Appendix C2

Suburban Rail Loop
Economic Appraisal Report

15 February 2021

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Inherent limitations and economic projections

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Contents

Index of Figures

Index of Tables

Glossary

Term	Definition
ABS	Australian Bureau of Statistics
AJM	Aurecon Jacobs Mott McDonald Joint Venture
AM Peak	The two-hour AM peak period (7:00am to 9:00am) on a typical weekday
ATAP	Australian Transport Assessment and Planning
AV	Autonomous vehicle
AVOT	Air passenger value of travel time
Base Case	Starting point for the modelling and economic appraisal, consisting of the Reference Case transport network for a given year, but excluding some infrastructure projects such as Suburban Rail Loop (SRL), along with SRL enabled projects and critically interdependent projects
BCR	Benefit-cost ratio
CBD	Central business district
CDV	Conventionally driven vehicle
CGE	Computable General Equilibrium
CI	Congestion index
CIE	Centre for International Economics
CS	Consumer surplus
CV	Coefficient of variation
DECCW	Department of Environment Climate Change and Water
DELWP	Department of Environment, Land, Water and Planning (Victoria)
Demand Modelling Report	Suburban Rail Loop Demand Modelling Report dated 15 February 2021 prepared by KPMG
DJPR	Department of Jobs, Precincts and Regions
DoT	Department of Transport
DTF	Department of Treasury and Finance
EV	Electric vehicle
FCP	Forced car ownership
GDP	Gross domestic product
GFC	Global financial crisis
GSP	Gross state product
GVA	Gross value added
HCV	Heavy commercial vehicles
HILDA	Household, Income and Labour Dynamics in Australia
HVHR	High value high risk
IA	Infrastructure Australia
IGR	Intergenerational report
ILM	Investment logic map
Inner ring	Inner ring of Greater Melbourne as defined in Section 3
Inter-peak	Inter-peak period (9:00 am – 3:00 pm) on a typical weekday
IPART	Independent Pricing and Regulatory Tribunal
IVT	In-vehicle time

Term	Definition
LCV	Light commercial vehicles
LSOA	Lower super output area
LUTI	Land use and transport interaction model
M2MPJ	Move to more (or less) productive jobs
MABM	Melbourne Activity and Agent Based Model
MACs	Metropolitan activity centres
MAR	Melbourne Airport Rail
Middle ring	Middle ring of Greater Melbourne as defined in Section 3
MRS	Marginal rate of substitution
NEICs	National employment and innovation clusters
NPV	Net present value
OCOC	Opportunity cost of capital
Off-peak	Off-peak period (6:00 pm – 7:00am) on a typical weekday
OMR	Outer Metropolitan Ring Road
Option A	Timing for delivery of SRL – Cheltenham to Airport to be completed in 2053
Option B	Timing for delivery of SRL – Cheltenham to Airport to be completed in 2043
Outer ring	Outer ring of Greater Melbourne as defined in Section 3
PAA	*Public Administration Act 2004* (Vic)
PC	Perceived cost
PM peak	The three-hour PM peak period (3:00 – 6:00 pm) on a typical weekday
Program Case	The representation of the SRL – Cheltenham to Airport scenario (including rail and precinct initiatives) for the modelling and economic appraisal, to compare against the Base Case scenario
PSPs	Precinct structure plans
RC	Resource cost
RCC	Resource cost correction
Reference Case	A set of current and future year network, land use and transport cost assumptions used for transport modelling in Victoria (developed and managed by DoT)
RP	Revealed preference
RPV	Rail Projects Victoria
SALUP	Small Area Land Use Projections (Victorian Government land use forecasts) based on DELWP Projections 2018 (Unpublished)
SP	Stated preference
SRL	Suburban Rail Loop, an orbital rail loop connecting Melbourne's middle suburbs stretching from Cheltenham to Werribee, together with a series of integrated initiatives to create value and improve the precincts around the new stations
SRL Business and Investment Case	The Business and Investment Case for SRL – Cheltenham to Airport providing the strategic rationale for the eastern and northern sections of SRL
SRL East	Section of the Suburban Rail Loop between Cheltenham and Box Hill
SRL North	Section of the Suburban Rail Loop between Box Hill and Melbourne Airport
SRL Precincts	An area which is a 1600m radius around an SRL station. The SRL East Precincts are: Cheltenham Precinct Clayton Precinct Monash Precinct Glen Waverley Precinct Burwood Precinct Box Hill Precinct

Term	Definition
	The SRL North Precincts are: Doncaster Precinct Heidelberg Precinct Bundoora Precinct Reservoir Precinct Fawkner Precinct Broadmeadows Precinct Melbourne Airport (anchor precinct)
SRL – Airport to Werribee	The section of SRL from Melbourne Airport to Werribee, together with a series of integrated initiatives to create value and improve the precincts in and around the new stations
SRL – Cheltenham to Airport	The section of SRL from Cheltenham to Melbourne Airport, together with a series of integrated initiatives to create value and improve the precincts in and around the new stations
SRLA	Suburban Rail Loop Authority
STPR	Social time preference rate
SVOT	Standard value of travel time
T3 WEBs	T3 wider economic benefits
TAG	Transport Analysis Guide
UCBs	Urban consolidation benefits
UHI	Urban heat island
V/C	Volume-capacity
VEM	VITM Economic Module
VISTA	Victorian Integrated Survey of Travel and Activity
VITM	Victorian Integrated Transport Model
VKT	Vehicle kilometres travelled
VOC	Vehicle operating cost
VOR	Value of reliability
VOT	Value of travel time
VPA	Victorian Planning Authority
WACC	Weighted average cost of capital
WCOF	Weighted cost of funds
WEBs	Wider economics benefits
WTP	WT Partnership
WTP	Willingness to pay

Executive summary

Plan Melbourne 2017-2050 is the Victorian Government's long-term planning strategy that sets out the vision for Melbourne as a global city of opportunity and choice.[1] A key principle of *Plan Melbourne* is that Melbourne's urban form needs to transform to be a 'city of centres'.

To help deliver on *Plan Melbourne* objectives, the Victorian Government investigated options to influence the distribution of population and employment across Melbourne. These investigations culminated in the 2018 *Strategic Assessment: Suburban Rail Loop*[2], which recommended an orbital rail line.

The Suburban Rail Loop (**SRL**) is a transformative, city- and State-shaping investment that will enhance Victoria's public transport system and deliver urban renewal outcomes. It includes a new, 90 kilometre rail link connecting Melbourne's middle suburbs from Cheltenham to Werribee and a series of integrated initiatives to create value and improve the precincts around the new stations. SRL is more than a strategic response to our city's future travel demands; it is about shaping Melbourne for the needs of future generations.

The Business and Investment Case (**SRL Business and Investment Case**) articulates the strategic rationale for the section of SRL between Cheltenham and Melbourne Airport (**SRL – Cheltenham to Airport**), which will be delivered by the Suburban Rail Loop Authority (**SRLA**).

SRL will:

- Connect every major railway line from the Frankston line to the Werribee line
- Establish a direct rail connection between Melbourne's major employment, health, education and activity precincts outside Melbourne's central business district (**CBD**), catalysing urban renewal across Melbourne's middle suburbs
- Implement new planning settings to catalyse urban renewal, facilitate developments around the new stations, provide local transport improvements, and deliver place-making initiatives and amenity improvements in the precincts around SRL stations (**SRL Precincts**)
- Unlock the economic potential of Melbourne's middle suburbs, including the national employment and innovation clusters (**NEICs**) of Werribee, Sunshine, La Trobe and Monash
- Deliver three new transport super hubs at Clayton, Broadmeadows and Sunshine that will connect regional passengers into the SRL rail line, providing more direct and convenient journeys
- Better connect our suburbs and regions to education and health precincts, Melbourne Airport and each other
- Improve access to jobs across Melbourne's middle suburbs for Melburnians and regional Victorians.

A program of works of this scale requires a sequenced approach. For the purposes of the economic assessment, it has been assumed that SRL – Cheltenham to Airport will be delivered in three sections:

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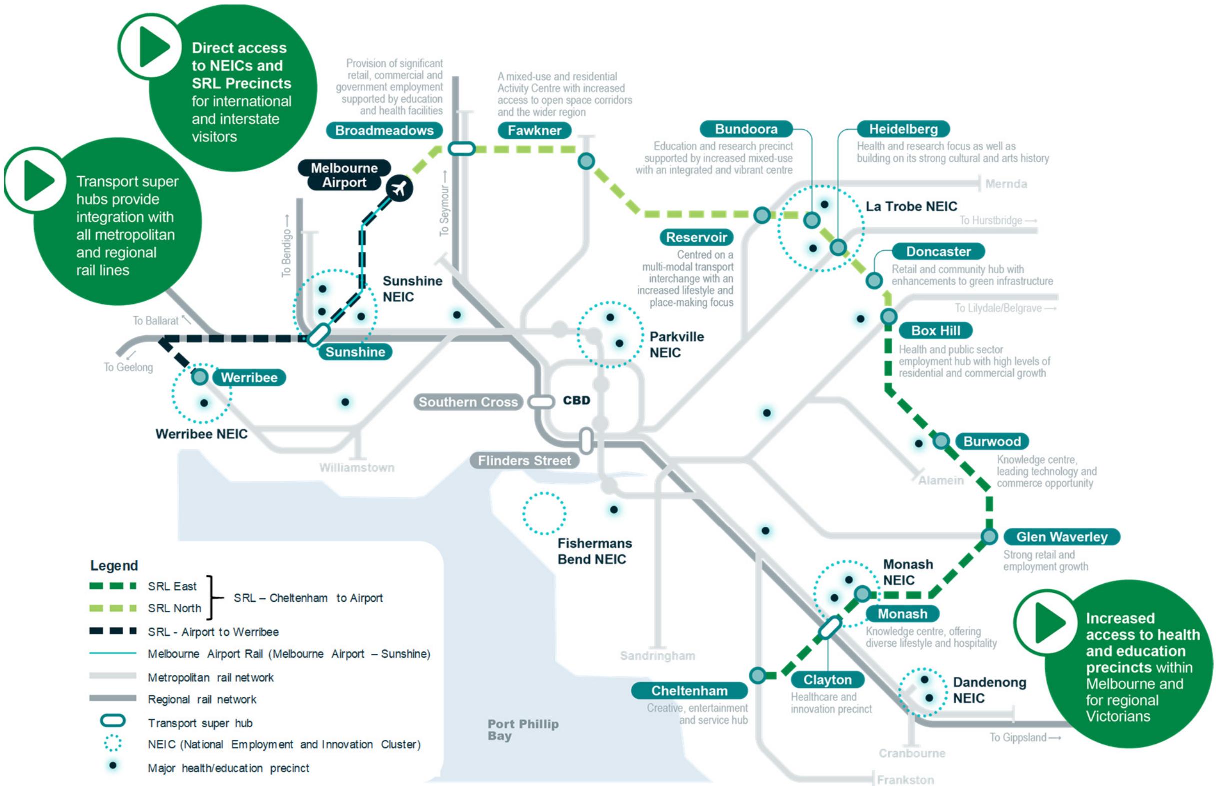
[1] Victorian Government, *Plan Melbourne 2017-2050*.
[2] Development Victoria, *Strategic Assessment Suburban Rail Loop*, (2018).
https://bigbuild.vic.gov.au/_data/assets/pdf_file/0006/325572/Suburban-Rail-Loop-Strategic-Assessment.pdf

between Cheltenham and Box Hill, followed by Box Hill to Reservoir and then Reservoir to Melbourne Airport.[3] For ease of reference, the section between Cheltenham and Box Hill is referred to as **SRL East**, and the section between Box Hill and Melbourne Airport is referred to as **SRL North**.

Figure ES - 1 illustrates the SRL – Cheltenham to Airport alignment in the context of the Melbourne's transport network.

Figure ES - 1: SRL – Cheltenham to Airport alignment, 2056



Source: SRLA

This report details the methodology adopted and the results of the economic appraisal undertaken for SRL – Cheltenham to Airport. For the purposes of the demand modelling and economic appraisal, two Program Cases have been assessed with SRL – Cheltenham to Airport delivered by 2053 (**Option A**) and by 2043 (**Option B**). As SRL North is still in early planning, the assessment of two Program Cases reflects that final delivery dates are yet to be confirmed. More detail on SRL – Cheltenham to Airport is provided in Chapters 1 and 2.

The economic appraisal has been undertaken in accordance with accepted transport evaluation techniques, including conventional cost benefit analysis (**CBA**), wider economic benefits (**WEBs**) analysis, Urban Consolidation Benefits (**UCBs**) and macro economy-wide impact assessment (using computable general equilibrium (**CGE**) modelling).

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[3] SRLA advises that further detailed planning and technical design for SRL North will be undertaken over the coming years. Specific packaging and procurement decisions will be made at an appropriate time in the future.

The following economic performance measures were calculated to determine the economic viability of SRL – Cheltenham to Airport:

- The Net Present Value (**NPV**), which gives an indication of the magnitude of net benefit to society. Positive NPVs indicate that the investment is desirable to society as a whole.
- The Benefit Cost Ratio (**BCR**), which is a measure of value for money for public expenditure, and is of principal value when Government is considering spending scarce funds.

The NPV, BCR and underlying economic benefits presented within this appraisal are shown as a range between the P10 and P90 values. The incorporation of uncertainty within the economic appraisal reflects best practice and response to broader recommendations within Victorian and Australia (including the Victorian Auditor-General's Office) regarding the appraisal of projects with long lead times.[4]

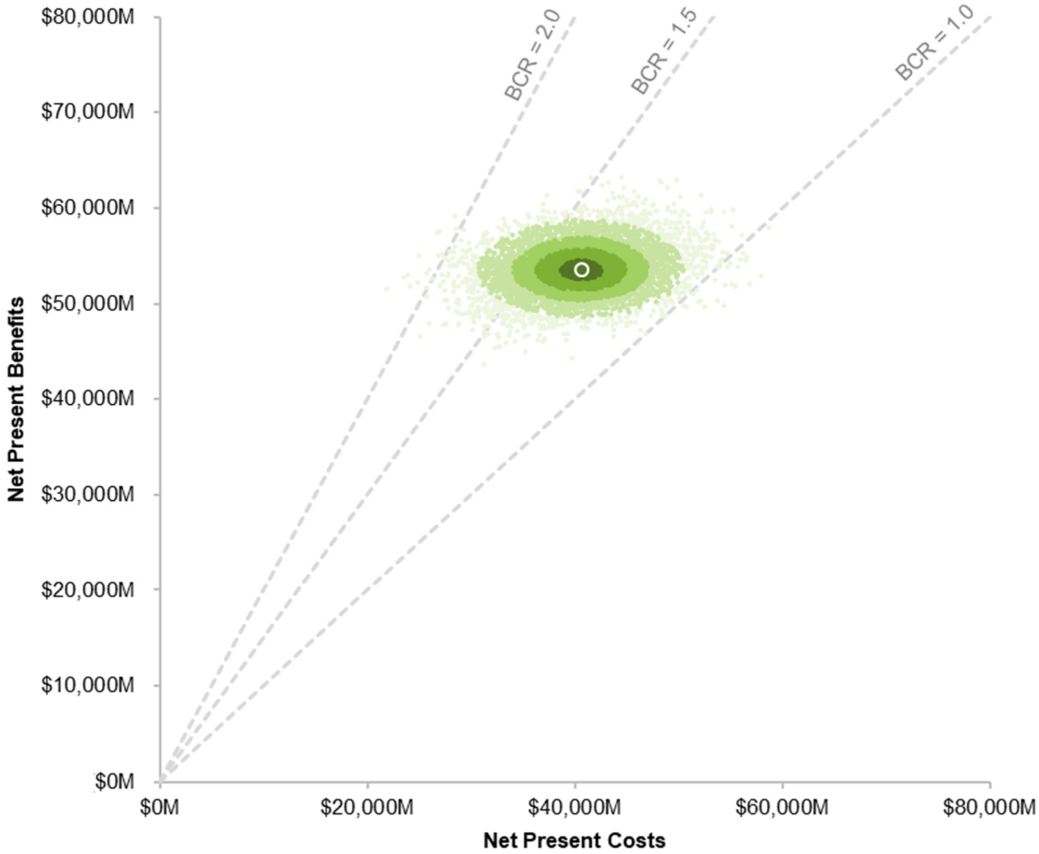
Figure ES - 2 and Figure ES - 3 present the probabilistic economic analysis results for Program Case Option A and Program Case Option B in present value terms at a discount rate of 4 per cent. In summary:

- Program Case Option A has the Net Present Value (**NPV**) ranging between $3.0 billion and $22.9 billion and a Benefit to Cost Ratio (**BCR**) ranging between 1.1 and 1.7.
- Program Case Option B has an NPV ranging between $2.4 billion and $25.2 billion and a BCR ranging between 1.0 and 1.7.

These indicate that both Program Case Option A and Program Case Option B are economically viable.

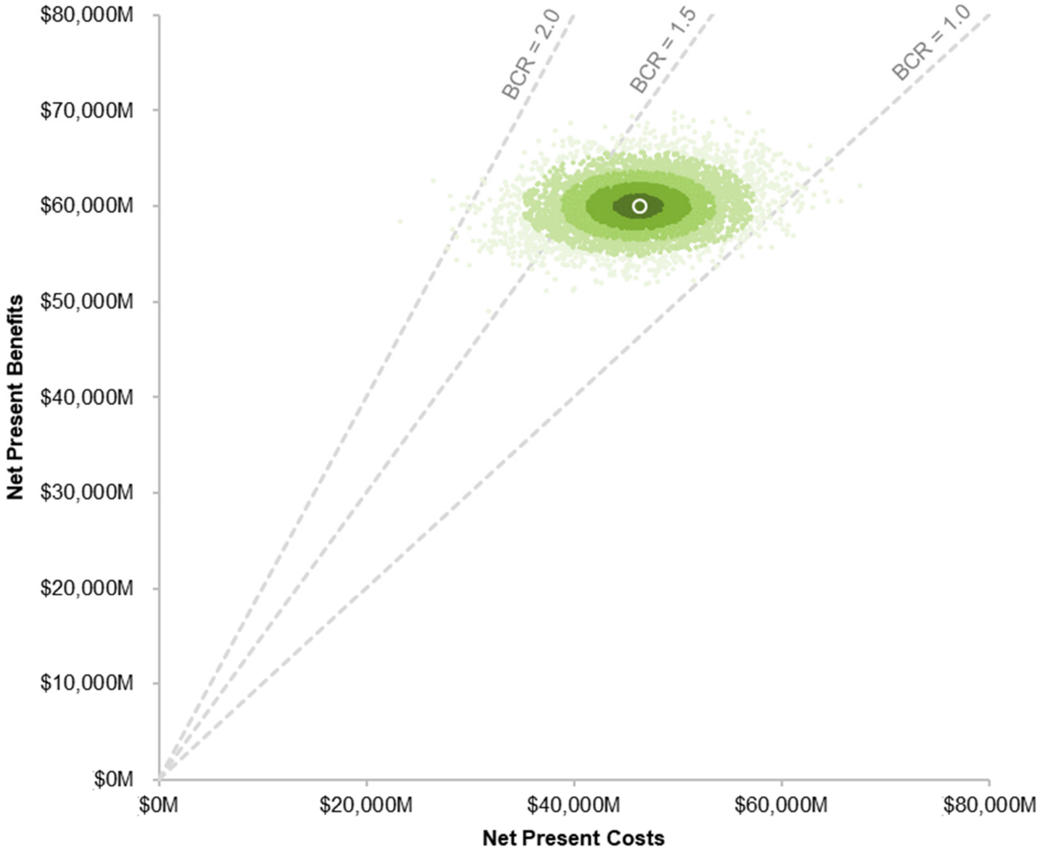
[4] Victorian Auditor-General's Office (2019, pg.11). *Melbourne Metro Tunnel Project - Phase 1: Early Works*

Figure ES - 2: SRL – Cheltenham to Airport economic evaluation result – Program Case Option A



Source: KPMG (2021) based on VITM and CityPlan modelling results, relevant guidelines and agreed assumptions.

Figure ES - 3: SRL – Cheltenham to Airport economic evaluation result – Program Case Option B



Source: KPMG (2021) based on VITM and CityPlan modelling results, relevant guidelines and agreed assumptions.

Table ES - 1 provides a breakdown of the economic evaluation results for both Program Case Option A and Program Case Option B, discounted at a 4 per cent discount rate. The economic analysis is based on land use impact assessment and demand modelling undertaken using CityPlan and the Victorian Integrated Transport Model (**VITM**). Capital costs have been distributed across the construction period, and economic benefits and operating costs are calculated over a 50-year period from project opening.

The analysis shows that both Program Case Option A and Program Case Option B are economically viable.

Table ES - 1: Economic evaluation results for Program Case Options A and B discounted at 4 per cent

	Program Case Option A	Program Case Option B
Conventional Benefits		
Public transport user benefits	$14.9bn to $19.8bn	$16.6bn to $21.7bn
Road user benefits	$10.0bn to $12.3bn	$11.7bn to $14.3bn
Externalities (non-user benefits)	$3.5bn to $3.7bn	$4.2bn to $4.6bn
Option and non-use value	$1.1bn to $5.4bn	$1.2bn to $5.7bn
Residual value of assets	$3.8bn to $6.4bn	$3.6bn to $6.0bn
Total conventional benefit	**$33.6bn to $40.9bn**	**$37.4bn to $45.2bn**
Wider Economic Benefits		
WEB1 - Agglomeration economies	$6.0bn to $9.7bn	$6.3bn to $10.3bn
WEB2 - Labour market deepening	$1.1bn to $1.8bn	$1.8bn to $3.0bn
WEB3 - Imperfect markets	$0.4bn to $0.5bn	$0.5bn to $0.6bn
Total Wider Economic Benefits	**$7.5bn to $11.9bn**	**$8.8bn to $13.9bn**
Urban Consolidation Benefits		
Essential infrastructure cost savings	$2.0bn to $3.3bn	$2.3bn to $3.7bn
Reduced non-urban land consumption	$0.01bn to $0.02bn	$0.01bn to $0.02bn
Improved social inclusion and equality	$1.0bn to $1.6bn	$1.2bn to $1.9bn
Total Urban Consolidation Benefits	**$3.2bn to $4.6bn**	**$3.7bn to $5.3bn**
Costs		
Capital costs	$24.1bn to $40.2bn	$27.1bn to $45.1bn
Recurrent costs	$6.3bn to $10.6bn	$7.6bn to $12.6bn
Total Cost	**$30.7bn to $50.5bn**	**$35.1bn to $57.6bn**
Total Benefit	**$48.5bn to $58.7bn**	**$54.7bn to $65.8bn**
Net Present Value (NPV)	**$3.0bn to $22.9bn**	**$2.4bn to $25.2bn**
Benefit Cost Ratio (BCR)	**1.1 to 1.7**	**1.0 to 1.7**

Notes:

1. *The probabilistic analysis uses 95% confidence intervals.*
2. *5,000 iterations were used for the analysis and ensure convergence.*
3. *The probabilistic ranges are not additive because the underlying distribution of inputs vary for each line item.*

Source: KPMG (2021) based on VITM and CityPlan modelling results, relevant guidelines and agreed assumptions.

Under Option A, SRL – Cheltenham to Airport will help support SRL East and SRL North Precincts to grow from 192,000 jobs and 92,500 households currently to 545,000 jobs and 232,000 households by 2056. Relative to a scenario where SRL – Cheltenham to Airport does not exist, it is estimated that Option A will directly lead to 165,000 additional jobs and 47,500 additional households locating in the SRL East and SRL North Precincts in 2056[5].

[5] CityPlan modelling

The construction and delivery of SRL East under Option A will directly employ 6,000 to 8,000 people, with SRL North directly employing 5,100 people. Across Victoria, the investment in SRL – Cheltenham to Airport will create 3,900 net additional jobs (FTE) at the peak of construction. SRL – Cheltenham to Airport is a long term, productivity enhancing investment. The impact of SRL – Cheltenham to Airport's precinct specific land use changes and productivity enhancements will lead to an increase in employment across the state with 4,000 net additional jobs (FTE) created at the peak of the operation phase.[6]

This level of economic activity is anticipated to increase Victoria's Gross State Product (**GSP**) by $50.8 billion in present value terms using a 4 per cent discount rate. Overall, Australia's Gross Domestic Product (**GDP**) will be higher by $49.3 billion in present value terms over the evaluation period. The increase in economic output as measured through GSP and GDP will lead to increased State and Australian Government tax receipts. Over the construction and operations phase, State Government's tax receipts will be higher by $3.2 billion in present value terms. The Australian Government's tax receipts will be substantially higher by around $10.9 billion in present value terms. Total tax receipts for the State and Australian Governments will therefore be around $14.1 billion in present value terms.

Under Option B, SRL – Cheltenham to Airport will help support SRL East and SRL North Precincts to grow to 551,500 jobs and 234,000 households by 2056. Relative to a scenario where SRL – Cheltenham to Airport does not exist, it is estimated that Option B will directly lead to 171,500 additional jobs and 49,500 additional households locating in the SRL East and SRL North Precincts in 2056[7]. Additionally, under Option B, SRL – Cheltenham to Airport will:

- Directly employ 6,000 to 8,000 people as part of SRL East, with SRL North directly employing 5,100 people
- Create 5,200 net additional jobs (FTE) at the peak of construction across Victoria[8]
- Increase employment across Victoria with 4,400 net additional jobs (FTE) at the peak of operation phase[9]
- Increase Victoria's GSP by $58.7 billion in present value terms using a 4 per cent discount rate
- Increase Australia's GDP by $58.0 billion in present value terms using a 4 per cent discount rate
- Increase State Government tax receipts by $3.7 billion in present value terms at a 4 per cent discount rate
- Increase Australian Government tax receipts by $12.9 billion in present value terms at a 4 per cent discount rate.

An alternative approach to assessing the economic contribution of the investment is to assess the return on investment as measured through change in economic output (GDP or GSP) against the funding cost of the investment. The analysis shows that the Victorian economy, as measured by change in GSP, will be better off by between 5.0 and 4.7 times the cost of investment (after allowing for borrowing costs), for Program Case Option A and Program Case Option B respectively.[10] Similarly, the

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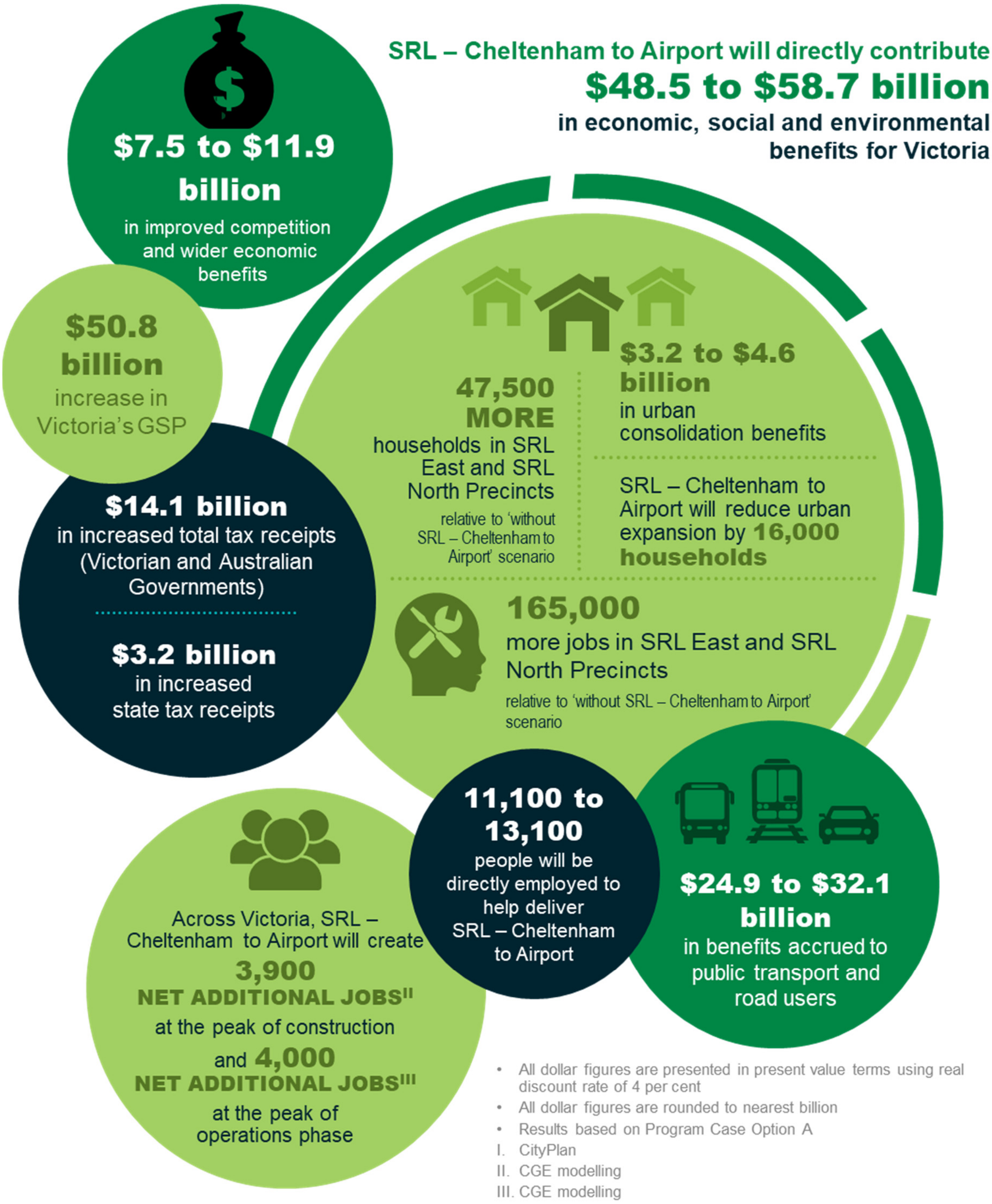
[6] CGE modelling
[7] CityPlan modelling
[8] CGE modelling
[9] CGE modelling
[10] For the purpose of this analysis, it was assumed that one-third of the cost is funded and financed by the private sector through value capture mechanisms, one-third by the State Government and the remaining one-third by the Australian Government. State and Australian Government finance their respective share of the capital expenditure from borrowings at applicable State and Commonwealth 10-year bond rate.

Australian economy, as measured by the change in GDP, will be better off by between 2.7 and 2.6 times the cost of investment for Program Case Option A and Program Case Option B respectively.

The increase in economic activity in turn will boost the Victorian and Australian Governments' tax receipts, with these tax receipts sufficient to cover government borrowing costs for both Program Case Option A and Program Case Option B.

Key findings of the economic analysis for Option A is summarised in the following graphic.

Figure ES - 4: Economic benefits of SRL – Cheltenham to Airport (Program Case Option A)



1. Introduction

1.1 Overview

The Suburban Rail Loop (**SRL**) is a transformative, city- and State-shaping investment that will enhance Victoria's public transport system and deliver urban renewal outcomes. It includes a new 90 kilometre rail link connecting Melbourne's middle suburbs from Cheltenham to Werribee and a series of integrated initiatives to create value and improve the precincts around the new stations.

The Business and Investment Case (**SRL Business and Investment Case**) articulates the strategic rationale for the section of SRL between Cheltenham and Melbourne Airport (**SRL – Cheltenham to Airport**), which will be delivered by the Suburban Rail Loop Authority (**SRLA**).

A program of works of this scale requires a sequenced approach. For the purposes of the economic assessment, it has been assumed that SRL – Cheltenham to Airport will be delivered in three sections: between Cheltenham and Box Hill, followed by Box Hill to Reservoir and then Reservoir to Melbourne Airport.[11] For ease of reference, the section between Cheltenham and Box Hill is referred to as **SRL East**, and the section between Box Hill and Melbourne Airport is referred to as **SRL North**. For the purposes of the demand modelling and economic appraisal, two Program Cases have been assessed with SRL – Cheltenham to Airport delivered by 2053 (**Option A**) and by 2043 (**Option B**). As SRL North is still in early planning, the assessment of two Program Cases reflects that final delivery dates are yet to be confirmed. More detail on SRL – Cheltenham to Airport is provided in Chapters 1 and 2.

The coordinated investments in rail infrastructure and precinct initiatives will deliver a step-change in economic outcomes transforming our communities for generations. This economic appraisal has therefore been developed to reflect the transformative and intergenerational nature of SRL – Cheltenham to Airport. The approach builds on established guidelines such as those from the Victorian Department of Transport (**DoT**), Department of Treasury and Finance (**DTF**) and Infrastructure Australia (**IA**), and incorporates techniques that delivers the depth and breadth of analysis necessary for this unprecedented investment.

This report details the methodology adopted and the results of the economic appraisal undertaken for SRL – Cheltenham to Airport.

1.2 Purpose

The economic appraisal detailed in this report has been undertaken to assess the economic merits of SRL – Cheltenham to Airport, a city-shaping investment including both a rail line and an indicative package of precinct initiatives designed to enhance productivity, connectivity and liveability for citizens across Victoria. This report is underpinned by results outlined in the Suburban Rail Loop Demand

[11] SRLA advises that further detailed planning and technical design for SRL North will be undertaken over the coming years. Specific packaging and procurement decisions will be made at an appropriate time in the future.

Modelling Report dated 15 February 2021 prepared by KPMG (and hereinafter referred to as the **Demand Modelling Report**).

1.3 Scope of economic appraisal

The economic appraisal of SRL – Cheltenham to Airport has been undertaken by KPMG with inputs from a range of stakeholders, including SRLA, Victorian Planning Authority (**VPA**), Department of Jobs, Precincts and Regions (**DJPR**) and DoT. As it is an integrated land use and transport program of works, the benefits generated by SRL – Cheltenham to Airport are intrinsically linked to both the enhanced transport connections and precinct development initiatives. As such, the economic benefits are assessed taking into consideration both elements.

The broad framework adopted for economic appraisal is summarised in Figure 1-1.

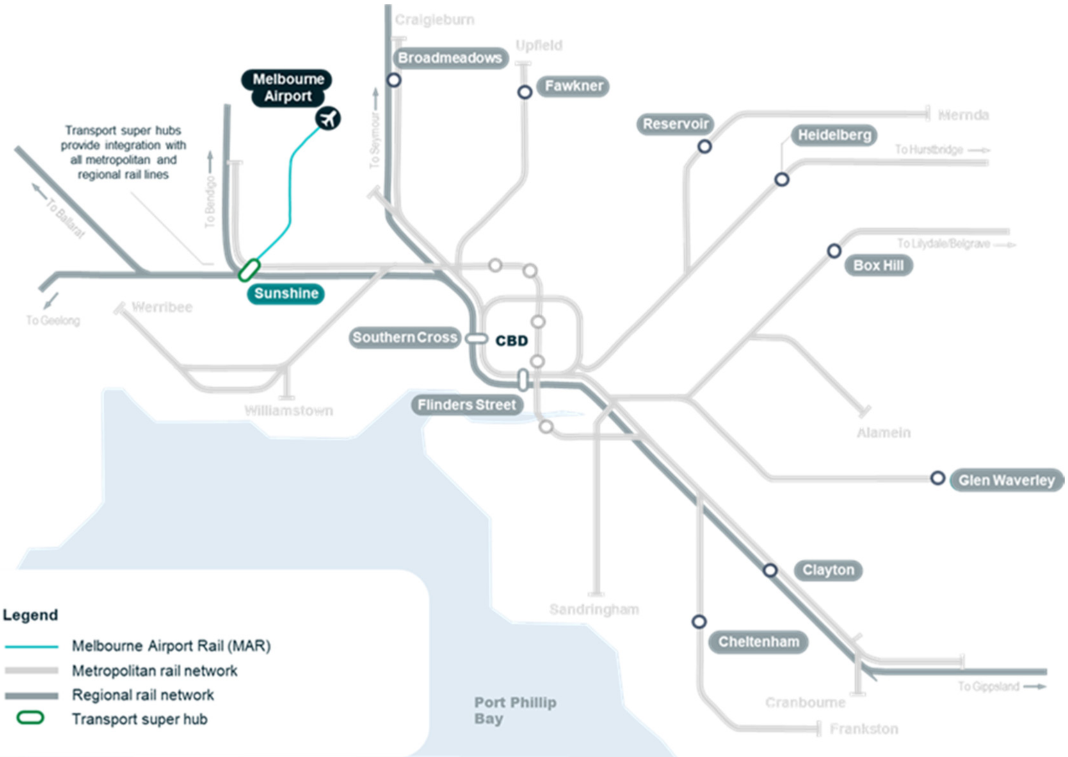
Figure 1-1: Economic evaluation framework

The approach and analysis has been reviewed by an independent peer reviewer separately appointed by DoT. The peer reviewer has been involved in the review of the economic appraisal throughout the process including reviewing the economic framework, the detailed approach and the draft analysis, and the peer reviewer's feedback has been incorporated in the final analysis and documentation as appropriate.

This economic evaluation assesses and compares the incremental costs and benefits of the Program Cases (Options A and B) relative to the Base Case as described below:

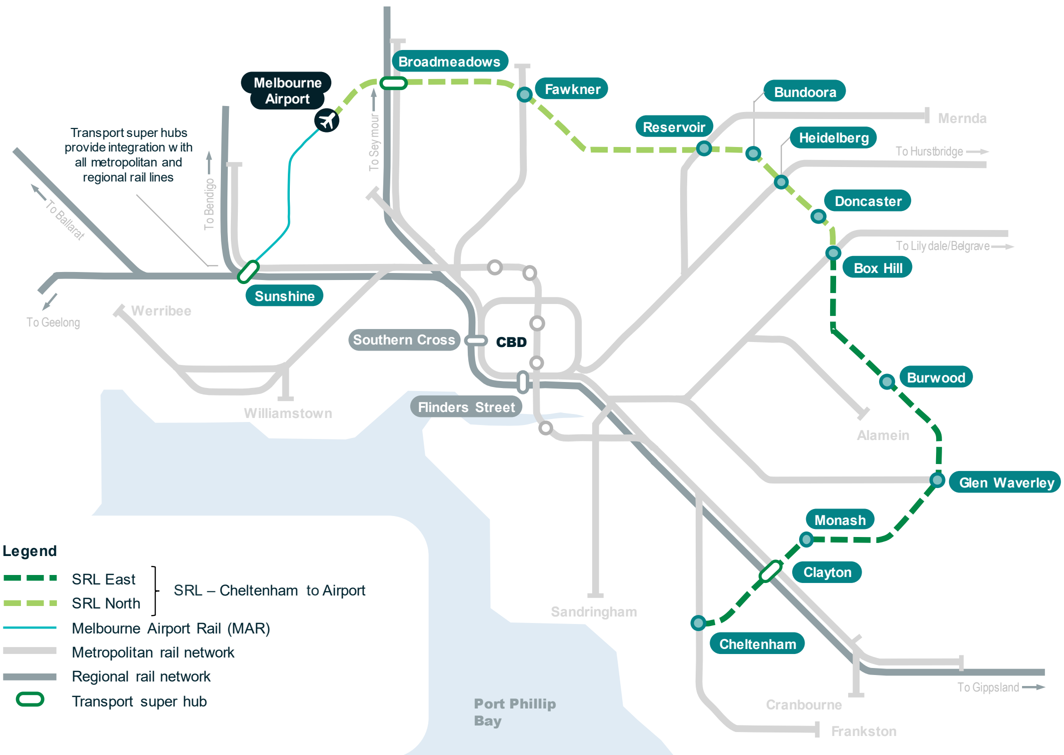
- **Base Case** – The Base Case is the reference point for the economic analysis and considers future transport network assumptions and land use projections consistent with the DoT Reference Case, but excludes SRL (including SRL – Cheltenham to Airport) or other Enabled Investments that are dependent on the Program Case being in place. The Base Case network configuration is presented in Figure 1-2.
- **Program Case** – The Program Case considers the Base Case described above, plus the changes to the transport network and land use and precinct initiatives delivered by SRL – Cheltenham to Airport. The network configuration associated with the Program Case is provided in Figure 1-3 below.

Figure 1-2: Base Case rail network (2056)



Source: DoT

Figure 1-3: Program Case rail network with SRL – Cheltenham to Airport alignment (2056)



Source: SRLA

Two options for the opening of SRL – Cheltenham to Airport have been assessed as outlined in Table 1-1.

Table 1-1: Summary of Program Case Option A and B

Section	Program Case Option A Opening Year	Program Case Option B Opening Year
Cheltenham to Box Hill	2035	2035
Box Hill to Reservoir	2043	2038
Reservoir to Melbourne Airport	2053	2043

For the avoidance of doubt, this assessment is provided for SRL – Cheltenham to Airport as a complete package of investment; sequencing has been developed to allow a practical delivery approach. Given the sequencing will affect the timing of benefits realisation, this has been incorporated within the economic appraisal. As SRL North is still in early planning stages, the assessment of two Program Cases reflects that final delivery dates are yet to be confirmed.

More details on the economic appraisal methodology is provided in Chapter 3.

1.4 Report Structure

Following this introductory chapter, the remainder of this report is structured as follows:

- **Section 2** provides the context for SRL – Cheltenham to Airport
- **Section 3** presents the economic appraisal framework
- **Section 4** outlines the scenarios assessed in the appraisal
- **Section 5** discusses the economic costs included in the appraisal
- **Section 6** outlines the conventional benefits assessed in the appraisal
- **Section 7** outlines the wider economic benefits assessed in the appraisal
- **Section 8** outlines the urban consolidation benefits assessed in the appraisal
- **Section 9** outlines the uncertainty analysis
- **Section 10** outlines the economic evaluation results
- **Section 11** outlines the macroeconomic impact of SRL – Cheltenham to Airport
- **Section 12** provides the distributional and spatial analysis results
- **Section 13** provides an overview of the qualitative benefits considered
- **Section 14** provides a conclusion of this economic appraisal
- **Attachment A** details the approach for the conventional economic benefits
- **Attachment B** details the approach for wider economic benefits
- **Attachment C** details the approach for urban consolidation benefits
- **Attachment D** details the approach for the macro-economic impact

2. Context

2.1 Background

Plan Melbourne 2017-2050 is the Victorian Government's long-term planning strategy that sets out the vision for Melbourne as a global city of opportunity and choice.[12] A key principle of *Plan Melbourne* is that Melbourne's urban form needs to transform to be a 'city of centres'. This reshaping of Melbourne's urban form will be a critical driver of the city's competitiveness for jobs and investment.

To help deliver on *Plan Melbourne* objectives, the Victorian Government investigated options to influence the distribution of population and employment across Melbourne. These investigations culminated in the 2018 *Strategic Assessment: Suburban Rail Loop*[13], which recommended an orbital rail line.

Three broad potential corridors were considered: inner, middle and outer Melbourne. Following an assessment of the three options, the middle region was selected as the preferred corridor. This 90 kilometre corridor through Melbourne's middle suburbs was selected on the basis that it would support mass transit through the emerging western and northern suburbs, close to some of Melbourne's largest growth areas and into the established eastern suburbs with some of the largest employment, health and education clusters outside of central Melbourne.

Following the *Strategic Assessment*, the Victorian Government announced its commitment to SRL in August 2018. In the 2019-2020 State Budget, the Victorian Government allocated $300 million for detailed planning and investigations and the development of a Business and Investment Case, together with the establishment of SRLA.[14]

SRL is more than a strategic response to our city's future travel demands; it is about shaping Melbourne for the needs of future generations.

SRL will:

- Connect every major railway line from the Frankston line to the Werribee line
- Establish a direct rail connection between Melbourne's major employment, health, education and activity precincts outside Melbourne's central business district (**CBD**), catalysing urban renewal across Melbourne's middle suburbs
- Implement new planning settings to catalyse urban renewal, facilitate developments around the new stations, provide local transport improvements, and deliver place-making initiatives and amenity improvements in the precincts around SRL stations (**SRL Precincts**)

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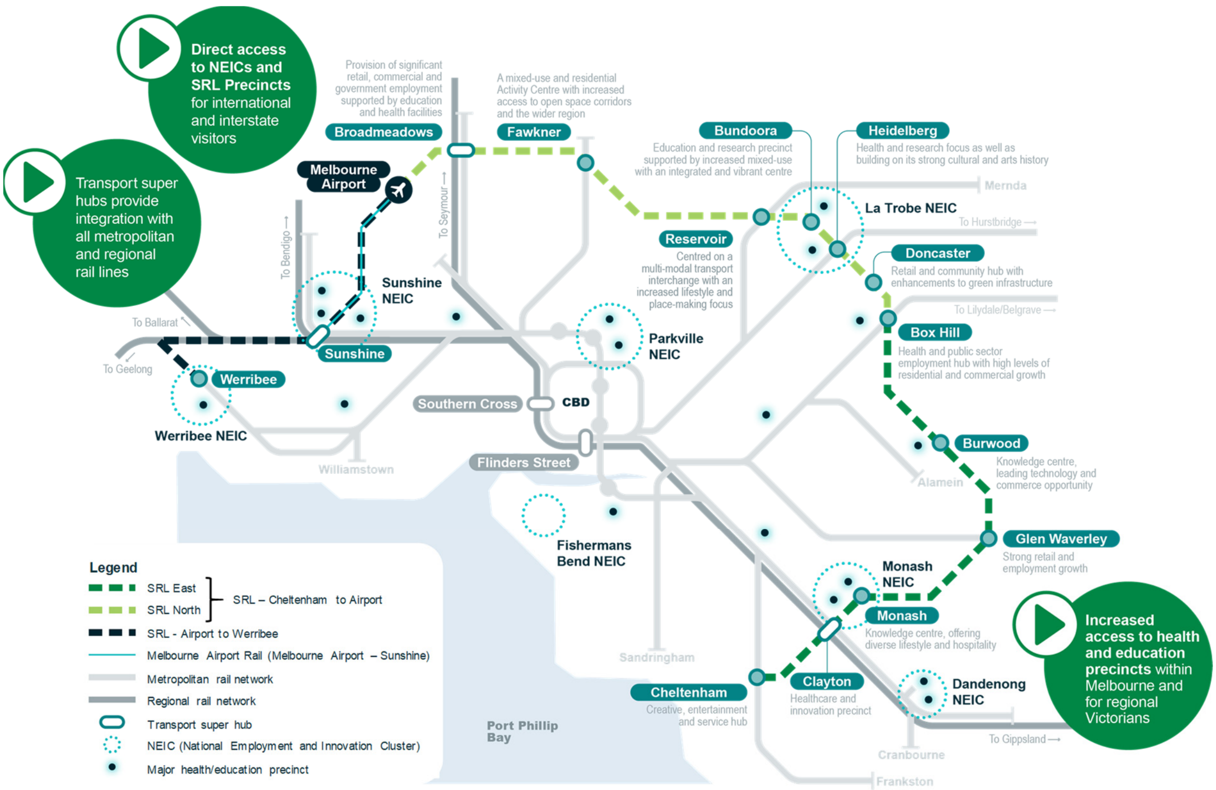
[12] Victorian Government, *Plan Melbourne 2017-2050*.
[13] Development Victoria, *Strategic Assessment Suburban Rail Loop*, (2018). https://bigbuild.vic.gov.au/_data/assets/pdf_file/0006/325572/Suburban-Rail-Loop-Strategic-Assessment.pdf
[14] Media release from the Premier of Victoria, *Underground Suburban Rail Loop to Connect Victoria,* (28 August 2018). https://www.premier.vic.gov.au/underground-suburban-rail-loop-connect-victoria

- Unlock the economic potential of Melbourne's middle suburbs, including the national employment and innovation clusters (**NEICs**) of Werribee, Sunshine, La Trobe and Monash
- Deliver three new transport super hubs at Clayton, Broadmeadows and Sunshine that will connect regional passengers into the SRL rail line, providing more direct and convenient journeys
- Better connect our suburbs and regions to education and health precincts, Melbourne Airport and each other
- Improve access to jobs across Melbourne's middle suburbs for Melburnians and regional Victorians.

The alignment of SRL through Melbourne's middle suburbs is shown in Figure 2-1.

Figure 2-1: SRL – Cheltenham to Airport alignment and SRL East and SRL North Precincts



Source: SRLA

The SRL Business and Investment Case, and the economic analysis within this report, is focussed on the assessment of SRL – Cheltenham to Airport.

An investment of this scale requires a sequenced approach. Further detailed planning and technical design for the sequencing and timing will be undertaken by SRLA over the coming years and the actual opening years will be finalised through this process. For the purpose of the SRL Business and Investment Case, assumptions for the sequencing of SRL – Cheltenham to Airport have been based around two options as outlined in Table 2-1.

Table 2-1: Summary of Program Case Option A and B[15]

Section	Program Case Option A Opening Year	Program Case Option B Opening Year
Cheltenham to Box Hill	2035	2035
Box Hill to Reservoir	2043	2038
Reservoir to Melbourne Airport	2053	2043

Along with the rail and transport interventions, SRL - Cheltenham to Airport will include a range of precinct initiatives to fully capture benefits and to derive continued value from this significant investment, including:

- **Planning settings** – developing framework plans and structure planning to guide land use, built form, local access and public spaces necessary to support changing community needs
- **Station development** – provision of over-station and adjacent-to-station development to capitalise on the opportunity to leverage land for additional commercial, residential and community infrastructure
- **Catalyst projects** – focal investments in transport interchanges, civic infrastructure and commercial developments that shape thriving communities and leverage Victoria's competitive strengths
- **Broader infrastructure** – coordinating the delivery of community facilities and services to enhance the liveability, productivity and connectivity of precincts for current and future generations.

2.2 The need for SRL - Cheltenham to Airport

Melbourne's population is expected to continue to grow, reaching 9 million people by 2050.[16] Although Melbourne's central city will continue to serve Victoria well for many years, it was not designed to support 9 million people to live and work. Many of the stresses of Melbourne's rapid population growth are starting to show and, without intervention, are expected to worsen over time.

- **Melbourne's monocentric urban form is constraining economic growth** – although the central city is well serviced by public transport connections, people living in the outer suburbs experience poor public transport accessibility, which includes limited accessibility to amenities and jobs in the suburbs. Dispersed businesses in the suburbs also miss out on agglomeration benefits that come from being located in clusters. With increasing pressure and congestion on our transport networks and a lack of alternative economic centres to the central city, Melbourne is at risk of becoming less attractive and less competitive compared to other cities, leading to an erosion in prosperity.
- **The concentration of population growth in the inner and outer suburbs of Melbourne is contributing to inefficient infrastructure and service provision** – continued population growth in the outer areas of Melbourne over the next few decades will mean that services and infrastructure in established middle suburbs will continue to be under-used. Ongoing population

[15] SRLA advises that further detailed planning and technical design for SRL North will be undertaken over the coming years. Specific packaging and procurement decisions will be made at an appropriate time in the future.
[16] ABS, Australian Historical Population Statistics (2019) and Victoria in Future, Population and Household Projections (2019).

growth in the outer suburbs also poses additional costs to ensure adequate provision of services and infrastructure.

- **Inequitable access to jobs and services and entrenching disadvantage** – Melbourne will become less affordable over time, but especially for people living in the outer suburbs and some areas in the middle suburbs. Although housing is more affordable in the outer suburbs, there is a trade-off between cheaper housing, poor access to services and amenities, and higher transport costs. This also means that people are increasingly living further away from key centres. Inequitable access to jobs, services and amenities in turn can lead to different outcomes for different communities across Melbourne.

Melbourne is at a critical point in its growth as a global city. Victorians are at risk of continuing to feel the increasing effects of urban expansion, congestion and reduced economic growth – all leading to a worsening in quality of life.

2.3 Outcomes

The anticipated outcomes of SRL – Cheltenham to Airport are provided below.

- **Increase Victoria's productivity and economic growth** – by connecting Melbourne's middle suburbs, SRL – Cheltenham to Airport will unlock the economic potential of the NEICs and Metropolitan Activity Centres (**MAC**s) within the middle corridor
- **Improve connectivity across Victoria** – by improving transport connectivity, SRL – Cheltenham to Airport will enhance the overall resilience, punctuality, reliability and safety of Melbourne's transport network, better connecting people and places across Victoria
- **Improve Melbourne's liveability and create thriving communities** – SRL – Cheltenham to Airport will create more opportunities for lifelong homes in locations with quality and inclusive spaces, and good access to jobs, services and amenities in Melbourne's middle corridor.

SRL – Cheltenham to Airport also aims to realise the objectives of *Plan Melbourne*.

- **Creating a 'city of centres'** – SRL – Cheltenham to Airport will re-shape Melbourne's urban form to become a polycentric city, supporting ongoing economic growth, jobs and investment. SRL – Cheltenham to Airport adopts a multi-faceted approach including integrated transport, land use and precinct planning to develop connected, liveable and productive polycentric centres that will accommodate around 232,500 households and 545,000 jobs by 2056.
- **Providing a transport network for the future** – SRL – Cheltenham to Airport will transform how we travel across and around our city, decreasing the demand on the existing transport network and shifting people out of their cars and off the road. By increasing the share of public transport and active transport trips across Melbourne, SRL – Cheltenham to Airport will help ensure Melbourne remains a sustainable and liveable city, as shown in Figure 2-2.
- **Encouraging 'local living'** – SRL – Cheltenham to Airport will create a healthier and more inclusive city comprised of 20-minute neighbourhoods to support people to live locally.
- **Connecting regional Victoria** – SRL – Cheltenham to Airport will improve access between regional rail lines, Melbourne's middle suburbs and the airport, increasing the accessibility of regions and the middle suburbs to health, education and jobs. SRL – Cheltenham to Airport will improve the connectivity, productivity and liveability of regional Victoria through improved connections and opportunities.

Figure 2-2: Transforming how we travel with SRL – Cheltenham to Airport

Benefits for SRL – Cheltenham to Airport passengers

- **More than 430,000 orbital journeys will occur per day**, enabling direct access and connectivity across the middle ring
- **Passengers will enjoy a median travel time saving of 40 minutes** for a one-way journey compared to a radial rail journey today
- **The busiest SRL – Cheltenham to Airport hubs will facilitate around 90,000 transfers per day** more than twice the transfers enabled by Richmond or Parliament stations today
- **Turn up and go service, enabling efficient journeys and reducing wait times**

Benefits for public transport passengers

- More than **230,000 extra public transport trips per day** across Melbourne compared to a future without SRL – Cheltenham to Airport
- **Crowding will be reduced on Melbourne's busiest radial rail lines**
- **Passengers in the outer ring and Regional Victoria will be able to transfer at stations along the SRL – Cheltenham to Airport corridor** improving their ability to move around the city more efficiently
- **More than 80 per cent of Melburnians will experience a more efficient journey**

Benefits for road users

- **There will be over 600,000 fewer vehicle-based journeys** across Melbourne per day
- **Travel time savings of 110,000 hours per day**
- **Major roads, such as the Monash Freeway and Tullamarine Freeway, will experience improved speeds and support travel time savings of up to 14 per cent between strategic precincts**

Source: Demand Modelling Report

This report provides the details of the economic assessment, using data from the Demand Modelling Report including land use, transport and customer modelling, that underpins the assessment of these outcomes.

3. Economic appraisal framework

3.1 Approach to economic appraisal

3.1.1 A holistic approach to economic appraisal

CBA is the most commonly used approach to economic appraisal for transport investments in Australia. A CBA is typically undertaken to understand the economic benefits and costs of a project or program to broader society.

A key output of a conventional CBA is the Benefit-Cost Ratio (**BCR**), a measure calculated based on the present value of the quantifiable benefits and the estimated cost of a Program Case scenario, relative to the Base Case.

Recognising the transformative nature of SRL – Cheltenham to Airport, its ability to facilitate land use change and deliver economy-wide productivity and social benefits, a broader approach – expanding beyond the conventional transport appraisal – was applied to ensure all relevant costs and benefits are appropriately evaluated.

Table 3-1 outlines key aspects of the SRL – Cheltenham to Airport evaluation that have been adopted for this context and the rationale for this approach.

Table 3-1: Key elements of the evaluation framework for SRL – Cheltenham to Airport

Framework element	What is the conventional approach?	The case for enhancing the approach for SRL – Cheltenham to Airport	What the SRL – Cheltenham to Airport approach includes
Accessibility benefits from land use change	Within the conventional CBA approach, land use assumptions are typically held constant between the Program Case and Base Cases and no allowance is made to capture land use changes.	A key objective of SRL – Cheltenham to Airport is to transform land use and urban settlement patterns across Melbourne. It is intended to shift Melbourne away from its current monocentric structure to a more balanced polycentric city of multiple employment and population centres outside the CBD.	• Integrated transport and land use modelling undertaken using land use and transport interaction model, 'CityPlan'

Framework element	What is the conventional approach?	The case for enhancing the approach for SRL – Cheltenham to Airport	What the SRL – Cheltenham to Airport approach includes
Intergenerational equity and social welfare	Infrastructure Australia and DTF both require future costs and benefits to be discounted at a real rate of 7 per cent, with limited consideration of the timeframes of these future cash flows. Furthermore, standard economic evaluation metrics measured and reported within the conventional approach (e.g. net present value, benefit cost ratio) compare total project costs to total project benefits. How these costs and benefits are distributed across different cohorts within society is sometimes a secondary consideration.	SRL – Cheltenham to Airport is intended to benefit Victorians for generations to come. Application of the standard 7 per cent discount rate would render almost worthless many of the benefits enjoyed by the intended beneficiaries of SRL – Cheltenham to Airport. SRL – Cheltenham to Airport is also intended to improve social equity across Melbourne, improving accessibility for many vulnerable residents. The particular value of SRL – Cheltenham to Airport to these individuals would not be reflected in standard economic evaluation metrics.	• Analysis of the geographic and social distribution of SRL – Cheltenham to Airport impacts, including through the use of the Melbourne Activity and Agent Based Model (**MABM**) • Quantification of accessibility benefits received by socially excluded people • Application of a 4 per cent discount rate for the core analysis to reflect the transformative and intergenerational nature of SRL – Cheltenham to Airport
Full scope of SRL – Cheltenham to Airport benefits	A conventional transport economic appraisal focuses on transport-specific benefits with additional benefits typically treated as sensitivities. Accordingly, benefits arising from precinct development and WEBs and UCBs), are reported separately and are not captured within the 'headline' BCR.	Benefits associated with precinct development, improved community wellbeing, WEBs and UCBs are each core benefits realised by SRL – Cheltenham to Airport. The evaluation framework must regard these as highly as conventional transport benefits, even if this means including them in the core benefits using a range to reflect uncertainty in the underlying benefit estimation methodologies.	• Inclusion of WEBs and UCBs in core evaluation results

Framework element	What is the conventional approach?	The case for enhancing the approach for SRL – Cheltenham to Airport	What the SRL – Cheltenham to Airport approach includes
Treatment of enabling infrastructure investments – a programmatic approach	Conventional CBA typically involves an assessment of the costs and benefits associated with an individual investment. Where an initial investment enables subsequent investments, the BCR does not take into account the benefits that the subsequent investments generate. This means the benefits for an initial 'enabling investment' made as part of a long-term program of works can be significantly understated.	Delivery of SRL – Cheltenham to Airport will be sequenced over multiple decades. This series of investments should be appraised programmatically. Failure to consider SRL – Cheltenham to Airport as one cohesive program of works will skew the appraisal of individual sections. For example, the initial investments include certain 'start up' costs that subsidise subsequent investments where more of the benefits are realised (from network wide impacts as well as cost efficiencies). With this in mind, the program of works from SRL – Cheltenham to Airport will be appraised.	• The economic appraisal takes a holistic approach, considering a broad range of costs and benefits • A programmatic approach to economic appraisal has been implemented.
Appraisal result	Conventional transport project appraisals focus on one headline BCR.	Compared to typical transport projects, SRL – Cheltenham to Airport comprises a long-term program of works that will be sequenced over the coming decades. This longer timeframe means that there is a greater level of uncertainty involved in evaluating the impacts of SRL – Cheltenham to Airport.	• Use of scenario based analysis • Uncertainty testing, including in relation to technology (such as autonomous vehicles) and policy change • Reporting of BCR and NPV as a range

Source: KPMG modelling framework agreed with DoT and SRLA

3.1.2 Key analysis steps

The analytical framework described above has been implemented in practice through nine key steps which are summarised in Figure 3-1.

