives and options be packaged together, or better coordinated, or sequenced over time?	



C5.2 Step 2: Capital and non-capital solutions

Table 5 Describe the capital and non-capital solutions considered

Key questions	Complete?
What regulatory reform, governance reform, better use reform and capital investment solutions have been considered?	
Please provide justification where options are not considered for any of these reform categories.	

C5.3 Step 3: Initiative identification long-list process

Table 6 Describe the process used to develop a long-list of initiatives (e.g. options development workshop)

Key questions	Complete?
What stakeholders were involved?	
How were stakeholders coordinated and how did workshops function (i.e. the structure and governance arrangements around the initiatives development process)?	
For what time period were the initiatives developed?	

C5.4 Step 4: Cost and funding

Table 7 Describe the funding and costs of each initiative

Key questions	Complete?
What are the initiative cost estimates (in real, \$million, \$20XX and PV terms)?	
What are the probabilistic cost estimates (where applicable), and the probability levels used (e.g. p50, p90)?	
What components of the initiative are seeking Australian Government funding?	
What components of the initiative are seeking state or other government funding?	
What components of the initiative are seeking non-government (private sector) funding?	



C5.5 Step 5: Key risks or sensitivities

Table 8 Describe risks or sensitivities

Key questions	Complete?
What risks or sensitivities have been identified that pose fundamental challenges or impose critical constraints on the successful implementation of the initiative?	
Where multiple future scenarios have been considered because of future uncertainties, does the initiative perform robustly across these scenarios?	

C5.6 Step 6: Supporting data

Table 9 Provide supporting data or key measures relevant to the initiative

Key questions	Complete?
Where applicable, what previous economic assessment(s) have been undertaken?	
Where applicable, what previous economic assessment of capital, operational and maintenance costs, including the relevant probabilistic (p) level assessments have been undertaken?	
Where applicable, what analysis has been produced on the wider benefits associated with the initiative?	
Is there any other supporting information? If so, what is it?	

C5.7 Step 7: Short-listing of options*

Table 10 Describe each option that has been short-listed and the short-listing process.

Key questions	Complete?
What options have been retained in the short-list following the options assessment exercise?	
What are the characteristics of the short-listed options?	
What is the status of each short-listed option's development? This includes, but is not limited to:	
<ul style="list-style-type: none"> ▪ Planning studies ▪ Feasibility studies ▪ Business case ▪ Environmental assessment or and Gateway reviews/approvals ▪ Economic appraisal studies ▪ Gateway reviews ▪ Approvals ▪ Benefit realisation plan development 	

* There should be at least two short-listed options.



C5.7 Step 7: Short-listing of options *(continued)*

Key questions	Complete?
What methodology was used to refine the long-list of options to a short-list of options to be considered in further detail in a business case?	
What are the costs of the different options? <ul style="list-style-type: none">▪ Provide initial estimates of the investment costs, as a minimum, at P50 real (current) \$▪ Proponents are encouraged to provide costs at P90 level real (current) \$▪ Any supporting data or information should be included.	
How will each option address the problem or opportunity of national significance?	
What is the economic, social and environmental impact of the option, in addition to the resolution of the problem/opportunity? <ul style="list-style-type: none">▪ Use the following hierarchy of evidence:<ul style="list-style-type: none">– monetisation of costs of a problem or value of an opportunity– quantification of impacts in terms of economic, social and environment– qualitative discussion of impacts in terms of economic, social and environment.	
What are the likely project externalities (positive and negative)?	
What are the linkages of each option to other problems and/or programs and projects?	
What opportunities exist to package different options?	
What are each option's deliverability risks and mitigation strategies?	
Over what timeframe is the option expected to address the problem/opportunity?	



C5.8 Step 8: Next steps

Table 11 *Specify the next activities planned to progress the initiative*

Key questions	Complete?
What are the next activities planned to progress the initiative?	
<p>What are the next planned outputs?</p> <p>This includes, but is not limited to:</p> <ul style="list-style-type: none"> ▪ demand modelling ▪ quantity surveyor's report ▪ economic analysis ▪ business case ▪ gateway review. 	
When are these activities due to commence and when are they due to be completed?	
When does the proponent expect to make a Stage 4 (business case) submission to Infrastructure Australia?	

C5.9 Step 9: Confidentiality

Table 12 *Confidentiality claim*

Key questions	Complete?
What information provided to Infrastructure Australia is confidential?	

C6. Checklist for Stages 3 & 4: Business Case Development and Business Case Assessment

The following provides a checklist for proponents when preparing a project business case submission to Infrastructure Australia.

This submission does not seek to duplicate work which has been prepared for state/territory approval processes. Infrastructure Australia encourages proponents to submit the business case and supporting material in their entirety, where they have already been prepared. Where proponents do not have existing documentation, the Stage 4 Business Case Assessment template can be used.

The development of business case occurs over the life of the project development from Stage 1 (Problem

Identification and Prioritisation) onwards. The Stage 4 submission should reflect and build upon work completed and submitted to Infrastructure Australia and earlier submissions will form part of the Stage 4 evaluation. This checklist should therefore be read alongside the checklists for Stages 1 and 2.

Proponents are encouraged to contact Infrastructure Australia for clarification on any part of this checklist, or for additional guidance in preparing a submission.



Infrastructure Australia can be contacted via email on mail@infrastructureaustralia.gov.au, or telephone on (02) 8114 1900.

C6.1 Step 1: Define the base case

Table 13 Describe the 'do minimum' base case

Key questions	Complete?
What service levels are delivered?	
What is the infrastructure network which provides this service?	
<p>What are the costs of the current infrastructure network faced by infrastructure owners over the evaluation period, not just in the present in the absence of the project?</p> <p>This includes, but is not limited to:</p> <ul style="list-style-type: none"> ▪ 'do minimum' capex and operating costs ▪ government (taxes and subsidies). 	

C6.2 Step 2: Describe the project case options

This should be consistent with information provided to Infrastructure Australia during Stage 3.

Table 14 Describe each option being considered in the business case

Key questions	Complete?
<p>What are the options and their characteristics? This description must include:</p> <ul style="list-style-type: none"> ▪ a description of each option ▪ cost information (including capital expenditure and operating expenditure, where relevant), at a high level ▪ a description of the options expected impact in terms of efficiency, equity and productivity, imposed on or gained by stakeholders by the possible initiatives ▪ where appropriate, a description of each future scenario considered. 	

C6.3 Step 3: Strategic alignment of the project case options

Table 15 Describe the strategic alignment of each project case option

Key questions	Complete?
<p>How does each project case align with relevant jurisdictional transport plans?</p> <ul style="list-style-type: none"> ▪ Proponents should provide supporting information such as Transport Master Plans or similar. 	
<p>How does each project case align with relevant land use plans?</p> <ul style="list-style-type: none"> ▪ Proponents should provide supporting information such as Regional Land Use Plans or similar. 	
<p>How does each project case align with jurisdictional strategic initiatives/economic objectives?</p> <ul style="list-style-type: none"> ▪ Proponents should provide supporting information such as policy documents or similar. 	
<p>How does each project case align with potential complements or substitutes?</p> <ul style="list-style-type: none"> ▪ For example, projects which are being planned, constructed or recently completed. 	

C6.4 Step 4: Economic modelling key assumptions

Demand modelling

Table 16 Describe and provide supporting material that demonstrates how demand is modelled

Key questions	Complete?
<p>What are the characteristics of the underlying demand model?</p> <ul style="list-style-type: none"> ▪ For example, in the case of a transport project this should include: <ul style="list-style-type: none"> – the name of the model – the types of behaviour it models (i.e. induced demand, land use change, mode switching etc.) (see section on induced demand in Section D3.3) – model inputs – how the model performs against existing and historical observed traffic – the years for which demand was measured – the time periods modelled (e.g. AM and PM peaks). ▪ Proponents should provide demand model(s) in excel attached to the submission. 	
<p>What timeframe has demand been modelled over (month, quarter, year etc.)?</p> <ul style="list-style-type: none"> ▪ Where demand has been modelled for only part of the year, or part of the day, expansion factors will be needed to estimate annual demand. 	
<p>Has the underlying demand model been independently reviewed?</p> <ul style="list-style-type: none"> ▪ Where a review has been conducted, information of the reviews findings must be provided. 	
<p>Where applicable, what expansion factor has been used to estimate annual demand and what sources informed this expansion factor?</p>	

Land use, population and employment forecasts

Table 17 Describe and provide supporting material that demonstrates how land use, population and employment projections are modelled

Key questions	Complete?
<p>What land use projections have been included in the demand modelling?</p> <ul style="list-style-type: none"> ▪ This should be supported by planning documents or other evidence. ▪ Where these documents are not publicly available, they must be provided to Infrastructure Australia. 	
<p>What is the source of population and employment projections used in the demand modelling?</p> <ul style="list-style-type: none"> ▪ The proponent must provide Infrastructure Australia with a copy of these projections, or a detailed summary, where these forecasts are not publicly available. 	
<p>What are the specific land use forecast characteristics used?</p> <ul style="list-style-type: none"> ▪ If applicable, what approaches and tools have been used in order to quantify the land use change? ▪ What is the difference in terms of number of jobs and residents compared to the base case land use in the last year the forecasts are produced for? ▪ What level of segmentation has been used (e.g. sociodemographics/ industry sector)? ▪ Has there been any redistribution of jobs and residents and if so, what are the assumptions underpinning this redistribution? 	

Costs

Table 18 Describe and provide supporting material that demonstrates how forecast costs are derived

Key questions	Complete?
<p>Who were the capital cost estimates prepared by?</p> <ul style="list-style-type: none"> ▪ Proponents should provide a detailed quantity surveyor's report outlining the capital costs of the project. These include: <ul style="list-style-type: none"> – the confidence level of capital cost estimates (i.e. are estimates expected values, P50 or P90 estimates?) – the timing of construction, the timing of costs over the evaluation period – the project's outturn costs (\$m, nominal, undiscounted) – the assumed escalation rate – the project's real costs in each year during construction (\$m, real, undiscounted). 	
<p>What are the ongoing costs associated with the project, including maintenance and operating costs? This information should include:</p> <ul style="list-style-type: none"> ▪ maintenance costs – describe the basis for estimating all maintenance costs, including growth rates over time (for both base and project cases). Are the maintenance costs P50, P90, P95? What is the basis for this estimate and who were the maintenance cost estimates prepared by? ▪ replacement – is there a need to replace or refurbish major components of the infrastructure/rolling stock during the appraisal period? If so, how are these replacement or refurbishment costs captured? ▪ operating costs – describe the basis for estimating all operating costs, including growth rates over time (for both base and project cases). Who were the operating cost estimates prepared by? Have they been independently verified? ▪ Where appropriate, how do these vary under different future scenarios? 	
<p>Have the costs been independently verified?</p> <ul style="list-style-type: none"> ▪ If they have been reviewed, a copy of the report must be provided to Infrastructure Australia. 	
<p>How was the project contingency estimated?</p>	
<p>If applicable, what external costs (for both the bases and project cases) have been estimated? Proponents should:</p> <ul style="list-style-type: none"> ▪ describe the basis for estimating all costs imposed/costs avoided by external parties (e.g. environmental harm). ▪ describe and provide the source of parameters/proxies used to generate these estimates ▪ explain how these align with current industry practice. 	
<p>Are any resource cost corrections appropriate and if so what are they?</p>	

Please note that for transport infrastructure submissions for which Australian Government funding may subsequently be sought, Infrastructure Australia recommends that proponents follow the capital cost breakdown and escalation approach outlined in the Department of Infrastructure and Regional Development's *Guidance Note 2: Base Cost Estimation*.¹² Doing so can potentially avoid any unnecessary subsequent re-categorisation of costs.

¹² Australian Government Department of Infrastructure and Regional Development (2017), *Guidance Note 2: Base Cost Estimation*, Department of Infrastructure and Regional Development, Canberra, http://investment.infrastructure.gov.au/publications/administration/pdf/Guidance_Note_2_Base_Cost_Estimation.pdf

Benefits

Table 19 Describe and provide supporting material that demonstrates how forecast benefits are derived

Key questions	Complete?
What are the forecast benefits?	
For each benefit component, how were the benefits estimated?	
For non-modelled years, how were benefits interpolated and/or extrapolated? Where appropriate, how do forecast benefits vary across different future scenarios?	

Cost-benefit analysis

Table 20 Describe and provide supporting material that demonstrates how the CBA was undertaken

Key questions	Complete?
What are the underlying characteristics of the CBA conducted for each project case? This includes, but is not limited to: <ul style="list-style-type: none"> ▪ What discount rates have been used? ▪ What is the base year? ▪ What is the length of the evaluation period and why was this chosen? ▪ What is the length of the principal asset's economic life? ▪ What is the net present value and benefit–cost ratio of each project case? Proponents should: <ul style="list-style-type: none"> ▪ provide the cost-benefit excel model ▪ attach an appendix showing the time stream for each benefit and cost component (\$m, real, undiscounted). 	
What sensitivity analysis has been undertaken? This includes but is not limited to: <ul style="list-style-type: none"> ▪ a description of the assumptions that have been tested and reasons for testing these parameters ▪ how are the net present value and benefit–cost ratio results affected if different estimates and assumptions are used? ▪ what happens when discount rates are varied? 	
What is the ranking of projects based on the results?	
Where appropriate, how robust are the costs and benefits of each project case across different future scenarios?	
What is the ranking of projects based on sensitivity tests?	
Related initiatives or projects – Are the benefits and costs closely related to, dependent upon or potentially influenced by other initiatives or projects?	
If so, how has this been accounted for in the benefit cost ratio?	
Has the economic appraisal been independently verified through a peer review? <ul style="list-style-type: none"> ▪ If a peer review has been completed, provide a copy of the peer review report. 	

Non-monetised costs and benefits

Some benefits may not be able to be quantified. Where this is the case, proponents should provide a qualitative description of the potential project benefits.

C6.5 Step 5: Deliverability

Table 21 *Describe and provide supporting material that demonstrates how the project will be delivered, financed and risks managed*

Key questions	Complete?
<p>What is the Delivery Strategy and Operations Strategy? Proponents should:</p> <ul style="list-style-type: none"> ▪ describe whether the feasibility of recovery of full or partial costs from users through mechanisms such as tolling or those who benefit from the project through mechanisms such as value capture has been considered ▪ provide a delivery options analysis and high level delivery schedule ▪ explain who will own operate and maintain the infrastructure. 	
<p>How will the project be funded and financed? This includes, but is not limited to:</p> <ul style="list-style-type: none"> ▪ Does the project include user funding? <ul style="list-style-type: none"> – If not, provide a justification for user funding not being included in the funding mix of the project. ▪ If a mix of private and public funding or full public funding is proposed, what are the market failures that require this? What is the viability gap for the project? <ul style="list-style-type: none"> – Outline how the market failures could be remedied through reforms or regulation ▪ Describe expected funding sources: private sector, federal, state and local government, and the proposed split of funding. Describe why this funding split has been proposed. 	
<p>What are the unmitigated project risks? This includes, but is not limited to:</p> <ul style="list-style-type: none"> ▪ Describe the risk evaluation approach used to identify and manage risks ▪ Provide a risk matrix that outlines the relevant risks identified for the project, the severity of the risk and how risks will be managed ▪ Outline the governance structures, accountabilities and responsibilities for the risk management for the project. 	

C6.6 Step 6: Post Completion Review strategy

Table 22 *Describe and provide supporting material that demonstrates how the Post Completion Review will be undertaken*

Key questions	Complete?
<p>What is the Post Completion Review strategy/approach? This includes, but is not limited to:</p> <ul style="list-style-type: none"> ▪ Describe the base line against which key performance indicators will be measured and governance structure as per Stage 5 guidance ▪ Proponents are encouraged to provide Infrastructure Australia with the Post Completion Review strategy when the business case submission is lodged. 	



C7. Checklist for Stage 5: Post Completion Review

The following provides a checklist for proponents to use during Stage 5.

Proponents are encouraged to contact Infrastructure Australia for clarification on any part of this checklist, or for additional guidance in preparing a submission.

Infrastructure Australia can be contacted via email on mail@infrastructureaustralia.gov.au, or telephone on (02) 8114 1900.



C7.1 Step 1: Planning for Post Completion Reviews

Planning for a PCR should be undertaken during the business case development phase.

Table 23 Describe the Post Completion Review and how it will be implemented

Key questions	Complete?
Is a PCR required for the project?	
Has a project plan been developed for how the PCR will be undertaken?	
When will the initial and subsequent PCRs be undertaken?	
Has the proponent identified the data organisation, capture and storage requirements that will make it easier for reviewers to gather the data and information at the time of completing the review?	
Has the responsibility for capturing and storing the information been assigned to a role or unit?	
Have the documents and information from the project planning phase been collated and stored in an accessible location? (e.g. the final business case, economic analysis, cost estimates, benefit realisation plan)	
Has a reporting template been prepared to capture information during project delivery? The template should capture information and data on the final costs, the timeframes, changes in scope, risk management processes, achievement of intended strategic objectives, and other issues that occur.	
What metrics will be used to review the project's actual outcomes against the forecasts, and have they been included in the reporting template?	
Who will be responsible for undertaking the PCR?	
What skills will the reviewer require to undertake the PCR?	
How will the forecast and actual project benefits and costs be collected and recorded?	

C7.2 Step 2: Supporting data for Post Completion Reviews

Infrastructure Australia requests project proponents to provide the data listed in C7.2 after the project is commissioned, even if it is partial and incomplete.

Table 24 *Supporting data checklist*

Key data	Complete?
Forecast and actual project delivery costs and timeframes	
Forecast and actual infrastructure performance data	
Forecast and actual operating and maintenance data	
Forecast and actual benefits	
Forecast and actual performance metrics	

C7.3 Step 3: Completing the Post Completion Reviews

Table 25 What needs to be done to complete the Post Completion Review

Key questions	Complete?
Has the documentation been collected and reviewed?	
Have interviews been undertaken with the project delivery team?	
How well do the outcomes from the document review and the interviews compare? Are there any discrepancies that need to be explored further?	
If required, has a further interview been undertaken with the project delivery team for clarification?	
Should the subsequent review be more independent or detailed, depending on the project's complexity, or due to findings that have emerged in the initial review?	
Was the information and method used in the initial review adequate, and therefore, should be used in subsequent reviews, or is an alternative baseline and/ or approach more appropriate?	
Have the key findings and recommendations from the PCR been identified?	
How will the key findings and recommendations from the PCR be disseminated, so that other people can learn from the experience and findings from the project?	
If reporting findings collectively from multiple projects, has it been decided which projects will be selected to draw collective findings from?	

PART D

Detailed Technical Notes

Introduction to Part D

Part D provides guidance for project proponents to understand the requirements for economic, social and environmental appraisal when preparing their business case submissions for Infrastructure Australia.

This part is structured as follows:

- Developing the base case and measuring the problem (Chapter D1)
- Selecting appraisal and evaluation methods (Chapter D2)
- Conducting economic appraisals (Chapter D3)
- Risk, uncertainty and sensitivity analysis (Chapter D4)
- Undertaking Post Completion Reviews (Chapter D5).

The Detailed Technical Notes are intended for practitioners such as project economists and analysts, and project managers developing business cases.

Additional technical material will be added as this is developed.

Relevant technical guidance documents are referenced throughout the following chapters.

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D1. Developing the base case and measuring the problem

D1.1 What is the base case?

Generically, project appraisals compare the costs and benefits of doing something – the project case (e.g. building infrastructure) – with a ‘do minimum’ base case (the ‘business as usual’ or ‘keep safe and operational’ situation).

The base case is important because it impacts on the estimated benefits and costs of the project being assessed. For example, a base case with low population growth may not lead to much additional demand and therefore a project that expanded capacity would have small estimated benefits.

Importantly, the ‘do minimum’ case is not the same as a ‘do nothing’ case as it should include any known (i.e. already committed and funded) changes to the infrastructure network or service that will occur in the absence of the project case or any other investment options. It is a modest cost option to maintain the existing level of service possible or to avoid further degradation in service levels.

In practice, the base case represents expenditure, generally of a non-capital nature to ensure that existing assets/networks can continue to provide a level of service to satisfy current requirements into the future. In short, that expenditure will not cover asset augmentation or enhancement to meet incremental demand beyond the capacity of the existing infrastructure. In some cases, the inclusion of progressive asset replacement may include minor capital expenditure.

However, in some circumstances where high levels of future growth are expected, incremental capacity enhancements may need to be assumed in order to obtain realistic future demand estimates within the technical limitations of transport models. On the occasions where this is the case, the incremental capacity assumptions should be discussed with Infrastructure Australia, with a view to understanding their likely impact on the project. Such incremental capacity assumptions should exclude enhancements that may form alternatives to or be dependent on the project over the life of the proposed project.

In practice, Infrastructure Australia acknowledges that specifying the base case may involve a conflict between

a scenario that maintains the current level of utility provided by the infrastructure (e.g. maintaining transport access, or reliability) and one that only includes approved investment/funded works.¹³ Infrastructure Australia expects that the proponent will adopt an objective and reasonable base case that is supported by independent justification. For example, it is unreasonable to include new large unfunded and material infrastructure in the base case, particularly if this is complementary to the project being considered.

The base case is therefore a ‘real world’ assessment of the future infrastructure and operations, making reasonable assumptions of future developments which can affect the existing network and the benefits and costs of proposed initiatives; it generally assumes that the infrastructure and operations of today continue ‘as is’. Departures from this assumption depend on the level of commitment made and an assessment of realistic probabilities.

D1.2 Specifying the base case

The base case should specify:

- **the service(s) being delivered** in the target region/area/jurisdiction, including identifying the users, demand, providers, service levels and pricing – currently and in the future over the appraisal period
- **current and future expected maintenance and capital works**, capturing all assets/services in the network that may impact the target region/area/jurisdiction
 - The probability of future works occurring should be considered: the proponent should provide specific details on the characteristics of future projects included in the base case and the rationale explaining their inclusion or exclusion from the base case
 - This is especially important if the project forms part of a larger network, where the benefits of an initiative may be contingent on other initiatives being implemented.
- **other future developments which will affect the service demand and quality**, such as one-off events (for example, Olympic or Commonwealth Games) and exogenous land use changes (e.g. for the transport sector, relocation of transport demand generators)

¹³ Further discussion on the utility/approved funding trade-off is found in Eivind Tveter (2013), *Dealing with the base case in cost-benefit analysis*, Molde University College presented at the European Transport Conference 2013, <http://abstracts.aetransport.org/paper/index/id/221/confid/1>

- Similar to future capital works, the proponent should consider the probability of these developments occurring and evidence to support the determined probability, details on the development’s characteristics, in particular, the expected impact of developments on the existing infrastructure network and rationale explaining the inclusion or exclusion from the base case
- **anticipated costs** such as renewal cost at the end of an asset’s life and replacement of component/part of the main asset or periodic maintenance costs that occur over time
- **the main constraint or issue presented by the base case** (e.g. lack of capacity, reliability issues, etc.). The base case should measure the opportunity cost of doing nothing or the minimum
- **whether assumptions have been independently verified or independently generated** (e.g. in the communications sector – from submissions to the Australian Competition and Consumer Commission, the Australian Communications and Media Authority, other government agencies, industry bodies or national/international benchmarks).

Proponents should include key planning documents that inform the base case.

D1.3 Benefits of a well-established base case

A well-established base case provides a fundamental foundation for the CBA and a comparison of prospective initiatives, options and projects at later stages. An incorrectly specified base case, on the other hand, can bias the assessment of alternative initiatives, options and projects by overstating the benefits and understating the costs. Alternatively, a base case could underestimate the future impact of the existing problem, thereby understating potential project benefits. Such outcomes may render the analysis speculative at best and redundant at worst.

D1.4 Measuring the problem in the base case

Identifying and measuring the problem is a critical part of defining and specifying the base case. One way of measuring the problem is to measure the costs that occur if nothing or a minimum is done. This should include the expected changes in costs caused by realistic trends of changes in population, technology and climate risks.

Quantifying the size of the problem is an important first step in understanding the potential benefits that can be realised from addressing the problem. It is also an important step in demonstrating the case for change.

Abstracting from costs, addressing large problems may result in larger net benefits than addressing smaller problems. It should be noted that the costs of a given problem may be larger than the benefits of a specific initiative to address that problem, as the initiative may not be able to completely resolve the underlying problem. Care must be exercised in attributing all the benefits exclusively to the specific initiative when additional, but separate projects might be required to ensure that together all the benefits are realised.

The proponent should provide quantification of the problem being addressed by the initiative proposed in the Stage 2 submission. This is central to Infrastructure Australia’s Stage 2 assessment.

Infrastructure Australia recommends the use of quantified and monetised estimates when analysing the cost of a problem or the value of an opportunity to enable comparison between different types of problems and opportunities.

- **Monetised costs and dis-benefits of the problem under the base case.** For a transport project, this would include measuring the delay cost for transport in the base case relative to free flow speeds. The difference between the two is the total delay per vehicle due to congestion, which can be combined with information on demand and the value of time to estimate the cost of congestion.

- **Quantify, but not monetise, the problem under the base case.** This approach may be used where there are difficulties in monetising specific costs and benefits, in particular where the necessary evidence base has not been developed to monetise costs and benefits for a CBA. As an example, the problem of flood resilience could be quantified with the frequency of flooding and the number of properties affected (both of which may be changing over time) and, from these, a measure of transport delays as a result of flooding. This information shows the number of users directly impacted by the problem, the location of the problem and how the problem is expected to evolve over time. Although not providing a monetised cost, quantification provides an indication of the magnitude of the problem and the potential size of benefits from resolving a problem. Quantification should be accompanied by qualitative information on the problem to help understand how the quantification of the problem corresponds to societal welfare.
- **Qualitative description of the problem only.** In general, proponents should be able to monetise and/or quantify the problem. Where proponents are unable to do this, guidance should be sought from Infrastructure Australia on how to proceed with assessing the problem.

Proponents should include key planning documents that inform the base case.

D1.5 What is the project case?

Typically, the project case is a ‘do something’ option that reflects a proposed intervention such as discrete capital investment. For example, in transport, the project case describes a future in which infrastructure and operational changes have taken place.

Proponents should describe each project case short-listed for appraisal. They could be described using the following criteria:

- effectiveness
- duration
- deliverability
- resilience
- estimated investment cost
- estimated annual operating costs.

In addition, proponents should provide additional detail about each project case. Proponents should undertake option development using a broader approach to avoid a limited two-option comparison (i.e. one project option vs. the base case) in the final CBA.

The project case(s) are compared against the base case to determine the incremental results for the project case(s). In other words, this measures the economic merit of the project case over and above the base case.



D2. Selecting appraisal and evaluation methods

A proponent should evaluate a range of options to ensure that the preferred option recommended in the business case is the one with the highest net benefit to the Australian community.

There are a number of different methods of evaluating options, which differ in their robustness and information requirements. Infrastructure Australia recommends the use of CBA as it measures the costs and benefits to the Australian community via efficiency gains, and is most closely aligned with Infrastructure Australia's legislation to consider infrastructure that materially improves national productivity.

This chapter sets out the guidance on the methods available to filter a long-list of options to a short-list and then to determine a preferred solution.

D2.1 Principles for evaluating options

The guiding principle during the options assessment stage is the progressive selection of an option or options that maximise the welfare of the Australian community.

Appraisal and evaluation methods differ in their levels of effort and costs. Using a less costly evaluation method to eliminate some options is reasonable as long as the method provides sufficient confidence that the option removed will not have maximised the welfare of the Australian community.

As the range of options is narrowed, more detailed analysis is required to differentiate the options and to determine which of the options has the highest net benefit.

