East West Needs Assessment Economic Benefits and Costs Analysis – Technical Report

Prepared for

East-West Needs Assessment Team

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EXECUTIVE SUMMARY

Introduction

Meyrick and Associates, together with EconSearch and Steer Davies Gleave were asked by the East–West Study Team for Melbourne to assess a range of transport options for the East–West Link. The economic benefits and costs of the transport infrastructure options considered by the Study Team have been quantified by the Study Team's economic advisers.

The economic analysis of potential solutions was constructed around three main work streams:

1. A benefit cost analysis (BCA), focusing on the direct impact of the proposed interventions
2. A quantitative assessment of the indirect or flow-on effects of the project using Computable General Equilibrium (CGE) modelling
3. An assessment of the economy-wide benefits that flow from improving the functioning of the transport sector – referred to as the Wider Economic Benefits (WEB).

It is the purpose of this paper to provide the technical detail regarding the approaches, outcomes and interrelationships between these three economic work streams. This technical paper is organised as follows. The remainder of this summary section outlines the base case and options modelled, as well as an overview of the outcomes of the work streams. Section 1 details the benefit cost model development, treatment of inputs and outputs. Section 2 details the CGE Model development and outputs; and section 3 details the WEB assessment and its 'additionality' with the CGE and BCA models. Finally, section 4 summarises the relationships between the outcomes of the work streams.

Base case and options modelled

Table 1 outlines the characteristics of the road development and public transport initiatives incorporated into the transport modelling and economic modelling for this study. A base or 'do nothing' case was developed to detail the performance of the transport network over the next 50 years in the absence of a significant intervention. This base case incorporated the forecast impact on demand and supply of road and public transport infrastructure investment that was outlined in the Meeting Our Transport Challenges policy statement, as well as ongoing network upgrade and maintenance of the road and public transport networks. The base case was compared to forecast performance under four different option scenarios for the benefit cost analysis. On advice from the Study Team, the CGE modelling and the wider economic modelling considered two of the four options - Option B and Option D.

TABLE 1 INTERVENTIONS INCORPORATED IN BASE CASE AND OPTIONS MODELLED

	Base Case	Option A	Option B	Option C	Option D
Public transport initiatives	All transport interventions detailed in Meeting Our Transport Challenges as well as general network upgrades	Base Case plus: ▪ CBD rail tunnel from Tottenham rail yards (Sunbury line) to Caulfield Station (Dandenong line). ▪ Doncaster Rapid Transport – upgrade of the DART bus services to incorporate bus only exit and entry from / to Eastern Freeway, bus interchange at Victoria Park Station and reallocation of road space for buses on Alexandra Parade or Johnston Street. ▪ Tarneit Rail – connection of V/Line Services from west of Werribee to Deer Park, providing for additional capacity to accommodate future growth on the Werribee line by the removal of V/Line Services from this line.	As for option A	As for option A	As for option A