Figure 3-1: Key steps in the appraisal of SRL – Cheltenham to Airport

Step	Description	Reference
1	**Identification of problems to be addressed** – Identify the specific issues which SRL – Cheltenham to Airport is intended to assist in resolving	Section 2.2
2	**Definition of scenarios** – Including Program Cases (with transport infrastructure investments and select precinct initiatives) and Base Case (without the proposed transport investment and precinct initiatives)	Section 4
3	**Transport and land use modelling** – Modelling of Base Case and Program Cases to determine impact of changes to service plans etc.	Section 3.4
4	**Economic costs** – Identification and quantification of economic costs	Section 5
5	**Economic benefits** – Identification and quantification of economic benefit	Sections 6, 7, 8, 12
6	**Distributional and spatial analysis** – Analysis of the distribution of benefits across socioeconomic and spatial groups as well as precinct distribution	Section 11
7	**Sensitivity analysis** – Analysis of the sensitivity of the performance measures to changes in key input variables and assumptions	Section 9
8	**Economic evaluation** – Evaluation of the economic viability of the Program Cases by comparing costs and benefits against the Base Case and calculating specific economic performance measures such as NPV and BCR. Includes conventional benefits, WEBs and UCBs	Section 10

Source: KPMG modelling framework agreed with DoT and SRLA

The remainder of this document follows the above appraisal steps.

3.1.3 Relevant guidelines

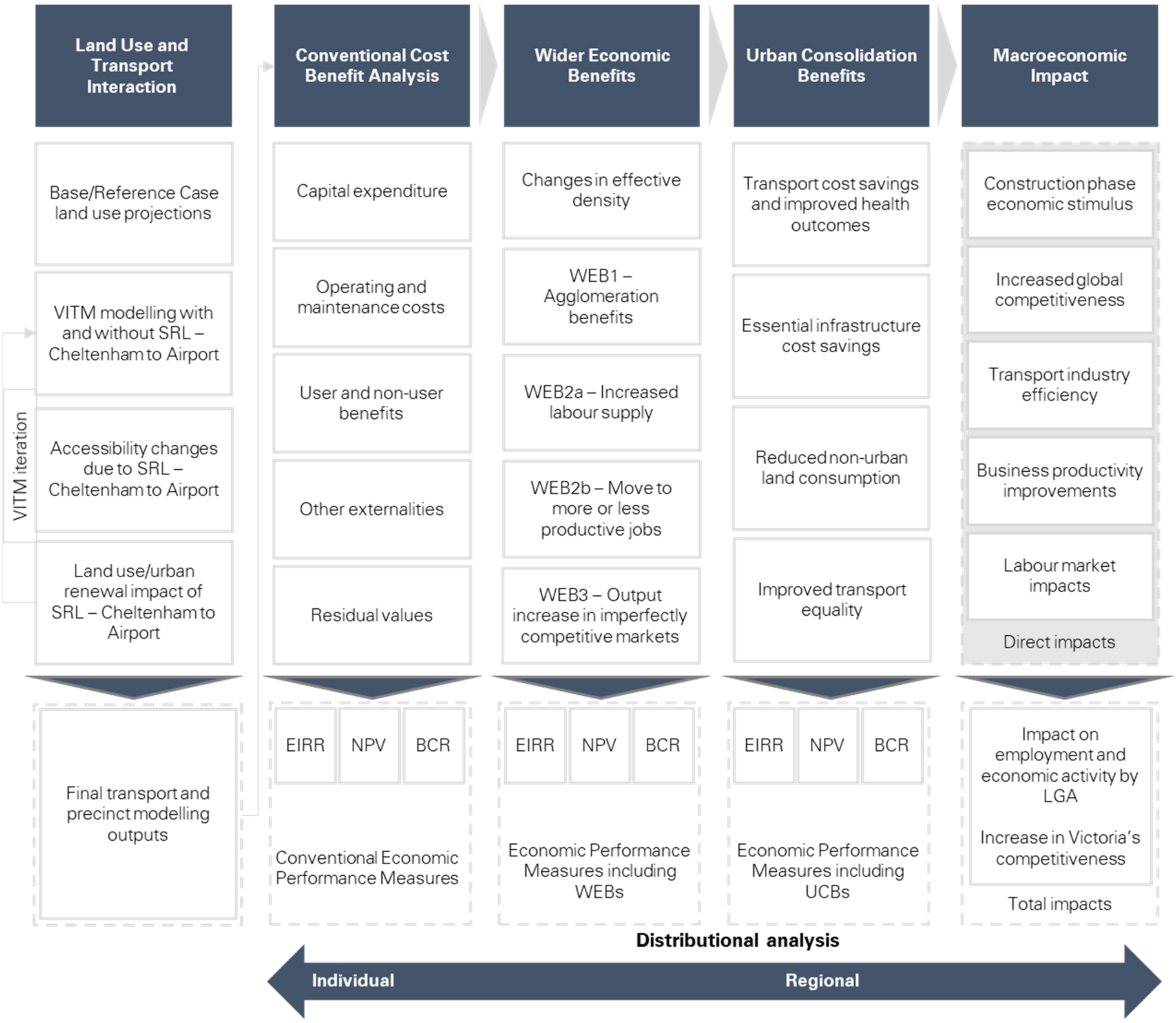
SRL – Cheltenham to Airport is a unique intervention and, as noted previously, requires a broad approach to quantify all relevant costs and benefits of this transformative and inter-generational project. The economic appraisal for SRL – Cheltenham to Airport builds on the established guidelines assessing major projects as listed below:

- Department of Treasury and Finance (2013) Economic Evaluation for Business Cases - Technical Guidelines
- Department of Transport (2020) April 2020 Reference Case
- Department of Transport (2019) The Standard Approach to Transport Modelling and Economic Evaluation in Victoria v4.0
- Austroads (2012) Guide to Project Evaluation Part 4: Project Evaluation Data
- Transport and Infrastructure Council (2016) Australian Transport Assessment and Planning (ATAP) Guidelines: Road Parameter Values [PV2]
- Transport and Infrastructure Council (2016b). Australian Transport Assessment and Planning Guidelines (ATAP): Active Travel [M4]
- Transport and Infrastructure Council (2018) Australian Transport Assessment and Planning (ATAP) Guidelines: Cost Benefit Analysis [T2]
- Transport Infrastructure Council (2018) Australian Transport Assessment and Planning Guidelines (ATAP): Public Transport [M1]
- Transport and Infrastructure Council (2020). Australian Transport Assessment and Planning Guidelines (ATAP): Wider Economic Benefits [T3] – December 2020 Draft
- Infrastructure Australia (2018) Assessment Framework – For initiatives and projects to be included in the Infrastructure Priority List

3.2 Appraisal framework

The economic appraisal framework captures the full spectrum of impacts expected from SRL – Cheltenham to Airport, with the approach summarised in Figure 3-2.

Figure 3-2: SRL – Cheltenham to Airport economic appraisal framework



Source: KPMG.

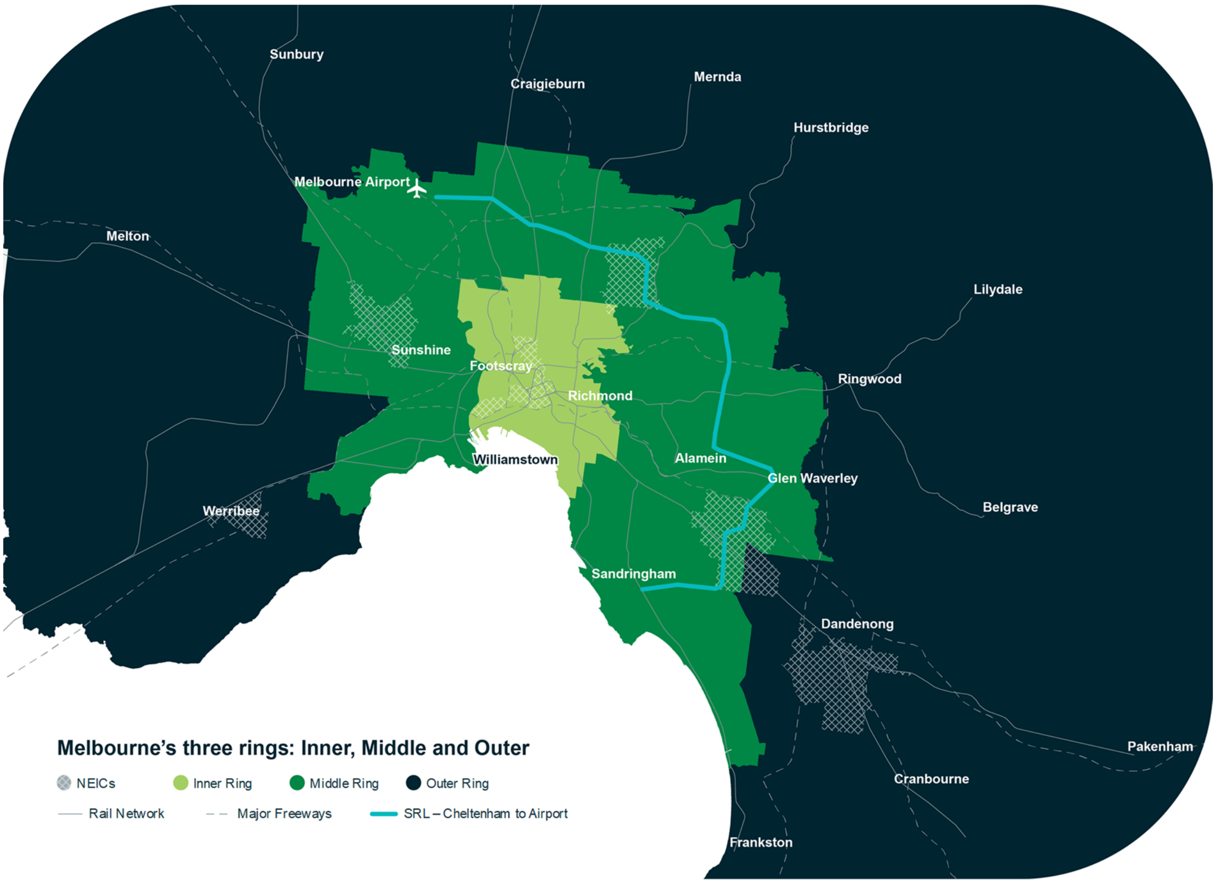
The economic appraisal also considers the distributional and spatial impacts of SRL – Cheltenham to Airport to identify how different individuals and groups across Melbourne will benefit. This is conducted at two levels; the MABM has been used to evaluate how conventional benefits are distributed across socioeconomic cohorts. Regional level analysis considers how WEBs, UCBs and macroeconomic impacts of SRL – Cheltenham to Airport are distributed across Melbourne and Victoria.

3.3 Approach to spatial analysis

To support the analysis in this demand modelling assessment for the SRL Business and Investment Case, Greater Melbourne has been conceptualised into three geographic 'rings': inner, middle and outer. The three geographic rings are based on statistical and government areas and enable a more comprehensive analysis of emerging problems and city-shaping outcomes discussed in this report.

Melbourne's three geographic rings and the seven NEICs (as defined in *Plan Melbourne*) are illustrated in Figure 3-3.

Figure 3-3: Melbourne's three rings: Inner, Middle and Outer



*Source: KPMG analysis, Victorian Integrated Transport Model (**VITM**) Zoning System and 2019 Small Area Land Use Projections (**SALUP**)*

3.4 Costs and benefits considered

3.4.1 Costs

The economic costs of SRL – Cheltenham to Airport considered in the appraisal include:

- **Transport infrastructure** - capital and recurrent costs
- **Precinct initiatives** - capital and recurrent costs based on an indicative allowance for precinct initiatives for the purposes of the appraisal only
- **Social costs incurred during construction** (e.g. disruption and environmental costs, discussed qualitatively).

More details on the economic costs are provided in Section 5.

3.4.2 Benefits

Figure 3-2 above summarises the expected benefits of SRL – Cheltenham to Airport that have been evaluated through the economic appraisal. These can be broadly conceptualised into four broad categories:

- **Conventional economic benefits** such as travel time savings, improved travel time reliability, reduced crowding and externalities and option and non-use value. These benefits have been quantified using CBA, drawing on relevant Victorian and Australian economic evaluation guidelines
- **WEBs**, including agglomeration, increased labour supply and moves to more or less productive jobs, labour market deepening and output increase in an imperfectly competitive market, which result from improved accessibility and connectivity, as well as changes in land use patterns
- **UCBs** which are derived due to more consolidated land use form and the resultant changes to the socio-economic fabric and more socially equitable and inclusive community
- **Macroeconomic impacts,** such as increased global competitiveness, labour productivity, economic output and employment, have been quantified using Computable General Equilibrium (**CGE**) modelling.

Specific benefits of SRL are discussed further in Section 6 to Section 9.

3.5 Land use impact assessment

Transportation systems have a major, enabling influence on the development of cities, including where people decide to live and work. This strong link between transport and urban form means that significant transport changes have the potential to alter urban development patterns and transform the shape of a city. This is referred to as the **land use impacts** of a project.

Significant city-shaping transport projects such as SRL – Cheltenham to Airport not only alter travel behaviour, they also alter relative accessibility across Melbourne. For example, by connecting NEICs across Melbourne with key precincts such as Box Hill, Burwood, Broadmeadows and Melbourne Airport, SRL – Cheltenham to Airport has the potential to attract people and improve land use development in these areas (e.g. residential, commercial and industrial).

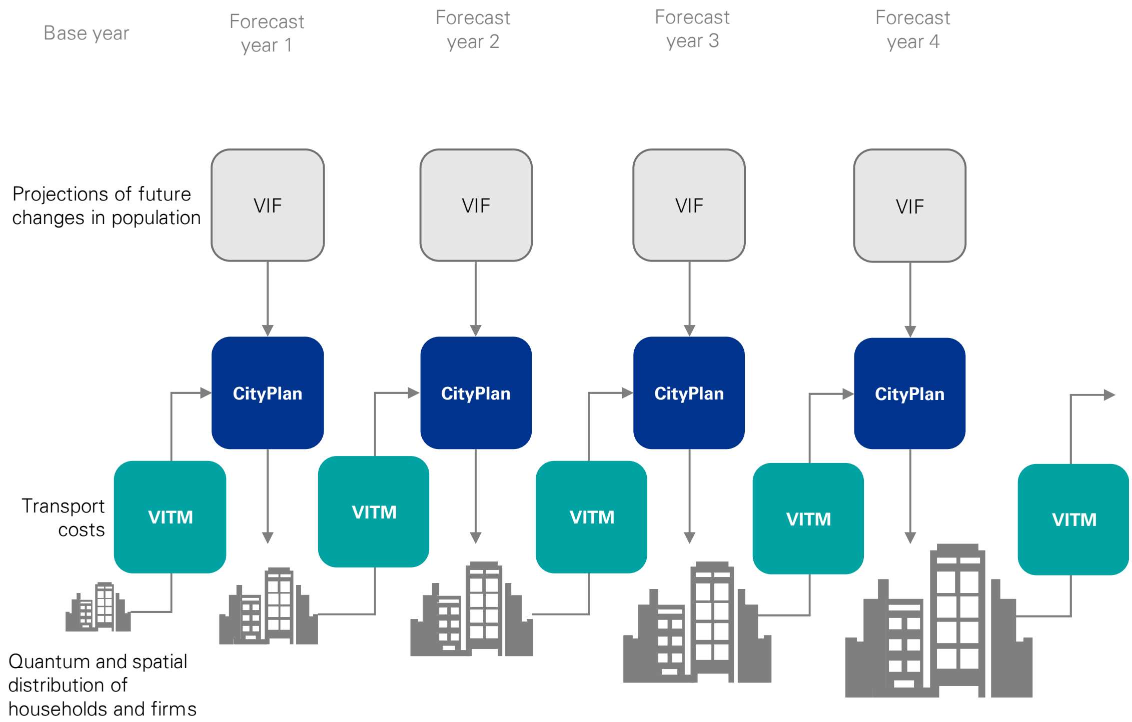
The transport network improvements delivered by SRL – Cheltenham to Airport will also be a catalyst for broader city shaping impacts. The shift in accessibility generated by SRL – Cheltenham to Airport will facilitate land use changes across Greater Melbourne as people, firms and developers respond to new opportunities. Improving the connectivity of key precincts outside of Melbourne's central city will allow businesses to decentralise away from the CBD and will enable people to live closer to where they work as employment opportunities are expanded.

These major changes in Melbourne's identity make it inappropriate to assess the economic benefits of SRL – Cheltenham to Airport without considering accompanying changes in land use. In particular:

- Without properly modelling the interaction between transport investments and land use, the land use changes to be catalysed by the improved transport accessibility under SRL – Cheltenham to Airport cannot be accurately assessed
- The economic and social value of improved urban amenity and liveability cannot be assessed if land use changes enabled by accessibility improvements are not accounted for
- A failure to appropriately quantify changes in land use will mean that induced transport demand is not fully assessed and the benefits of SRL – Cheltenham to Airport will be understated.

Therefore, this economic appraisal considers land use impact induced by SRL – Cheltenham to Airport, which has been modelled using **CityPlan**, a Land Use and Transport Interaction (**LUTI**) model, and the Victorian Integrated Transport Model (**VITM**) jointly. The interaction between CityPlan and VITM is shown in Figure 3-4, with further detail provided in the Demand Modelling Report.

Figure 3-4: Example of interaction between VITM and CityPlan



Source: KPMG CityPlan Volume 1: Model Specification Report

Improved transport accessibility is a necessary but not sufficient condition to fully realise potential land use changes. Planning controls also have a significant role in altering the capacity of a local area to accommodate development. Similarly, 'place making' initiatives, including improved surface access and safety for example, also have the potential to make a place more amenable and attractive for development.

SRL – Cheltenham to Airport includes rail investment along with select precinct initiatives. Together, these will alter land use, making key precincts along the SRL – Cheltenham to Airport rail corridor more attractive for people to live and employers to locate.

3.6 Key evaluation inputs and assumptions

Key inputs to the economic appraisal include:

- **Capital costs** – all non-recurrent capital costs (for transport and an indicative package of precinct initiatives) that are expected to be incurred to deliver the Program Cases after the economic evaluation commences. For the purposes of this analysis, capital cost estimates have been developed in real (2020 dollar) terms.
- **Operating and maintenance costs** – all necessary recurrent costs to operate and maintain SRL – Cheltenham to Airport assets over the evaluation period. For the purposes of this analysis, operating and maintenance costs have also been estimated in real (2020 dollar) terms.
- **Demand analysis** – outputs from VITM[17] for the Base Case and Program Cases for the years 2018, 2031, 2036, 2041, 2046, 2051 and 2056. For each scenario and model year, outputs are provided for four time periods across an average weekday from which benefits (including travel time savings, vehicle operating cost savings, crash cost savings and environmental externality savings) are calculated.
- **Unit rates** – for each of the benefits calculated from the modelling outputs. Unit rates for conventional benefits are drawn primarily from Australian Transport Assessment and Planning (ATAP, 2018), with additional sources identified for further benefit categories such as social equity, precinct benefits, UCBs and WEBs.
- **Applicable evaluation parameters** – these are provided in Table 3-2.

[17] VITM is maintained by the Victorian DoT.

Table 3-2: Key input parameters

Parameter	Value	Description
Discount rate, real	4 per cent (real)	As endorsed by the Victorian Government, the economic assessment has been undertaken using a discount rate of 4 per cent.
Cost certainty	P10 to P90 cost range	Costs are included as a range between P10 and P90. The midpoint cost estimate is P50, as per ATAP and DoT guidelines.
Evaluation period	50 years	From the first year of operation of the Program Case. 50 years is used in line with ATAP (2018) [18] for rail infrastructure. As per Infrastructure Australia and DTF guidance, residual value of assets is included in the last year of evaluation to incorporate the benefits that will continue to be delivered by the main asset.
Price base	2020	To align with price base used for construction costs as per estimated by SRLA's cost advisor WTP.
Base year for discounting	2022	To align with first year of construction as provided by SRLA.
Construction period	(1) Program Case Option A: 2022 to 2053 (2) Program Case Option B: 2022 to 2043	As per the construction schedule.
First year of operations[19]	(1) Program Case Option A Cheltenham to Box Hill: 2035 Box Hill to Reservoir: 2043 Reservoir to Melbourne Airport: 2053 (2) Program Case Option B Cheltenham to Box Hill: 2035 Box Hill to Reservoir: 2038 Reservoir to Melbourne Airport: 2043	SRLA assumption.
Public transport expansion factors	Peak to Annual (train) – 241.2 Off Peak to Annual (train) – 354.5 Peak to Annual (public transport in general) – 241.7 Off Peak to Annual (public transport in general) – 355.7 Daily to Annual Factor (public transport in general) – 298.3	Based on travel patterns informed by Myki data for work days, public / school holidays and weekends.

[18] ATAP Guidelines 2018: Cost Benefit Analysis [T2].
[19] SRLA advises that further detailed planning and technical design for SRL North will be undertaken over the coming years. Specific packaging and procurement decisions will be made at an appropriate time in the future.

Parameter	Value	Description
Road expansion factors	Daily to annual demand – 330	In line with Austroads, 2012 for road expansion factor.
Value of travel (VOT) time savings	VOT: • Business-to-business trips: $52.84 (as per ATAP 2018) • Other trips: $16.38 (as per ATAP 2018)	As per ATAP 2018.
Indexation	VOT indexed at 1.5 per cent per year for work related travel. For non-work-related travel, VOT indexed at 0.75 per cent (calculated as the estimated real long-term average growth in real income in Victoria multiplied by an elasticity of 0.5).	Based on productivity growth forecasts in DoT (2016) guidelines. Indexed as per ATAP.
Demand modelling years	(1) Program Case Option A: Cheltenham to Box Hill: 2031 and 2036; Box Hill to Reservoir: 2041 and 2046; Reservoir to Melbourne Airport: 2051 and 2056 (2) Program Case Option B: Cheltenham to Box Hill: 2031 and 2036; Box Hill to Reservoir: 2036 and 2041; Reservoir to Melbourne Airport: 2041, 2051 and 2056	Benefits linearly interpolated between modelled years
Interpolation and extrapolation	Linear interpolation used to determine the magnitude of benefits for intermediate years. Benefits beyond the final demand modelling year are flattened, with the exception of public transport benefits which are extrapolated on the basis of the 2051 and 2056 PT CAGR.	Consistent with ATAP (2018).[20]

Source: Various sources as indicated

3.6.1 Discount rate selection

The DTF and IA advise the use of a discount rate of 7 per cent (real) for the majority of public infrastructure projects, largely on the basis that it reflects the opportunity cost of the investment. This rate has been in place since (at least) 1989, at the Australian and (most) State Government levels, and is appropriate for assessment of investments with relatively short delivery period and in turn short assessment periods.

[20] ATAP Guidelines 2018: Cost Benefit Analysis [T2].

For some time, there has been growing local and global support for fit-for-purpose discount rates for multi-generational projects. For example, research from the Grattan Institute noted that longer-term projects should require lower discount rates that vary to reflect the current risk free rate and the sensitivity of the project's expected returns to the economy[21].

In recent years, fit-for-purpose discount rates have been applied on a number of major infrastructure project appraisals, such as:

- In the UK, London's Crossrail project[22], High Speed Rail 1[23] and High Speed Rail 2[24] - these projects were assessed over a 60 year period utilising a discount rate of 3.5 per cent for the first 30 years and 3 per cent thereafter to reflect the impacts on future generations;
- Grand Paris Express, a large scale automated metropolitan transport project under construction in Paris and greater Ile-de-France – this was assessed using a discount rate of 4 per cent to demonstrate the rate of return required for public projects in France[25]; and,
- Inland Rail, an expansive multigenerational rail infrastructure initiative – the Australian Government and Australian Rail Track Corporation applied and reported against a discount rate of 4 per cent as part of the project's economic appraisal.

Using a discount rate for multi-generational investments – such as SRL – Cheltenham to Airport – in line with standard investment guidance results in latter year benefits (and equally costs) being discounted to near zero. For example, the equivalent of $1 in undiscounted economic benefit in 2053, the year when SRL – Cheltenham to Airport is planned to be fully delivered and operational under Option A and the first year when the full project benefits are realised, would be valued at just 12 cents in present value terms (at 7 per cent).

An investment appraisal methodology that utilises relatively high discount rates therefore creates an incentive towards investment in projects that provide short-term benefits, but that may fail to effectively address long-term, structural problems or that enable long-term productivity benefits to be achieved.

Accordingly, the economic assessment of SRL – Cheltenham to Airport has considered and selected a discount rate that:

- better reflects the intended outcomes of the multi-generational SRL – Cheltenham to Airport investment;
- is more in-line with low risk-free rate over the last decade and more as well as the current global economic environment; and

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[21] Terrill, M. and Batrouney, H. (2018). Unfreezing discount rates: transport infrastructure for tomorrow. Grattan Institute. Available at https://grattan.edu.au/wp-content/uploads/2018/02/900-unfreezing-discount-rates.pdf. Accessed 23 March 2020

[22] Transport for London (July, 2010). *Crossrail business case summary report*. Available at https://2577f60fe192df40d16a-ab656259048fb93837ecc0ecbcf0c557.ssl.cf3.rackcdn.com/assets/library/document/c/original/crossrailbusinesscasefinal300710.pdf. Accessed 24 September 2020

[23] London & Continental Railways (2009). *Economic Impact of High Speed 1.* https://volterra.co.uk/wp-content/uploads/2013/02/Economic-Impact-of-High-Speed-1.pdf

[24] UK Department for Transport (2020). *High Speed 2 Phase One – Full Business Case.* Available at https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/879445/full-business-case-hs2-phase-one.pdf.

[25] International Transport Forum (2018) pp.54. *Strategic Investment Packages – Case-Specific Policy Analysis.* Available at https://www.itf-oecd.org/sites/default/files/docs/strategic-investment-packages.pdf

- is consistent with global and local practice for appraising long term, multi-generational investments.

The fit-for-purpose discount rate selection provides the opportunity to deliver:

- A more transparent prioritisation of projects that better reflects the desired objectives of the initiatives being assessed, i.e. long-term community benefits are captured for projects that are intended to generate multigenerational outcomes
- Proactive investment that is directed towards initiatives that plan and invest 'ahead of the curve', mitigating the risk of costly investments where the need has become overwhelming
- Reprioritisation of project scoping away from reducing upfront costs and towards delivering solutions optimised for society – for example, investing in initiatives that allows for productivity and efficiency gains in operations and maintenance.

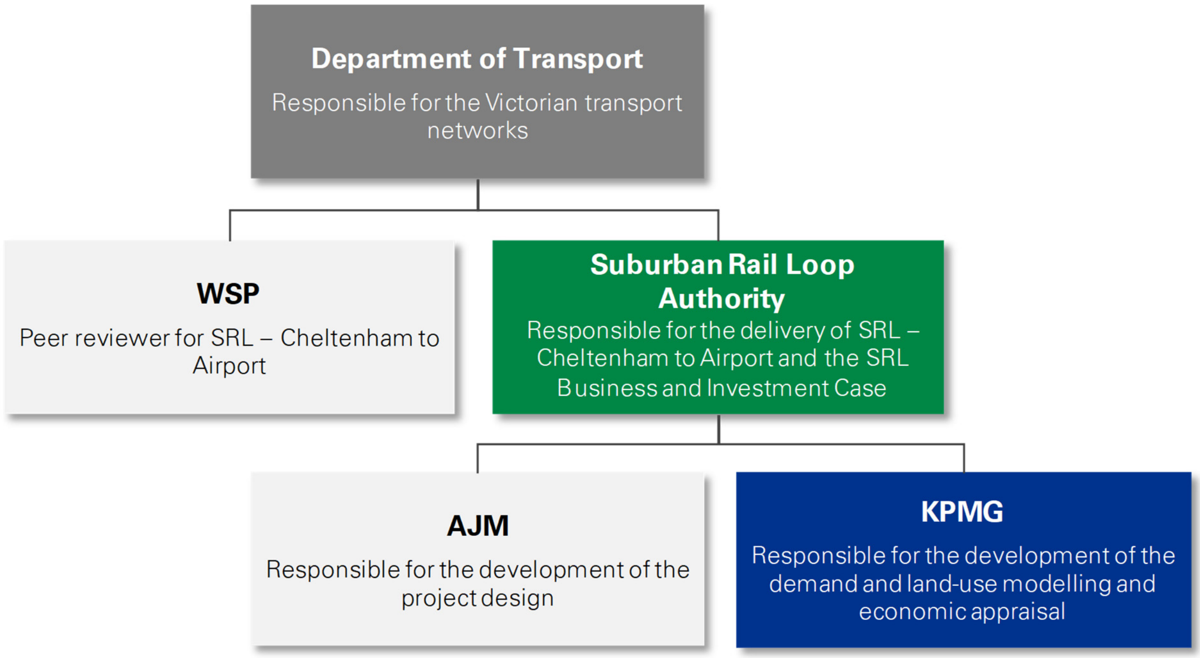
Applying a discount rate that places a greater emphasis on the benefits to future generations for long-term, transformative and multi-generational projects will not only incentivise proactive long-term planning but is an appropriate approach to robust investment decision making for major infrastructure investments.

Considering these points, and within the context of the historically low opportunity cost of capital, the Victorian Government has endorsed the use of a 4 per cent discount rate for the appraisal of SRL – Cheltenham to Airport.

3.7 Governance

Governance arrangements for the SRL Business and Investment Case have been established by DoT to provide inquiry and oversight of demand modelling and economic appraisal for SRL – Cheltenham to Airport, and are outlined in Figure 3-5. These arrangements aim to ensure a high degree of rigour and consistency in transport modelling and economic appraisal undertaken on behalf of the Victorian Government.

Figure 3-5: Governance framework for SRL – Cheltenham to Airport



Source: KPMG modelling framework agreed with DoT and SRLA

An overview of responsibilities is provided below:

- VITM is owned and managed by the Victorian State Government and key inputs are provided by SRLA, DoT or its advisors to inform the demand model runs. Demand forecasting for the economic analysis has been undertaken by KPMG while demand forecasting for design purposes has been undertaken by Aurecon Jacobs Mott McDonald Joint Venture (**AJM**).
- Project capital, operating, maintenance and renewal costs have been independently estimated by WT Partnership (**WTP**).
- The land use modelling, demand modelling and economic analysis have been undertaken by KPMG and independently peer reviewed by WSP and Centre for International Economics (**CIE**) as part of a separate engagement directly appointed by DoT.
- A peer reviewer has been involved in reviewing the land use modelling, demand modelling and economic appraisal throughout the process including the review of the framework, the detailed approach and the draft analysis; and the peer reviewer's feedback has been incorporated in the final analysis as appropriate.

4. Scenarios assessed

This economic evaluation has assessed and compared the incremental costs and benefits of two Program Cases relative to the Base Case. Program Cases consider both the rail and select precinct initiatives of SRL – Cheltenham to Airport:

- Program Case Option A: Comprises the proposed SRL – Cheltenham to Airport rail along with select precinct initiatives, with completion scheduled for 2053
- Program Case Option B: Rail and precinct initiatives as per Program Case Option A, with completion scheduled for 2043.

4.1 Scenario definitions

4.1.1 Reference Case

KPMG have adopted the Reference Case approach in line with relevant DoT guidelines.[26] The Reference Case transport network includes committed projects in addition to an agreed set of projects, including arterial road upgrades, rail service upgrades, motorway improvements, tram and bus upgrades and service level augmentations to supply a reasonable capacity that is supportive of the future demand associated with the Reference Case land use.

Inclusion of projects in the Reference Case does not imply there is any commitment from Government to undertake these projects. It merely indicates that Government has determined that it is reasonable to represent the project, or a similar investment, in the future network for the purposes of modelling demand in the transport system.

The Reference Case is managed, coordinated and produced by DoT. This is generally produced on an annual basis, or as required to suit major updates or releases of key inputs such as:

- New government policies or strategies
- Population and employment forecasts
- Updated travel survey data
- Significant changes to transport networks.

The responsibilities for the various inputs to the Reference Case are shown in Table 4-1.

[26] DoT (2019). *The standard approach to transport modelling and economic evaluation in Victoria, 2019-20 v4.0.*

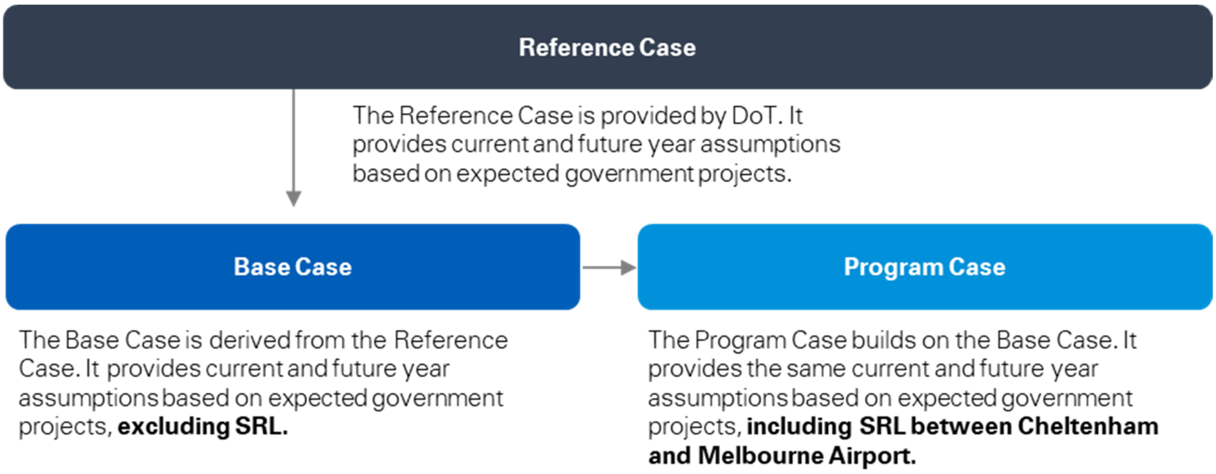
Table 4-1: Responsibilities for inputs to Reference Case

Reference Case Inputs	Responsibility
Population forecasts	DoT, Department of Environment, Land, Water and Planning
Employment forecasts	DoT, Department of Jobs, Precincts and Regions
Road Network	DoT (Network Planning)
Public Transport Network and Service Plans	DoT (Network Planning)
Freight Network and Forecasts	DoT (Freight Victoria)
Air Passenger Forecasts	DoT
Transport Modelling Parameters	DoT (Transport Analysis and Assessment Branch, Economic Reform Branch)

Source: DoT (2019, pg. 9). The standard approach to transport modelling and economic evaluation in Victoria, 2019-20 v4.0

The Reference Case also includes some assumptions regarding potential SRL infrastructure and/or complementary projects. These assumptions must be removed to produce a Base Case to realistically compare and assess the impacts of the Program Case, as discussed in the following section.

Figure 4-1: Reference Case, Base Case and Program Case



Source: KPMG modelling framework agreed with DoT and SRLA

4.1.2 Definition of Base Case and Program Case

The definition of networks and demographic / land use for the Base Case and Program Case scenarios are critical for economic appraisal and the modelling runs which support it. Where projects are assessed in parallel, consistency between the appraisals is important.

The Base Case scenario is the starting point for the economic appraisal. It consists of the Reference Case transport network for a given year, but excludes some infrastructure projects such as SRL, along with SRL enabled projects and critically interdependent projects.

The Program Cases include the SRL – Cheltenham to Airport rail and precinct initiatives to be assessed.

Sections 4.2 and 4.3 outline the inclusions and exclusions of these scenarios.

4.1.3 Forecast years

Transport modelling demand forecasts have been developed across a number of years to 2056.

Table 4-2: Purpose of model runs

Transport Impact Appraisal / Economic / Financial Appraisal Data Points	Modelling Year						
	2018	2031	2036	2041	2046	2051	2056
Base Case for economic appraisal	✓ For model validation	✓	✓	✓	✓	✓	✓
Program Cases A and B for economic appraisal		✓	✓	✓	✓	✓	✓
Sensitivity tests and alternative future scenarios		✓		✓			✓

Source: KPMG modelling framework agreed with DoT and SRLA

Details regarding the change in transport networks, households, employment and other assumptions are provided in the following sections.

4.2 Economic Base Case

The Economic Base Case is developed from the DoT Reference Case, and includes the Reference Case transport network and land use projections, but excludes SRL (including the section between Cheltenham to Airport) or other Enabled Investments that are dependent on the Program Case being in place. As such, the Base Case for this appraisal:

- Reflects the scenario without costs or benefits associated with SRL – Cheltenham to Airport
- Includes land use assumptions similar to the Reference Case, but without SRL – Cheltenham to Airport investments.

Table 4-3 shows key transport projects and land use projections included in the Economic Base Case.

Table 4-3: Economic Base Case

Parameter	Description
Road network	Includes road network projects in line with the Reference Case. The most significant projects contained within the Base Case are: In 2026: • Mordialloc Freeway (2021) • Monash Freeway widening Springvale Road to East link and Clyde Road to Cardinia Road (2021) • North East Link and other associated upgrades to Eastern Freeway • M80 widening (8 lanes) • Several other widening projects of major roads in the West, North and the South East

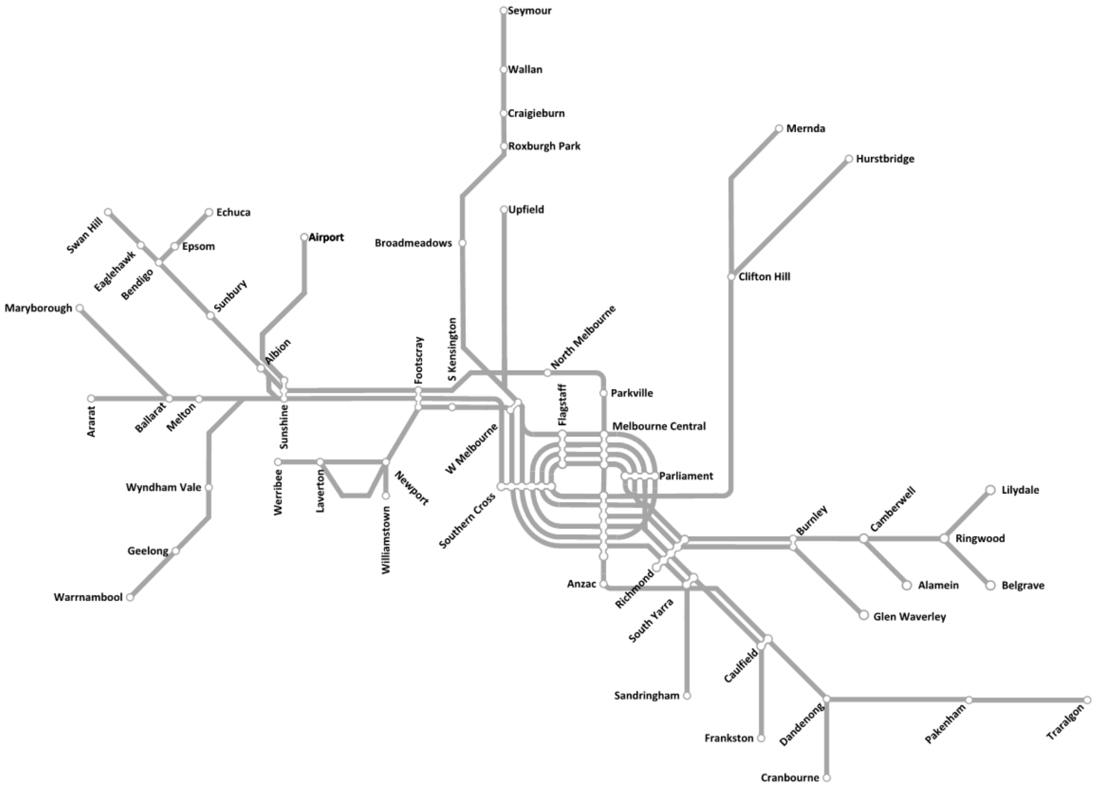
Parameter	Description
	In 2031: • Bulla Bypass (Sunbury Road to Wildwood Road and Tullamarine Extension • Calder Freeway widening • Craigieburn Road Duplication • Melbourne Airport - New elevated ring road connecting to Tullamarine Freeway • Melton Highway Duplication • New East West Connector. In 2036: • Boundary Road Widening • Calder Freeway Widening • Completion of E6 • Hume freeway widening • M80 widening (associated with E6) • Western Freeway Widening. In 2041: • North South Connector • Western Link Road • Monash Freeway Widening – Cardinia Road to Koo Wee Rup Road • EastLink Widening. In 2051: • Dingley Freeway • Outer Metropolitan Ring Road (**OMR**) • Tullamarine Freeway Extension to OMR • Mornington Peninsula Freeway widening.

Parameter	Description
Public transport network	Includes public transport investment projects in line with the Reference Case. The most significant projects contained within the Base Case are: In 2026: • Melbourne Metro Tunnel operational • Cranbourne Line Duplication and extension to Clyde complete • Cross-City Line Upgrade Stage 1 complete • VL9s introduced on Bacchus Marsh and Geelong lines. In 2031: • Loop split (City Loop reconfiguration) complete • Melbourne Airport Rail (**MAR**) • Cross-City Line Upgrade Stage 2 complete • Geelong Fast Rail Stage 1 complete • Extension from Wyndham Vale to Black Forest Rd and connection to Werribee complete. In 2036: • Hopkins Road quadruplication and electrification complete • Sunshine to Southern Cross RRL capacity uplift works. In 2041: • Melbourne Metro 2 including Newport Tunnel operational with Geelong and Werribee services diverted.
Land use	The Base Case land use projections are in line with the Reference Case.

Source: DoT. Full details of the transport network inputs are provided in the DoT Reference Case (Department of Transport, 2018) and Victorian Rail Infrastructure Plan: Strategic Demand Modelling Specification (RPV, 2018)

A schematic of the Base Case network configuration is provided in Figure 4-2.

Figure 4-2: Base Case network configuration



Source: DoT Reference Case

4.3 Program Case

This economic evaluation assesses and compares the incremental costs and benefits of the Program Cases relative to the Base Case. The Program Cases consider both the rail and precinct initiative aspects of SRL – Cheltenham to Airport:

- Rail – proposed SRL – Cheltenham to Airport rail and the associated changes to planning controls or any surface access
- Precinct initiatives – includes an indicative package of works to derive value from the transport investment including planning settings, station development, catalyst projects and broader infrastructure.

Alongside the significant investment in rail infrastructure, a range of precinct initiatives will be delivered as follows:

- Planning settings – developing framework plans and structure planning to guide land use, built form, local access and public spaces needed to support changing community needs
- Station development – provision of over-station and adjacent-to-station development to capitalise on the opportunity to leverage land for additional commercial, residential and community infrastructure

- Catalyst projects – focal investments in transport interchanges, civic infrastructure and commercial developments that shape thriving communities and leverage Victoria's competitive strengths
- Broader infrastructure – coordinating the delivery of community facilities and services to enhance the liveability, productivity and connectivity of precincts for current and future generations.

4.3.1 SRL – Cheltenham to Airport key inputs and assumptions

The Program Case uses the Base Case as a starting point but also incorporates the network improvements delivered by SRL – Cheltenham to Airport. A core component of the SRL – Cheltenham to Airport improvements is the sequenced delivery of a heavy rail link between Cheltenham and Melbourne Airport in three sections.

Two Program Case scenarios have been assessed, taking into account two timing alternatives for sequencing. As SRL North is still in early planning stages and consequently delivery timelines are yet to be confirmed, two different dates for the commencement of services have been used to define the Program Cases. Under Option A, delivery of SRL – Cheltenham to Airport will be complete by 2053, while Option B will be complete by 2043.

Detailed rail parameters for SRL – Cheltenham to Airport that are assumptions or inputs for the modelling are described in the table below.

Table 4-4: Key inputs and assumptions – SRL – Cheltenham to Airport

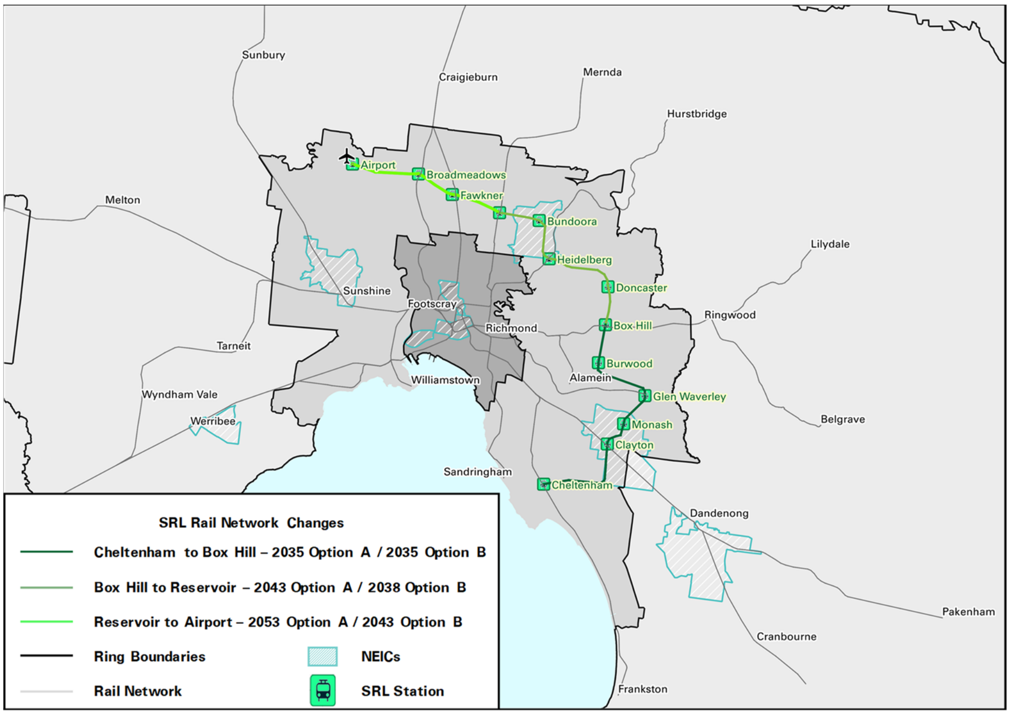
	Cheltenham – Box Hill	Box Hill – Reservoir	Reservoir – Melbourne Airport
Opening Year (Option A)	2035	2043	2053
Opening Year (Option B)	2035	2038	2043
Rail Distance (Combined)	26.0 kilometres	45.0 kilometres	60.2 kilometres
Travel Time (Combined)	22 minutes	38 minutes	50 minutes
Trains per hour (peak periods)	10	12	24
Trains per hour (inter-peak)	6	6	12
Trains per hour (off-peak)	6	6	6
Seated Capacity	188 passengers per service	188 passengers per service	188 passengers per service
Load Standard	820 passengers per service	820 passengers per service	820 passengers per service
Crush capacity	1,136	1,136	1,136

Source: SRLA

4.3.2 Public transport network

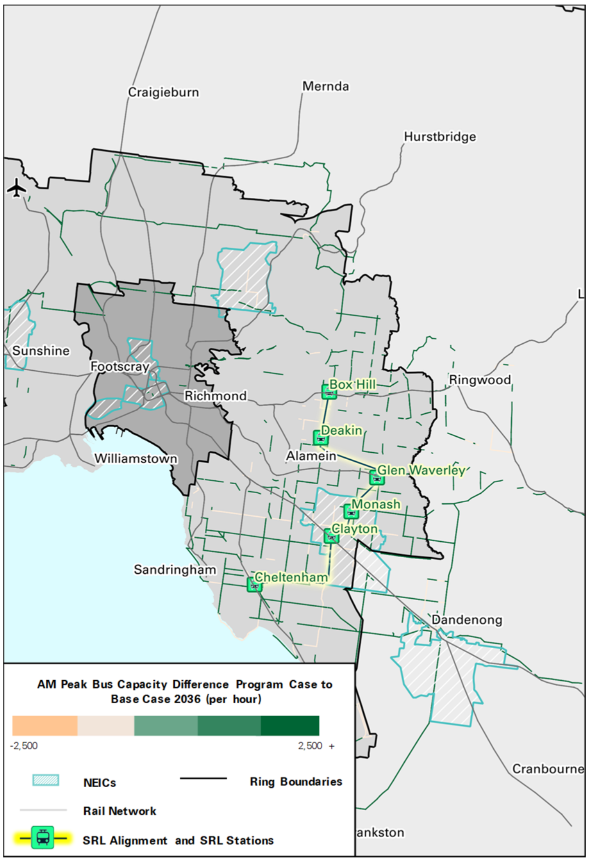
In addition to the SRL – Cheltenham to Airport rail network changes, shown in Figure 4-3, the Program Cases includes tailored bus service plans. These are designed to provide buses feeding the SRL East and SRL North Precincts. Separate sets of bus service plans corresponding to the relevant phase in the SRL – Cheltenham to Airport sequence were modelled. The indicative bus network changes are illustrated in Figure 4-4 (2036) and Figure 4-5 (2056).

Figure 4-3: Program Case rail network changes



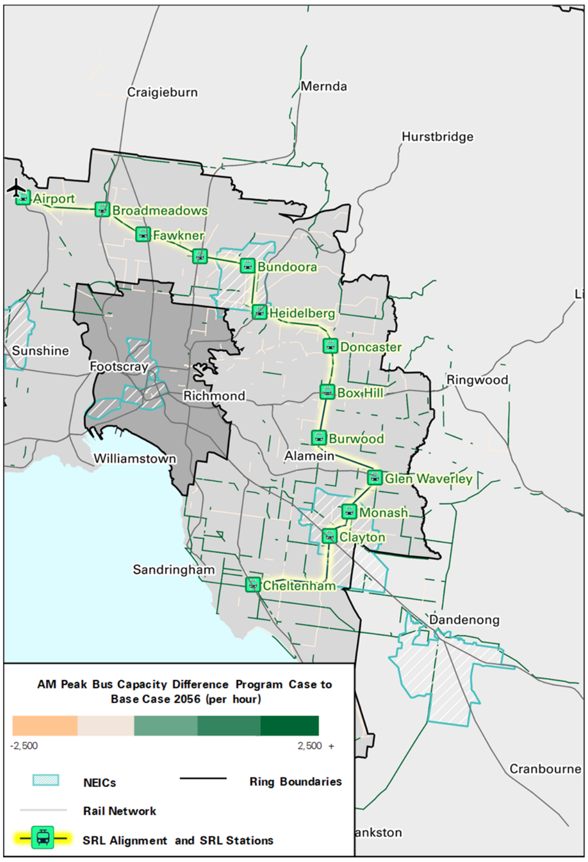
Source: SRLA

Figure 4-4: Program Case bus network changes, 2036



Source: SRLA, DoT

Figure 4-5: Program Case bus network changes, 2056



Source: SRLA, DoT

4.3.3 Road network

The road network for the Program Case utilises the same road network used in the Base Case.

4.3.4 Land use

Population and employment distribution across Melbourne will change in response to the transport interventions and precinct initiatives of SRL. The extent of these land use changes have been modelled using CityPlan. Through specification of distinct Base and Program Cases, the extent of change due to different interventions and initiatives can be quantified.

Assumptions regarding interventions have included changes in accessibility due to alternative specifications of the transport network, along with additional land use development capacity and development rates facilitated by the provision of additional mass transport capacity.

Assumptions have also been made regarding initiatives for select liveability and productivity changes in the SRL East and SRL North Precincts which could impact demand for specific locations. The productivity initiatives are assumed to result in the creation of jobs within the SRL East and SRL North Precincts. Liveability initiatives relate to the inclusion of different amenities within the SRL East and SRL North Precincts that may make a location more attractive for residents. These initiatives have been grouped into broad categories of civic squares, station plazas, community parks, neighbourhood parks and community facilities.

A summary of the assumptions regarding capacity changes, productivity and liveability initiatives in each SRL East and SRL North Precinct has been provided in the following table. Further input assumptions in relation to indicative precinct initiatives were also provided by SRLA. These form the basis for the assumptions used in CityPlan to help assess the impacts of the Program Case on land use changes. More detail on the specific assumptions and inputs are provided in the Demand Modelling Report.

Table 4-5: Summary of land use capacity, productivity and liveability assumptions

Household Capacity Change		Jobs Capacity Change	Productivity Initiatives	Liveability Initiatives
Cheltenham	+97%	+96%	✓	✓
Clayton	+106%	+24%		
Monash	+93%	+111%		
Glen Waverley	+175%	+48%		
Burwood	+113%	+66%		
Box Hill	+106%	+15%		
Doncaster	+148%	+48%		
Heidelberg	+174%	+15%		
Bundoora	+113%	+211%		
Fawkner	+172%	+59%		
Reservoir	+130%	+81%		
Broadmeadows	+145%	+46%		

Source: SRLA

Growth of SRL East and SRL North Precincts

The introduction of SRL – Cheltenham to Airport has a significant impact on where people live and work, and on how people move around Greater Melbourne, with the city shifting to a more polycentric form. This will help realise *Plan Melbourne's* vision to transform Melbourne into a 'city of centres'.

The land use impacts of SRL – Cheltenham to Airport, including the response to rail and transport interventions, along with planning settings, catalyst projects and broader infrastructure (liveability) initiatives, are expected to lead to significant additional growth in and around the SRL East and SRL North Precincts, compared with the SALUP19 forecasts.

5. Economic costs

5.1 Overview

This chapter outlines the economic costs used in the economic appraisal.

The economic evaluation requires that only the economic costs are included in the analysis. Economic costs include incremental changes relative to the Base Case and include capital costs and recurrent cost (operating, maintenance and renewal costs) but exclude all sunk costs and transfer payments (levies/ taxes and profit margin).

For the purposes of the economic evaluation, costs are expressed as real values (using a 2020 price base). A real value is a value that has been adjusted to remove the effects of general price level changes over time (e.g. inflation).

Cost information has been provided by SRLA as an input to this work; precinct capital costs provided for SRL North are indicative estimates only.

These costs are incremental to the Base Case and are detailed in Table 5-1. The economic analysis is based on P10 to P90 cost range. The midpoint estimate is P50, as per ATAP and DoT guidelines.

Economic analysis uses capital cost estimates that are based at the concept and detailed stages of development and actual costs are likely to differ from those currently provided.

Table 5-1: Economic costs of SRL – Cheltenham to Airport (real, undiscounted, P10 to P90 range, $2020)

	Program Case Option A	Program Case Option B
Rail capital cost	$48.5bn to $67.4bn	$45.5bn to $63.1bn
Precinct capital cost[27]	$2.3bn to $3.1bn	$2.3bn to $3.1bn
Recurrent cost[28]	Average $0.7bn to $0.9bn per annum	Average $0.7bn to $1.0bn per annum

Sources: Based on SRLA and Cost estimation report from WTP.

[27] Precinct capital cost is based on high level estimates of an indicative package of precinct initiatives provided by SRLA.
[28] Recurrent costs per annum are slightly higher for Program Case Option B as SRL North accrues more operational costs, due to the earlier opening date.

5.2 Capital costs

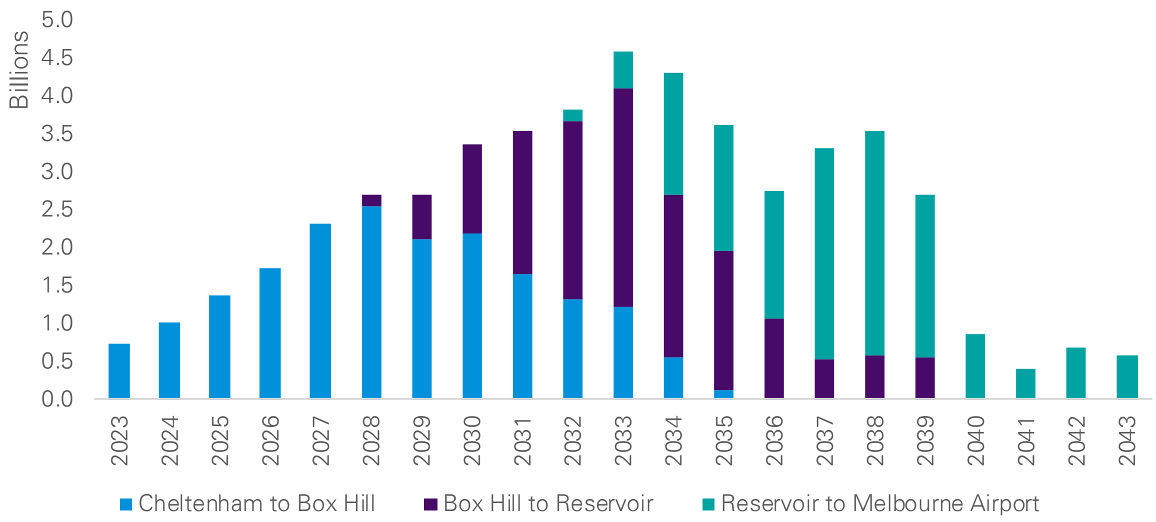
Capital costs include all economic costs incurred when delivering and commissioning the infrastructure and rolling stock required for the Program Cases.

Figure 5-1 and Figure 5-2 show the economic capital cost profile for the Program Case Option A and Program Case Option B over the economic appraisal period respectively.

Figure 5-1: Rail capital cost (economic) profile for the Program Case Option A (P50, real, undiscounted, $2020)

Sources: Cost advisor report by WTP (excludes precinct cost)

Figure 5-2: Rail capital cost profile for the Program Case Option B (P50, real, undiscounted, $2020)



Sources: Cost advisor report by WTP (excludes precinct cost)

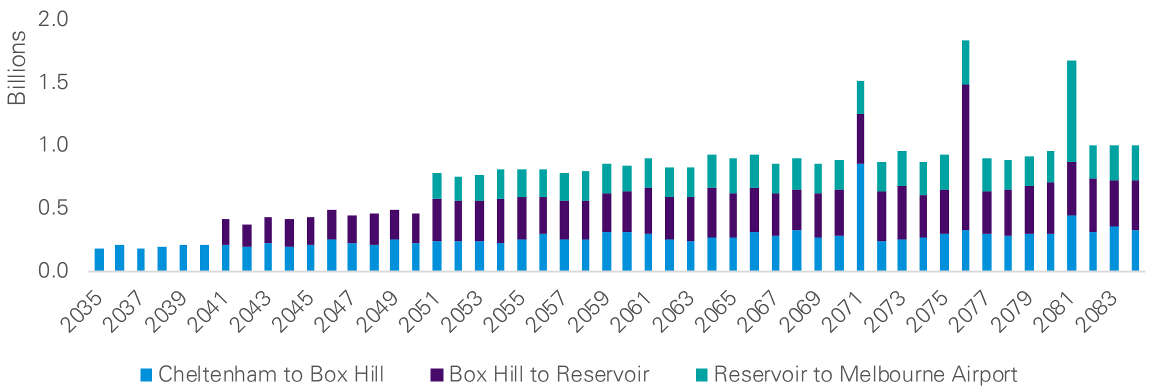
Road and public transport disruptions may occur during the construction of SRL – Cheltenham to Airport, as timetable changes and road closures are required in order to accommodate planned works. These disruptions may extend travel times, potentially in congested conditions. The additional disruption costs to road and public transport users during these periods have been discussed qualitatively.