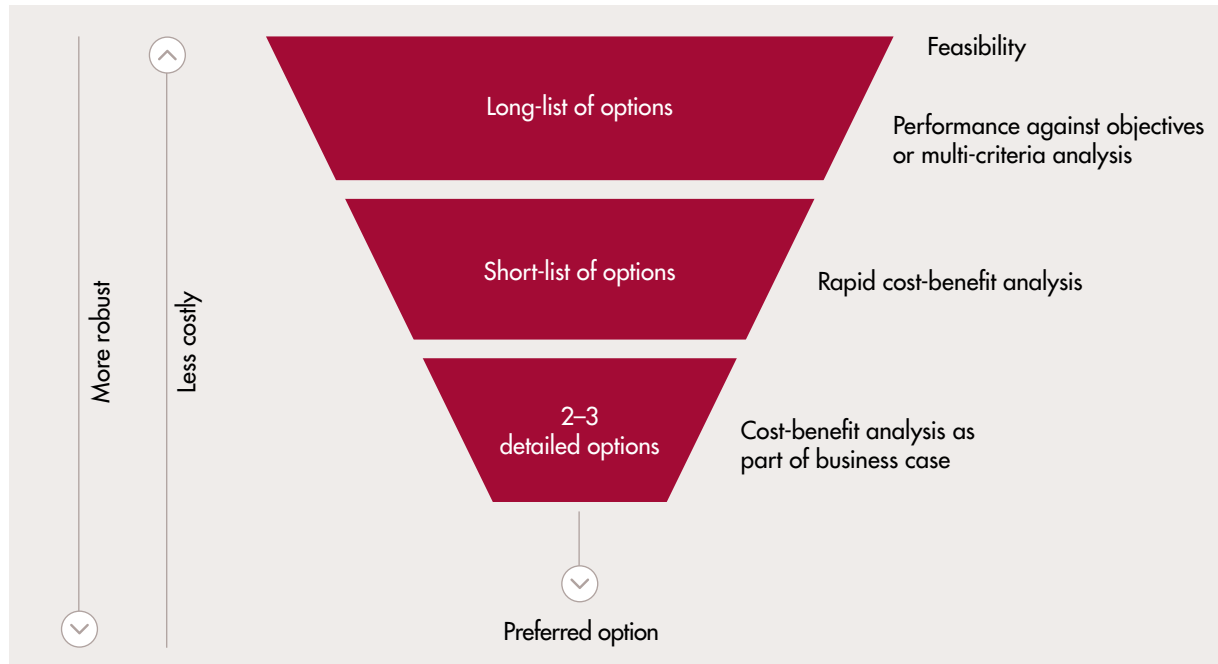
D2.2 Overview of types of evaluation techniques

The standard acceptable techniques for evaluating infrastructure project options are:

- **Cost–benefit analysis (CBA)**¹⁴ – this seeks to systematically measure the costs and benefits of each option over time from the perspective of the Australian community. Costs and benefits are typically expressed in dollars for comparison. CBA can be undertaken at different levels of analysis. For example, ‘rapid CBA’ is often used to support a preliminary/strategic business case, while a ‘detailed CBA’ is applied for a final business case. Furthermore, CBA can be applied to different levels of scope and different types of interventions. It can be applied to policy and regulation changes, projects and programs.
- **Cost–effectiveness analysis (CEA)** – this compares costs against a specified level of service or output. It does not seek to place a value on the outputs, which provide benefits to the community. For example, CEA might indicate a cost for Option A of \$3 per kL of additional water supply, while Option B has a cost of \$2 per kL of water supply. In this case, as the outputs are the same, Option B is the preferred option as it is more cost effective. CEA should only be used when the size or value of benefits do not differentiate between the options. This is essentially a ‘least cost’ approach for the same output. If there are differential benefits between options, then CBA should be used. In practice, CEA is rarely applied for infrastructure projects, with the exception of projects in very small communities.
- **Multi-criteria analysis (MCA)** – this differentiates and evaluates options using a set of identified assessment criteria with weights assigned to each criterion. The analysis involves subjectively scoring each option against each criterion and calculating a weighted score.

¹⁴ CBA is also sometimes referred to as benefit–cost analysis (BCA).

Figure 16 When to use different evaluation techniques



Source: Infrastructure Australia.

D2.3 When to use different methods of appraisal

During options assessment, Infrastructure Australia supports using less costly methods to narrow a large range of options “the long-list” and then using more resource intensive, but robust methods for a smaller range of options “the short-list” (see Figure 16). The objective of the assessment is to exclude or eliminate options where the proponent can be confident that those options do not have the highest net benefit.

- Options can be excluded from a long-list of options where:
 - they are not physically feasible or feasible only at a cost much greater than the monetised cost of the problem or opportunity
 - they are inferior to other options in terms of both high-level estimates of cost and performance against how much they address the problem. This can be approximated by a well-designed MCA where there are multiple objectives/problems
 - they have been subject to CEA, if appropriate (i.e. options can be compared against a specified level of service or output), and are shown to be significantly less cost effective than the other options

- they have been subject to a ‘rapid CBA’ – this can provide a useful discipline to assess a long-list of options. It does not have to represent a complete and detailed CBA but it can identify the major components and provide insightful orders-of-magnitude results which can materially assist in culling inappropriate options.
- Short-listed options typically require more detailed analysis to arrive at a preferred option – generally through CBA for a set of options (e.g. 2–3 options compared with the base case).

In some policy areas, other types of analysis, such as computable general equilibrium (CGE) modelling, can provide useful additional information. CGE modelling traces the flow-on impacts of a policy change in a systematic way, such as indirect impacts on sectors of the economy.

However, there is limited value in this kind of modelling for infrastructure because the directly measured impacts in the infrastructure sector (e.g. time savings in transport) will capture the majority of the welfare impacts on the Australian community. Furthermore, CGE is unlikely to clearly differentiate marginal options

due to the aggregate level of analysis. For policy changes such as taxes and tariffs, CGE modelling provides insights because the flow-on impacts are much higher relative to the direct impacts.

The following sections set out the types of appraisal in more detail, starting with CBA, as this is Infrastructure Australia's recommended method.

D2.4 Further details on cost–benefit analysis (CBA)

CBA is widely recognised as the most appropriate tool for considering and comparing the costs and benefits of a wide variety of policies and projects, including infrastructure projects. Australian governments at various levels provide guidelines on the use of CBA (see, for example, NSW Treasury 2017,¹⁵ Victorian Department of Treasury and Finance 2013,¹⁶ Building Queensland 2016¹⁷).

The use of CBA for the evaluation of infrastructure investments is also supported by international agencies including:

- the World Bank¹⁸
- the European Commission¹⁹
- the European Investment Bank²⁰
- the OECD²¹
- the World Health Organisation.²²

Key features of CBA include the following:

- It is a procedure for evaluating the economic and social worth of investment projects (i.e. increase in social welfare) over the economic life of the project, designed to assist in decision making on these projects.
- It considers a benefit as any gain in human well-being, and a cost as any loss in well being.
- Within CBA, a gain in well-being is measured by how much an individual is willing to pay (WTP) to secure that gain, or how much they are willing to accept (WTA) in compensation to forgo that gain.
- Conversely, within CBA a loss in well-being is measured by how much an individual is willing to accept in order to tolerate the loss, or how much they are WTP to prevent the loss.
- WTP and WTA are measures of human preference. CBA assumes that individual preferences form the basis for rational economic decisions.
- If benefits are greater than costs, then the project is potentially worthwhile. There may be other better projects, so projects may need to be ranked, particularly if there is an overall budget constraint.
- Benefits and costs stretch over time, which needs to be explicitly incorporated in the analysis. Benefits and costs are 'discounted' over time to arrive at a present value (today's dollars). This is why CBA is a type of discounted cashflow analysis.

15 NSW Government The Treasury (2017), *Policy and Guidelines Paper: NSW Government Guide to Cost-Benefit Analysis*, NSW Treasury, Sydney, http://arp.nsw.gov.au/sites/default/files/TPP17-03_NSW_Government_Guide_to_Cost-Benefit_Analysis_0.pdf

16 Victorian Government Department of Treasury and Finance (2013), *Economic Evaluation for Business Cases Technical Guidelines*, Department of Treasury and Finance, Melbourne, <http://www.dtf.vic.gov.au/Publications/Investment-planning-and-evaluation-publications/Lifecycle-guidance/Technical-guides>

17 Queensland Government Building Queensland (2016), *Business Case Development Framework: Cost Benefit Analysis Guide Supporting Business Case Development*, Building Queensland, Brisbane, <http://buildingqueensland.qld.gov.au/wp-content/uploads/2016/05/45399-Cost-Benefit-Analysis-report-7.pdf>

18 Independent Evaluation Group (2010), *Cost-Benefit Analysis in World Bank Projects*, World Bank, Washington, DC, <https://openknowledge.worldbank.org/handle/10986/2561>

19 European Commission (2014), *Guide to Cost-Benefit Analysis of Investment Projects: Economic appraisal tool for Cohesion Policy 2014-2020*, European Commission, Brussels, http://ec.europa.eu/regional_policy/sources/docgener/studies/pdf/cba_guide.pdf

20 European Investment Bank (2013), *The Economic Appraisal of Investment Projects*, EIB, http://www.eib.org/attachments/thematic/economic_appraisal_of_investment_projects_en.pdf

21 Organisation for Economic Co-operation and Development (2006), *Cost-Benefit Analysis and the Environment: Recent Developments*, OECD, <http://www.oecd.org/env/tools-evaluation/cost-benefitanalysisandtheenvironmentrecentdevelopments.htm>; and Little and Mirrlees (1974), *Project Appraisal and Planning for Developing Countries*

22 Hutton and Rehfuess (2006). Guidelines for conducting cost–benefit analysis of household energy and health interventions, World Health Organisation, Geneva, http://www.who.int/indoorair/publications/guideline_household_energy_health_intervention.pdf

CBA is often characterised as ‘monetary evaluation’ where all units are in monetary terms, in contrast with other methods such as MCA which are ‘non-monetary evaluation’.

Economic appraisal of options is about measuring preferences.

Further detail on how to undertake a CBA is set out as part of chapter D3.

D2.5 Further details on cost-effectiveness analysis (CEA) – an approach to partial evaluation within a CBA framework

CEA is a partial cost-benefit approach that compares the relative costs of different options in reference to a specific outcome that has been agreed upon (for example, reducing the road toll by a specified number of lives). CEA expresses the result in terms of the average cost per unit of effectiveness (for example, the average cost per life saved). CEA is generally used when the benefits of project options are identical. Its aim is to identify the least cost option.

While CEA can be used when the main benefits cannot be easily valued, it does not indicate if the preferred option is of net benefit to society.

If, however, a major concern is with ranking a series of broadly similar projects, then CEA provides a viable, partial, approach that remains within a CBA framework, when CBA cannot be used.

CEA is appropriate if it is not possible (practically, given data constraints, or within the evaluation budget) to fully value particular outcomes and benefits. In this case, CEA is concerned with maximising a particular outcome within a given cost constraint. It is concerned with calculating the ‘cost per unit outcome’ for particular projects and particular outcomes. In this way, it makes effective use of partial cost-benefit information that may be available.

However, CEA cannot be used to find or compare alternative projects that could achieve greater net social benefits by targeting different outcomes. CEA is thus generally used where the decision to target a specific outcome has already been agreed upon by decision-makers.

Indeed, it is important when using CEA that the outcome used by the proponent for the cost calculations is one that is clearly related to the overall objectives of the project.

Costs are ‘discounted’ over time to arrive at a present value (today’s dollars). This is why CEA is also a type of discounted cashflow analysis.

For the vast majority of the business cases for infrastructure projects, CBA is the appropriate appraisal tool to use.

Applying CEA

Table 26 illustrates a simple case where the full economic costs are compared with a single specific outcome (number of families with increased service access). In this case, it is clear that Option A would be preferable to Option B because it shows a lower cost per family provided with increased access.

Table 26 CEA with costs and one intangible benefit

	Option A	Option B
Cost (full economic cost, present value terms)	\$5 million	\$10 million
Number of families with increased access to services as a consequence of project	50	80
Cost effectiveness (\$ cost per family with increased access)	\$100 000	\$125 000

Source: CIE.

Table 27 illustrates a more complex case where there are fully valued costs, and benefits valued for some outcomes with one remaining intangible outcome. This is where CEA can be combined with information

from a partially complete CBA to estimate “net cost effectiveness”. In this case, the costs net of the valued benefits are compared with the unit outcomes. In this case, Option B is preferred to Option A.

Table 27 CEA with mixed measurable and unmeasured benefits

	Option A	Option B
Cost (full economic cost, present value terms)	\$5 million	\$10 million
Measurable benefits (present value terms)	\$0.5 million	\$3.5 million
Cost, net of tangible benefits	\$4.5 million	\$6.5 million
Number of families with increased access to services as a consequence of project	50	80
Net cost effectiveness (\$ net cost per family with increased access)	\$90 000	\$81 250

Note: A more sophisticated approach would incorporate the number of families for each of the appraisal years.
Source: Infrastructure Australia.

These illustrations show that information from a partially complete CBA can still be effectively used with a CEA framework.

D2.6 Further details on multi-criteria analysis (MCA)

MCA is often seen as a form of ‘non-monetary’ valuation. It emerged from the broad operations research literature and is concerned with the general mathematical problems of optimising multi-attribute functions.

MCA is seen as simpler to apply than CBA and, in some ways, may be less data intensive; but as argued below, this simplicity comes at a cost.²³

There are many variants in the actual application of MCA, but it generally involves:

- defining policy objectives
- determining a set of criteria to measure performance against each objective

- assigning weights to criteria
- providing a score for each project for each criterion
- weighting the criteria and then adding them for each project to provide an overall score.

The result is a weighted score or an index that allows the comparison of projects. It is important to note that because the criteria all involve different scales, the resulting index can only be used as an ordinal ranking, not a cardinal one. In other words, both the raw and weighted scores are often not comparable in terms of scale and magnitude of scope and service levels.

A different starting premise to CBA

MCA starts from a fundamentally different premise from CBA – it is not concerned with valuation and aggregation of individual preferences. Therefore, a number of studies have expressed substantive concerns about the use of MCA.²⁴

²³ In some ways, this apparent simplicity is misleading. Any project analysis requires a good understanding of the causal relationship between the investment and outcomes of interest (e.g. the link between doctor visits and health, for example). To be done properly, MCA also requires this linkage.

²⁴ For example, Dobes and Bennett (2009), “Multi-criteria Analysis: Good Enough for Government Work?”, *Agenda: A Journal of Policy Analysis and Reform*, Vol 16, No. 3, pp 7-29; Dobes et al (2016); *Social-Cost Benefit Analysis in Australia and New Zealand: The State of Current Practice and What Needs to be Done*, Australian National University Press, ACT; Pannell et al (2013), *Designing a practical and rigorous framework for comprehensive evaluation and prioritisation of environmental projects*, Wildlife Research, vol. 40, no. 2, pp. 126-133; and Baker and Rutting (2014), *Environmental Policy Analysis: A Guide to Non-Market Valuation*, Productivity Commission Staff Working Paper, Productivity Commission, Canberra.

A primary issue with MCA is that it compares and sums metrics in different, incompatible dimensions. The resulting score has no units and no meaning beyond the specific piece of analysis. Even the meaning within the analysis is questionable due to the subjectivity and lack of transparency around conversion, scores and weights.

Other concerns and limitations of MCA

The following summarises other concerns and limitations of MCA:

- While one motivation for choosing MCA is to avoid assigning dollar values to non-market social outcomes, the method implicitly assigns dollar values.
 - Implicit values from MCA are a consequence of the framing of the policy problem and the way that a particular MCA is done, meaning that two analyses may produce very different values for the same outcome.
 - MCA implicitly applies a similar monetary value to attributes when scoring, weighting and summing attributes with different metrics where any one metric is measured in monetary terms.
 - In contrast, CBA makes this valuation explicit, and uses shadow prices (rather than market prices) which accurately captures social values.
- MCA does not explicitly assume a particular accounting stance or perspective of a stakeholder or the community in the analysis. The determination of weights and/or scores for specific goals is generally determined by subject matter experts, focus groups (which are subject to self-selection bias), or specific interest groups. The analytical method is open to influence from interest groups and the likelihood that the results would be biased in favour of a proposal is high. The analyst's interpretation of views of stakeholders also has the potential to influence the selection of weights and scores.
- The goals (or impacts) that are included in analysis of a project come from a very large set of possible goals. It is unlikely that any two analysts or decision makers would select the same goals to assess. The selection of criteria is likely to be subject to bias based on the interests of the analyst or decision maker.
 - The number of goals considered may affect the overall and relative scoring of impacts and result in different rankings of alternative projects.
 - Assessment of goals or impacts of a particular project may not consider implications for areas outside the analysis focus. For example, a project may be seen to increase tourism revenue at a local area. However, this is likely to come through a reduction in tourism revenue at alternative sites:
 - the impact on alternative sites would often not be considered in a MCA
 - in contrast, a CBA would only consider additional national demand for tourism (assuming a national perspective)
 - a CBA would also include a comprehensive assessment of a wide range of impacts and their interactions and complexities that may not be included in a MCA with very specific goals.
 - Examples of MCA include 'change in number of jobs' as an impact. The implicit assumption is that a project that generates jobs is positive. However, there are many impacts of job generation, both positive and negative, depending on where workers are sourced from, and there are impacts on related markets (for example, real estate). CBA will consider these complexities which are likely to be overlooked when using MCA.

Using MCA, it is not possible to compare projects that are unrelated because of the divergence in goals/impacts considered.

While CBA is the preferred method for evaluating options, we recognise that MCA is often the most appropriate tool for short-listing options during the Options Assessment stage. There are a number of ways to improve the application of MCA and its robustness. The simplest way is to incorporate more quantitative criteria such as cost estimates and measures of demand (e.g. number of passenger kilometres).

D3. Conducting economic appraisals

D3.1 Purpose of this chapter

This chapter provides further guidance on conducting economic appraisals. The form of economic appraisal required in an Australian business case for an infrastructure project is typically a CBA.

The CBA methodological framework involves a number of key assumptions and parameters, including the real discount rate and the appraisal period. Infrastructure Australia will carefully scrutinise methodologies and assumptions used to avoid the overstatement of benefits and understatement of costs. Infrastructure Australia will take account of unrealistic or inappropriate assumptions during its review of the business case.

In summary, this chapter provides detailed guidance for practitioners on:

- setting up the analytical framework – what discount rate and price year to use and how long should the appraisal period be?
- developing the demand estimates which underpin the CBA
- identifying, quantifying and monetising costs and benefits
- analysing non-monetised costs and benefits
- performing the discounted cashflow analysis to measure net benefits
- calculating the measures of economic worth for each project case/option.

Guidance on other areas such as cost-estimation methods, land use impacts and wider economic benefits and induced demand is also provided in this chapter.

D3.2 Cost–benefit analysis (CBA)

An economic appraisal seeks to determine the net benefits from a project for the Australian community as a whole, relative to the base case. CBA does this by calculating the net benefit of a project, which is the total project benefit less the total project costs.

Economic appraisals seek to measure the opportunity cost of addressing the economic problem or leveraging an opportunity. Therefore, economic appraisals use resource costs, which do not include taxes and subsidies. Taxes and subsidies are financial transfers²⁵ between individuals in an economy, and do not lead to an increase in net economic benefits. CBA is different from a financial appraisal, which measures financial costs and benefits from a producer's perspective, not the overall community perspective.

In economics, net benefits to society are described as the change in social surplus. This is made up of changes resulting from the project:

- the change in consumer surplus – put simply, the net cost or benefit to consumers
- the change in producer surplus – the net cost or benefit to producers
- the change in externalities – the net impact on third parties.

Mathematically, the net benefit to society is expressed as follows:

$$\Delta \text{Social surplus} = \Delta \text{Consumer Surplus} + \Delta \text{Producer Surplus} + \Delta \text{Externalities}$$

25 Purely financial transfer payments between various individuals/firms are not included in the economic CBA because they do not represent changes in resource costs. Transfer payments are sums of money that changes hands without any net change in welfare. It is purely a financial gain or loss, without a change in economic efficiency.

They result in a change in the distribution of benefits or costs without changing the overall net benefits. Most taxes, fares and tolls are transfer payments from consumers to government or infrastructure owners/operators, while subsidies are often transfer payments from government to consumers.

Understanding the component parts of net benefits to society is important because it identifies the beneficiaries and stakeholders of the project.

At the highest level, they are:

- the consumers (or the users)
- the producers (or the service providers or operators)
- third parties (or the non-users), including the Government.

Understanding the beneficiaries and stakeholders of the projects allows the identification and quantification of the costs and benefits in an economic appraisal.

D3.3 Types of costs and benefits and approaches to quantification

While conventional ‘monetised’ CBA is at the core of the business case, Infrastructure Australia will also consider other important impacts, including wider economic benefits, land use costs and benefits, productivity, urban regeneration, and local equity and distributional impacts.

After specifying the base case and the initiative options, the next step of a CBA is to identify the benefits and costs.

As far as practicable, all costs and benefits arising from an initiative or project should be identified, quantified and monetised in the CBA for the business case.

Monetised benefits and costs, which can be expressed in dollar units, are at the core of CBA used for Stage 4 evaluation. Infrastructure Australia will also consider other costs and benefits which cannot easily or reliably be monetised.

Table 28 below describes Infrastructure Australia’s suggested categorisation of costs and benefits for a typical infrastructure project. Proponents do not have to follow this categorisation, although this should help capture all of the costs and benefits in the business case, and hence avoid a potential understatement of the net benefits.

Table 28 *Suggested categories of benefits and costs*

Category	Cost/benefit ⁽¹⁾	Description
Private costs (offset to producer surplus)	Initial project capital costs	Upfront capital costs ⁽²⁾ . Avoided capital costs should be reported separately and not netted off in the total capital costs.
	Project operating costs	Operating expenditure, maintenance costs
	Capital replacement costs	Costs for capital replacement such as for smart motorway systems and IT
	Decommissioning and rehabilitation costs	Decommissioning existing assets and services; rehabilitation of contaminated environment
Costs incurred indirectly by project, such as by other government agencies		These should be included where they are necessary to achieve the project benefits

Category	Cost/benefit ⁽¹⁾	Description
Private benefits (producer surplus)	Increased operating revenue	The economic value from changes in revenue to the owner or operator (e.g. tolls or passenger farebox revenue). Put simply, operating revenue less capital and operating costs equates to producer surplus.
	Increased ancillary revenue	The increase in revenue from other activities, e.g. airport or station retail concessions, advertising revenue, car parking revenue.
	Avoided capital costs ⁽³⁾	Avoided capital investment costs (e.g. avoided rolling stock acquisition costs).
	Avoided operating costs ⁽³⁾	Reduced expenditure, for example, savings in operating, maintenance, compliance and investment costs.
Private benefits (consumer surplus)	Improved accessibility	Reduced accessibility costs in accessing facilities such as hospitals and educational institutions, or services such as improved water supply. It could also include improved accessibility to transport for passengers with disabilities.
	Travel time savings	The economic value of reduced scheduled journey time.
	Savings in vehicle operating costs	The economic value of reduced costs of operating a vehicle.
	Service reliability	The economic value of improvements in service reliability (e.g. journey time variability on the transport network compared to published timetable or service availability for telecommunications).
	Service improvement	The economic value of greater amenity from higher specification of services (i.e. greater amenity of travel from improved rolling stock and stations, and lower levels of crowding)
	Health and safety	The economic value arising from a reduction in the number of accidents, deaths and security incidents. Initiatives may also improve health outcomes by encouraging additional physical activity (e.g. active transport) or by mitigating the health impacts associated with high temperatures. This may also include improved personal security.
	Resilience	Benefits derived from improved resilience to adverse events (e.g. the value of reducing the frequency, severity or recovery of flooding events).
	Residual value of assets	<p>The measurement of residual values or terminal asset values is a proxy for future user benefits generated by the asset beyond the appraisal period.</p> <p>In practice, it is measured as the scrap or residual value of assets at the end of the evaluation period, when the asset's economic life is greater than the evaluation period.</p>

Category	Cost/benefit ⁽¹⁾	Description
External costs and benefits	Environmental externalities	Description of any significant positive or negative environmental externalities of the project in considering the merits of a project. This may include air quality, carbon emissions, water pollution, noise and vibration, biodiversity and climate adaptation issues.
	Network externalities of the project (e.g. Network Resilience)	Changes in user behaviour may have implications for the broader infrastructure network and infrastructure users not directly affected by the project (e.g. congestion and health and safety network externalities arising from a project).
	Land use impacts	Benefits and costs derived from land use changes due to the project. This may include higher value land use and public infrastructure cost changes, impacts on wider economic benefits, as well as second round impacts on transport benefits and costs and public health costs.
	Health and safety externalities	Third parties may enjoy health and safety benefits or suffer from disbenefits from infrastructure projects. For example, residents may suffer from health problems from local air pollution.
	Social impacts	Description of any significant positive or negative social impacts of the project in considering the merits of the project. This may include considerations of equity or the distribution of benefits (i.e. by income groups or spatial/geographical spread), the groups/individuals impacted as a result of the initiative (local community, infrastructure users only, new or existing customers) and any other relevant social impacts.
	Other external benefits	Include and justify other sources of external benefit, including assumptions and supporting data.

Notes:

- (1) Resource cost corrections have to be made sometimes because perceived costs and resource costs are not the same. For example, the resource cost of fuel is different to the perceived costs of fuel. The resource costs of fuel do not include all the taxes. To make a resource cost correction, costs are often subtracted from consumer surplus based on the perceived cost of consuming a good or service.
- (2) Note that, in the case of land, the capital costs should include the opportunity cost of the land used, even where this is currently owned by government. This means that capital costs in the base case should include any incremental land costs.
- (3) While avoided costs could be counted as a cost offset (i.e. it is used to net off gross costs), it is acceptable and conventional to count avoided costs as a benefit to the producer or the community. It may also be necessary to offset the avoided benefits, where applicable.

In addition to the benefits and costs outlined above, Infrastructure Australia will consider any other benefits set out in business cases. Submissions to Infrastructure Australia should contain compelling supporting evidence for these benefits, as well as clearly set out the assumptions and methodology used to calculate and monetise these benefits.

In considering benefits and costs, proponents should guard against ‘double counting’ – that is, counting the same benefits and costs across two or more categories. Where proponents believe that this may be an issue, they should highlight this in their submission to Infrastructure Australia.

The benefits of initiatives are often not uniformly distributed across the population. CBA does not explicitly take this into account, generally being conducted from the perspective of society as a whole. Proponents should describe and assess as best as possible the distributional effects of the change resulting from the initiative. An indication of the scale of those effects is also desirable at both a spatial and temporal level. Infrastructure Australia recommends the use of maps, diagrams and charts to help illustrate the scale of those effects.

Where possible, the costs and benefits should be monetised, but this may not always be possible. In such cases, quantitative analysis, or failing that, qualitative analysis, of the benefits and costs should be prepared. Ultimately, the submission should enable the benefits and costs of an initiative to be comprehensively understood.

Before further guidance is given on how to value or monetise costs and benefits, the following section provides some general guidance on demand forecasting, as future demand in the base case and the project case underpins the CBA. Generally, it is not possible to monetise costs and benefits without estimating demand first.

Demand forecasting for infrastructure projects

A key determinant of the benefits of a proposed project is the demand for the infrastructure and the resultant service. Therefore, demand forecasts play a critical role in the appraisal of initiatives. Infrastructure Australia needs to understand the basis upon which demand estimates have been produced.

Even when a proposed project relates, for example, more to an improvement in service quality rather than an increase in infrastructure capacity, demand information will assist Infrastructure Australia to understand the scale/location/nature of users benefitting and being otherwise impacted by a particular investment.

For each initiative, the following information should be provided:

- A comprehensive list of the detailed assumptions which drive demand, including the rate of population growth, employment growth, technological change²⁶, number of households, number of businesses, the price of services²⁷, price elasticity, take-up of services, consumer preferences, climate change (see Section D4.6), and how these may change over the appraisal period.
- The magnitude and basis of probabilities assigned to uncertain events (e.g. technological change and level of consumer demand – low, medium or high), and the basis for selecting the central scenario.
- Detail of land use assumptions in the base case and with the proposed project options such as residential or employment densification assumed in the demand modelling, including any commitments to rezoning or other planning law changes which would be necessary to facilitate land use changes.
- The methodology used to estimate demand – the nature of the demand model used and how ‘knock-on’ and wider network effects are calculated; plus an explanation of the independence of forecasts and the degree of external or independent scrutiny of the

²⁶ For planned investments in enabling infrastructure, such as network infrastructure that increases transmission speeds, future technology should be considered, analysed and explained. While it may be challenging to forecast future technology that is not yet in existence, proponents should attempt to project future scenarios and changes in the market as much as possible to avoid overstating benefits specific to the proposed initiative.

²⁷ The assumed price of services to be provided and the impact on demand will be important because many communications products have commercial (or at least non-zero) prices. The methodology should detail assumed prices along with outlining how price assumptions are derived and what impact they are expected to have on demand for the service(s).

forecasts. This should include full details on how the model forecasts ‘induced’ demand. See further below in this chapter for further details on induced demand.

- The underlying justification for assumptions and growth rates and sensitivity testing of core economic and project specific assumptions.
- A detailed disaggregation – by year, date and user type – of the results of the demand modelling.

Demand forecasting – transport sector

For transport projects, in addition to the above, the following information should be provided:

- A comprehensive list of the detailed assumptions which drive demand, including the rate of population growth, employment growth, land use changes (see third point below), private vehicle demand, public transport demand; and how these change over the appraisal period.
- A description of how the assumptions change due to significant exogenous project drivers such as technological disruption and climate change.
- The underlying justification for these assumptions and growth rates, particularly the expansion and extrapolation factors used and sensitivity testing of core assumptions such as Gross Domestic Product (GDP) growth rates.
- Detail of any changes in land use expected with the proposed Project such as residential densification or Transport Orientated Developments (TODs), including any commitments to rezoning or other planning law changes which would be necessary to facilitate those land use changes. Note that land use change may or may not be appropriate for direct incorporation into the appraisal. It is suggested that the proponent discuss this with Infrastructure Australia before undertaking modelling.
- The approach used to forecast network demand and behavioural change – the nature of the analysis/ modelling, an explanation of the degree of external or independent scrutiny of the forecasts, and full details on how the model forecasts ‘generated’ or ‘induced’ demand (see the following sections).

- A detailed disaggregation – by year, forecast period, scenario and user type – of the results of the demand modelling, following the information requirements set out in Infrastructure Australia’s templates.

Typically, this information will be contained in a detailed transport modelling report and/or patronage forecast report, which will have been prepared by proponents. Wherever possible, in addition to completing the templates, proponents should submit this report and then provide page references to the key sections containing this information.

Demand forecasting – energy sector

Wherever possible, in addition to completing the tables (included in the submission templates), proponents should submit supporting energy demand modelling report(s) prepared to document future demand and then provide page references to the key sections containing this information.

A number of organisations provide national, state/territory and zone substation level electricity forecasting and planning reports. Proponents are encouraged to consider/reference these documents as the basis for developing project-specific methodologies for demand and to align with current public information²⁸.