	Base Case	Option A	Option B	Option C	Option D
Road network development initiatives	Regular road network upgrade and maintenance.	Base Case plus: ▪ East-West Road connection from Eastern Freeway to West Gate Freeway (east of Williamstown Road) and Western Ring Road*. Has connections to the existing network at Hoddle Street/Alexandra Parade, Queens Parade, CityLink, the Port, Hyde Street and West Gate Freeway. Freight network connectivity enhancements (Truck Action Plan), comprising: ▪ Upgrade of Ballarat Road between Ashley Street and Geelong Road ▪ Upgrading Ashley Street / Paramount Road to two lanes each direction from Geelong Road to Ballarat Road ▪ Connection of Ashley Street to West Gate Freeway via Cemetery Road upgrade ▪ Connection from Hyde Street to West Gate Freeway ▪ Connection from Dynon Road to Smithfield Road ▪ Upgrading of Western Ring Road (Deer Park bypass to West Gate Freeway) and West Gate Freeway (Williamstown Road to Western Ring Road)	Base Case plus: ▪ East-West Road connection from Eastern Freeway to Deer Park Bypass*. Has connections to the existing road network at Hoddle Street/Alexandra Parade, Queens Parade, CityLink, the Port, Sunshine Road /Geelong Road and Ashley Road / Paramount Street. Freight network connectivity enhancements (Truck Action Plan), comprising: ▪ Upgrading Ashley Street / Paramount Road to two lanes each direction between Geelong Road and Ballarat Road. ▪ Connection from Hyde Street to West Gate Freeway ▪ Direct connection from Princes Highway west to the Western Ring Road and upgrade of Western Ring Road (between Deer Park Bypass and West Gate Freeway)	Base Case plus: ▪ Upgrade of the existing road system from Eastern Freeway to Smithfield Road, comprising widening of Alexandra Parade, Cemetery Road to Royal Park; Tunnel from Royal Park to Smithfield Road. Freight network connectivity, comprising enhancements (Truck Action Plan) comprising: ▪ Upgrade of Ballarat Road between Ashley Street and Geelong Road ▪ Upgrading Ashley Street / Paramount Road to two lanes each direction between Geelong Road and Ballarat Road. ▪ Connection of Ashley Street to West Gate Freeway via Cemetery Road upgrade ▪ Connection from Hyde Street to West Gate Freeway ▪ Connection from Dynon Road to Smithfield Road	No addition to base case
*The Western Extension to the Western Ring Road (A) or Deer Park bypass (B) is assumed to occur after 2021 so is not included in the 2021 performance indicators included in appendix A					

Outcomes

The summary results of these economic assessments for two options (Options B and D) are outlined in Table 2. All monetary values in this table are in 2008 dollars.

The present value of expenditure (Row A) incorporates capital and operating expenditure for the options.

The most significant contributor to the direct economic benefits (Row B) of the interventions results from travel time savings. Better transport allows public transport users, car drivers and commercial vehicles to save travel time which can be converted into more productive activities. The interventions also resulted in vehicle operating cost benefits, reduced externalities, as well as enabling savings in vehicle crash costs.

Row C details the conventional benefit cost ratio (BCR) calculations. Explicitly the BCRs are the present value of the estimated benefits divided by the present value of estimated costs.

The wider economic benefits that are omitted in a conventional BCR are estimated in Row D. The most significant contributor to this increased benefit is what is known as “agglomeration economies”. Put simply, this is the clustering effect and can be explained in terms of how better transport allows more workers to be connected with more jobs and better jobs and how transport facilitates more efficient business interaction. The wider economic benefits add around 35 per cent to the conventional transport user benefits of the combined road and public transport solutions and 20 per cent to the public transport only solutions. After including these benefits (Row E), the BCRs increase to 1.0 and 1.2 for Options B and D respectively (Row F).

In parallel to estimating the wider economic benefits, the CGE model took the outputs of the benefit cost analysis to determine the flow-on impact of the proposed solutions on the broader economy of Victoria. From this analysis it was determined that output of the economy, as measured by Gross State Product, would rise significantly as a result of the proposed solutions. The estimated increase in GSP as a result of the proposed solutions is outlined in Row G.

TABLE 2 SUMMARY ECONOMIC ASSESSMENT

	Combined Road and Public Transport Solution (Option B)	Public Transport Only Solution (Option D)
A. Present Value of Costs	$15.0 billion	$7.9 billion
B. Present Value of Benefits	$11.1 billion	$7.9 billion
C. Benefit Cost Ratio	0.7	1.0
D. Wider Economic Benefits (WEB)	$3.3 billion	$1.3 billion
E. Present Value of all Benefits (incorporating WEB)	$14.4 billion	$9.2 billion
F. Benefit Cost Ratio incorporating WEB	1.0	1.2
G. Computable General Equilibrium (CGE) Increased Output (GSP) for 2031	$624 million	$493 million
H. Agglomeration and Labour Supply GSP Impact 2031	$275 million	$132 million
I. Adjusted increased in GSP for 2031	$852 million	$589 million

As with the benefit cost analysis, the impact of some of the wider economic benefits is currently excluded from conventional CGE modelling techniques. In particular, the CGE modelling does not incorporate the economies of increased agglomeration or some labour supply impacts. This is because agglomeration benefits are derived from reducing the perceived distance between locations within an urban area, which the CGE modelling does not take into account. By incorporating the GSP impact of agglomeration and labour supply (Row H) the GSP impact of the intervention rises considerably (Row I).