5.3 Recurrent costs

Recurrent costs include all necessary operating, maintenance and renewal costs for running additional train services, supporting infrastructure, and new rail track and systems. It also includes the operating and maintenance costs of the new precinct facilities. Periodic refurbishment and renewal costs have also been included. Similar to capital costs, all transfer payments such as profit margin and levies have been excluded. Given the economic analysis is undertaken in real costs, the effect of general inflation (CPI) have also been excluded from the analysis.

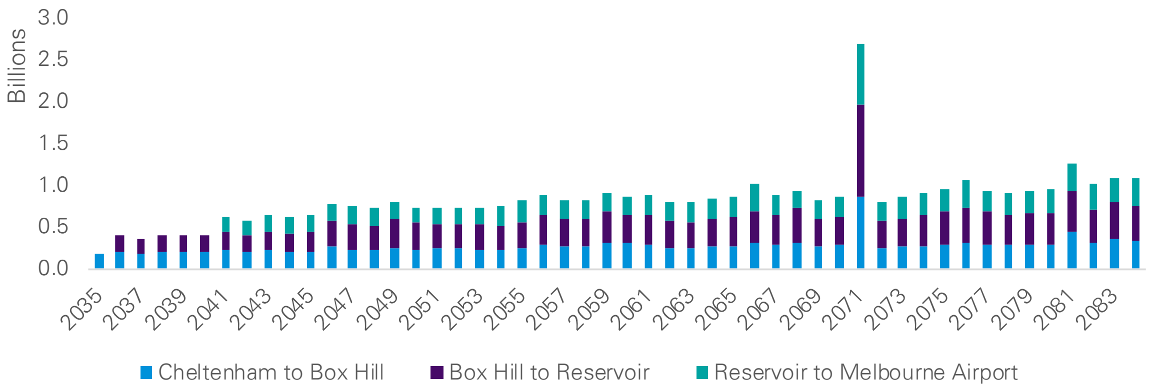
Figure 5-3 and Figure 5-4 show the recurrent cost profile for the Program Case Option A and Program Case Option B over the economic appraisal period respectively. The spikes in the figures are due to rolling stock replacement (as part of renewal costs), which typically occurs in approximately 30 to 40 years after the purchase of the rolling stock. The initial rolling stock investment is included in capital cost as discussed in Section 5.2.

Figure 5-3: Recurrent cost profile for the Program Case Option A (P50, real, undiscounted, $2020)



Sources: Cost advisor report by WTP

Figure 5-4: Recurrent cost profile for the Program Case Option B (P50, real, undiscounted, $2020)



Sources: Cost advisor report by WTP

5.4 Escalation rates

The escalation rates considered are summarised in Table 5-2. To ensure consistency within the economic analysis, only real escalation is used as per the ATAP T2 guideline.

Table 5-2: Escalation rates, nominal rates (real rates in parentheses)

	Capital costs – rail	Capital costs – road	Capital costs – tunnel (road)	Operating costs – other
2019-20	6.9% (4.4%)	6.9% (4.4%)	6.0% (3.5%)	2.5% (0.0%)
2020-21	5.2% (2.7%)	5.3% (2.8%)	4.7% (2.2%)	2.5% (0.0%)
2021-22	4.7% (2.2%)	4.7% (2.2%)	4.3% (1.8%)	2.5% (0.0%)
2022-23	4.4% (1.9%)	4.4% (1.9%)	4.1% (1.6%)	2.5% (0.0%)
2023-30	3.8% (1.3%)	3.9% (1.4%)	3.6% (1.1%)	2.5% (0.0%)
2030+	3.8% (1.3%)	3.9% (1.4%)	3.6% (1.1%)	2.5% (0.0%)

Source: Major Transport Infrastructure Authority (MTIA), 2020

As detailed in Attachment A, real incomes used in the analysis are assumed to increase by 1.5 per cent per annum over the economic evaluation period (as per DoT guidelines). Accordingly, operational and maintenance costs used in the analysis have been adjusted to account for increases in labour costs. It is estimated that 30 per cent of operating costs are labour-related, and consequently these have been escalated at 1.5 per cent per annum (real). The remaining 70 per cent of operating costs are unchanged.

6. Conventional economic benefits

6.1 Overview

Conventional economic benefits assessed for SRL – Cheltenham to Airport include primarily transport-related benefits quantified in accordance with ATAP, DoT and DTF guidelines where appropriate. Conventional economic benefits fall into three main categories:

- **User benefits (public transport and road users)** – benefits to public transport and remaining road users as a result of the Program Case. User benefits include, for example, reductions in crowding and waiting times on public transport, or travel time savings and vehicle operating cost savings for commercial vehicles resulting from people switching from car to public transport. The majority of benefits are calculated using the consumer surplus approach. Certain benefits are not perceived by users but result in a change in consumption of resources, therefore resource cost corrections need to be applied.
- **Other societal benefits (externality effects)** – benefits accruing to Victorians as a whole as a result of changes to travel behaviour following the introduction of the Program Case. For example, the reduction in crashes, greenhouse gas emissions and improved health (due to increased walking) resulting from people switching from car to public transport. Other societal benefits also include the values Victorians place on having a suburban rail link, including benefits associated with Option And non-use value.
- **Infrastructure residual value** – the infrastructure to be constructed for the Program Case will have an economic life beyond the end of the evaluation period. The residual value is an estimate of the economic benefit of the infrastructure from the end of the evaluation period to the end of the economic life of the asset.

The user and non-user benefits are calculated from VITM outputs and are valued using unit costs sourced from ATAP (2018) and Austroads (2012).

Further detail on each of the benefit items is provided below.

6.1.1 Public transport user benefits

Public transport user benefits accrue from changes to the public transport service levels, resulting in improvements to capacity, quality and convenience.

Benefits to customers comprise changes to generalised journey time (a weighted measure of the door-to-door travel time, including time spent walking and waiting for a service as well as time spent on board); reduced crowding on trains, trams and in stations; improved reliability and resilience of the network; and improvements to the journey experience. Table 6-1 shows the public transport user benefits quantified in the analysis.

Benefits to public transport users have been calculated primarily using outputs of VITM. Benefits to users have been valued using parameters within ATAP (2018).

Public transport user benefits have been calculated using the consumer surplus approach described in Section A.2.1. New public transport users (who use a car in the Base Case but switch to public transport in the Program Case) receive half of the benefit accrued by existing users in accordance with the 'rule of a half' convention. The exception is farebox revenue which is subject to a resource cost correction.

Table 6-1: Public transport benefits

Benefit type	Description
Generalised travel time savings	The change in door-to-door travel times includes time spent walking (or driving) to and from stops / stations (and interchanging between services); waiting for a train, tram or bus; and time spent on-board the vehicle. Various components of time are weighted to reflect how passengers perceive their time in accordance with weightings provided in the ATAP M1 guideline: passengers generally perceive time spent waiting for a service to be longer than time spent on board a moving vehicle. Consequently, passengers tend to value improvements in frequency (leading to reduced wait times) more than they do improvements in in-vehicle time (**IVT**).
Reduced crowding on trains and trams	Crowding, or crowded IVT reflects the discomfort customers feel from travelling in varying levels of crowded conditions. As crowding levels increase to crush capacity, the valuation of crowding in IVT minutes also increases. Where customers are unable to board a service due to it being at capacity, they will also incur additional wait time or costs associated with changing mode.
Improved vehicle quality	Improved vehicle quality benefit is related to the quality and amenity aspects of transport vehicles (e.g. bus and trains), such as age, cleanliness, availability of facilities.
Farebox resource cost correction	A resource cost correction to offset the perceived disbenefit of fares in the public transport user benefits.

Source: ATAP, 2018

6.1.2 Road user benefits

Road user benefits principally accrue due to some road users switching from car in the Base Case to public transport in the Program Case. Consequently, there is less congestion on the road and other road users, including freight vehicles, benefit from the reduced traffic on the road.

Benefits to road users consist of travel time savings, improvements in journey time reliability, and monetary items such as vehicle operating cost savings, parking cost savings and toll savings. Road user benefits to be captured in the analysis are shown in Table 6-2.

Benefits to road users have been calculated using outputs of VITM and valued using parameters provided in ATAP (2018).

Road user benefits have also been calculated using the consumer surplus approach as used for public transport users. In some cases, road conditions may improve such that some public transport users divert to road in the Program Case (induced demand). Benefits to these users have also been calculated according to the 'rule-of-a-half' convention.

Some benefits are not directly perceived by road users (and so do not constitute part of their willingness to pay) but do result in a change in consumption of resources. These benefits have been accounted for through resource cost corrections.

Road user benefits are identified in Table 6-2 below. Certain benefit types are calculated for road users and public transport users, however care has been taken to ensure there has been no double counting of beneficiaries.

Table 6-2: Road user benefits

Benefit type	Description
Travel time savings	The change in door-to-door travel times resulting from reduced levels of traffic on the road network due to some car users switching to public transport.
Vehicle operating cost savings	Operating costs of vehicles, such as fuel and maintenance, are a function of distance and speed travelled across the network. In general, fuel consumption is higher at low speeds in interrupted flow / stop-start conditions than it is on free flowing conditions. As a result of some drivers switching from car to public transport, road network speeds can increase leading to fuel savings for other road users. For vehicles which operate in fleets (such as commercial vehicles), if travel times decrease as a result of network speeds increasing, then operators will be able to undertake either the same freight task with a smaller number of fleet vehicles or undertake more trips with the same vehicle. This leads to savings related to vehicle capital costs including time-related depreciation, registration and insurance. A resource cost correction is applied to the unperceived (non-fuel) component of vehicle operating costs.
Road journey time reliability	Road journey time reliability is a function of congestion in the road network – when links are at or near capacity, any unplanned incident, such as a crash or breakdown, is more likely to result in major delays to other vehicles than if the crash or breakdown occurred on a more lightly trafficked route. Consequently, drivers must allow more buffer time before making trips to ensure that they arrive on time. Some road links will become less congested and trips by road for remaining road users will become more reliable, allowing them to reduce the buffer time and use the time saved more productively.
Travel time in congested conditions	Research from overseas[29] shows that the value of time increases with the level of congestion, reflecting the increased stress and effort associated with driving in more congested conditions. As the Program Case results in some mode shift from road to public transport, some road links will become less congested and remaining road users will benefit from travelling in less congested conditions.
Savings in parking and toll charges	Savings due to road users switching from car to public transport, or from remaining road users changing routes due to reduced road congestion as a result of some users switching to public transport. A resource cost correction has been applied to the unperceived component of tolls and parking charges.

Source: ATAP, 2018

6.1.3 Other societal benefits

Other societal benefits of SRL – Cheltenham to Airport include reduced road crashes and environmental costs (resulting from drivers switching from road to public transport), improved public health (through increased walking or cycling to/from public transport) and Option And non-use value. Table 6-3 details the other societal benefits that have been included in the analysis.

These benefits have been quantified using outputs of VITM and *Victoria in Future* (VIF) Population Forecasts. They have been valued using parameters drawn from ATAP (2019), Austroads (2012) and benefit valuation literature. As these are unperceived by transport users, they are not subject to the

[29] See for example Wardman & Ibanez (2012).

consumer surplus calculation approach. Instead, they have been calculated from the total change in consumption of resources.

Table 6-3: Other societal benefits

Benefit type	Description
Crash cost savings	Crash costs are a function of the number of vehicle kilometres travelled on a particular road type. In general, limited access roads such as freeways have lower crash rates per vehicle kilometre travelled than roads in residential areas. As a result of some road users switching from car to public transport, there will be fewer vehicle-kilometres travelled on the network. Consequently, fewer crashes will occur.
Environmental cost savings	Environmental cost savings to be quantified include reduced greenhouse gas emissions, air pollution, noise pollution, water pollution, nature and landscape impacts, urban separation effects and upstream and downstream impacts. These savings are likely to arise as transport users shift from private vehicles to public transport. This cost reduction has been calculated using network wide changes in vehicle kilometres travelled or net tonne kilometres travelled by road and public transport vehicles and application of valuation parameters.
Improved health due to increased walking and cycling	Public transport users walk an average of 41 minutes per day compared to 8 minutes per day for car users. As a result of car drivers switching to public transport, these individuals' levels of physical activity will increase, resulting in improved health. Walking undertaken by new public transport users (e.g. those who mode shift from car) incurs a benefit (Transport and Infrastructure Council, 2014). The total benefit from increased active transport is comprised of two main categories: • Morbidity and mortality benefits because people who are active become ill less often and have a longer life expectancy than people who are inactive (user benefit). • Reduction in health system costs because active people are less likely to need medical and hospital care (societal benefit). Only the reduction in health system costs have been considered a broader societal benefit. Morbidity and mortality benefits have been considered user benefits.
Option and non-use value	Option and non-use value should be included in the economic appraisal if the project being appraised includes measures that will change the availability of transport services within the study area (e.g. the opening of a rail service). Option and non-use value is considered relevant for this economic appraisal as SRL – Cheltenham to Airport provides a new rail service for travellers around Metropolitan Melbourne. An option value is the willingness to pay to preserve the option of using a transport service for trips not yet anticipated or currently undertaken by other modes, over and above the expected value of any such future use. Non-use values are the values that are placed on the continued existence of a service, regardless of any possibility of future use by the individual in question. The motivation for the desire for a transport service to continue to exist may vary from one circumstance to another. Whilst a full analysis of user benefits includes the expected value of any such occasional use, theory suggests that, in circumstances where the lack of the transport facility would cause inconvenience, people may be willing to pay a premium over and above their expected use value to ensure that the service exists for unplanned trips, as a sort of insurance.

Source: ATAP, 2019 and DfT UK, 2014

6.1.4 Residual value

Benefits have been assessed over a 50-year period from project opening. However, the infrastructure will have an economic life beyond the end of the evaluation period. The residual value is an estimate of the economic benefit of the infrastructure from the end of the evaluation period to the end of the economic life of the asset.

As per the ATAP (2018) guidelines, a number of asset types, in particular rail infrastructure, are estimated to have an economic life that extends beyond the 50 year evaluation period. It is therefore prudent to accurately reflect the residual value of the assets beyond the end of the evaluation period.

A weighted average asset life for the project has been developed based on cost information provided by the cost advisor. Based on the method described above, the estimated weighted asset life of SRL – Cheltenham to Airport is 100 years, which is used in the residual value calculation for this appraisal. For assets that have lower asset life, infrastructure renewal and replacement cost have been included in the operating costs.

The residual value method applied within the economic appraisal considers the lower of the present value of the replacement cost at the end of the evaluation period, or the present value of the future stream of net benefits from the end of the evaluation period to the end of the economic life of the asset in line with DTF guidelines.

6.2 Key findings

6.2.1 Overview

The following sections discusses the conventional benefits attributable to SRL – Cheltenham to Airport. The results at a 4 per cent discount rate are summarised below in Table 6.4.

Table 6-4: Conventional benefits of Program Case Option A and Option B discounted at 4 per cent

	Program Case Option A	Program Case Option B
Conventional benefits		
Public transport user benefits	$14.9bn to $19.8bn	$16.6bn to $21.7bn
Road user benefits	$10.0bn to $12.3bn	$11.7bn to $14.3bn
Externalities (non-user benefits)	$3.5bn to $3.7bn	$4.2bn to $4.6bn
Option And non-use value	$1.1bn to $5.4bn	$1.2bn to $5.7bn
Residual value of assets	$3.8bn to $6.4bn	$3.6bn to $6.0bn
Total conventional benefit	**$33.6bn to $40.9bn**	**$37.4bn to $45.2bn**

Notes:

1. *The probabilistic analysis uses 95% confidence intervals.*
2. *5,000 iterations were used for the analysis and ensure convergence.*
3. *The probabilistic ranges are not additive because the underlying distribution of inputs vary for each line item.*

Source: KPMG (2021) based on VITM and CityPlan modelling results, relevant guidelines and agreed assumptions

The following sections highlight both the magnitude and composition of conventional benefits at a 4 per cent discount rate.

6.2.2 Public transport user benefits

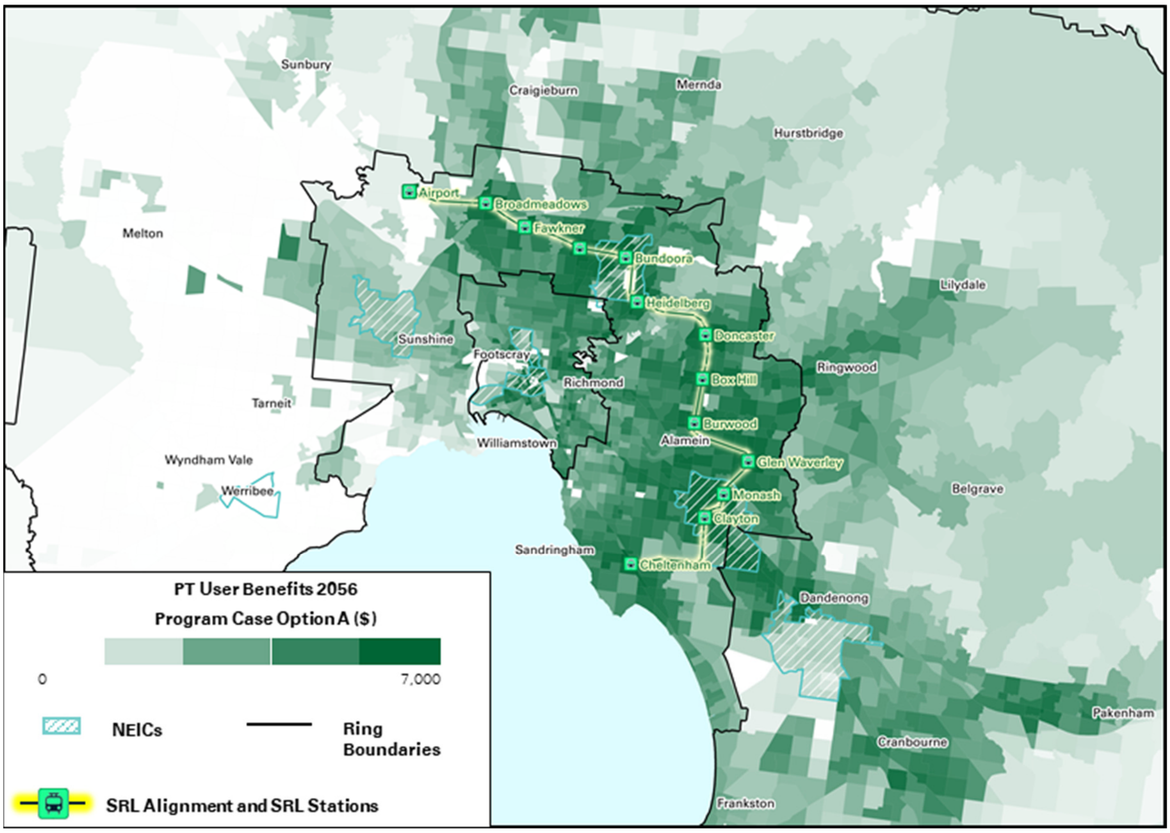
Public transport benefits make up the largest component, accounting for approximately 43 per cent of the conventional benefits for both Program Case Option A and Program Case Option B.

The additional public transport user benefit generated is estimated to be in the order of $14.9 billion to $19.8 billion for Program Case Option A and $16.6 billion to $21.7 billion for Program Case Option B in present value terms at a 4 per cent discount rate.

Figure 6-1 and Figure 6-2 show the distribution of public transport user benefits (by origin) as modelled for the AM peak for Program Case Option A and Program Case Option B respectively. As can be observed across both Figures, users with trips originating along the SRL – Cheltenham to Airport corridor tend to derive the greatest share of PT benefits, along with users originating along existing radial rail lines in the outer ring areas on the north, east and south-east extents of the network.

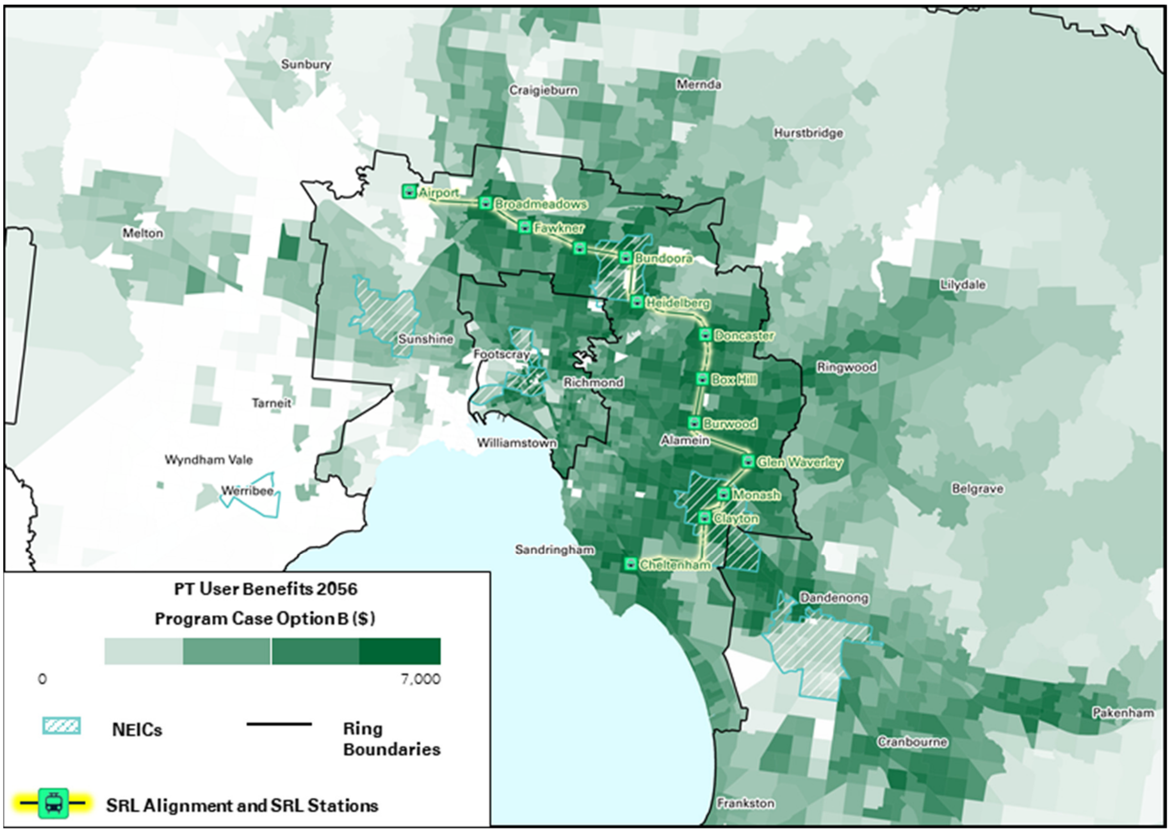
SRL – Cheltenham to Airport delivers public transport benefits across the majority of metropolitan Melbourne in 2056. The scale of benefits is driven by improved public transport provision making public transport more attractive, as well as the changes in land use enabled by SRL – Cheltenham to Airport, with more people and jobs locating closer to stations along the SRL – Cheltenham to Airport corridor and within SRL East and SRL North Precincts.

Figure 6-1: Public transport user benefits by origin of trip for 2056, AM peak period – Program Case Option A



Source: KPMG (2021) based on VITM and CityPlan modelling results, relevant guidelines and agreed assumptions

Figure 6-2: Public transport user benefits by origin of trip for 2056, AM peak period – Program Case Option B



Source: KPMG (2021) based on VITM and CityPlan modelling results, relevant guidelines and agreed assumptions

6.2.3 Road user benefits

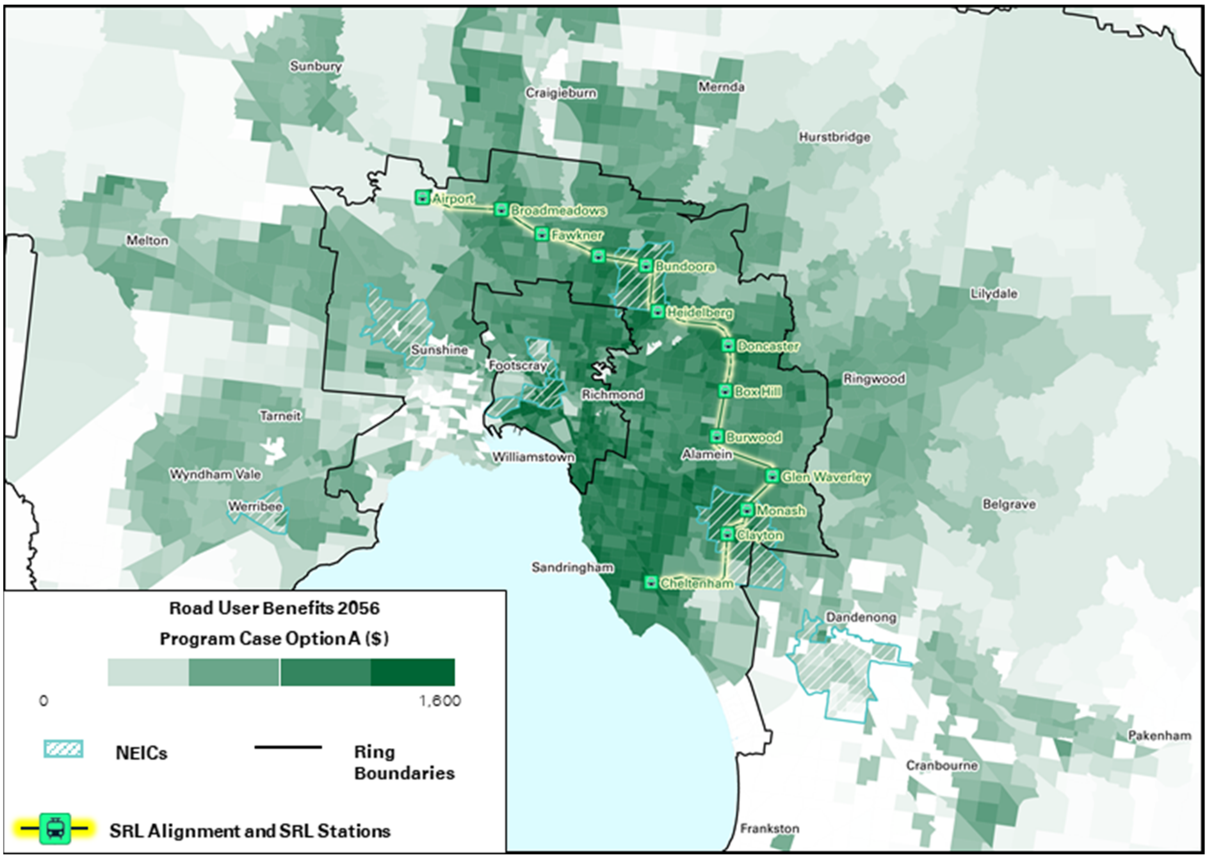
Road user benefits make up approximately 28 per cent of the conventional benefits for Program Case Option A and approximately 29 per cent of the conventional benefits for Program Case Option B.

The additional road user benefit generated is estimated to be in the order of $10.0 billion to $12.3 billion for Program Case Option A and $11.7 billion to $14.3 billion for Program Case Option B in present value terms at a 4 per cent discount rate.

Figure 6-3 and Figure 6-4 show the distribution of road user benefits (by origin) as modelled for the AM peak for Program Case Option A and Program Case Option B. These show that, in 2056, the road user benefit is higher for Program Case Option A than Program Case Option B. This is due to the earlier opening of SRL North under Program Case Option B bringing more employment and population into the SRL East and SRL North Precincts in the years leading up to 2056, which results in marginally higher congestion (especially in the SRL East and SRL North Precincts) when compared to Program Case Option A.

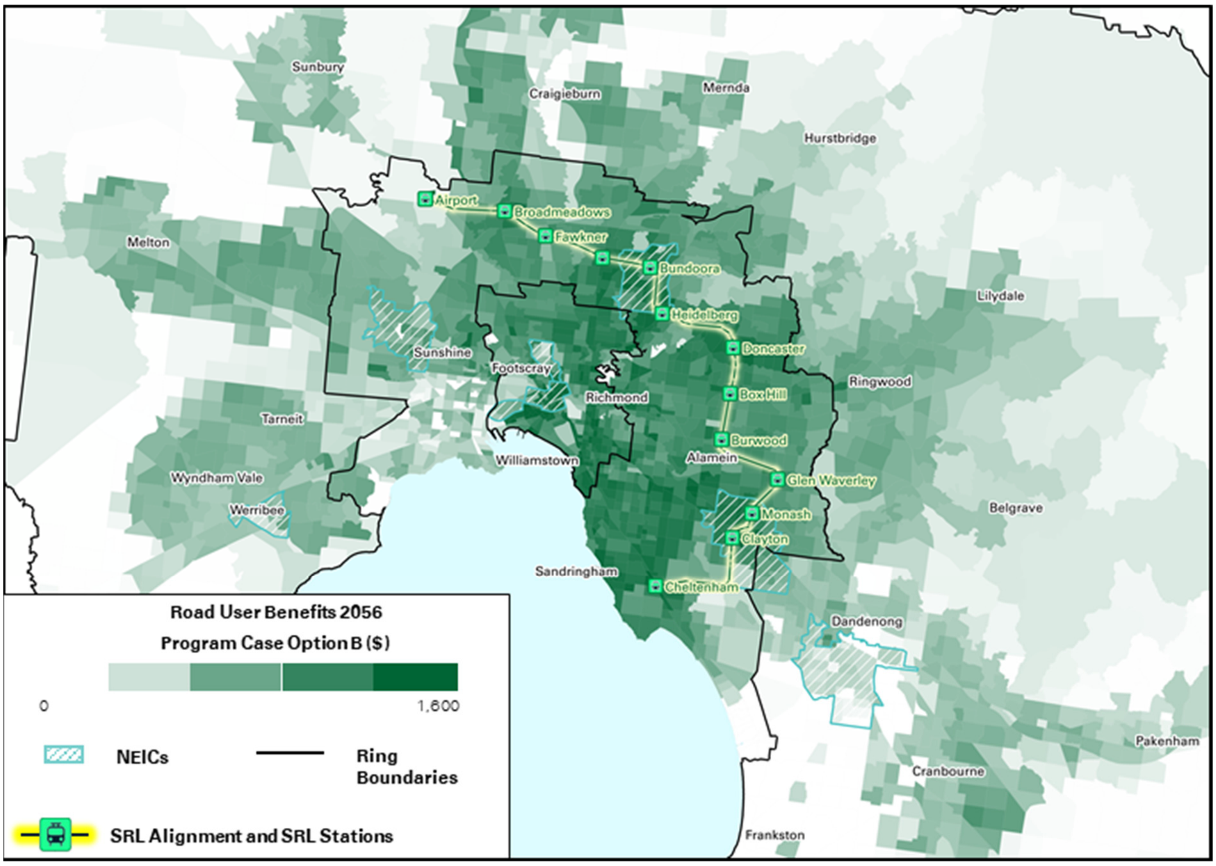
Road users originating west of SRL – Cheltenham to Airport benefit from the transport network improvements generated by the combination of land use change and enhanced public transport capacity afforded by SRL – Cheltenham to Airport. This demonstrates that the investment in SRL – Cheltenham to Airport will provide significant benefits beyond the SRL – Cheltenham to Airport corridor, improving the overall transport network performance.

Figure 6-3: Distribution of road transport user benefits by origin of trip for 2056, AM peak period – Program Case Option A



Source: KPMG (2021) based on VITM and CityPlan modelling results, relevant guidelines and agreed assumptions

Figure 6-4: Distribution of road transport user benefits by origin of trip for 2056, AM peak period – Program Case Option B



Source: KPMG (2021) based on VITM and CityPlan modelling results, relevant guidelines and agreed assumptions

6.2.4 Other societal benefits (externalities)

Considering a 4 per cent discount rate, the quantifiable non-user benefits included in the analysis make up approximately 16 per cent and approximately 21 per cent of conventional benefits for Program Case Option A and Program Case Option B respectively.

Externalities

The externalities generated are estimated to be in the order of $3.5 billion to $3.7 billion for Program Case Option A and $4.2 billion to $4.6 billion for Program Case Option B in present value terms at a 4 per cent discount rate.

Externality benefits are driven primarily by improvements to road conditions. As such, they are distributed in a similar pattern to the road user benefits shown in Section 6.2.3 above.

Option and non-use value

The option and non-use value is estimated to be in the order of $1.1 billion to $5.4 billion for Program Case Option A and $1.2 billion to $5.7 billion for Program Case Option B in present value terms at a 4 per cent discount rate.

6.2.5 Residual value

The residual value method applied within the economic appraisal uses the replacement cost approach as per DTF guidelines.

With this approach, at the end of the appraisal period, the residual asset value is estimated to be in the order of $3.8 billion to $6.4 billion for Program Case Option A and $3.6 billion to $6.0 billion for Program Case Option B in present value terms at a 4 per cent discount rate.

7. Wider Economic Benefits

7.1 Overview

The conventional CBA assumes perfect competition and lack of market imperfections. The presence of additional market imperfections (beyond those externalities typically identified in a conventional CBA) means that not all the impacts of changes in the marginal costs of travel are assessed in a conventional CBA. In addition, the cost of travel does not equate to the marginal social cost of transport supply. This divergence between price and marginal social cost gives rise to potential for additional impacts (benefits or costs) that are not captured in the conventional CBA.

These impacts are commonly referred to as WEBs and have become core to the appraisal of significant transport and urban regeneration projects.

7.2 SRL - Cheltenham to Airport WEBs

SRL – Cheltenham to Airport will deliver transport network improvements that will facilitate changes in land use and urban development. Improving accessibility and the connectivity of key precincts outside of Melbourne's CBD will allow people to live closer to where they work as employment opportunities are expanded and will also enable firms to locate in close proximity to each other. This will result in the realisation of a range of WEBs, particularly:

- **Agglomeration** – SRL – Cheltenham to Airport will support growth of major employment centres outside of the CBD, especially in the SRL East and SRL North Precincts, and increase employment density in these areas.
- **Labour market deepening** – competitive marketplaces present businesses with different labour options, and facilitate better skills matching, allowing them to better align jobs with skills of employees thereby generating higher productivity.
- **Output increase in imperfectly competitive markets** – in an imperfectly competitive market, prices may exceed production costs and output may be less than optimal. The benefit arises from a reduction in transport costs due to SRL – Cheltenham to Airport, allowing for an increase in production or output of goods or services that use transport.

The evaluation of WEBs for the Program Cases was undertaken in accordance with guidance provided in the ATAP T3 guideline (December 2020 draft)[30].

Table 7-1 discusses the treatment in the economic appraisal of individual WEB categories.

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[30] Except for the quantification of WEB2b, for which the ATAP T3 WEBs guideline (December 2020) does not offer an algebraical form for quantification. The estimation of WEB2b employs the quantification method provided within the draft ATAP T3 published in 2018.

Table 7-1: WEBs descriptions

WEB type	Description
WEB1 – Agglomeration economies	'Agglomeration economies' (WEB1) refers to benefits which flow to firms and workers located in close proximity (or agglomerating). Agglomeration economies arise from economies of scale and scope. The three principal sources of agglomeration economies include input sharing (including labour market pooling), knowledge / technological spillovers and output sharing. By lowering travel costs and enabling land use densification, transport projects can have a significant impact on agglomeration / density (e.g. effective density). Lower generalised costs or greater physical density of employment results in enhanced accessibility / connectivity which facilitates increased formal and informal interaction. This in turn enables increased input and output sharing and, more importantly, knowledge spillovers, the principal source of agglomeration economies in the modern economy. Agglomeration economies can be facilitated by either improving connectivity between employment dense areas (proximity effects), or enabling land use changes which lead to more jobs locating in areas that are already employment dense (cluster effects) or both.
WEB2 – Labour market deepening	Labour market deepening refers to two distinct impacts: • WEB2a – Increased labour supply • WEB2b – Move to more or less productive jobs. **WEB2a – Increased labour supply** In deciding whether to work, a worker weighs, among other factors, travel costs associated with the job against the wage received from the job. Lowering of transport cost may encourage workers to work longer hours or encourage the under-engaged and disengaged workforce into active employment. This may result in an increase in overall labour supply in the economy. This increased labour supply, in turn, will result in increased value added or gross domestic or state product (**GDP / GSP**). The marginal change in tax receipts from changes in labour supply (e.g. WEB2a) is then estimated for inclusion in the economic evaluation. **WEB2b – Move to more or less productive jobs** 'Move to more or less productive jobs' (**M2MPJ**) (WEB2b) refers to how improved transport accessibility may provide employers with access to a broader range of employees (to recruit the most suitable skills), and employees with access to a wider range of jobs better suited to their skills. Better skills matching / alignment, in turn, results in workers being more productive. Ultimately, this will lead to an increase in GSP and GDP. Similar to WEB2a, the changes in tax receipts can then be estimated for inclusion in the analysis.
WEB3 – Output increase in imperfectly competitive markets	In an imperfectly competitive market, prices may exceed production costs and output may be less than optimal. 'Output change in imperfectly competitive markets' (WEB3) arises from a reduction in transport costs allowing for an increase in production or output of goods or services that use transport. The existence of price-cost mark up under imperfect competition implies that some consumers are willing to pay more, e.g. there are additional consumer surpluses. This impact is not captured in conventional CBA as it assumes that markets are perfectly competitive. WEB3 is considered minimal in countries with a highly competitive market like Australia. Therefore, WEB3 is not included in this economic appraisal.

WEB4 – Increased competition	Any transport project which makes an area significantly more accessible has the potential to increase market competition (WEB4) in that area. Significant enhancement in accessibility, and therefore reduction in transport cost, allows new firms to enter the market and effectively compete with incumbent firms. The theory behind WEB4 is that reducing transport costs opens up areas to increased competition, driving production efficiencies, which in turn results in lower prices for consumers. Any transport projects in developed countries, which are characterised by reasonable transport access, are unlikely to generate significant enough travel cost savings to have any material impact on competition. Consequently, WEB4 is not discussed in this economic appraisal.

Source: KPMG adapted from ATAP T3 guideline (2020) WEBs

7.3 Overview

The estimated WEBs are summarised below in Table 7.2.

Table 7-2: Wider economic benefits of Program Case Option A and Option B discounted at 4 per cent

	Program Case Option A	**Program Case Option B**
Wider Economic Benefits		
WEB1 - Agglomeration economies	$6.0bn to $9.7bn	$6.3bn to $10.3bn
WEB2a – Increased labour supply	*$0.06bn to $0.09bn*	*$0.04bn to $0.07bn*
WEB2b – Move to more productive jobs	*$1.0bn to $1.7bn*	*$1.8bn to $2.9bn*
Total WEB2 - Labour market deepening	$1.1bn to $1.8bn	$1.8bn to $3.0bn
WEB3 - Imperfect markets	$0.4bn to $0.5bn	$0.5bn to $0.6bn
Total Wider Economic Benefits	**$7.5bn to $11.9bn**	**$8.8bn to $13.9bn**

Notes:

1. *The probabilistic analysis uses 95% confidence intervals.*
2. *5,000 iterations were used for the analysis and ensure convergence.*
3. *The probabilistic ranges are not additive because the underlying distribution of inputs vary for each line item.*

Source: KPMG (2021) based on VITM and CityPlan modelling results, relevant guidelines and ag*reed assumptions*

As shown in Table 7-2, agglomeration economies (WEB1) and labour market deepening (WEB2) account for the majority (approximately 95 per cent) of the total WEBs for both Program Case Option A and Program Case Option B.

7.4 WEB1 – Agglomeration economies

Agglomeration economies were estimated using the ATAP T3 WEBs guideline (December 2020 draft).

Quantification of agglomeration economies relies on the concept of Effective Density:

- **Physical density** is the number of jobs within a given unit of area (e.g. jobs per square kilometre)
- **Effective density** is the (weighted) number of jobs accessible within a given travel impedance. This uses a decay function to assign high weights to 'near' jobs and low weights to 'far' jobs.

The introduction of SRL – Cheltenham to Airport leads to improvements in Effective Density in and around the SRL East and SRL North Precincts. This is driven by mode shift from road to rail, acting to reduce road congestion and improving the performance of the transport network in these areas.

The appraisal for SRL – Cheltenham to Airport considers dynamic agglomeration, which is caused not only by improved transport network performance (static agglomeration), but also the land use impact and the clustering of jobs within SRL East and SRL North Precincts.

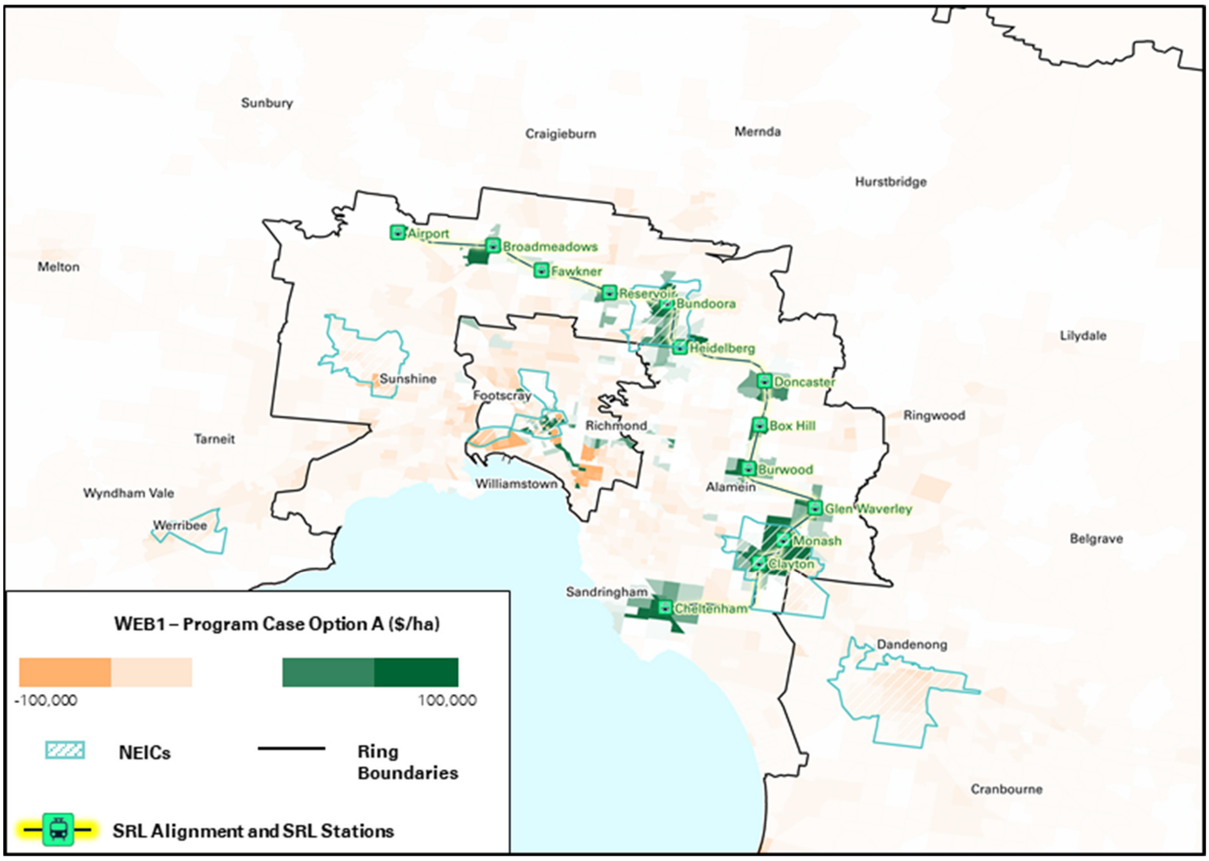
The SRL East and SRL North Precincts are centred around existing NEICs and MACs in the middle corridor, locations which are already centres of economic activity. Fostering and facilitating further employment growth in these centres will enhance productivity. Consolidating businesses and economic activity in a precinct generates agglomeration benefits due to the increased opportunities to collaborate, share resources, and capture flow-on customers and market opportunities. These interactions and relationships in close proximity to businesses can help drive innovation, growth, and productivity, ultimately generating value. While the central city has benefitted from these agglomeration benefits, SRL – Cheltenham to Airport will provide opportunities to capture benefits of agglomeration across Melbourne including within the SRL East and SRL North Precincts.

Figure 7-1 and Figure 7-2 show the estimated concentration of agglomeration benefits (dollars per hectare) attributable to SRL – Cheltenham to Airport for Program Case Option A and Program Case Option B.

The additional agglomeration benefit generated is estimated to be in the order of $6.0 billion to $9.7 billion for Program Case Option A and $6.3 billion to $10.3 billion for Program Case Option B in present value terms at a 4 per cent discount rate.

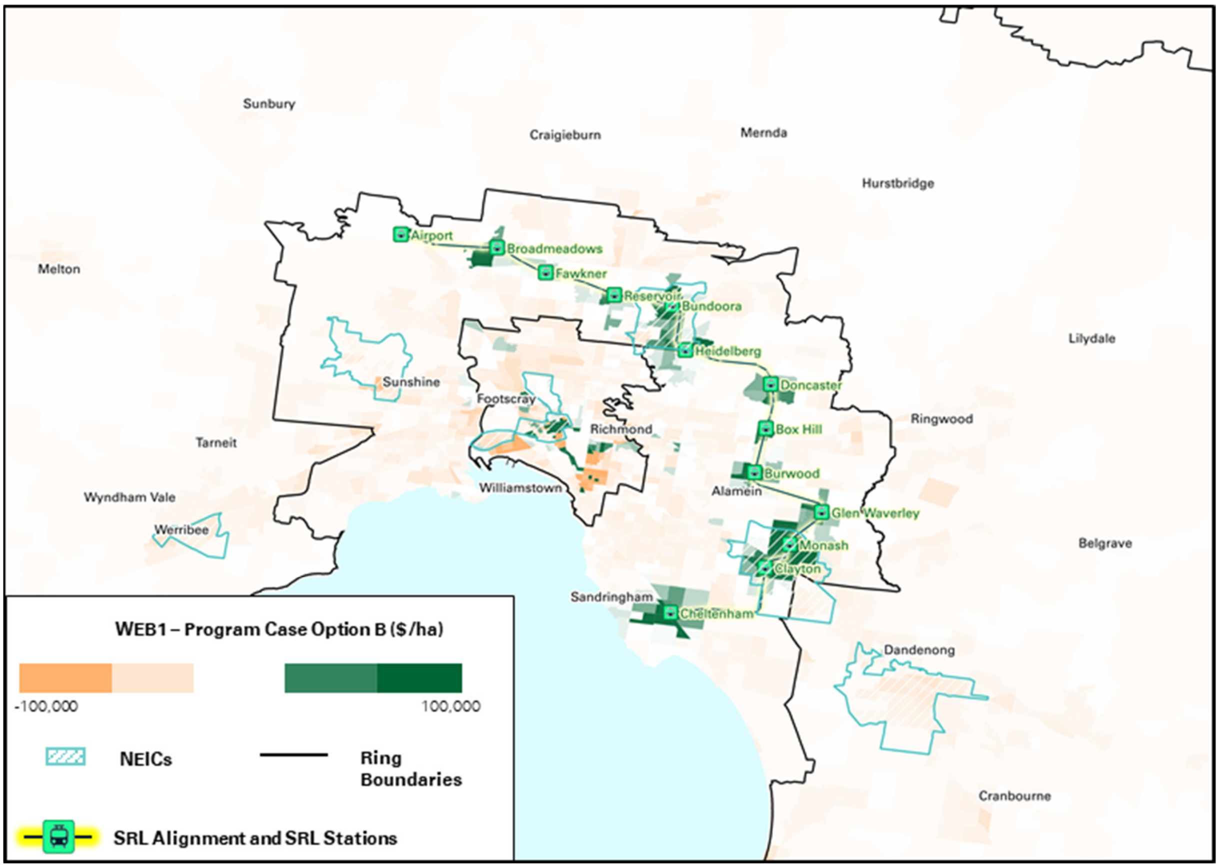
Agglomeration benefits are mostly derived by businesses located in and around the SRL East and SRL North Precincts and select inner city locations. There are however marginal negative (dis-economies) benefits across Melbourne. This is primarily driven by the shift of employment from these areas to the SRL East and SRL North Precincts.

Figure 7-1: Concentration of agglomeration benefits attributable to SRL – Cheltenham to Airport for model year 2056 – Program Case Option A



Source: KPMG (2021) based on VITM and CityPlan modelling results, relevant guidelines and agreed assumptions

Figure 7-2: Concentration of agglomeration benefits attributable to SRL – Cheltenham to Airport for model year 2056 – Program Case Option B



Source: KPMG (2021) based on VITM and CityPlan modelling results, relevant guidelines and agreed assumptions

7.5 WEB2 - Labour market deepening

Labour market deepening benefits were quantified following the ATAP T3 guideline (public consultation draft). The WEB2 category contains two components:

- **Increased labour supply** - the impact generated from more people choosing to work due to changes in effective wage rates, i.e. after commuting cost wage (WEB2a); and,
- The impacts generated from **moving to more productive jobs** (WEB2b).

WEB2 captures the tax wedge associated with the impacts generated from changes in the labour market.

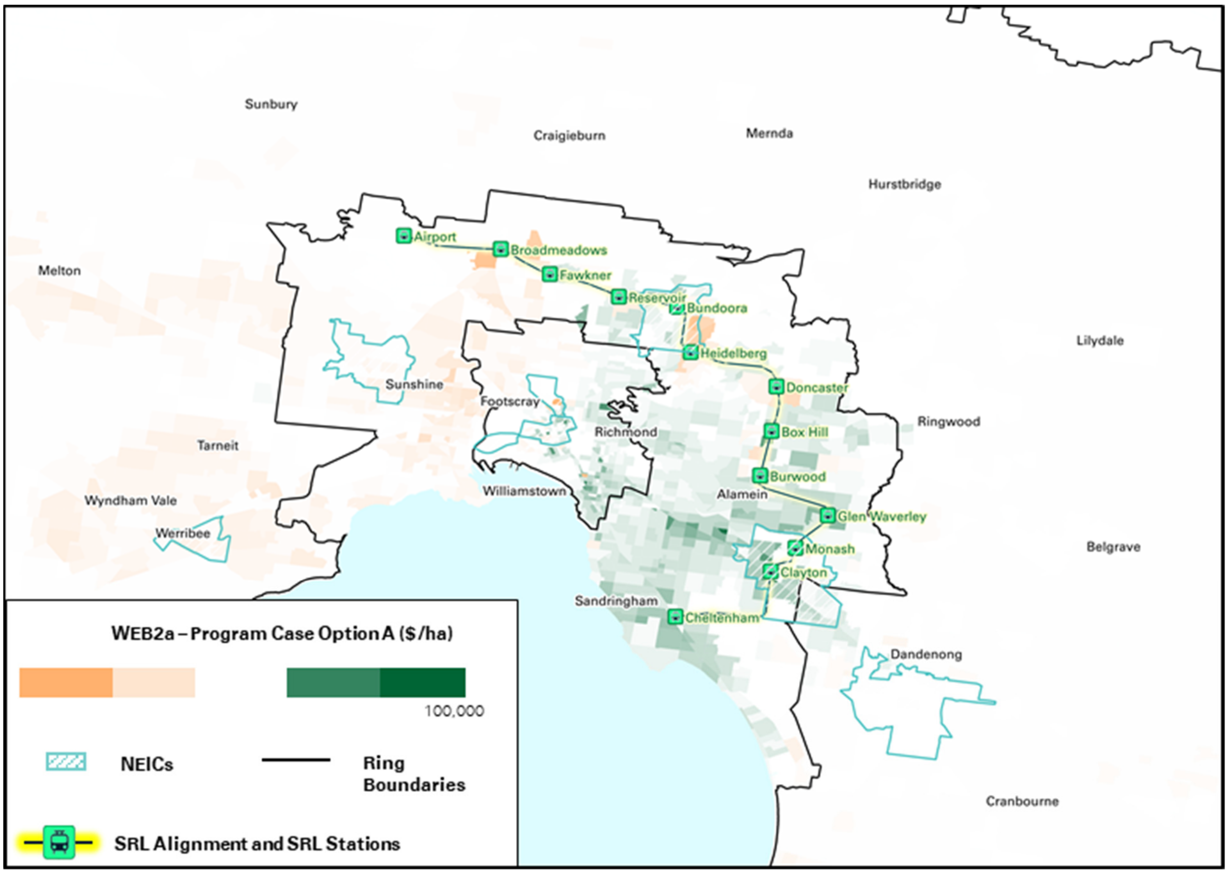
SRL – Cheltenham to Airport has the potential to realise labour market benefits by reducing the generalised cost of commuting (e.g. reduced travel time and/or improve journey reliability). Lower generalised costs of commuting reduces barriers to people taking up work / working longer hours or switching to jobs that better match their skills and areas of interest, e.g. less burdensome to get to and from work, especially for people with caring responsibilities.

In choosing whether to take up work, individuals trade off the perceived benefit of the potential wages with the perceived disbenefit of commuting. A reduction in commuting costs due to SRL – Cheltenham to Airport can impact the supply of labour. It is quantified by estimating the change in the average daily generalised cost of commuting due to the transport improvement for all travel zones in Melbourne. The perceived benefit of working (measured in dollars) for each area is defined as the average daily wage minus the average daily generalised cost of commuting. A reduction in the generalised cost of commuting translates to an increase in the perceived benefit of working (and thus has the potential to increase labour supply and its associated Government tax revenue streams).

SRL – Cheltenham to Airport is expected to reduce commuting costs for Melburnians, with some Melburnians choosing to use part of the additional time to work longer hours. This contributes to increased labour supply (WEB2a) across the economy. The additional WEB2a benefit generated by SRL – Cheltenham to Airport is estimated to be in the order of $0.06 billion to $0.09 billion for Program Case Option A and $0.04 billion to $0.07 billion for Program Case Option B in present value terms at a 4 per cent discount rate.

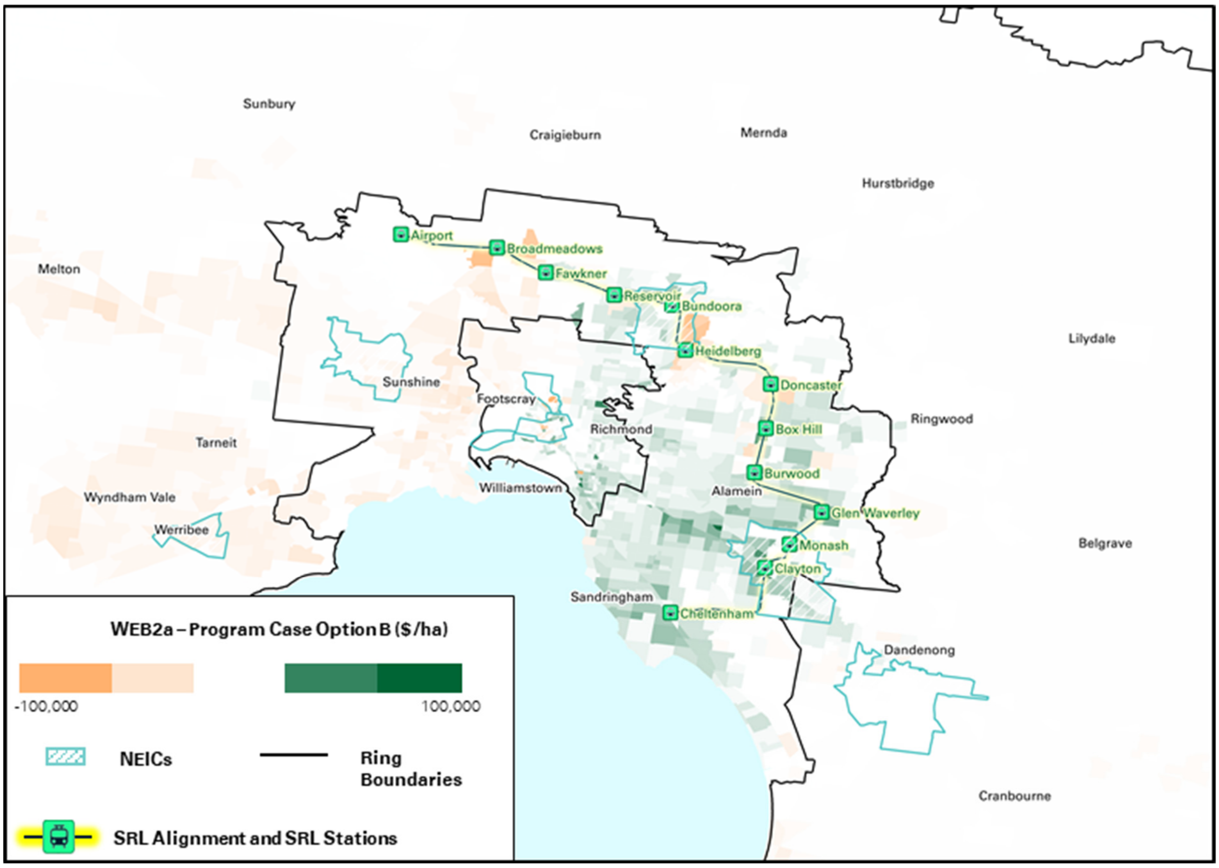
Figure 7-3 and Figure 7-4 show the estimated concentration of WEB2a 'increased labour supply' benefit (dollars per hectare) attributable to SRL – Cheltenham to Airport in 2056 for Program Case Option A and Program Case Option B. The areas that benefit from increased labour supply are in and around the SRL East and SRL North Precincts. Similar to WEB1 discussed above, western Melbourne sees a moderate decrease in WEB2a due to the shift in employment to the SRL East and SRL North Precincts.

Figure 7-3: Concentration of increased labour supply attributable to SRL – Cheltenham to Airport for model year 2056 – Program Case Option A



Source: KPMG (2021) based on VITM and CityPlan modelling results, relevant guidelines and agreed assumptions

Figure 7-4: Concentration of increased labour supply attributable to SRL – Cheltenham to Airport for model year 2056 – Program Case Option B



Source: KPMG (2021) based on VITM and CityPlan modelling results, relevant guidelines and agreed assumptions

People usually have a "travel time limit" of around 60 minutes for their daily commute to work and will seek employment within these boundaries. This is known as Marchetti constant, named after Italian physicist Ceasare Marchetti. Marchetti observed that throughout human evolution and despite technological advances and increased urbanisation, people's willingness to travel to work has broadly remained constant at around an hour. It is within this 'commuting budget' that most people choose / seek employment.