Induced demand

For major transport projects, demand forecasts should account for an appropriate range of user behaviour changes that can be expected with the project.

For example, in the case of major road projects, it is not sufficient to assume that the same number of peak period private vehicle trips will be present in the base case and project option, i.e. the only difference between the cases being a proportion of users who switch routes to take advantage of improved speeds on the project route. This approach is known as a ‘fixed matrix’ approach in transport network modelling, and is appropriate only for minor improvement projects.

²⁸ While these forecasts do not include off grid demand, any forecasting undertaken would be expected to follow a similar approach as these reports.

Proponents of major urban transport projects should follow a ‘variable matrix’ approach in their network modelling. This means adopting a variable origin-destination matrix that accounts for the additional (induced) demand where measurable and appropriate²⁹.

Sources of induced demand include:

- changing mode – e.g. public transport passengers switch to car because highway improvement makes road travel more attractive than bus or rail
- making additional journeys – e.g. people are willing to make additional car journeys because of the improvement in accessibility
- changing destination – e.g. drivers decide to travel to more distant destinations because the improvement makes the journey time acceptable
- changing time of travel – e.g. drivers decide to travel in the peak period because the improvement reduces journey times to an acceptable level
- land use changes – e.g. over time the new or improved part of the transport system may encourage higher population and business activity near the improved facility and/or encourage households and firms to locate further away from their usual destinations.

Proponents should in submissions set out clearly the types of demand responses that demand models include and exclude.

Large projects may generate different components of induced demand, while small projects may cause only a change of route. Induced demand may potentially reduce private benefits as the additional traffic ‘uses up’ the additional network capacity before the end of the appraisal period. This could lead to:

- reduced travel time savings
- reduced vehicle operating cost savings
- increased external costs – in particular, congestion and environmental externalities arising from additional journeys.

The modelling of induced demand is of greater importance for those transport networks with:

- high levels of congestion
- high elasticity of demand (i.e. a small change in generalised costs results in a large change in demand)
- relatively large changes in transport costs.

It should be noted that it is appropriate for smaller projects to use fixed matrix modelling and not account for induced demand if the proponent is confident that the estimated traffic demand will not exceed the expanded capacity within the appraisal period.

Over the course of 2016–17, Infrastructure Australia has reviewed and assessed a significant number of road project business cases. An important learning drawn from the review of the road business case assessments is the need for the appropriate use of fixed matrix and variable matrix modelling. Inappropriate use of modelling approaches may overstate or understate the economic merit of the project, which creates risks in the design of the Project and the economic appraisal.

Further guidance on modelling induced demand is provided in ATAP Guidelines for Transport, *T1 Travel Demand Modelling*³⁰.

Monetised benefits and costs

In a CBA, costs and benefits are classified as either ‘private’ or ‘external’. External costs and benefits are conventionally termed ‘externalities’. Such classifications are used to help identify the beneficiaries of the project and those stakeholders who may be disadvantaged by the project.

Private costs and benefits accrue to either consumers/ users (e.g. consumer surplus derived from consuming a good or service) or producers (e.g. producer surplus or value of avoided capital, replacement, maintenance, operating and compliance costs).

External costs and benefits are accrued by third parties not directly involved in the market for a good or service (e.g. costs of damage to the environment, reduction in visual and other amenity).

²⁹ Victorian Auditor-General (2011), *Management of Major Road Projects Report 2010-11*, Victorian Government Printer, Melbourne, <http://www.audit.vic.gov.au/publications/2010-11/20110601-Major-Roads.pdf>

³⁰ Transport and Infrastructure Senior Officials’ Committee (2016), *Australian Transport Assessment and Planning (ATAP) Guidelines T1 Travel Demand Modelling*, Transport and Infrastructure Council, Canberra, www.atap.gov.au

Both private and external costs and benefits should be monetised where possible.

Where benefits and costs are monetised in the CBA, they should be expressed in real terms (i.e. adjusted to remove the effect of inflation). The base year for the monetised values should be consistent for all costs and benefits included in the CBA and should be clearly stated in CBA reporting. Where CBA results are reported in

submissions, proponents should also report annual real benefits and costs for each year of the evaluation period, for each benefit and cost component.

The following tables respectively list the potential costs and benefits that are generally monetised in a CBA of a passenger transport, freight transport, telecommunications, or energy project.

Table 29 *Typical monetised benefit and cost items: Passenger transport*

Private benefits and costs (for users and producers)	External benefits and costs (for the broader community)
<p>Project costs and benefits:</p> <ul style="list-style-type: none"> Investment and ongoing project expenditure, e.g. operating expenditure, maintenance costs, decommissioning costs <p>User value (commercial and private consumers of transport infrastructure), e.g. increased surplus from:</p> <ul style="list-style-type: none"> Timeliness/speed – Changes in travel times such as in-vehicle time and out-of-vehicle time (e.g. wait, access and transfer/boarding) Frequency – how many services per hour Reliability – Changes in unscheduled delays Other quality measures – Changes in crowding (rolling stock and platform) and amenity (e.g. station, rolling stock) Access and egress times Safety and security (upgrade lighting, CCTV cameras) Changes in vehicle operating costs (perceived and unperceived) Changes in health and physical fitness Residual values <p>Producer value (producers of transport services and/or infrastructure), e.g. increased surplus from:</p> <ul style="list-style-type: none"> Expenditure avoided, e.g. savings in operating, maintenance, compliance and investment costs Incremental fare box/toll revenue Incremental costs of realising land use changes 	<p>Environmental:</p> <ul style="list-style-type: none"> Changes in values associated with environmental externalities, including noise and vibration, local air pollution, greenhouse gases (e.g. CO₂, CH₄, NO_x) Climate change influencing existing economic, land-use and cultural activities (e.g. due to inundation, or excessive heat) <p>Social/cultural:</p> <ul style="list-style-type: none"> Changes in values associated with aesthetics and visual amenity Changes in heritage values, including Aboriginal sites of importance or to historic buildings, sites and landscapes <p>Safety and network:</p> <ul style="list-style-type: none"> Changes in crash costs Road network decongestion <p>Other:</p> <ul style="list-style-type: none"> Competition benefits taking into account the behaviour of competitors who may have a degree of market power Consequential costs during construction (e.g. noise, delay, congestion during, displaced economic activity etc.) Wider Economic Benefits or Costs from agglomeration, imperfect competition and labour supply effects Land use benefits or costs, e.g. from higher value land use, public infrastructure cost changes, etc. Market and policy responses to climate and technological disruptions (e.g. renewable energy and carbon pricing)

Table 30 Typical monetised benefit and cost items: Freight transport

Private benefits and costs (for users and producers)	External benefits and costs (for the broader community)
<p>Project costs and benefits:</p> <ul style="list-style-type: none"> ▪ Investment and ongoing project expenditure, e.g. operating expenditure, maintenance costs, decommissioning costs <p>User value (commercial and private consumers of freight transport infrastructure), e.g. increased surplus from:</p> <ul style="list-style-type: none"> ▪ Timeliness/speed – Changes in freight travel times (e.g. faster loading, improved network speeds) ▪ Increased capacity – Change in tonnes of freight transported along the network ▪ Reliability – Changes in unscheduled delays ▪ Other quality measures – Changes in flexibility of supply chains (e.g. ability to provide freight services when and where required) ▪ Safety and security ▪ Changes in vehicle operating costs (perceived and unperceived) ▪ Residual values <p>Producer value (producers of freight transport services and/or infrastructure), e.g. increased surplus from:</p> <ul style="list-style-type: none"> ▪ Expenditure avoided, e.g. savings in operating, maintenance, compliance and investment ▪ Increased freight operating margin ▪ Increased government revenue (e.g. access charges) 	<p>Environmental:</p> <ul style="list-style-type: none"> ▪ Changes in values associated with environmental externalities, including noise and vibration, local air pollution, greenhouse gases (e.g. CO₂, CH₄, NO_x) ▪ Climate change influencing existing economic and land-use activities (e.g. due to increased extreme events) <p>Social/cultural:</p> <ul style="list-style-type: none"> ▪ Changes in values associated with aesthetics and visual amenity (e.g. from fewer heavy vehicle movements) ▪ Changes in heritage values, including Aboriginal sites of importance or to historic buildings, sites and landscapes affected by freight supply chains <p>Safety and network:</p> <ul style="list-style-type: none"> ▪ Changes in crash costs (e.g. from fewer heavy vehicle movements) ▪ Road network decongestion <p>Other:</p> <ul style="list-style-type: none"> ▪ Competition benefits taking into account the behaviour of competitors who may have a degree of market power ▪ Consequential costs during construction (e.g. noise, delay, congestion during, displaced economic activity etc.) ▪ Market and policy responses to climate and technological disruptions (e.g. renewable energy and carbon pricing)

Table 31 Typical monetised benefit and cost items: Telecommunications

Private benefits and costs (for users and producers)	External benefits and costs (for the broader community)
<p>Project costs:</p> <ul style="list-style-type: none"> ▪ Investment and ongoing project expenditure, e.g. operating expenditure, maintenance costs, decommissioning costs <p>User value (commercial and private consumers of telecommunications), e.g. increased surplus from:</p> <ul style="list-style-type: none"> ▪ Reliability ▪ Timeliness/speed ▪ Consistency ▪ Other quality measures ▪ Residual values <p>Producer value (producers of communications services), e.g. increased surplus from:</p> <ul style="list-style-type: none"> ▪ Expenditure avoided, e.g. savings in operating, maintenance, compliance and investment costs ▪ Increased communications service revenues 	<p>Environmental:</p> <ul style="list-style-type: none"> ▪ Changes in values associated with environmental externalities, including greenhouse gases (e.g. CO₂, CH₄, NO_x) ▪ Climate change influencing emergency needs or reliability (e.g. due to increased extreme events) <p>Social/cultural:</p> <ul style="list-style-type: none"> ▪ Changes in values associated with aesthetics and visual amenity ▪ Reduced public health costs from improved access to information ▪ Changes in heritage values, including Aboriginal sites of importance or to historic buildings, sites and landscapes <p>Other:</p> <ul style="list-style-type: none"> ▪ Competition benefits taking into account the behaviour of competitors who may have a degree of market power ▪ Consequential costs during construction (e.g. noise, delay, disrupted services, congestion etc.)



Table 32 Typical monetised benefit and cost items: Energy

Private benefits and costs (for users and producers)	External benefits and costs (for the broader community)
<p>Project costs:</p> <ul style="list-style-type: none"> Capital and ongoing project expenditure, e.g. operating expenditure, maintenance costs, decommissioning costs <p>User value (commercial and private consumers of energy), e.g. increased surplus from:</p> <ul style="list-style-type: none"> Reliability Timeliness Consistency Other quality measures Residual values <p>Producer value (producers of energy), e.g. increased surplus from:</p> <ul style="list-style-type: none"> Expenditure avoided, e.g. savings in operating, maintenance, compliance and investment costs Increased energy revenues 	<p>Environmental:</p> <ul style="list-style-type: none"> Changes in values associated with environmental externalities including greenhouse gases (e.g. CO₂, CH₄, NO_x) Climate change influencing existing economic, land-use and cultural activities (e.g. due to inundation, extended periods of excessive heat and dryness, increased extreme events) <p>Safety:</p> <ul style="list-style-type: none"> Change in value associated with safety improvements <p>Social/cultural:</p> <ul style="list-style-type: none"> Changes in values associated with aesthetics and visual amenity Changes in heritage values, including Aboriginal sites of importance or to historic buildings, sites and landscapes <p>Other:</p> <ul style="list-style-type: none"> Competition benefits taking into account the behaviour of generators who may have a degree of market power Consequential costs during construction (e.g. noise, delay, congestion etc.) Market and policy responses to climate and technological disruptions (e.g. renewable energy and carbon pricing)

In undertaking a detailed CBA, proponents may wish to refer to guidelines. A number of general and sector specific guidelines are outlined at the end of this chapter.

Quantification of benefits

To quantify the benefits specific to each initiative/project, there is a range of possible approaches.

These different methods value benefits with varying degrees of accuracy. In general, valuations based on market prices, or other observed consumer and producer behaviour will provide more reliable estimates of benefit values compared to non-market valuation techniques.

The following section summarises common valuation approaches.

1. Using market prices to measure economic benefits where available.

Market prices, where they exist, provide a great deal of information concerning the magnitude of costs and benefits. Market prices may be relevant as a signal of how much the community/businesses value the quantity or quality of the infrastructure. In such situations, demand and price forecasts for the base case and project case with the initiative could be made based on the available market information.

If relevant markets are efficient, these estimates could then be used to estimate consumer and producer benefits from an initiative. However, whenever there is a market failure (i.e. capacity constraints or externalities), market prices may not reflect true marginal social costs or benefits. In these cases, the true marginal social cost of benefit should be measured by calculating the shadow price, which does not exist in the market, but is the true social costs and benefits reflected imperfectly in the market price.³¹

³¹ Stiglitz, J.E. (2000), *Economics of the Public Sector*, 3rd Edition, Norton & Company, New York

2. Using non-market valuation to measure economic benefits.

Often valuations for goods or services are not reflected in market prices (e.g. the value of future technologies enabled by improved quality of communications infrastructure or the value of biodiversity). In such cases, a range of techniques is available to estimate the non-market value for the costs and benefits, which are often measured as the aggregate willingness to pay for a particular good, service or outcome.

There are two main types of non-market valuation methods: revealed preference and stated preference.

- a. **Revealed preference approaches – use market/historical data such as prices or the number of users of a service.** They use observations of purchasing decisions and other behaviour (e.g. the number of users) to estimate non-market monetary valuations. By isolating a specific characteristic and the change in price or users, it may be possible to estimate the value placed on a particular characteristic. For example, higher prices paid for internet with faster download and upload speeds could reveal information about the value of higher quality communications infrastructure. Revealed preference methods include the travel-cost method (e.g. generalised travel costs can be used to estimate an implied demand curve for visiting an unpriced attraction such as an urban green space, from which consumer surplus can be measured) and hedonic pricing methods (isolates the influence of non-market attributes on the price of goods).
- b. **Stated preference approaches** – aim to simulate a hypothetical market or choice experiment for assessing preferences for the provision of non-market goods and services. They are a survey-based method, which impute values for non-market characteristics by asking people to make choices between hypothetical policy options. The willingness to pay for a specific outcome is inferred from these survey responses. The accuracy of stated preference approaches is highly dependent on survey design and the types of outcomes being valued (value estimates for unfamiliar outcomes may be less accurate).

3. Other rapid non-market valuation techniques.

It is recognised that undertaking original research using revealed and stated preference methods can be costly and time consuming. However, there are approaches that can be used to provide an indication of economic value, and enable comparative assessments of options. The following discussion outlines some of these methods which lend themselves to the task of rapidly placing monetary values on benefits:

- a. **Replacement-cost method** – the cost of replacing an unpriced asset or service can be a useful measure of benefit. For example, an area of parkland may be endangered by investment in infrastructure, but perhaps it could be replaced, or an equivalent area provided. The cost of this replacement is a measure of the benefit of the parkland. The key assumption is that the replacement costs can be calculated and that they are not greater than the value of the asset which would otherwise be destroyed.
- b. **Interpretation of previous decisions** – occasionally, a decision to spend or save money in a similar situation elsewhere can be interpreted to value a non-market benefit. The level of past expenditure to achieve similar benefit characteristics, in similar situations, and in similar economic circumstances, can be used as an estimate of the value of a resource. When the similarities are strong, the method is useful in providing an indication of value. It is advisable to exercise caution when using this method as the past may not be a reliable indicator of the future, particularly given the speed of technological development taking place in the infrastructure sector.
- c. **Benefit Transfer** – Benefit Transfer is the process of taking willingness-to-pay estimates from one context (the ‘study site’) and transferring it to another context (the ‘option site’). It may be appropriate to transfer an average willingness-to-pay estimate from one primary study, transfer willingness-to-pay estimates from many studies, or transfer a willingness-to-pay function. The first option is the most practised. In selecting the appropriate value for transfer from the literature, a good understanding of the quality of the original study is required and the following criteria should be met to ensure that the original

study and the new context are similar enough to ensure a valid result:

- Physical characteristics of the two sites should be similar.
- Changes being valued in study should be similar.
- Policy context should be similar.
- Cultural and socio-economic characteristics of the populations should be similar.

Where justified, Infrastructure Australia generally supports use of the above techniques. Where market values are not available, the proponent should provide the rationale for the technique/parameters chosen and the prediction of the scale of the benefits relative to each specific initiative, so that Infrastructure Australia can treat each case on its own merits.

For transport projects in Australia, the estimation of benefits is generally treated through demand models which calibrate to existing conditions and then forecast changes in demand. Guidance on travel demand models is provided in the Australian Transport Assessment and Planning Guidelines, *T1 Travel Demand Modelling*.³²

Social capital, health and other benefits of Active Transport initiatives

Active Transport initiatives (walking and cycling) can make a significant impact on Australia's transport problems. They should be subject to the same analytical rigour as other infrastructure initiatives.

Infrastructure Australia is aware of a set of impacts commonly associated with such initiatives, such as social capital and health benefits, that are less commonly included in traditional appraisals. The methodology underpinning quantification and monetisation of these benefits is still under development. Where justified, such benefits should be included in submissions, with full detail on the rationale for the parameters chosen and the prediction of the scale of the benefits, so that Infrastructure Australia can treat each case on its merits.

Non-Monetised Benefits and Costs

A CBA should identify all direct costs and benefits (i.e. those directly attributable to the project) and quantify these where possible. Where it is not possible to fully quantify direct costs and benefits of the project, these should be discussed qualitatively and/or supported by available quantitative data. As discussed above, non-monetised benefits identified for the appraisal should align with a CBA framework and demonstrate a clear link to the project.

Non-monetised benefits and costs should also be assessed on an incremental change basis (as per monetised benefits and costs). That is, the non-monetised benefits and costs of each option should be compared with the base case.

The following summarises the non-monetised benefit and cost categories that are relevant to the determination of net benefits of an initiative:

- social impacts
- cultural impacts
- visual amenity/landscape
- biodiversity
- heritage impacts.

Any non-monetised benefits/costs identified should be discussed after the monetised CBA results in the templates.

D3.4 Expected values of costs

The investment and operational costs of initiatives play a fundamental role in determining their economic, social and environmental value. It is therefore imperative that the capital expenditure and operating expenditure estimates used in the economic appraisal are robust and consistent.

Proponents should detail full year-by-year costs for the lifetime of the initiative or project and present these as 'the expected cost' – P50 and P90 cost estimates. In addition, the basis for those costs, including specialist engineering and operations reports, should be provided.

³² Transport and Infrastructure Senior Officials' Committee (2016), *Australian Transport Assessment and Planning (ATAP) Guidelines T1 Travel Demand Modelling*, Transport and Infrastructure Council, Canberra, <https://atap.gov.au/tools-techniques/travel-demand-modelling/index.aspx>

P50 costs and P90 costs are estimates of project costs based on 50 per cent and 90 per cent probability respectively that the cost estimate will not be exceeded. The P50 cost is the median of the cost distribution, while the expected value or mean cost may be above or below the P50 value, depending on the shape of the distribution.

The P50 and P90 estimates should be based on detailed probabilistic cost estimates, which are in turn based on risk analysis of the project, not by incorporating large generic contingencies.³³

The risk analysis of the project should also inform the timing of these cost estimates, which will be influenced by the design of the options in relation to the climate-change and technology-change scenarios used (e.g. larger upfront costs with smaller ongoing maintenance/repair costs vs. smaller upfront costs with larger ongoing staged expenses depending on the nature of the changes in climate impacts and technology).

The CBA should present the central case scenario results using expected values. That is, capital costs should reflect the mean of the cost distribution. If the cost distribution is symmetrical, the P50 value, which is the median of the distribution, will be equal to the mean (Figure 17). If however the cost distribution is positively skewed, the P50 value will be above the mean and may lie closer to the P90 value (see Figure 18).

In the absence of an estimate of the expected value of costs or evidence around the shape of the cost distribution, Infrastructure Australia accepts both P50 and P90 cost estimates in the central CBA scenario.

In summary, Infrastructure Australia supports the adoption of the following practices in estimating and presenting costs:

- Capital expenditure (or ‘Capex’) estimates be presented separately from Operating expenditure (or ‘Opex’) estimates.
- Capital and operating expenditure be estimated using a probabilistic risk-based cost estimation process, where possible.
- For transport infrastructure submissions for which Australian Government funding may subsequently be sought, it is recommended that proponents follow the capital cost breakdown and escalation approach outlined by the Department of Infrastructure and Regional Development.³⁴ Proponents should also consider preparing a project cost breakdown template and including it with their submission.
- The central case scenario in the CBA should use expected cost values: P50 and P90 cost estimates are acceptable for final business cases. Irrespective of the probability-based estimates used in the central case scenario, sensitivity tests should be applied on capital costs.

Figure 17 Symmetrical cost distribution

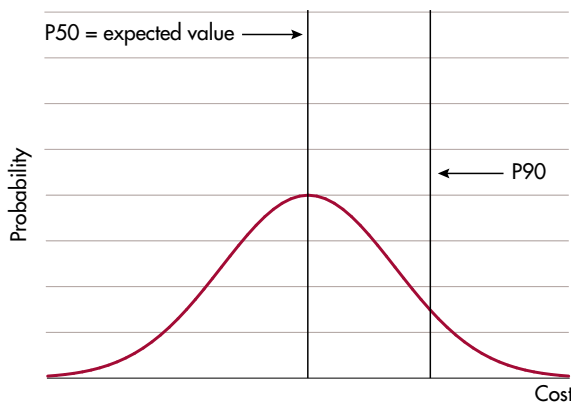
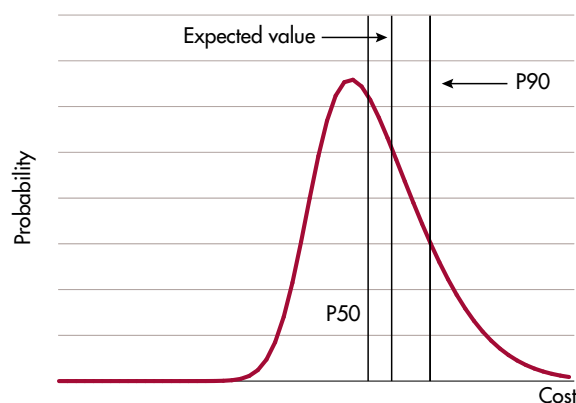


Figure 18 Positively skewed cost distribution



³³ Probabilistic project cost estimates identify cost components, determine the probability distribution for each cost component and then undertake a simulation, often a Monte Carlo simulation, to generate a probability distribution of project costs.

³⁴ Australian Government Department of Infrastructure and Regional Development (2017), *Guidance Note 2: Base Cost Estimation*, Department of Infrastructure and Regional Development, Canberra, http://investment.infrastructure.gov.au/publications/administration/pdf/Guidance_Note_2_Base_Cost_Estimation.pdf

- Where reliable historical data exists for project scopes of relatively low risk, single point cost estimates, instead of P50 and P90, might be acceptable. Infrastructure Australia recommends that the proponent seek advice early if they are planning to use single point estimates derived from historical data for capital expenditure estimates.

D3.5 Appraisal methodology and parameter references

Appraisal methodology techniques are subject to constant development, both in Australia and worldwide, reflecting a welcome emphasis on improving the understanding of an initiative's total costs and benefits. However, it is important to achieve an appropriate balance between, on the one hand, the desire to be as comprehensive as possible and, on the other hand, maintaining the methodological rigour of the appraisal process. Proponents wishing to make submissions in the transport sector are expected to have used relevant guidance from the ATAP guidelines (2016).

In all cases, Infrastructure Australia will consider additional benefits/costs arising from methodological developments (e.g. WEBS) separate to the traditional and widely accepted benefit/cost analysis, and treating each case on its merits. The results should be presented separately in the documentation.

Infrastructure Australia supports the use of available best practice and standard parameter values, such as the ATAP guidelines³⁵ in the transport sector.

D3.6 Appraisal period

The length of the appraisal period is a key input into the CBA. It determines the period of time over which to discount the lifetime costs and benefits of a proposed project. It is therefore important for proponents to use an appraisal period that matches the benefits generated by the project to the proposed assets' expected cost lifecycle to achieve the most robust net benefit result in the CBA.

The appraisal period should be based on the expected life of the asset created by the initiative or project, with the construction period added. It is assumed that the expected life of the asset is generally equivalent to the operating phase of the asset, which is measured from the first year in which the benefits of the initiative accrue. This recommendation is consistent with the recommendations made in 2016 ATAP guidelines³⁶.

The proponents must provide justification and evidence for the proposed asset life evaluation period. This includes, but is not limited to:

- undertaking longer term modelling of transport or other infrastructure network implications of the project, rather than simply extrapolating benefits over long intervals of the overall appraisal period
- understanding the sensitivity of project benefits to demand changes, as forecasting over long time horizons will become increasingly uncertain
- considering the costs of the project over the entire appraisal period, such as capital replacement and periodic maintenance costs within the period.

ATAP provides some guidance on the typical economic lives of some infrastructure assets:

- 30 years for road infrastructure projects
- 50 years for rail infrastructure projects.³⁷

Further, the Commissioner of Taxation has made a determination on the effective life of certain depreciating assets applicable for section 40–100 of the *Income Tax Assessment Act 1997*.³⁸

Because of the uncertainty of demand modelling over longer time horizons, many jurisdictions suggest 30-year appraisal periods and include a residual value for longer lived assets.

Table 33 summarises the jurisdictional guidance on the setting of appraisal periods.

³⁵ Transport and Infrastructure Senior Officials' Committee (2016), *Australian Transport Assessment and Planning (ATAP) Guidelines PV2 Road Parameter Values*, Transport and Infrastructure Council, Canberra, <https://atap.gov.au/parameter-values/road-transport>

³⁶ Transport and Infrastructure Senior Officials' Committee (2016), *Australian Transport Assessment and Planning (ATAP) Guidelines T2 Cost-Benefit Analysis*, p. 19, Transport and Infrastructure Council, Canberra, https://atap.gov.au/tools-techniques/cost-benefit-analysis/files/t2_cost_benefit_analysis.pdf

³⁷ *ibid.*

³⁸ Australian Government Australian Taxation Office (2016), *TR 2016/1 – Income tax: effective life of depreciating assets (applicable from 1 July 2016)*, Australian Taxation Office, Canberra, <https://www.ato.gov.au/law/view/document?DocID=TXR%2FTR20161%2FNAT%2FATO%2F00002>

Table 33 Guidance on appraisal period by jurisdictions

Jurisdiction	Guidance	Notes
National (ATAP)	<p>Expected life of the asset created by the initiative in its intended use, plus the construction period. For example:</p> <ul style="list-style-type: none"> ▪ 30-year life for road initiatives (except bridges) ▪ 50-year life for rail initiatives ▪ 10 years for Intelligent transport system (ITS) initiatives 	<p>When comparing options with different asset lives for a particular initiative, make adjustments to ensure a valid comparison. There are two ways to do this:</p> <ul style="list-style-type: none"> ▪ Find a common multiple of the lives (for example, 150 years for a 30-year road initiative and a 50-year rail initiative) ▪ Convert the NPV to an annuity over the initiative's life
Queensland	Life of the project, but the measurement of project impacts which are longer than 30 years is generally not recommended due to uncertainty in the forecast	Calculate residual value for extremely long-lived assets
NSW	For major new capital expenditure, NSW recommends a practical asset life of 20–30 years	<p>Calculate residual value for longer-lived assets</p> <p>Proposals to adopt longer analysis periods beyond the recommended 20–30 years should be discussed with Treasury, having regard to the plausibility of data and assumptions over long time periods</p>
Victoria	<p>Projects should generally be evaluated over their full lifecycle. However, it is acknowledged that evaluation may be difficult for infrastructure projects (or alternative options) with a long lifecycle</p> <p>Accordingly, agencies may wish to limit the evaluation to a shorter period, such as to 30 years, by including any estimated residual value at the end of the evaluation period (which reflects any further unmodelled values)</p>	When the economic life of an asset (or alternative option) exceeds the evaluation period of the project, the residual value can be counted as an inflow of benefits (or costs) in the last year

Sources: Transport and Infrastructure Senior Officials' Committee (2016), *Australian Transport Assessment and Planning (ATAP) Guidelines T2 Cost-Benefit Analysis*, Transport and Infrastructure Council, Canberra, https://atap.gov.au/tools-techniques/cost-benefit-analysis/files/t2_cost_benefit_analysis.pdf; Queensland Department of Transport and Main Roads (2011), *Cost-benefit Analysis manual*, First Edition, <http://www.tmr.qld.gov.au/business-industry/Technical-standards-publications/Cost-Benefit-Analysis-Manual.aspx>, p. 2.16; NSW Government The Treasury (2017), *The Treasury Guide to Cost-Benefit Analysis*, <https://www.treasury.nsw.gov.au/sites/default/files/2017-03/TPP17-03%20NSW%20Government%20Guide%20to%20Cost-Benefit%20Analysis%20-%20pdf.pdf> p. 55; and Victorian Government Department of Treasury and Finance (2013), *Economic Evaluation for Business Cases Technical Guidelines*, Department of Treasury and Finance, Melbourne, <http://www.dtf.vic.gov.au/Publications/Investment-planning-and-evaluation-publications/Lifecycle-guidance/Technical-guides>

In estimating the net benefits over a long time horizon, proponents should examine the suitability of their existing demand models and pursue improvements to their modelling capabilities.