1. BENEFIT COST ANALYSIS

1.1 Inputs

1.1.1 Parameter values included in the benefit cost analysis

The parameters that are included in the benefit cost analysis, their values and source are outlined in Table 3.

TABLE 3 MODEL PARAMETERS

Parameter	Measure	Source / Notes
Base Year	2011	Agreed between economic consultants and East-West Study Team
Time period	50 years from base year	Agreed between economic consultants and East-West Study Team
Discount rate	6.5% real	Agreed between economic consultants and East-West Study Team in line with DOI discount rates for transport and energy projects
Number of days per annum	300	Agreed between economic consultants and East-West Study Team
Value of time savings for non-business travel (2008 prices)	$11.54/hour	2006 estimates provided by DOI inflated to 2008 prices using inflation rate
Value of time savings for business travel (2008 prices)	$26.18/hour	2006 estimates provided by DOI inflated to 2008 prices using inflation rate
Long term Inflation Rate (CPI) per annum	2.00%	Agreed between economic consultants and East-West Study Team
Net Present Value	January 08 dollar terms	Agreed between economic consultants and East-West Study Team
Externality Valuations	**$/tonne**	
NO_x	$1 750	Watkiss, P (2002) Fuel Taxation Inquiry: the Air Pollution Costs of Transport in Australia
NMVOC	$850	Watkiss, P (2002) Fuel Taxation Inquiry: the Air Pollution Costs of Transport in Australia
SO_x	$11 380	Watkiss, P (2002) Fuel Taxation Inquiry: the Air Pollution Costs of Transport in Australia
CO_2	$10	Sources include Watkiss, Cosgrove (2003) Urban Pollutant Emissions from Motor Vehicles, BTRE (2005) Greenhouse Gas Emissions from Australian Transport (Calculation provided by Caroline Evans).
CH_4	$10	
N_2O	$10	
CO	$3	Watkiss, P (2002) Fuel Taxation Inquiry: the Air Pollution Costs of Transport in Australia
Particulate Emissions	$341 650	Watkiss, P (2002) Fuel Taxation Inquiry: the Air Pollution Costs of Transport in Australia

1.1.2 Veitch Lister transport model

The Veitch Lister transport model summary performance indicators provided the main input to the benefit cost analysis in terms of informing the development of the base case and informing the detail regarding the performance of the network for the various options. The full list of summary indicators provided to the economics consulting team is outlined in Appendix A to this report. They were provided for the years 2006, 2011, 2021 and 2031 for the base case and for the years 2021 and 2031 for each of the options assessed.

1.2 Background model calculations

1.2.1 Extending the performance indicators from 2006–2061

As discussed earlier, input from the Veitch Lister transport model was provided to the economic consultants for four years (2006, 2011, 2021 and 2031) in the base case and two years for each intervention option (2021 and 2031). Yearly output for each performance indicator was determined by calculating the total growth rate for intervening periods of input data (2006–2011, 2011–2021 and 2021–2031) and applying it to the number of years between the data period. A worked example is outlined in Box 1.

BOX 1 CALCULATING GROWTH RATES IN THE BENEFIT COST MODEL

Passenger Transport revenue $m per day Base Case	2006	$1.799m
Passenger Transport revenue $m per day Base Case	2011	$2.048m
Number of years (n)	2011–2006	5
Per annum growth rate applied to passenger transport revenue 2006-2011 in base case	$(2.048/1.799)^{(1/n)} - 1$	2.62%

To extend the performance indicators from the last year of data (2031) to the end of the assessment period (2061), the respective indicator for 2031 was multiplied by BTRE long term transport demand growth rates of 1.8% per annum for passenger travel indicators and 2.6% for commercial vehicle transport demand (BTRE 2007).