When a person has poor job accessibility they have fewer employment opportunities within their 'commuting budget' they may be settling for a 'second best job' – a job that may not best match their skills and qualifications. A person that is overqualified for their job is not fully utilising their knowledge and skills, and is more likely to be unfulfilled. This acts as a barrier to the achievement of their full potential – not only for the individual, but also for the economy.

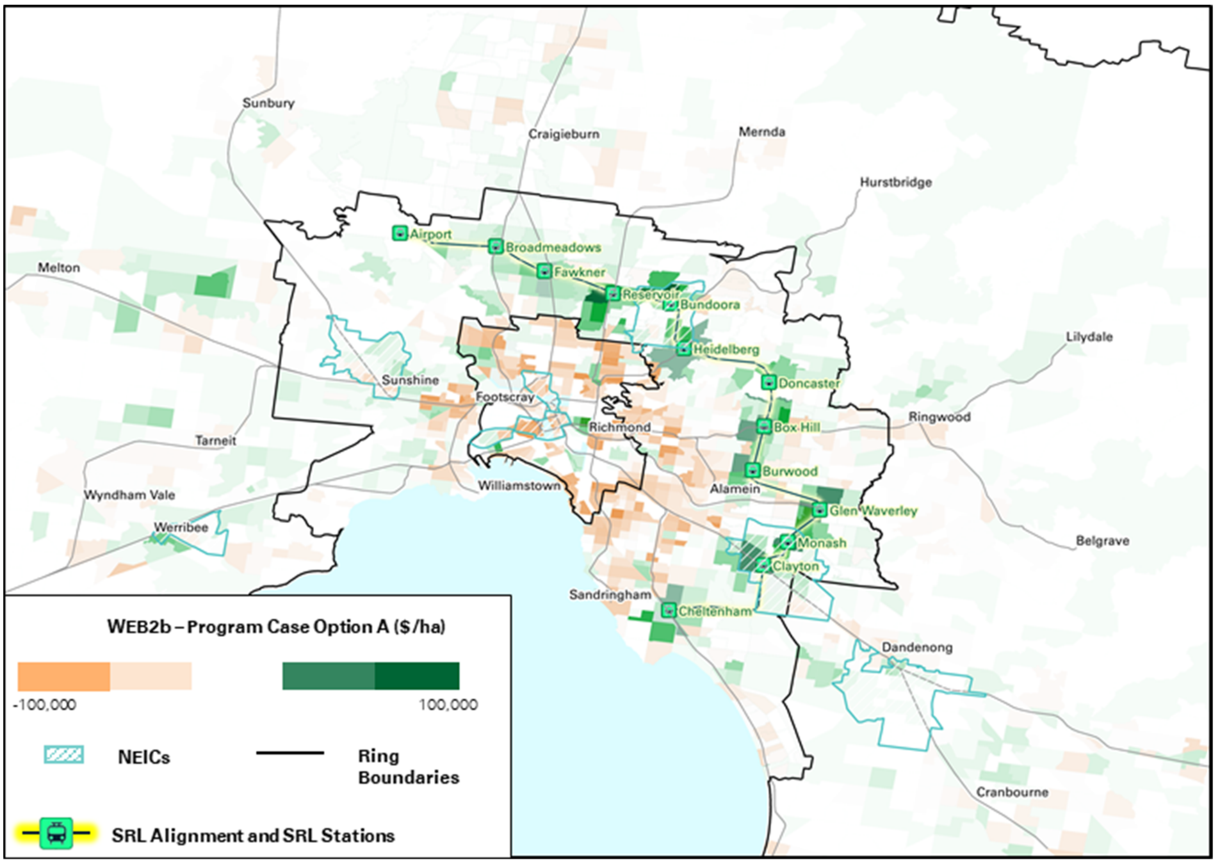
Many of Melbourne's high-value, knowledge-based jobs are in the central city or NEIC's in the inner and middle ring – places that are not always easily accessed from Melbourne's outer ring.

However, housing affordability means that Melbourne's inner and middle ring are becoming increasingly unaffordable for many households within the lower ranges of household income. This is encouraging some households to move to the outer ring in search of more affordable housing choices, resulting in lower levels of accessibility to job opportunities. This can further entrench economic disparity. Inequitable access to services also diminishes productivity and overall community wellbeing.

SRL – Cheltenham to Airport will catalyse productivity within the middle ring – bringing higher-value, knowledge-based job opportunities much closer to people. People living in both the middle and outer ring will benefit from greater accessibility to these jobs, removing some of the barriers caused by long-commutes to reach high productivity employment opportunities. With access to a larger number and broader range of jobs, people can find employment that better matches their skills and experience, generating increased economic output.

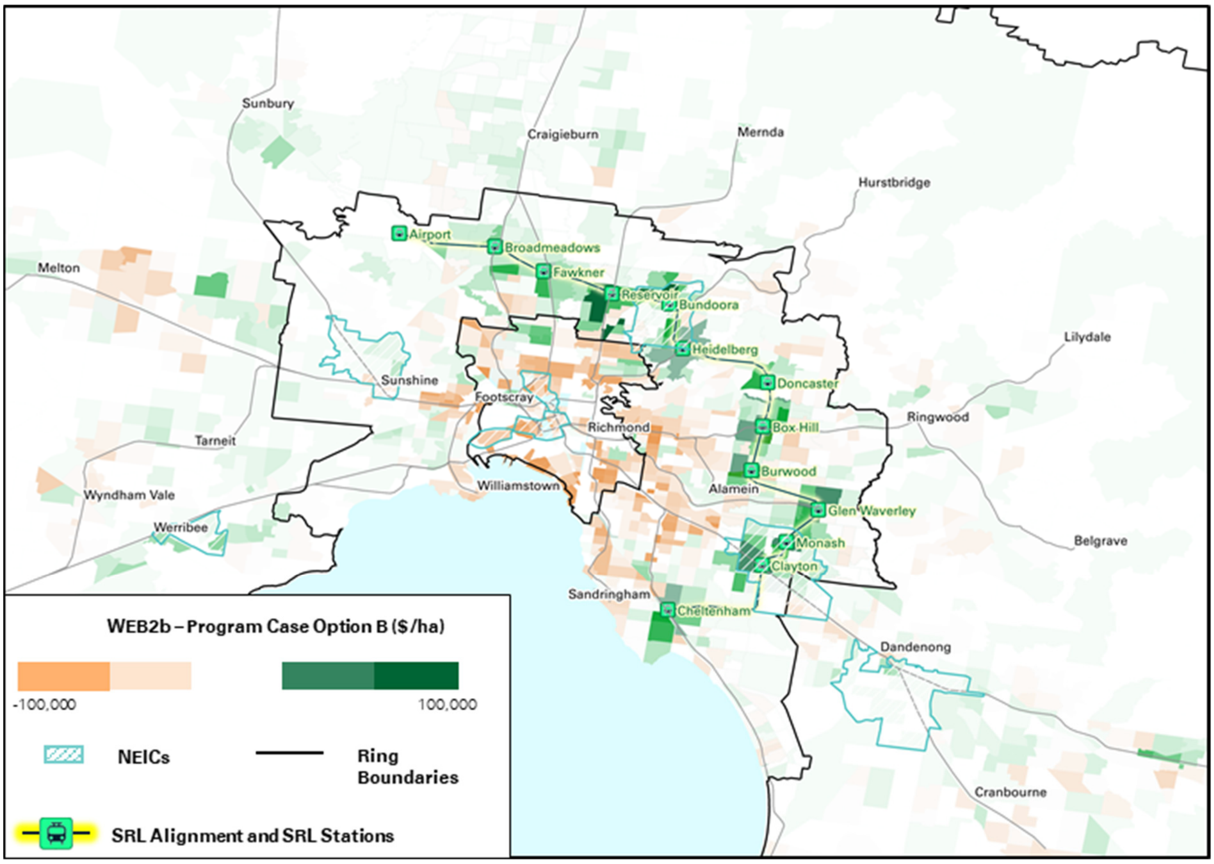
The enhanced WEB2b outcomes are generated by SRL – Cheltenham to Airport as a greater volume of jobs are now closer and more accessible to a greater portion of the workforce - particularly for those living in south eastern Melbourne, the outer ring and along the SRL – Cheltenham to Airport corridor (see Figure 7-5 and Figure 7-6). These enhanced opportunities will provide greater productivity outcomes for the state.

Figure 7-5: Concentration of improved productivity attributable to SRL – Cheltenham to Airport for model year 2056 – Program Case Option A



Source: KPMG (2021) based on VITM and CityPlan modelling results, relevant guidelines and agreed assumptions

Figure 7-6: Concentration of improved productivity attributable to SRL – Cheltenham to Airport for model year 2056 – Program Case Option B



Source: KPMG (2021) based on VITM and CityPlan modelling results, relevant guidelines and agreed assumptions

Benefits from WEB2b are estimated to be in the order of $1.0 billion to $1.7 billion for Program Case Option A and $1.8 billion to $2.9 billion for Program Case Option B in present value terms at a 4 per cent discount rate.

7.6 WEB3 - Output increase in imperfectly competitive markets

The reduction in transport costs catalysed by SRL – Cheltenham to Airport results in the increased production of goods and services. The additional WEB3 generated is estimated to be in the order of $0.4 billion to $0.5 billion for Program Case Option A and $0.5 billion to $0.6 billion for Program Case Option B in present value terms at a 4 per cent discount rate.

8. Urban Consolidation Benefits

8.1 Overview

UCBs are recognised by IA, ATAP and other international transport appraisal guidelines (e.g. United Kingdom). UCBs arise if a project / initiative contributes to greater urban development in established areas and therefore lowers the need for development in the outer metropolitan areas or greenfield suburbs.

SRL – Cheltenham to Airport's transport and precinct development initiatives are expected to result in an increased number of households living in SRL East and SRL North Precincts and lower number of households living in growth areas. The reduced demand for dwellings in growth areas is expected generate UCBs as the need for further urban development on the outer metropolitan / peri-urban areas and outer suburbs is reduced. This will drive public infrastructure cost savings associated with providing essential infrastructure, as well as improve urban amenity, reduce non-urban land consumption and contribute to environmental and biodiversity benefits.

The movement of households away from dwellings in growth areas in the Program Cases compared to the Base Case was modelled using CityPlan and is driven by a set of assumptions including property market capacity, demand for different types of housing and house price. Details on these assumptions and the drivers for households' incentives to settle in the SRL East and SRL North Precincts instead of urban growth areas are provided in Appendix C1: Demand Modelling Report (CityPlan Volume).

In addition, SRL – Cheltenham to Airport can help 'consolidate' the social fabric (e.g. a more socially cohesive community) and improve life satisfaction of a community. These benefits arise as SRL – Cheltenham to Airport is expected to deliver services to meet the needs of a broader society, such as better transport connectivity for those living in the middle and outer metropolitan areas. By better meeting the needs of society as a whole, SRL – Cheltenham to Airport promotes social inclusion, equality and coherence.

Table 8-1 below provides a description of the different UCBs to be used in the context of SRL – Cheltenham to Airport.

Table 8-1: Description of UCBs

UCB	Description
Public infrastructure cost savings – essential economic infrastructure	Reduction in demand for dwellings in Melbourne's outer metropolitan areas can reduce the need for public sector (state and local government) investment in essential economic infrastructure on the urban fringe. Typically, these relate to reduced need to extend essential trunk infrastructure services such as water, sewerage and electricity.
Improved neighbourhood amenity	Compact urban form can make an area more vibrant, attractive and generally contributes to enhanced amenity. Benefits from improved amenity of an area due to urban consolidation typically flow to three distinct cohorts: • New residents to an area / precinct that has gone through urban consolidation • Existing residents of an area / precinct that has gone through urban consolidation • Existing residents who reside in close proximity to the area / precinct that has gone through urban consolidation. The value of the amenity benefits derived by the first cohort would be factored into the cost of dwellings and, as such, its inclusion in the analysis would be invalid. The second and third cohorts however, derive amenity improvements without them needing to pay for the amenity improvement. In other words, the benefits to these cohorts are an externality and, as such, its inclusion is valid. This benefit is discussed qualitatively due to lack of data to monetise the benefits.
Reduced non-urban land consumption	Each dwelling transferred from the outer metropolitan areas to the established urban area enables land that otherwise would be consumed by urban development to be dedicated to other uses, including agriculture, horticulture or some other usage (e.g. climate regulation and intrinsic value). The value of this reduced non-urban land consumption for urban development can be estimated by adopting the community's willingness-to-pay for protecting non-urban land from urban encroachment. This benefit is discussed qualitatively due to lack of data to monetise the benefits.
Improved transport equality	This benefit accrues from removing transport barriers for people such that their ability to participate fully in the society and community improves. Against the backdrop of rising property prices in major cities across Australia, it is increasingly difficult for lower income households to live affordably in areas that have acceptable transport connectivity, resulting in financial pressures to relocate to outer fringe areas (where property prices are lower). Migrant families, newly established families (first home buyers), sole-parent families and key workers are over-represented in these outer fringe suburbs. A lack of appropriate transport connectivity can entrench social exclusion as access to major employment and other services becomes increasingly more difficult, being primarily reliant on private vehicle travel. Improving transport infrastructure and concentrating population, and therefore the need for infrastructure provisions in the middle ring, has the ability to improve social inclusion by strengthening people's ability to participate in social and economic activities.

Source: KPMG analysis based on literature review detailed in Attachment C

8.2 Key findings

A comprehensive literature review was undertaken to determine the most appropriate approach to quantifying the UCBs in Victoria and for the purpose of this economic appraisal. The findings of this review along with a detailed discussion on the UCBs' quantification methodology is provided in Attachment C.

Among the UCBs outlined in Section 8.1, the below UCB benefit items have been quantified. The rest of the UCBs have not been quantified due to the lack of robust data and/or are not applicable to SRL – Cheltenham to Airport. The quantifiable UCBs are discussed in the sections below.

- Public infrastructure cost savings – essential economic infrastructure
- Reduced non-urban land consumption
- Improved transport equality

Table 8-2 provides a summary of the UCBs result. At a 4 per cent discount rate, UCBs account for approximately 7 per cent of the total benefit for Program Case Option A and approximately 8 per cent for Program Case Option B. Public infrastructure cost savings account for the highest proportion of UCBs (over 65 per cent).

The results at a 4 per cent discount rate are summarised below in Table 8.2.

Table 8-2: Urban Consolidation Benefits of Program Case Option A and Option B discounted at 4 per cent

	Program Case Option A	Program Case Option B
Urban Consolidation Benefits		
Essential infrastructure cost savings	$2.0bn to $3.3bn	$2.3bn to $3.7bn
Reduced non-urban land consumption	$0.01bn to $0.02bn	$0.01bn to $0.02bn
Improved social inclusion and equality	$1.0bn to $1.6bn	$1.2bn to $1.9bn
Total Urban Consolidation Benefits	**$3.2bn to $4.6bn**	**$3.7bn to $5.3bn**

Notes:

1. *The probabilistic analysis uses 95% confidence intervals.*
2. *5,000 iterations were used for the analysis and ensure convergence.*
3. *The probabilistic ranges are not additive because the underlying distribution of inputs vary for each line item.*

Source: KPMG (2021) based on VITM and CityPlan modelling results, and relevant guidelines and agreed assumptions

8.2.1 Public infrastructure cost savings – essential economic infrastructure

The land use change facilitated by SRL – Cheltenham to Airport is the source of the public infrastructure cost saving benefit. SRL – Cheltenham to Airport improves accessibility in SRL East and SRL North Precincts and stimulates residential development in established areas. As a result, SRL – Cheltenham to Airport reduces the demand for urban development in greenfield areas.

The CityPlan model captures this urban consolidation impact of SRL – Cheltenham to Airport. The modelling shows that by 2056 SRL – Cheltenham to Airport will have reduced urban expansion by 16,000 households under Program Case Option A and by 17,000 households under Program Case Option B.

Table 8-3: Reduction in demand for dwellings in growth areas between Program Case and Base Case in 2056

Local Government Area	Dwellings – Program Case Option A	Dwellings – Program Case Option B
Cardinia	-1,000	-1,000
Casey	-3,000	-3,000
Hume	-2,000	-2,000
Melton	-3,000	-3,500
Mitchell	-1,000	-1,000
Whittlesea	-2,000	-2,500
Wyndham	-4,000	-4,000
Total	**-16,000**	**-17,000**

Source: KPMG (2021) based on VITM and CityPlan modelling

The reduction in the number of dwellings in greenfield areas serves as the base for calculating the urban consolidation benefit.

Using the cost differential for provision of essential infrastructure in greenfield locations vs established suburbs as estimated by Infrastructure Victoria, the societal wide cost savings from reduced urban expansion was estimated. The analysis shows that reduced urban expansion will contribute to more efficient provision of essential infrastructure, resulting in benefits in the order of $2.0 billion to $3.3 billion for Program Case Option A and $2.3 billion to $3.7 billion for Program Case Option B in present value terms at a 4 per cent discount rate.

8.2.2 Reduced non-urban land consumption

SRL – Cheltenham to Airport improves transport accessibility within existing transport corridors and encourages the densification of land use in SRL East and SRL North Precincts. Thus, it has the potential to curb the urban expansion in outer fringe areas (and facilitate urban development within established urban areas. This reduces demand for non-urban land for urban development purposes, enabling existing non-urban land to be available for other uses, including agriculture, horticulture or environmental, bushland, or some other non-urban usage. The value of this reduced non-urban land consumption for urban development can be estimated by adopting the community's willingness-to-pay for protecting peri-urban land from urban encroachment.

Benefits generated by reduced non-urban land consumption are estimated to be in the order of $0.01 billion to $0.02 billion Program Case Option A and $0.01 billion to $0.02 billion Program Case Option B in present value terms at a 4 per cent discount rate.

8.2.3 Improved transport equality

A lack of connectivity to public transport infrastructure can act to entrench social exclusion as access to major employment and other services becomes increasingly more difficult. This issue has been a significant focus over the last two decades both in Australia and abroad with the promotion of social connectivity and inclusion as a dedicated, long-term goal for the Australian Government and society

(Australian Government, 2010[31]), and the focus of a great deal of policy attention in the UK on reducing social exclusion (UK Social Exclusion Unit 2003[32]).

SRL – Cheltenham to Airport is expected to remove transport barriers for people such that their ability to participate fully in society and the community improves. SRL – Cheltenham to Airport will improve transport connectivity and reduce travel time and make access to major employment and other services easier, especially for people living in the middle and outer ring.

Figure 8-1 below provides the distribution of transport inequality (persons) across Greater Melbourne in 2016, based on the analysis of Census 2016 and Victorian Integrated Survey of Travel and Activity (**VISTA**) data. Figure 8-2 provides the distribution of the improved transport equality benefit (daily trips) in 2056 for Program Case Option A. Figure 8-3 provides the distribution of the improved transport equality benefit (daily trips) in 2056 for Program Case Option B, which exhibits a similar pattern to Option A.

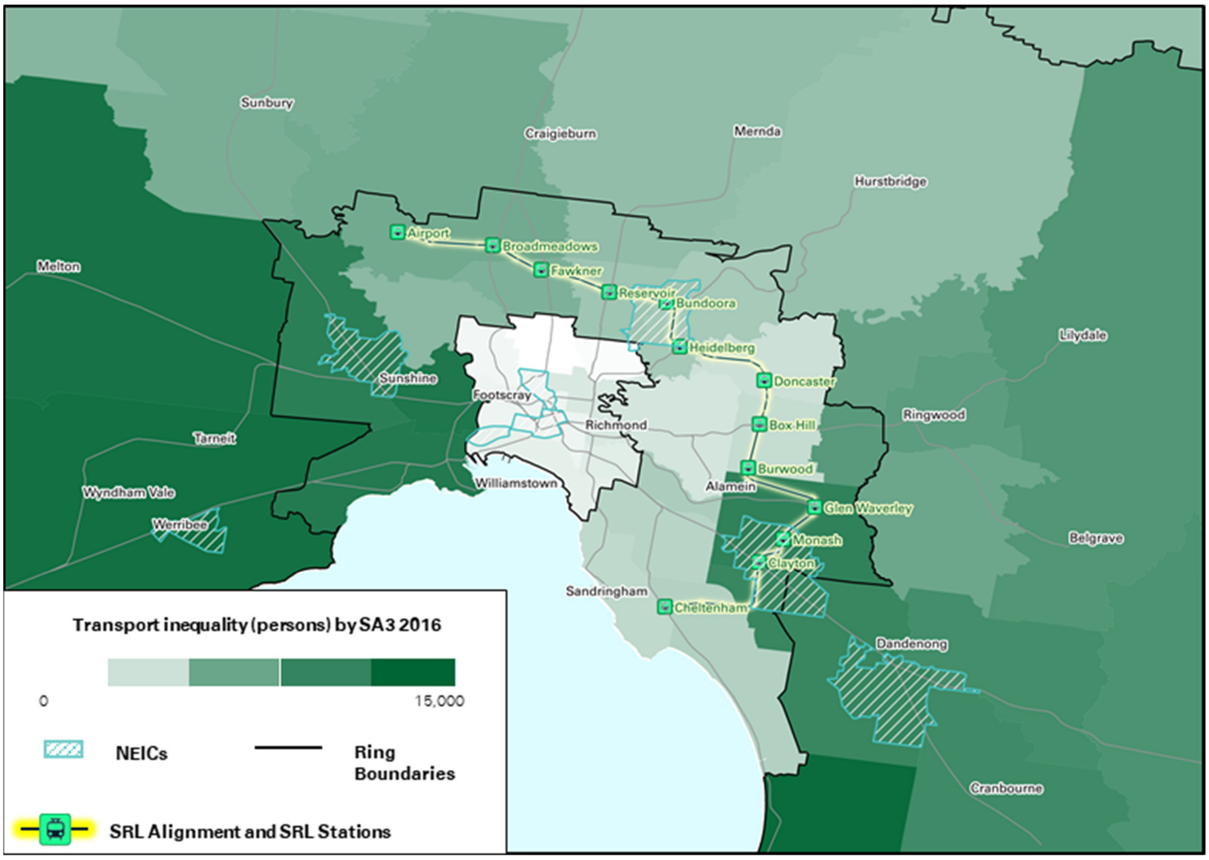
The SRL East Precincts of Clayton, Monash and Glen Waverley have been identified as areas with comparatively higher number of residents at risk of transport inequality. The improvement in accessibility (reflected in increased public transport trips) due to SRL – Cheltenham to Airport in these areas is expected to contribute to reducing transport inequality.

The additional transport equality benefit generated is estimated to be in the order of $1.0 billion to $1.6 billion for Program Case Option A and $1.2 billion to $1.9 billion for Program Case Option B in present value terms at a 4 per cent discount rate.

31 (Australian Federal Government, 2010). Social Inclusion.

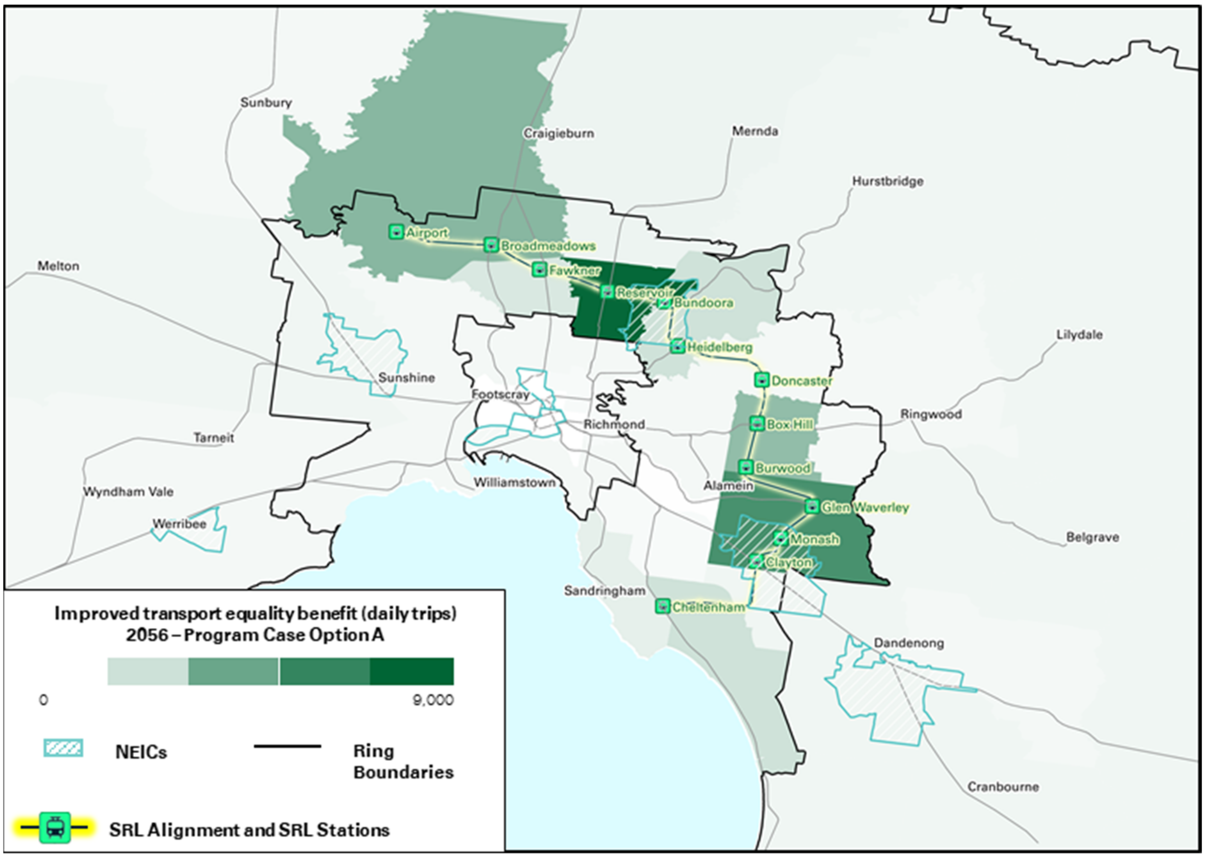
32 (UK Social Exclusion Unit , 2003). Making the Connections: Final Report on Transport and Social Exclusion.

Figure 8-1: Transport inequality (persons) by SA3 2016



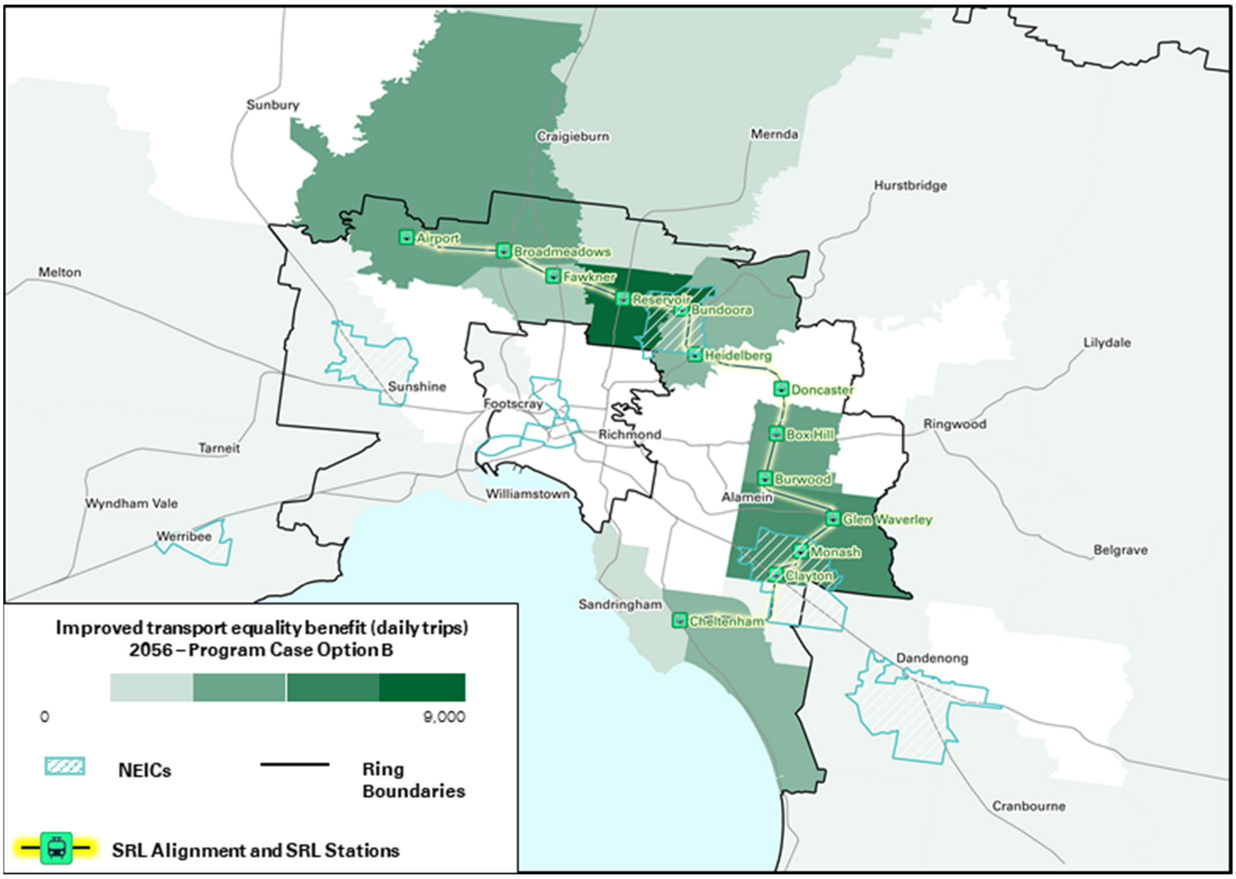
Source: KPMG (2021) based on VITM and CityPlan modelling results and Hensher (2010) parameters

Figure 8-2: Improved transport equality benefit (daily public transport trips) 2056 by SA3 – Program Case Option A



Source: KPMG (2021) based on VITM and CityPlan modelling results and Hensher (2010) parameters

Figure 8-3: Improved transport equality benefit (daily public transport trips) 2056 by SA3 – Program Case Option B



Source: KPMG (2021) based on VITM and CityPlan modelling results and Hensher (2010) parameters

9. Economic analysis considering uncertainty

The economic analysis undertaken for major transport infrastructure business cases is typically reflected through the reporting of a single 'headline' BCR. However, due to the range of intrinsic uncertainties associated with cost planning, transport modelling and a range of other assumptions (including long-term projections of land use and the future transport network configuration), the presentation of a single economic result fails to adequately capture the possibility of a range of scenarios and economic outcomes.

The impact of changes in key inputs and assumptions was tested through an uncertainty analysis, comprising both Monte Carlo simulation and scenario testing.

9.1 Probabilistic analysis

Monte Carlo simulation was undertaken to analyse the impact of key uncertainties on the NPV and BCR. The need for this approach is driven by uncertainties associated with key inputs and assumptions. To account for this, an input distribution has been considered for the following economic parameters:

- **Air passenger value of time**: The underpinning economic metrics associated with air passenger value of time differ from other transport users. Research indicates that the standard value of travel time (**SVOT**) may under-estimate the air passenger value of travel time (**AVOT**), such that air passengers are less sensitive to the transport fare associated with travelling to and from the airport.[33]
- **Public transport expansion factors**: The outcome of the economic appraisal is critically dependent on the expansion factors considered within the appraisal. The central public transport expansion factors considered are derived based on 2018 Myki data provided by DoT.
  - **Upside potential**: More passengers use Melbourne Airport during school holiday weekday peak periods and off-peak demand is more concentrated on weekends and public holidays for air passengers, relative to standard public transport travel.[34] Given that VITM models the standard working weekday, air passengers require higher expansion factors and therefore accrue more economic benefits relative to standard public transport travel.
  - **Downside potential**: There is an increasing shift to remote working, particularly in professional industries, which has been catalysed by the impacts of COVID-19. The potential outcome of this is that the current travel patterns and volumes coded in VITM for a standard working weekday, which is calibrated against observed data, does not reflect travel patterns and

[33] KPMG, 2019. *Value of time for airport travel.*
[34] KPMG, 2019. Analysis based on traffic arrival and departure data collected at the terminals between July 2016 and June 2017.

volumes moving forward. Given the potential for larger proportions of the population choosing to work remotely, VITM may currently overstate benefits. A lower expansion factor can be used as a proxy to test for this in the interim, prior to VITM being calibrated against future travel data.

- **Willingness to pay for option and non-use:** The central value used for willingness to pay per household (**WTP per household**) for option and non-use is derived by taking the WTP per household for a train service (in this case SRL – Cheltenham to Airport) less the WTP per household for a bus service.

Costs are also reported in ranges for this appraisal, taking into consideration the risk-adjusted cost distribution provided by the cost advisor. In particular, for capital costs, this captures the upside risk and thus provides a more robust estimate for NPV and BCR.

The key uncertainties and their corresponding distribution parameters used for the Monte Carlo simulation are provided in Table 9-1.

Table 9-1: Uncertainties and assumptions used in the Monte Carlo simulation

Uncertainties	Distribution parameters[4]	Distribution	Truncation points (if applicable)
Peak to annual factor (PT)	μ = 241 P5 = 217 (0.9μ) – pre-truncation P95 = 265 (1.1μ) – pre-truncation	Normal	± 25 per cent of μ
Non-peak to annual factor (PT)	μ = 355 P5 = 319 (0.9μ) – pre-truncation P95 = 389 (1.1μ) – pre-truncation	Normal	± 25 per cent of μ
Non-business VoT[1,2]	μ = \$17.70 P5 = \$15.93 (0.9μ) P95 = \$19.47 (1.1μ)	Normal	N/A
Business VoT[1,2]	μ = \$57.42 P5 = \$51.68 (0.9μ) P95 = \$63.16 (1.1μ)	Normal	N/A
Non-business VoT – airpax[1,2]	P2.5 = \$17.70 (SVOT) P95 = \$31.38 (AVOT)	Log-normal	N/A
Business VoT – airpax[1,2]	P2.5 = \$57.42 (SVOT) P95 = \$73.72 (AVOT)	Log-normal	N/A
WEBs	Core Option A: μ = \$9.7B P5 = \$7.8B (0.8μ) P95 = \$11.6B (1.2μ) Core Option B: μ = \$11.2B P5 = \$9.0B (0.8μ) P95 = \$13.4B (1.2μ)	Normal	N/A

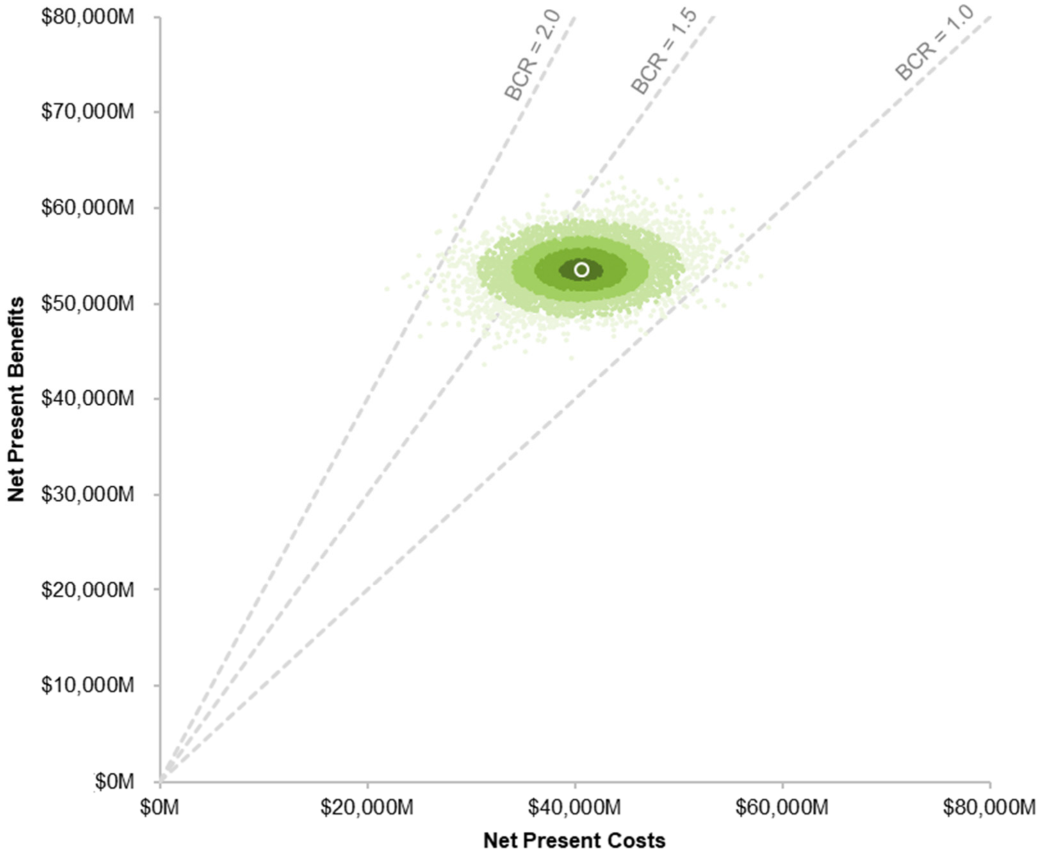
UCBs	Core Option A: μ = \$4.0B P5 = \$3.2B (0.8μ) P95 = \$4.8B (1.2μ) Core Option B: μ = \$4.5B P5 = \$3.6B (0.8μ) P95 = \$5.4B (1.2μ)	Normal	N/A
Option and non-use willingness to pay	μ = \$202 P97.5 = \$407 (willingness to pay for option and non-use of train service)	Log--normal	N/A
Capital cost[3]	P10 = 0.9 × P50 P50 = P50 economic cost provided by cost advisor P90 = 1.25 × P50	Normal	N/A
Operations, maintenance and renewals cost[3]	P10 = 0.9 × P50 P50 = P50 economic cost provided by cost advisor P90 = 1.25 × P50	Normal	N/A

1. *A correlation coefficient of 0.9 has been considered for non-business and business value of time to reflect the propensity of these variables to move together in direction and magnitude.*
2. *A correlation coefficient of 1.0 has been considered between the airpax and non-airpax VoT for both business and non-business to reflect the propensity of these variables to move together in direction and magnitude.*
3. *A correlation coefficient of 0.9 has been considered for the cost distributions to reflect the propensity of these variables to move together in direction and magnitude.*
4. *The symbol 'μ' denotes the mean / expected value of the distribution. P'X' denotes a percentile and reflects that there is an X per cent chance that the variable being tested will fall below this value.*

An overview of the probabilistic results using a 4 per cent discount rate is presented in Figure 9-1 and Figure 9-2 below. At a 95 per cent confidence level, Program Case Option A has a BCR of 1.1 to 1.7 while Program Case Option B has a BCR of 1.0 to 1.7.

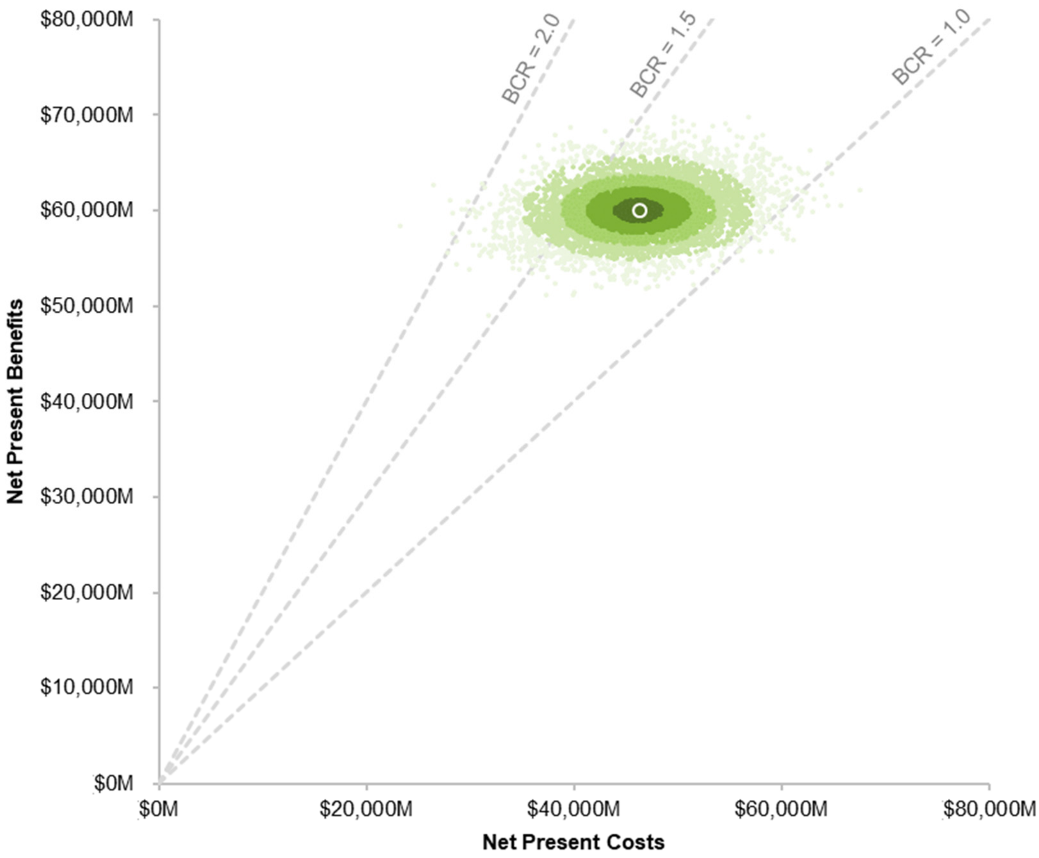
This indicates that SRL – Cheltenham to Airport is economically viable under both Program Case Option A and Program Case Option B under a discount rate of 4 per cent.

Figure 9-1: Monte Carlo simulation results – Program Case Option A



Source: KPMG analysis

Figure 9-2: Monte Carlo simulation results – Program Case Option B



Source: KPMG analysis

9.2 Uncertainty regarding COVID-19

The economic appraisal for SRL – Cheltenham to Airport was undertaken during 2020. During this time, the outbreak of COVID-19 and the necessary measures implemented to slow its spread have led to unprecedented economic challenges. At the time of writing, these measures included:

- Restrictions on international travel for Australian citizens
- All inbound travellers, except those from New Zealand, subject to mandatory 14-day quarantine
- COVIDSafe Summer restrictions in Victoria which include people caps and / or density quotient restrictions on social gatherings, religious gatherings, hospitality, community facilities and recreation, as well as ongoing limitations to on-site and office working.

Despite the loosening of restrictions in Victoria, the length and severity of the economic contraction, and the subsequent pace and shape of the recovery, remain uncertain. The observed impacts of COVID-19 on population growth and the economy, and the potential implications for SRL – Cheltenham to Airport are discussed further below.

9.2.1 Population impact

Migration is a key driver of population growth in Australia, and is expected to decline significantly as a result of the travel restrictions and border closures induced by COVID-19.

Ongoing constraints to work, study and visitor conditions will have a considerable impact on migration to Australia. fall to the lowest rate in more than a century, from 232,000 in 2018-19 to 154,000 in 2019-20 and -72,000 in 2020-21 before gradually increasing to approximately 201,000 in 2023-24.[35] By 2021, Victoria's population is expected to be approximately 140,000 lower than pre-COVID forecasts.[36]

The weaker economic outlook is also expected to contribute to a decline in the fertility rate. The combined impact of lower fertility rate and migration level is anticipated to slow the rate of population growth to 1.2 per cent for 2019-20 (compared to 1.5 per cent in 2018-19[37]), and then further to 0.2 per cent in 2020-21 – the lowest annual rate of growth since 1916-17.[38]

9.2.2 Economic impact

The measures introduced by the government to contain the spread of COVID-19 through the community has had a considerable impact on the livelihoods of all Australians. The most visible impacts have been the effective shutdown of non-essential retail trade, the hospitality industry and arts and recreational venues which has led to a large employment downturn, and contributed to a substantial drop in economic activity.

Historically, immigration has been a strong driver of recovery following economic shocks, with immigrants accounting for over 80 per cent of employment growth between July 2011 and July 2016 post the Global Financial Crisis (**GFC**).[39] However as highlighted above, the nature of the current crisis is likely to result in an extended period of subdued migration, which will have considerable impacts on consumer spending and the housing sector, as well as the supply of skilled labour.

While the longer-term implications of the COVID-19 crisis have yet to be fully realised, current data suggests that the unemployment rate in Australia has risen to 7.0 per cent in October, a 1.7 per cent increase from the same time last year.[40] This is expected to peak at 8 per cent in the December quarter of 2020.[41] There is also potential that the downturn will have an enduring impact on the labour market and economy as people who have lost their jobs may leave the labour force entirely.

The timing and speed of economic recovery will depend on a number of factors: potential outbreaks and associated lockdown measures, the effectiveness of public health responses to contain the virus and the fiscal response of both state governments and the Australian Government. In part, the stimulus packages and targeted support from both the Australian Government and respective state governments have helped to bolster the economy.

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35 Commonwealth of Australia (2020). *Budget 2020-21: Budget Strategy and Outlook, Budget Paper 1 – October 2020.*

36 Department of Transport (2020). *COVID-19 related scenario and sensitivity testing for projects – October 2020*

37 ABS (2019). *Australian Demographic Statistics, Jun 2019*. Cat. No 3101.0

38 Commonwealth of Australia (2020). *Budget 2020-21: Budget Strategy and Outlook, Budget Paper 1 – October 2020*

39 McDonald, P. International migration and employment growth in Australia, 2011–2016. (2017). Australian Population Studies, 1(1), 3-12.

40 Australian Bureau of Statistics (2020). *Labour Force, Australia, October 2020*

41 Commonwealth of Australia (2020). *Budget 2020-21: Budget Strategy and Outlook, Budget Paper 1 – October 2020.*

The second wave outbreak in Victoria has demonstrated the way in which the ongoing health threat can set back the pathway to recovery. It is estimated that this outbreak, and the concomitant reintroduction of restrictions, will have lowered national GDP growth by around 2 per cent in the September quarter of 2020.[42] Assuming Victoria's activity restrictions are progressively lifted and broadly converge with the other states towards the end of the year, real GDP is forecast to fall by 3.75 per cent in calendar year 2020, and grow by 4.25 per cent in calendar year 2021.[43]

9.2.3 Possible changes to mobility patterns

There is also uncertainty around how COVID-19 will impact mobility patterns over the longer term. As people shift to working from home or remote schooling where possible during the lockdown period, the share of active and private transport, and shorter local trips has increased.

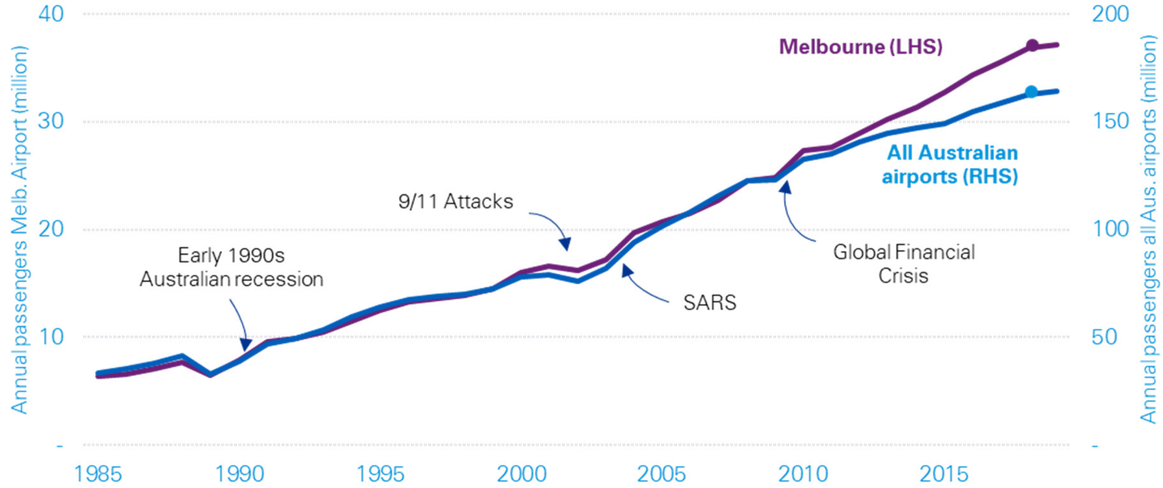
How, and if, this period fundamentally affects the amount and way people travel and conduct business will only be made apparent in the years to come. It is possible that COVID-19 may lead to a changing of mindsets around remote working and grow the role technology can play in how we work. On the other hand, concerns around supply chain resiliency and minimising operational disruptions may catalyse a shift towards logistics networks with a larger local footprint.

9.2.4 Airport patronage impact

The nature and extent of longer-term implications that the current health crisis will have on the aviation industry remains unknown. Historically, air passenger traffic has recovered relatively quickly from short-term upheavals, with typical returns to pre-shock trend levels occurring within four years.[44] Global patterns indicating the resilience of the aviation industry are also reflected in airport traffic data from Melbourne Airport and Australian airport totals, which similarly show that, following recovery from major shocks, air passenger traffic continues to grow more or less in line with long-term trends (refer Figure 9-3).

[42] Ibid.
[43] Ibid.
[44] International Air Transport Association (2015). *Global Air Passenger Markets: Riding Out Periods of Turbulence.*

Figure 9-3: Air passenger traffic at Melbourne and all Australian airports, 1985–2019[45]



Source: Bureau of Infrastructure, Transport and Regional Economics, Airport Traffic Data 1985-86 to 2018-19. (2019)

However, each shock is different, and the sharp decline in aviation activity caused by COVID-19 has been much worse than those seen after the 9/11 attacks and the GFC. Specifically, Melbourne Airport experienced a 98.3 per cent drop in international passenger numbers and a 93.7 per cent drop in domestic passenger numbers in June 2020 compared to the same period a year earlier. Overall, traveller numbers were down 27.2 per cent from 37.4 million in 2018-19 to 27.2 million in 2019-20.[46] This is expected to fall even further in 2020-21, with international travel assumed to remain at low levels until at least mid-2021.[47] Even as restrictions are eased, the weakening of markets globally is likely to soften airport patronage for several years following the pandemic.

Whilst the industry has historically been able to adapt its operations and business model to new challenges and disruptions, the regulatory environment and local market dynamics retain significant power to reduce the industry’s ability to weather shocks. It is also plausible that the crisis may lead people to self-assess their individual risks and decide to curtail travel indefinitely as containment measures are gradually eased.

9.2.5 Implications for SRL – Cheltenham to Airport

The combined impact of this is that land use (employment and population) may be delayed relative to the business as usual projections. Working from home rates may also increase with almost one third of jobs in Victoria able to be done remotely. Airport patronage growth will also be impacted in the short term but based on the historical recovery of air travel to external shocks, it may return to pre-COVID trend within ten years. To test for this uncertainty and better understand the potential implications of COVID-19 on SRL, an additional COVID-19 sensitivity scenario has been considered as discussed in Section 9.3.

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[45] BITRE (2019). *Airport Traffic Data 1985-86 to 2018-19*

[46] Melbourne Airport (2020). *Melbourne Airport passenger performance FY19/20.* Retrieved from: https://www.melbourneairport.com.au/Corporate/News/Melbourne-Airport-passenger-performance-FY19-20

[47] Commonwealth of Australia (2020). *Economic and Fiscal Update – July 2020*

9.3 Scenario tests

The SRL – Cheltenham to Airport economic appraisal horizon spans over five decades. Within this period, it is reasonable to expect changes in the supply of transport infrastructure and people's behaviour towards transport costs and accessibility. These uncertainties, which may materially impact the economic viability of the project, include future network supply changes, changes in travel behaviour, alternative fare structures, and potential variations in project scope.

Given the inherent uncertainties associated with the long-term projections underpinning the SRL – Cheltenham to Airport economic appraisal, it is appropriate to consider the economic outcomes of a range of future scenarios via alternative Base Case and / or Program Case combinations.

These scenarios are based on downside assumptions / parameters to capture any uncertainties that may result in divergence from the 'the most likely' central scenario over the longer term. In order to capture the downside effect, highly conservative parameters and assumptions, have been utilised to identify the lower bound benefits under extremely pessimistic circumstances. The following have been considered as part of the scenario testing.

- *COVID-19 sensitivity* which considers the following revised modelling assumptions[48]:
  - Based on analysis undertaken by DELWP, growth in population and employment is expected to be delayed by two years in early model years, increasing to a delay of four years by 2056. For example, the growth originally forecast for 2020 is expected to be realised by 2022, while 2052 growth levels are expected to be realised by 2056
  - Based on analysis undertaken by DoT and DJPR, 29 per cent of Victorian jobs are suited for remote work and those employed in these jobs are assumed to work from home for two to three days a week
  - Air passenger numbers fall in the short term, with travel returning to 2019 levels by 2023 for domestic and short haul travel, and by 2024 for all travel. By 2031, air travel forecasts are assumed to revert to pre-COVID levels.
- *Airport user preference* – this scenario uses different alternative specific constants (**ASC**) in the VITM airport module to test different user response assumptions to public transport to the airport.[49] This test provides a 10 minute preference to rail as a mode choice for air passengers.
- *Airport user rail fares* – applies an alternative fare structure of $14.42 + Myki for those travelling to the Melbourne Airport upon the completion of SRL – Cheltenham to Airport.
- *High AV / EV use* - which tests potential consequences or includes potential scenarios of higher prevalence of autonomous vehicles (**AVs**) and Electric Vehicles (**EVs**):
  - High technology and automation, high private use scenario – assumes 35 per cent conventionally driven vehicles (**CDVs**) which are EVs and 65 per cent privately owned AVs / EVs

[48] Department of Transport (2020). *COVID-19 impacts on demand forecasts – sensitivity and scenario testing project analysis.* Note that air passenger assumptions are based on IATA and Qantas announcements and have been agreed with RPV / DoT.
[49] The ASCs in the Airport Module account for the unobserved attributes not captured by the time and cost incurred by a user which impact air passenger mode choice. The use of alternative ASCs aims to test the variability of the unobserved user attributes on modelled results (e.g. sensitivity of mode share).

  - In a high technology and automation, high rideshare scenario – assumes 21 per cent CDVs / EVs, 39 per cent private AVs / EVs and 40 per cent shared, on-demand AVs / EVs.

- *Transport network pricing* – this scenario tests the potential impact of a revised pricing system for public and private transport, including flagfall and a distance-based public transport fare system, road distance pricing, and an inner Melbourne road cordon charge. The network pricing is based on time of today, mode of transport and location. Specifically, it tests an alternative pricing strategy for both road and public transport travel, as follows:
  - Road pricing: $0.165/km
  - Public transport (peak): $1.70 flag fall and $0.09/km
  - Public transport (off-peak): $1.50 flag fall and $0.07/km.

In addition to above, simple scenario tests were also undertaken as follows:

- +/- 20 per cent increase in public transport benefits
- +/- 20 per cent increase in road user benefits
- Alternate extrapolation method that flatline all benefits after the last model year 2056 (i.e. SRL – Cheltenham to Airport does not deliver any additional benefits beyond 2056, a highly conservative assumption).

Refer to the Demand Modelling Report (Appendix C.1) for further details on the modelled scenarios and the associated demand findings. Economic results for the scenario tests are presented in Section 10.

10. Economic evaluation

10.1 Performance indicators

This section provides a summary of the key economic performance measures that have been reported for the economic evaluation. These measures have been based on the results of CBA, which compares the costs and benefits of the Program Cases against the Base Case.

The metrics against which SRL – Cheltenham to Airport has been evaluated are:

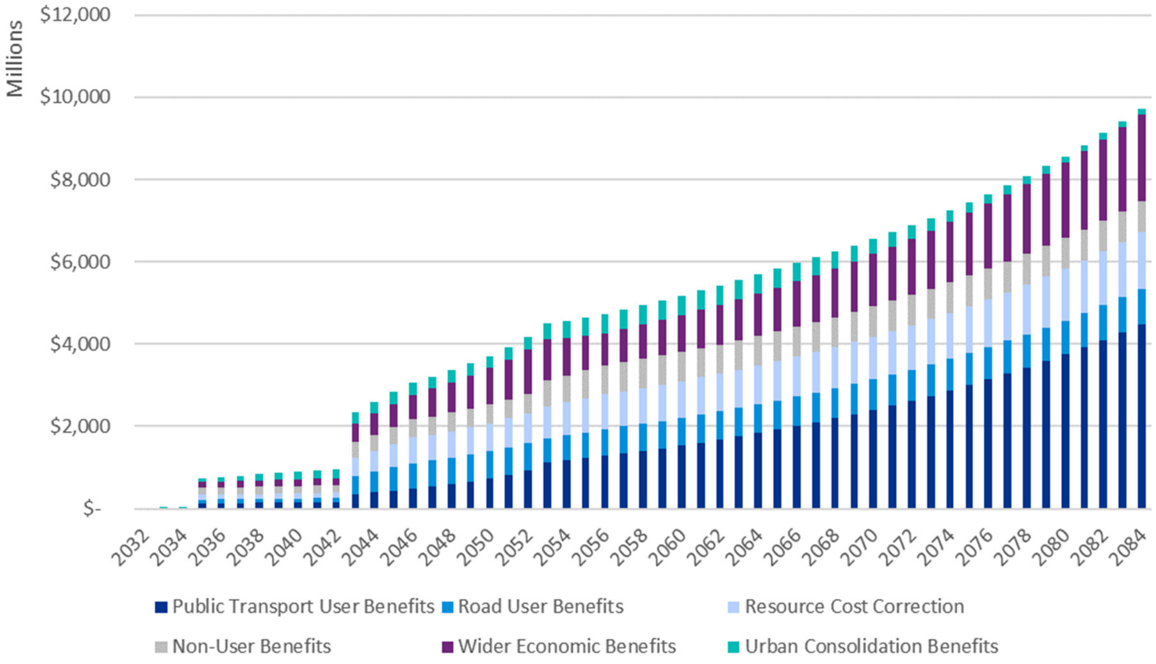
- **NPV** – the NPV gives an indication of the magnitude of net benefit to society, calculated by taking the difference between the present value of the total incremental benefits and the present value of the total incremental costs. Positive NPVs indicate that an investment is desirable to society as a whole.
- **BCR** – the BCR is a measure of value for money for government expenditure, calculated by dividing the present value of total incremental benefits by the present value of the investment and recurrent operating and maintenance costs. It is of principal value when Government is considering spending scarce funds. BCRs greater than one indicates that an investment is economically efficient. Reflecting the programmatic approach to appraisal, the BCR has been reported as a range.