For marginal projects, proponents should undertake a sensitivity test to evaluate the change in the net benefits from deferring the initiative or project.

To do this, proponents could:

- determine whether net benefits will increase if the project is deferred
- if net benefits increase by delaying the project, consider the length of deferral which maximises the net benefits.

Evaluating the impact of deferral is important to ensure that a project proceeds when it will deliver the greatest net benefits. If the costs of the problem the project is addressing are immediately material and will persist in the longer term, the deferral sensitivity test can provide confidence that the greatest net benefits can be achieved by implementing the project now.

Proponents are encouraged to contact Infrastructure Australia for assistance in determining the appropriate asset life and appraisal period to use.

D3.7 Discount rate

The theory of discounting is to translate future costs and benefits to a common time unit, in order to compare costs and benefits that accrue at different times and express them as an equivalent amount in today's dollars. It is usual to undertake the CBA in real terms. To discount real cash flows used in the economic appraisal, a real discount rate should be used.

Discounting also allows the appropriate comparison of costs and benefits over different timescales between different options and projects. For assessment purposes and comparability, Infrastructure Australia requests appraisal summary results be presented for the following real discount rates:

- 4 per cent per annum
- 7 per cent per annum (for the central case)
- 10 per cent per annum.

This aligns with the majority of current national, state and territory guidelines on CBA in Australia. In cases where a different real discount rate is used in an appraisal, the basis for doing so should be specified. Proponents should contact Infrastructure Australia for specific advice in these cases.

D3.8 Measures of economic worth

The outcomes of an economic appraisal or a CBA are conventionally presented as measures of economic worth for each option, incremental to the base case.

These include but are not limited to:

- net present value
- benefit–cost ratio
- net present value per dollar of capital investment
- first year rate of return.

Net present value

The net present value (NPV) is the difference between the present value (PV) of benefits and the present value of costs. It should be calculated using the following formula:

$$NPV = PV \text{ of benefits} - PV \text{ of costs}$$

The NPV should be presented in real values (constant prices) in the current year, generally expressed in \$ millions. A positive NPV indicates that the project has economic merit.

Benefit–cost ratio

The benefit–cost ratio (BCR) could be calculated in a number of ways.

Consistent with the majority of the state and territory guidelines, Infrastructure Australia recommends the use of the following formula:

$$BCR = \text{benefits}^* / (\text{investment costs} + \text{net increase in operating costs})^{**}$$

* generally represented by the PV of total benefits

** generally represented by the PV of total costs

The benefit and cost measures above are incremental to the base case and discounted over the evaluation period (i.e. present values).

A BCR equal to or greater than 1 for the central case indicates that the project has economic merit (i.e. the present value of benefits exceeds the present value of costs) and is used to rank projects in a budget constrained environment.

To calculate the BCR, proponents can use costs at P50 or P90 level, or single point estimates if reliable historical data exist.

Net present value per dollar of capital investment

The NPV per dollar of capital investment (NPVI) is a measure of the overall economic return of a project in relation to its requirement for initial capital expenditure and is used where there is a constraint on the availability of capital funds.

It is defined as the net present value divided by present value of the investment costs:

$$NPVI = NPV / PV \text{ of investment costs}^*$$

**generally represented by the PV of capital expenditure*

NPVI is also used to rank projects in a budget constrained environment as it measures the total benefit received for each dollar of capital expenditure incurred.

First year rate of return

The first year rate of return (FYRR) is a measure of the value delivered by a project in its first year of operation. It can provide insight into whether a project's intended date of operation is early, late or appropriate.

A FYRR below the discount rate suggests the project could be delayed in order to deliver optimal value; conversely an FYRR significantly greater than the discount rate suggests that it may be worth delivering earlier, if possible. FYRR is calculated as:

$$FYRR = \text{first year net benefits discounted to year 0} / \text{discounted total cost}^*$$

**generally represented as the PV of capital expenditure*

The first year net benefits are measured as benefits less operating costs, discounted to the start of the valuation period.

D3.9 Land use impacts

Background and context

The measurement of welfare gain in cost-benefit analysis has its origins in applied microeconomics in the 19th century and it has been a key feature in the appraisal of infrastructure investments and practical decision-making for over the last 50 years. The body of economics knowledge and guidance on investment appraisal has grown in recent years as economists and cost-benefit analysis practitioners seek to measure the welfare gain which have been unaccounted for due to imperfect markets. It is important to recognise that the growing practice of quantifying and monetising land use impacts emerged from the same imperfect market theories which led to the development of guidance on wider economic benefits (WEBs), and hence the estimation of land use benefits are grounded in economic principles.

Infrastructure projects can have significant land use impacts that are not easily captured in conventional CBA. For example, major transport projects, such as metro style train services, are often considered to be 'city shaping' because they influence where people choose to live and where businesses choose to locate on a large scale over time. Similarly, airports, ports, major roads and intermodal terminals can influence land use via land take, ancillary services and the impact on location decisions for households, firms and population.

Understanding such land use impacts can be important for several reasons. For some projects, changing land use may be a primary objective of the project and being able to predict the degree to which they achieve this aim will then be important. Land use impacts may also give rise to a range of benefits and costs in addition to the time savings and other impacts typically captured in an appraisal, for example the cost of providing public utilities such as water, electricity and gas to less dense urban areas as compared to more dense areas.

Not all infrastructure projects are expected to incorporate land use costs and benefits into a CBA. Submissions should only include such impacts where there is compelling supportive evidence and clear justification for why the project is expected to generate significant land use impacts. Evidence collected as part of updating these guidelines suggests that land use changes are most likely to occur where there is expected to be areas undergoing a change in density (e.g. population or employment density), or a clear relieving of a land, property or infrastructure supply-side constraint (see section below for further discussion of this).

Measuring land use impacts

In order to determine costs and benefits associated with land use impacts, the magnitude and distribution of change must first be determined. In a practical sense, land use can be taken to refer to the spatial distribution and intensity of population, households and economic activity. There are a number of different models and approaches to measuring land use impacts, which can be delineated along multiple lines of separation. For instance, demand-side approaches follow the impacts infrastructure can have on land use by making a location more attractive, while supply-side approaches consider how infrastructure can unlock additional development through reducing the cost of private development or by allowing a relaxation of planning controls. Another line of separation is static structures, which focus on a single year, compared to dynamic structures, which represent an evolution over time. Lastly, linked models involve separate land use and transport models, while integrated models have an interaction of land use patterns and transport needs within the same model. Different models face different trade-offs between their respective advantages and disadvantages.

Infrastructure Australia does not prescribe that a particular approach be used. However, proponents should clearly indicate the type of approach or model used, including the name of the model, the types of behaviours it models, key inputs and assumptions, and interaction with other demand- and supply-side models (for example, traffic models). Proponents should also provide details on how the following methodological issues have been treated:

- **Interaction between supply and demand** – consideration of both demand- and supply-side influencers must be made when modelling land use change. Submissions should set out how quantified land use impacts reflect demand and supply-side opportunities and constraints. For approaches that separate out the demand and supply-side components, there should be an iterative approach whereby a change in demand is considered with any regulatory constraints (i.e. can the forecast land use change be achieved given the current regulatory controls?). Forecast supply-side land use change should also be considered with demand estimates (i.e. can the envisaged land use be achieved given the demand?).
- **Dual causality** – any approach used to measure and model land use change should seek to correct for the dual causality between infrastructure and density. This dual causality arises through both infrastructure improving accessibility to change density and density itself driving infrastructure change. It is critical that, when estimating land use change, this reverse causality is corrected for so as to isolate the impact of accessibility and attractiveness of an area on density, as opposed to density impacting an area's accessibility and attractiveness.
- **Attribution** – often a change in both the regulatory environment and the infrastructure project are needed for the land use impacts to occur. In many cases, it may therefore be inappropriate for proponents to attribute all land use impacts to the project in question. Proponents should clearly document the proportion of land use change attributed to the project, supported by a clear rationale. Any costs and benefits from land use change that would be likely to occur in the absence of the infrastructure project (e.g. through supply-side regulatory intervention only (i.e. zoning change)) should not be incorporated into the cost-benefit analysis.
- **Compatibility** – when selecting a modelling approach, proponents should be mindful of the need for outputs to be at the appropriate level of spatial disaggregation so that they can inform benefits estimation. In transport projects, for example, traffic models generally require a high level of spatial disaggregation of inputs, at a base travel zone unit.
- **Time Dimension** – approaches used for measuring land use should be able to consider over what time horizon the change is likely to happen. Often there may be a lag between an infrastructure project and its associated land use change. For example, there may be a delay between an accessibility change brought about by a transport project, and a response from residents and firms to relocate closer to the affected corridors. Likewise, land use change could lead an infrastructure project where planning change and investment happen in anticipation of the completion of the project. Where possible, land use modelling techniques should incorporate such potential lead and lag effects to land use change being realised.

- **Additionality** – this refers to the proportion of the estimated benefits that are truly net additional to the national economy. It is difficult to measure this at a national level in Australia given the geographical scale, distance between major urban centres and the inhabited land mass in the country. As a result of this measurement issue, project developers should attempt to measure net additionality at a city, region, or in some instances, at a state level.
- **Displacement** – this refers to a specific land use impact which simply displaces activity elsewhere in the geography. This is a situation that is likely to occur in a situation of full employment, such that employment created at one site simply displaces employment elsewhere. The net impact then depends on whether there is a societal value from the employment being located at the new site. While in practice, this might be difficult to support analytically, project developers should articulate a narrative of where there is value to society from the displaced activity.
- **Net Effects – Additionality and Displacement** – It is important to recognise that, while the “additionality” of land use is highly visible at a local and city level (e.g. the development of commercial office buildings), the net benefits related to land use do not always flow to the national level because of displacements which occur within the national economy. For example, the increase in population density in a new area might be made up by the decrease in density in another area. Therefore, the estimation of land use benefits need to take into account any displacements which might offset the original increase in density. This is particularly important for submissions to Infrastructure Australia given the need to demonstrate the national significance of the problem or opportunity being addressed. The current lack of definitive evidence and the difficulty in estimating “additionality” at the national level means that land use impacts should be considered as a sensitivity test with the total impacts estimated being effectively an upper bound.

Dependency and conditionality

Not all infrastructure projects will be eligible to incorporate costs and benefits associated with land use change. Projects should demonstrate that any land use impacts—and therefore any additional costs and benefits to those captured in the conventional CBA – are dependent on the infrastructure project in question. Projects should also demonstrate that the necessary conditions (such as zoning changes, other infrastructure, ‘excess demand’ or associated public and private investment) are present in order for the identified land use impacts to materialise. This is expanded on below:

- **Dependency** means that infrastructure proposals should establish that the change in land use (i.e. any land use impacts) directly depends upon implementing the proposed infrastructure investment. Any land use change that would be permissible without the project in question – that is, changes to land use that could have gone ahead anyway – should not be used to inform any CBA land use benefit quantification³⁹. Supporting material for dependency could include evidence of current or predicted capacity constraints on nearby infrastructure, infrastructure needs assessments from infrastructure providers and/ or government agencies or findings from consultation with local, regional and state planning agencies.

A useful approach in helping to establish dependency could be to undertake an analysis of the impacts of the expected change in land use in the absence of the infrastructure project. If this were to show an unacceptable increase in congestion or crowding on the local transport network, the change might be unlikely to take place without an improvement to that infrastructure, and some or all of the land use change might be dependent development. (See for instance UK webTAG: <https://www.gov.uk/government/publications/webtag-tag-unit-a2-3-transport-appraisal-in-the-context-of-dependent-development-july-2016>).

³⁹ It is important here to distinguish between what could happen in theory and what would happen in reality. For example, theoretically the densification of inner city areas could be achieved through supply side regulatory intervention alone given demand (i.e. zoning change). In practice, however, planning regulations (and public sentiment) would be likely to prohibit this as it would impose negative impacts on existing residents or the existing transport system. If a project ameliorates these negative impacts and thus enables the planning regulations to be changed, then there are grounds to claim that the land use change is dependent on the project.

- **Conditionality** refers to the supporting conditions and activities necessary for the expected land-use impacts to materialise and ensuring that costs and delivery of these are part of the economic appraisal and business case. For example, whether the necessary supply-side factors such as zoning changes to allow densification, and public and/or private investment (e.g. water upgrades or remediation, schools and hospitals) are in place. It should also include factors that can hinder the realisation of benefits (for example, local opposition to increased density). To claim land use benefits, proponents should provide assurance in the project submission that all the necessary supporting conditions are in place and their associated costs are included in the economic appraisal.

Quantifying costs and benefits

Based on the quantified and fully attributed set of land use impacts, supported by evidence of dependency and conditionality, costs and benefits could be captured within a CBA framework. There are a number of possible land use benefits and costs that may be considered in addition to typical transport user benefits⁴⁰. Note that the benefit is only a **net** benefit where there is evidence of additionality and/or where the displacement is deemed to be of higher societal value:

- **Changes in value through land use changes**⁴¹ – a change in land use will generate a net economic benefit if the value of the new use is higher than the value of the current use, less the cost of achieving the change. Importantly, this benefit must **not** capture any land value uplift caused by the infrastructure itself (which would be captured through the direct benefits such as travel time savings, and externalities such as noise and air pollution). Rather, it should capture any unrealised value uplift less the additional costs incurred in deriving that input that has been suppressed through other constraints (such as planning controls). Subject to the above qualifications on attribution, dependency and conditionality, if an infrastructure investment unlocks this development and leads to an increase in land value which is more

than what would have occurred in the absence of the investment, this value is a net economic benefit which is appropriate to capture in a CBA. In some circumstances, an infrastructure investment may trigger a change in land use that reduces the value of some sites. Excluding costs that are captured separately through externalities, this estimation should take into account all changes in land use from the infrastructure project, and should be presented as a net figure in the CBA.

- **Public infrastructure cost changes** – connecting and providing infrastructure services such as utilities (water, electricity and gas), transport and larger scale social infrastructure (e.g. schools and hospitals) in less dense urban environments tends to be more expensive per dwelling than providing or upgrading the same infrastructure in denser environments. If these infrastructure costs are not fully recovered from the developers that create them, a project that leads to a change in the balance of distribution of future growth across denser and less dense parts of a city can lead to a net change in the cost of facilitating this growth. Changes in the costs of providing public infrastructure and services should be included only where the proponent can show evidence. Where possible, this should be specific to the location being studied, take into account variability in the type of housing, and have been tested with infrastructure and service providers. In particular, it would be necessary to assess the comparative costs of providing new schools and hospitals in greenfield or established areas, noting the differences in land costs and availability of infrastructure capacity. Further guidance for estimating benefits associated with avoiding infrastructure costs from unlocking new housing developments is available at <https://www.gov.uk/government/publications/webtag-tag-unit-a2-3-transport-appraisal-in-the-context-of-dependent-development-july-2016>
It should be noted that the public infrastructure cost changes depend on the pricing framework applicable. In many cases, a reduction in the costs of supply in one area will simply shift fixed costs

⁴⁰ Typical transport user benefits should be based on fixed land use scenarios only (using the base case land use in the project case).

⁴¹ Measurements of changes in land use value (or value uplift) in CBA's should not be confused with value capture concepts. According to the Commonwealth Bureau of Infrastructure, Transport and Regional Economics (BITRE, 2015), value uplift is "the process where the value flows on the transport network are capitalised into land values", while value capture taps into this by capturing some of the uplift around infrastructure investments for funding the project. Value capture is the act of collecting a portion of the benefits from public infrastructure investments that flow to the value of land.

to other users. For example, with water recycling plants in infill developments, the per-connection costs of supply to those users may be lower for the utility, but the third party pricing arrangement in some states could effectively shift these users off the utility's revenue base and increase the cost burden (maintenance and renewal of trunk infrastructure, etc) per connection across the rest of the catchment. The public infrastructure cost changes should be the cost incurred by the public infrastructure provider or utility net of revenue from developers and user prices, relative to the base case.

- **Second round user benefits and costs** – Once we allow for a change in land use in response to an infrastructure investment, there may be additional costs and benefits to those that relocate that should be captured in CBA. For instance, new residents that are attracted to a location in order to access improved amenities, better transport, etc, do so because they are better off. These benefits should be captured using the rule of a half.
- **Second round transport externalities** – Households clustered more tightly around trip destinations typically make shorter trips and make more use of walking, cycling and public transport, while more spread out land uses are usually associated with longer trips and higher share of car use⁴². Therefore, by changing land use, a project can change transport patterns and external costs (crowding, congestion, pollution, crash costs, etc.) of the total transport task. These second-round effects can be isolated, and attributed as benefits (or disbenefits) of a transport project. This would require robust analysis of the land use changes expected, as well as separate demand model forecasts that incorporate both the project and the forecast land use changes⁴³. Total benefits can then be estimated comparing the 'with

project, with land use change' scenario against the base case transport and land use scenario. To help understand the magnitude of the total benefits related to the transport improvement vs the land use change, promoters should show benefits both for a fixed land use scenario (i.e. first-round transport benefits) as well as for the full land use change scenario (e.g. by showing the total impacts as an increment to the first-round benefits).

- **Public health cost changes** – infrastructure projects that result in a denser pattern of urban development have grounds to claim public health cost savings associated with net increased incidence of trips using active transport. The NSW Government's 'Economic Framework for Urban Renewal' identifies the possibility of health benefits from increased active transport use as a result of urban infill⁴⁴.

When calculating the above costs and benefits, proponents will need to be mindful of the following methodological issues:

- **Double counting** – in incorporating benefits and costs associated with land use changes, proponents should guard against double counting. For land use benefits, this principally concerns the extent to which any land use costs and benefits may be implicitly included in other components of benefits, such as travel time savings. For example, in transport projects, if the traffic model includes induced demand and this (implicitly or explicitly) reflects induced demand from a change in land use, then the benefits to households and businesses changing location will already be captured in the first round transport benefits. Where this is the case, a CBA cannot also attempt to account for the costs and benefits of this land use change on the transport network.

⁴² See, for example, Brandes, U. et al (2010), "Land use and driving: The role compact development can play in reducing greenhouse gas emissions- Evidence from three studies"; *Urban Land Institute*; and Ewing R. and Cervero, R (2010), "Travel and the built environment: A meta-analysis", *Journal of the American Planning Association*, 76(3), pp. 265-294..

⁴³ In estimating land use change attributable to the transport project, there needs to be a good understanding of existing exogenous land use forecasts (e.g. from State Planning Departments). These forecasts would typically represent Base Case land use against which the land use model would estimate land use changes. Of particular importance is whether the exogenous land use forecast already considers the transport project in question. This would result in the land use modelling and the exogenous land use forecasts both measuring the impact of the transport investment. In such circumstances, it may be appropriate to consider the problem in 'reverse' – i.e. how would future land use growth change if the transport project was not delivered.

⁴⁴ This is supported by data from the ABS census which suggests there are significant differences in the rate of active travel as part of travel to work in infill and greenfield areas. Although workers living in greenfield areas that walk or cycle to work travel further than infill residents, the vast majority are heavily dependent on motor vehicles.

- **Redistribution** – land use benefits captured in the CBA should only reflect a redistribution of population and employment in the geographic area that is modelled⁴⁵. The modelled area must be defined so that that all positive and negative impacts are captured. This ensures that the benefits reflect all displacement of activity elsewhere and are net incremental benefits. Given the lack of appropriate evidence on the treatment of inward migration (population or firms) in the literature, it is recommended that no new activity as a result of this is considered in a CBA analysis unless compelling evidence can be presented to support such impacts, and the resulting costs and benefits are included.
- **Net negative impacts** – land use changes can have positive and negative impacts (i.e. benefits and costs). Where projects incorporate costs and benefits associated with land use impacts, proponents should ensure that both positive and negative land use impacts are translated into the CBA. In some projects, this may result in the land use impacts resulting in a net negative outcome.

Reporting of results

Proponents seeking to incorporate costs and benefits associated with land use changes should consult with Infrastructure Australia to discuss the justification for including these benefits in the context of the initiative's strategic objectives. Economic appraisal results should first be presented without land use benefits. Where second round transport impacts are identified, they should be included as core benefits but reported as a separate line item. If measuring other land use benefits is justified, then the results of each project option should be presented with land use benefits or dis-benefits as a 'below the line' item (similarly to WEBs).

Future developments

The guidance provided in this sub-section is a new area of guidance for this framework. It is intended to outline the guiding principles and provide initial foundational guidance, which will be expanded upon in future years as part of the continuous improvement of the Assessment Framework.

D3.10 Wider Economic Benefits

Where appropriate, Infrastructure Australia will consider wider economic benefits (WEBs) such as agglomeration effects for particular types of initiatives and projects. In general, these are the benefits derived from face-to-face contact, information exchange and networking only available to industries working close to each other.

WEBs are improvements in economic welfare that are acknowledged but which have not been typically captured in traditional CBA. Importantly, WEBs are not the same as the economic benefits determined by CGE or input-output models. WEBs can be disaggregated into a number of specific sources of benefits. The most significant is agglomeration, the notion that similar firms are drawn towards the same location since "proximity generates positive externality".⁴⁶

While it is recognised that the quantification of these wider benefits is still in development, both in Australia and internationally, the correct interpretation and accurate calculation of WEBs (using the most suitable data available) can add depth to the decision-making process for certain initiatives.

As part of its commitment to continuous improvement, the ATAP Steering Committee has commissioned work to develop detailed Australian guidelines on WEBs by 2017. In the interim, proponents may use principles outlined in the current ATAP guidelines.⁴⁷ They may also apply the Transport Analysis Guidance (WebTAG) approach, developed by the UK Government.⁴⁸

⁴⁵ Note, however, that dwelling numbers may increase.

⁴⁶ Head, Ries, and Swenson 1995, "Agglomeration benefits and location choice: Evidence from Japanese manufacturing investment in the United States", *Journal of International Economics*, 38, pp. 223-247.

⁴⁷ Transport and Infrastructure Senior Officials' Committee 2016, *Australian Transport Assessment and Planning (ATAP) Guidelines T3 Wider Economic Benefits*, Transport and Infrastructure Senior Officials' Committee, Australian Government, Canberra, viewed 31 May 2017 https://atap.gov.au/tools-techniques/wider-economic-benefits/files/t3_wider_economic_benefits.pdf

⁴⁸ United Kingdom Department for Transport 2013, *Transport analysis guidance: WebTAG*, Department for Transport, London, viewed 31 May 2017, <https://www.gov.uk/guidance/transport-analysis-guidance-webtag>

It should also be noted that some jurisdictions have developed guidance on the treatment of WEBs in recent years, for example, the Transport for NSW guidelines (2016).⁴⁹ While national guidelines on WEBs are being developed, proponents should consult the relevant state and territory guidelines. In quantifying WEBs, proponents should discuss with Infrastructure Australia which guidelines they propose to use.

In particular, it is crucial to acknowledge that:

- only certain initiatives, addressing a specific set of economic fundamentals, will generate WEBs
- significant WEBs will only be found in initiatives with strong traditional benefits, since WEBs require high levels of behaviour change, e.g. strong demand for the new asset/service
- some initiatives may have negative WEBs that need to be deducted from the positive WEBs
- the availability of Australian specific data to calculate WEBs is currently very limited.

Proponents seeking to calculate WEBs should consult with Infrastructure Australia to discuss the justification for including WEBs in the context of the initiative's strategic objectives, and its impacts upon the transport and labour markets. Economic results should firstly be presented without WEBs. If measuring WEBs is justified, then the results of each project option should be presented with WEBs as a supplementary result.

The quantitative analysis should follow the latest guidance and use well-informed assumptions about the most appropriate initiative-specific data. Applying a broad percentage uplift to the results of the conventional appraisal does not provide any additional or meaningful information for Infrastructure Australia to consider in the evaluation process.

Further guidance on WEBs published by the UK Government is available at: <https://www.gov.uk/government/publications/webtag-tag-unit-a2-1-wider-impacts>

Please note that the UK Government conducted stakeholder consultation on their draft guidelines on wider impacts in late 2016 and that the above reference is subject to change.

The use of computable general equilibrium (CGE) models

The outputs of computable general equilibrium (CGE) models do not usually play a role in CBA. CGE models focus on 'economic activity impacts', which are not a measure of efficiency effects.

It is usually not necessary to undertake CGE modelling for Infrastructure Australia submissions unless the proponent believes that the project will have a significant macroeconomic impact at the national level.

Infrastructure Australia will primarily use CBA data for assessing the measurement of the benefits of a project and is unlikely to consider CGE benefits as additive or complementary to CBA benefits.

Infrastructure Australia departures from ATAP guidelines

For transport appraisals, Infrastructure Australia recommends the ATAP Guidelines as the default guidance for almost all aspects of the appraisal process.

In some cases, Infrastructure Australia's approach departs from the ATAP Guidelines. These include the methods to quantify and monetise vehicle operating costs, and the assumptions for vehicle occupancy rates. Infrastructure Australia considers that the current ATAP approach may overestimate these benefits.

Infrastructure Australia is working with the ATAP Steering Committee to determine if Infrastructure Australia's recommended policy positions could be accommodated within the ATAP guidelines.

At present, Infrastructure Australia's recommended approach for estimating vehicle operating cost and assuming vehicle occupancy rates is outlined below.

⁴⁹ Transport for New South Wales 2016, Principles and Guidelines for Economic Appraisal of Transport Investment and Initiatives, NSW Government, Sydney, viewed 31 May 2017, <https://www.transport.nsw.gov.au/sites/default/files/b2b/publications/principles-and-guidelines-for-economic-appraisal-of-transport-investment.pdf>

D3.11 Other guidelines

In undertaking a detailed CBA, proponents may wish to refer to the guidance noted in Table 34.

Table 34 Other guidance documents

Author	Document	Sector	Area of guidance
ATAP	Transport and Infrastructure Senior Officials' Committee 2016, <i>Australian Transport Assessment and Planning (ATAP) Guidelines</i> , Transport and Infrastructure Council, Canberra, viewed 31 May 2017 www.atap.gov.au	Transport	<ul style="list-style-type: none"> ▪ Evaluation frameworks ▪ Travel demand modelling ▪ Transport CBA methodology ▪ Parameter values ▪ Mode specific guidance
Transport for NSW	Transport for NSW 2016, <i>Principles and Guidelines for Economic Appraisal of Transport Investment and Initiatives</i> , NSW Government, Sydney, viewed 31 May 2017 https://www.transport.nsw.gov.au/newsroom/publications-and-reports/principles-and-guidelines-economic-appraisal	Transport	<ul style="list-style-type: none"> ▪ Evaluation frameworks ▪ Transport CBA ▪ Parameter values ▪ Worked examples
NBN Panel of Experts	Department of Communications 2014, <i>Independent cost-benefit analysis of broadband and review of regulation</i> , Department of Communications, Canberra, viewed 31 May 2017 https://www.communications.gov.au/departamental-news/independent-cost-benefit-analysis-nbn	Telecommunications	<ul style="list-style-type: none"> ▪ Worked example
AER	Australian Energy Regulator 2013, <i>Regulatory investment test for distribution application guidelines</i> , AER, Melbourne, viewed 31 May 2017 https://www.aer.gov.au/networks-pipelines/guidelines-schemes-models-reviews/regulatory-investment-test-for-distribution-rit-d-and-application-guidelines	Energy	<ul style="list-style-type: none"> ▪ Energy CBA methodology ▪ Worked examples
AER	Australian Energy Regulator 2013, <i>Regulatory investment test for transmission application guidelines</i> , AER, Melbourne, viewed 31 May 2017 https://www.aer.gov.au/networks-pipelines/guidelines-schemes-models-reviews/regulatory-investment-test-for-transmission-rit-t-and-application-guidelines-2010	Energy	<ul style="list-style-type: none"> ▪ Energy CBA methodology ▪ Worked examples

Author	Document	Sector	Area of guidance
THINK	THINK 2013, <i>Cost-Benefit Analysis in the Context of the Energy Infrastructure Package</i> , European University Institute, Firenze, viewed 31 May 2017 http://www.eui.eu/Projects/THINK/Documents/Thinktopic/THINKTopic10.pdf	Energy	<ul style="list-style-type: none"> Energy CBA methodology
European Network of Transmission System Operators for Electricity (ENTSO-E)	ENTSO-E 2013, <i>Guideline for Cost-Benefit Analysis of Grid Development Projects</i> , ENTSO-E, Brussels, viewed 31 May 2017 https://www.entsoe.eu/major-projects/ten-year-network-development-plan/CBA-Methodology/Pages/default.aspx	Energy	<ul style="list-style-type: none"> Energy CBA methodology Parameter values
Department of Finance and Administration	Department of Finance and Administration 2006, <i>Handbook of Cost-Benefit Analysis</i> , Department of Finance and Administration, Canberra, viewed 31 May 2017 https://www.finance.gov.au/sites/default/files/Handbook_of_CB_analysis.pdf	General	<ul style="list-style-type: none"> Evaluation frameworks CBA methodology Worked examples
European Commission	European Commission 2014, <i>Guide to Cost-Benefit Analysis of Investment Projects: Economic appraisal tool for Cohesion Policy 2014–2020</i> , European Commission, Brussels, viewed 31 May 2017 http://ec.europa.eu/regional_policy/sources/docgener/studies/pdf/cba_guide.pdf	General	<ul style="list-style-type: none"> Evaluation frameworks Sector specific guidance Worked examples
CSIRO/NCCARF	Wise, R.M. and Capon, T. 2016. Assessing the costs and benefits of coastal climate adaptation. CoastAdapt Information Manual 4, National Climate Change Adaptation Research Facility, Gold Coast. https://coastadapt.com.au/sites/default/files/information-manual/IM04_Costs_and_benefits.pdf	General/climate change	<ul style="list-style-type: none"> General guidance on how to think about and account for economic values in decision making; considering the role of rules and discount rates

Infrastructure Australia's recommended vehicle operating cost method

Infrastructure Australia considers the vehicle operating cost method outlined in the 2016 ATAP guidelines⁵⁰ may lead to overstated vehicle operating cost savings for the project cases.