10.2 Monetised costs and benefits

10.2.1 Benefit profile overview

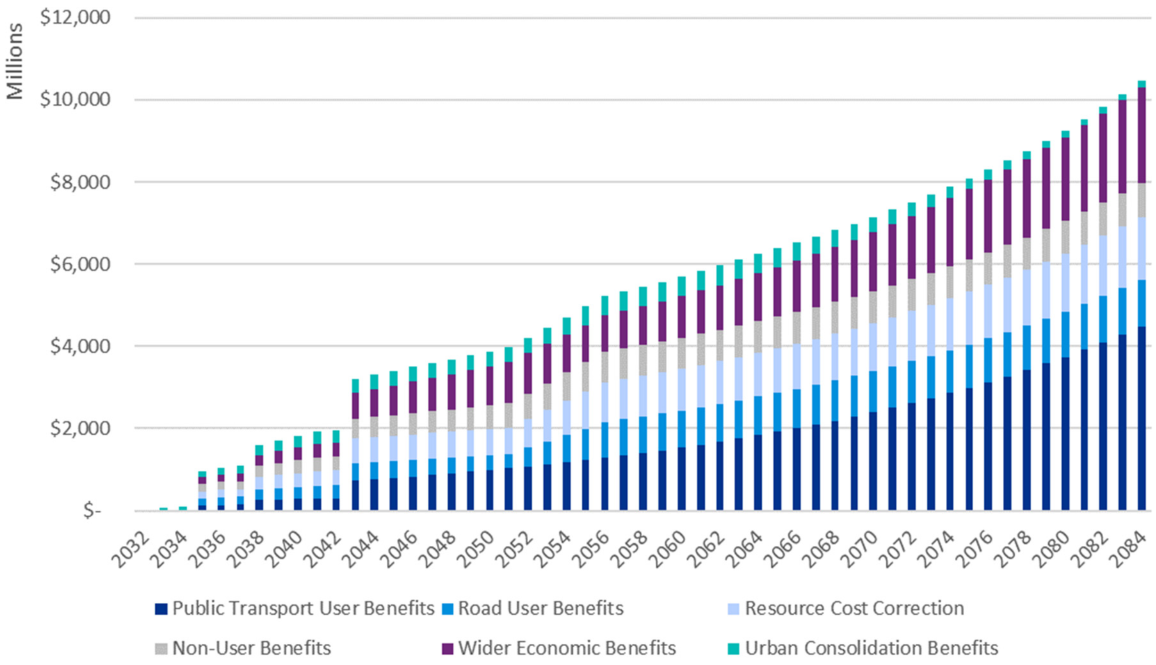
The time profiles by key benefit categories are provided in Figure 10-1 and Figure 10-2 for Program Case Option A and Program Case Option B respectively.

Figure 10-1: Program Case Option A benefit time profile (discounted at 4 per cent)



Source: KPMG analysis

Figure 10-2: Program Case Option B benefit time profile (discounted at 4 per cent)



Source: KPMG analysis

10.2.2 Key findings

Table 10.1 summarises the economic evaluation results for SRL – Cheltenham to Airport discounted at 4 per cent.

Under Program Case Option A, SRL – Cheltenham to Airport has a BCR of 1.1 to 1.7. Under Program Case Option B, SRL – Cheltenham to Airport has a BCR of 1.0 to 1.7.

This indicates SRL – Cheltenham to Airport is economically viable under both Program Case Option A and Program Case Option B under a discount rate of 4 per cent.

Table 10-1: Economic result of SRL – Cheltenham to Airport under Program Case Option A and B discounted at 4 per cent

	Program Case Option A	Program Case Option B
Conventional Benefits		
Public transport user benefits	$14.9bn to $19.8bn	$16.6bn to $21.7bn
Road user benefits	$10.0bn to $12.3bn	$11.7bn to $14.3bn
Externalities (non-user benefits)	$3.5bn to $3.7bn	$4.2bn to $4.6bn
Option and non-use value	$1.1bn to $5.4bn	$1.2bn to $5.7bn
Residual value of assets	$3.8bn to $6.4bn	$3.6bn to $6.0bn
Total conventional benefit	**$33.6bn to $40.9bn**	**$37.4bn to $45.2bn**
Wider Economic Benefits		
WEB1 - Agglomeration economies	$6.0bn to $9.7bn	$6.3bn to $10.3bn
WEB2 - Labour market deepening	$1.1bn to $1.8bn	$1.8bn to $3.0bn
WEB3 - Imperfect markets	$0.4bn to $0.5bn	$0.5bn to $0.6bn
Total Wider Economic Benefits	**$7.5bn to $11.9bn**	**$8.8bn to $13.9bn**
Urban Consolidation Benefits		
Essential infrastructure cost savings	$2.0bn to $3.3bn	$2.3bn to $3.7bn
Reduced non-urban land consumption	$0.01bn to $0.02bn	$0.01bn to $0.02bn
Improved social inclusion and equality	$1.0bn to $1.6bn	$1.2bn to $1.9bn
Total Urban Consolidation Benefits	**$3.2bn to $4.6bn**	**$3.7bn to $5.3bn**
Costs		
Capital costs	$24.1bn to $40.2bn	$27.1bn to $45.1bn
Recurrent costs	$6.3bn to $10.6bn	$7.6bn to $12.6bn
Total Cost	**$30.7bn to $50.5bn**	**$35.1bn to $57.6bn**
Total Benefit	**$48.5bn to $58.7bn**	**$54.7bn to $65.8bn**
Net Present Value (NPV)	**$3.0bn to $22.9bn**	**$2.4bn to $25.2bn**
BCR	**1.1 to 1.7**	**1.0 to 1.7**

Source: KPMG (2021) based on VITM and CityPlan modelling results, relevant guidelines and agreed assumptions.

Public transport user benefits accrue from changes to the public transport service levels, resulting in improvements to capacity and convenience. This improves the public transport customers' overall experience as they benefit from reduced door-to-door journey times along with the benefits derived from more reliable services, and network resilience. Public transport benefits make up the largest component and account for between $14.9 billion to $19.8 billion of the benefits for Program Case Option A and between $16.6 billion to $21.7 billion of the benefits for Program Case Option B.

Road user benefits principally accrue due to some road users switching from car in the Base Case to public transport in the Program Case. Consequently, there is less congestion on the road network for remaining road users, including freight vehicles, allowing them to navigate the network more efficiently. The additional road user benefits generated are estimated to be between $10.0 billion to $12.3 billion for Program Case Option A and between $11.7 billion to $14.3 billion for Program Case Option B.

Other societal benefits include externalities arising from SRL – Cheltenham to Airport including improved road safety and avoided environmental externality costs (resulting from drivers switching from road to public transport), improved public health (through increased walking or cycling to/from public transport). The new public transport services will also generate option and non-use benefits for households within close proximity to train stations. The present value of externalities is between $3.5 billion to $3.7 billion for Program Case Option A and between $4.2 billion to $4.6 billion for Program Case Option B. The estimated present value of option and non-use benefits is between $1.1 billion to $5.4 billion for Program Case Option A and between $1.2 billion to $5.7 billion for Program Case Option B.

Benefits have been assessed over a 50-year evaluation period from SRL opening. However, the infrastructure asset will continue to yield benefits for its remaining economic life beyond the evaluation period. To provide consideration for these benefits, a residual value has been estimated to capture the benefits of the infrastructure asset's remaining useful economic life beyond the evaluation period. The present value of the residual asset value is between $3.8 billion to $6.4 billion for Program Case Option A and between $3.6 billion to $6.0 billion for Program Case Option B.

SRL – Cheltenham to Airport will deliver transport network improvements that will facilitate changes in land use and urban development. Improving the accessibility and connectivity of key precincts outside of Melbourne's CBD will allow people to live closer to where they work, as employment opportunities are expanded. In addition, more firms will be able to locate in closer proximity to each other generating proximity and cluster effects such as knowledge spillovers and improving the productivity of local industries. This will result in the realisation of a range of WEBs including agglomeration economies and a shift to more productive jobs. The present value of the WEBs is estimated to be between $7.5 billion to $11.9 billion for Program Case Option A and $8.8 billion to $13.9 billion for Program Case Option B.

SRL – Cheltenham to Airport will contribute to greater urban development in established areas resulting in UCBs such as public infrastructure cost savings associated with providing essential infrastructure, and improved transport equality In particular, SRL – Cheltenham to Airport enables greater densification and increased development within middle ring suburbs, which reduces the reliance on greenfield development and reduces urban expansion. This results in avoided additional trunk infrastructure costs that may otherwise be required. The present value of the UCBs is estimated between $3.2 billion to $4.6 billion for Program Case Option A and $3.7 billion to $5.3 billion for Program Case Option B.

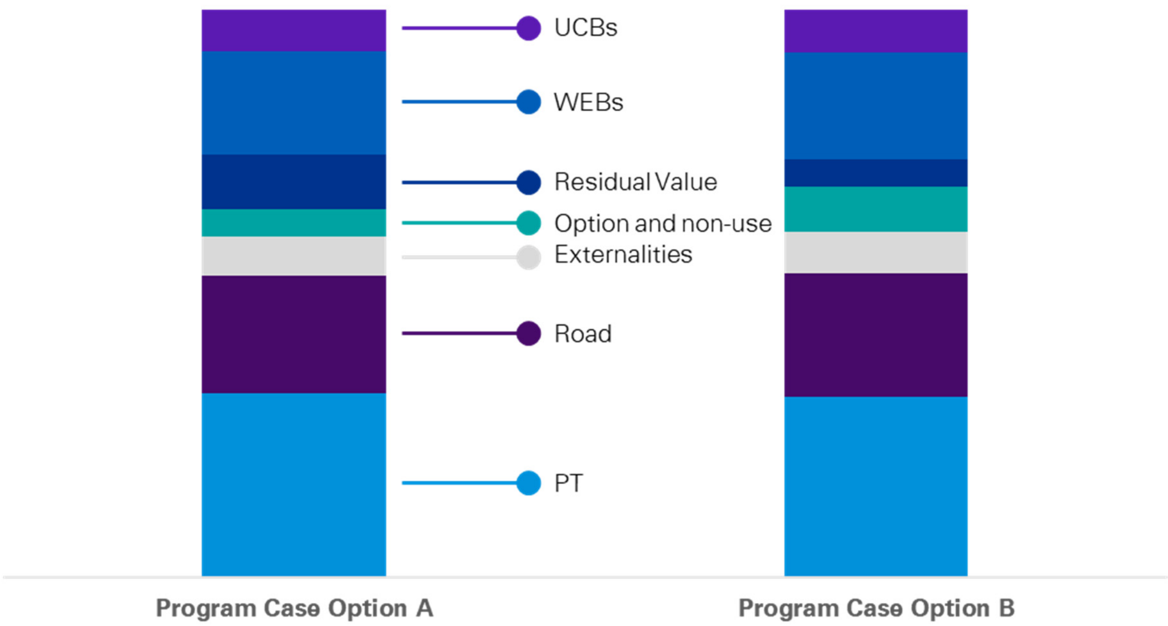
Capital costs include all costs incurred when delivering and commissioning the infrastructure and rolling stock required for the Program Cases. The present value of capital costs is between $24.1 billion to $40.2 billion for Program Case Option A and between $27.1 billion to $45.1 billion for Program Case Option B.

Recurrent costs include all necessary operating, maintenance and renewal costs for running additional train services, supporting infrastructure, and new rail track and systems. It also includes the operating and maintenance costs of the new precinct facilities. The present value of recurrent costs is between $6.3 billion to $10.6 billion for Program Case Option A and between $7.6 billion to $12.6 billion for Program Case Option B.

The NPV for Program Case Option A is estimated to be between $3.0 billion to $22.9 billion and between $2.4 billion to $25.2 billion for Program Case Option B. The BCR is therefore estimated to range between 1.1 to 1.7 and between 1.0 to 1.7 respectively for Program Case Option A and B.

The approximate composition of benefits is shown in Figure 10-3 below.

Figure 10-3: SRL – Cheltenham to Airport benefit composition (discounted at 4 per cent)



Source: KPMG analysis

As previously noted, when assessing the composition of benefits the largest component is public transport user benefits, accounting for approximately 32 per cent and 32 per cent of total benefits for Program Case Option A and Program Case Option B respectively at a 4 per cent discount rate. The primary beneficiary of public transport benefits is in-vehicle time.

Road user benefits arising from decongestion comprise the second largest component of the benefit stream, accounting for approximately 21 per cent and 22 per cent for Program Case Option A and Program Case Option B respectively. The primary beneficiary of road user benefits is travel time.

Other conventional benefit streams, including externalities, option and non-use value, and the residual value of assets account for approximately 21 per cent and 20 per cent of total benefits for Program Case Option A and Program Case Option B respectively. Wider economic benefits make up 18 and 19 per cent and UCBs make up 7 and 8 per cent of total benefits for Program Case Option A and Program Case Option B respectively.

10.3 Scenario & sensitivity tests

Given the outcomes of the economic analysis are reliant on strategic land use impact modelling, strategic transport demand modelling and a range of other assumptions, including transport network in the future, it is important to test the impact of changes in these inputs and assumptions on the economic viability of SRL – Cheltenham to Airport.

To test for this, a number of scenarios were modelled in VITM. Corresponding economic evaluation for the scenarios are summarised in Table 10.2.

Program Case Option A and Program Case Option B are based on dynamic CityPlan and VITM interactions, which require long computational and model run times. For the purpose of scenario and sensitivity testing, Static Sensitivity Option A and Static Sensitivity Option B were modelled, which require less processing time, yet produces comparable results to Program Case Option A and Program Case Option B discussed in in the Demand Modelling Report, Volume B, Section B.6.2.

Given the:

- Similarities in economic performance of Option A and Option B
- Similarities in the land use impact and economic performance between Dynamic and Static land use impact assessment
- Time constraints

the scenario tests were undertaken using Option A as a reference point except for the COVID-19 sensitivity, for which scenario tests were undertaken for both Program Cases.

The scenario and sensitivity tests demonstrate that SRL – Cheltenham to Airport is economically viable under most scenarios tested except for:

- High AV / EV high rideshare scenario for Program Case Option A which has a BCR range of 0.8 to 1.3
- The COVID-19 scenario for Program Case Option B which has a BCR range of 0.8 to 1.4
- Where public transport or road user benefits are lower by 20 per cent or where no growth in benefits post 2056 is expected to be realised.

Table 10-2: Economic results for SRL – Cheltenham to Airport scenario tests

Scenario	Net present value	Benefit cost ratio
Option A		
Core (Program Case Option A[50])	$3.0bn to $22.9bn	1.1 to 1.7
Core (Static Sensitivity Option A)	$4.4bn to $24.1bn	1.1 to 1.8
COVID-19 sensitivity	$0.2bn to $19.8bn	1.0 to 1.6
Airport user preference (ASCs)	$10.1bn to $30.5bn	1.2 to 2.0
Airport user rail fare $14.42 + Myki (reduced from $18 + Myki)	$-0.6bn to $18.9bn	1.0 to 1.6
High AV / EV use – high private vehicle use	$0.1bn to $19.3bn	1.0 to 1.6
High AV / EV use – high ride sharing use	$-8.4bn to $10.7bn	0.8 to 1.3
Transport network pricing scenario	$8.2bn to $28.7bn	1.2 to 1.9
+/-20 per cent public transport benefits[51]	$1.2bn to $28.3bn	0.9 to 2.1
+/-20 per cent road user benefits	$1.8bn to $27.2bn	0.9 to 2.1
Alternate extrapolation method – flatline all benefits from final model year 2056	-$4.3bn to $14.7bn	0.9 to 1.5
Option B		
Core (Program Case Option B[52])	$2.4bn to $25.2bn	1.0 to 1.7
Core (Static Sensitivity Option B)	$0.7bn to $23.7bn	1.0 to 1.7
COVID-19 sensitivity	$-8.7bn to $13.1b	0.8 to 1.4

Source: KPMG analysis

Summary of impacts[53]

- *COVID-19 sensitivity* includes adjustments to population growth projections, the impact of increased rates of working from home and reduced domestic and international air travel. Along with the associated reduced land-use growth in the SRL East and SRL North Precincts determined through the land-use sensitivity test this scenario resulted in a 5 to 10 per cent reduction in daily SRL – Cheltenham to Airport boardings by 2056. Accordingly, it reduces the BCR in the range of 0.1 to 0.2.
- *Airport user preference* – this scenario uses different ASCs in the VITM airport module to test different user response assumptions to public transport to the airport.[54] This test provides a 10 minute preference to rail as a mode choice for air passengers and reflects higher travel time reliability of rail. Melbourne Airport boardings and alightings increased by around 5,000 per day, however the impacts on SRL – Cheltenham to Airport total boardings were negligible. The BCR increased by a range of 0.1 to 0.2.

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[50] Program Case Option A is based on dynamic interaction between CityPlan and VITM.
[51] This sensitivity test assumes a scenario where there is an additional -/+20% per cent of public transport benefit variation on top of the variation tested in the probabilistic analysis (e.g. through value of time and annualisation) in the Uncertainty Analysis.
[52] Program Case Option B is based on dynamic interaction between CityPlan and VITM.
[53] This section compares the relative marginal impact on BCR by comparison to the Static scenario

- *Airport user rail fares* – Applying an alternative fare structure of $14.42 + Myki for those travelling to Melbourne Airport upon the completion of SRL – Cheltenham to Airport (reduced from $18.00 + Myki). This fare structure applied to both MAR and SRL – Cheltenham to Airport results in an increase in rail patronage at Melbourne Airport. However, the impacts on SRL – Cheltenham to Airport rail boardings are negligible. The BCR decreased by between 0.1 to 0.2.
- *High AV / EV use*, which tests potential consequences of higher private vehicle use, higher ride sharing use and higher network pricing scenarios associated with AV / EV. These scenarios also include 20 per cent to 48 per cent increases in road capacity assumed to reflect higher efficiency of autonomous vehicles. SRL – Cheltenham to Airport boardings were reduced by between 5 and 10 per cent in 2056 under these tested scenarios. Accordingly, the BCR decreased by a range of 0.1 to 0.2 under the higher private vehicle use scenario of the high AV / EV sensitivity; and the BCR decreases by a range of 0.3 to 0.5 for the higher shared vehicle use scenario of the high AV / EV sensitivity.
- *Transport network pricing* – this scenario tests potential impacts of a revised pricing system for public and private transport, including a flagfall and distance-based public transport fare system, road distance pricing, and an inner Melbourne road cordon charge. This has a positive impact on SRL – Cheltenham to Airport boardings. Accordingly, the BCR increases by a range of 0.1 to 0.2.
- With an additional +/-20 per cent of public transport benefit and road benefit and alternate extrapolation method (assuming no growth after the last model year) on top of the variation captured in the probabilistic analysis, the analysis suggests that BCRs remain above a lower bound of 0.9.

11. Macroeconomic impact

11.1 Overview

Conventional economic appraisal does not consider the economy-wide impact of an investment on productivity, the labour market and other economic variables, such as employment, GDP and GSP. While these impacts are not intended to contribute to the calculation of a project's NPV or BCR, they provide an alternative perspective on the total economic contribution of SRL – Cheltenham to Airport on the Victorian and national economies.

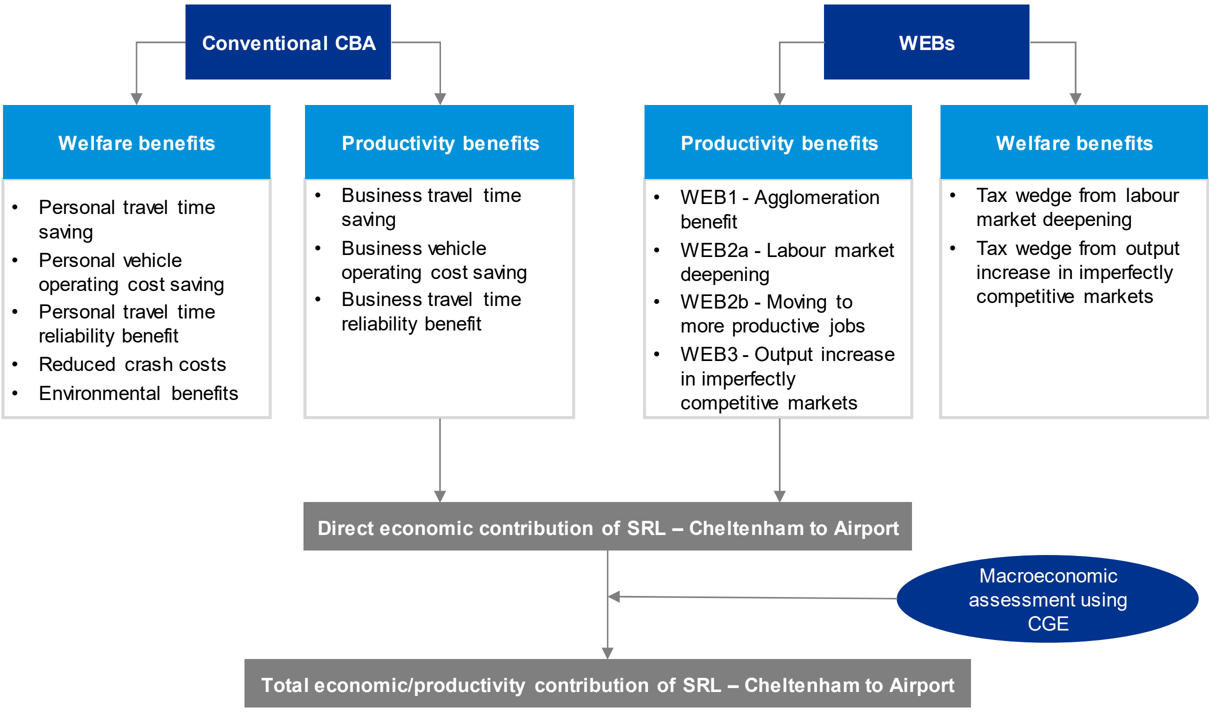
11.1.1 Macroeconomic impact of SRL – Cheltenham to Airport

SRL – Cheltenham to Airport will contribute to significant changes in the labour market by providing greater access to employment and education opportunities across Melbourne. Given the wide-reaching labour market impacts generated by SRL, it is pertinent that total economic contribution is assessed to obtain an understanding of how SRL – Cheltenham to Airport will affect the broader economy. Major rail infrastructure investments, such as CrossRail 2 (discussed in Case Study 2), have adopted this approach and made significant findings associated with the total economic contribution of these projects.

The economy-wide impact of SRL – Cheltenham to Airport has been assessed using KPMG-SD, a regional Computable General Equilibrium (**CGE**) model of the Australian economy. This approach assesses the total impact that SRL – Cheltenham to Airport has on the labour market, including flow-on effects and other key markets. As such, the analysis estimates the economy-wide impacts of the proposed infrastructure investment and the operational phase at state and national levels. CGE modelling simulates the total impact of SRL – Cheltenham to Airport on the economy via 'shocks' in monetary terms (e.g. investment in the transport sector) and therefore, granular details on the changes (e.g. specific precinct initiatives) are less relevant to the analysis.

The framework, inputs and process for assessing the macroeconomic impact of SRL – Cheltenham to Airport is illustrated below. Further detail regarding the methodology and the KPMG-SD model is provided in Attachment D.

Figure 11-1: Framework for assessing the macroeconomic impact of SRL – Cheltenham to Airport



Source: KPMG (2021)

The CGE modelling uses the productivity metrics as inputs when simulating the macroeconomic indicators and includes the following variables across two distinct phases:

- Construction phase – this phase assesses the impact of the construction of SRL – Cheltenham to Airport by applying the planned capital expenditure in rail and precinct infrastructure in Melbourne. These effects are largely transient as the construction activity is temporary
- Operational phase impact – this phase assesses ongoing effects of SRL – Cheltenham to Airport once operations commence. These effects are simulated by applying the planned operational expenditure, changes in demand for rail transport by firms and households, changes in demand for road transport and related road vehicle expenditure, time savings for road and rail users, and WEBs.

The inputs applied in the two phases can be considered the direct effects of SRL – Cheltenham to Airport. These inputs are taken from the SRL – Cheltenham to Airport CBA and WEBs.

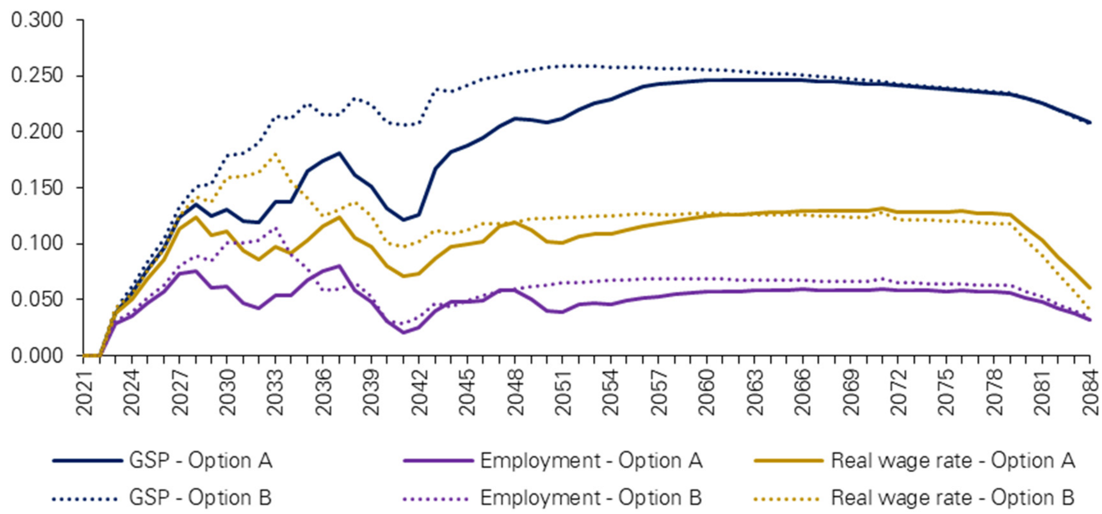
11.2 Key findings

11.2.1 Economic output and employment impacts

Figure 11-2 shows the economy-wide effects of SRL – Cheltenham to Airport on GSP, the average real wage rate and employment for Victoria. The key observations include:

- During the construction phase, the investment stimulus increases labour demand and decreases the unemployment rate, which in turn puts upward pressure on real wage rates.[55] For Option A, the construction phase is from 2022 to 2053. As observed in Figure 11-2 below, there are various peaks and troughs over this period. This is due to the sequencing of the investment schedule.
- Peaks of the investment spending in as a result of the sequenced delivery occur in 2028, 2036 and 2048. It is in these years where kinks are observed in the employment and real wage results over the construction period. The increase in employment causes real GSP to increase with the peak observed in 2036-37, i.e. within the SRL North construction phase.
- In the long-run, the main benefits of SRL – Cheltenham to Airport during the operational phase are in the form of higher GSP and real wage rates with smaller benefits in employment. Note that the imposition of a consumption tax in Victoria from 2080-81 onwards to pay for the Victorian Government's share of the debt associated with the cost of SRL – Cheltenham to Airport causes consumption, and therefore GSP, to fall noticeably. Relative to Option A, the economic effects are higher in Option B due to the frontloading of the CAPEX and, consistent with this, a starting date for operations that is 10 years earlier.

Figure 11-2: Effect of SRL – Cheltenham to Airport on Victorian GSP, real wage rate and employment, % deviation from baseline



Source: KPMG-SD simulation

55 In the KPMG-SD model real wage rates are assumed to respond with a lag to changes in labour market conditions. This relationship is calibrated using coefficients estimated by the NIGEM macroeconomic model.

Under Option A, SRL – Cheltenham to Airport will help support SRL East and SRL North Precincts to grow from 192,000 jobs and 92,500 households currently to 545,000 jobs and 232,000 households by 2056. Relative to a scenario where SRL – Cheltenham to Airport does not exist, it is estimated that Option A will directly lead to 165,000 additional jobs and 47,500 additional households locating in the SRL East and SRL North Precincts in 2056[56].

The construction and delivery of SRL East will directly employ 6,000 to 8,000 people, with SRL North directly employing 5,100 people. Across Victoria, this level of investment will create 3,900 net additional jobs (FTE) at the peak of construction. SRL – Cheltenham to Airport is a long term, productivity enhancing investment. The combined impact of SRL – Cheltenham to Airport's precinct specific land use changes and productivity enhancements will lead to an increase in employment across the state with 4,000 net additional jobs (FTE) created at the peak of operation phase.[57]

This level of economic activity is anticipated to increase Victoria's GSP by $50.8 billion in present value terms using 4 per cent discount rate. Overall, Australia's GDP will be higher by $49.3 billion in present value terms over the evaluation period. The increase in economic output as measured through GSP and GDP will lead to increased Victorian and Australian Government tax receipts. Over the construction and operations phase, State Government's tax receipts will be higher by $3.2 billion in present value terms. The Australian Government's tax receipts will be substantially higher by around $10.9 billion in present value terms. Total tax receipts for the State and Australian Governments will therefore be around $14.1 billion in present value terms.

Table 11-1: Economy-wide impact for Program Case Option A and Option B discounted at 4 per cent

	Region	Construction phase	Operational phase	Total
Program Case Option A				
Output (GDP or GSP in $bn, present value using 4 per cent discount rate)	Victoria	23.6	27.2	50.8
	Australia	22.7	26.6	49.3
Net additional jobs (FTE), in peak year	Victoria	3,900	4,000	n/a
	Australia	4,100	3,400	n/a
Net additional jobs (FTE), average per year	Victoria	2,400	3,400	n/a
	Australia	2,000	3,000	n/a
Program Case Option B				
Output (GDP or GSP in $bn, present value using 4 per cent discount rate)	Victoria	19.4	39.3	58.7
	Australia	18.5	39.5	58.0
Net additional jobs (FTE), in peak year	Victoria	5,200	4,400	n/a
	Australia	5,300	4,800	n/a
Net additional jobs (FTE), average per year	Victoria	2,900	3,700	n/a
	Australia	2,500	3,900	n/a

Source: KPMG-SD simulation

[56] CityPlan modelling
[57] CGE modelling

Under Option B, SRL – Cheltenham to Airport will help support SRL East and SRL North East Precincts to grow to 551,500 jobs and 234,000 households by 2056. Relative to a scenario where SRL – Cheltenham to Airport does not exist, it is estimated that Option B will directly lead to 171,500 additional jobs and 49,500 additional households locating in the SRL East and SRL North Precincts in 2056[58]. Additionally, under Option B, SRL – Cheltenham to Airport will:

- Directly employ 6,000 to 8,000 people as part of SRL East, with SRL North directly employing 5,100 people
- Create 5,200 net additional jobs (FTE) at the peak of construction across Victoria[59]
- Increase employment across Victoria with 4,400 net additional jobs (FTE) at the peak of operation phase[60]
- Increase Victoria's GSP by $58.7 billion in present value terms using a 4 per cent discount rate
- Increase Australia's GDP by $58.0 billion in present value terms using a 4 per cent discount rate
- Increase State Government tax receipts by $3.7 billion in present value terms at a 4 per cent discount rate
- Increase Australian Government tax receipts by $12.9 billion in present value terms at a 4 per cent discount rate

Attachment D provides a complete description of the economy-wide effects of the SRL – Cheltenham to Airport.

11.2.2 Economic Return on Investment

An alternative approach to assessing the economic contribution of the investment is to assess the return on investment as measured through the change in economic output (GDP/ GSP) against the funding cost of the investment. This is especially relevant in the current environment of economic recession and the need to stimulate the economy.

To assess the impact, two separate KPIs have been developed at both the state and national level to assess the value of investing in SRL – Cheltenham to Airport to bolster and catalyse growth in the Victorian and national economies as follows:

- KPI 1: Compares the total cost (capital expenditure and benchmark borrowing cost) against the real increase in GSP / GDP
- KPI 2: Compares the financing cost (benchmark borrowing cost) against the marginal increase in tax receipts (as a result of increases to GSP / GDP).

This return on investment analysis assumes that the investment cost is borrowed and split one-third State Government funding, one-third Australian Government funding and the balance of one-third from value capture. Borrowing cost is based on the 10-year TCV bond rate and 10-year Commonwealth bond rate for the State and Australian Governments respectively. The KPIs have been calculated using total cost (capital expenditure and benchmark borrowing cost) and the real increase in GSP / GDP.

The KPIs are summarised in Table 11-2.

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58 CityPlan modelling
59 CGE modelling
60 CGE modelling

Table 11-2: CGE KPIs

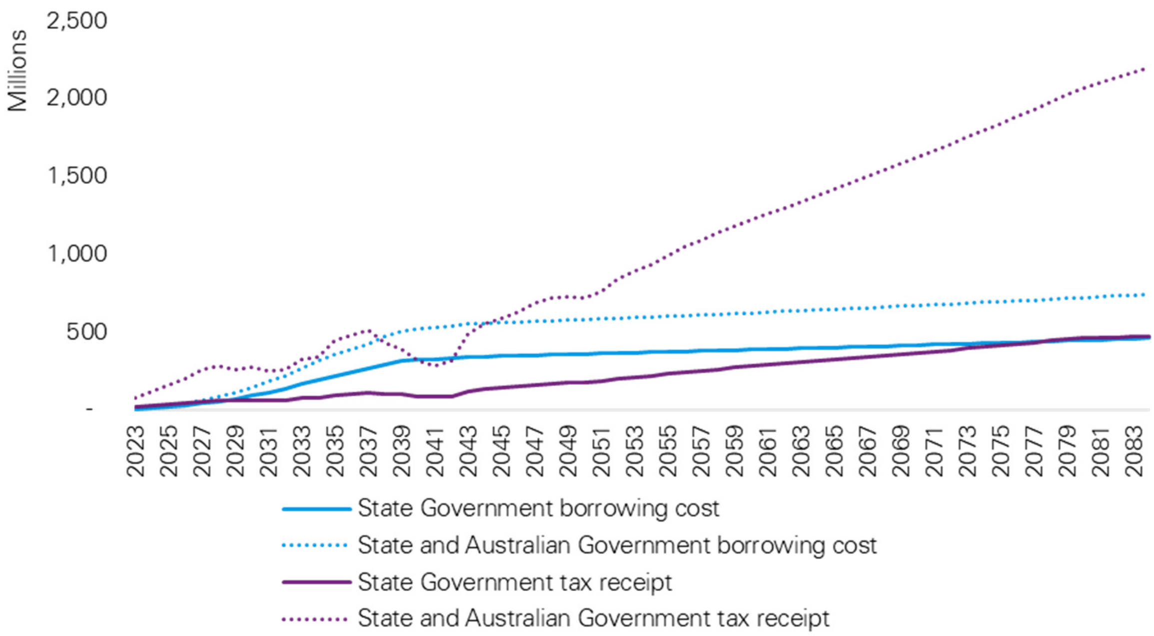
KPI	Program Case Option A	Program Case Option B
KPI 1		
Victoria (Δ GSP / State total cost)	5.0	4.7
National (Δ GDP / State + Australian Governments' total cost)	2.7	2.6
KPI 2		
Victoria (Δ State tax receipts / State interest)	0.7	0.7
National (Δ State + Australian Government tax receipts / State + Australian Government interest)	2.0	2.1

Source: KPMG based on CGE modelling

KPI 1 in Table 11-2 highlights the economic return on investment compared to the funding cost. This analysis shows that the state economy will be better off by five times the SRL – Cheltenham to Airport investment cost (after allowing for borrowing costs) for Program Case Option A and by more than four times for Program Case Option B. Similarly, the national economy will be better off by more than two times the SRL – Cheltenham to Airport investment cost for both Program Case Option A and Program Case Option B.

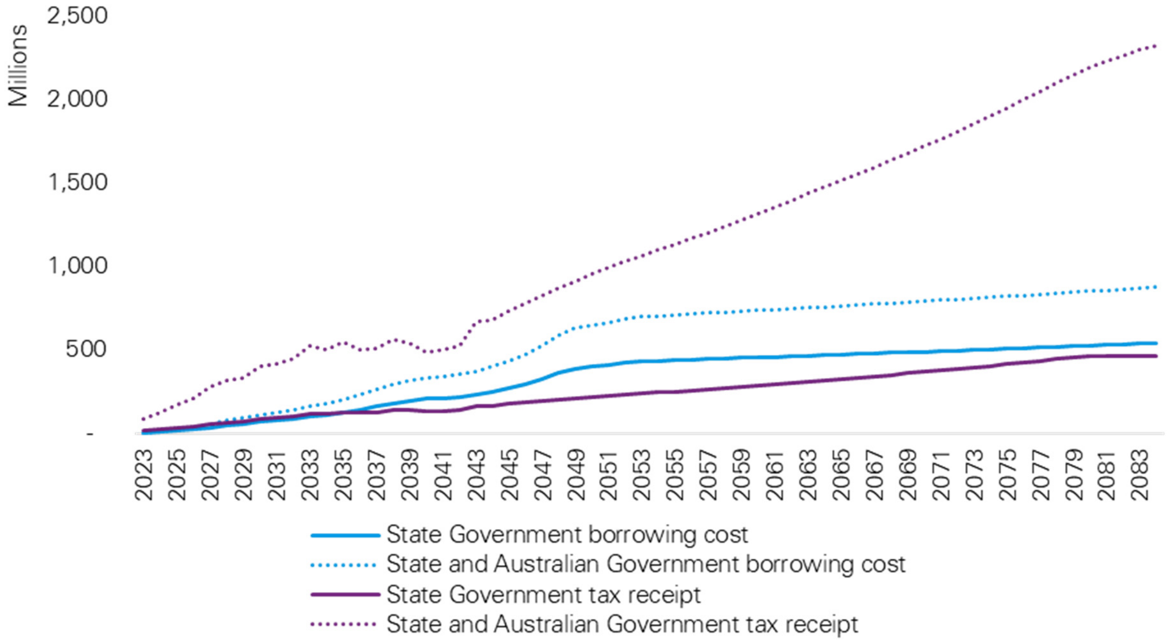
This increase in economic activity will, in turn, boost Victorian and Australian Governments' tax receipts. KPI 2 in Table 11-2 shows that the tax receipts from increase in GSP and GSP is sufficient to cover Australian and State Government borrowing costs for both Program Case Option A and Program Case Option B, with a small shortfall if only state borrowing cost versus state tax receipts are compared. This is shown in Figure 11-3 and Figure 11-4 below.

Figure 11-3: SRL – Cheltenham to Airport borrowing cost against tax receipt – Program Case Option A



Source: KPMG based on CGE modelling

Figure 11-4: SRL – Cheltenham to Airport borrowing cost against tax receipt – Program Case Option B



Source: KPMG based on CGE modelling

12. Distributional and Spatial Analysis

12.1 Overview

SRL – Cheltenham to Airport aims to improve equity and liveability across Melbourne. Distributional, equity and spatial analysis determines how the economic benefits of SRL – Cheltenham to Airport are distributed geographically and across socioeconomic cohorts.

Two levels of distributional analysis have been undertaken:

- Individual analysis – the MABM models how travel behaviours of individual users change following the introduction of SRL – Cheltenham to Airport. It has been used to estimate the level of benefit enjoyed by different demographic and socioeconomic cohorts.
- Regional analysis – the distribution of benefits across regions has been determined based on the outputs of the transport and precinct benefits, WEBs, UCBs and macroeconomic analyses. The socioeconomic composition of these regions has been compared and contrasted to identify the overall distributional impacts of SRL – Cheltenham to Airport.

12.2 Individual analysis

Outputs of the MABM have been used to complement the economic analysis results and identify how the benefits of SRL – Cheltenham to Airport are distributed across different demographic and socioeconomic cohorts.

The MABM assessment was carried out for only one Program Case scenario, therefore the following analysis covers only the comparison of benefits for Program Case Option A against the Base Case scenario.

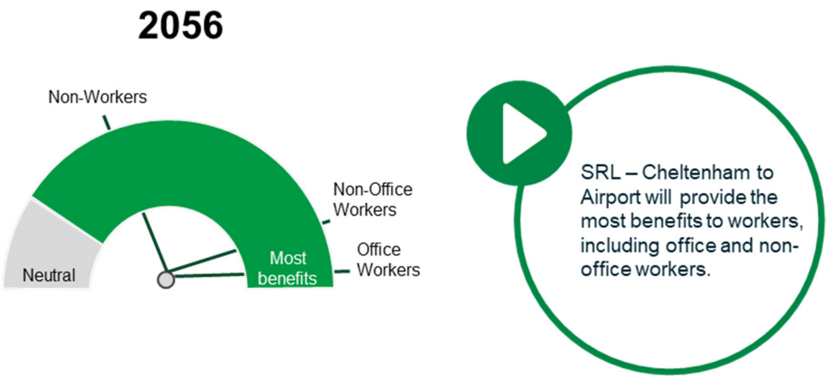
The economic analysis determines the quantum of benefits generated by the SRL – Cheltenham to Airport land use uplift. MABM identifies individuals (including SRL – Cheltenham to Airport customers and other transport network users), enabling the total benefits to be distributed across cohorts based on the following socioeconomic characteristics:

The analysis identifies the expected benefits distributed for workers across different demographic cohorts in the following sections.

Worker cohorts

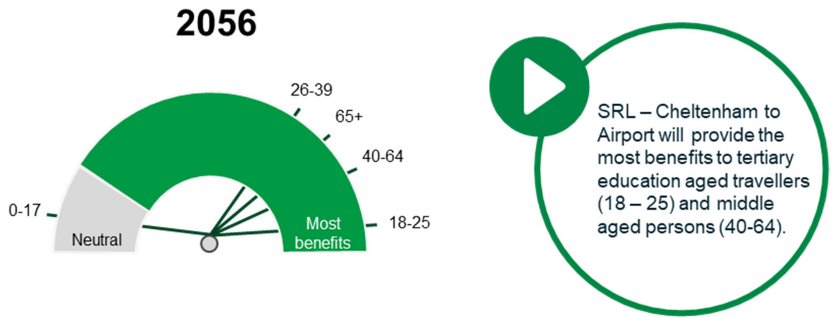
Figure 12-1, Figure 12-2 and Figure 12-4 summarise the insights on particular beneficiaries drawn from the modelling and reported for three key demographic groups (work status, age and equivalised house income).

Figure 12-1 Beneficiaries of SRL – Cheltenham to Airport based on their work status



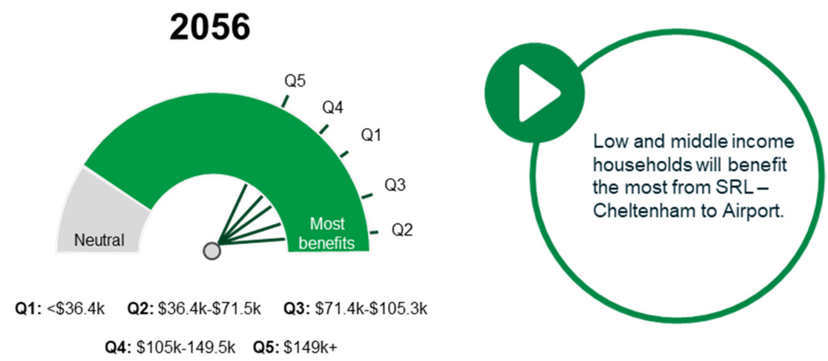
Source: KPMG analysis of MABM modelling

Figure 12-2: Beneficiaries of SRL – Cheltenham to Airport based on their age



Source: KPMG analysis of MABM modelling

Figure 12-3: Beneficiaries of SRL – Cheltenham to Airport based on their equivalised household income

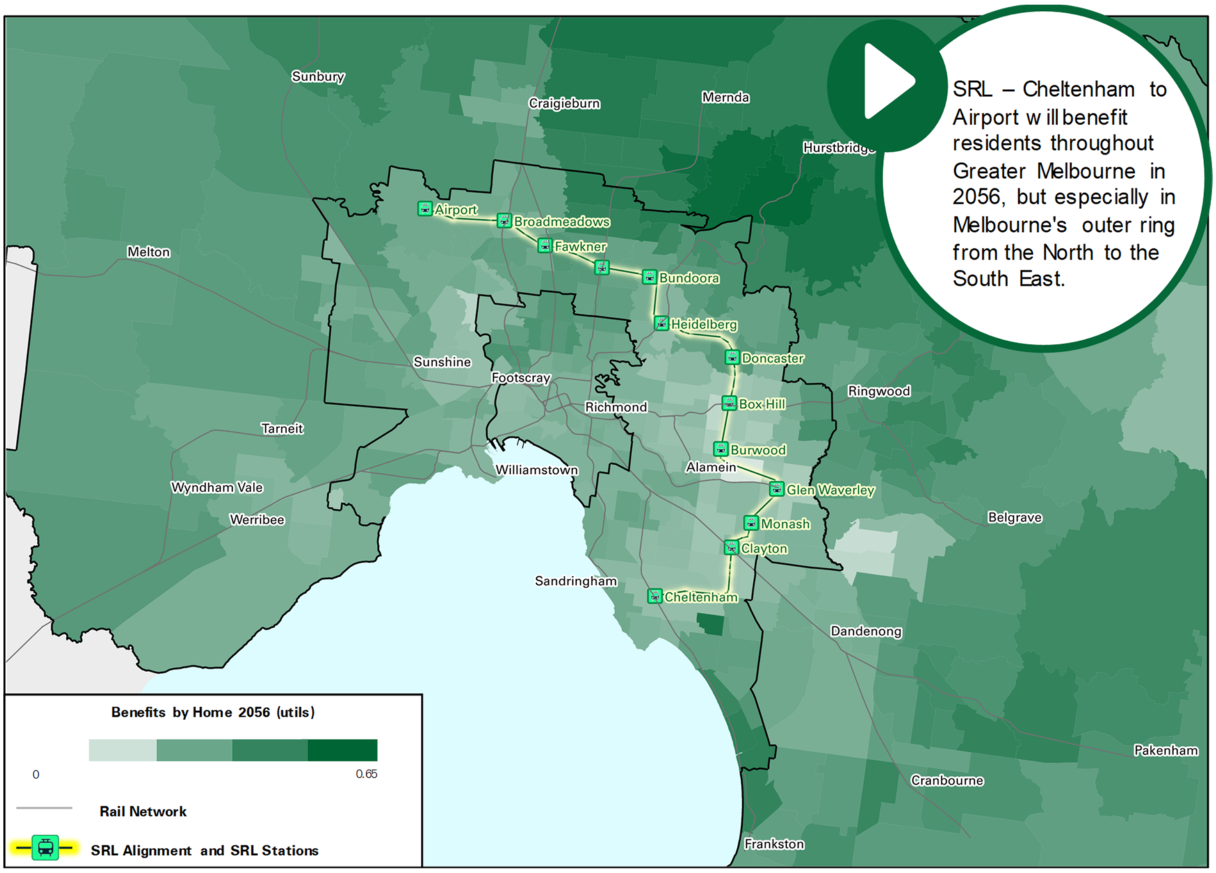


Source: KPMG analysis of MABM modelling

Home location

SRL – Cheltenham to Airport beneficiaries are primarily residents of middle and outer suburbs. Residents in these areas benefit from alternative transport options and improved accessibility. Figure 12-4 shows the Statistical Areas Level 2 (SA2s) with residents who are better-off on average with SRL – Cheltenham to Airport. The metric to identify a SA2's status is the average of all residents' difference in utility between the Base Case and Program Case.

Figure 12-4: Beneficiaries home location by SA2s with SRL – Cheltenham to Airport in 2056



Source: KPMG analysis of MABM modelling

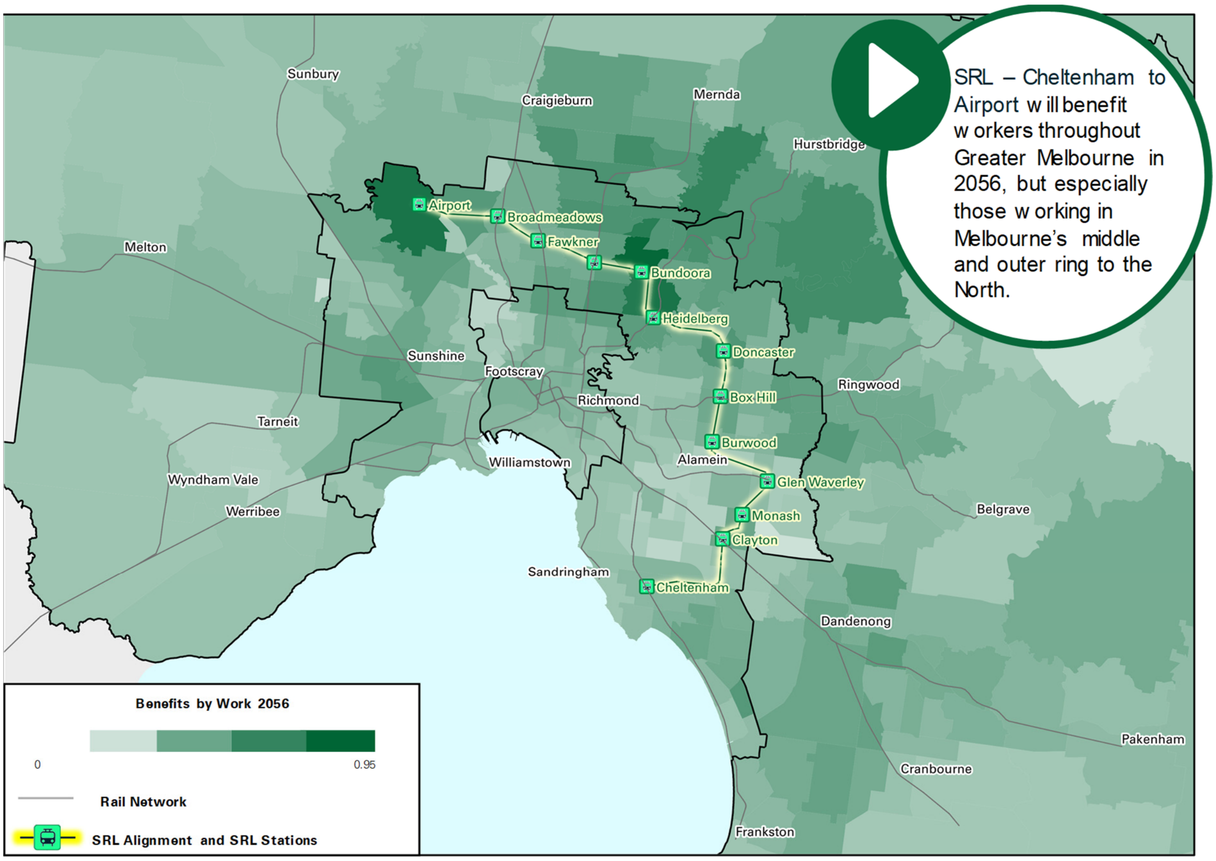
Work location

People working in the middle and outer suburbs of Melbourne are the primary beneficiaries of SRL – Cheltenham to Airport in 2056. There are two primary reasons for this:

1. An increase in public transport access for workers in those areas
2. A shift towards public transport due to SRL – Cheltenham to Airport easing congestion for on-road public transport users.

Figure 12-5 shows SA2s with workers who are better off on average with SRL – Cheltenham to Airport in 2056.

Figure 12-5: Beneficiaries by work location by SA2s with SRL – Cheltenham to Airport in 2056



Source: KPMG analysis of MABM modelling

12.3 Regional analysis

In addition to identifying the individual beneficiaries of SRL – Cheltenham to Airport, distributional and spatial analysis has been undertaken to understand how SRL – Cheltenham to Airport may benefit regions throughout Victoria. This analysis details how regions benefit from each of the benefit categories.

Results have been reported at a geographic level appropriate to each individual component of the analysis.

Table 12-1 summarises the regional analysis undertaken for each component of the economic appraisal.

Table 12-1: Regional analysis approaches

Item	Regional analysis	Beneficiaries
Conventional benefit	This economic appraisal focuses on the magnitude of the conventional benefit; the regional distribution by VITM travel zones are provided in the Demand Modelling Report.	Under Program Case Option A, public transport user benefits (approximately 43 per cent) and road user benefits (approximately 28 per cent) account for the majority of the total conventional benefits. Under Program Case Option B, public transport user benefits (approximately 43 per cent) and road user benefits (approximately 29 per cent) account for the majority of the total conventional benefits. Public transport user and road user benefits appear to be most prevalent in Melbourne's middle ring. Refer to Section 6 for more detail.
WEBs	The discussion of wider economic benefits generated through the SRL – Cheltenham to Airport transport and precinct initiatives considers the distribution of impacts geographically and across occupations, including: • Relocation of employment (including consideration of existing and forecast employment in each area with and without SRL – Cheltenham to Airport) • Changes in accessibility between major travel origins and destinations. This appraisal reports the distribution of WEBs at VITM travel zone level, in line with the disaggregations allowed in VITM and CityPlan.	Agglomeration economies (WEB1) and labour market deepening (WEB2) account for the majority (approximately 95 per cent) of the total WEBs for both Program Case Option A and Program Case Option B. WEBs appear to be most prevalent in south-eastern Melbourne and along the SRL – Cheltenham to Airport corridor.

UCBs	The analysis of urban consolidation benefits draws on the outputs of CityPlan to determine how population and employment are redistributed across Greater Melbourne following the implementation of SRL – Cheltenham to Airport. The analysis determines the potential locations for public infrastructure savings which arise from greater concentration of activity in Melbourne's central suburbs. It also identifies areas' potential implications for urban amenity within and across individual regions. The implications for social equity across Melbourne are also presented.	Public infrastructure cost savings accounts for the highest proportion of UCBs (over 65 per cent) for both Program Case Option A and Program Case Option B. The improved transport equality benefit component of UCBs appears to be most prevalent along the SRL – Cheltenham to Airport corridor. Refer to Section 8 for more detail.
Macro-economic analysis	The macroeconomic analysis assesses the impact of transport and precinct initiatives at the national, Victorian and Greater Melbourne levels. The analysis determines how SRL – Cheltenham to Airport may impact the magnitude of economic activity (including individual components), wages and employment.	Under Program Case Option A, SRL – Cheltenham to Airport will: • increase Victoria's GSP by $50.8 billion, and Australia's GDP by $49.3 billion in present value terms using a 4 per cent discount rate • Additional employment across Victoria peaks at 3,900 jobs (FTE) during construction and 4,000 jobs (FTE) during the operational phase. Under Program Case Option B, SRL – Cheltenham to Airport will: • increase Victoria's GSP by $58.7 billion, and Australia's GDP by $58.0 billion in present value terms using a 4 per cent discount rate • Additional employment across Victoria peaks at 5,200 jobs (FTE) during construction and 4,400 jobs (FTE) during the operational phase. Refer to Section 11 for more detail.

Source: KPMG

13. Qualitative benefits considered

A range of other economic effects (Table 13-1) have been identified but were not quantified due to lack of data. The impact and nature of these benefits and costs have been discussed qualitatively.

Table 13-1: Other economic effects of the Program Case

Benefit Stream	Cost or Benefit	Impact on benefits	Rating
Conventional Benefits	Reduced roadway costs	Roadway costs include road maintenance, construction and land acquisition. These costs are affected by vehicle weight, size and speed. In urban areas with significant congestion problems and high land values, even a modest reduction in volumes can provide large savings. SRL – Cheltenham to Airport reduces car use and it is anticipated that the reduction in road travel will provide some additional benefits.	Slight positive impact on benefit
	Construction disruption	While a range of construction related impacts are captured in the economic costs (including business disruption and costs to mitigate impacts), some costs have not had an economic value placed on them. It is anticipated that due to the scale of the construction activity under both Program Cases disruption to traffic flows may occur, which would likely result in a disbenefit.	Slight negative impact on benefit
	Civic pride	Civic pride relates to how places and public infrastructure promote and foster local identity and autonomy. Civic pride is often attributed to the realm of architecture, where grand public infrastructure is often said to convey civic victory and subsequently civic pride. Civic pride refers to a feeling of self-worth or self-respect and the different ways people value or praise their identity or community; it links pride to a sense of self-esteem, confidence and local integrity and prosperity. Most of the literature on civic pride relates to symbolic civil infrastructure such as bridges, light rail, stadiums and parks. Within the context of SRL – Cheltenham to Airport, involvement in precinct design, increased community participation, connectivity and sense of belonging may all enhance civic pride and therefore benefits.	Moderate positive impact on benefit

UCBs	Improved neighbourhood amenity	Compact urban form can make an area more vibrant, attractive and generally contributes to enhanced amenity. Diversity is often an urban amenity, since urban consumers are attracted to cities with ethnic restaurants, international cultural offering, and a lively street scene. SRL – Cheltenham to Airport has the potential to attract investment for higher density housing and provide greater urban amenity. However, due to the lack of reliable data and a robust method for quantification, this benefit has been discussed qualitatively by this economic appraisal. Further discussion is provided in Attachment C.	Moderate positive impact on benefit
	Environmental and biodiversity impacts	Non-urban land offers a range of environmental and bio-diversity benefits, such as regulating and stabilising water runoff, buffering heavy rain and its effects, and vegetation cover. Biodiversity loss and degradation of natural habitats can lead to disruption to the ecosystem services, and consequently cause economic and social losses. SRL – Cheltenham to Airport can help consolidate the urban form from expanding and thus provide biodiversity conservation benefits. However, due to the lack of reliable data and a robust method for quantification, this benefit has been discussed qualitatively by this economic appraisal. Details are provided in Attachment C.	Moderate positive impact on benefit
Local area benefits[61]	Benefits associated with local area improvements	The SRL – Cheltenham to Airport precinct initiatives will facilitate a broad range of improvements for local communities that have potential to, for example: • Reduce heat through tree planting • Improve mental and physical health by developing public open space • Increase volunteering participation The specific precinct initiatives being developed for SRL – Cheltenham to Airport are intended to deliver on these benefits. However, at time of assessment quantitative data was not available for inclusion in the CBA. It is anticipated that a moderate benefit would be achieved from the suite of precinct initiatives to be implemented.	Moderate positive impact on benefit

Source: KPMG

[61] Note, this benefit stream is not included in the core economic appraisal.

14. Conclusions

The economic appraisal for SRL – Cheltenham to Airport assesses its economic viability, as well as the key risks associated with its economic benefit and cost.

The economic appraisal has been undertaken in accordance with accepted transport evaluation techniques, and takes a holistic evaluation approach that quantifies the conventional transport economic benefits, WEBs and UCBs, in addition to the macro economy-wide impact (assessed using CGE modelling).

The economic appraisal for SRL – Cheltenham to Airport demonstrates that at 4 per cent discount level:

- Program Case Option A has the NPV ranging between $3.0 billion and $22.9 billion and a BCR ranging between 1.1 and 1.7.
- Program Case Option B has an NPV ranging between $2.4 billion and $25.2 billion and a BCR ranging between 1.0 and 1.7.

Scenario and sensitivity analysis have also been undertaken to evaluate the economic results based on the variation of key project assumptions and parameters. The scenario tests have demonstrated that SRL – Cheltenham to Airport is economically viable under most scenarios tested. This is except for:

- the AV/ EV high rideshare scenario for Program Case Option A which has a BCR range of 0.8 to 1.3
- COVID-19 scenario for Program Case Option B which has a BCR range of 0.8 to 1.4.
- where public transport or road user benefits are lower by 20 per cent or where no growth in benefits are expected post 2056, in addition to the uncertainty already captured in the probabilistic analysis, the BCRs remain above the lower bound of 0.9.

The economy-wide modelling demonstrates that Program Case Option A will create 3,900 additional jobs (net) across Victoria at the peak of construction. Across Australia, approximately 4,100 additional jobs (net) are expected to be generated at the peak of construction. For Program Case Option B it will create 5,200 additional jobs (net) across Victoria and 5,300 additional jobs (net) across Australia at the peak of construction.