ATAP's recommended methodology assumes a stop-start traffic model whereby an increase in the speed of the vehicle will increase the distance the vehicle is able to travel, leading to a reduction in capital costs and associated interest payments. This is relevant for only couriers or freight delivery vehicles which operate throughout the day. It is not likely to be relevant for the vast majority of car users such as commuters.

Applying this methodology to all vehicles means the higher the increase in the speed, the higher the vehicle operating cost savings.

The reasoning is that, if average travel speed can increase from 30 kilometres per hour to 60 kilometres per hour, a vehicle can travel twice the distance, thereby spreading capital costs of the vehicle over twice the kilometres. Hence, the cost per kilometre falls rapidly with higher speeds. However, for most car users, the car is likely to be used for the same number of trips regardless of the speed it goes. It is not likely that a driver will decide to make more trips unnecessarily simply because he/she can travel at a higher speed. Therefore, the decline in vehicle operating costs as speeds increase would be overstated.

The ATAP 2016 approach also has a discontinuity in the vehicle operating cost function at 60 kilometres per hour. This is a methodological issue, not a real reduction in vehicle operating costs at that point.

Infrastructure Australia has seen a number of CBA results using ATAP's approach compared to other methods. The resultant estimated benefit can differ by a factor of 10, making a substantial difference to CBA results.

Until further notice, Infrastructure Australia suggests that the proponents adopt the vehicle operating cost method recommended in the Austroads 2012 guidelines.⁵¹

Vehicle occupancy rates

Infrastructure Australia is concerned that the urban vehicle occupancy rates recommended in the 2016 ATAP guidelines are higher than those recommended by other jurisdictional guidelines and actual rates observed.⁵²

For example, Table 35 shows the vehicle occupancy rates recommended by the NSW Government (Transport for NSW), compared to the ATAP/Austroads guidelines.

Table 35 *Vehicle occupancy rates in Australian guidance material*

Vehicle type	Urban	Non-urban
NSW – recommended vehicle occupancy rates		
Cars private	1.46	1.7
Cars business	1.07	1.3
Heavy trucks	1.17	1–1.3
Bus passengers	20	21
ATAP – recommended vehicle occupancy rates		
Cars private	1.6	1.7
Cars business	1.4	1.3
Heavy trucks	1	1
Bus passengers	20	20

Sources: NSW Government Transport for New South Wales (2016), *Principles and Guidelines for Economic Appraisal of Transport Investment and Initiatives*, NSW Government, Sydney, <https://www.transport.nsw.gov.au/sites/default/files/b2b/publications/principles-and-guidelines-for-economic-appraisal-of-transport-investment.pdf>; Transport and Infrastructure Senior Officials' Committee (2016), *Australian Transport Assessment and Planning (ATAP) Guidelines PV2 Road Parameter Values*, Transport and Infrastructure Council, Canberra, <https://atap.gov.au/parameter-values/road-transport>, Table 12, p. 19; and Austroads (2012), *Guide to Project Evaluation Part 4: Project Evaluation Data*, Austroads, Sydney, <https://ngtsguidelines.files.wordpress.com/2014/08/agpe04-12.pdf>, Table 3.4, p. 21

⁵⁰ Transport and Infrastructure Senior Officials' Committee 2016, *Australian Transport Assessment and Planning (ATAP) Guidelines PV2 Road Parameter Values*, Transport and Infrastructure Senior Officials' Committee, Australian Government, Canberra, viewed 31 May 2017 <https://atap.gov.au/parameter-values/road-transport/>

⁵¹ Austroads 2012, *Guide to Project Evaluation Part 4: Project Evaluation Data*, Austroads, Sydney, viewed 31 May 2017, <https://ngtsguidelines.files.wordpress.com/2014/08/agpe04-12.pdf>

⁵² Transport and Infrastructure Senior Officials' Committee 2016, *Australian Transport Assessment and Planning (ATAP) Guidelines PV2 Road Parameter Values*, Transport and Infrastructure Senior Officials' Committee, Australian Government, Canberra, viewed 31 May 2017 <https://atap.gov.au/parameter-values/road-transport/>

As can be seen from Table 35, the urban occupancy rates in ATAP are higher than those recommended by the NSW Government.

Furthermore, there is evidence that the actual vehicle occupancy observed are lower than the assumptions recommended by ATAP. Table 36 shows the vehicle occupancy rates observed in Sydney and Melbourne by time periods.

Table 36 *Observed private vehicle occupancy rates for Sydney and Melbourne*

	Average weekday (all day)	AM peak	PM peak	Off peak/non-work trips
Sydney	1.46	1.45	–	1.67
Melbourne	1.20	1.16	1.20	1.21

Sources: NSW Government Transport for NSW Bureau of Transport Statistics (2014), *2012/13 Household Travel Survey Summary Report*, Transport for NSW, Sydney, <http://www.bts.nsw.gov.au/Publications/Reports/Reports/default.aspx>; and VicRoads (2015), *Traffic Monitor 2013/14*, Vic Roads, Melbourne <https://public.tableau.com/views/TM-Occupancy/TM-OccupancyDashboard>

The data from VicRoads 2015⁵³ and the Bureau of Transport Statistics 2014⁵⁴ for Melbourne and Sydney respectively indicate occupancy rates for private vehicles range between 1.16 and 1.67, depending on time of day and the journey purpose. This implies that the recommended figures used in the guidelines for some categories are higher than the actual vehicle occupancy rates observed.

High occupancy rate parameters overstate benefits when vehicle kilometres are converted to passenger kilometres to which a value of time is applied. However, without new surveys, it is not possible to determine which of the observed vehicle occupancy rates are most appropriate for assuming in other jurisdictions.

To mitigate the impacts of this uncertainty, Infrastructure Australia suggests proponents undertake the following:

- first, use the observed occupancy rates collected for a specific project (location specific data). However, this may be cost prohibitive to do for all projects
- where project specific occupancy rates cannot be collected, a second best solution is to use the latest and most relevant empirical data available. This may also not be possible, as the variance between the Victorian and NSW empirical study results indicate
- finally, where no updated information exists, use the current published rates recommended by ATAP for consistency.

D3.12 Reporting and documentation

The results of the appraisal need to form a central element of the business case for each initiative submitted to Infrastructure Australia. The appraisal needs to comply with this guide. Proponents should provide Infrastructure Australia with:

- completed templates
- full business cases
- where available, a series of supporting documentation, including:
 - a detailed, independent report setting out predicted demand and the basis/drivers for any changes in demand
 - a detailed, independent specialist cost estimation report, which reports costs at both the P50 and P90 level
 - a detailed report of the economic appraisal methodology, including a full explanation of all the assumptions and parameters used, and the sensitivity tests applied.

⁵³ VicRoads 2015, *Traffic Monitor 2012-13*, Vic Roads, Melbourne, viewed 31 May 2017 https://www.google.com/url?q=https://www.vicroads.vic.gov.au/~media/files/documents/traffic%2520and%2520road%2520use/trafficmonitorreport20122013.ashx&sa=U&ved=0ahUKEwiEos2v_pnUAhXLIZOKHYtvCniQFggKMAE&client=internal-uds-cse&usg=AFQjCNE98oQeafdU6xYNz14CpA9duTy-nA

⁵⁴ Transport for NSW Bureau of Transport Statistics 2014, *2012/13 Household Travel Survey Summary Report*, Bureau of Transport Statistics, Sydney, viewed 31 May 2017, <http://www.bts.nsw.gov.au/Publications/Reports/Reports/default.aspx>

D4. Risk, uncertainty and sensitivity analysis

D4.1 Overview of risk and uncertainty

All infrastructure projects have project risks, even after risk mitigation measures have been applied.

Project risks are defined as outcomes that have measurable probabilities, while uncertainty involves outcomes or events with no measurable probability. For simplicity, these guidelines will use the term risk and uncertainty synonymously.

Generally, the main sources of project risks include:

- investment cost risks created by unforeseen construction, technical or other project scope issues
- operating cost risks (including maintenance) created by unforeseen market impacts/changes and technical issues
- demand forecast risks driven by changes in factors such as unforeseen population growth or cost of living
- environmental impacts driven by unforeseen circumstances
- network effects caused by unexpected and inter-related network projects/changes.

A number of tools exist to determine the impact of risks on a CBA. They range from relatively low-cost methods such as sensitivity analysis through to more sophisticated methods such as the development of probabilistic estimates using Monte Carlo analysis.

One of the easiest ways to test impact of risks and uncertainty on the option is to conduct sensitivity tests. Infrastructure Australia recommends that all business cases have a sensitivity analysis of the options accompanying the CBA.

D4.2 Purpose of sensitivity analysis

Sensitivity testing of the options in a CBA is a key element of risk assessment.

The purpose of sensitivity analysis is to assess the possible impact of risks and uncertainty on project outcomes. This is performed by determining the change in project outcomes with respect to changes in specific project variables, inputs and assumptions. More specifically, undertaking sensitivity analysis allows proponents to:

- acknowledge that there is always a degree of uncertainty and ultimately risk surrounding an initiative or project
- understand the key factors and project variables that impact on project outcomes
- prioritise, assess and select options based on different assumptions and project outcomes.

A risk assessment should be undertaken to estimate the typical variations on the inputs with the sensitivity testing undertaken based on the variations. Depending on the project, the sensitivity tests should include:

- changes in global oil prices
- fluctuations in carbon prices
- different population growth/decline scenarios
- changes in prices of alternative products and services (e.g. mobile broadband for communication initiatives)
- fluctuations in prices of inputs
- different demand and bidding scenarios (e.g. high, medium and low; and competitive vs. strategic bidding)
- changes in modal competition
- more integrated public transport
- other key relevant scenarios, e.g. flooding probability scenarios, if flooding was flagged as key project risk.

D4.3 Common sensitivity tests

Project proponents are required to identify and assess project variables, inputs and assumptions in a systematic and meaningful manner i.e. chosen project variables must be relevant to project objectives and outcomes. A systematic approach is required, as there is limited value in undertaking a sensitivity analysis on variables that have been chosen arbitrarily.

Table 37 identifies the minimum standard sensitivity tests and ranges that should be carried out for projects. Infrastructure Australia encourages proponents to refer to sector specific guidance, such as ATAP, for further guidance in undertaking sensitivity analysis.

Table 37 Sensitivity tests commonly used in business cases

Test	Ranges used
Discount rate	4% and 10%
Under/over estimation of costs (maintenance/capital costs)	±20% and/or P50 and P90 costs
Under/over estimation of benefits	±20% of project specific benefits
Economic appraisal period	30 year and 50 year appraisal periods
Wider economic benefits (WEB's)	Inclusion and exclusion of WEBs
Best case scenario	Simple: Assume -20% total costs and +20% benefits Complex: Assume upside adjustments for 4–5 key variables
Worst case scenario	Simple: Assume +20% total costs and -20% benefits Complex: Assume downside adjustments for 4–5 key variables

Source: Infrastructure Australia.

Wherever possible, Infrastructure Australia recommends the testing of project-specific risks on the options, rather than simply applying a set of standard sensitivity tests.

Furthermore, Infrastructure Australia recommends the use of combination sensitivity tests which test a number

of reasonable and realistic scenarios, in particular, the worst case scenario.

More sophisticated and specific sensitivity analysis on key project inputs would be required for larger and more complex projects. Table 38 provides examples of some key variables for transport projects:

Table 38 Examples of transport specific variables for sensitivity analysis

Test	Ranges used
Total traffic volume (AADT)	±5 percentage points
Proportion heavy vehicles	±0.3 from estimate
Traffic growth rate	± 2% pa (absolute) from the forecast rate
Traffic diverted or generated by the initiative	± 50% of estimate

Source: Austroads.

Sensitivity analysis and managing risk

By identifying the most critical risks to achieving benefits, the proponent will be better able to focus on which risks to manage and what further information to seek in making final decisions.

For example, if a high risk is identified for a particular project around population growth in a particular spatial area, then further work might be undertaken on the development potential and timing in the area, and whether options could be staged or delayed to minimise risk that development occurs more slowly than expected.

D4.4 Sensitivity test ranges for costs

The ATAP guidelines⁵⁵ recommend project proponents undertake sensitivity analysis of costs, based on the project proponent's view of plausible values the variables could take.

The ATAP guidelines also suggest sensitivity ranges for costs, as shown in Table 39. In the absence of project specific data for contingencies, Infrastructure Australia supports the use of these as a guide to the sensitivity analysis that should be undertaken for costs and encourages proponents to refer to project specific guidelines e.g. ATAP.

Table 39 ATAP suggested sensitivity ranges for cost testing

Stage of development	Suggested Minimum value	Suggested Maximum value
Concept estimate	-20% of estimate	+20% to 35% of estimate
Detailed costing	-15% of estimate	+15% to 25% of estimate
Final costing	-10% of estimate	+10 to 20% of estimate
Road-agency operating and maintenance costs	-10% of estimate	+10% of estimate

Source: Transport and Infrastructure Senior Officials' Committee (2016), *Australian Transport Assessment and Planning (ATAP) Guidelines Step 11: Assess risk and uncertainty*, Transport and Infrastructure Council, Canberra, <http://atap.gov.au/tools-techniques/cost-benefit-analysis/12-step-11-assess-risk-and-uncertainty.aspx>

D4.5 Project interactions

A proponent may be considering multiple projects at the same time, and these may interact. Projects may be substitutes, complements or independent (see Table 40).

Understanding how projects fit together can provide for better decision-making:

- Where projects are either substitutes or complements, it is helpful to understand the net benefits undertaken by themselves and together to inform the preferred options
 - This can occur through considering multiple projects within a single business case or through sensitivity analysis testing whether projects have net benefits if the other project occurs or does not occur.
- Where projects are independent, they should not be combined into a single business case.

⁵⁵ Transport and Infrastructure Senior Officials' Committee (2016), *Australian Transport Assessment and Planning (ATAP) Guidelines Step 11: Assess risk and uncertainty*, Transport and Infrastructure Council, Canberra, <http://atap.gov.au/tools-techniques/cost-benefit-analysis/12-step-11-assess-risk-and-uncertainty.aspx>

Table 40 Project relationships

Project relationship	Definition
Substitutes	<p>The net benefits of undertaking both Project A and Project B are lower than the net benefit of undertaking Project A by itself, plus the net benefit of undertaking Project B by itself.</p> <p>For example, Project A has a net benefit of \$100m and Project B \$200m if undertaken alone. The net benefit if both are undertaken is \$250m.</p>
Complements	<p>The net benefits of undertaking both Project A and Project B are higher than the net benefit of undertaking Project A by itself, plus the net benefit of undertaking Project B by itself.</p> <p>For example, Project A has a net benefit of \$100m and Project B \$200m if undertaken alone. The net benefit if both are undertaken is \$400m.</p>
Independent	<p>The net benefits of undertaking both Project A and Project B are equal to the net benefit of undertaking Project A by itself, plus the net benefit of undertaking Project B by itself.</p> <p>For example, Project A has a net benefit of \$100m and Project B \$200m if undertaken alone. The net benefit if both are undertaken is \$300m.</p>

Source: Infrastructure Australia.

In some cases where short term uncertainty can be very high, such as for water infrastructure whose need depends on rainfall and dam levels, decision-makers should keep open the option of halting a project where dam levels rapidly increase.



D4.6 Considering climate change risks

Why is climate change risk important in the appraisal of infrastructure projects?

It is timely to consider the impact of climate change risk on the investment appraisal of infrastructure projects because there is now strong evidence that the Australian climate is changing due to greenhouse gas emissions globally (see ‘State of the Climate’, BoM/CSIRO, 2016⁵⁶).

There are already detectable increases in temperatures, extreme events and sea level that have potentially material impacts on the service lifetime and reliability of infrastructure⁵⁷. These will also affect some demand drivers for infrastructure, such as changing needs for energy, water and transport for urban and rural users.

Although there is uncertainty about exactly how much change will eventually play out, there is very high confidence that risks arising from failing to plan for these changes will continue to increase over coming decades. Planning for these changes may mean building infrastructure to different standards (e.g. building a bridge to a higher flood specification), but may also mean considering different options for achieving the same service outcomes (e.g. moving a road corridor away from areas of possible future coastal inundation, or changing transport mode to become more flexible).⁵⁸

There is growing evidence that early action on these risks can result in rapid payback times – for example, the Queensland Reconstruction Authority’s DARMsSys monitoring⁵⁹ is showing that improving infrastructure resilience can pay for itself within 2-4 years.

Why is it important to consider different scenarios?

Most large infrastructure projects have a long operating life; many also entail other developments (such as ‘asset anchoring’) and consequently create even longer path dependencies for society. For example, an expanded transport corridor may facilitate the development of a new suburb which requires a new sea wall. The expanded

transport corridor may result in developments behind the sea wall that assume flood protection far beyond the operating life of the wall itself. Such projects need to take account of long term trends in society, such as population growth, technology disruptions, consumer expectations, climate change, and economic growth. There is uncertainty about the trajectories of all of these factors, especially beyond one or two decades. Failure to consider these trends now may lead to wasted investments, stranded assets or even danger to human well-being.

A key risk in the face of uncertain futures is that a project case is chosen that performs well against one possible future, but fails in others. For example, a dam storage of a particular size is optimal for some combination of rainfall and demand levels. However, if demand falls and/or rainfall increases, its cost may not have been warranted, whilst in the reverse case, it may fail to deliver the services intended.

Scenario analysis should be used to help identify and design response options, especially to ensure an appropriate diversity of project cases is considered, and that preferred options are ‘robust’ to the diversity of possible future scenarios that may play out.

In the context of cost-benefit analysis, ‘scenarios’ mean coherent futures driven by plausible sets of exogenous trends in factors such as population, economic growth and climate change (please see Box 9). While it is often conventional to assume a fixed scenario in the base case for many projects (particularly transport projects), it is good practice to model at least one future scenario in the base case, particularly in the treatment of climate change risk. For large, long-lived investments, the base case should explore a diversity of future scenarios in the same way that the project cases do. This will ensure a more accurate estimation of expected benefit flows in the CBA.

If proponents plan to apply a full scenario analysis in the cost-benefit analysis, we encourage proponents to contact Infrastructure Australia to discuss their proposed approach.

⁵⁶ Australian Government Bureau of Meteorology (2016), *State of the Climate 2016*, <http://www.bom.gov.au/state-of-the-climate/>

⁵⁷ For example, see <https://www.nccarf.edu.au/localgov/keywords/infrastructure>

⁵⁸ It is important to separate natural disaster or natural hazard risks from the climate change risks. A natural disaster is one, or a combination of the following rapid onset events of bushfire, earthquake, flood, storm, cyclone, storm surge, landslide, tsunami, meteorite strike, or tornado. Events where human activity is a significant contributing cause (for example, poor environmental planning, commercial development, personal intervention (other than arson), or accident) may not be natural disasters for the purposes of this determination.

⁵⁹ Queensland Government Reconstruction Authority (2017), DARMsSys™, <http://qldreconstruction.org.au/about/darmsys>

In conventional cost-benefit analysis, an option is generally considered to be “robust” if its benefit-cost ratio stays above 1 under a range of sensitivity tests, including a combination sensitivity test which represents a worst case scenario.

In the context of climate change risk, the robustness of an option is described in stricter terms. A response option is said to deliver ‘robust’ outcomes in the face of future uncertainty if it performs satisfactorily in most plausible future scenarios (i.e. lower risk), compared to an option which performs well under one scenario but fails in others. A variety of ways of creating flexibility in project proposals is identified by the Victorian Department of Treasury and Finance⁶⁰. Table 41 summarises these options or adaptations and provides some examples.

Table 41 Approaches to creating flexibility or reducing decision risk in the face of uncertainty

Options or adaptations	Examples
<p>Timing</p> <ul style="list-style-type: none"> ▪ Abandon a project at an early stage ▪ Plan projects in discrete stages triggered by demand metrics ▪ Invest in flexibility by committing to time critical elements but delaying major investments ▪ Invest in R&D to reduce uncertainty and reduce the risk of regret 	<ul style="list-style-type: none"> ▪ Build with a deliberately shorter operational lifetime so the asset can be efficiently replaced when we know more about how the future is unfolding (e.g. a coastal tourist development could be built with short lived units that are relatively cheaply recycled in 30 years once the rate of sea level rise is clearer) ▪ Invest in new transport technologies that facilitate market instruments and other policies, e.g. number plate recognition supports a congestion tax
<p>Scale and scope</p> <ul style="list-style-type: none"> ▪ Scale a project up or down ▪ Change the scope of a project to provide a different mix of services ▪ Switch inputs or outputs to meet changing needs ▪ Alter existing infrastructure to serve new purposes, allow intermittent service delivery, or mothball ▪ Use inherently flexible technologies, such as a sequence of small projects instead of one large project ▪ Use non-asset measures to reduce demand, such as market instruments and other policies 	<ul style="list-style-type: none"> ▪ Build to a higher standard that can cope with higher usage or with increased future flooding, but whether this is robust depends on the net costs or net benefits (e.g. a bridge could be built to cope with larger floods, but this may not be the most efficient way to achieve the same level of robustness) ▪ Multiple irrigation water storages on a river might be developed over time as future demand becomes clearer. ▪ Build in a more flexible form (e.g. a dam wall could be built with larger foundations so that, if needed, the wall height could be increased in future more cheaply than by re-building) ▪ Use congestion taxes to manage transport demand

Note: based on Victorian Department of Treasury and Finance (2016), *Investment Lifecycle and High Value/High Risk Guidelines*, Table 3, p.10, <http://www.dtf.vic.gov.au/files/cb413283-913e-4ec1-9a2d-a678010dc56c/Investment-Lifecycle-and-HVHR-Guidelines-Stage-2-Prove-Guideline-September-2016.pdf>

⁶⁰ Victorian Department of Treasury and Finance (2016), *Investment Lifecycle and High Value/High Risk Guidelines*, Table 3, p.10, <http://www.dtf.vic.gov.au/files/cb413283-913e-4ec1-9a2d-a678010dc56c/Investment-Lifecycle-and-HVHR-Guidelines-Stage-2-Prove-Guideline-September-2016.pdf>. Five general approaches to reducing the risk of a decision now in the face of future uncertainty are also outlined by Hallegatte, S. (2009) Strategies to adapt to an uncertain climate change. *Global Environmental Change* 19, pp. 240-247.

Long-term changes raise challenges of uncertainty, path dependencies and irreversibility, and highlight the need to look for options that provide outcomes that are robust across futures; these issues matter more for projects with longer lifetimes.

Flexibility has value because the ability to defer an investment can provide time to learn about uncertainties and to respond better in the project design. The value of flexibility is further enhanced where uncertainties are expected to become greater over time, where project actions involve some degree of irreversibility, and where a commitment to one project extinguishes options to undertake other possible projects. Flexibility values are sometimes quantified using real options analysis in cases where uncertainties are relatively well-specified, although versions of real options analysis have value for structuring responses to more complex forms of uncertainty (e.g. see Hertzler⁶¹ 2007). This should be considered at the early stage of developing project options and also during sensitivity analysis.

It is important to consider costs and benefits resulting from all the aspects of infrastructure projects which may be affected by climate change risk. Broadly, there are three ways in which climate risks may affect the value of an infrastructure project:

- **Direct effects** on an asset that alter its ability to deliver the intended services or its costs; these may be acute (e.g. increasing disaster impacts from natural hazards such as flooding) or chronic (e.g. trends towards higher average temperatures promoting faster corrosion)
- **Indirect effects** of climate that alter benefits flows even if the infrastructure itself is working as intended (e.g. changing temperatures and rainfall altering demand for agriculture-related commercial transport)
- **Transition risks** where changes in technology, policy or sentiment occur in response to climate change, altering the relevance of the services delivered by the infrastructure whether or not climate change itself eventuates (e.g. changing fuel markets which reduce the demand for coal transport to export ports, driverless truck technology or improved telework which reduce the demand for transport).

When should climate change scenarios be considered?

Many projects may not need to consider future climate risks in detail. This section provides a simple decision tree to determine whether such consideration is needed. Determining whether to incorporate climate change risks into a CBA depends on an *a priori* assessment of the plausible impacts of these risks on the costs and benefits of the project.

It has been argued that a conventional CBA does not deal with climate change risk adequately because it generally assumes that decisions are concerned with actions of limited irreversibility, limited path dependency, short life-time, small value changes, limited interdependencies, low levels of uncertainty, and small option values associated with delay or other sources of flexibility. Whether climate change needs explicit consideration depends on expectations about how well these assumptions are likely to be met, which can be assessed in the following stepwise fashion.

These steps first distinguish projects that are specifically aimed at adapting to climate change, then categorises other projects:

1. *Is the project specifically aimed at climate adaptation?* In the future, there will be some future infrastructure projects which are designed as a direct response to changing climate risks, such as barriers to protect against the increased risks of flooding from storm surges under sea level rise scenarios (e.g. the Thames Barrier); these necessarily require consideration of climate change. However, these projects also require an assessment of the consequences of uncertainties, other long-term changes and interdependencies that occur over the timeframe of possible climate change impacts. Real options and scenario analysis methods can be used in conjunction with ‘adaptation pathways’ approaches in these contexts.

⁶¹ Hertzler, G. (2007), “Adapting to climate change and managing climate risks by using real options”, *Australian Journal of Agricultural Research*, 58, 985-992.

Box 9 Creating future scenarios

In most cases, the goal with scenario analysis is to consider 3-4 coherent pictures of the future that enable key areas of uncertainty to be explored¹. For example, a scenario that could be compared might represent:

- high population and economic growth coupled with higher levels of climate change and low technology disruption
- lower population and economic growth, less climate change, but significant technology disruption (e.g. complete move to driverless electric vehicles)

Such scenarios can be created through a combination of formal projections for population (e.g. Australian Bureau of Statistics projections²) and climate (please see below), and sensible narrative for the more uncertain aspects such as technology and consumer sentiment. The Bureau of Meteorology (BoM) website³ provides up-to-date present day climate hazards. Authoritative projections of future climate may be found at the *Climate Change in Australia* (CCiA) website as well as various state-based resources⁴. The level of detail recommended for different Stages is described in the next section.

When using scenario analysis to frame alternative response options, the proponent should consider

scenarios of *greatest plausible change* in order to encompass the range of uncertainty; this usually means examining projections for the highest emissions scenario (“RCP8.5”). When selecting the best response, it is appropriate to evaluate the least, medium and greatest plausible levels of change, to help identify options that provide robust outcomes across all three scenarios.

It is also important to consider the lifetime of the asset (and possible subsequent path dependencies): if this is short (5-10 years), it is generally sufficient to consider current climate risks; if it is longer (2030 and beyond), then it is important to consider future change.

Trajectories of change can be examined through the CCiA’s ‘Time Series Explorer’.

Finally, climate changes will need to be translated into impacts on assets. This may be done directly for some measures such as extreme temperatures but, for other impacts, further analysis may be needed. There is a wide range of impact resources available through sites such as CCiA and CoastAdapt. Where there are gaps in data, the advice is often available in sector specific documentation (e.g. for flooding through the Australian Rainfall and Run-off Guidelines, Chapter 6). Where none can be found, an analysis may need commissioning if the size of project warrants it.

Notes:

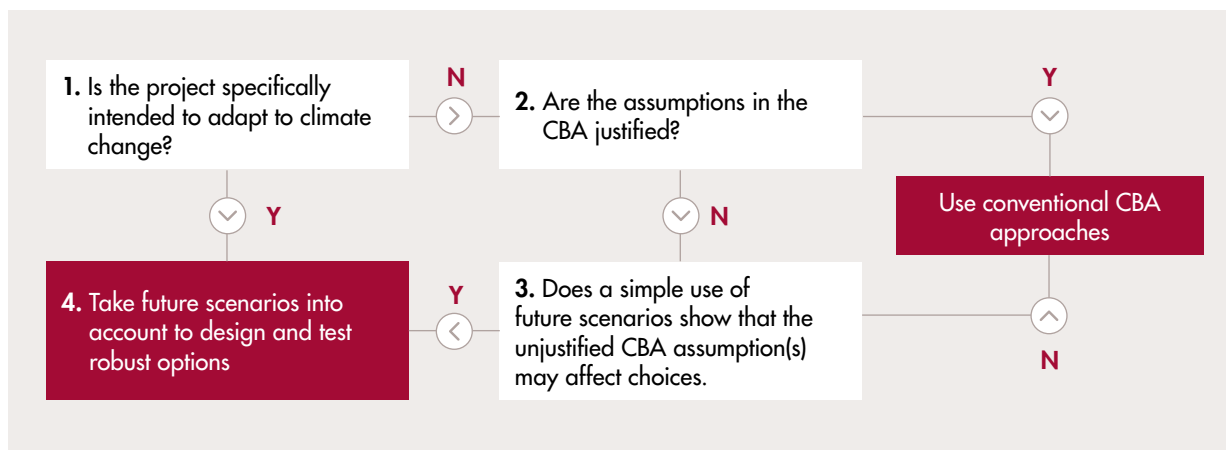
1. For very large or contentious investments, more comprehensive, quantitative scenario analysis may be warranted: e.g. using Robust Decision Making (RDM) see Groves, D.G., Lempert, R.J. (2007) A new analytic method for finding policy-relevant scenarios. *Global Environmental Change* 17, 73-85.
2. Australian Government Australian Bureau of Statistics (2013), *Population Projections, Australia, 2012 (base) to 2101*, <http://www.abs.gov.au/ausstats/abs@.nsf/mf/3222.0>
3. Australian Government Bureau of Meteorology (2017), *Climate and past weather*, <http://www.bom.gov.au/climate/>
4. Australian Government Department of the Environment and Bureau of Meteorology (2017), *Climate Change in Australia*, www.ClimateChangeinAustralia.gov.au. See also: for NSW & ACT <http://climatechange.environment.nsw.gov.au/Climate-projections-for-NSW/About-NARCLiM>; for Tasmania <http://acecrc.org.au/climate-futures-for-tasmania/>; for South Australia <http://data.gov.au/dataset/goyder-institute-for-water-research-downscaled-climate-projections-for-south-australia>; for Queensland <https://www.qld.gov.au/environment/climate/resources>. Also CoastAdapt for sea level rise and related coastal information <https://coastadapt.com.au/>.

2. *Are the assumptions in a conventional CBA justified?*
For other projects not specifically aimed at climate adaptation, a project proponent can present an argument that the assumptions of a conventional CBA can be expected to be met reasonably well. For example, the project proponent would need to argue that there are no long-term consequences of the infrastructure project in relation to possible climate changes, and to justify the decision lifetime used in the CBA. This assessment can be made on the basis of general climate change trends descriptions. In this case, no further consideration of future climate change is needed.
3. *Are unjustified assumptions important to the decision?* If one or more of these assumptions is challenged by climate change risks and the need to evaluate the uncertain longer term consequences of an infrastructure project, some additional verification is needed that the consequences of these assumptions not being met are small compared to the net benefit of the infrastructure project. This kind of verification can include sensitivity analysis against possible future scenarios or assessment of option values to test whether net benefits are robust across a plausible range of futures. This analysis requires the development of some simple future scenarios, at least in Stage 2, for example using general trajectories of greatest and least plausible changes.
4. *Design robust and flexible infrastructure projects.* If the assumptions do have a significant effect, then multiple climate change scenarios must be incorporated in the design process, using the approaches described in the next section. This could include testing whether an option is robust (i.e. provides net benefits across a plausible range of future scenarios), for example, by incorporating hard and soft measures that provide flexibility and opportunities for learning; this will involve a more rigorous consideration of option values using real options analysis and scenario analysis. After this analysis, even if climate change may have an impact on the infrastructure project, these impacts may be shown not to change the choice of infrastructure option (e.g. the infrastructure option may provide a net benefit even under an increased risk of flooding that would affect the reliability of service or increase maintenance costs).

The decision tree for determining whether it is necessary to incorporate climate change risk scenarios in the project design and assessment phase is shown in Figure 19.

When preparing a proposal, proponents should briefly discuss their conclusion as to whether or not further consideration of climate change is needed.

Figure 19 Climate change risk decision tree for cost-benefit analysis



Source: Infrastructure Australia.

What key steps should be followed if climate change risk is to be included?

If climate change scenarios (and other uncertainties such as population or technological change) need to be considered in a proposal, then see Table 42 which provides guidance on how to take climate change risk into account.

Table 42 Key steps on how to incorporate and consider climate change risks in economic appraisals

IA Assessment			
Stages and Steps	Actions to consider climate change risks	Examples	Reference information
Stage 1	<ul style="list-style-type: none"> Incorporate a medium scenario of climate change (as well as other trends such as population) in the problem analysis 	<ul style="list-style-type: none"> Does this climate change scenario affect projected demands for, or the reliability and affordability of, the supply of the targeted critical services (transport, communications, etc)? Is the need for access/escape routes in fires likely to intensify in future? 	<ul style="list-style-type: none"> Use general climate trends from sub-cluster descriptions on CCiA
Stage 2	<ul style="list-style-type: none"> Use plausible least and greatest climate change scenarios to (i) help include options that are robust across scenarios on the timeframe of the options and their consequences, and (ii) include consideration of robustness in the short-listing process. When short-listing options, the steps below can be used at the appropriate (lower) level of detail. 	<ul style="list-style-type: none"> Do some scenarios of inundation (sea level rise or flooding) suggest an alternative location (for a transport corridor) that is unaffected? If changes in temperature and rainfall affect future water demand, is there a water storage option that can be staged flexibly? How may changes in temperature and rainfall affect regional agricultural production and consequent freight demand? 	<ul style="list-style-type: none"> Least and greatest plausible future changes of key climate variables can be found in the trajectories section of CCiA. Use these estimates to find relevant projections of impacts for each type of option. For more detail on approaches, please see sources listed in Stage 3 Steps below, but apply more lightly in Stage 2

IA Assessment Stages and Steps	Actions to consider climate change risks	Examples	Reference information
Stages 3-4			
Stage 3	<ul style="list-style-type: none"> Define plausible least, middle and greatest climate change scenarios (where 'least' and 'greatest' are defined in terms of risks important for the short-listed options, and may be combined with other long-term changes such as population and economic growth). These should be for the region of the project, and extend in time to at least the full lifetimes of the options being considered 		<ul style="list-style-type: none"> Use CCiA to define these scenarios – regional trajectories may be sufficient, but major assessments may require more detailed projections. Please seek expert advice for these. These levels of climate change should then be used to determine the likely levels of relevant impacts
Step 1: Articulate the decision being evaluated	<ul style="list-style-type: none"> Keep the problem focus from Stage 1 in mind: how is this affected in the least and greatest plausible climate change scenarios? 	<ul style="list-style-type: none"> E.g. How does transport demand change over the timeframe relevant to climate change risks? 	
Step 2: Develop the base case and options	<ul style="list-style-type: none"> Consider the performance of options at coping with the enhanced risks caused by the least and greatest plausible climate change scenarios. Identify options that do not cope and explore how to widen the set of options (develop new, or modify/adapt existing) to include those able to cope under different possible future states Consider the full range of approaches for responding to climate change risks⁶² 	<ul style="list-style-type: none"> E.g. Include measures for mitigating climate change risks, such as consideration of additional costs for cooling such as tree-planting for an urban warming scenario 	<ul style="list-style-type: none"> To generate mitigation options, follow the NERAG (2016) processes for risk identification, analysis, evaluation, and treatment (see pp.19–24)
Step 3: Identify, quantify and monetise the costs of the base case and the options	<ul style="list-style-type: none"> Identify, quantify and monetise the costs of the base case and the options for each future scenario. If significant, can options be modified to reduce these costs? Include the costs of risk mitigation options 	<ul style="list-style-type: none"> E.g. costs of maintaining road infrastructure under plausible flooding and temperature regimes consistent with the climate change scenarios 	

⁶² Consider the full range of approaches for responding to climate change risks, as covered by Table 3 on page 10 of <http://www.dtf.vic.gov.au/files/cb413283-913e-4ec1-9a2d-a678010dc56c/Investment-Lifecycle-and-HVHR-Guidelines-Stage-2-Prove-Guideline-September-2016.pdf>

IA Assessment Stages and Steps	Actions to consider climate change risks	Examples	Reference information
Step 4: Identify, quantify and monetise the benefits of the base case and options	<ul style="list-style-type: none"> Identify, quantify and monetise the benefits of the base case and options for each future scenario Include the benefits of risk mitigation options 	<ul style="list-style-type: none"> E.g. changing levels of benefit if freight projections change with changes in regional crop types due to climate change 	<ul style="list-style-type: none"> See example of scenario analysis calculations: p.35 of the Economic Evaluation Technical Guide
Step 5: Generate the incremental appraisal metrics of each option	<ul style="list-style-type: none"> Calculate the difference in costs and benefits between each option and the base case for each future scenario Consider the relative performance of each option over the range of scenarios 		
Step 6: Undertake sensitivity analysis	<ul style="list-style-type: none"> Test the sensitivity of the performance (net benefit) of each option under each climate change scenario as a process of 'stress-testing' and assessing robustness Use a break-even analysis to see whether additional mitigation is affordable If the preferred option is sensitive to the choice of assumptions, it is necessary to consider ways to mitigate climate change risks, including potentially re-designing infrastructure projects. In this case, loop back to Step 2 	<ul style="list-style-type: none"> E.g. risk mitigation Is there still a net benefit once the costs of responding to a climate risk are taken into account? 	<ul style="list-style-type: none"> See step 8 on page 41 of the Economic Evaluation Technical Guide⁶³
Step 7: Determine the preferred option	<ul style="list-style-type: none"> When determining the preferred option take into account the performance of the options in terms of their net benefits and how well they perform across the range of scenarios (i.e., their robustness) 		<ul style="list-style-type: none"> See step 9 on page 42 of the Economic Evaluation Technical Guide
Step 8: Report on CBA results	<ul style="list-style-type: none"> Include appraisal across the range of sensitivity tests and future scenarios 		

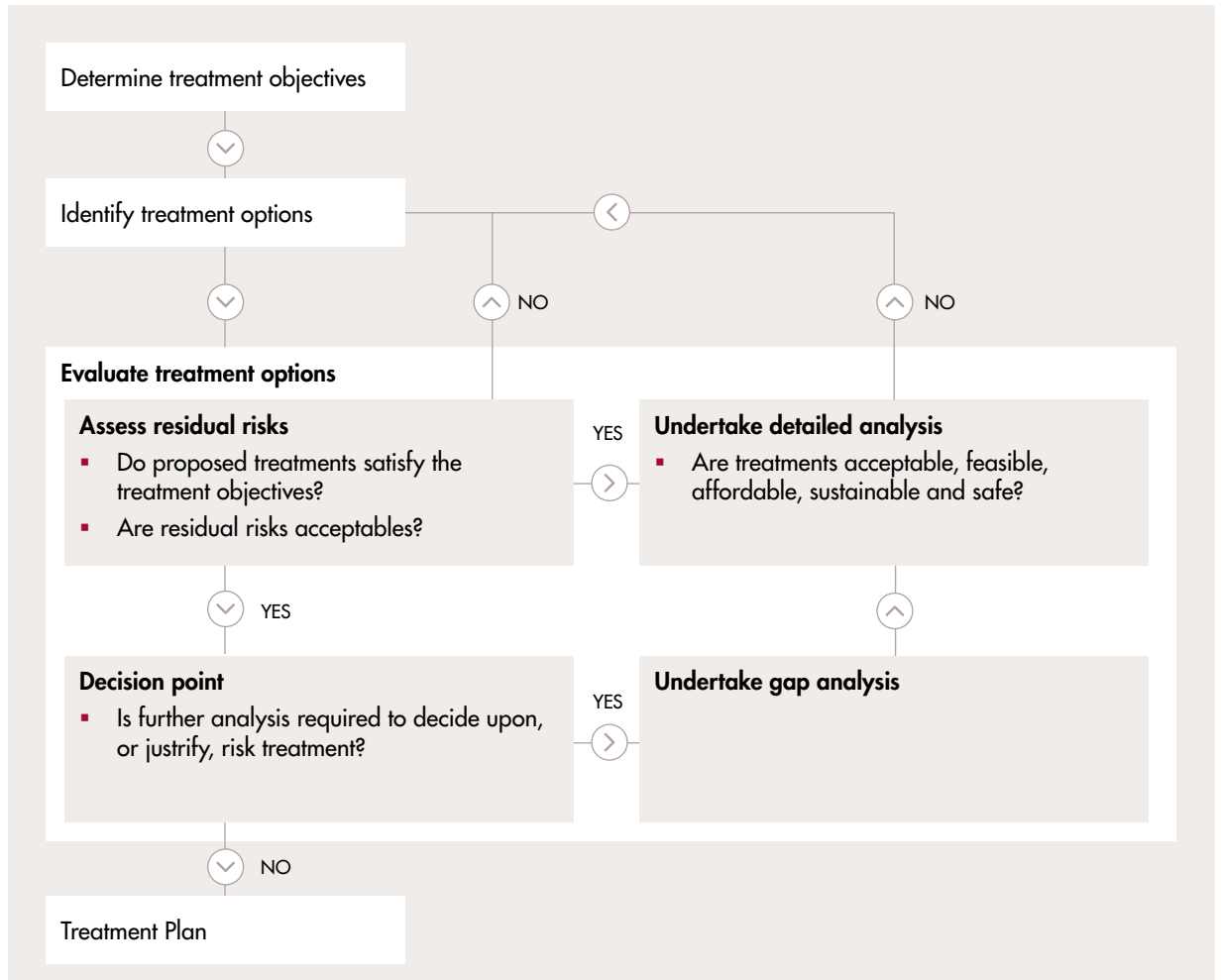
Note: The steps in the above table refer to the steps in Table B3.2. "CCiA" refers to the Climate change in Australia website, and in all places may be substituted with other valid State resources (see Box 9).

The guidance in Table 42 suggests an iterative approach to the implementation of the Stages of the IAAF and the steps of the CBA. This is consistent with the recommended approach to risk management proposed under the Australian risk management standards (AS/

NZS ISO 31000:2009), operationalised for emergency management in the National Emergency Risk Assessment Guidelines (see Figure 20). This shows how an adaptive, non-linear approach to identifying and evaluating options in IA Stages 2 and 3 can be

⁶³ Victorian Department of Treasury and Finance (2013), *Economic Evaluation for Business Cases Technical guidelines*, <http://www.dtf.vic.gov.au/files/bad1e4dd-01e5-4cbe-99f0-a1e000de5f26/Economic-Evaluation-Technical-Guide.pdf>

Figure 20 Example process for evaluating options using risk assessments



Source: Australian Institute for Disaster Resilience (2013), *National Emergency Risk Assessment Guidelines*, Figure 11, p.89, <https://knowledge.aidr.org.au/resources/handbook-10-national-emergency-risk-assessment-guidelines/>

Table 43 *Examples of potential climate risk impacts on infrastructure projects*

Phase and effect	Examples
1. Disrupting the construction phase	Higher risk of flooding during construction or heatwaves inhibiting outdoor work
2. Interrupting the flow of services from the asset once operating	High temperatures causing a transformer to shut down or a flood event closing down a road
3. Increasing maintenance and repair, or other running costs like cooling	Damage from storms, fires or high winds, or changed corrosion rates Increased cooling demands due to poor design for high temperatures
4. Reducing the asset's lifetime	Inability to cope as long as intended with coastal flooding as sea levels rise – i.e. expected benefit flows are not able to be maintained due to direct effects
5. Altering the expected demand for the asset during its lifetime	Changes in need for agricultural transport occur because of climate change affecting what crops can be grown, or global policy changes reduce the viability of coal exports – i.e. expected benefit flows change due to indirect effects
6. Affecting the residual value of the asset, particularly creating public liabilities beyond an evaluation period	A flood mitigation dam that cannot cope with increased flood sizes later in the century; sea walls that become prohibitively expensive to maintain with sea level rise.
7. Altering cross-dependencies, where the asset depends on other infrastructure, which may also be affected by climate	Water supplies which are dependent on electricity for pumping but power poles at risk from increasing high winds

implemented. The process in Figure 20 identifies opportunities to mitigate risks and can help identify when further analysis is needed (NERAG, 2015).

The NERAG (2015) process also helps users to populate a risk register that (1) identifies links between the sources of risks and their consequences, (2) identifies controls already in place to mitigate its effects and assess the adequacy of those controls, (3) the magnitude of consequences, (4) likelihood, (5) risk level, (6) confidence level, (7) priority level, and (8) whether (a) further risk mitigation is prescribed, (b) further risk analysis is needed to improve confidence, or (c) ongoing monitoring and maintenance of existing controls are recommended.

Whilst this framework was constructed specifically for the emergency response and disaster mitigation context, the same basic risk management framework applies in the climate change risk context. Climate change risks include the possibility of more frequent

and severe natural disasters such as floods as well as other consequences that unfold more slowly over time.

This means that infrastructure proponents may need to consider some of the same treatments commonly considered for disaster mitigation and also other treatments for non-emergency events. Table 43 provides examples of potential climate risk impacts on infrastructure projects which could be considered by proponents when developing options and assessing the costs and benefits of an option for CBA.

Future developments

The guidance provided in this sub-section is a new area of guidance for this framework. It is intended to outline the guiding principles and provide initial foundational guidance, which will be expanded upon in future years as part of the continuous improvement of the Assessment Framework.

D5. Undertaking Post Completion Reviews

In collaboration with proponents, Infrastructure Australia will seek to understand project outcomes, as well as project delivery, against the benefits and costs described in the business case. This will assist Infrastructure Australia and proponents in developing future policy and project business cases, respectively. This process is a Post Completion Review (PCR).

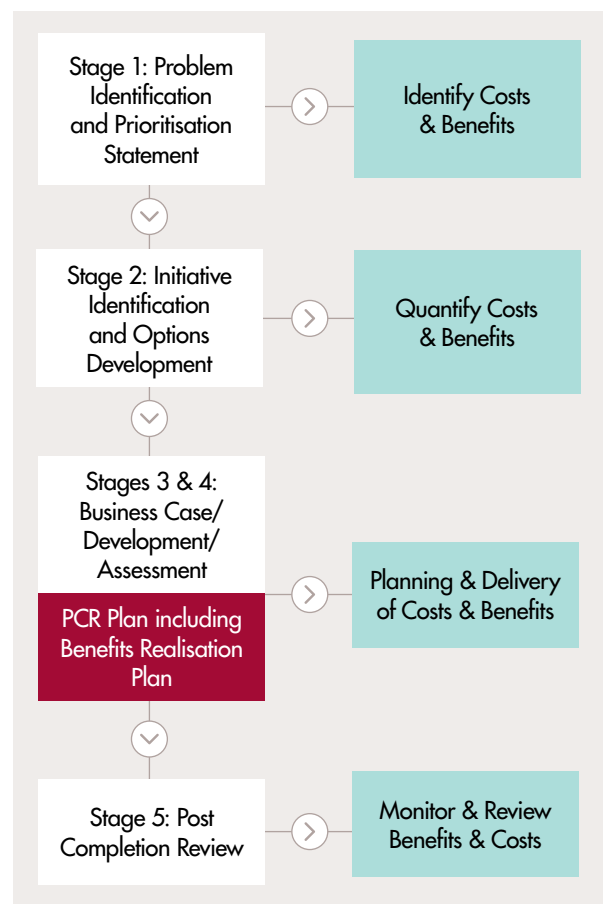
Infrastructure Australia has reviewed the existing guidance for PCRs and developed a structured step-by-step approach which relates to Infrastructure Australia's evaluation process. This is described in Section D5.2.

Figure 21 illustrates how PCRs fit in the Infrastructure Australia business case process.

The PCR process in Stage 5 involves both costs and benefits being reviewed after the project has been commissioned or become operational, and during different stages of operation. Traditionally, a PCR was known as an 'ex-post evaluation' to signify that the project was being evaluated "after the event" (i.e. after the investment).

This section was originally developed to reflect the introduction of Benefits Management in the ATAP guidelines of September 2016 and builds on that content. For further information on benefits management, please see ATAP, *T6 Benefits Management*.⁶⁴

Figure 21 Context of Post Completion Reviews in Infrastructure Australia's business case process



Sources: Adapted from Loader 2005, 'Reaping the value – benefits management in project environments', InFinsia, Vol. 119, No. 5, Oct-Nov 2005: 21-25, viewed 31 May 2017, <http://search.informit.com.au/documentSummary;dn=200602493;res=IELAPA> and the Infrastructure Australia Assessment Framework.

In short, a PCR should monitor and review both the costs and benefits of a project.

⁶⁴ Transport and Infrastructure Senior Officials' Committee (2016), *Australian Transport Assessment and Planning (ATAP) Guidelines T6 Benefits Management*, Transport and Infrastructure Council, Canberra, <https://atap.gov.au/tools-techniques/benefit-management>

D5.1 Benefits Realisation Plan

Given that most jurisdictions have Benefits Realisation Plans as part of their standard business case templates, Infrastructure Australia expects proponents to develop and submit a Benefits Realisation Plan as part of a broader PCR Plan in their business case submissions.

A Benefits Realisation Plan typically focuses on identifying and quantifying project benefits or key performance metrics. Examples of industry specific benefit categories are outlined in Table 29, Table 30, Table 31 and Table 32. This is not an exhaustive list and proponents are encouraged to discuss proposed benefit categories with Infrastructure Australia.

In some cases such as water, energy and telecommunications, it may not be possible to observe some project benefits due to their random or subjective nature, for example:

- rainfall and flood mitigation in the case of dams
- measurement errors relating to customer satisfaction metrics of broadband services.

The key elements of a Benefits Realisation Plan are described in Table 44.

Benefits Realisation Plans help reviewers to understand how and when the benefits of the project will be realised. The key risks of benefits being unrealised are:

- poorly stated project benefits and strategic objectives
- unclear measurement and ownership of benefits realisation
- lack of necessary stakeholder buy-in⁶⁵.

A Benefits Realisation Plan is a useful tool to mitigate such risks.

In recent years, there has been a strong development towards Benefits Realisation Plans amongst the jurisdictions. Infrastructure Australia's proposed PCR process takes this further to include costs and benefits, and project delivery, to understand whether the community is better off as a result of the project. The PCR process and review criteria are discussed in the next sections.

Table 44 Key elements of a Benefits Realisation Plan.

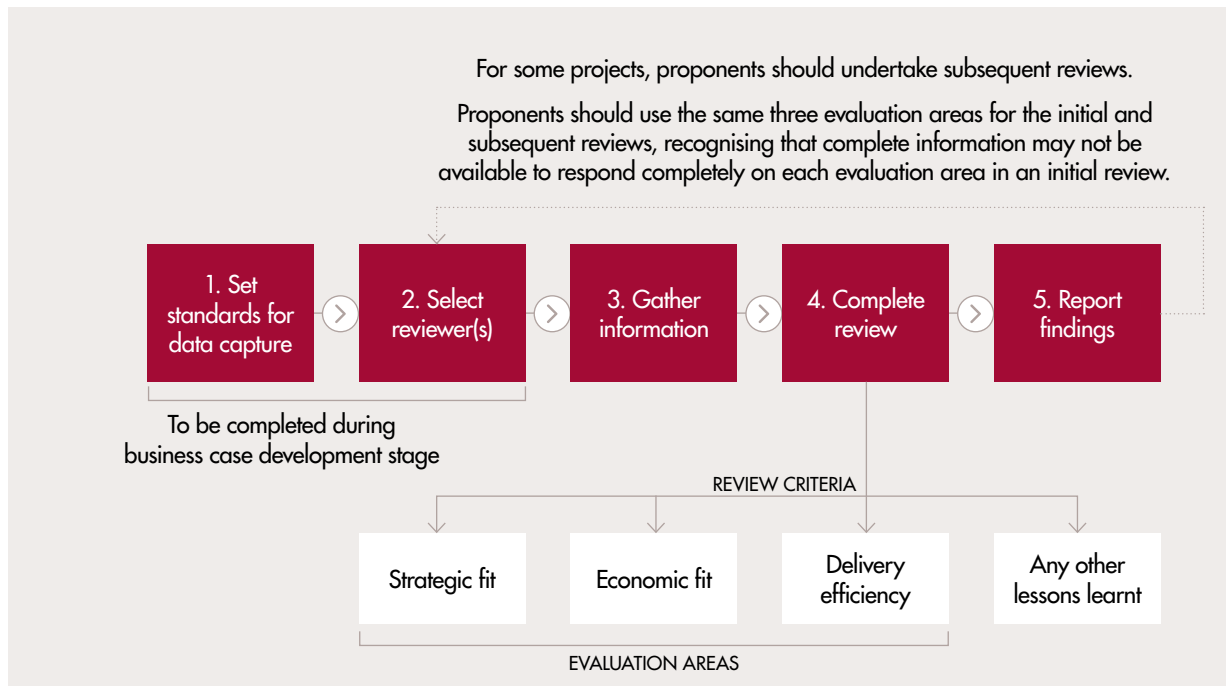
Step	Description	Output
Benefits planning	An agreed process to evaluate post completion infrastructure benefits.	<ul style="list-style-type: none"> ▪ Benefits review accountability is assigned to responsible parties ▪ Details of how benefits will be measured, monitored and reviewed, including data collection analysis ▪ Tracking document created to monitor data collection, analysis and reporting ▪ Indication of when the proponent will perform the review

⁶⁵ NSW Department of Finance 2015, *Benefits Realisation Management Framework Part 3: Guidelines*, Department of Finance, Sydney, viewed 31 May 2017, https://www.finance.nsw.gov.au/sites/default/files/BRMFramework_PART3.pdf p. 7.

D5.2 Overview of Post Completion Review Process

This section provides a step-by-step approach to undertake a PCR, which is Stage 5 in the Assessment Framework. The five-step process for completing PCRs is shown in the flowchart below, and described in the discussion that follows.

Figure 22 Post Completion Review methodology



Step 1: Plan for Post Completion Reviews

The proponents should make a plan to undertake a PCR when the final business case for the project or program of works is being developed. At this point, jurisdictions should understand the scope, cost and risks of the project, and, if the project will seek Commonwealth funding support. Once the project is delivered, the proponents should prepare a detailed program and scope of the PCR in consultation with Infrastructure Australia, each jurisdiction’s Treasury, or an infrastructure assurance agency of the jurisdiction. The delivery agency (led by the project sponsor) should also be able to self-nominate a project for review.

Where appropriate, proponents could prioritise PCRs for more complex and transformative projects. For example, these could include:

- a project where a delivery model is applied for the first time
- a project with a higher than normal risk profile
- projects that have a delivery cost of over \$500 million, or
- where there are many beneficiaries.

All projects selected for a review should undertake at least two reviews: an initial review completed a year after a project has been delivered, and a subsequent review at a later point during the operational period.

Box 10 provides further guidance on when to complete subsequent reviews. The scope of these reviews is detailed later in this section.

Each review should consider three evaluation areas, plus lessons learned:

- **Strategic Fit:** Whether the project achieved its intended strategic objectives.
- **Economic Merit:** An ex-post evaluation of the economic merit and performance of the project (including a review of project options developed).

- **Delivery Efficiency:** An analysis of how efficiently the project was delivered against forecast capital costs, and if delivery objectives were achieved.

The PCR should also capture other lessons to improve project planning, delivery and risk mitigation.

Reviewers may not have sufficient detail at the time of the initial review to fully address all aspects of the evaluation areas. The reviewer should discuss where more information is required and recommend that the proponent collect this information prior to the subsequent review. Further information on each of the evaluation areas is provided in Section D5.3.

Box 10 *Timing for subsequent reviews*

The timing of the subsequent reviews should depend on the type of infrastructure or asset class that is the subject of the review:

- Projects where the benefits are expected to be realised sooner or which have an asset life of no more than five or ten years (e.g. ICT projects) should have the second review undertaken approximately two years after delivery.
- Projects where it takes longer to realise benefits, or projects with a relatively long asset life (e.g. transport and water assets) should have a subsequent review undertaken approximately five years after delivery.
- For some projects, further subsequent reviews may be completed at the asset's half-life or end of life. Proponents should undertake a third review for very large projects (over \$1 billion), or where there are a large number of beneficiaries, or for types of projects that involve a recurring investment (e.g. rolling stock fleet procurement).

A third review would consider the longer-term performance of the asset and may, in some cases, be undertaken up to 30 or 50 years after the project was delivered, depending on the asset type, to understand the success of the business case over the life of the asset.

However, we recommend that the emphasis should be on the short-to-medium term, say, 5 and 10 years. Proponents should not defer PCRs indefinitely.

The third review should compare actual costs against expected costs and expected benefit drivers against realised benefit drivers. More information on benefit drivers is provided later in the chapter. A third review could provide insights and lessons on the predictability of longer-term forecasting techniques and models by enabling a longer-term comparison of forecasts against actual realised costs and benefit drivers.

The findings from the initial review may also lead to a modified recommended timing for the subsequent review(s). For instance, if the reviewer forms the view after the completion of the initial review that sufficient information will be available to fully address all four review criteria sooner than expected, then a subsequent review may be undertaken sooner than what is suggested by this guidance. We recommend a pragmatic approach such as applying the 80:20 rule. For example, if 80% of the required data can be obtained, covering some but not necessarily all of the four review criteria, to perform a credible PCR within 2–5 years, this would be preferable to waiting for over 10 years to collect 100% of the data.

Step 2: Set requirements for data capture

If it is decided that a PCR is required, then the proponents should set the requirements for data organisation, capture and storage for the project that will be needed to review the project. This should include developing a brief project plan for the PCR that outlines what to review, how to review, and by when (see Box 11).

This will ensure that the proponents collect the necessary data and information as the project progresses and store it in a consolidated and centrally-stored repository. This will help to ensure that those completing the business case and delivering the project, including external consultants (if engaged), to understand and follow the needs set out for data capture as the project progresses. This, in turn, will make it easier for reviewers to retrieve and examine this information at the time of completing the PCR.

Box 11 Data organisation, capture and storage requirements

In the project plan for the PCR, proponents should identify what information to collect, who should collect the information, when to collect this information and where to store it. Proponents should collect data and information for the PCR as the project progresses.