The construction and operation of SRL – Cheltenham to Airport is expected to increase Victoria's GSP by approximately $50.8 billion and $58.7 billion in present value terms using a 4 per cent discount rate for Program Case Option A and Program Case Option B respectively. Overall, Australia's GDP will be higher by $49.3 billion and $58.0 billion in present value terms using a 4 per cent discount rate for Program Case Option A and Program Case Option B respectively.

The economic contribution of the investment has also been assessed by analysing the return on investment against the funding cost of the investment. The analysis shows that the Victorian economy, as measured by change in GSP, will be better off by 5.0 and 4.7 times the cost of investment (after allowing for borrowing cost), for Program Case Option A and Program Case Option B respectively. Similarly, the Australian economy, as measured by the change in GDP, will be better off by 2.7 and 2.6 times the cost of investment for Program Case Option A and Program Case Option B respectively.

The increase in economic activity in turn will boost Victorian and Australian Governments' tax receipts, with these tax receipts sufficient to cover Government borrowing costs for both Program Case Option A and Program Case Option B.

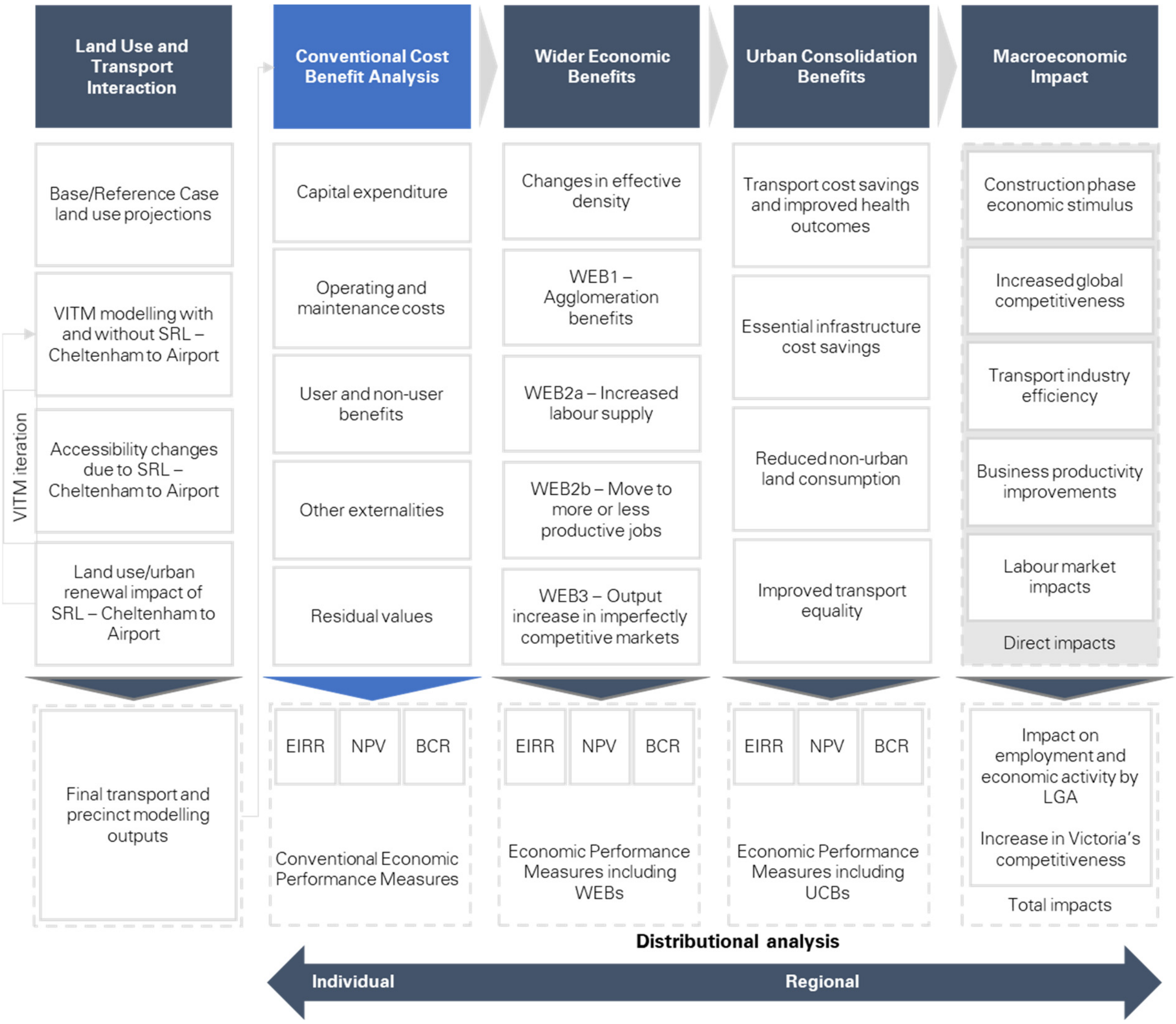
These results indicate that both Program Case Option A and Program Case Option B are economically viable.

Many different cohorts of the Victorian community will benefit from SRL – Cheltenham to Airport, including those that need it most. By reducing reliance on private vehicles for orbital trips, SRL – Cheltenham to Airport will help to make travel more affordable and alleviate household financial stress for some of the more vulnerable cohorts within the community. Lower and middle income households will benefit the most from SRL – Cheltenham to Airport. Moreover, SRL – Cheltenham to Airport will provide the most benefits to tertiary-aged travellers (18-25 year olds), as well as middle-aged persons (40-64 year olds).

Attachment A: Conventional cost benefit appraisal approach

This attachment provides the detailed approach and relevant economic theory underpinning the calculation of the conventional benefit streams. Figure A - 1 highlights the components of the conventional benefits analysis which have been quantified for SRL – Cheltenham to Airport.

Figure A - 1: Conventional benefits within the overarching economic appraisal framework



Source: KPMG

A.1 Values of time

Time-related savings used in the analysis have been valued using a VOT, which differs by trip purpose:

- **Business-to-business trips** reflect trips made during the course of the working day. The VOT reflects the cost to the employer in lost productivity from time spent travelling.
- **Non-business trips** reflect trips made in an individual's own time. The VOT reflects the individual's 'willingness-to-pay' to avoid time spent travelling. People implicitly put a value on their own time in that they will trade a slow, cheaper journey against a fast, more expensive one.

Based on productivity growth forecasts in the 2015 Intergenerational Report (The Treasury, 2015), the value of time has been indexed using long-term average growth in real income.

Analysis of AWE and CPI data from ABS for Victoria demonstrates that real average weekly earnings in Victoria grew at a rate of 1.55 per cent per annum over the last 20 years to 2015.

The 2015 Intergenerational Report published by the Australian Government states that during the 1990s, Australia's productivity grew at an average of 2.2 per cent per year. This declined to 1.5 per cent per year during the 2000s. The Intergenerational Report assumes that over the next 40 years, Australia's productivity will increase by 1.5 per cent per year.

To be consistent with the Intergenerational Report, and given the marginal difference between that assumed by the Intergenerational Report and the observed real growth in AWE in Victoria, the VOT was indexed at 1.5 per cent per year. For non-work related benefits, the estimated real long-term average growth in real income in Victoria is multiplied by an elasticity of 0.5[62]. In other words, the non-work benefit streams were indexed at half the rate of growth in real income. The values of time used in the analysis are shown in Table A - 1 and Table A - 2 for public transport and road users.

Table A - 1: Values of time – public transport and car users ($ per person-hour)

	2019	2026	2036	2051
Non-business trips	$16.62	$17.51	$18.87	$21.11
Business-to-business trips	$53.92	$59.84	$69.45	$86.83

Source: ATAP (PV2 Road Parameter Values, 3.1 Value of travel time for vehicle occupants, 2016, P. 16). 2019 values have been inflated from June 2013 to March 2019 using ABS average weekly earnings data (ABS Catalogue 6302). Future year values have been indexed at 1.5 per cent p.a. for business-to-business related benefits, and 0.75 per cent p.a. for non-business related benefits

62 The elasticity of 0.5 is based on Hensher & Goodwin (2003) and is also consistent with the elasticity recommended by TfNSW (2013).

Table A - 2: Values of time – freight

Vehicle type	2019			2026	2036	2051
	Driver time ($ per person-hour)	Freight travel time ($ per vehicle-hour)	Total travel time ($ per vehicle-hour)	Total travel time ($ per vehicle-hour)	Total travel time ($ per vehicle-hour)	Total travel time ($ per vehicle-hour)
Heavy rigid trucks	$29.04	$15.76	$44.80	$47.21	$50.87	$56.90
Artic 6-axle trucks	$29.73	$46.68	$76.41	$84.80	$98.42	$123.04

Source: ATAP (PV2 Road Parameter Values, 3.1 Value of travel time for vehicle occupants, 2016, P. 16). 2019 values have been inflated from June 2013 to March 2019 using ABS average weekly earnings data (ABS Catalogue 6302). Future year values have been indexed at 1.5 per cent p.a. for business-to-business related benefits, and 0.75 per cent p.a. for non-business related benefits

Table A - 3: Values of time – traveller to the airport ($ per person-hour)

	2018	2026	2036	2051
Non-business trips	$29.77	$31.37	$33.80	$37.81
Business-to-business trips	$69.95	$77.63	$90.10	$112.64

Source: KPMG (2019) Review of values of travel time savings and value of reliable service

A.1.1 Other societal benefits (externalities)

Table A - 4: Crash cost savings

	2019
Crash cost benefits ($/vehicle-km)	$0.16

Source: Based on crash rates given in Austroads (2012, p. 23) and crash costs given in the ATAP (2018) RV2. Further details given in Section A.4.7. Values have been inflated from June 2013 to March 2019 using ABS CPI (Catalogue 6201)

Table A - 5: Environmental externalities

	Car ($/1000 pkm)	Bus ($/1000 pkm)	Rail ($/1000 pkm)	LCV ($/1000 tkm)	HCV ($/1000 tkm)
Greenhouse gas emissions (CO_2)	$4.33	$2.07	$0.48	$12.26	$2.80
Air Pollution	$8.18	$8.44	$4.04	$27.45	$12.10
Noise	$1.95	$1.80	$1.67	$8.38	$2.56
Soil and Water	$0.44	$1.03	$0.75	$2.53	$1.26
Biodiversity	$0.39	$0.53	$0.01	$1.03	$0.85
Nature & Landscape	$0.09	$0.03	$0.03	$1.35	$0.10
Urban Separation	$1.40	$0.54	$0.75	$4.84	$0.82
Upstream & Downstream Costs	$5.33	$2.09	$8.66	$13.75	$2.95
Total	**$22.11**	**$16.53**	**$16.39**	**$71.59**	**$23.44**

Source: Austroads (2014) Further details given in Section A.4.8. Values have been inflated from June 2013 to March 2019 using ABS CPI (Catalogue 6201).

Table A - 6: Health benefits due to increased walking and cycling

	Proportion using mode to access public transport[1]	Health benefit per kilometre[2]
Walking	98.6%	$2.77
Cycling	1.4%	$1.39
Weighted average		**$2.75**

Source: 2010 Metlink Train O-D Station Access Survey

Based on rates given ATAP 2018 (PV4 - 5.3.7 Parameter values for walking and cycling benefits, Table 9) adjusted for Melbourne data. Further details given in Section A.4.9

A.2 Relevant economic theory

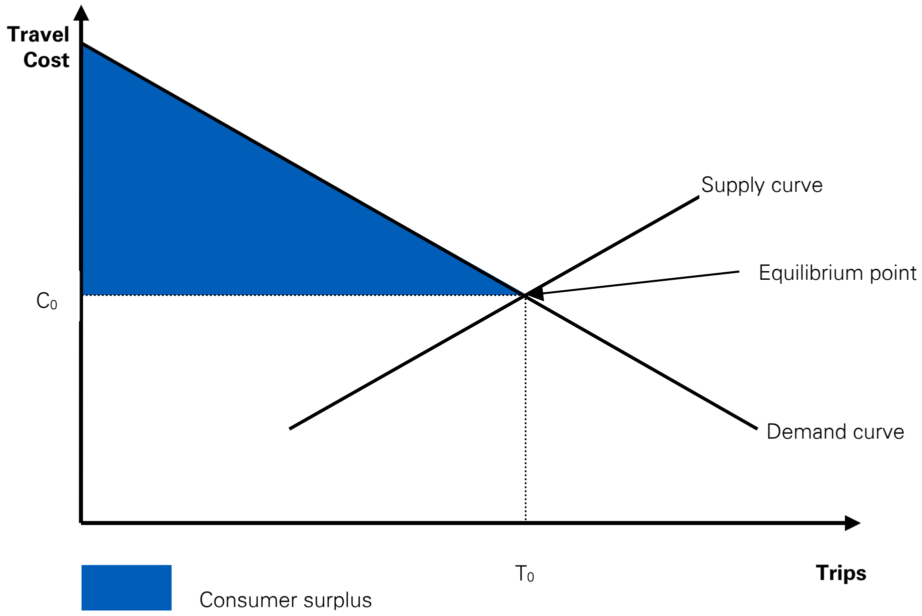
A.2.1 Consumer surplus

The calculation of transport user benefits was based on the conventional consumer surplus theory. 'Consumer surplus' is defined as the benefit which a consumer enjoys, in excess of the costs which he or she perceives. For example, if a journey would be undertaken by a traveller provided it takes no more than 20 minutes, but not if it takes more than 20 minutes, then the total value of the journey is equivalent to the cost to that traveller of 20 minutes of travel time. If actual travel time for the journey is only 15 minutes, then the traveller enjoys a surplus of 5 minutes. If a new proposal reduces travel time further, to 12 minutes, then the increase in consumer surplus from the proposal is 3 minutes.

The evaluation of economic benefits to transport users relies on the transport system equilibrium being correctly assessed by the transport model. At the equilibrium point, the numbers of trips T_0 (demand) and system performance (supply) are in balance producing an average trip cost of C_0.

At this equilibrium point there are benefits to the consumer over and above the actual trip costs, that is, there is a difference between what they would be willing to pay and what they actually pay. This difference is the consumer surplus. This is shown diagrammatically in Figure A - 2.

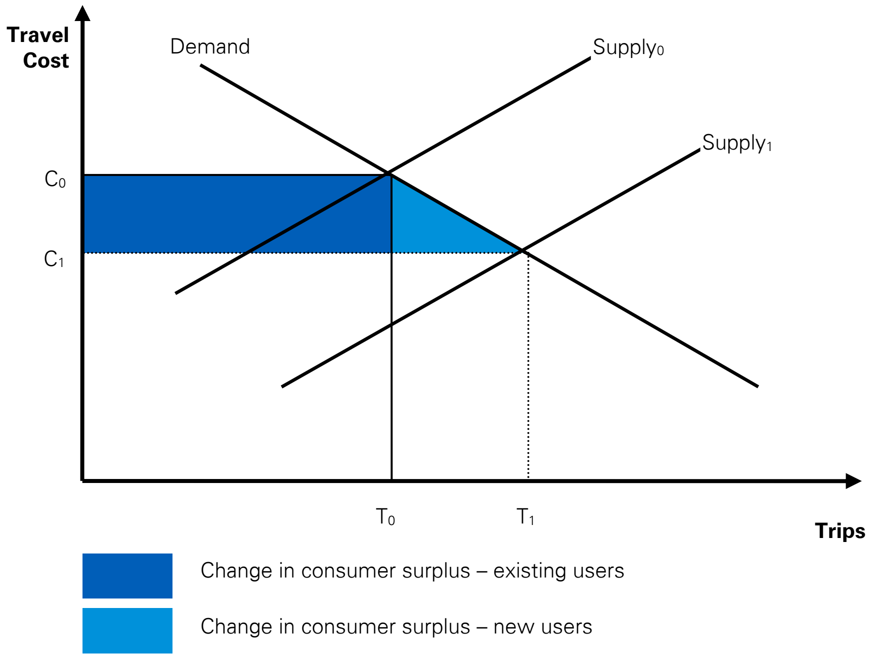
Figure A - 2: Supply / demand equilibrium showing consumer surplus



Source: KPMG analysis

A new public transport scheme will reduce travel costs. This shifts the supply curve down as shown in Figure A - 3. A new market equilibrium point is found where the demand is T_1 and the supply cost is C_1. The benefit to transport users is therefore the change in the consumer surplus, which is shown by the red and grey shaded area of the chart.

Figure A - 3: Change in consumer surplus



Source: KPMG analysis

For small changes in costs, the demand curve can be considered to be linear.

In the case of *existing public transport users*, a change in door-to-door travel time from 20 minutes to 15 minutes will equate to a full five minutes in consumer surplus benefit. Therefore, the change in consumer surplus for existing travellers who were already making trips in the Base Case is given by the area of the shaded rectangle:

$$CS_{existing} = T_0(C_0 - C_1)$$

In contrast, *new public transport users* (who switch from car in the Base Case to public transport in the Program Case receive half the benefit of existing users in accordance with the 'Rule of a Half' convention as described in the NGTSM[63].

For some journeys on the transport network, there may be cases where existing public transport users cease to use public transport, and instead switch to road based modes in the Program Case. The benefits to these new road users are also calculated in accordance with the 'Rule of a Half' convention.

The change in consumer surplus for new trips (those who switch from car to public transport or vice versa) is given by the area of the shaded triangle:

$$CS_{new} = \frac{1}{2}(T_1 - T_0)(C_0 - C_1)$$

The total change in change in consumer surplus is calculated by summing the areas of the rectangle and triangle, which simplifies to:

$$CS_{total} = \frac{1}{2}(T_0 + T_1)(C_0 - C_1)$$

A.2.2 Resource cost corrections

The change in consumer surplus theory outlined in Section A.2.1 is based on consumers' *willingness to pay* for certain goods. It can only be applied where changes to costs are fully perceived by the user. In the context of travel, transport users fully perceive time, comfort aspects and out of pocket costs such as fuel, train / bus fares and car parking. These aspects / costs are taken into account in their choice of mode and hence in the benefit enjoyed by people who change their travel behaviour as estimated by the transport model.

Transport user benefits (both public transport and road), which are obtained from the change in consumer surplus outputs, reflect perceived costs and therefore include the perceived disbenefit of paying fares, car parking or road tolls.

However, transport users do not perceive that fares, tolls or parking costs are transferred to the rest of the economy. In economic terms the exchange should be considered a financial transfer rather than an economic cost. A *resource cost correction* is therefore required in the economic analysis to offset the perceived disbenefit of fares, tolls and parking.

In the case of public transport, the transfer is from public transport user to public transport operator. Fares are charged to recover some of the operating and capital costs of providing public transport services (which are resource costs). Given the cost benefit analysis explicitly includes capital and operating costs associated with SRL – Cheltenham to Airport, a correction must be applied to avoid double counting of resource costs.

The following general form of calculation is used for calculating resource cost corrections.

$$RCC = (T_0RC_0 - T_0PC_0) - (T_1RC_1 - T_1PC_1)$$

---

[63] Transport and Infrastructure Council (2006b, p. 26).

Where:

RCC = resource cost correction

T = number of trips

PC = perceived cost

RC = resource cost

Subscripts 0, 1 refer to the Base Case and Program Case.

A.2.3 Computation of benefits

The VITM output of the number of users for each origin-destination pair in the Base Case and Program Cases was used. Benefits were calculated for each origin-destination pair for existing and new users using the formulae given in Sections A.2.1 and A.2.2. Benefits were then aggregated for all origin-destination pairs. The aggregated outputs were then monetised within a bespoke Microsoft Excel CBA model built specifically for the SRL – Cheltenham to Airport economic appraisal.

Certain benefit streams – predominantly those calculated from outputs of the ClicSIM model were calculated externally from the model; further details are provided in the following sections.

A.3 Public transport user benefits

This section sets out the approach and key outputs resulting from calculation of public transport user benefits relating to SRL – Cheltenham to Airport. These include calculations for:

- Generalised travel time savings
- Reduced crowding on trains and trams
- Improved service punctuality
- Improved network resilience
- Improved customer environment on trains and stations
- Reduced crowding in stations
- Resource cost corrections for public transport fares.

A.3.1 Generalised travel time savings

Total journey travel time savings comprise of discrete parts of the overall public transport journey which include both time and monetary components. The components of generalised travel time savings which were measured from the outputs of the transport models include:

- Walk access and egress time savings – reflect the aggregate change in walk access and egress time. The change in access / egress time was calculated within the patronage model and multiplied by the VOT given. For non-business trips, a weighting of 1.4 times was applied to the IVT as passengers value out-of-vehicle time higher than that of time spent in vehicle.
- Park & Ride drive access and egress time savings – reflect the aggregate change in car access and egress time. The change in access / egress time was calculated within the patronage model and multiplied by the VOT.

- Wait time savings – reflects the reduction in wait time due to greater service frequency. The change in wait time was calculated within the patronage model and multiplied by the VOT. For non-business trips, a weighting of 1.4 times was applied to the value of IVT as passengers value out-of-vehicle time higher than that of time spent in vehicle.
- In-vehicle travel time savings – reflect changes in in-vehicle travel time due to service pattern changes. The change in IVT was calculated within the patronage model and multiplied by the VOT.
- Walk transfer time savings – reflects the change in transfer time (within or between modes) due to service changes. The change in transfer time was calculated within the patronage model and multiplied by the VOT. For non-business trips, a weighting of 2.0 times the value of IVT was applied as passengers value time spent transferring between services at twice that of time spent in vehicle.
- Transfer penalty savings – transfer penalties represent user preferences which are not explicitly measured by variables in the patronage model. Transfer penalties were included to reflect the disutility that most users associate with interchanging, over and above the measured travel time. The transfer and access penalties were calculated within the patronage model and multiplied by the VOT.
- Fare – fares paid by transport users form part of their generalised journey time that they perceive. In VITM, fares were converted into generalised time using the VOT.

The transport models measure the time spent by passengers on different parts of their trip between each origin-destination pair in the model, some of which were weighted as described above. The consumer surplus of generalised travel time savings were applied using the general approach given in Section A.2.1 to the travel times (weighted as described above) and trip numbers as output from VITM as follows:

$$CS = \frac{1}{2}(T_0 + T_1)(PC_0 - PC_1)$$

Where:

CS = consumer surplus

T = number of trips

PC = generalised travel time (perceived cost)

Subscripts 0,1 refer to the Base Case and Program Case

The time savings were then calculated using the values of time given in Section A.1.

A.3.2 Reduced crowding on trains and trams

Crowding disbenefits reflect the discomfort that passengers feel from travelling in varying levels of crowded conditions. As crowding levels increase towards crush capacity, the valuation of passengers' in-vehicle time also increases – e.g. if a train is at crush capacity, standing passengers will perceive their journey to take twice as long. A reduction in crowding occurs when additional services are provided; consequently existing public transport users experience a reduction in their perceived value of time.

VITM has the ability to assign public transport trips with the application of crowding constraints. The Public Transport program within VITM supports two types of crowd models:

- In-vehicle travel time adjustment
- Wait time adjustment.

In-vehicle travel time adjustment

In-vehicle travel time adjustment models a passenger's perception that travel time is more onerous when standing (rather than sitting), or when on crowded vehicles. This adjustment is specified with a crowding factor. The program multiplies the crowding factor by in-vehicle time to determine the perceived 'crowded in-vehicle time'.

For example, suppose a vehicle has a seating capacity of 40, crush capacity of 50, and load distribution factor of 0.85 (standing occurs when more than 85 per cent of 40 – that is, 36 seats – are occupied). Once standing starts, the crowding factor might increase slowly from 1.0 for the first few standing passengers, then more steeply once vehicle loading exceeds 40.

The Public Transport program within VITM uses crowding curves, which set the relationship between the crowding factor and the vehicle utilisation. The utilisation is the percentage of standing places occupied and can vary between 0 and 100.

Crowd factors are 1.0 in uncrowded conditions, and typically rise to values in the ranges 1.0 to 1.4 for seated passengers and 1.5 to 3.0 for standing passengers when the vehicle is fully loaded with standing occurring.

The ATAP (2018) provides weighting factors for in-vehicle travel time that when all seats are occupied, the seated time should be valued at 110 per cent of the IVT, increasing linearly to 130 per cent of IVT at crush capacity. For standing passengers, it is recommended that standing time is values at 140 per cent of IVT when all seats are occupied, increasing linearly to 200 per cent of IVT at crush capacity. These factors are shown in Table A - 7.

Table A - 7: Crowded in-vehicle time weighting factors

Load factor (passengers: seats)	Seated passenger IVT weighting factor	Standing passenger IVT weighting factor
70%	1.0	n/a
100%	1.20	1.65
Crush capacity (6 passengers per square metre)	1.50	2.10

Source: ATAP 2018 (pv1, pp50)

Wait time adjustment

The wait time adjustment reflects the ability to board a service. In simple models (without crowd modelling) travellers typically board the first service that arrives at a stop and goes to the required alighting point. As loadings on services increase, this becomes less realistic, as travellers will choose the first appropriate service that has available capacity. Using measures of demand and available capacity, the wait-time adjustment computes the probability of being able to board a service. With heavily loaded services, some travellers will wait for the next service, incurring additional wait time at the boarding node.

The wait time adjustment module redistributes public transport line loadings whenever any line does not have the available capacity to take its assigned demand. The program reassigns this excess demand to other lines with spare unused capacity; those travellers incur additional wait time.

The additional wait time might make this route less attractive, resulting in diversion of demand to other public transport routes.

If demand exceeds capacity and no alternative routes are available, a 'bottleneck' occurs and not all of the travel demand is able to use the service during the modelled period. The demand remaining at the end of the modelled period would discharge once peak travel volumes subside; those travellers experience additional delays, which form a second component to the wait-time adjustment.

'Flow metering' handles the bottleneck effect and the inability of demand to pass through that point. Flow metering removes the excess demand from later stages in the trip; thus demand at any downstream point reflects the number of travellers who can reach that point. For any origin-destination pair, the program can calculate the proportion of flow-metered demand (that is, demand unable to reach its destination due to network bottlenecks), and the number of trips affected.

Calculation

The transport models measure the crowded in-vehicle time and crowded wait time between each origin-destination pair in the model. The consumer surplus of crowded travel time savings were applied using the general approach given in Section A.2.1 to the travel times (weighted as described above) and trip numbers as output from VITM as follows:

$$CS = \frac{1}{2}(T_0+T_1)(PC_0-PC_1)$$

Where:

CS = consumer surplus

T = number of trips

PC = crowded travel time (perceived cost)

Subscripts 0,1 refer to the Base Case and Program Case

The crowded travel time savings were then valued using the values of time.

A.3.3 Farebox resource cost correction

All new public transport users have to pay a fare, which is part of their perceived costs in making their mode choice decision. Fares are charged to recover (some of) the operating and capital costs of providing public transport services (which are resource costs) and therefore could be considered to reflect a resource cost.

However, when an economic analysis of a public transport project is undertaken the capital and operating costs associated with the project are explicitly included in the costs of the project. It would be double counting to include fare payments by new public transport users in a public transport CBA in addition to the public transport capital and operating costs. Accordingly, it is necessary to add back in, as a component of the benefits to accurately derive the net resource benefit.

The public transport generalised travel time savings, which are obtained from the change in consumer surplus outputs, reflect perceived costs and hence, for someone transferring to public transport, include the perceived disbenefit of paying a fare. However, CBAs are conducted in resource cost terms. Therefore, because public transport fares are not a resource cost, a resource cost correction is required in the economic analysis to offset the perceived disbenefit of fares in the public transport generalised travel time savings.

The resource cost correction was calculated by applying the general approach given in Section A.2.2 to public transport fares and trip numbers as output from VITM as follows:

$$RCC = (T_0RC_0 - T_0PC_0) - (T_1RC_1 - T_1PC_1)$$

Where:

RCC = resource cost correction

T = number of trips

PC = fare (perceived cost)

RC = fare (resource cost)

Subscripts 0,1 refer to the Base Case and Program Case.

Since the fare resource cost (RC) is zero and the fare perceived cost (PC) is the fare amount, the above formula can be simplified to:

$$RCC = T_1 PC_1 - T_0 PC_0$$

A.3.4 Gross MSC – improved vehicle quality

Any new trains purchased or old trains refurbished as part of SRL – Cheltenham to Airport will improve the vehicle quality provided to passengers and therefore produce vehicle quality benefits.

The calculation of improved vehicle quality benefit follows the ATAP (2018) approach for valuing facility provision – replacing old trains with new or refurbished trains. The replacement of an old train with a new train has an IVT multiplier of 8.0[64] per cent and the refurbishment of an old train has an IVT multiplier of 5.4[30] per cent. The 8.0 or 5.4 per cent IVT multiplier means SRL – Cheltenham to Airport will provide improved customer amenity that is equivalent to an 8.0 or 5.4 per cent in vehicle time saving for passengers.

The improved vehicle quality was calculated by applying the ATAP IVT multiplier of 8.0 or 5.4 per cent to the in vehicle time of the new diesel train passengers:

$$IVQ = IVT_D \, M_D \, VOTT$$

Where:

IVQ = improved vehicle quality

IVT = in vehicle time

M = IVT multiplier of 8.0 or 5.4 per cent

VOTT = value of travel time

Subscripts D refer to the passengers who use the new electric trains (currently using diesel trains).

A.3.5 Intrinsic MSC

SRL – Cheltenham to Airport may capture some passengers who otherwise would have taken buses for their transit. ATAP (2018) suggests that passengers have a higher willingness to pay for rail, given its greater amenity, net of travel metrics (e.g. travel time and reliability) and vehicle and station quality. This could include SRL – Cheltenham to Airport passengers who previously would have taken the Skybus to the airport, or university students who previously would have taken a bus to their campus.

For a 25 minute trip, rail has a MSC of 0.11 compared to bus[65]. This 0.11 MSC is an IVT multiplier applied to the in vehicle time in bus as recommended by ATAP (2018).

The intrinsic MSC due to SRL – Cheltenham to Airport was calculated by applying the ATAP IVT multiplier of 0.11 to the in vehicle time of bus passengers:

$$IMSC = IVT_B \, M_B \, VOTT$$

64 ATAP (2018), M1, page 55, Table A.10.
65 ATAP (2018), M1, pp 77, Table 52.

Where:

IMSC = intrinsic MSC

IVT = in vehicle time

M = IVT multiplier of 0.11

VOTT = value of travel time

Subscripts b refer to the bus passengers.

Note that the scope of precinct initiatives may include scope of additional bus routes or transport networks. Where this occurs the switch has also been factored into the calculation above.

A.4 Road user benefits

This section sets out the approach, inputs, parameters and flow of detailed calculations undertaken for road user benefits relating to SRL – Cheltenham to Airport. These include calculations for:

- Travel time savings for road users
- Vehicle operating cost savings
- Road journey time reliability
- Travel time in congested conditions
- Toll cost savings
- Car parking cost savings.

A.4.1 Travel time savings

The change in door-to-door travel times resulting from reduced levels of traffic on the road network due to some car users switching to public transport.

The transport models measure the travel time spent by road users between each origin-destination pair in the model. The consumer surplus of travel time savings is applied using the general approach given in Section A.2.1 to the travel times and trip numbers as output from VITM as follows:

$$CS = \frac{1}{2}(T_0 + T_1)(PC_0 - PC_1)$$

Where:

R = consumer surplus

T = number of trips

PC = travel time (perceived cost)

Subscripts 0,1 refer to the Base Case and Program Case

The time savings where then valued using the values of time.

A.4.2 Vehicle operating cost savings

Vehicle operating costs (**VOCs**) such as fuel and maintenance, are a function of distance and speed travelled across the network. In general, fuel consumption is higher at low speeds in interrupted flow / stop-start conditions than it is on free flowing conditions.

As a result of some drivers switching from car to public transport, road network speeds can increase leading to fuel savings for other road users.

For vehicles which operate in fleets (such as commercial vehicles), if travel times decrease as a result of network speeds increasing, then operators will be able to undertake either the same freight task with a smaller number of fleet vehicles or undertake more trips with the same vehicle. This leads to savings related to vehicle capital costs including time-related depreciation, registration and insurance.

Road users only perceive the fuel cost of VOC. Non-fuel costs are unperceived and hence are accounted for as a resource cost correction.

The consumer surplus component of VOC savings have been applied using the general approach to the VOC and trip numbers as output from VITM as follows:

$$CS = \frac{1}{2}(T_0 + T_1)(PC_0 - PC_1)$$

The resource cost correction has been calculated by applying the general approach given in Section A.2.2 to VOC and trip numbers as output from VITM as follows:

$$RCC = (T_0 RC_0 - T_0 PC_0) - (T_1 RC_1 - T_1 PC_1)$$

Where:

CS = consumer surplus

RCC = resource cost correction

T = number of trips

PC = vehicle operating cost (perceived cost)

RC = vehicle operating cost (resource cost)

Subscripts 0,1 refer to the Base Case and Program Cases

The perceived and resource cost components of VOC has been calculated in VITM using the VOC model given in the ATAP guidelines:

$$c_{stop-start} = A + \frac{B}{V}$$

$$c_{freeflow} = C_0 + C_1 V + C_2 V^2$$

where:

A, B, C_0, C_1, C_2 = model coefficients given in Table A - 8 and Table A - 9

c = vehicle operating cost (c/km) or fuel consumption (litres/km)

V = average travel speed in km/h

Table A - 8: Fuel consumption model coefficients for stop-start and free-flow models (litres per 100km)

	Stop-start (journey speed <60 km/h)		Free-flow (journey speed >60 km/h)		
	A	B	C_0	C_1	C_2
Medium car	8.8017	179.6890	9.8014	-0.0785	0.0008
Heavy rigid truck	45.5089	535.1584	32.0378	-0.2949	0.0040
Articulated 6 axle truck	75.4028	547.8857	45.8457	-0.3168	0.0049

Source: ATAP PV2 Road parameter values (2016, p. 16)

Table A - 9: VOC model coefficients for stop-start and free-flow models (cents per km, $2013)

	Stop-start (journey speed <60 km/h)		Free-flow (journey speed >60 km/h)		
	A	B	C_0	C_1	C_2
Medium car	12.6514	1315.518	35.047	-0.1751	0.0012
Heavy rigid truck	57.16	2556.077	82.29	-0.5525	0.0053
Articulated 6 axle truck	98.6903	3991.276	128.6879	-0.6878	0.0066

Source: ATAP PV2 Road parameter values (2016, p. 16)

Perceived costs (fuel costs)

VOC perceived costs have been calculated using the VOC model given above and applying the coefficients given in Table A - 10 to calculate total fuel consumption for different vehicle types. The fuel consumption model used depends upon whether the modelled speed on a road link is above or below 60 km/h. Multiplying the fuel consumption by the market price of fuel and dividing by 100 gives the perceived VOC per km for non-work trips.

Table A - 10 shows an example of the calculation of weighted average VOC in perceived costs for non-work trips.

Table A - 10: Example calculation of VOC perceived cost

	Freeflow	Stop-start
Proportion of total VKT (assumption)	30%	70%
V (km/h) (assumption)	80	50
A		8.8017
B		179.689
C_0	9.8014	
C_1	-0.0785	
C_2	0.0008	
Fuel consumption (litres/100km)	8.6	12.4
Weighted average fuel consumption	11.3 litres/100km	
Average retail price[1]	144.8 cents/litre	
Weighted average VOC perceived cost per vehicle-km for non-work trips	**16.3 cents/km**	

Source: KPMG example calculation based on ATAP PV2 Road parameter values (2016)

Resource cost correction

VOC resource costs have been calculated using the VOC model given above and applying the coefficients given in A.4.2 to calculate total VOC resource costs for different vehicle types. The VOC model used depends upon whether the modelled speed on a road link is above or below 60 km/h.

Table A - 11 shows an example calculation of weighted average VOC in resource costs.

Table A - 11: Example calculation of VOC resource cost

	Freeflow	Stop-start
Proportion of total VKT (assumption)	30%	70%
V (km/h) (assumption)	80	50
A		12.6514
B		1315.5178
C_0	35.047	
C_1	-0.1751	
C_2	0.0012	
VOC (cents/km)	28.7	39.0
Weighted average VOC resource cost per vehicle-km	**35.9 cents/km**	

Source: KPMG analysis based on ATAP parameters

A.4.3 Improved journey time reliability

Road journey time reliability is a function of congestion in the road network – when links are at or near capacity, then any unplanned incident, such as a crash or breakdown is more likely to result in major delays to other vehicles than if the crash or breakdown occurred on a more lightly trafficked route. Consequently, drivers must allow more buffer time before making trips to ensure that they arrive on time.

As the Program Cases result in some mode shift from road to public transport, then some road links will become less congested and trips by road for remaining road users will become more reliable, allowing them to reduce the buffer time and use the time saved more productively.

Travel time reliability benefits have been estimated based on the approach adopted by WebTag Unit A1.3 (DfT UK, 2014). The approach considers reliability benefits as the change in monetised journey time variability, between the Base Case and the Program Case, using the following formula, to forecast changes in the standard deviation of travel time from changes in journey time and distance:

When travel time reliability is expressed in terms of changes in standard deviation, a typical approach is to convert changes in travel time variability into in-vehicle time equivalents. In line with the ATAP guidelines, a conversion factor of one in-vehicle time minute for a minute change in the standard deviation for all vehicle types has been assumed.

The UK approach links reliability to a 'congestion index' (**CI**): the ratio between modelled average (or equilibrium) travel time and free flow travel time.

$$CI = \frac{t_{modelled}}{t_{freeflow}}$$

Where $t_{modelled}$ is the modelled travel time and $t_{freeflow}$ is the freeflow travel time between an origin-destination pair.

Reliability was then measured by the coefficient of variation (**CV**): the standard deviation of travel time to the average travel time. The relationship links the CV as a function of distance and the CI:

$$CV = \alpha \cdot CI^{\beta} \cdot d^{\delta}$$

where d is the distance between the origin-destination pair, α is a scaling factor (estimated at 0.16) and β and δ are coefficients (estimated to be 1.02 and -0.39 respectively).

Multiplying CV by the average travel time between each origin-destination pair gives an estimate of the standard deviation of travel time reliability. The standard deviation of travel time in the Base Case and Program Cases is therefore given by:

$$\begin{aligned} \sigma &= t_{modelled} \cdot CV \\ &= t_{modelled} \cdot 0.16 \left(\frac{t_{modelled}}{t_{freeflow}}\right)^{1.02} d^{-0.39} \end{aligned}$$

The benefit was then calculated using the consumer surplus approach given in Section A.2.1 to the standard deviation of travel time and trip numbers as output from VITM as follows:

$$CS = \tfrac{1}{2}(T_0 + T_1)(\sigma_0 - \sigma_1) \cdot VOR$$

where:

CS = consumer surplus

T = number of trips

σ = standard deviation of travel time (perceived cost)

VOR = value of reliability

Subscripts 0,1 refer to the Base Case and Program Case.

With respect to the value of reliability (**VOR**) relative to value of time, WebTag guidance (2014) advises that travel time reliability for:

- Cars is equivalent to 0.8 units of in-vehicle travel time
- Commercial vehicles is equivalent to 1.2 units of in-vehicle travel time.

A.4.4 Travel time in congested conditions

Standard travel time benefits capture changes in the opportunity cost of time spent travelling, measured as either willingness to pay for additional leisure time or the resource costs of labour.

However, this does not capture the full benefits to road users who also perceive a reduction in utility as a result of discomfort and lack of amenity from travelling in congested conditions. Research from overseas[66] shows that the value of time increases with the level of congestion, reflecting the increased stress and effort associated with driving in more congested conditions.

As the Program Cases result in some mode shift from road to public transport, some road links will become less congested and remaining road users will benefit from travelling in less congested conditions.

Travel time benefits from improved congestion have been valued by applying estimates of the value of time in congested compared to uncongested conditions.

These have been estimated in the VITM model by calculating whether weighted travel time hours experiencing volume to capacity ratios reduce relative to the Base Case.

The benefit is incremental to road user travel time savings (described in Section A.4.1) and is related to reduced discomfort from travelling in congested conditions (deemed to be roads with volume-capacity (**V/C**) ratios greater than 0.7), similar to the way that weightings are applied to crowded in-vehicle time on public transport (as described in Section A.3.2).

The congested time saving benefit is calculated by:

$$\sum Congested\ time\ saving * Value\ of\ congested\ travel\ t\ ime$$

[66] See for example Wardman & Ibanez, (2012).

Where the perceived change in travel time caused by congestion on the road is given by:

$$\Delta T_1^C = \min\left(0.0, \max\left(1.0\frac{V_l - 0.7C_l}{0.3C_l}\right)\right) \cdot T_l$$

where:

ΔT_1^C = perceived incremental travel time caused by congestion

T_l = congested travel time on link

V_l = traffic volume on link

C_l = capacity on link

The transport models measure the travel time spent by road users in congested conditions between each origin-destination pair in the model. The time savings are then valued using values of time given in Table A - 12.

Table A - 12: Value of time in congested conditions (V/C ratio equal to 1.0 or higher) ($ per person-hour)

	Value of time in congested conditions[1]
Car	$5.30
Rigid truck	$4.04
Articulated truck	$4.04

Note 1: Source: Department of Treasury and Finance (2015, p. 62)

The values of time given in the above table increase linearly in proportion to the V/C ratio whereby travel time costs on links with V/C ratios of 0.7 or below are valued at zero, and those on links with V/C ratios of 1.0 or above are valued at the full rate.

The transport models measure the amount of time spent by road users travelling on roads with V/C ratios greater than 0.7 between each origin-destination pair. The consumer surplus of travel time savings is applied using the general approach given in Section A.2.1 to the travel time in congested conditions and trip numbers as output from VITM as follows:

$$CS = \frac{1}{2}(T_0 + T_1)(PC_0 - PC_1)$$

Where:

CS = consumer surplus

T = number of trips

PC = travel time in congested conditions (perceived cost)

Subscripts 0,1 refer to the Base Case and Program Case.

A.4.5 Toll cost savings

Toll charges form part of drivers' perceived cost of travel between an origin and destination. The perceived costs of tolls are the actual toll amounts and charges paid by toll road users or faced by potential users. However, the resource costs of tolls, for cars at least, are near zero.

Tolls are charged to recover the capital and operating costs of toll roads and therefore could be considered to reflect a resource cost. However, sometimes tolls are just charged to recover the cost of purchasing a concession from the government to charge tolls on an existing road. In either case, by the time trips are made on a road the capital costs are 'sunk' and use of the road causes minimal on-going resource costs. Trucks may cause pavement wear and the road operator needs to provide traffic management and incident response functions but these costs are small compared to the financing and amortisation of the capital costs.

It might also be argued that cars impose congestion costs on other road users in peak periods and that the tolls reflect this resource cost. However, congestion costs and reductions in congestion are explicitly estimated in an economic analysis. It would be double counting to include tolls paid by new road users (or saved by lost users) as a resource cost in a project evaluation in addition to the congestion costs (or savings) resulting from changes in traffic volume. Each of the foregoing explanations result in the conclusion that tolls are a transfer and the resource cost of tolls is zero.

Because the resource costs of tolls are different from perceived costs, a resource cost correction is required in the economic analysis.

The consumer surplus component of toll cost savings is applied using the general approach to the tolls and trip numbers as output from VITM as follows:

$$CS = \frac{1}{2}(T_0+T_1)(PC_0-PC_1)$$

The resource cost correction is calculated by applying the general approach given in Section A.2.2 to tolls and trip numbers as output from VITM as follows:

$$RCC = (T_0RC_0 - T_0PC_0) - (T_1RC_1 - T_1PC_1)$$

Where:

CS = consumer surplus

RCC = resource cost correction

T = number of trips

PC = toll (perceived cost)

RC = toll (resource cost)

Subscripts 0,1 refer to the Base Case and Program Cases

Since the toll resource cost (**RC**) is zero and the fare perceived cost (**PC**) is the fare amount, the above formula can be simplified to:

$$RCC = T_1PC_1 - T_0PC_0$$

A.4.6 Car parking cost savings

Car parking costs form part of drivers' perceived cost of travel between an origin and destination.

The perceived costs of parking charges are the actual charges paid by road users or faced by potential users.

Reduced car usage results in a reduction in the demand for parking facilities. The resource costs of car parking can include the opportunity cost of land, the capital cost of parking facilities and the provision of adequate security.

The consumer surplus component of car parking cost savings is applied using the general approach given in Section A.2.1 to the parking charges and trip numbers as output from VITM as follows:

$$CS = \frac{1}{2}(T_0+T_1)(PC_0-PC_1)$$

The resource cost correction is calculated by applying the general approach given in Section A.2.2 to car parking charges and trip numbers as output from VITM as follows:

$$RCC = (T_0RC_0 - T_0PC_0) - (T_1RC_1 - T_1PC_1)$$

Where:

RCC = resource cost correction

T = number of trips

PC = parking cost (perceived cost)

RC = parking cost (resource cost)

Subscripts 0,1 refer to the Base Case and Program Cases

However, as the car parking charges for any given zone and year are assumed to be the same in the Base Case and Program Cases, C_0 is equal to C_1 and hence the resultant consumer surplus is zero. The resource cost correction simplifies to:

$$RCC = (T_0 - T_1)(RC_0 - PC_0)$$

A.4.7 Other societal benefits / externalities

Crash cost savings

Crash cost savings relate to reduction in road crashes which is a function of the change in the number of vehicle kilometres travelled as a result of some car drivers switching from car to public transport use.

The unit rates per vehicle-kilometre for crash costs have been derived from crash rates given in Austroads (2012) and crash costs given in the NGTSM (Transport and Infrastructure Council, 2015). A crash cost unit rate was derived for freeways and undivided roads and a weighted average taken, as shown in Table A - 13, Table A - 14 and Table A - 15.

The crash cost savings are obtained by multiplying the unit rates given in Table A - 13 to the change in the number of vehicle-kilometres travelled between the Base and Program Cases as output by the VITM model.

Table A - 13: Crash rate for undivided roads

	Crash rate (Crashes per 100m vehicle-kilometres)	Crash cost ($ per crash, $2013)
Fatal	1.28	$8,409,584
Injury	24.33	$178,552
Property damage only	41.87	$9,257
Weighted average crash cost per vehicle-kilometre		**$0.16/vehicle-km**

Notes:

1. *Source: Austroads (2012, p. 23)*
2. *ATAP (2018), PV2, page 30, Table 20*

Table A - 14: Crash rate for freeways

	Crash rate (Crashes per 100m vehicle-kilometres)	Crash cost ($ per crash, $2013)
Fatal	0.4	$8,409,584
Injury	5.35	$178,552
Property damage only	14.25	$9,257
Weighted average crash cost per vehicle-kilometre		**$0.04/vehicle-km**

Notes:

1. *Source: Austroads (2012, p. 23)*
2. *ATAP (2018), PV2, page 30, Table 20*

Table A - 15: Weighted average crash costs

	Assumed proportion of vehicle-km	Crash cost per vehicle-km[2]
Undivided roads	70%	$0.16
Freeway	30%	$0.04
Weighted average crash cost per vehicle-kilometre ($2013)		$0.12
Weighted average crash cost per vehicle-kilometre ($2018)[2]		**$0.16**

Notes:

1. *From Austroads (2012)*
2. *Indexed from June 2013 to March 2019 using ABS CPI component of medical, dental and hospital services (ABS Catalogue 6201)*

A.4.8 Environmental externalities

Environmental externality cost savings are calculated as a function of the change in the number of vehicle kilometres travelled as a result of some car drivers switching from car to public transport use.

The greenhouse gas emission savings based on CO_2 equivalent is estimated separately in line with IA guidelines.

The unit rates per passenger-kilometre and per tonne-kilometre are adopted from Austroads (2014) and shown in A.4.2. For light commercial vehicles (**LCV**) and heavy commercial vehicles (**HCV**), the rate given in Austroads are per tonne-km. A rate per vehicle-km has been derived using estimates of average load per trip. Similarly, for car, bus and rail the vehicle-km rates have been derived using estimates of average vehicle occupancy.

The environmental externality cost savings are obtained by multiplying the unit rates given in Table A - 16 to the change in the number of vehicle-kilometres travelled between the Base and Program Cases as output by the VITM model.

Table A - 16: Environmental externality parameters[1]

	Car ($/1000 pkm)	Bus ($/1000 pkm)	Rail ($/1000 pkm)	LCV ($/1000 tkm)	HCV ($/1000 tkm)
Greenhouse gas emissions (CO_2)	$4.33	$2.07	$0.48	$12.26	$2.80
Air Pollution	$8.18	$8.44	$4.04	$27.45	$12.10
Noise	$1.95	$1.80	$1.67	$8.38	$2.56
Soil and Water	$0.44	$1.03	$0.75	$2.53	$1.26
Biodiversity	$0.39	$0.53	$0.01	$1.03	$0.85
Nature & Landscape	$0.09	$0.03	$0.03	$1.35	$0.10
Urban Separation	$1.40	$0.54	$0.75	$4.84	$0.82
Upstream & Downstream Costs	$5.33	$2.09	$8.66	$13.75	$2.95
Total	**$22.11**	**$16.53**	**$16.39**	**$71.59**	**$23.44**

Notes:

1. *From Austroads (2012)*
2. *All values indexed to March 2019 using ABS Australia CPI for all groups*

A.4.9 Improved health due to increased walking and cycling

Transport systems and urban form are also increasingly recognised as a factor influencing public health outcomes, and in particular it is considered that car-dependency has led to the creation of obesogenic environments (an environment which promotes gaining weight and is not conducive to losing weight).

By increasing the attractiveness of rail travel as an alternative to car travel, people are more likely to engage in incidental exercise when travelling to stations. This is likely to produce a reduction in the intensity and health care costs.

The value of health benefits associated with walking and cycling have been derived from the ATAP guidelines. This provides a unit rate per kilometre for walking and cycling based upon the avoidable annual mortality and morbidity costs and health sector costs associated with inactivity. The Guidelines also provide the number of additional kilometres required to be walked or cycled to achieve the required level of activity for people who fall into three categories: inactive, insufficiently active and sufficiently active. The reduction in mortality and morbidity costs have been considered a user benefit, whereas the reduction in health sector costs have been considered an externality.

The ATAP rate per kilometre are based upon the proportion of inactive, insufficiently active and sufficiently active people for the whole Australian population (20.5 per cent, 36 per cent and 43.5 per cent respectively. However, analysis of VISTA data cited in Rissel, Curac, Greensway, & Bauman (2012) shows that public transport users walk up to 41 minutes per day (which would categorise them as 'sufficiently active') whilst car users walk only 8 minutes per day (which would categorise them as 'insufficiently active'). Therefore the proportions of inactive, insufficiently active and sufficiently active were modified based upon the estimated number of new users who switch from car to public transport with SRL – Cheltenham to Airport (insufficiently active, 6 per cent), and the number of existing public transport users (sufficiently active, 94 per cent) to derive a weighted average appropriate to Melbourne public transport users. A weighted average rate for walking and cycling was derived based upon surveys of access mode to public transport. Table A - 17, Table A - 18 and Table A - 19 show the calculation steps in the derivation of unit rate for the health benefit per additional kilometres walked / cycled to access public transport.

The ATAP provided parameter values demonstrate the total health benefit accruing from active transport. That is, that the values provided consider both the benefit to the user (such as the longer life expectancy of active people relative to inactive) and the external benefit to society (such as the reduction in health system costs as active people are less likely to require medical and/or hospital care). To provide consideration for the two different benefit streams a scaling factor of 35 percent (consistent with Table 7 of the ATAP guidelines) has been applied to total health benefit to estimate the proportion of the benefit attributed to society.

To calculate the total health benefits from improved health due to increased walking and cycling, the derived rate was multiplied by the change in the number of kilometres walked by public transport users (as output from the VITM model).

Table A - 17: Per-kilometre weighted health benefits from walking

		Inactive	Insufficiently active	Sufficiently active
A	Annual health benefit (avoided health cost) for active travel[1]	$2,858 per person annum		
B	Weighting applied to persons health status[2]	1	0.85	0.15
C	Walking distance required to achieve Annual Health Benefit[2]	625km	450km	312km
D=AxB	Maximum allowable annual benefit by persons health status	$2,928	$2,489	$293
E=D/C	Benefit per kilometre walked	$4.68	$5.53	$0.94
F	Proportion of inactive / insufficiently active / sufficiently active public transport users[3]	20.5%	36%	43.5%
G	**Weighted average rate per kilometre walked**	**$3.56**		

Notes:

1. *Source: ATAP (PV4 - 5.3.7 Parameter values for walking benefits, 2016, Table 9). Annual benefit indexed to March 2019 using ABS CPI component of Medical, dental and hospital services*
2. *Source: Transport and Infrastructure Council (2014, p. 41)*
3. *Source: ABS, 4364.0.55.004 - Australian Health Survey: Physical Activity, 2011-12, Download Data cube Table 4. Sufficient physical activity measure by selected population characteristics, Persons aged 18 years and over (estimate) (43640DO004_20112012 Australian Health Survey: Physical Activity, 2011-12-Australia), 2013*

Table A - 18: Per-kilometre weighted health benefits from cycling

		Inactive	Insufficiently active	Sufficiently active
A	Annual health benefit (avoided health cost) for active travel[1]	$2,858 per person annum		
B	Weighting applied to persons health status[2]	1	0.85	0.15
C	Cycling distance required to achieve Annual Health Benefit[2]	1250km	900km	624km
D=AxB	Maximum allowable annual benefit by persons health status	$2,928	$2,489	$293
E=D/C	Benefit per kilometre cycled	$2.34	$2.77	$0.47
F	Proportion of inactive / insufficiently active / sufficiently active public transport users[3]	20.5%	36%	43.5%
G	**Weighted average rate per kilometre cycling**	**$1.78**		

Notes:

1. *Source: ATAP (PV4 - 5.3.7 Parameter values for cycling benefits, 2016, Table 10). Annual benefit indexed to March 2019 using ABS CPI component of Medical, dental and hospital services*
2. *Source: Transport and Infrastructure Council (2014, p. 41)*
3. *Source: ABS, 4364.0.55.004 - Australian Health Survey: Physical Activity, 2011-12, Download Data cube Table 4. Sufficient physical activity measure by selected population characteristics, Persons aged 18 years and over (estimate) (43640DO004_20112012 Australian Health Survey: Physical Activity, 2011-12-Australia), 2013*

Table A - 19: Weighted average rate for walking and cycling

	Proportion using mode to access public transport[1]	Health benefit per kilometre
Walking	98.6%	$3.56[2]
Cycling	1.4%	$1.78[3]
Weighted average		**$3.54**

Notes:

1. *Source: 2010 Metlink Train O-D Station Access Survey*
2. *Table A - 18 Per-kilometre weighted health benefits from cycling*
3. *Table A - 19: Weighted average rate for walking and cycling*

A.4.10 Infrastructure residual value

Benefits have been assessed over a 50-year period from project opening. However, the infrastructure has an economic life beyond the end of the evaluation period. The residual value is an estimate of the economic benefit of the infrastructure from the end of the evaluation period to the end of the economic life of the asset.

Table A - 20 below includes economic life estimates for assets as per ATAP guidelines. A number of these assets, in particular rail infrastructure, are estimated to have an economic life that extends beyond the 50 year evaluation period. It is therefore prudent to accurately reflect the residual value of the assets beyond the end of the evaluation period.

A weighted average asset life for the project as a whole has been developed based on cost information provided by the cost advisor.

Table A - 20: Typical economic lives for infrastructure assets

Asset class	Estimated economic life (years)
Network infrastructure	
Rail extensions	70
Earthworks	50–150
Bridges – concrete	120
Bridges – timber	40
Tunnels	100
Culverts	100–120
Rail track	50–100
Turnouts	15–50
Ballast	60
Sleepers – concrete	50
Sleepers – timber	20
Nodal infrastructure	
Stations – rail / light rail	50

System and miscellaneous infrastructure	
Depots, buildings (miscellaneous)	40–50
Plant and equipment (miscellaneous)	12
Control centres (IT systems, excl. buildings)	5
Rail signals and communications	20

Source: Australian Transport Council (2006). National Guidelines for Transport System Management in Australia

A.4.11 Option and non-use values

Option and non-use value should be included in the economic appraisal if the project being appraised includes measures that will change the availability of transport services within the study area (e.g. the opening of a rail service), according to the Transport Analysis Guide (**TAG**) of the UK Government[67]. Option and non-use value is considered relevant for this economic appraisal. SRL – Cheltenham to Airport provides a new rail service for travellers to the Melbourne airport.

An **option value** is the willingness-to-pay to preserve the option of using a transport service for trips not yet anticipated or currently undertaken by other modes, over and above the expected value of any such future use. Important features for option values include:

- They are associated with uncertainty about use of the transport facility
- They may exist even if the option of using the transport service is never taken up
- They are related to the individual's attitude to uncertainty.

Non-use values are the values that are placed on the continued existence of a service, regardless of any possibility of future use by the individual in question. The motivation for the desire for a transport service to continue to exist may vary from one circumstance to another. For example, individuals may value a transport facility for altruistic reasons, reasons of indirect use or because it has some existence, bequest or intrinsic value. For example, a project that introduces a railway line, linking a series of towns and villages to a major town or city that already has a highway connection. Even if a particular individual living in one of the villages along the route does not intend to use the rail service, they may still value having the option to use the service. A car owner may value the ability to use the service when, for whatever reason, they cannot drive or their car is unavailable. A non-car-owning resident who generally does not travel beyond the village may value the knowledge that, should they need to reach the town or city, the facilities exist for them to do so, at reasonable cost and with a reasonable level of convenience. Whilst a full analysis of user benefits will include the expected value of any such occasional use, theory suggests that, in circumstances where the lack of the transport facility would cause inconvenience, people may be willing to pay a premium over and above their expected use value to ensure that the service exists for unplanned trips, as a sort of insurance.

Option and non-use value is recognised by ATAP (2018), but it does not provide detailed quantification parameters. More literature and quantification guides are available by the UK government and are provided by its TAG.

According to the TAG, when quantifying option and non-use value, it is necessary to calculate the number of households that will be affected by the project, then apply the willingness to pay to have the new mode of service of interest. Table A - 21 below provides the willingness to pay for the option and

[67] (UK Government, 2017). Transport Analysis Guide (TAG) unit A4-1 social impact appraisal.

non-use value of a new train service (bus service previously exists). Thus, £119 has been used as the relevant quantification value for SRL – Cheltenham to Airport's option and non-use value.

Table A - 21: Option and non-use value for rail and bus

	Willingness to pay per household per year (in 2010 pounds terms)[1]
Train service	£241
Bus service	£122
New train service in addition to existing bus service	**£119**

Notes:

1. *Source: TAG of UK Government (2017). Unit A4-1 social impact appraisal, Appendix A*
2. *UK pounds are converted to Australian dollars based on five year term exchange rate published by Reserve bank of Australia*
3. *CPI (all goods component) indices published by ABS is used to inflate the 2010 dollars to its current value*

This value was then multiplied by the number of households SRL – Cheltenham to Airport will impact to calculate the economic benefit of option and non-use value for SRL – Cheltenham to Airport. The number of households that will be impacted are those who have travelled via Melbourne Airport, as well as universities students, which can be sourced from VITM. As recommended by TAG (2017), the households applicable are those living in the project catchment area (Victoria in the context of this appraisal) who travel for personal reasons (as opposed to business purposes). Given the scope of SRL – Cheltenham to Airport it is reasonable to assume that all Victorians will at some stage have the option to utilise the line.