- **Project planning:** Proponents should collate the documents and analysis that will be used to prepare the business case, and store the information in one place. In particular, proponents should make sure they have access to the assumptions and methods used to undertake the economic cost-benefit analysis underpinning the business case so that the reviewer(s) can test these during the PCR.

Information on the short-listing and selection of appropriate project options that were canvassed in the business case should also be collected.

All of this information should be provided to the reviewer(s) once project delivery is complete.

- **Project delivery:** Proponents should develop a reporting template to collect information on project delivery and whether the project met

its objectives. The template should capture information and data on the final costs, the timeframes, changes in scope, risk management processes, achievement of intended strategic objectives, and other issues that occur.

The reporting template should be completed by the proponent as the project delivery progresses and then provided to the reviewer(s) once project delivery is complete.

- **Project operational performance:** Proponents should identify the metrics that they need to measure the operational performance of the project in the project plan and capture this in the reporting template. These metrics should be reported in the benefits realisation register or other attachments to the business case, or in the main body of the business case document. For example, if the project is for a new road, the proponent needs to be able to capture information on the level of congestion, the travel time per trip, travel speeds on the road, and any safety-related incidents affecting traffic on the new road.

Step 3: Select reviewers

For all projects, the proponent organisation should conduct the initial review of a project internally, using a different team independent from the project team. For example, the proponent organisation may select reviewers from the internal assurance team of the delivery agency. We recommend a different team to promote independence, while keeping the initial review in house to limit cost and complexity. Proponent organisations contemplating a PCR can seek Infrastructure Australia's advice and assistance with completing the review. The skills required to complete the review are outlined in Box 12.

To enhance the integrity and objectivity of the review, the State or Territory Treasury of the relevant jurisdiction, or the Secretary / Head of the delivery agency, in consultation with Infrastructure Australia, may have the option to choose the appropriate reviewers from within the delivery agency.

If the initial review raises concerns with the delivery of the project, or if there is a high level of risk involved with the project, an external subsequent review may be useful to provide a fully independent review of the project.

Where the initial review does not identify any major issues, a subsequent review by an internal reviewer may be sufficient, who may also be chosen from the panel of reviewers from the assurance team of the delivery agency.

Step 4: Gather information for review

The business case, including its associated appendices such as economic appraisal report, risk registers, operations modelling, transport modelling report, benefit realisation plans, whole-of-life cycle costs (cost estimates) and the signed contract typically provide the best reference points against which to review the benefits, costs, strategic fit and delivery efficiency. More specifically:

- The business case will provide the expected strategic objectives, project scope, costs, demand profiles, benefits and delivery approach.
- The contract will provide the final costs, project scope and delivery approach that the proponent has committed to, and which may have changed since the business case, as a result of contract negotiation.

Box 12 Skills required of the reviewer

To undertake the PCR, the reviewer(s) should have the following skills:

- **Stakeholder consultation skills:** The reviewer will be required to consult with a number of stakeholders, including members of the project team, other people within the proponent organisation, other government stakeholders and potentially, customers and users of the project in question.
- **Economic analysis skills (for the economic merit review):** The reviewer will be required to understand the economic model used in the business case and to compare this with the actual costs and benefits from the project. The reviewers should have an understanding of using real prices, escalation factors, discounting, and subject matter experts in the fields of the project being reviewed (i.e. transport, health, ICT, education etc).
- **Technical skills in engineering, project management and risk management:** The reviewer will need to understand the impact of changes in scope and changes in design on project delivery. The reviewer will require technical skills in order to undertake the review of deliverability.
- **Analytical skills:** The reviewer will need to gather all of the required information and then analyse it to distil the key findings and provide recommendations as part of the PCR.
- **Report writing and communication:** The reviewer needs to communicate clearly the findings and recommendations from the PCR to a broad audience. This is essential for the findings from the PCR to lead to better project assessment and delivery.

While the reviewer should reference the costs to the contract (to compare final outlays with signed contract amounts), there is also a strong case for a review of both the contract amounts and final outlays compared with the earlier estimates contained in the business case. This also applies to scope, to compare the original scope as set out in the business case and the contract specified scope to the final delivered asset.

What is also important is a **comparison** of the ‘planned to build’ as per the business case with the ‘as built’.

The information used for the PCR should be a combination of documented evidence (i.e. actual cost data and performance criteria) and workshops, interviews and user questionnaires where required. As mentioned previously, data organisation, capture and storage should have been determined during the business case development stage.



Examples of documentation to be reviewed during the PCR include:

- Business Case(s) – Typically, the reviewer will use the final business case as the ‘baseline’ to compare against for the purposes of the PCR, which was the basis for funding to deliver the project. However, in the instances where multiple rounds of business cases occur, the reviewer may reference the other business cases for contextual purposes. For instance, some jurisdictions follow the practice of submitting a preliminary, or a strategic business case, followed by a final business case. The preliminary or strategic business case may be reviewed for context, but the final business case should provide the ‘baseline’ for the PCR.
- Cost estimate – the full range of cost estimate documentation (e.g. whole-of-life costs) used to support the approved business case.
- Project cost documentation – This may include final contractor invoice, budget reports, project finance reports to steering committee or other executives, and project contracts register.
- Economic appraisal.
- Benefit realisation plans – prepared as part of the final business case, or separately, during the procurement phase.
- Tender Documents – including tender briefing documents, tender decision and award documents, and tenderers’ responses.
- Design Documents – particularly final design documents.
- Investment logic map to understand how the options were developed.
- Feasibility/options study.
- Transport modelling study (in case of a transport project).
- Risk Management – including any risk analysis, risk registers and mitigation plans and any risk management documentation used throughout the project.
- Objectives Measurement – this will vary per asset type and project and in particular includes documentation post completion that shows the project has met its planned service objectives.
- Value management report or the investment logic map report – to understand how the options were developed.
- Project management plan.
- Outline change management plan.
- Financial appraisal (if appropriate).
- Progress reports.

After reviewing the material contained in the relevant documents, the reviewer should undertake interviews to get a firsthand perspective from project team members who had, or have, a role in either the planning, delivery or operations of the asset. The interviews are an important step to identify the key lessons learned. Interviews will be key for understanding if the project met its strategic objectives and how the project performed during the delivery stages of the project.

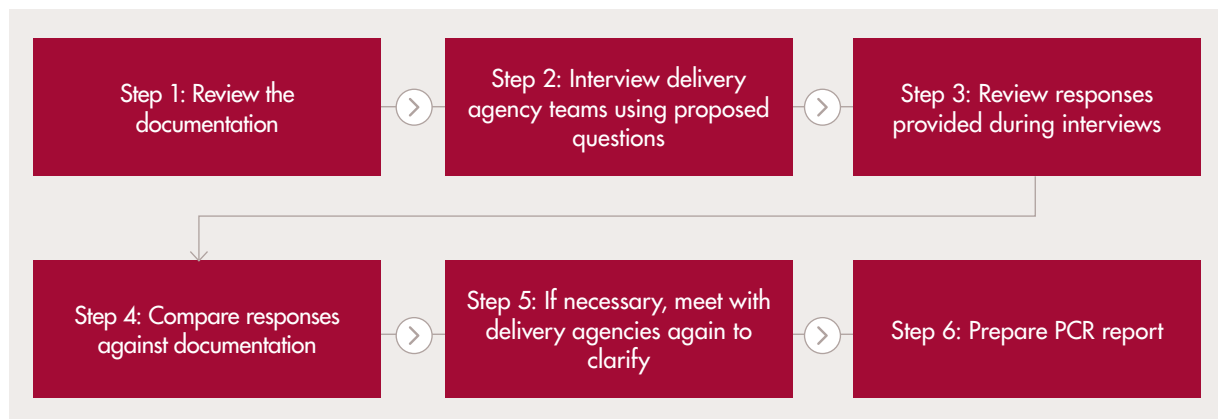
After the interviews, the reviewer can use the document review and analysis to confirm the information gathered by the interview and conduct a more detailed analysis of forecast outcomes against actual outcomes if necessary.

Step 5: Complete the review

The PCR should include a review of the strategic fit, economic merit, delivery efficiency and other lessons. The steps for the review are shown in Figure 23.

The reviews should cover all three review criteria and lessons learnt each time but potentially covering the areas to a different depth each time.

Figure 23 Steps to complete a Post Completion Review



Adequate information on the following evaluation areas is likely to be available during the initial review:

- Strategic fit.
- Economic merits including whether the appropriate project options were assessed.
- How efficiently the project was delivered, including a review of the estimated capital cost of delivering the project versus actual outcomes.
- Any other lessons.

In the initial review, where there are information gaps, reviewers should recommend that the proponent collect further information during subsequent reviews.

During the initial review, the reviewer should also determine whether:

- The subsequent review of the project should be more independent or detailed, depending on the project's complexity, or due to findings that have emerged in the initial review. This may require that an external reviewer completes the second review, or a panel comprising external reviewers, and/or that the reviewers use extensive user surveys to supplement findings from discussions with project teams.

- The information and method that was used in the initial review is adequate, and therefore, should be used in subsequent reviews, or if an alternative baseline and/ or approach is more appropriate.

The review of strategic fit and delivery efficiency should be based on quantitative and qualitative analysis using the information collected through the workshops, interviews and, where required, user questionnaires. This should include a comparison of final construction costs against forecasts.

The review of the economic merit would be undertaken as an ex-post evaluation that examines the appropriateness of the project options chosen for evaluation and the validity of assumptions underpinning the cost-benefit analysis against actual realised values, and estimating the deviations in estimated costs and benefits against actual outcomes. The step-by-step approach for undertaking the ex-post evaluation using cost-benefit analysis is included in Section D5.3.

The ex-post evaluation should compare the:

- Expected delivery, operational and maintenance costs (at the time of completing the business case and contract negotiation) of the project against the actual cost profile of the project.
- The drivers of key benefit categories that the proponent anticipated at the time of completing the project assessment, against the actual manifestation of these drivers. In order to focus efforts, the comparison should focus on the **key benefits** identified as material in the business case, and not necessarily, all benefit categories. A more detailed discussion on benefit drivers is shown in Section D5.3.

This would determine whether the proponent would have changed the initial assumptions used in the business case, if the decision were being made with the information available at the time of conducting the PCR.

The other lessons for consideration may include project governance, management of project risk and risk mitigation or any other factors that arose during project planning and delivery that provide insights for future projects.

The additional information the reviewer should gather for the subsequent review(s) will primarily be on the operational performance of the asset, as well as the actual operating and maintenance costs of the asset. The reviewer should also consider additional factors that have arisen between the initial and subsequent review, which could assist with future projects, as part of the subsequent review, e.g. whether the project is continuing to meet its strategic objectives or whether any additional project risks have emerged.

By the time of completing subsequent review(s), adequate information should be available to complete a review on all evaluation areas and, importantly, should be focused more on:

- An ex-post review of the economic merit of the project, including options identification (whether the right options were chosen) and net benefits to determine whether the expected benefits of the investment have been realised over the initial years of operations, compared to the costs incurred.
- Other lessons for consideration of how the project planning and delivery could be improved.

The suggested interview questions on all four review criteria are given in Section D5.3.



Step 6: Reporting and next steps

Once the information is collected and analysed, the reviewer should summarise the responses to the questions across the completed evaluation areas.

The delivery agency and reviewers should look at all the responses and determine the key findings of the review. For the subsequent review(s), the reviewers should also look at the key findings and recommendations from the previous review(s), and consider these as part of the subsequent review.

The key findings from the review should be distributed and considered to guide better project planning and delivery. The purpose of sharing the findings is to capture key lessons from the project.

In the case of problematic findings, proponents should seek to understand the reason for the result and include recommendations on how proponents can avoid this for future projects. Similarly, in the case of positive findings, the reviewer should provide recommendations on what steps the proponents should adopt on future projects to achieve a similar positive result.

The reviewer should then prepare a report that describes the project, the information and analysis for each of the evaluation areas and the key findings and recommendations from the review. Figure 24 provides a guide to the contents that should be included in a PCR report.

In accordance with the Australian Infrastructure Plan, jurisdictions or proponent organisations should publish the findings from the PCRs, so that others can learn from their experience. Jurisdictions or proponent organisations should publish the PCR report in full for each project.

Once a delivery agency has completed multiple PCRs, Infrastructure Australia recommends that the delivery agency capture all of the findings from the PCRs to identify the key lessons and findings collectively across several projects. Delivery agencies should use these findings in future projects.

Figure 24 Example table of contents for a Post Completion Review

Post completion review:	
Project X	
Table of contents	ILLUSTRATIVE
Executive Summary	
1. Project overview	
2. Findings from earlier PCRs (if applicable)	
3. Strategic fit	
4. Economic merit	
4.1	Review of project options developed
4.2	Capital costs
4.3	Operation costs
4.4	Other costs
4.5	Benefits
4.7	Other benefits
4.8	Net results
5. Delivery efficiency	
5.1	Construction costs and budgets
5.2	Project scope
5.3	Schedule and timing
5.4	Risk assessment and management
5.5	Procurement and delivery model
5.6	Financing
6. Other lessons	
6.1	Management and governance
6.2	Change management
6.3	Regulatory environment
7. Conclusions	
8. Recommendations	

A robust PCR process needs to be cumulative and not undertaken in isolation. This means that for a specific project, reviewers need to consider the findings from any previous or earlier PCRs in undertaking their review. Jurisdictions and proponent organisations should also consider PCR findings collectively, to identify where there are systemic (rather than project-specific) issues. This will assist jurisdictions or delivery agencies who deliver very few projects in any given year.

D5.3 Guidance on specific review criteria

The following sections provide further detail on each review criterion.

Strategic Fit

The review of strategic fit should determine whether the project or program of works met their state-, and national-level strategic objectives, and if relevant, whether the project supports the strategic objectives of any associated agencies or applicable jurisdictions.

The proponent should have established the problem and strategic objectives of the project during the project assessment phase of the project and this information should have been included within the approved business case for capital funding to deliver the project. Therefore, the business case, tender documentation and any design documentation should form the basis of the strategic objectives for the project or program of works. In order to assess whether the project has met each strategic objective, the reviewer should use proponent interviews, PCR workshops and/or user questionnaires.

Questions that should be asked for the **Strategic Fit** review include:

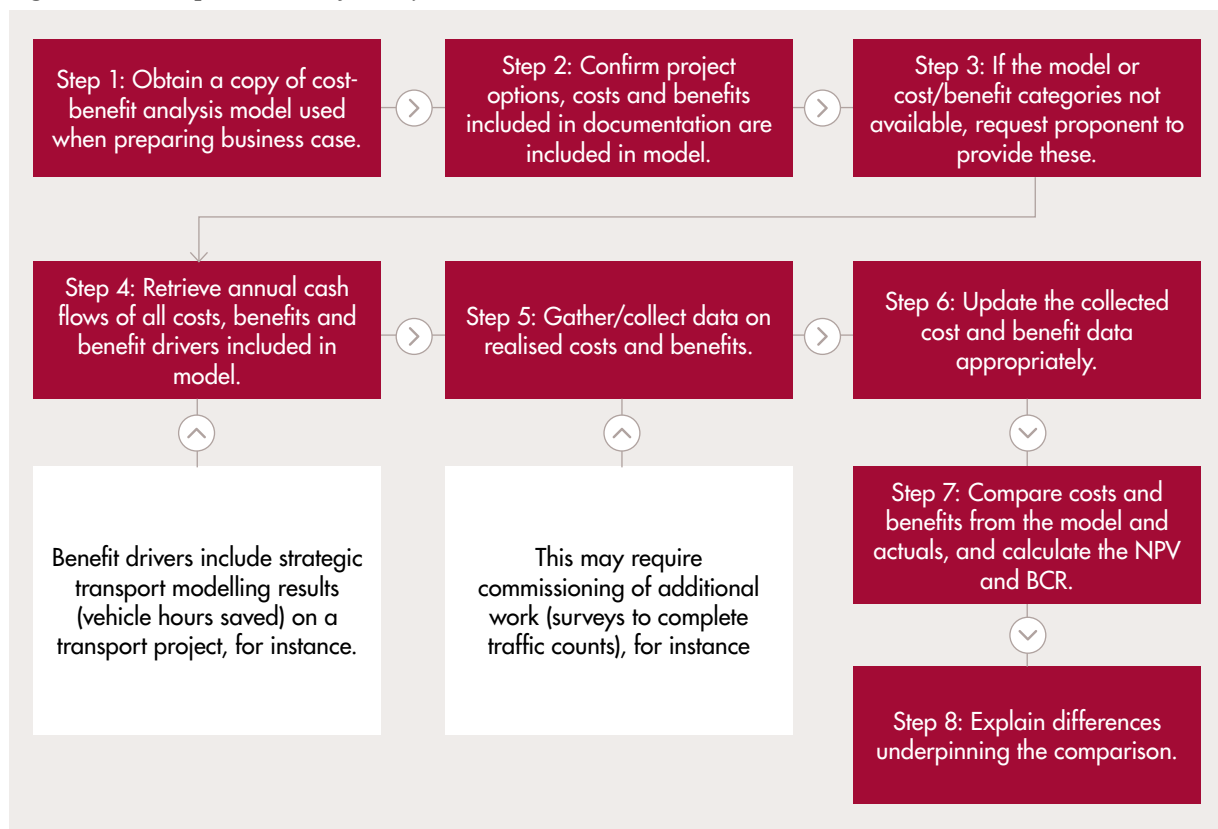
1. Did the project solve the identified problem? If not, why not?
2. To what extent did the project or program of works meet its strategic objectives?
3. If relevant, which nationally significant and State significant objectives did the project or program of works contribute to?
4. What were some of the factors that led to the project or program of works contributing to meeting these objectives?
5. Were there some objectives that remain unmet? If yes, what was the reason(s) for any unmet objectives (e.g. changes in the macro environment, scoping error)? Describe how the planning or scoping of future projects might better contribute to meeting these outcomes.
6. Were there other strategic benefits or objectives that were not identified by the baseline (i.e. the final business case) that have been achieved? Describe those benefits or objectives.
7. If relevant, does the project represent a good fit within the program of works? In what way does it contribute to meeting program objectives? If the project did not contribute to realising program benefits, comment on how the planning or scoping of future projects might better contribute to meeting program objectives.
8. If relevant, to what extent has the project or program of works achieved the requirements of policies relating to building and fleet design and sustainability, energy and water efficiency, waste and recycling?

Economic merit

The review of the economic merit of the project or the program of works should compare the actual operational performance of the project against the expected performance at the time of completing the final business case.

The reviewer should follow the step-by-step approach for undertaking an ex-post cost-benefit analysis shown in Figure 25.

Figure 25 *Ex-post cost-benefit analysis*



This comparison should be made on an annual basis, that is starting in year one of project delivery and finishing in the year in which the review is undertaken. This review should compare the:

- Expected delivery, operational and maintenance costs of the project gathered from the project documentation against the actual cost profile of the project.
- The drivers of key benefit categories that the proponent anticipated at the time of completing the project assessment, against the actual manifestation of these drivers. In order to focus efforts, the comparison should focus on the **key benefits** identified as material in the business case, and not

necessarily, all benefit categories.

The reviewer should use quantitative analysis such as cost-benefit analysis, or, on rare occasions, cost-effectiveness analysis, for the review of economic merit. The reviewer should use the business case, economic analysis report, financial analysis report, benefit realisation plans and statements, cost estimate report, options report, state budget papers and the value management report to draw estimates of planned costs and key benefits.

For comparability, the actual costs and benefits collected for the ex-post evaluation should be converted to real prices as used in the ex-ante cost-benefit analysis.

The reviewer should compare these with the information on actual costs and benefit drivers collected through PCR workshops, interviews and/or user questionnaires.

A review of forecast operational and maintenance costs against actuals constitutes a review of the operational performance of the project post commissioning. It will measure performance against any stated maintenance

cost or service outcomes expectations, as well as measure satisfaction of end users and stakeholders as appropriate. This should cover outcomes or benefits that are in addition to any benefits included in the baseline cost-benefit analysis. The objective is to determine how the infrastructure is operating compared to its intended performance. This applies not only to situations where operating performance is lower than expected, but also where performance is exceeding expectations.

The reviewer should gather demonstrable and measurable evidence to support their findings.

Table 45 *Examples of key benefit drivers / performance metrics*

Industry	Key benefit drivers/metrics	Industry	Key benefit drivers/metrics
Train	Travel time per trip	Telecommunications	Upload/download speeds
	Occupancy / train load		Bandwidth
	Crowding – in-vehicle, platform, concourse		Customer numbers
	Journey time reliability (e.g. on-time running)	Education	Student enrolments
	Service frequency		Performance of students
	Wider economic benefits		Research grants submitted by, and granted to institutions
	Land use impacts e.g. population, densities, changes in zoning and planning regulation		Performance of teachers at institutions
Road	Travel time per trip	Health	Additional number of separations (including pathology, imaging, and procedures and treatments)
	Travel speed per trip		Proportion of patients who otherwise would not have received treatment
	Distance travelled per trip		Percentage reduction in hospital acquired infections as a result of better infection control
	Congestion		Reduction in subsidy payments targeted to help with travel and accommodation costs for people (and eligible escorts) who need to travel long distances for surgeries and procedures and other separations
	Safety incidents per million kilometres travelled		Operational cost saving per unit of separation
	Journey time reliability		Average length of stay for admitted separations
	Road degradation		Bed occupancy days
	Wider economic benefits		Emergency response times
Land use impacts e.g. population, densities, changes in zoning and planning regulation	Staffing levels		
Water	Actual storage capacity		
	Structural integrity (cracking, movement)		
	Release volumes		
	Levels of contaminants		
Energy	Service reliability		
	Supply capacity		

Source: Infrastructure Australia

Questions that should be asked for the review of **economic merit**, and to determine whether in hindsight the right option was selected, include:

1. Given what you know today, would you have specified the base case as was done in the baseline? Why or why not?
2. Given what you know today, would you have selected the preferred option in the business case as the preferred one today? Why or why not? If not, which alternative might have been picked? Why was this option not advanced or selected in the project assessment stage?
3. To what extent were the forecast delivery, operational and maintenance costs realised? Have these costs been exceeded in any given year? Have actual costs been lower than anticipated costs in any given year? What were the causes of the deviation?
4. Have other costs arisen that were not included in the base case? If so, which ones are these? Why were these costs not considered during the project assessment stage?
5. To what extent were the key benefit drivers realised? What were the causes of the deviation?
6. Who were the beneficiaries of the project? Were there any unintended beneficiaries?
7. Have other benefits been realised that the proponent did not capture during the assessment? If so, which benefit types are these? Why did the proponent not consider these benefits during the project assessment stage?
8. To what extent is the project delivering the anticipated and required levels of service?
9. Where the project has not delivered anticipated benefits, or adverse impacts are greater than anticipated, what are the reasons for this and what strategies have been identified and taken to rectify?
10. Did the project deliver the benefits at the lowest cost compared with the cost of alternative options?
11. Did the proponent capture the residual value of the asset in the analysis? Why or why not? Was the inclusion or exclusion of this residual value in the baseline accurate?

Two worked examples of assessing project benefits are provided in Box 13 and Box 14.

Box 13 Worked example 1 of a project benefit review

Continuing with the hypothetical road project example, improvement in travel times was a key benefit identified at the Problem Identification and Prioritisation stage and used in the CBA.

Without the project, it was forecast that travel times would steadily increase from 40 minutes to 55 minutes, measured over the transport corridor, due to population growth and urban development. Travel times after the completion of the motorway was forecast to reduce from 40 minutes to 30 minutes. After 12 months of operation, the actual observed

travel time remained constant at 40 minutes over the length of the transport corridor.

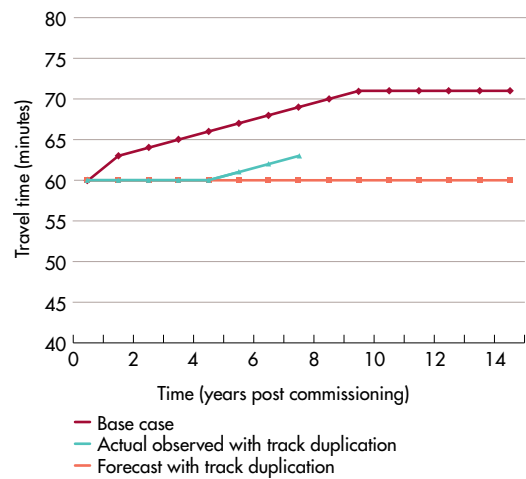
During the PCR, it became clear that the reason for the longer than forecast travel time was lower average travel speeds than anticipated in the business case. The PCR identified that higher than anticipated use resulted in unforeseen congestion. As a result of this finding, further analysis was conducted on population growth and other demand factors to improve transport model forecasts in future projects.

Box 14 Worked example 2 of a project benefit review

Suppose that a hypothetical train track duplication was commissioned eight years ago after successfully progressing through the Assessment Framework’s first four stages and being listed as a Priority Project on the IPL.

The graph illustrates the forecast and observed travel times over the transport corridor:

- The **base case (that is without the project)** was forecast to increase from 60 minutes in Year 1, to 70 minutes in Year 10 and beyond
- **With the track duplication project**, it was forecast to remain constant at 60 minutes
- **Actual observed travel after the track duplication was commissioned** remained constant at 60 minutes for 5 years, before increasing steadily each year to 63 minutes in Year 8.



A PCR identified an unforeseen increase in other train lines and ‘flow on’ platform crowding had increased city station dwell times for all train lines.

Delivery efficiency

The reviewer should base the review on a combination of qualitative and quantitative analysis. The reviewer should use the business case, tender documentation, cost estimate report, state budget papers and any design documentation as the basis of determining intended cost efficiency and delivery models, using information collected through PCR workshops, interviews and/or user questionnaires.

To compare the estimated costs against actual out-turn costs in contracts, estimated real costs need to be converted into nominal costs or the actual costs need to be converted into real costs (i.e. costs excluding inflation).

The reviewer should seek demonstrable and measurable evidence during the review to support findings.

The areas to be assessed under **delivery efficiency** include:

- **Project construction costs compared to forecasts** – Construction cost estimates are a fundamental input into a project’s economic evaluation, and contribute to determining if and when a project should proceed. Therefore, it is important that cost forecasts are robust and reliable; acknowledging actual construction costs will only be revealed after the asset is commissioned. A PCR of a project’s costs is a valuable tool to improve cost forecasting. This is achieved by identifying the causes of project cost variations so that they can be accounted for in future projects.

As part of this review, the reviewer should compare the forecast annual profile of capital and delivery costs against the actual cost delivery timeline.

Box 15 presents a worked example of an ex-post cost review which relates to common causes of ex-ante cost forecast errors identified in various published studies (see Box 16).



Box 15 Worked example of a post completion construction cost assessment

The original cost forecast and actual cost outcome provide a starting point to establish a post completion construction cost assessment.

Suppose a major road project was recently constructed after successfully progressing through the Assessment Framework's first four stages and being listed as a Project on the IPL. The project construction cost forecast used in the CBA, actual construction costs and a breakdown of the cost variation is shown in the table below.

Post completion construction cost assessment – example

Cost	Amount (million)
Ex – ante forecast	4 500
Actual	6 000
Variation	(1 500)
Breakdown of variation	
Scope changes [^]	
2 additional highway off ramps	500
Cost increases	
Increased tunnelling depth to avoid identified heritage items during construction	650
Higher than anticipated land acquisition and litigation costs	250
Construction tender prices higher than forecast	100
Total variation	1 500

Note: [^]Scope changes refer to project amendments that materially improve end-user benefits

A key issue in this example (and likely to apply across all post completion cost reviews) is how to attribute cost variations. In the example above, \$500 million was attributed to a project scope change of two additional highway off ramps, and \$1 billion to cost increases from higher than expected acquisition/construction costs.

The additional off ramps are categorised as a scope change as it materially improves end user benefits in the form of increased utilisation. The increased tunnelling depth however, does not materially improve end-user benefits. The deeper tunnels and their costs arise from an unforeseen event, not captured as part of the original business case. The end outcome is more money was needed to be spent to resolve this unforeseen issue, with no empirical improvement in end-user benefits.

Source: Infrastructure Australia

Box 16 Identified common causes of ex-ante forecast cost errors

- Premature cost announcement prior to analysis and lack of cost re-evaluation
- Project scope changes
- Cost forecasts for large projects (defined as those that cost over \$500 million) and projects that have long lead times not accounting for project complexity and interrelated components
- Cost forecasts not accounting for industry/mode specific differences in the size and timing of project costs.

Sources: Terrill & Danks. 2016, Cost overruns in transport infrastructure, Grattan Institute, Carlton, viewed 31 May 2017, <https://grattan.edu.au/report/cost-overruns-in-transport-infrastructure/>; and Flyvbjerg, et al 2004, 'What Causes Cost Overrun in Transport Infrastructure Projects?', Transport Reviews, vol. 24, no. 1, January, pp. 3-18

It is likely that as more post completion assessments are undertaken, additional causes of cost variations (both above and below the ex-ante forecast) will emerge and these should be incorporated into future reviews, for example, unexpected primary input cost increases such as raw materials.

Infrastructure Australia anticipates that project cost information will be available within one year of construction being completed.

- **Project Scope** – Closely tied to project costs is the project scope. It is important as part of the review to consider if the project scope requirements were met. If there were significant changes in scope during the project planning and delivery, the reviewer should find out why this occurred.
- **Project Schedule and Timing** – Determining the required project timing is an important step in the planning process and can also impact the urgency with which projects must be approved. Timing can also be directly tied with satisfying key project objectives as a result of external factors requiring completion of a project within a particular timeframe. The PCR provides the opportunity to assess reasons why a project finished on or behind schedule and also provides the opportunity to revisit original assumptions as to why the project needed to be delivered under a particular timeframe and assess if these assumptions were warranted.

Questions that should be considered for the review of **delivery efficiency** include:

1. Was the project or program of works delivered within budget? Describe any changes from the baseline and reasons for variances. In which delivery years did variances arise, if any? What lessons can be drawn for future projects from this review?
2. Describe if the delivered project met the scope requirements stated in the business case (or contract documents)? Provide an explanation for any variances
3. To what extent has the identified problem been resolved or reduced as a result of the project or program of works? Was the solution appropriate for the problem (i.e. was the project appropriately scoped, or was there over-engineering or under-engineering of the project)? Provide an explanation if the solution is not deemed appropriate.
4. Did the scope of the project change after the submission of the business case? Was this captured by the tender documentation or any other documentation during the project assessment stage?
5. If the scope of the project changed during the project delivery stage, did this have an impact on planned costs? Describe these impacts. Could these scope changes and impacts have been avoided in any way?
6. What lessons might you draw for the planning of future projects from this review of project scope?
7. Was the project or program of works delivered on time? Describe any changes from the baseline and reasons for variances. What lessons can be drawn for future projects from this review?
8. Were the identified milestones in the baseline appropriate for a project of this nature? Could these milestones be defined differently for improving planning and delivery of future projects?

- **Project procurement and delivery model** – The project delivery model can have a significant impact on the success of a particular project. Project asset types and circumstances lend themselves to particular delivery models. The proponent should choose the delivery model based on a thorough review of relevant project risks and desired project objectives. The PCR is a key stage to consider if the delivery model was successful in mitigating the project risks and achieving the desired outcomes. Reviewing the performance of the selected delivery model will support future decisions making regarding what situations are best suited for particular delivery model types.
- **Project financing** – The review of project finance arrangements should consider what mix of financing sources were used for the project and determine the extent to which these match the anticipated funding profile foreshadowed in the baseline. The review should determine if the proponent considered all feasible financing options, e.g. value capture, during the planning stages of the project.

Questions that should be considered for the review of **project costs** include:

1. To what extent did the procurement process meet policy and procedural requirements?
2. Was the project procured using the model proposed in the business case and the contract (e.g. design and construct)?
3. Was the project delivered using the model proposed in the business case and the contract (e.g. PPPs)?
4. Did the selected procurement/delivery model achieve the intended outcomes? Describe these outcomes? Comment on whether the selected model was considered appropriate
5. What were the strengths and/or weaknesses of the selected procurement/delivery model?
6. Did the procurement/delivery model mitigate identified risks?
7. Did the procurement/delivery model introduce additional risks?
8. What lessons can you draw from this review of procurement and delivery models for improving planning of future projects?
9. Who contributed to financing the project? Were there any issues with financing?
10. Were non-government financing sources considered for delivering this project, e.g. tolls revenue or value sharing mechanisms?
11. If such sources of revenue were not considered, was this the right decision? What are the lessons for financing of future projects that you can draw from this review?

Other lessons

In addition to the evaluation areas described above, the PCR should consider any other relevant factors that arise during the project planning and delivery, or are uncovered during the PCR. For example, this could include consideration of project management performance during project delivery or unintended outcomes of the project overall. The areas to be assessed under here may include:

- **Project Risk Assessment and Management** – Project risk analysis and risk management should play a key role throughout the whole project lifecycle. In some cases, a project can start out with strong risk management processes in one phase of the project but they are not sufficiently applied throughout all project delivery phases. The PCR should assess the adequacy and constancy of the risk analysis and risk management process throughout the project planning and delivery phases.
- **Project Management and Governance** – Appropriate level of project management and governance will support successful project delivery and hold teams accountable for achieving project outcomes. Often a project governance structure will be prescribed within the business case or other project planning documentation. The PCR provides an opportunity for assessing the implementation of governance compared to the project plan and also determining to what extent project management and governance attributed to successful project outcomes.
- **Effective change management** – where the roles and functions of project teams will change significantly as a result of the project, effective change management mechanisms may need to be put in place. This would be particularly true for health projects or information, communications and technology projects, where changes to process are critical for realising the benefits of the project.

The reviewer should base the review of lessons learned on qualitative analysis using the information collected through the interviews, user questionnaires, and documentation review as appropriate. The business case, risk registers, change management plans, stakeholder management and project governance plans should be used to determine what activities were planned to deliver the project or program smoothly. Lessons should be derived using information collected through PCR workshops, interviews and/or user questionnaires.

Questions that should be considered for the review of **other lessons** include:

1. How successfully was the project or program of works managed during delivery?
2. Were the project risks managed effectively? Confirm whether the risk management approach in the business case was adopted
3. Was the proposed risk management approach adequate?
4. Were there risks that the project assessment documentation did not identify to an appropriate standard for the asset type (i.e. did the risk assessment meet the required safety standards and regulations)? How might you manage these risks, or manage risks differently going forward, when implementing a project of a similar nature?
5. Were there any unintended outcomes that have arisen due to this project or program? If so, what were they?
6. Were stakeholder management plans developed and implemented? Describe how stakeholder management was conducted and what the outcomes were.
7. Was a change management plan required and adequately defined? Was this implemented appropriately? Describe how change management was undertaken and what the outcomes were.
8. To what extent are stakeholders satisfied with the project outcomes and the level of consultation during project planning and delivery?
9. Was the level of project management and governance sufficient to support successful project outcomes? Describe the approach taken and what the outcomes were.
10. What lessons for future projects can you draw from this review?

D5.4 Further guidance on Post Completion Reviews

Different jurisdictions have published guidance and material on PCRs. See Table 46 for details.

Table 46 Jurisdictional Post Completion Review guidance material

Jurisdiction	Guidance material
Australia	Transport and Infrastructure Senior Officials' Committee 2016, <i>Australian Transport Assessment and Planning (ATAP) Guidelines F7 Review and Post Completion Evaluation</i> , Transport and Infrastructure Senior Officials' Committee, Australian Government, Canberra, viewed 31 May 2017 https://atap.gov.au/framework/review-evaluation/files/f7_review_and_post_completion_evaluation.pdf
Commonwealth	Australian Department of Finance 2015, <i>Guidance on the Assurance Reviews Process Resource Management Guide No 106 – Assurance Reviews for Programmes and Projects</i> , Department of Finance, Canberra, viewed 31 May 2017, https://www.finance.gov.au/assurance-reviews/guidance-on-assurance-reviews/
Victoria	VicRoads 2016, <i>Investment Evaluation Framework – Post Completion Evaluation</i> , VicRoads, Melbourne, viewed 31 May 2017, https://www.vicroads.vic.gov.au/planning-and-projects/evaluating-investments
Victoria	Victorian Department of Treasury and Finance 2008, <i>Investment Lifecycle Guidelines – Post Implementation Review</i> , Department of Treasury and Finance, Melbourne, viewed 31 May 2017, www.lifecycleguidance.dtf.vic.gov.au
NSW	NSW Treasury 2004, <i>Total Asset Management – Post Implementation Review Guideline</i> , NSW Treasury, Sydney, viewed 31 May 2017, https://www.procurepoint.nsw.gov.au/system/files/documents/total_asset_management_post_implementation_review_0.pdf
NSW	NSW Department of Finance 2015, <i>Benefits Realisation Management Framework Part 3: Guidelines</i> , Department of Finance, Sydney, viewed 31 May 2017, https://www.finance.nsw.gov.au/sites/default/files/BRMFramework_PART3.pdf
ACT	ACT Treasury 2016, <i>The Capital Framework – Post Implementation Review</i> , ACT Treasury, Canberra, viewed 31 May 2017, http://www.procurement.act.gov.au/about/capital-framework/post-implementation
Queensland	Queensland Treasury 2015, <i>Project Assessment Framework – Benefits Realisation</i> , Queensland Treasury, Brisbane, viewed 31 May 2017, https://www.treasury.qld.gov.au/publications-resources/project-assessment-framework/paf-benefits-realisation.pdf
Tasmania	Tasmanian Department of Premier and Cabinet 2007, <i>Realising Project Benefits – Stage 1 Project Evaluation and Review</i> , Department of Premier and Cabinet, Hobart, viewed 31 May 2017, http://www.egovernment.tas.gov.au/data/assets/pdf_file/0004/78304/RRealising_Project_Benefits_Project_Stage_2_Output_Development_Strategy.pdf
New Zealand	New Zealand Treasury 2014, <i>Better Business Cases – Managing Benefits from Projects and Programmes</i> , The Treasury, Wellington, viewed 31 May 2017, http://www.infrastructure.govt.nz/publications/betterbusinesscases/files/bbc-benmgt-2014.pdf

PART E

Appendices

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E1. Glossary

Appraisal

The process of determining impacts and overall merit of a proposed initiative, including the presentation of relevant information for consideration by the decision-maker.

Appraisal period

In a CBA, the number of years, including construction, over which the benefits and costs of an initiative are assessed. A default value of 30 operational years plus construction time is generally used for transport initiatives.

Assessment

A generic term referring to the quantitative and qualitative analysis of data to produce information to aid decision-making.

Assessment Framework

Infrastructure Australia's approach to infrastructure planning that provides structure to the identification, analysis, appraisal and selection of initiatives and projects. The Assessment Framework comprises the following five stages:

- Stage 1: Problem Identification and Prioritisation
- Stage 2: Initiative Identification and Options Development
- Stage 3: Business Case Development
- Stage 4: Business Case Assessment
- Stage 5: Post Completion Review.

Base case

A CBA is a comparison between two or more alternative states of the world – e.g. the base case and the project case. The base case is the state of the world without (i.e. in the absence of) the proposed initiative. The project case is generally the state of the world with the proposed initiative. However, it might be appropriate to include other options in the CBA for comparison (e.g. alternative routes or alternative modes).

Base year

The year to which all values are discounted when determining a present value.

Benefit–cost ratio (BCR)

Ratio of the present value of economic benefits to the present value of economic costs of a proposed initiative. Indicator of the economic merit of a proposed initiative presented at the completion of CBA. Commonly used to aid comparison of initiatives competing for limited funds.

Business case

A document that brings together the results of all the assessments of a proposed initiative. It is the formal means of presenting information about a proposal to aid decision making. It includes all information needed to support a decision to proceed with the proposal and to secure necessary approvals from the relevant government agency.

Consumer surplus

Consumer surplus is the difference between the price at which a consumer is willing to pay for a particular good or service and the price the consumer actually pays.

City-shaping

The desired shape or structure of a city is defined by its metropolitan strategy. Strategic infrastructure which is large enough to influence the metropolitan urban form could be referred to as city-shaping infrastructure. The impact of city-shaping infrastructure can be positive, neutral or negative as it could accelerate, complement or affect the implementation of the metropolitan strategy.

Cost-benefit analysis (CBA)

An economic analysis technique for assessing the economic merit of a proposed initiative by assessing the benefits, costs and net benefits to society of the initiative. Aims to value benefits and costs in monetary terms wherever possible and provide a summary indication of the net benefit.

Cost-effectiveness analysis (CEA)

Cost-effectiveness analysis is used when the benefits of project options are identical. Its aim is to identify the least cost option. The technique for valuing costs is the same as for cost-benefit analysis.

Demand forecasting

Estimating demand in a particular year or over a particular period.

Depreciation

The amount that an asset reduces in value due to wear and tear, or environmental factors. Specifically, it could be defined as:

- Economic depreciation: A decline in the value of an asset over time due to general wear and tear or obsolescence.
- Financial depreciation: The allocation of the cost of an asset over a period of time for accounting and tax purposes.

In an economic appraisal (using CBA), residual values are sometimes estimated based on the effects of economic depreciation.

Discount rate

The interest rate at which future values are discounted to the present and vice versa to account for the observation that a dollar tomorrow is worth less than a dollar today (i.e. the time value of money).

Cost-benefit analysis should use real social discount rates.

Discounted cash flow (DCF)

An analytical technique for converting a monetary impact at one point in time to a monetary impact at another so as to allow for the time value of money; the family of project performance measures (including IRR and NPV) are based on the foregoing technique.

Discounting

The process of converting money values that occur in different years to a common year. This is done to convert the dollars in each year to present value dollars.

Distributional effect

A change (positive or negative) in the economic welfare of a group of individuals or firms caused by an initiative.

Economic efficiency

A measure of the extent to which economic gains (referred to as increases in social welfare) have been or could be achieved. Economic efficiency is improved whenever the gainers from a change could compensate the losers out of their gains and still have some gain left over. Maximum economic efficiency is said to be obtained when no further changes of this type are possible, i.e. there are no unexploited opportunities to improve everybody's welfare.

Economic impact analysis

A form of economic analysis aimed at establishing the effect that an initiative will have on the structure of the economy, or on the economic welfare of groups of people or firms. Usually expressed in terms of employment and income effects, broken down by economic sector and/or region.

Elasticity

A mathematical measure used in economics to describe the strength of a causal relationship between two variables. It measures the responsiveness of the dependent variable to the changes in the independent variable (e.g. the price elasticity of demand). An elasticity value can be interpreted as the percentage change in the dependent variable in response to a one per cent change in the independent variable.

Escalation index

A number by which a base-year real price must be multiplied in order to obtain the real price in the year of the index.

Ex-ante and ex-post

The term "ex-ante" is a phrase meaning "before the event" and is applied to forecast or intended outcomes. This contrasts with "ex-post" which means "after the event" and reflects actual outcomes or performance. An ex-post evaluation (or post completion review) involves comparisons between actual outcomes and forecasts or benchmarks and provides insights into why a project has succeeded or failed.

External cost

Cost imposed on third parties, including time lost from delays, accident risks and environmental impacts (valued at resource costs where applicable).

Externality

An effect that one party has on another that is not transmitted through market transactions. An example is noise pollution from vehicles: those operating the vehicles disturb other parties such as nearby residents, but a market transaction between these parties is absent.

Financial analysis

The evaluation of the benefits and costs, measured in cash-flow terms, to a single entity (i.e. not the community or the economy).

Financial cost

The cash-flow expenses incurred by purchasing resources through markets at market prices.

First-year rate of return (FYRR)

Benefits minus operating costs in the first full year of operation of an initiative discounted to the start of the evaluation period, divided by the present value of the investment costs, expressed as a percentage. The first-year rate of return is used to determine the optimum timing of initiatives.

Generalised cost

Generalised costs are the sum of monetary cost inputs (e.g. in the case of a transport project, vehicles, fuel, parking spaces, etc.) which users pay for in the market and non-monetary inputs, primarily travel time, which users supply themselves. The reduction in generalised cost constitutes the benefit to the user.

Impact

A generic term to any specific effect of an initiative. Impacts can be positive (a benefit) or negative (a cost).

Incremental BCR

Ratio of the present value of increase in benefit to the increase in investment cost that results from switching from one option to the adjacent, more expensive option. The incremental BCR is used to choose between different options for a particular initiative, having different levels of investment cost.

Infrastructure

Civil engineering structures that have been built to facilitate the movement of people and/or goods for various social and business reasons.

Infrastructure operating costs

The costs of providing the infrastructure after the initiative has commenced operation, e.g. maintenance, administration and operating costs of a facility.

Infrastructure targets

Quantity and standard of infrastructure that is desired at some future time.

Infrastructure Priority List (IPL)

The IPL is a list of initiatives and projects which have been identified by Infrastructure Australia as potential infrastructure solutions to address nationally significant infrastructure problems and opportunities, including those identified in the 2015 *Australian Infrastructure Audit*. It is a statement of where governments, the community and the private sector can best focus their infrastructure efforts.

Initiative

Potential infrastructure solutions for which a business case has not yet been completed. Initiatives are identified through a collaborative process between proponents and Infrastructure Australia, using the Australian Infrastructure Audit and other data as evidence.

Internal rate of return (IRR)

The discount rate that makes the net present value equal to zero. IRR must be greater than or equal to the discount rate for an initiative to be economically justified. The discount rate is therefore also known as the hurdle rate.

Investment costs

The costs of providing the infrastructure before the initiative has commenced operation, e.g. planning and design, site surveying, site preparation, investigation, data collection and analysis, legal costs, administrative costs, land acquisition, construction costs, consequential works, construction externalities.

However, in some cases, investment costs can recur throughout the appraisal period (e.g. asset replacement or renewal costs). For a CBA, these should all be expressed in economic cost terms (also known as resource costs).

Jurisdiction

In this context, an Australian state or territory government.

Land use impacts

A change in, or a change in the intensification of, the types of activities that occur in places. Changes in activity may be from a change in use of the existing built form or a change in the built form itself

Maintenance

Incremental work to restore infrastructure to an earlier condition or to slow the rate of deterioration. Distinct from construction and upgrading.

Multi-criteria analysis (MCA)

A systematic tool to assist in decision-making where the impact of an initiative is assessed across a range of criteria. The development of business cases often requires both a MCA and a CBA to be undertaken.

Mutually exclusive

In the CBA context, the term is used to refer to options where choice to adopt one option precludes adoption of all the other options.

Net present value (NPV)

The combined discounted present value of one or more streams of benefits and costs over the appraisal period. The term 'net' denotes that the NPV is calculated as present value of benefits minus the present value of costs.

Nationally significant problem

An evidence-based problem of national significance that applies across states and/or territories. These problems are identified by Infrastructure Australia and jurisdictions, working in collaboration.

Network

Collection of routes that provide interconnected pathways between multiple locations for similar traffic. Can be multi-modal (typically comprising several uni-modal networks) or uni-modal.

Network assessment

Assessment of a whole network using data collection and analysis. Provides information to support development of network and corridor or area strategies.

Nominal prices

A value or price at a given time. Nominal prices rise with inflation. In contrast, real prices are prices after the effect of inflation has been removed.

Non-infrastructure options/solutions

Initiatives that make better use of existing infrastructure and avoid the need for large capital expenditures. Also referred to as reform or non-capital options/solutions.

Opportunity cost

The value forgone from using a resource in its next best alternative use. Synonymous with resource cost and social cost.

Option

Alternative possible solution to a problem, including base case options such as 'do nothing' or 'do minimum'.

Option value

The value that consumers place on being able to keep an option available, even though they may never in fact choose it. For instance, habitual air travellers may be willing to subsidise a competing train service in order to be in a position to use it if the need arises. Another example might be the preservation of a national park which people may never visit, but derive a benefit from knowing that the option exists.

Options assessment

The assessment of alternative options for solving an identified problem.

Payback period

The period required for an initiative's net recurrent benefits to equal its initial investment cost.

Performance target

Level of performance outcome/objective that is sought for a specific defined performance indicator.

Planning horizon

The year, or time period, into the future at which a planning exercise is focused. Long term planning can range from 30 to 50 year horizons, while at the other end of the scale short-term planning may be focused on a 1-3 year timeframe.

Post Completion Review

A review of a completed set of actions to determine whether the desired objects and/or forecast benefits and costs have been realised, and to explain the reasons for any differences between the expected and actual outcomes. The aim is to establish appropriate lessons for future project identification and assessment. A post completion review is sometimes referred to as an ex-post evaluation. Undertaken in Stage 5.

Price year

The price year is the year in which the prevailing prices are used in the analysis for the valuation of impacts.

Private cost

Cost incurred by an individual user or service provider. Private costs are valued at market prices, where applicable and may include user costs but exclude external costs imposed on others.

Probabilistic project cost estimates

Probabilistic project cost estimates identify cost components, determine the probability distribution for each cost component and then undertake a simulation, often a Monte Carlo simulation, to generate a probability distribution of project costs (for example, see P50 and P90).

Problem

An evidence-based reason for action that results from a gap between an actual and a desired outcome. In this context, problems are informed by the Australian Infrastructure Audit, and by Infrastructure Australia in collaboration with jurisdictions, to identify jurisdiction problems and national problems.

Producer surplus

Producer surplus is the difference between the price at which a producer is willing to supply a particular good or service and the price the producer actually receives.

Project (Priority or High Priority)

Potential infrastructure solutions for which a full business case has been completed and positively assessed by Infrastructure Australia as either Priority or High Priority.

Program

Suite of related initiatives to be delivered within a specified timeframe and sequence.

Proponent

A private sector organisation or jurisdiction that makes an initiative or project business case submission to Infrastructure Australia. To be a proponent of a business case, the organisation must be capable of delivering that proposal.

Public-private partnership (PPP)

An infrastructure project delivery model involving both the private and public sectors.

P50 cost

A P50 cost is an estimate of project costs based on a 50 per cent probability that the cost estimate will not be exceeded.

P90 cost

A P90 cost is an estimate of project costs based on a 90 per cent probability that the cost estimate will not be exceeded.

Real prices

Prices that have been adjusted to remove effects of inflation. They must be stated for a specific Base Year, e.g. 2016 dollars.

Residual value

The value of an asset at the end of the appraisal period. They are used in CBA calculations involving long-lived assets whose life extends beyond the end of the appraisal period.

Resource cost

Opportunity cost to society as a whole. Synonymous with opportunity cost and social cost. Reflects market prices where there is an absence of market failure. Where market failure exists, appropriate adjustments are required to estimate the true resource cost (Resource cost = market price – indirect taxes + subsidies).

Risk

A state in which the number of possible future events exceeds the number of events that will actually occur, and some measure of probability can be attached to them (Bannock et al 2003, p. 338).

Scenario analysis

Scenario analysis provides a framework for exploring the uncertainty about future consequences of a decision, by establishing a small set of internally consistent future scenarios and assessing options in each of these. This form of analysis is especially useful for decision-makers faced with forms of uncertainty that are uncontrollable or irreducible (e.g. future technology change or increased climate variability).

Sensitivity analysis

Changing a variable, or a number of variables, in a model or analysis to discover how the changes affect the output or results.

Social cost

Opportunity cost to society as a whole. Synonymous with opportunity cost and resource cost. Reflects market prices where there is an absence of market failure. Where market failure exists, appropriate adjustments are required to estimate the true resource cost.

Strategic planning

High-level planning involving fundamental direction-setting decisions.

Narrows down the types of options that will be pursued. Involves consideration of present and future environments. Asks questions such as: ‘Are we doing the right thing?’ ‘What are the most important issues to respond to?’ and ‘How should we respond?’ Balances many competing considerations including value judgements, subjective assessments and political considerations. Involves iteration, stakeholder consultation and analysis.

Sunk cost

A cost that cannot be retrieved by resale in the market. More specifically, a sunk asset is one which, once constructed, has no value in any alternative use. Bridges and railway tunnels are typically sunk assets. Sunk costs incurred in the past should be excluded from a CBA.

Sustainability

Development that meets the needs of the present without compromising the ability of future generations to meet their own needs.

User costs

Costs incurred by a transport user in addition to the money price – waiting time, time in transit, unreliability, damage to freight, passenger discomfort, additional costs to complete the door-to-door journey. Quality attributes such as time and reliability need to be expressed in dollar terms based on user valuations.

Willingness-to-pay (WTP)

The maximum amount a consumer is willing to pay for a given quantity of a particular good or service (rather than go without it). Total value that consumers place on a given quantity of a good or service. It is measured as the total area under the demand curve up to the given quantity.

E2. Consolidated list of questions for Post Completion Reviews

Reviewers should assess the following questions:

Review Area	Review Questions
Strategic fit	1. Did the project solve the identified problem? If not, why not?
	2. To what extent did the project or program of works meet its strategic objectives?
	3. <i>If relevant</i> , which nationally significant and State significant objectives did the project or program of works contribute to?
	4. What were some of the factors that led to the project or program of works contributing to meeting these objectives?
	5. Were there some objectives that remain unmet? If yes, what was the reason(s) for any unmet objectives (e.g. changes in the macro environment, scoping error)? Describe how the planning or scoping of future projects might better contribute to meeting these outcomes.
	6. Were there other strategic benefits or objectives that were not identified by the baseline (i.e. the final business case) that have been achieved? Describe these benefits or objectives.
	7. <i>If relevant</i> , does the project represent a good fit within the program of works? In what way does it contribute to meeting program objectives? If the project did not contribute to realising program benefits, could you please comment on how the planning or scoping of future projects might better contribute to meeting program objectives.
	8. <i>If relevant</i> , to what extent has the project or program of works achieved the requirements of policies relating to building and fleet design and sustainability, energy and water efficiency, waste and recycling?
Economic merit	1. Given what you know today, would you have specified the base case as was done in the baseline? Why or why not?
	2. Given what you know today, would you have selected the preferred option in the business case as the preferred one today? Why or why not? If not, which alternative might have been picked? Why was this option not advanced or selected in the project assessment stage?
	3. To what extent were the forecast delivery, operational and maintenance costs realised? Have these costs been exceeded in any given year? Have actual costs been lower than anticipated costs in any given year? What were the causes of the deviation?
	4. Have other costs arisen that were not included in the base case? If so, which ones are these? Why were these costs not considered during the project assessment stage?
	5. To what extent were the key benefit drivers realised? What were the causes of the deviation?
	6. Who were the beneficiaries of the project? Were there any unintended beneficiaries?
	7. Have other benefits been realised that the proponent did not capture during the assessment? If so, which benefit types are these? Why the proponent did not consider these benefits during the project assessment stage?
	8. To what extent is the project delivering the anticipated and required levels of service?
	9. Where the project has not delivered anticipated benefits, or adverse impacts are greater than anticipated, what are the reasons for this and what strategies have been identified and taken to rectify?

Review Area	Review Questions
	10. Did the project deliver the benefits at the lowest cost compared with the cost of alternative options?
	11. Did the proponent capture the residual value of the asset in the analysis? Why or why not? Was the inclusion or exclusion of this residual value in the baseline accurate?
	12. What assumptions have changed in the cost-benefit analysis, and how have they impacted on the net benefits (NPV) and the benefit-cost ratio for the project?
	13. Which changes in the assumptions should be adopted for future cost-benefit analyses?
	14. Do you expect the ex-post NPV and BCR to change after subsequent PCRs?
Delivery efficiency	1. Was the project or program of works delivered within budget? Describe any changes from the baseline (i.e. the final business case) and reasons for variances. In which delivery years did variances arise, if any? What lessons can be drawn for future projects from this review?
	2. Describe if the delivered project met the scope requirements stated in the business case (or contract documents)? Provide an explanation for any variances
	3. To what extent has the identified problem been resolved or reduced as a result of the project or program of works? Was the solution appropriate for the problem (i.e. was the project appropriately scoped, or was there over-engineering or under-engineering of the project)? Provide an explanation if the solution is not deemed appropriate.
	4. Did the scope of the project change after the submission of the business case? Was this captured by the tender documentation or any other documentation during the project assessment stage?
	5. If the scope of the project changed during the project delivery stage, did this have an impact on planned costs? Describe these impacts. Could these scope changes and impacts have been avoided in any way?
	6. What lessons might you draw for the planning of future projects from this review of project scope?
	7. Was the project or program of works delivered on time? Describe any changes from the baseline and reasons for variances. What lessons can be drawn for future projects from this review?
	8. Were the identified milestones in the baseline appropriate for a project of this nature? Could these milestones be defined differently for improving planning and delivery of future projects?
	9. To what extent did the procurement process meet policy and procedural requirements?
	10. Was the project procured using the model proposed in the business case and the contract (e.g. design and construct) ?
	11. Was the project delivered using the model proposed in the business case and the contract (e.g.. PPPs)?
	12. Did the selected procurement/delivery model achieve the intended outcomes? Describe these outcomes? Comment on whether the selected model was considered appropriate?
	13. What were the strengths and/or weaknesses of the selected procurement/delivery model?
	14. Did the procurement/delivery model mitigate identified risks?

Review Area	Review Questions
	15. Did the procurement/delivery model introduce additional risks?
	16. What lessons can you draw from this review of procurement and delivery models for improving planning of future projects?
	17. Who contributed to financing the project? Were there any issues with financing?
	18. Were non-government financing sources considered for delivering this project, e.g. tolls revenue or value sharing mechanisms?
	19. If such sources of revenue were not considered, was this the right decision? What are the lessons for financing of future projects that you can draw from this review?
Other lessons	1. How successfully was the project or program of works managed during delivery?
	2. Were the project risks managed effectively? Confirm if the risk management approach in the business case was adopted?
	3. Was the proposed risk management approach adequate?
	4. Were there risks that the project assessment documentation did not identify to an appropriate standard for the asset type (i.e. did the risk assessment meet the required safety standards and regulations)? How might you manage these risks, or manage risks differently going forward, when implementing a project of a similar nature?
	5. Were there any unintended outcomes that have arisen due to this project or program? If so, what were they?
	6. Were stakeholder management plans developed and implemented? Describe how stakeholder management was conducted and what the outcomes were.
	7. Was a change management plan required and adequately defined? Was this implemented appropriately? Describe how change management was undertaken and what the outcomes were.
	8. To what extent are stakeholders satisfied with the project outcomes and the level of consultation during project planning and delivery?
	9. Was the level of project management and governance sufficient to support successful project outcomes? Describe the approach taken and what the outcomes were.
	10. What lessons for future projects can you draw from this review?



**Infrastructure
Australia**

Assessment Framework

For initiatives and projects to be included
in the Infrastructure Priority List (IPL)

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