A conversion factor of 2.6 is assumed to convert the number of persons generated by VITM to the number of households. This conversion factor is based on the 2016 ABS Census for Victoria publication of average number of persons per household. This is a conservative measure given that it is not necessary that the entire household travel together.

The above can be summaries in mathematic forms as follows:

$$O = \left(HH_{PC} - HH_{BC}\right) \times WTP$$

where:

O = Option And non-use value

HH = number of households

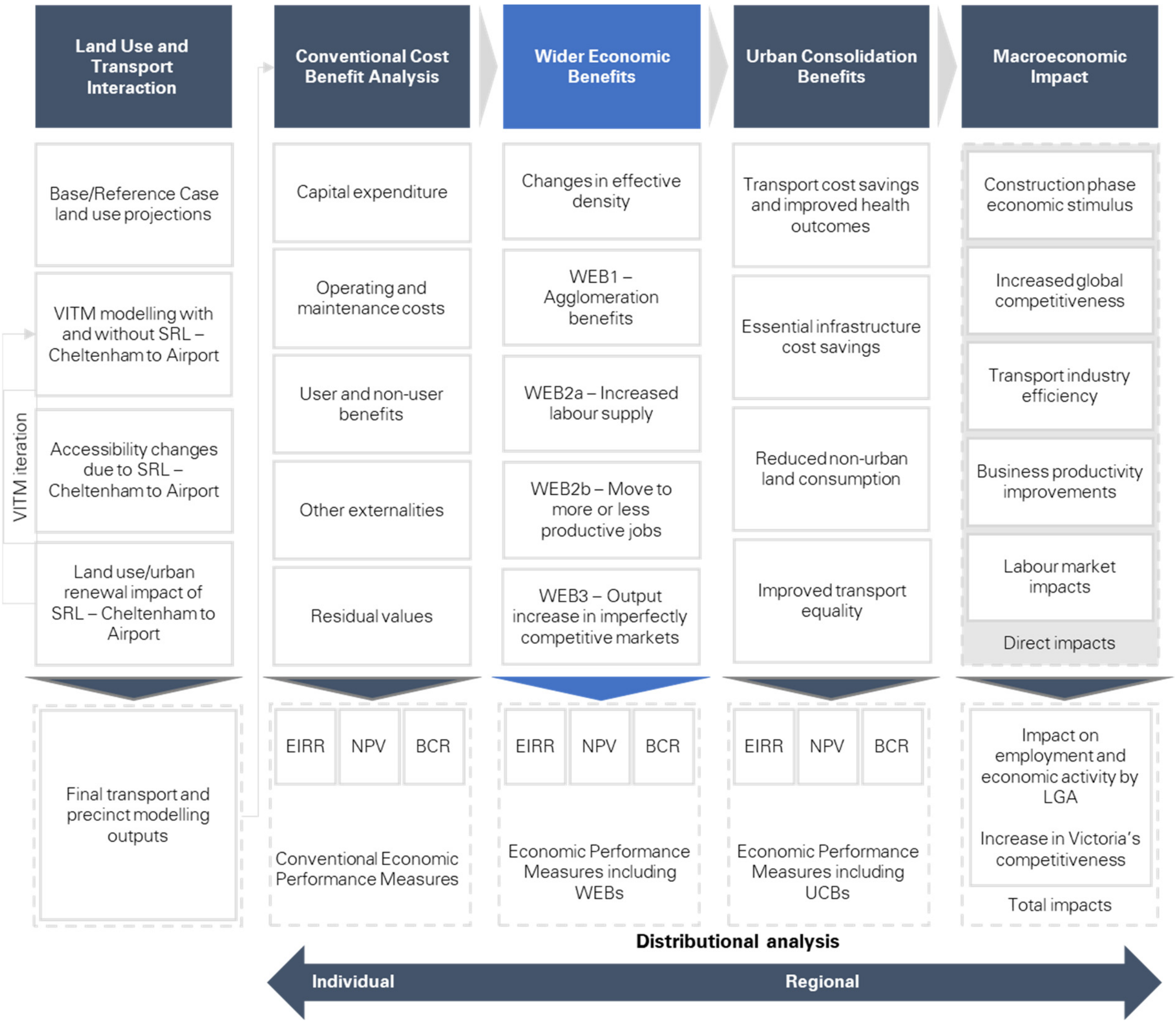
WTP = willingness to pay for the rail service as an option

Subscripts BC refers to the Base Case and PC refers to the Program Case.

Attachment B: WEBS appraisal approach

This attachment presents the detailed approach and assumptions regarding the calculation of WEBs for SRL – Cheltenham to Airport. Figure B - 1 highlights the components of the WEBs analysis that have been quantified for the economic evaluation.

Figure B - 1: WEBs within the overarching economic appraisal framework



Source: KPMG.

B.1 Approach for assessing WEBs

The methodologies used to quantify the WEBs for SRL – Cheltenham to Airport comply with the relevant draft ATAP guideline (2020) *T3 Wider Economic Benefits* (**T3 WEBs**).

Consistent with the T3 WEBs guideline, the WEBs expected to be generated by SRL – Cheltenham to Airport were quantified in consideration of the dynamic effect caused by land use. The appraisal of land use impacts caused by changes in accessibility due to transport projects is considered best practice and parallels the approach used in the UK 2007 CrossRail business case and the Australian 2016 Melbourne Metro business case.

A key benefit of SRL – Cheltenham to Airport is improving the connectivity to the SRL East and SRL North Precincts that account for a significant part of the NEICs. SRL East and SRL North Precincts are among the locations with greater employment mass in Melbourne, and thus are subject to greater productivity potential (after the Melbourne CBD).

Similar to CrossRail and Melbourne Metro, SRL – Cheltenham to Airport bolsters continued employment growth in these employment centres, through both more efficient transport network (e.g. reduced journey time) and attractiveness of the place for working and living (e.g. agglomeration and precinct development).

The increase in employment can lead to higher employment density which results directly in additional WEBs due to agglomeration (WEB1) and a move to more productive jobs (WEB2b). Increased employment accessibility in these employment centres enables agglomeration benefits by facilitating increased economic interactions between firms, and also between firms and customers. This leads to benefits as firms are able to enhance their productivity through reaching wider markets, gaining scale economies and developing more specialised skills. Additionally, increased employment density leads to a greater number of high productivity jobs being available for workers. This benefit is known as a 'move to more productive jobs' and in turn leads to greater tax receipts.

B.2 WEB1: Agglomeration economies

Agglomeration economies are positive externalities which arise from increases in the density of economic activity. The existence of agglomeration economies is one of the reasons that cities exist, as inner city offices continue to attract tenants despite increasing rents and congested transport networks. Firms benefit from access to greater numbers of other firms, workers and customers. These benefits arise from sharing of inputs and outputs, better matching of workers to employers, and suppliers or customers to firms, and employees learning from one another.

The Melbourne CBD is characterised as high concentration of employment, with a peak employment density of 110,000 jobs per square kilometre in the Hoddle Street Grid. This concentration has increased over time, as agglomeration economies have created a positive feedback loop, encouraging more firms to locate centrally. This same dynamic is apparent in other major cities. In New York and London, peak employment density have reached around 150,000 jobs per square kilometre[68]. High employment density leads to increased economic interactions between firms, and also between firms and

[68] Smith, Duncan. World City Living and Working Densities: Poles Apart? (2012).

customers. This leads to benefits as firms are able to enhance their productivity through input sharing, knowledge / technological spillovers and output sharing.

Also, the SRL East and SRL North Precincts (accounting for a significant part of the NEICs) are among the locations with greater employment mass in Melbourne. They are subject to greater agglomeration and productivity potential after the Melbourne CBD which is saturated with high rents and affordability.

Fostering employment growth in the SRL East and SRL North Precincts and support productivity growth in these locations can help addressing the inefficiencies posed by Melbourne's monocentric urban form (discussed in the SRL Business and Investment Case as one of the key challenges). For example, from a productivity perspective, supporting growth in the SRL East and SRL North Precincts can create agglomeration among businesses who are crowded out by the high rents of the CBD, and would have to scatter across the middle and outer suburbs without SRL – Cheltenham to Airport.

The method used for estimating the SRL – Cheltenham to Airport agglomeration economies is consistent with the methodology and parameters specified in T3 WEBs guideline.

In particular, agglomeration impacts are determined by the changes in Gross Value Added (**GVA**) for all industries and all origins (at travel zone level as per T3 WEBs guideline). The change in GVA by industry for each origin is mainly driven by the percentage change in productivity between Base Case and Program Case which reflects the rate of change in Effective Density. Change in Effective Density is the mechanism through which agglomeration impacts are transmitted (either through changes in transport network performance, changes in land use or both). Effective Density is a quantitative measure of access to opportunities, for instance typical jobs, which is quantified using a measure of travel impedance (e.g. generalised cost, time or distance of travel).

The impact of SRL – Cheltenham to Airport on Melbourne's agglomeration economy is through its potential to increase job density in current employment centres (especially in the NEICs) and subsequently increase the productivity in these centres (and Melbourne collectively). The appraisal for SRL – Cheltenham to Airport considers dynamic agglomeration, which is caused by not only improved transport network performance (static agglomeration), but also the land use impact on the clustering of jobs as per the T3 WEBs guideline.

Algebraically, agglomeration economies can be estimated as:

WEB1 = Change in Gross Value Added for all industries across all origins

The mathematical form is shown in Equation 1 below.

Equation 1

$$WB1 = \sum_{ind} \sum_{i} D\ GVA_{ind,i} \qquad (1)$$

Where:

$D\ GVA_{ind,i}$ = the change in Gross Value Added of all industries in origin i

The change in gross value added ($) by industry for each origin i ($D\ GVA_{ind,i}$) can be estimated as set out below.

Equation 2

$$\Delta GVA_i = \frac{\Delta Productivity_i}{Productivity_i} \cdot GVApw_i^B \cdot M_i^B \qquad (2)$$

Where:

$\frac{\Delta Productivity_i}{Productivity_i}$ = percentage change in productivity at origin i

$GVApw_i^B$ = gross value added per worker by industry at origin i, Base Case ($)

M_i^B = employment by industry at origin i, Base Case ($)

The percentage change in productivity by industry for each origin i can be estimated as set out below.

Equation 3

$$\frac{\Delta Productivity_i}{Productivity_i} = \left(\frac{ED_i^P}{ED_i^B}\right)^{\rho} - 1 \qquad (3)$$

Where:

ED_i^B = the Effective Density at origin i in the Base Case

ED_i^P = the Effective Density at origin i in the Program Case

ρ = productivity elasticity for a given industry group

The T3 WEBs guideline suggested the use of gross value added per worker by industry for each small area provided on the ATAP website. This appraisal has thus adopted these values; when applying these values to estimate productivity impacts in future years, the gross value added per worker was adjusted for changes in labour productivity over time for the appraisal period. The annual productivity growth is assumed to be 1.5 per cent based on Commonwealth Government projections of long-term labour productivity growth published in the 2015 Intergenerational Report (**IGR**) (Commonwealth of Australia, 2015).

Effective Density

The quantification of agglomeration economies relies on the concept of Effective Density, the elasticity parameters and estimation method of which by this appraisal are in accordance with the T3 WEBs guideline.

SRL – Cheltenham to Airport is expected to improve journey time for those travel to and from the middle ring (details provided in the Demand Modelling Report) and employment density in the SRL East and SRL North Precincts (discussed in the CityPlan Modelling Report). Thus, it is expected that SRL – Cheltenham to Airport will increase effective density for Melbourne overall, and especially in and around the SRL East and SRL North Precincts.

The concept of Effective Density is built on physical density, which is the number of jobs within a given unit of area (e.g. jobs per square kilometre). Effective density is the weighted number of jobs accessible within a given travel impedance.

The overall Effective Density for a particular zone is the sum of the Effective Density within all other zones (including itself). The equation for estimating Effective Density (noted as ED) is shown in Equation 4 below.

Equation 4

$$ED_i = \sum_j \frac{M_j}{(ACG_{ij})^{\alpha}} \qquad (4)$$

Where:

M_j = the total employment at destination j

ACG_{ij} = factor representing accessibility of destination j from origin i

α = decay curve parameter

The above specification for Effective Density takes into account both the proximity (due to transport network impacts) and the scale (due to land use impacts) of economic activity at the destination, ensuring that those destinations that have low travel impedance but also low employment are weighted lower when compared to destinations that have low travel impedance and high employment.

Proximity effects and cluster effects arise from two different mechanisms for changing Effective Density, via either a change in the denominator (Decay factor – enabled by changes in travel impedance) or the numerator (Employment – enabled by increases in physical employment density) in Equation 4. This means that either or both impacts, e.g. decrease in travel times (proximity effects) or an increase in physical employment density (cluster effects), can lead to an increase in Effective Density and therefore give rise to agglomeration economies.

Measure of travel impedance

The purpose of the decay factor is to assign high weights to 'near' jobs and low weights to 'far' jobs. As per the T3 WEBs guideline, the appropriate measure to use as the travel impedance between travel zones is travel time.

Average generalised cost (AGC)

In order to measure Effective Density, a single measure of travel impedance that considers all modes, trip purposes and time periods is necessary. As per T3 WEBs guideline, the sum of Base Case and Program Case trip numbers are used as weights to take a weighted average as shown in Equation 5 and 6 below. This equation is applied separately to each origin-destination pair for Base Case and Program Cases.

Equation 5

$$AGC_{ij}^{\boldsymbol{B}} = \frac{\sum_{m,p,t}\left(T_{ij}^{B,m,p,t}+T_{ij}^{P,m,p,t}\right)g_{ij}^{\boldsymbol{B},m,p,t}}{\sum_{m,p,t}T_{ij}^{B,m,p,t}+\sum_{m,p,t}T_{ij}^{P,m,p,t}} \quad (5)$$

Equation 6

$$AGC_{ij}^{\boldsymbol{P}} = \frac{\sum_{m,p,t}\left(T_{ij}^{B,m,p,t}+T_{ij}^{P,m,p,t}\right)g_{ij}^{\boldsymbol{P},m,p,t}}{\sum_{m,p,t}T_{ij}^{B,m,p,t}+\sum_{m,p,t}T_{ij}^{P,m,p,t}} \quad (6)$$

Where:

AGC_{ij} = average generalised cost of travel between origin i and destination j

T_{ij} = number of trips

g_{ij} = generalised cost of travel between zones

m = transport mode (e.g. car, public transport)

p = trip purpose (e.g. business, commuting, freight)

t = time period (e.g. AM peak, inter-peak, PM peak, off-peak)

AGC can be calculated using inputs from the VTIM.

Decay factors

The decay factor represents how the propensity to travel declines as travel time increases. As per the T3 WEBs guideline, decay factors are specified with per industry group as with production elasticities as shown in Table B - 1 below.

Table B - 1: Estimated elasticities of productivity with respect to ED by industry

ANZSIC	Industry	Group	Productivity elasticity	Decay curve parameter
A	Agriculture Forestry and Fishing	1. low productivity elasticity, low distance decay rate	0.025	**1.1**
B	Mining			
C	Manufacturing			
D	Electricity Gas Water and Waste Services			

ANZSIC	Industry	Group	Productivity elasticity	Decay curve parameter
E	Construction	2. low productivity elasticity, high distance decay rate	0.025	**1.8**
F	Wholesale Trade			
G	Retail Trade			
H	Accommodation and Food Services			
I	Transport Postal and Warehousing			
P	Education and Training			
Q	Health Care and Social Assistance			
R	Arts and Recreation Services			
S	Other Service			
J	Information Media and Telecommunications	3. high productivity elasticity, high distance decay rate	0.08	**1.8**
K	Financial and Insurance Services			
L	Rental Hiring and Real Estate Services			
M	Professional Scientific and Technical Services			
N	Administrative and Support Services			
O	**Public Administration and Safety**			

Source: The draft ATAP guideline (2020) T3 Wider Economic Benefits

B.3 WEB2: Labour market deepening

Transport projects can enable labour market benefits by reducing the generalised cost of commuting. Lower generalised costs of commuting reduces barriers to people taking up work / working longer hours or switching to jobs that better match their skills and areas of interest, e.g. moving to more productive jobs. Conventional economic analysis captures the benefits of transport infrastructure to new users through time and operating cost savings, but does not capture the benefits of additional tax revenue due to increased labour force participation or increased productivity of workers. Therefore, labour market deepening benefits arise from the market imperfection created by taxation, in which Government realises a proportion of the benefits of increased economic activity.

Labour market deepening benefits arise from increased participation in the labour market (*WEB2a: increased labour supply*) and from existing workers switching to more productive jobs (*WEB2b: move to more productive jobs*).

SRL – Cheltenham to Airport reduces travel time and improves travel time reliability, which in turn encourages job participation (e.g. less burdensome to get to and from work, especially for people with caring responsibilities) and allows greater accessibility to better matched jobs (e.g. quicker to get to the precincts which provides a diverse pool of employment options, and thus greater opportunity to find a more matched / productive / paid job).

B.3.1 WEB2a: Increased labour supply

Increased labour supply benefits (WEB2a) are based on the theory that in choosing whether to take up work, individuals trade off the perceived benefit of the potential wages with the perceived disbenefit of commuting. A reduction in commuting costs can impact the supply of labour, either by increasing the number of people who choose to work (e.g. an increased participation rate) or by increasing the number of hours worked by those already working. This can be alternatively described as an increase in the labour supply at the extensive and intensive margin respectively.

In either case, there is no additional benefit to the individual. An individual who is encouraged to work by a change in transport cost previously assessed the utility of leisure time as greater than the utility of working net of transport costs. If that individual enters the labour force, the benefit to them cannot be greater than the user benefit counted as part of the conventional travel time savings.

The welfare benefit then is the additional tax revenue received by Government, which is a combination of taxes on labour (income and payroll tax) as well as tax on the additional output created by businesses.

Increased labour supply benefits are quantified by estimating the change in the average daily generalised cost of commuting due to the transport improvement for all travel zones in Melbourne. The perceived benefit of working (measured in dollars) for each area is defined as the average daily wage minus the average daily generalised cost of commuting. A reduction in the generalised cost of commuting translates to an increase in the perceived benefit of working.

Algebraically, increased labour supply can be estimated as:

WEB2a = Change in Tax revenue between the Base and Program Cases

The mathematical form is shown in Equation 7 below.

Equation 7

$$WB2a = \sum_i(\tau_{LS} \cdot D\ GW_i) \qquad (7)$$

Where:

$D\ GW_i$ = additional gross wages earned by workers resident at each origin i

τ_{LS} = the effective tax take resulting from changes in labour supply (0.17)

The total change in gross wages ($D\ GW_i$) earned by workers resident at each origin i attributable to the transport intervention can be estimated as below.

Equation 8

$$D\ GW_i \approx \eta_h \cdot \eta_w \cdot (LFP_{i,PC} - LFP_{i,BC}) \cdot WAP_i \cdot AGW_i \qquad (8)$$

Where:

$LFP_{i,PC}$ = labour force participation rate for the Program Case for each origin i

$LFP_{i,BC}$ = labour force participation rate for the Base Case for each origin i

WAP_i = working age population usually resident at origin i

AGW_i = average gross wage per worker at origin i

η_h = a reduction factor for the reduced working hours of a marginal worker relative to an average worker (0.7)

η_w = a reduction factor for the reduced hourly wage of a marginal worker relative to an average worker (0.8)

The labour force participation rate for the Program Case $LFP_{i,PC}$ for each origin i can be estimated as set out in Equation 9 below.

Equation 9

$$LFP_{i,PC} = LFP_{i,BC} + \varepsilon \cdot \%D\ PNRW_i \quad (9)$$

Where:

$LFP_{i,BC}$ = labour force participation rate for the Base Case for each origin i

$\%D\ PNRW_i$ = percentage change in the perceived net return from working for a marginal worker

ε = the semi-elasticity of labour force participation with respect to the perceived net return from working (0.18)

The labour force participation rate can be defined as set out in Equation 10 below.

Equation 10

$$LFP_i = \frac{W_i}{WAP_i} \quad (10)$$

Where:

W_i = number of workers usually resident at origin i

WAP_i = working age population usually resident at origin i

The percentage change in the perceived net return from working for a marginal worker between the Base and Program Cases $\Delta\ PNRW_i$ for each origin i may be estimated as set out in Equation 11 below.

Equation 11

$$\%D\ PNRW_i = \left(\frac{PNRW_{i,PC}}{PNRW_{i,BC}}\right) - 1 \quad (11)$$

Where:

$PNRW_{i,PC}$ = perceived net return from working at origin i in the Program Case

$PNRW_{i,BC}$ = perceived net return from working at origin i in the Base Case

The perceived (weekly) net return from working $PNRW_i$ for a marginal worker[69] at origin i may be conceptualised as the net wage after taxes and generalised commuting. It is assumed that a full time worker makes five return commuting trips per week (10 trips in total) and a marginal worker takes fewer trips in proportion to fewer hours worked. $PNRW_i$ may be estimated as set out in Equation 12 below.

[69] 'Marginal worker' refers to the worker who is at the margins of decision making and weighs the benefit from working (wages after tax and transport cost) equally to the utility from other activities including leisure.

Equation 12

$$PNRW_i = \eta_h \cdot \eta_w \cdot (1 - \tau_w) \cdot AGW_i - 10 \cdot \eta_h \cdot AGCC_i \qquad (12)$$

Where:

$PNRW_i$= perceived (weekly) net return from working for a marginal worker at origin i

AGW_i = average gross weekly wage per worker at origin i

η_h = a reduction factor for the reduced working hours of a marginal worker relative to an average worker (0.7)

η_w = a reduction factor for the reduced hourly wage of a marginal worker relative to an average worker (0.8)

τ_w = tax wedge for a marginal worker (0.093)

$AGCC_i$ = average generalised cost of one-way commuting trip at origin i

Average gross wages per worker (by usual residence) was sourced from ABS Census data at an SA1 level. Gross wages may be escalated by 1.5 per cent per annum from the evaluation year to forecast years. This aligns with the Commonwealth Government's current assumption from the Intergenerational Report (2015) that labour productivity will grow by 1.5 per cent per annum over the next 40 years.

The average, one-way generalised cost of commuting $AGCC_i$ at origin i for a typical weekday AM peak (e.g. 7am – 9am) can be estimated using Equation 13.

Equation 13

$$AGCC_i = \frac{\sum_j ((V_{ij,car} + V_{ij,pt}) \cdot GC_{ij})}{\sum_j (V_{ij,car} + V_{ij,pt})} \qquad (13)$$

Where:

$V_{ij,car}$ = volume of commuting trips between origin i and destination j by car

$V_{ij,pt}$ = volume of commuting trips between origin i and destination j by public transportation

GC_{ij} = logsum generalised cost ($) of commuting between origin i and destination j

Commuting trip volume inputs can be sourced from a strategic transport model. Logsum generalised cost for each origin-destination pair GC_{ij} can be estimated using Equation 14.

Equation 14

$$GC_{ij} = \frac{\ln \sum_m e^{(\lambda \cdot GC_{ij,m})}}{\lambda} \qquad (14)$$

Where:

λ = a scaling parameter (-0.3)

m = a transport mode (car or public transport)

$GC_{ij,m}$ = generalised travel cost ($) between origin i and destination j for mode m

B.3.2 WEB2b: Move to more productive jobs

Increased employment opportunities within a worker's travel budget mean that a worker can search through a larger range of jobs and better match their skills to the jobs on offer. There is a literature that supports the theory that, at the aggregate level, urban residents tend to have an approximate predetermined daily travel time budget of between one and 1.5 hours (Mokhtarian & Chen, 2004; Stopher & Zhang, 2011). It is within this travel budget that workers search for suitable employment. A transport initiative that lowers the generalised cost of travel could bring more jobs within the travel time budgets of individual workers. Some of them might be able to find higher paying, and therefore, more productive jobs.

The labour productivity differences between locations that give rise to WEB2b are 'place-based effects'. They arise from the specific characteristics of locations such as natural resource endowments and agglomerations that confer productivity advantages on firms and individuals. Such effects are external to the firm or individual, that is, they only act upon firms and individuals in the specific location (UK DfT 2018, pp. 3-4). Differences in productivity between locations that arise from employee characteristics, such as skills, are not relevant. For example, an employee switching jobs to a location where average wages are higher because the existing employees there are more highly skilled, will not automatically acquire additional skills and be paid more.

By removing barriers associated with commuting capacity, SRL – Cheltenham to Airport provides employees with quicker and greater access to a wider number and range of jobs. The improved accessibility due to SRL – Cheltenham to Airport (especially from the SRL East and SRL North Precincts) is evident from the conventional benefit analysis (e.g. improved journey time and reliability). This enables Victorians to better match their skills and experience with the jobs on offer, thereby increasing the economic output and the resultant tax revenue.

The welfare benefit from WEB2b is estimated as the tax raised on the additional value created by existing workers becoming more productive as they move to jobs with higher productivity. The increased tax revenue is estimated by applying the effective tax take resulting from a move to more or less productive jobs to estimate the additional tax revenue attributable to the Program Cases.

WEB2b can only be estimated where land use impacts of the transport intervention are available. This is because the benefit is fundamentally driven by land use changes (e.g. jobs moving from lower to higher productivity areas). As supported by T3 WEBs guideline, the appraisal for SRL – Cheltenham to Airport considers dynamic impact caused by land use change. This land use change is catalysed by agglomeration and precinct development through attracting additional jobs and residents. The estimation of land use impact and its associated rationale and assumptions are provided in the CityPlan Modelling Report.

T3 WEBs guideline does not provide an algebraical method for quantifying WEB2b, due to limited data in Australia to estimate necessary parameters.

One of the key objectives of SRL – Cheltenham to Airport is supporting skills match and productivity improvement. As discussed in the SRL Business and Investment Case, many of Melbourne's established suburbs in the inner and middle rings are unaffordable for moderate and low income households, both from a housing and transport perspective (financial cost and time spent commuting). This is encouraging some households to move to the outer suburbs in search of more affordable choices. More people are living further away from key centres and their places of work. Access to employment opportunities is a key factor for a person securing a job, especially for low skilled or unskilled workers. As people live further away from jobs, more are likely to choose work that may not reflect their qualifications and skills. This entrenches economic disparity. Inequitable access to services also diminishes productivity and overall community economic wellbeing.

SRL – Cheltenham to Airport includes transport network and precinct development initiatives to address this productivity and skills matching issue that is expected to worsen over time. Therefore, it is important WEB2b is quantified for the SRL – Cheltenham to Airport economic appraisal to fully understand its impact. Failing to do so would result in significant underestimation of the benefit associated with SRL – Cheltenham to Airport.

An earlier version of the T3 WEBs guideline ATAP (2018) T3 provides a method that can be used for quantifying WEB2b, in the absence of other more reliable sources.

WEB2b 'move to more productive jobs' can be estimated as the following based on the earlier version of the draft WEBs guideline ATAP (2018) T3:

> *WEB2b = Change in Tax revenue attributable to a move to more productive jobs between the Base and Program Cases*

The mathematical form is shown in Equation 15 below.

Equation 15

$$WB2b \approx \tau_{MP} \cdot \Delta\, TW \qquad (15)$$

Where:

$\Delta\, TW$ = change in total gross wages resulting from SRL – Cheltenham to Airport

τ_{MP} = the effective tax take resulting from a move to more or less productive jobs (0.42)[70]

The change in total gross wages $\Delta\, TW$ can be estimated as set out in Equation 16 below.

Equation 16

$$\Delta\, TW \approx \sum_z \left(\left(\frac{W_{z,PC}}{W_{z,BC}} - 1 \right) \cdot\ AGW_{z,pur} \cdot W_{z,BC} \right) \qquad (16)$$

Where:

$W_{z,PC}$ = number of workers usually resident in zone z in the Program Case

$W_{z,BC}$ = number of workers usually resident in zone z in the Base Case

$AGW_{z,pur}$= average gross wage per worker by usual residence in zone z

B.4 WEB3: Output increase in imperfectly competitive markets

Transport costs act as a barrier to competition and therefore help to maintain imperfect competition. Imperfectly competitive markets mean firms are incentivised to sell less output at higher prices than they would in a perfectly competitive market. Projects that reduce transport costs can enhance the ability for the firms to produce goods at a lower cost, therefore generating additional consumer surplus due to the existence of the price-cost mark-up which is not captured in the conventional economic analysis.

[70] Note that τ_{MP} is the marginal tax take for an average worker moving to a higher productivity job. In contrast, τ_{LS} from WEB2a is the average tax take for a marginal worker entering the workforce.

The welfare impact of transport improvement depends on the increase in output attributable to the transport improvement and the price-cost margin applicable to the industry sector. The welfare gain is the product of the two.

Algebraically, output change in imperfectly competitive markets benefit can be estimated as:

*WEB3 = Price-cost margin * Output change*

The mathematical form is shown in Equation 17 below.

Equation 17

$$WB3 = Benefits\ to\ business\ travel \cdot V \qquad (17)$$

Where:

$Benefits\ to\ business\ travel$ = business travel time savings due to SRL – Cheltenham to Airport and business reliability benefits

V = uprate factor

The recommended uprate factor in the draft ATAP guideline (2020) is 0.10, T3 WEBs, based on indicative values for mark-up and averaged price elasticity of demand for goods and services across all industries and cities. The use of the uprate factors presented here implicitly assumes that the uprate factors will remain stable over the course of the horizon for the project evaluation.

B.5 WEB4: Increased competition

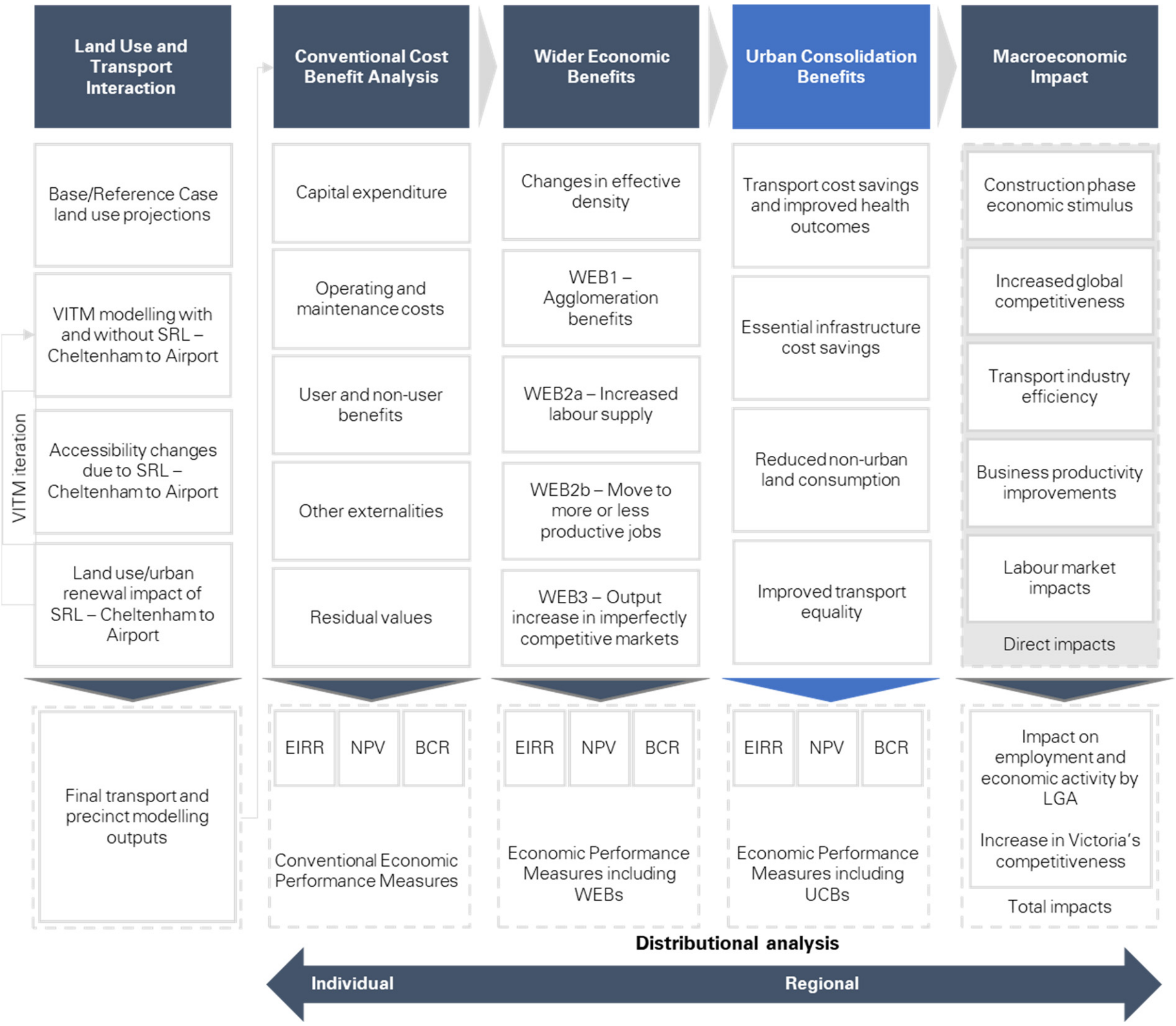
Any transport project which makes an area significantly more accessible has the potential to increase market competition (WEB4) in that area. Significant enhancement in accessibility and therefore reduction in transport cost allows new firms to enter the market and effectively compete with incumbent firms. The theory behind WEB4 is that reducing transport costs opens up areas to increased competition, driving production efficiencies, which in turn results in lower prices for consumers.

Any transport projects in developed countries, which are characterised by reasonable transport access, are unlikely to generate significant enough travel cost savings to have any material impact on competition, as is the case for SRL – Cheltenham to Airport. Consequently, the approach to estimating benefits from increased competition is not discussed in this economic appraisal.

Attachment C: UCBs appraisal approach

This attachment provides the detailed approach and relevant literature review underpinning the calculation and inclusion of UCBs for SRL – Cheltenham to Airport. Figure C - 1 highlights the components of the UCBs analysis which have been quantified as part of the economic evaluation.

Figure C - 1: UCBs within the overarching economic appraisal framework



Source: KPMG.

C.1 UCBs overview

UCBs arise if a project / initiative contributes to greater urban development in established areas and therefore lowers the need for development in the outer metropolitan areas or regions. The benefit also arises if a project is able to improve social coherence and equality by better connecting communities in the outer suburbs and stimulating denser housing options that suit diversified needs of society.

SRL – Cheltenham to Airport's combined transport and precinct development initiatives will result in greater population and employment density in Melbourne's outer suburbs. This should generate UCBs as the need for further urban development on the outer metropolitan areas / outer suburbs is expected to be reduced. SRL – Cheltenham to Airport is also expected to stimulate diversified housing supply along the corridors and reduce travel time for the community living in the outer suburbs. As a result, this can consolidate the existing urban form and 'bring the community closer' that improves social connectivity, needs and coherence.

There is extensive literature on the costs and benefits of different urban forms, both from Australian and international studies. The literature confirms that there are a range of resource cost savings to be derived from developing in existing urban areas compared to the outer metropolitan areas. However, the extent of UCBs are location specific and depend on the specific opportunities and constraints facing the local area (e.g. within the established area being investigated).

Key benefit items that may apply to typical urban consolidation initiatives include:

- Transport cost savings (quantification included in the conventional CBA)
- Reduced health costs (quantification included in the conventional CBA)
- Public essential infrastructure cost savings
- Reduced non-urban land consumption
- Improved amenity
- Reduced transport inequality
- Increased housing diversity.

Whilst urban consolidation has the potential to offer some significant economic benefits, it can also trigger investment to facilitate urban consolidation. To incorporate the benefits without including the costs will result in biased estimates.

Selected costs that may apply to typical urban consolidation initiatives include:

- Public infrastructure augmentation costs
- Other costs associated with facilitating urban consolidation (changes to planning schemes, zonings, place making initiatives, land amalgamation etc.).

These benefits and costs of urban consolidation are discussed below.

C.2 Transport cost savings

The primary impact of urban consolidation initiatives are the changes in transport patterns which can impact on transport costs. Relevant components of transport costs that are impacted by urban consolidation include:

- Travel time savings
- Vehicle operating cost savings
- Travel accident savings
- Greenhouse gas and other environmental externality savings.

These benefits have been captured through the demand modelling. As a result, the travel cost savings component of the UCBs have been included in the conventional CBA and have been monetised using the approach described in Attachment A.

C.3 Reduced health costs

Extensive research exploring the links between different urban forms and health care have been undertaken. The literature suggests that neighbourhoods characterised by low density, poor connectivity and poor access to jobs and services are associated with low levels of active travel (including cycling and walking). Conversely, compact urban form and built environment has been found to enable increased incidental and planned physical activity.

Low levels of planned and incidental physical activity (such as walking to and from train stations / bus stops, walking to shops etc.) have been linked to obesity and numerous other chronic illnesses[71]. In addition to the direct health care costs, increased illness also impacts on labour productivity through absenteeism and reduced on-the-job productivity.

These benefits should be captured through the demand modelling (based on mode shift from road to public transport that encourages walking and cycling). As a result, the health cost savings component of the UCBs have been included in the conventional CBA and have been monetised using the approach described in Attachment A.

C.4 Public essential infrastructure cost savings

Reduction in demand for dwellings in Melbourne's outer metropolitan areas will lead to reduced public sector (state and local government) investment in infrastructure in the fringe. Typically, these relate to reduced need to extend essential trunk infrastructure services, such as roads, public transport, water and sewerage, drainage and storm water, electricity, gas and other utilities.

Note that only the component of infrastructure costs that are funded by the public sector (national, state and local governments) can be included in the analysis. The private sector component of the

[71] (Trubka & al., 2008) *The Costs of Urban Sprawl (3): Physical Activity Links to Healthcare Costs and Productivity.*

infrastructure costs are either passed on by developers (or infrastructure providers) to the purchasers of dwellings, or are absorbed by the developers. The cost of a dwelling must at least be equal to the benefit that the owner derives from purchasing that dwelling. In the event that the infrastructure cost is absorbed by the developer, this will form part of the developer's commercial assessment. Consequently, any private infrastructure cost savings, from a welfare economics perspective, has not been included in the assessment.

In addition, it is recognised that urban consolidation will reduce public cost on other infrastructure types, such as emergency services (fire and ambulance), education, health, sporting and other community facilities (e.g. local libraries, community centres and childcare facilities). However, it is possible for residents living in the newly established outer metropolitan areas to use those facilities in the established areas in the short term. This could potentially lead to decreased customer satisfaction of services provided by those established social facilities due to longer waiting time and crowding. Even upgrading of the existing social infrastructure (to facilitate extra customers) will mean the residents living in the newly developed outer metropolitan areas will need to travel extra distance to attend essential services which leads to inconvenient and less optimal economic and social outcomes (e.g. travel time and lower productivity), before service is eventually established in their own suburbs.

Despite the fact that there are various aspects of public infrastructure cost that can be saved due to urban consolidation, this economic appraisal only focuses on the 'essential trunk infrastructure', namely sewage, electricity and water. These are the types of infrastructure that play an essential role in people's living and must be extended if urban development expands beyond the existing urban footprint (e.g. new suburbs emerge). As a result, the UCBs quantified in this appraisal is deemed conservative.

C.4.1 Quantification approach

Quantification of this benefit requires an understanding of the essential public sector infrastructure cost for each dwelling developed in Melbourne's outer metropolitan areas. Infrastructure Victoria (IV, 2019)[72] published the cost of public sector infrastructure provision for various infrastructure types[73], estimated using a database comprised of primarily quantitative survey data and Government regulator data for Melbourne over the past 10 years.

The IV (2019) publication estimated the capital and operating and maintenance cost per dwelling for public infrastructure provision for four development types (greenfield, brown field, infill and high density). This estimate is conservative compared to comparable studies in Australia. For example, the difference in economic essential infrastructure (sewage, electricity and water) servicing cost between greenfield and infill development was estimated to be approximately $18,000 per dwelling in 2018 dollar terms by IV (the difference between $38,900 for greenfield and $19,950 for established areas is shown in Table C - 1). The equivalent estimated by SGS[74] was about $30,000 per dwelling in 2018 dollar terms (based on the $20,000 in 2001 dollars, indexed using an average inflation rate of 2.5 per cent per year).

This economic appraisal focusses on capital cost for greenfield versus established areas that is the weighted average of brown field, infill and high density as provided by IV (2019). Operating and maintenance costs savings have not been included in this appraisal, which provides a conservative estimate of benefits quantified. This appraisal focuses on the infrastructure cost savings of established areas (average of brown, infill and high density) compared to greenfield.

[72] (Infrastructure Victoria, 2019) *Infrastructure Provision in Different Development Settings in Metropolitan Melbourne.*
[73] This includes transport, sewage, water, electricity, gas, telecommunication, emergency services, health and education.
[74] (SGS, 2005) *Costs and Benefits of Urban Form.*

The land use for the Base Case versus Program Cases, namely the number of dwellings expanded into greenfield areas (without SRL – Cheltenham to Airport) have been estimated using the LUTI model, as discussed below.

C.4.2 CityPlan - LUTI modelling

The LUTI model, CityPlan, enables the estimation of land use outcomes for the Program Cases compared to the Base Case. CityPlan uses VITM output (transport matrices) to calculate the change in accessibility under the Program Cases compared to Base Case, and then re-distributes population and employment to areas with greater accessibility.

SRL – Cheltenham to Airport improves accessibility in the existing corridors and stimulates residential and employment developments in these established areas, thus refraining the urban fringe from expanding into the greenfield areas.

CityPlan captures this urban consolidation impact of SRL – Cheltenham to Airport; it estimates the number of dwellings under the Program Cases and Base Case living in greenfield versus established areas. The reduction in the number of greenfield dwellings under the Program Cases (compared to the Base Case) provides the urban consolidation land use impact of SRL – Cheltenham to Airport. This serves as the base for calculating the urban consolidation benefit by applying the per dwelling saving (in dollar terms) in later steps (discussed in Table C - 1 below).

The key steps in deriving the number of dwellings in the greenfield versus established areas using CityPlan include:

- Undertake CityPlan modelling at the travel zone level within the extent of Greater Melbourne to estimate the impact of the Program Case on land use
- Estimate the land use change (e.g., change in population or housing density) based on the change in accessibility change in the Program Case from the Base Case. Accessibility measures the ease of reaching desired destinations, and is calculated in CityPlan using the cost of travel and number of opportunities, both provided by the VITM
- Determine the extent of greenfield and established areas within Greater Melbourne as defined in Plan Melbourne
- Calculate housing density (the number of households) in the greenfield areas under the Base Case versus the Program Case
- Convert the housing density to dwelling density under the Program Case versus the Base Case by dividing housing density by housing vacancy rate in Melbourne.

The quantification method of public infrastructure cost savings for essential economic infrastructure due to SRL – Cheltenham to Airport is provided in Table C - 1 below.

Table C - 1: Public infrastructure cost savings – essential economic infrastructure

Key inputs	Approach
IV (2019) estimate of public sector economic infrastructure provision capital cost for greenfield versus established areas in Melbourne – million dollars per dwelling (in 2018 dollars). The land use for the Base Case versus Program Cases, namely the number of dwellings that would otherwise expand	SRL – Cheltenham to Airport is expected to increase population density in Melbourne's established suburbs. This is expected to reduce the need for public sector (state and local government) investment in essential economic truck infrastructure in the fringe, including sewage, water and electricity. Other non-essential infrastructure types, such gas, telecommunication and transport, are not included and thus the quantification of this UCB provides a conservative estimate. **Economic / cost parameters** IV (2019) estimated the cost savings of provision of public essential truck economic infrastructure in the established area (compared to in

Key inputs	Approach
into greenfield areas in the absence of SRL – Cheltenham to Airport, are provided by the LUTI model CityPlan.	greenfield) is $18,950 per dwelling in 2018 dollar terms. Service provision in greenfield is nearly twice as expensive compared to an established area ($38,900 versus $19,950 per dwelling). The cost of provision of economic infrastructure in Melbourne in the outer metropolitan areas (typically greenfield) is on average $38,900 per dwelling: • Sewage: lower estimate of $6,300 and upper estimate of $23,200 – thus an average of $14,750 per dwelling • Water: lower estimate of $4,100 and upper estimate of $15,500 – thus an average of $9,800 per dwelling • Electricity: lower estimate of $7,500 and upper estimate of $21,200 – thus an average of $14,350 per dwelling. The cost of provision of economic infrastructure in Melbourne in the established area is on average $19,950 per dwelling: • Sewage: lower estimate of $2,500 and upper estimate of $9,200 – thus an average of $5,850 per dwelling • Water: lower estimate of $1,000 and upper estimate of $7,900 – thus an average of $4,450 per dwelling • Electricity: lower estimate of $2,300 and upper estimate of $17,000 – thus an average of $9,650 per dwelling. The above figures are on the conservative side compared to other recent publications on this topic (e.g. Trubka et al[75]). **Land use change caused by SRL – Cheltenham to Airport** The land use for the Base Case versus Program Cases, namely the number of dwellings that would otherwise expand into greenfield areas, are provided by the CityPlan model. The IV (2019) economic parameter uses the number of dwellings as a basis (rather than population as provided by the CityPlan model). As a result, conversion was undertaken to turn population by development type (obtained from the CityPlan model) into dwellings by development type using the population to dwelling ratio obtained from the 2016 Census household composition data by SA2. It is assumed that the number of households and population stays constant across the Base and Program Cases. This is because people typically choose where to live (and their dwelling type) based on their household composition, rather than the other way round.

[75] (Trubka, Newman, & Bilsborough, Assessing the Costs of Alternative Development Paths in Australian Cities, 2008) *Assessing the Costs of Alternative Development Paths in Australian Cities.*

Key inputs	Approach
	Quantification Public sector essential trunk economic infrastructure cost saving: $CS = (GreenField\ dwelling_{PC} - GreenFiled\ dwelling_{BC})(Cost_{gf} - Cost_{ea})$ where: CS = public sector essential truck economic infrastructure cost saving $GreenField\ dwelling_{PC}$ = number of greenfield dwellings under the Program Cases (with SRL – Cheltenham to Airport led land use) $GreenField\ dwelling_{BC}$ = number of greenfield dwellings under the Base Case (without SRL – Cheltenham to Airport led land use) $Cost_{gf}$ = public sector essential truck economic infrastructure cost for greenfield in Melbourne $Cost_{ea}$ = public sector essential truck economic infrastructure cost for established area in Melbourne

C.5 Reduced non-urban land consumption

C.5.1 Function of urban green land

Urban consolidation conserves land (e.g. agriculture, horticulture, grassland, and wetland) that otherwise would be consumed by urban development. This in turn has the potential to enhance the liveability, amenity, ecosystem health and resilience, and contribute to biodiversity.

Environmental psychologists have explored how people value urban green land (Zube[76], 1987) and develop attitudes such as preference (Herzog, 1992[77]; Arriaza et al., 2004[78]). Ecologists have adopted the ecosystem services framework to study the socio-economic benefits of green land (Daily[79], 1997; Bolund and Hunhammar, 1999[80]; de Groot et al., 2010). Economists have used various economic valuation techniques to quantify production (Antle and Capalbo, 2001[81]) and amenity values (Rosenberger and Loomis, 1999; Fleischer and Tsur, 2000[82]).

The increasing role of urban green land as a provider of environmental amenities, in addition to its traditional role as a primary input of agricultural production, has been recognised in developed countries.

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76 (Zube, 1987) *Perceived Land Use Patterns and Landscape Values*.
77 (Herzog, 1992) *A Cognitive Analysis of Preference for Urban Spaces*.
78 (Arriaza, Canasortega, Canasmadueno, & Ruizavilles, 2004) *Assessing the Visual Quality of Rural Landscapes*.
79 (Daily, 1997) *Nature's Services: Societal Dependence on Natural Ecosystems*.
80 (Bolund & Hunhammar, 1999) *Ecosystem Services in Urban Areas*.
81 (Antle & Capalbo, 2001) *Econometric-process Models for Integrated Assessment of Agricultural Production Systems*.
82 (Fleischer & Tsur, 2000) *Measuring the Recreational Value of Agricultural Landscape*.

Rising living standards, population growth and added leisure all operate to increase the demand for environmental amenities, such as urban green land.

Benefits of urban green land have been identified by a number of studies. Vejre et al. (2010[83]) found that for residents outside Copenhagen, 'intangible' services such as recreational opportunities and aesthetic values may outweigh more tangible benefits such as the production of agricultural products. Mallawaarachchi et al. (2006[84]) also found a high willingness to pay for unique or rare vegetation and a strong appreciation of the visual amenity of cane fields by local residents in South-East Queensland, Australia.

Urban green land has an impact on health and security such as air purification, noise reduction, urban cooling, and runoff mitigation (Bolund and Hunhammar, 1999[85]). The impact on a given city varies depending on the environmental and socio-economic characteristics of each site. For example, natural barriers to buffer environmental extremes are critical for cities located in or close to coastal areas (e.g. New Orleans); air quality regulation can be of significance in cities severely polluted due, for instance, to topography of heat inversions (e.g. Santiago de Chile), but may be of secondary importance in cities where atmospheric pollution is favoured by topography, as well as policy (e.g. Helsinki).

People also hold moral, spiritual, educational, aesthetic, place-based, and other values towards the urban environment, all of which can affect their attitudes and actions toward urban green land and the services they provide (Millennium Ecosystem Assessment, 2003[86]). These values reflect emotional, effective, and symbolic views attached to urban nature that, in most cases, cannot be adequately captured by commodity metaphors or monetary metrics (Martínez-Alier et al., 1998[87]; Norton and Hannon, 1997[88]).

Key functions of urban green land are provided in Table C - 2 below. For a comprehensive framework for urban green land functions, see Dobbs and Escobedo (2011).

Table C - 2: Key functions of urban green land

Functions and components	Ecosystem services	Examples	References
Energy conversion into edible plants through photosynthesis	Food supply	Vegetables produced by urban allotments and peri-urban areas	Altieri et al. (1999)[89]
Percolation and regulation of runoff and river discharge	Water flow regulation and runoff mitigation	Soil and vegetation percolate water during heavy and / or prolonged precipitation events	Villarreal and Bengtsson (2005)[90]

[83] (Vejre, Jensen, & Thorsen, 2010) *Demonstrating the Importance of Intangible Ecosystem Services from Peri-urban Landscapes.*
[84] (Mallawaarachchi, Morrison, & Blamey, 2006) *Choice Modelling to Determine the Significance of Environmental Amenity and Production Alternatives in the Community Value of Peri-Urban Land.*
[85] (Bolund & Hunhammar, 1999) *Ecosystem Services in Urban Areas.*
[86] (Millennium Ecosystem Assessment, 2003) *Millennium Ecosystem Assessment.*
[87] (Martínez-Alier & al. , 1998) *Weak Comparability of Values as a Foundation for Ecological Economics.*
[88] (Norton & Hannon, 1997) *Environmental Values: A Place Based Theory.*
[89] (The Greening of the "Barrios": Urban Agriculture for Food Security in Cuba , 1999) *The Greening of the "Barrios": Urban Agriculture for Food Security in Cuba.*
[90] (Response of a Sedum Green-roof to Individual Rain Events , 2005) *Response of a Sedum Green-roof to Individual Rain Events.*

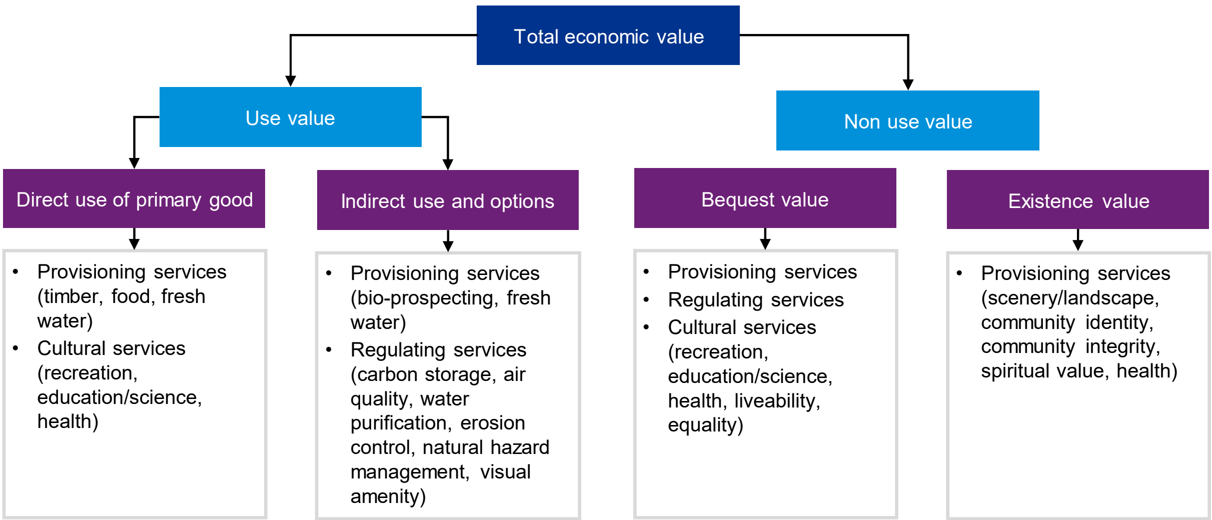
Functions and components	Ecosystem services	Examples	References
Photosynthesis, shading and evapotranspiration	Urban temperature regulation	Trees and other urban vegetation provide shade, create humidity and block wind	Bolund and Hunhammar (1999)[91]
Absorption of sound waves by vegetation and water	Noise reduction	Absorption of sound waves by vegetation barriers, especially thick vegetation	Ishii (1994)[92]
Filtering and fixation of gases and particulate matter	Air purification	Removal and fixation of pollutants by urban vegetation in leaves, stems and roots	Chaparro and Terradas (2009)[93]
Physical barrier and absorption on kinetic energy	Moderation of environmental extremes	Storm, floods, and wave buffering by vegetation barriers; heat absorption during severe heat waves	Dansielsen et al. (2005)[94] Costanza et al. (2006b)[95]
Removal or breakdown of xenic nutrients	Waste treatment	Effluent filtering and nutrient fixation by urban wetlands	Vauramo and Setala (2011)[96]
Carbon sequestration and fixation in photosynthesis	Climate regulation	Carbon sequestration and storage by the biomass of urban shrubs and trees	McPherson (1998)[97]
Movement of floral gametes by biota	Pollination and seed dispersal	Urban ecosystem provide habitat for birds, insects, and pollinators	Andersson et al. (2007)[98]
Ecosystems with recreational and educational values	Recreation and cognitive development	Urban parks provide multiple opportunities for recreation, meditation and pedagogy	Chiesura (2004)[99]
Habitat provision for animal species	Animal sighting	Urban green space provide habitat for birds and other animals people like watching	Blair and Launer (1997)[100]

[91] (Bolund & Hunhammar, Ecosystem Services in Urban Areas, 1999) *Ecosystem Services in Urban Areas*.
[92] (Ishii, 1994) *Urban Ecosystem Services*.
[93] (Centre de Recerca Ecològica iAplicacions Forestals, 2009) *Ecological Services of Urban Forest in Barcelona*.
[94] (The Asian Tsunami: A Protective Role for Coastal Vegetation, 2005) *The Asian Tsunami: A Protective Role for Coastal Vegetation*.
[95] (Changes in the Global Value of Ecosystem Services , 2014) *Changes in the Global Value of Ecosystem Services*.
[96] (Department of Environmental Sciences Faculty of Biological and Environmental Sciences, University of Helsinki Finland.) Urban *Ecosystem Services at the Plant-Soil Interface*.
[97] *What we know and don't know about the carbon storage and sequestration of urban trees.*
[98] (Interannual Variation and Trends in Air Pollution Over Europe Due to Climate Variability During 1958-2001 Simulated with a Regional CTM Coupled to the ERA40 Reanalysis) *Interannual Variation and Trends in Air Pollution Over Europe Due to Climate Variability During 1958-2001 Simulated with a Regional CTM Coupled to the ERA40 Reanalysis*.
[99] (The Role of Urban Parks for the Sustainable City , 2004) *The Role of Urban Parks for the Sustainable City*.
[100] (Butterfly Diversity and Human Land Use: Species Assemblages Along an Urban Gradient) *Butterfly Diversity and Human Land Use: Species Assemblages Along an Urban Gradient*.

C.5.2 Economic value of urban green land

Given the functions of urban green land, it has economic value (not necessarily always monetary) to its users and broader community. The economic value suggested by literature is summarised in Figure C - 2 and explained in Table C - 3.

Figure C - 2: Economic value of green land



Source: KPMG

Table C - 3: Explanation of green land economic value

Type of value	Meaning
Economic value	The worth of a good or service, or the measure of benefit provided by that good or service. Economic value is not just monetary, and there are many definitions across different economic traditions, from financial to philosophical.
Use value (and non-use value)	The exchange value or price of a commodity or service in the open market. Sometimes also synonymous with economic value in neoclassical economics. Non-use value refers to the opposite.
Option value	A willingness to pay a certain sum today for the future use of an asset.
Bequest / vicarious values	A willingness to pay to preserve the environment for the benefit of other people, intra- and inter-generationally.
Existence value	The value attached to the knowledge that species, natural environments and other ecosystem services exist, even if the individual does not contemplate ever making active use of them.

Source: KPMG

C.5.3 Quantification approach

The economic analysis for SRL – Cheltenham to Airport employs existing estimated willingness to pay parameters published by authoritative sources for quantifying the benefit.

Literature for the relevant method

There is a body of both Australian and international literature estimating the value of urban green land and the impact of urban infrastructure on it, mostly using hedonic pricing or a contingent valuation approach.

Infrastructure Victoria (2018)[101] used a hedonic pricing approach to demonstrate the positive relationship between property prices and urban parks in Victoria. Moving from the median to the first percentile of distances from a park is associated with increased property prices of up to $86,000. Tapsuwan et al. (2009)[102] found that moving one metre closer to the nearest wetland (from an average distance of 943m) increases house prices by $42.40 in Perth. Mahmoudi et al. (2012)[103] showed moving one metre closer to Adelaide Parklands (from an average distance of 10.74km) increases house prices by $1.55. CRC for Water Sensitive Cities (2017)[104] has used a hedonic pricing approach and estimated that Australian households are willing to pay between 9 and 16 per cent more for a house that has access to public open space.

Several studies have tried to apply the choice modelling to assess the value the community places on protecting peri urban land from urban encroachment. One such study was undertaken by Thilak et al (2001)[105] for Queensland's Sunshine Coast. This study estimated the willingness-to-pay to protect non-urban areas with unique and rare vegetation at $1,292 per hectare / year / person (2001 dollars). A study by Morrison and Mathieson (2008)[106] found that the net social benefits of a 5 per cent increase in green open space were worth between $1.4 million and $1.7 million ($2015-16) for the Ashfield and Mosman local government areas in Sydney, respectively. The benefits valued were environmental services, increased property values and reduced health issues, such as obesity and depression. On average, Perth households are Willing(ness) To Pay (**WTP**) $1.00 per annum to avoid a 1 per cent reduction in the area of green land in their local area (Van Bueren et al, 2018)[107].

In the United States, willingness to pay of USD$302 per household within one mile of property to preserve a 5.5-acre parcel of undeveloped land in Boulder, Colorado[108]. The undeveloped urban land is to provide views, open space and wildlife habitat according to Breffle et al (1998)[109]. There is also a range of studies that used an avoided cost approach to value urban green land in terms of its air purification and climate regulation properties (Caprro and Terradas 2009[110] and Nowak et al 2008[111]).

Method selected for SRL – Cheltenham to Airport

SRL – Cheltenham to Airport has the potential to limit urban expansion and facilitate urban development within the established areas. This enables the land to be available for other uses, including agriculture, horticulture or environmental, bushland, or some other non-urban usage. The value of this reduced non-

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101 (What Makes a Locality Attractive? Estimates of the Amenity Value of Parks for Victoria.) *What Makes a Locality Attractive? Estimates of the Amenity Value of Parks for Victoria.*
102 (Capitalized Amenity Value of Urban Wetlands: A Hedonic Property Price Approach to Urban Wetlands in Perth, Western Australia) *Capitalized Amenity Value of Urban Wetlands: A Hedonic Property Price Approach to Urban Wetlands in Perth, Western Australia.*
103 (Space Matters: The Importance of Amenity in Planning Metropolitan Growth) *Space Matters: The Importance of Amenity in Planning Metropolitan Growth.*
104 ('How Much Do We Value POSs?', Industry Note, Program A: Society, Project A1.1 and A1.2, 2017) *'How Much Do We Value POSs?', Industry Note, Program A: Society, Project A1.1 and A1.2.*
105 (Thilak, Mark, & Blamey, 2001) *Determining the Community Value of Peri-Urban Land: The Significance of Environmental Amenity and Production Alternatives.*
106 (Morrison & Mathieson, 2008) *Scoping Study: Economic Value of Irrigation in Urban Green Open Space.*
107 (Van Bueren & Blamey, 2018) *Community Values for Green Public Open Space in Perth - A Choice.*
108 (Brefe, Morey, & Lodder, 1998) *Using Contingent Valuation to Estimate a Neighbourhood's Willingness to Pay to Preserve Undeveloped Urban Land.*
109 (Brefe, Morey, & Lodder, 1998) *Using Contingent Valuation to Estimate a Neighbourhood's Willingness to Pay to Preserve Undeveloped Urban Land.*
110 (Chaparro & Terradas, 2009) *Report on Ecological Services of Urban Forest in Barcelona.*
111 (Nowak, Walton, Stevens, Crane, & Hoehn, 2008) *Effect of Plot and Sample Size on Timing and Precision of Urban Forest Assessments.*

urban land consumption for urban development can be estimated by adopting the community's willingness-to-pay for protecting non-urban land from urban encroachment.

Where it is appropriate, it is important to understand the context of the urban green land that can potentially benefit from SRL – Cheltenham to Airport in selecting the most appropriate quantification method. This includes the value component of the urban green land of interest, such as its current use and future use value without SRL – Cheltenham to Airport (e.g. agricultural and recreational) and non-use value (e.g. landscape and emotional attachment of community).

Given the context for quantification set out above, the method chosen needs to reflect the specific function and value of the urban green land in the context of SRL – Cheltenham to Airport. That is, the economic parameter used for benefit transfer for SRL – Cheltenham to Airport needs to be derived for comparable land use type which is peri-urban land.

There is limited literature on the benefit of peri-urban land, especially in Australia. One of the most relevant and recent studies that can be used is by Bockarjova et al (2016)[112]. This study employed a meta analysis approach to understand the value of urban nature including peri-urban land. The meta analysis pooled 60 international studies[113] (containing 147 observations) that estimated the monetary value of urban nature using stated preference methods, including the contingent valuation and discrete choice experiment methods (Table C - 4 below).

Table C - 4: Studies used in meta analysis

	Number of studies	Number of observations
Europe	20	81
North America	12	26
South America	2	3
Asia	22	33
Africa	2	2
Australia	2	2
Total	**60**	**147**

Source: Bockarjova et al (2016)

The Bockarjova et al (2016)[114] meta analysis found that the average willingness to pay value of peri-urban land that can provide ecosystem service (climate and flood regulation) ranges between USD$670 to USD$1,706 per hectare per year in 2016 US dollar terms.

The average willingness to pay value per hectare of peri-urban land derived from the Bockarjova et al (2016)[115] meta analysis is considered to be suitable to be transferred to the SRL – Cheltenham to Airport analysis, because:

- The type of urban green land the average value is derived from is comparable with the urban green land that may benefit from SRL – Cheltenham to Airport.

[112] (Bockarjova, Botzen, & Koetse, 2018) *Economic Value of Green and Blue Nature in Cities.*
[113] *Only peer reviewed and published articles were selected for Meta Analysis by Bockarjova et al (2016).*
[114] (Bockarjova, Botzen, & Koetse, 2018) *Economic Value of Green and Blue Nature in Cities.*
[115] (Bockarjova, Botzen, & Koetse, 2018) *Economic Value of Green and Blue Nature in Cities*

- The meta study used pooled studies that cover a range of countries (with a large sample size) and is thus a representative value that is likely to be unbiased.
- The meta study used pooled peer reviewed, published studies that supports its robustness.

The quantification of the benefit of reduced urban land consumption due to SRL– Cheltenham to Airport is provided in Table C - 5 below.

Table C - 5: Benefit of reduced urban land consumption

Key inputs	Approach
The Bockarjova et al (2016)[116] meta analysis found that the average willingness to pay value of peri-urban land that can provide an ecosystem service (climate and flood regulation) ranges between USD$670 to USD$1,706 per hectare per year in 2016 US dollar terms.	SRL – Cheltenham to Airport has the potential to contain the outer metropolitan areas to the established area that otherwise would be consumed by urban development to be dedicated to other uses, including agriculture, horticulture or some other non-urban usage. The value of this reduced non-urban land consumption for urban development can be estimated by adopting the community's willingness-to-pay for protecting non-urban land from urban encroachment.
	Economic parameters
The land use for the Base Case versus Program Cases, namely the area / hectare of land that would expand into greenfield (without SRL – Cheltenham to Airport), are provided by the CityPlan model.	The average willingness to pay value of peri-urban land derived by the Bockarjova et al (2016)[117] meta analysis is used to provide the unit economic value of peri-urban land otherwise consumed without SRL – Cheltenham to Airport. The ranges provided by the meta analysis is between USD$670 to USD$1,706 per hectare per year in 2016 US dollar terms. As a result, the mid-point of $1,188 per hectare per year in the 2016 US dollars term is employed. This figure is then converted to Australian dollars and indexed to 2020 (SRL – Cheltenham to Airport economic analysis base year) using published historical exchange rates (by Reserve Bank Australia) and Consumer Price Index (by Australian Bureau of Statistics). The size of the willingness to pay employed here is consistent with other comparable willingness to pay for peri-urban land per hectare based studies, such as by Thilak et al (2001)[118] for Queensland's Sunshine Coast.

[116] (Bockarjova, Botzen, & Koetse, 2018) *Economic Value of Green and Blue Nature in Cities.*
[117] (Bockarjova, Botzen, & Koetse, 2018) *Economic Value of Green and Blue Nature in Cities.*
[118] (Thilak, Mark, & Blamey, 2001) *Determining the Community Value of Peri-Urban Land: The Significance of Environmental Amenity and Production Alternatives.*

Key inputs	Approach
	Land use change caused by SRL – Cheltenham to Airport The land use for the Base Case versus Program Cases, namely the number of dwellings that would otherwise expand into peri-urban land (without SRL – Cheltenham to Airport), are provided by the CityPlan model. This follows the same approach as discussed in Chapter C.4.2 above. It is assumed that greenfield and peri-urban land are exchangeable in the context of urban development. Bockarjova et al (2016)[119] estimated willingness to pay is for each hectare of peri-urban land per year. Thus, conversion was needed to convert the number of dwellings into hectares of land. Based on past evidence (e.g. Victorian Planning Authority historical data), CityPlan assumes five dwellings per hectare for peri-urban land development. **Quantification** Economic benefit associated with reduced peri-urban land consumption due to SRL – Cheltenham to Airport: $E = (PeriUrban_{PC} - PeriUrban_{BC})WTP$ where: E = Economic benefit associated with reduced peri-urban land consumption due to SRL – Cheltenham to Airport $PeriUrban_{PC}$ = hectares of peri-urban land under Program Cases (with SRL – Cheltenham to Airport led urban consolidation) $PeriUrban_{BC}$ = hectares of peri-urban land under Base Case (without SRL – Cheltenham to Airport led urban consolidation) WTP willingness to pay value of peri-urban land saved by SRL – Cheltenham to Airport

C.6 Improved amenity associated with greater urban density

Compact urban form can make an area more vibrant, attractive and generally contribute to enhanced amenity. Diversity in itself is often an urban amenity, since consumers are attracted to cities with diverse restaurants, international cultural offering, and a lively street scene.

The amenity gain from a denser city originate in part from shorter trip times, but mostly arise because increased choice in denser areas allows individuals to visit destinations that they prefer. The consumption benefits of density in the restaurant industry demonstrate that cities, and CBD cores in particular, enjoy a large advantage in non-tradable service provision.

Large, urban markets may increase the welfare of consumers because of goods which appear to have substantial scale economies. For example, baseball teams, opera companies, and comprehensive art

[119] (Bockarjova, Botzen, & Koetse, 2018) *Economic Value of Green and Blue Nature in Cities*.

museums all need large population catchment to be viable. The advantages from scale economies and specialisation are also clear in the restaurant business where compact urban areas will have restaurants that specialise in a wide range of cuisines – scale economies mean that specialised retail can only be supported in places that are sufficiently large and compact to have a critical mass of customers.

The ATAP (2018) appraisal methodology recognises all benefits and costs—monetised and non-monetised regarding amenity and liveability.

Benefits from improved amenity of an area due to urban consolidation typically flow to three distinct cohorts:

- New residents to an area / precinct that has gone through urban consolidation
- Existing residents of an area / precinct that has gone through urban consolidation
- Existing residents who reside in close proximity to the area / precinct that has gone through urban consolidation.

The value of the amenity benefits derived by the first cohort would be factored into the cost of dwellings and, as such, its inclusion in the analysis would be invalid.

The second and third cohorts however, derive amenity improvements without them needing to pay for the amenity improvements. In other words, the benefits to these cohorts are an externality and, as such, its inclusion is valid.

C.6.1 Quantification

DJPR has recently assessed the impact on property values of access to amenity. DJPR found that property values were found to increase with proximity to certain amenities (e.g. green space, libraries and education facilities), but decrease with proximity to playgrounds, bus stops and community centres. KPMG found similar results in a review of Australian and international literature.

However, applying these findings to the SRL – Cheltenham to Airport economic appraisal poses particular challenges:

- Price premiums attributable to certain amenities tend to be location specific, due to differing preferences by the residents – e.g. a study based on European data is less applicable than an Australian study because of differences in urban form, preferences and demographic characteristics.
- Amenity is relative; green space may be highly valued in areas where green is sparse but the impact will be less pronounced in areas that are already relatively green.
- CityPlan is a strategic model which considers the overall attributes of regions. Property-specific inputs such as proximity to individual playgrounds or bus stops are difficult to incorporate into a strategic level model.

Where appropriate, improved amenity associated with greater urban density has been incorporated and quantified as a part of the CityPlan and land use modelling.

C.7 Improved transport equality

Promoting social connectivity and inclusion have been a dedicated, long-term goal for the Australian Government and society (Australian Government, 2010[120]). Maximum participation in economic, social and community life is a defining characteristic of a well-rounded, sustainable and resilient society. Achieving this outcome for all Australians means preventing social exclusion and delivering policies and programs that support people to strengthen their ability to participate actively in the labour market and in their communities (Australian Inclusion Board, 2010[121]).

Social exclusion has been described as the existence of barriers which make it difficult or impossible for people to participate fully in society or to obtain a decent standard of living (Social Exclusion Unit, 2003[122]). Transport accessibility and connectivity plays a key role in achieving social inclusion. There is a large body of literature regarding how transport disadvantage can exacerbate social exclusion or reduce quality of life. Interest in reducing transport related social exclusion stems from French social policy (Lenoir 1989[123]) and more recently the UK has focussed a great deal of policy attention on reducing social exclusion (UK Social Exclusion Unit 2003[124]). The UK is also one of the few governments to make the transport-exclusion relationship a focus of policy (Hodgson and Turner 2003[125]; Department for Transport 2006[126]). The European Commission has also funded a comprehensive best practice review of transport programs to reduce exclusion across Europe (Holmes et al. 2007[127]).

Barriers to transport accessibility and connectivity were seen as centring around a number of factors including (Janet Stanley, 2017[128]):

- Availability and physical accessibility of transport
- Cost of transport
- Services located in inaccessible places
- Safety and security – fear of crime
- Travel horizons – people on low incomes were found to be less willing to travel to access work than those on higher incomes largely due to relative high (to income) cost and travel time required.

A number of other studies have also targeted accessibility around specific groups of people. For example, Cartmel and Furlong (2000[129]) found youth are more likely to suffer transport exclusion;

[120] (Australian Federal Government, 2010). Social Inclusion.
[121] (Australian Social Inclusion Board, 2010). Social Inclusion in Australia: How Australia is Faring.
[122] (Social Exclusion Unit, 2003). Making the Connections: Final Report on Transport and Social Exclusion.
[123] (Lenoir, 1989). *Les Exclus, and Francais sur Dix, 2nd edition.*
[124] (UK Social Exclusion Unit , 2003). Making the Connections: Final Report on Transport and Social Exclusion.
[125] (Hodgson & Turner, 2003). Participation not Consumption: the Need for New Participatory Practices to Address Transport and Social Exclusion.
[126] (Department for Transport, 2006). *Guidance on Accessibility Planning in Local Transport Plans.*
[127] (Holmes, Clifford, Gregory, & Mabelis, 2007). *ECLIPSE: Good Practice Review - Final Version Year Two.*
[128] (Stanley J. , 2017). The Usefulness of Social Exclusion as a Theoretical Concept to Inform Social Policy in Transport.
[129] (Cartmel & Furlong, 2000). *Youth Unemployment in Rural Areas.*

Bradshaw et al. (2004)[130] reinforced the importance of transport to those with limited financial means such as the key service workers[131].

There has been little application of social exclusion concepts within the transport field in Australia, until the 2000s. Research has been undertaken on specific groups who are at risk of social exclusion such as people with limited financial means (Stanley and Stanley 2004). Also, Alsnith and Hensher (2003)[132] and Harris (2005[133]) have researched transport issues for seniors and Currie et al (2005[134]) have worked on accessibility to transport for youth and found youth are one of the groups over-represented in 'transport disadvantage' in Australia.

C.7.1 Transport inequality in Melbourne

Against the backdrop of rising property prices in major cities across Australia, it is increasingly difficult for lower income households to live affordably within inner-city areas, resulting in financial pressures to relocate to outer fringe areas (where property prices are lower). Migrant families, newly established families (first home buyers), sole-parent families and key workers are over-represented in these outer fringe suburbs (Stanley and Stanley, 2017[135]).

Even in outer suburban/regional areas where the public transport network is currently available, the quality and frequency of services means that households may face a daily long distance commute and high transport costs. Transport accounts for 14.5 per cent of household expenditure (Australian Bureau of Statistics, 2017), the third highest expenditure share (behind housing, and food and beverages). In such settings, people generally have little alternative to buying and using a car to be able to participate in the opportunities available in their society, because of a lack of alternative mobility choices (Currie & Senbergs, 2007).

Currie and Delbosc (2010[136]) developed an empirical model to measure links between transport disadvantage, social exclusion and well-being through a Melbourne based study. The study drew on an interview questionnaire measuring transport disadvantage through self-reported difficulties with transport in Melbourne, especially in the outer suburbs. The model quantitatively proved that transport disadvantage is positively associated with social exclusion and is strongly negatively associated with wellbeing.

Currie et al (2011[137]) undertook a study to investigate the transport disadvantage through an analysis of existing census and travel survey data. The concept of 'forced' car ownership (**FCO**) as it applies to outer Melbourne has been explored.

Overall, some 20,831 households were identified in outer Melbourne which may be considered to have FCO including no / low relative public transport service levels, lack of walkability to activities, an income below $500 / week, and who also run two or more cars. These households were found to own smaller and older cars and spent a higher share of motor vehicle expenditure on registration and insurance and

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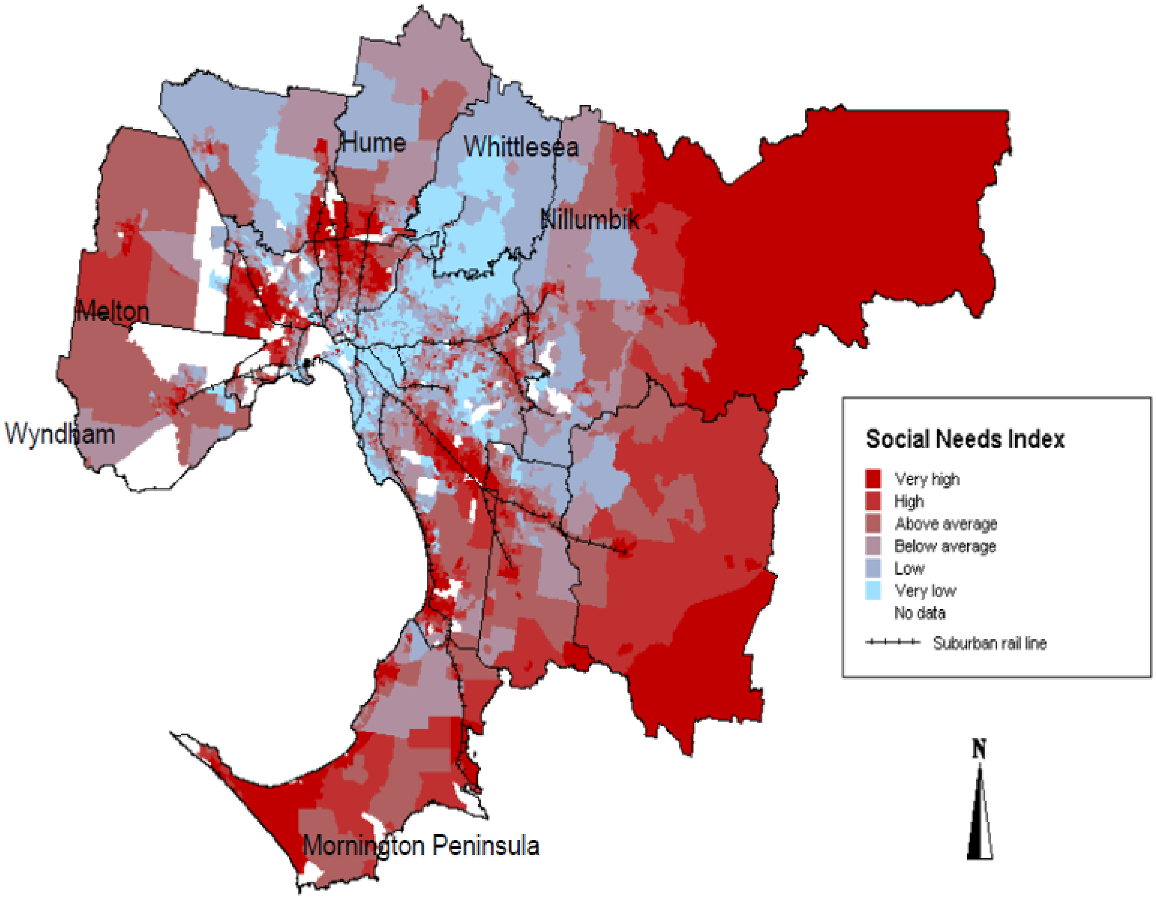
[130] (Bradshaw, Kemp, Baldwin, & Rowe, 2004). *The Drivers of Social Exclusion: A Review of the Literature for the Social Exclusion Unit in the Breaking the Cycle Series.*
[131] Key service workers often encompass teachers, nurses, police officers, social workers, therapists and firefighters.
[132] (Alsnith & Hensher, 2003). *The Mobility and Accessibility Expectations of Seniors in an Aging Population.*
[133] (Harris, 2005). *Transport and Mobility: Challenges, Innovations and Improvement.*
[134] (Currie G. , Gammie, Waingold, Paterson, & Vandersar, 2005). *Rural and Regional Young People and Transport: Improving Access to Transport for Young People in Rural and Regional Australia.*
[135] (Stanley & Stanley, 2017). *The Importance of Transport for Social Inclusion.*
[136] (Curries & Delbosc, 2010). *Modelling the Social and Psychological Impact of Transport Disadvantage.*
[137] (Currie, 2011). *Investigating Links Between Transport Disadvantage, Social Exclusion and Well-being in Melbourne.*

less on vehicle purchase. Analysis found that FCO households make less trips (12.9 per cent less) and travel shorter distances than the average households in outer Melbourne. This relative propensity to travel less may be illustrative of financial pressures and a desire to reduce the costs of travel compared to other income groups in similar circumstances.

It is worth noting that areas in Melbourne with very high public transport needs but very little supply include Melbourne's north west, such as parts of Deer Park, Albion / Ginifer, Keilor Plains, Meadow Heights, Dallas, Campbellfield and Laylor (Currie et al, 2011).

Figure C - 3 and Figure C - 4 below provide the estimated public transport demand and supply gap as well as the distribution of lower income households in Melbourne (Currie et al, 2011).

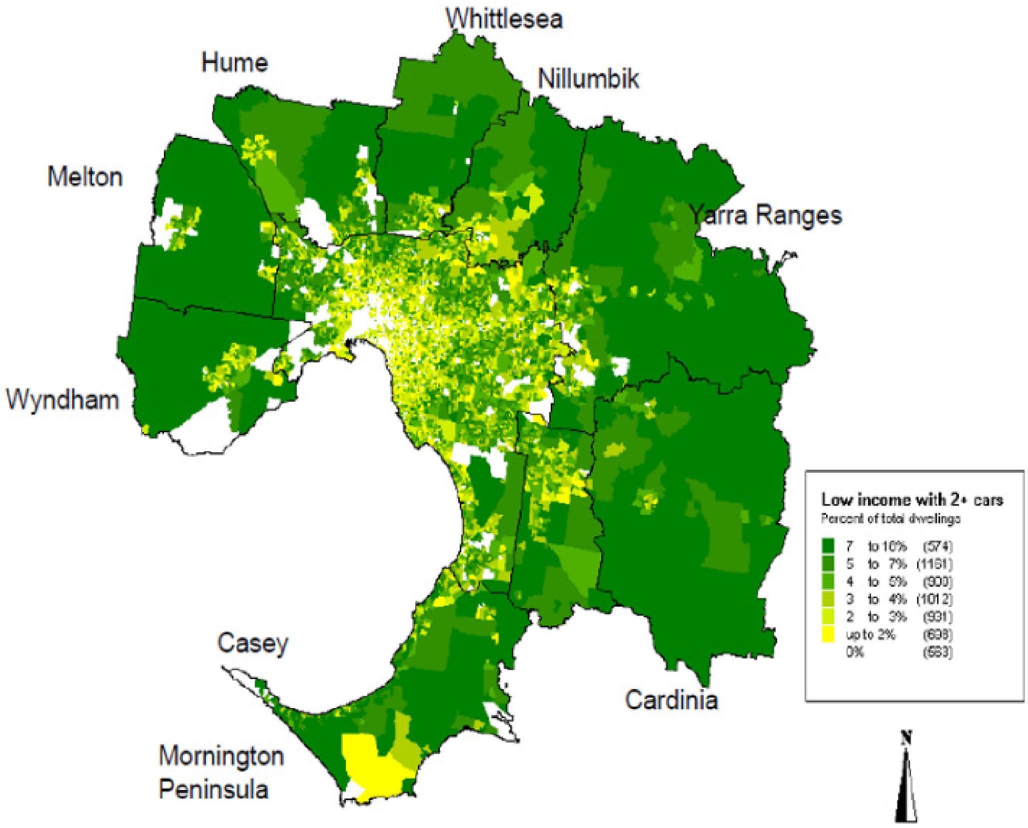
Figure C - 3: Public transport supply and demand gap, metropolitan Melbourne (2011)



Note: 'Suburban rail lines' as labelled in this figure correspond to the Melbourne metropolitan rail network in 2011, hence these do not include or correspond to SRL – Cheltenham to Airport.

Source: Currie et al, 2011

Figure C - 4: Distribution of low income households (2011)



Source: Currie et al, 2011

C.7.2 Valuing transport related social inclusion for Melbourne

The value of improved social inclusion for Melbourne

Stanley, Hensher et al (2011[138]) quantified the value of social inclusion enabled by better transport accessibility using a Generalised Ordered Logit regression model.

The model was built using Melbourne based survey data (a face-to-face survey undertaken for the purpose of the study). The survey sampling covered inner and outer metropolitan areas, people living in areas within walking distance to public transport and outside such distance, low and high income levels, and representative characteristics.

The regression model included variables to control for and to capture:

- Social exclusion (various social exclusion indicator questions and questions related to social capital, community strength and social wellbeing measures)
- Well-being (various well-being and personality measures)

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[138] (Stanley H. e., 2011). *Social Exclusion and the Value of Mobility.*

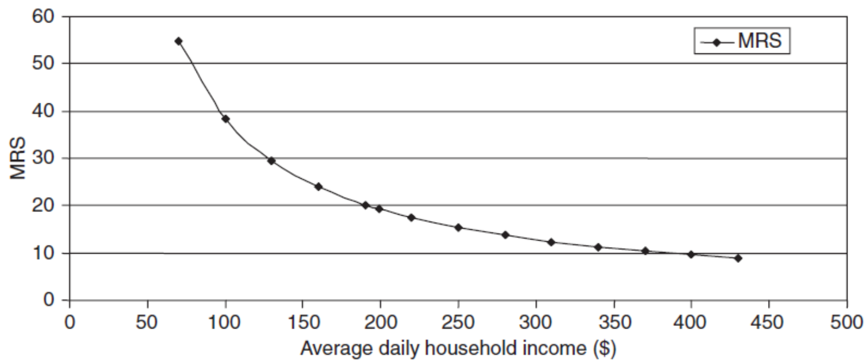
- Transport (building on details in the household travel survey)
- Socio-economic characteristics (education, country of birth, various income questions, including relative poverty).

The findings provide statistically significant evidence to suggest that transport accessibility and connectivity is positively correlated with the likelihood of social inclusion. In particular, higher trip-making implies less risk of social exclusion. Higher household income, connection with community, and personal growth (being open to new experiences) are also positively related to a lower risk of social exclusion. Stanley and Stanley (2019[139]) further emphasised the importance of mobility, which can be facilitated by public transport, in bridging social capital.

Using the statistically significant relationships between household income, number of trips, and level of social exclusion, the Marginal Rate of Substitution (**MRS**) between number of daily trips and average daily household income was derived (Figure C - 5). The MRS are estimated to decline with increasing household income levels.

Using the average daily household income and the MRS, the value of an additional trip was estimated at $19.30 per trip (in 2011 dollar terms).

Figure C - 5: MRS between number of daily trips and average daily household income



Source: Hensher et al, 2011

Compared to the $19.30 per trip set out above, the value estimated using a generalised travel cost approach based on ATAP (2018) measures the monetised vehicle operating cost fares and travel time savings.

Applying the conventional generalised cost approach, and based on the survey data underpinning Stanley and Hensher et al (2011), it results in a value of $3.50 for an additional car trip and $4.80 for a public transport journey (both in 2011 dollar terms, and applied 'rule-of-a-half').

According to Stanley and Hensher et al (2011), the difference is likely to be due to generalised cost estimates being appropriate for benefit estimation for small changes in travel opportunities (such as a small increase in public transport service) but not for major changes in trip behaviour (for example, major improvement in public transport service or new service).

With a typical daily trip rate of about 2.5 to 5 return trips (based on the survey), an additional trip is a non-marginal change in activity, where valuation should incorporate expected consumer's surplus on the travel activity, not be simply estimated based on expected travel costs. This implies higher values

[139] (Stanley and Stanely, 2019). *Social exclusion: the roles of mobility and bridging social capital in regional Australia*

for non-marginal changes in travel activity, which is what the result show in Stanley and Hensher et al (2011).

However, it needs to be noted that the $19.30 is more suitable for economic appraisal of major public transport projects that provides significant accessibility and connectivity uplift to communities in relative disadvantage and / or in the outer metropolitan areas.

The application of using the $19.30 as an economic parameter to estimate the economic benefit from 'Connected Communities: Better Bus Services in Tasmania' was demonstrated in Currie (2017[140]).

C.7.3 Quantification

SRL – Cheltenham to Airport will expand the capacity of public transport networks. It will connect the middle suburbs of Melbourne to priority growth precincts in Monash, La Trobe and Sunshine, improving access to major health, education and employment centres.

The quantification of the reduced transport inequality due to SRL – Cheltenham to Airport is provided in Table C - 6 below.

Table C - 6: Benefit of reduced transport inequality

Key inputs	Approach
Stanley and Hensher et al (2011) estimated WTP per trip for those at risk of social exclusion (e.g. mid-point estimate of $19.30 in 2010 dollar terms). The number of trips made by the people at risk of social exclusion (details see page 201, Section 2.1 of Stanley and Hensher et al). This has been estimated using LUTI demographic files and **VISTA**). Additional trips made (by those at risk of social exclusion) under the Program Cases compared to Base Case. The additional trips have been estimated based on the relationship with accessibility (elasticity of trips to accessibility changes estimated using a regression).	SRL – Cheltenham to Airport has the potential to contain the outer metropolitan areas to the established area that otherwise would be consumed by urban development to be dedicated to other uses, including agriculture, horticulture or some other non-urban usage. The value of this reduced non-urban land consumption for urban development can be estimated by adopting the community's willingness-to-pay for protecting non-urban land from urban encroachment. **Economic parameters** Stanley and Hensher et al (2011) estimated WTP per trip for those at risk of social exclusion (e.g. mid-point estimate of $19.30 in 2010 dollar terms). This has also accounted for the decay in the value as household income increases (e.g. the WTP decreases to about $10 for those with an average daily household income of $450 whereas the WTP is over $50 for those who earn below $60 per day). **Number of trips made by people at risk of social exclusion** To calculate the reduced social inequality benefit, it is necessary to estimate the number of trips made by those at risk of social exclusion. Total trips made by all Victorians are available from LUTI model files which can be used as a base and then overlaid with other data to derive the number of trips made by those at risk of social exclusion. The criteria to determine the number of trips and people who are at risk of social exclusion broadly mirrors[141] those on page 201, Section 2.1 of Stanley and Hensher et al (2011). In particular, the

[140] (Currie, New Perspectives and Methods in Transport and Social Exclusion Research , 2017). *New Perspectives and Methods in Transport and Social Exclusion Research.*

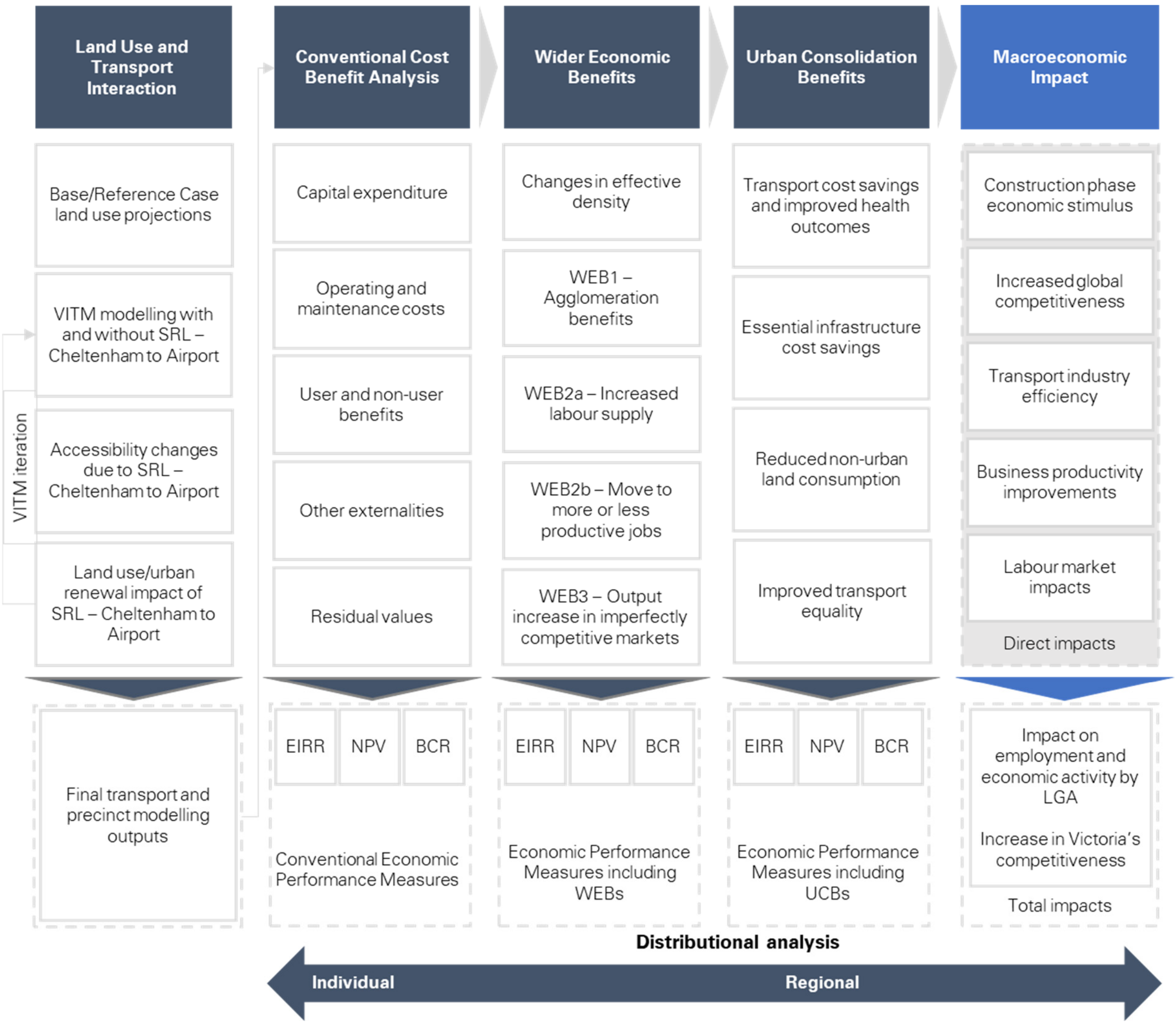
[141] Some criteria (e.g. political activity and social support) in Stanley and Hensher et al (2011) are not able to be included in this economic appraisal due to the lack of data. These were specific to the survey undertaken for the purpose of the Stanley and Hensher et al (2011) paper only, and not available in any database this appraisal could employ.

Key inputs	Approach
	following criteria have been used to derive the number of trips made by people at risk of social exclusion: • Household income: less than a threshold of \$500 gross per week (2010 dollars) but inflated to current dollar value • Employment status: those without a job (either part or full time); • Participation: no trips made for leisure purposes. These trips and people were identified using the Household, Income and Labour Dynamic (**HILDA**) survey (wave 17) by Melbourne Institute. **Additional trips made under Program Cases compared to Base Case:** The additional trips have been estimated based on the elasticity of trips to changes in accessibility. The elasticity has been estimated (using a regression) based on historical data of number of trips and accessibility changes using data from VITM. The accessibility (scores) improvement have been estimated by VITM for the Program Cases compared to Base Case. **Quantification** Economic benefit associated with reduced transport inequality due to SRL – Cheltenham to Airport: $$E = (Trips_{PC} - Trips_{BC})WTP$$ where: E = Economic benefit associated with reduced transport inequality due to SRL – Cheltenham to Airport $Trips_{PC}$ = number of trips made by those at risk of social exclusion under Program Case $Trips_{BC}$ = number of trips made by those in risk of social exclusion under Base Case WTP willingness to pay for each additional trip by those in risk of social exclusion

Attachment D: Macroeconomic impacts

This attachment presents the detailed approach and assumptions regarding the quantification and modelling of the macroeconomic impacts associated with SRL – Cheltenham to Airport. Figure D - 1 highlights the specific elements of the macroeconomic impact that has been quantified for the economic evaluation.

Figure D - 1: Macroeconomic impacts within the overarching economic appraisal framework



Source: KPMG.

The macroeconomic wide impact of SRL – Cheltenham to Airport can be attributable to (and reflected in) its ability to improve the attractiveness of Victoria and Melbourne as a place for investment and to live in, among other international cities. This is known as the economic benefit of improved global competitiveness and 'Brand Victoria'.

D.1 Improved Global Competitiveness and 'Brand Victoria'

D.1.1 Transport infrastructure provision and a state's global competitiveness

The concept of global competitiveness[142] stems from the competitiveness of businesses and industries, with its application in comparing countries, states and cities first appearing in the 1990s during the rise of globalisation[143,144]. Rather than the primary focus being profit maximisation (as it is for many businesses), states compete for much more complex long-term goals such as:

- Attracting population and workforce talent
- Gaining private sector investment
- Increasing tourism
- Receiving funding for public infrastructure
- Holding major cultural or sporting events.

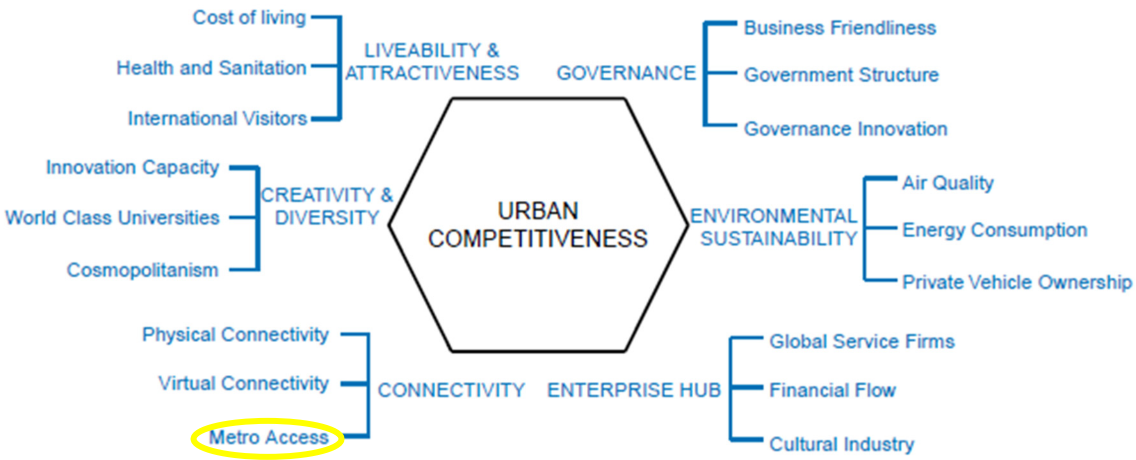
These more complex goals set the foundation for the states' long-term growth, liveability, sustainability and prosperity, going beyond short-sighted financial returns alone. In many cases, the global competitiveness of a state is related to the mix of attributes it has which improves the environment in which businesses operate[145]. This can be manifested in the state's economic success in the global market, displayed in 'outcomes' such as gross state product (GSP), employment and income which are driven by 'determinants' including productivity, innovation and the provision of infrastructure[146].

As part of the above measures, the provision of transport infrastructure plays an important role in contributing to competitiveness. The enabling qualities of having good transport infrastructure on a state's competitiveness is well understood and documented in the literature. Transport infrastructure investments spur business interaction and knowledge exchange, allowing communities to leverage combined resources and assets and has the potential to influence productivity through accessibility and travel time. Transport infrastructure is also considered a 'key service' in modern societies that affects people's daily lives including life satisfaction and perceived wellbeing. It promotes the progression of modern society by supporting people's interaction, cooperation and mutual understanding[147]. All of these are key for developing productivity, business and growing employment and population in Victoria.

[142] State Competitiveness can also be referred to as 'urban competitiveness' or 'social competitiveness.'
[143] (Porter, 1990). *The Competitive Advantage of Nations.*
[144] (Porter, The Competitive Advantage of the Inner City, 1995). *The Competitive Advantage of the Inner City.*
[145] (Begg, 1999). *Cities and Competitiveness.*
[146] (Greene, Tracey, & Cowling, 2007). *Recasting the City into City-regions: Place Promotion.*
[147] (Kiel, 2013). The Impact of Transport Investments on Competitiveness.

Figure D - 2 shows an example of the factors in a state competitiveness model to compare cities on a global scale, with 'Metro Access' (e.g. the connectivity of the passenger rail network) identified as one of the headline criteria.

Figure D - 2: Example model of urban competitiveness[148]



Source: KPMG.

This importance of transport infrastructure provision has also been recognised by a number of international growth promoting bodies and publications, notably the World Economic Forum *Global Competitiveness Report*[149] which includes two public transport metrics in railroad density (measured via length of railway per km^2) and efficiency of train services (measured via qualitative survey). In another urban competitiveness model (used to compare cities within the same country), infrastructure was identified as the carrier of economic and social development, with public transport provision being a key metric of this (measured by the number of public transport vehicles per 10,000 population[150]).

D.1.2 Competitiveness of Melbourne and Victoria

Victoria and Melbourne are generally seen as being broadly competitive on a global scale, owing to the good mix of institutions and services provided within the state. Victoria already has the second largest GSP[151] and highest population growth rate[152] in Australia, with the Economist Intelligence Unit's Global Liveability Index ranking Melbourne as the second most liveable city in the world[153].

However, other measures show significant room for improvement. In a report benchmarking Melbourne against 10 other 'global cities' (such as New York, London and Hong Kong), Melbourne ranks at the bottom in terms of 'Connectivity' and 'Metro Access'[154], and is behind cities such as Sydney, San Francisco and Shanghai.

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148 (Hu, 2013). Benchmarking the Competitiveness of Australian Global Cities: Sydney and Melbourne in the Global Context.
149 (Schwab, 2018). *The Global Competitiveness Report.*
150 (Liu, 2016). Measuring the Urban Competitiveness of Chinese Cities Based on Multi-attribute Decision Making Approach.
151 (Australian Bureau of Statistics, 2018). *Australian National Accounts: State Accounts, 2017-18.*
152 (Australian Bureau of Statistics, 2019). *Australian Demographic Statistics.*
153 (The Economist Intelligence Unit, 2018). *The Global Liveability Index.*
154 (Hu, 2013). Benchmarking the Competitiveness of Australian Global Cities: Sydney and Melbourne in the Global Context.

For example, Melbourne's northern and western regions have been growing slower than the other regions (e.g. southern and eastern) in terms of transport infrastructure investment over the past decades. This has implications in these regions such as longer travel time to the CBD, lower private investment and business developments; this has been recognised as a policy priority for the Government (Parliament of Australia, 2018[155]).

Melbourne is one of the few major international cities that does not have an airport rail service. Introducing an airport rail and to be in line with other comparable major cities can increase the 'perceived' value of doing business in Victoria for global investors and skilled migrants who consider living in Victoria. Key infrastructure such as an airport rail can improve the competitiveness of Victoria in attracting talent and investment.

D.2 Quantification of macroeconomic benefits

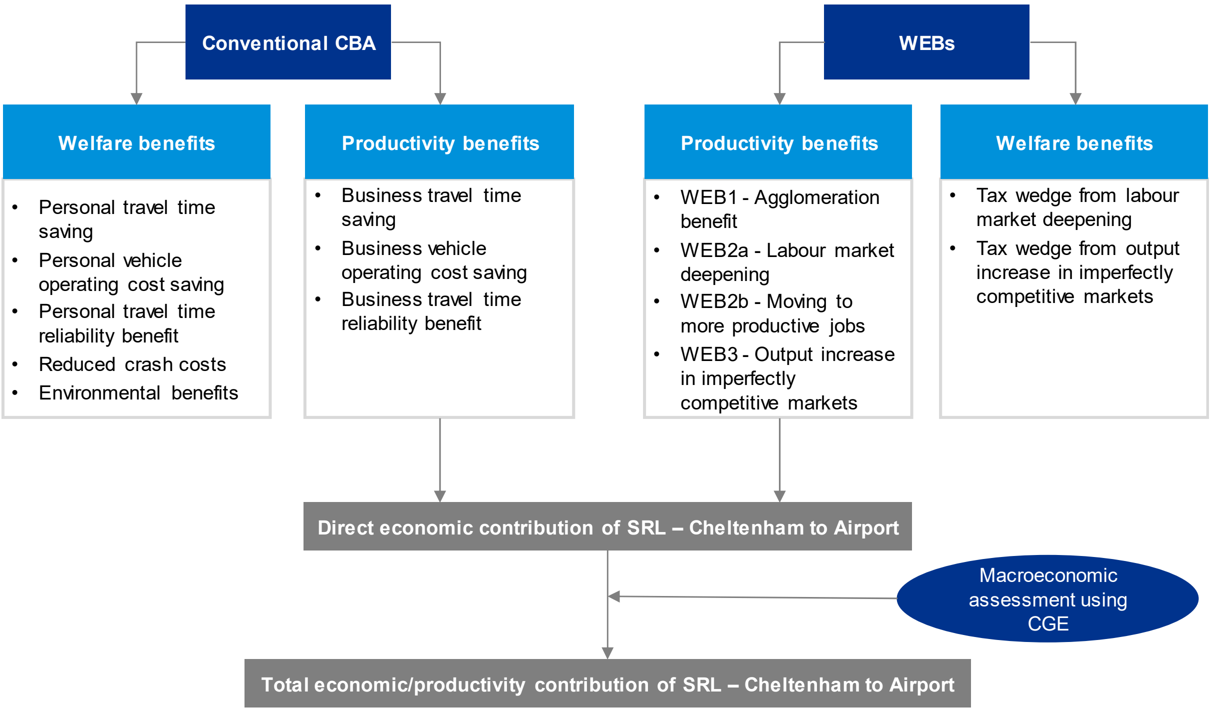
CGE modelling has been undertaken to assess the net and total (including flow-on) impact of SRL – Cheltenham to Airport on the macro economy.

CGE modelling is a widely used tool for quantifying the economy-wide impacts of policies or major infrastructure investments. The proposed geographic structure applied in the macroeconomic modelling is presented in Table D - 1.

The CGE modelling simulates the investment and operational phases of SRL – Cheltenham to Airport and draws on the financial modelling and CBA of SRL – Cheltenham to Airport as well as the WEBs. The framework, inputs and process for assessing the macroeconomic impact of SRL – Cheltenham to Airport are illustrated in Figure D - 3.

155 (Parliament of Victoria, 2013). Inquiry on Growth of the Suburbs: Infrastructure and Business Development in Outer Suburbs Melbourne.

Figure D - 3: Framework for assessing the macroeconomic impact of SRL – Cheltenham to Airport



Source: KPMG.

The macroeconomic indicators assessed using CGE modelling draw on the following (Table D - 1) productivity metrics associated with SRL – Cheltenham to Airport as sources of stimulus:

Table D - 1: Productivity metrics of SRL – Cheltenham to Airport (as source of stimulus simulated by CGE)

Direct investment (financial) related productivity metrics	CBA related productivity metrics	WEBs related productivity metrics
The productivity metrics associated with the direct investment in SRL – Cheltenham to Airport include: • Construction phase capital investment • Operational phase operational expenses.	The productivity metrics associated with SRL – Cheltenham to Airport CBA benefits include: • Direct estimated changes in business travel time, reliability and vehicle operating costs.	The productivity metrics associated with SRL – Cheltenham to Airport WEBs include: • Increase productivity by increasing economies of agglomeration • Increase labour supply by reducing commuting costs • Increase labour productivity by better matching workers skills with employers' skill needs.

That is, CGE uses the above productivity metrics as inputs when simulating the macroeconomic indicators.

The macroeconomic impacts (indicators) of SRL – Cheltenham to Airport that have been simulated by CGE include the following:

- Construction phase stimulus (e.g. on the labour market and consumption)
- Operational phase impact - improved global competitiveness and 'Brand Victoria', that is reflected in:
  - Increased immigration
  - Increased productivity by industries (including improved transport efficiency)
  - Increased production (e.g. GDP, GSP) and employment
  - Increased household income and consumption
  - Increased tax revenue collected by Government.

D.3 KPMG-SD model

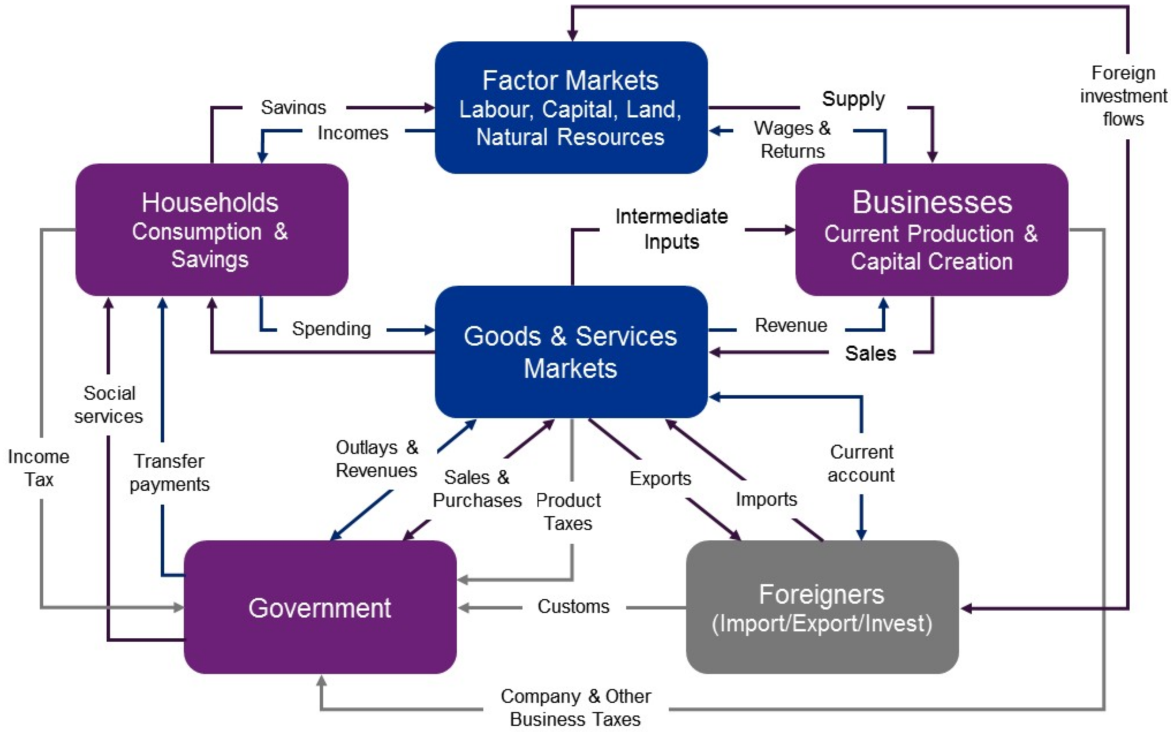
D.3.1 Model overview

The approach to estimating the economy-wide effects of SRL – Cheltenham to Airport is based on a detailed, policy-focussed model of the Australian economy: the KPMG-SD model. This is KPMG's proprietary computable general equilibrium model of the Australian statistical divisions (hereafter referred to as regions). KPMG-SD has been specifically designed for the analysis of regional policies as it explicitly captures

- Linkages between industries within and between regions
- Flows of income stemming from jobs and profits supported by industry activity within each region
- Relationships between the government sector and the rest of the economy.

The KPMG-SD model represents the economy as a system of interrelated economic agents and thus is capable of tracing and quantifying the impact of SRL – Cheltenham to Airport from one sector to another. Figure D - 4 shows the transmission channels through which the impact of SRL – Cheltenham to Airport affects the whole economy.

Figure D - 4: System of interrelated economic agents



Source: KPMG.

Economic theory is used to specify the behaviour and market interactions of economic agents in KPMG-SD. Defining features of the theoretical structure of KPMG-SD include:

- optimising behaviour by households and businesses in the context of competitive markets with explicit resource constraints and budget constraints
- the price mechanism operates to clear markets for goods and factors, such as labour and capital i.e. prices adjust so that supply and demand are equal
- marginal costs are equal to marginal revenues in all economic activities.

The model combines data from input-output tables, labour force surveys and other sources with the model theory to quantify sophisticated behavioural responses such as:

- price and wage adjustments driven by resource constraints
- household spending and government spending, and taxing adjustments driven by budget constraints
- allowance for input substitution possibilities in production (e.g. allowing the combination of labour, capital, and other inputs required for production to vary in response to relative price changes).

KPMG-SD takes a ‘bottom-up’ approach to multiregional modelling. In each region, economic agents decide the allocation of labour, capital and land to different productive activities. The cost structure of firms in each sector, the composition of investment goods, the endowments and preferences of households and the level and composition of public expenditures are all region-specific. Regions are interdependent via bilateral flows of goods and services between regions and with the rest of the world. These bilateral trades are facilitated in the model via a detailed specification of transport margins for goods.

The dynamic features of KPMG-SD are built on the premise that economic adjustment to economic shocks takes place over a period of years with the economy demonstrating much greater flexibility in the long-run than in the short-run. A core dynamic feature is the accumulation of capital. Investment behaviour is industry-specific and is positively related to the expected rates of return, which depend on the growth rates of the capital stock. The capital growth rate is determined by investment in the previous year less capital depreciation. Another dynamic feature of KPMG-SD is the lagged adjustment process in the labour market. The real wage rate adjusts gradually over time until employment reaches its long-run equilibrium level; this relationship is calibrated using coefficients estimated by the NIGEM macroeconomic model. Workers are somewhat mobile between regions in response to changes in real wage rate relativities.

D.3.2 Model implementation

The KPMG-SD database typically represents regional economies aligned to Statistical Areas Level 4 (SA4) of the Australian Statistical Geography Standard (AGSG). For this study, we use a regional aggregation that explicitly captures the areas through which SRL – Cheltenham to Airport will run, as well as other surrounding areas of Melbourne. The regional aggregation includes eight SA4 regions representing the Greater Capital City area of Melbourne, and composite rest of Victoria and rest of Australia regions. These regional economies represented in KPMG-SD are integrated through interregional flows of goods and services, factors of production and the explicit representation of population and labour supply.

The KPMG-SD model also represents the economy at a high level of industry detail. In standard form, the model has 117 sectors but these are aggregated to a more manageable number to focus on sectors of particular interest to the analysis. Table A1 presents the final industry aggregation. The aggregated sectors correspond to the broad sectors defined in National Accounts except for the transport sector and industries servicing the transport sector. We have separately identified 28 sectors for each of the 11 regional economies with each sector producing one good or service. We use the terms 'sectors' and 'industries' interchangeably throughout this report.

Table A1: Industry aggregation in KPMG-SD

1. Agriculture, Forestry & Fishing	15. Air Passenger
2. Mining	16. Air Freight
3. Petroleum products	17. Other Transport, Support Services and Storage sector
4. Motor vehicle, Parts and Auto Repair	18. Information Media & Telecommunications
5. Other manufacturing	19. Financial & Insurance Services
4. Electricity, Gas, Water & Waste Services	20. Rental, Hiring & Real Estate Services
5. Construction	21. Professional, Scientific & Technical Services
6. Wholesale trade	22. Administrative & Support Services
7. Retail trade	23. Public Administration and Defence
8. Accommodation & Food Services	24. Education
9. Road Passenger	25. Healthcare & Social Assistance
10. Road Freight	26. Arts & Recreation Services
11. Rail Passenger	27. Other Services
12. Rail Freight	28. Dwellings

Source: KPMG.

D.3.3 Key model assumptions

In the project case we inform the model with numerical inputs (e.g., CAPEX, OPEX and project benefits) to estimate the direct and indirect annual effects on the economy of the rail project. The assumptions regarding the economic environment in the construction and operational phases are described below.

The choice of exogenous variables for the construction phase represents the behaviour of the economy in the short term. The key settings include:

i. Tax rates and government policy settings are held fixed at baseline values with budget balances free to vary.

ii. A value for investment in the Rail Transport sector is imposed to reflect SRL – Cheltenham to Airport's capital expenditure assumptions whilst investment in the remaining sectors responds to sector-specific rates of return.

iii. All investment is financed by the government so we increase government debt by the amount of total investment cost per year. Thus, the government budget and government debt move above baseline levels reflecting the cost of constructing SRL – Cheltenham to Airport.

iv. The treatment of the current account and net foreign liabilities in the project cases are like those applied for the government budget and government debt. That is, we allow the current account deficit and net foreign liabilities to rise as ratios of GDP during the construction phase.

v. The labour market is assumed to have sufficient slackness in the short term that wage rates respond slowly to changes in labour demand while unemployment rates adjust more rapidly.

vi. The average propensity to consume out of household disposable income (i.e., the household saving rate) is endogenous in each region and is a lagged function of (a) real household disposable income, (b) real household wealth, and (c) the number of liquidity constrained consumers.

vii. Consumer preferences and technical change parameters are held fixed at baseline values.

The operational phase of the project is represented in the context of a long-run economic environment where SRL – Cheltenham to Airport is operating at capacity within an economy that has stabilised by end of the simulation horizon (as opposed to a cyclical high or low). This approach recognises (i) the permanent nature of the increment to rail capacity in Victoria and (ii) that estimates of the impacts should not be biased by temporary cyclical factors. The selection of exogenous variables for the operational phase simulation is described by the following assumptions:

i. Rates of return on capital gradually return to baseline values except for the passenger rail industry, which responds to operational expenditure.

ii. Consumer preferences are held fixed at baseline values except for household tastes for passenger rail, i.e., this assumption facilitates the implementation of exogenous shocks to household passenger rail expenditure.

iii. Technical change parameters are held fixed at baseline values except for input-saving technical change and labour productivity in the passenger rail industry, i.e., this assumption facilitates the implementation of exogenous shocks to cost savings by firms.

iv. The government budget (as a ratio of GDP) is slowly reduced towards baseline levels by 2079. This is achieved through higher income taxes raised by the Australian Government and paid to Victoria via higher intergovernmental grants. From 2080 to 2084 the Victorian government pays back all borrowings used to finance their share of the investment cost (50%). This is achieved via a broad-based consumption tax raised in Victoria. These assumptions ensure that the project build cost is equally shared by the Australian and Victorian Governments reflecting the financing arrangements of the project.

v. The current account and net foreign liabilities return to baseline levels via an adjustment of the national household saving rate in response to the household consumption function. This function makes consumption respond to real household disposable income, real household wealth and the number of liquidity constrained consumers. This means that the saving rate must rise in the long-run to reduce the current account deficit to baseline levels.

vi. The national unemployment rate returns to baseline levels.

We assume that all investment is initially financed by the government through foreign borrowing. So government debt is increased by the total investment cost per year. Thus, during the construction phase the government debt rises above baseline levels reflecting the cost of implementing the rail project. Once the construction phase ends the government budget (as a ratio of GDP) is slowly reduced to baseline levels by 2079. This is achieved through higher income taxes raised by the Australian Government and paid to Victoria via higher intergovernmental grants. From 2080 to 2084 the Victorian Government pays back all borrowings used to finance their share of the investment cost (50 per cent). This is achieved via a broad-based consumption tax raised in Victoria. These assumptions ensure that the project build cost is equally shared by the Australian and Victorian Governments reflecting the financing arrangements of the project.

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