1.2.2 Discount factor profile

To determine the discount factor to be applied to all costs and benefits all years in the analysis period were numbered according to the number of years they were from the base case year 2008 (year 0). The discount factor for each year in the analysis period is therefore equal to one divided by one plus the discount rate to the power of the difference between the year in question less the base case year. A worked example is provided in Box 2.

BOX 2: CALCULATING DISCOUNT FACTORS IN THE BENEFIT COST MODEL

Year of consideration	2010
Base year	2008
Discount factor for year of consideration	$= 1/(1+ \text{discount rate})^{(\text{year of consideration} - \text{base year})}$
Discount factor for 2010	$= 1/(1+6.5\%)^{(2010-2008)}$ = 0.882

The analysis period and the respective discount factors are outlined in Table 4.

TABLE 4 DISCOUNT FACTORS FOR EACH YEAR OF ANALYSIS

Year	Number of years from base	Discount factor	Year	Number of years from base year	Discount factor
2008	0	1.000	2035	27	0.183
2009	1	0.939	2036	28	0.171
2010	2	0.882	2037	29	0.161
2011	3	0.828	2038	30	0.151
2012	4	0.777	2039	31	0.142
2013	5	0.730	2040	32	0.133
2014	6	0.685	2041	33	0.125
2015	7	0.644	2042	34	0.118
2016	8	0.604	2043	35	0.110
2017	9	0.567	2044	36	0.104
2018	10	0.533	2045	37	0.097
2019	11	0.500	2046	38	0.091
2020	12	0.470	2047	39	0.086
2021	13	0.441	2048	40	0.081
2022	14	0.414	2049	41	0.076
2023	15	0.389	2050	42	0.071
2024	16	0.365	2051	43	0.067
2025	17	0.343	2052	44	0.063
2026	18	0.322	2053	45	0.059
2027	19	0.302	2054	46	0.055
2028	20	0.284	2055	47	0.052
2029	21	0.266	2056	48	0.049
2030	22	0.250	2057	49	0.046
2031	23	0.235	2058	50	0.043
2032	24	0.221	2059	51	0.040
2033	25	0.207	2060	52	0.038
2034	26	0.194	2061	53	0.036

1.3 Costs of options

1.3.1 Present value of capital expenditure

Capital expenditure profiles for intervention options were developed from raw capital data provided to the economics consultants by the East–West Study Team. From this information an expenditure profile was established for each option.

The capital expenditure profile for each option was discounted using the discount factors listed in Table 4 and then summed for the analysis period to achieve a present value.

The present value of capital expenditure for each option is listed in Table 5.

TABLE 5 PRESENT VALUE OF CAPITAL EXPENDITURE

Option	PV of Capital Expenditure
	$m
Base Case	0
Option_A	$12 576
Option_B	$12 985
Option_C	$8 550
Option_D	$6 353

1.3.2 Present value of operational expenditure

Operational expenditure for the first 30 years of each intervention was provided to the economic consultants by the East–West Study Team, including allowance for rolling stock. Operational expenditure would not begin until all or part of the options capital expenditure was completed and use of the transport intervention commenced. Given the multi-part nature of many of the options, some elements of the operational cost begin earlier in the study period than others. In discussion with the Study Team a profile was developed regarding the proportion of the full operational expenditure that would be likely to occur while further construction continued.

The operational expenditure profile for each option was discounted using the discount factors listed in Table 4 and then summed for the analysis period to achieve a present value.

The present value of operational expenditure for each option is listed in Table 6.

TABLE 6 PRESENT VALUE OF OPERATIONAL EXPENDITURE

Option	PV of Operational Expenditure
	$m
Base Case	0
Option_A	$1 983
Option_B	$1 983
Option_C	$1 644
Option_D	$1 544

1.3.3 Total costs of options

The capital and operational expenditure was summed to determine the total cost of each option. The present values of total expenditure for Options A, B, C and D are summarised in Table 7.

TABLE 7 PRESENT VALUE OF EXPENDITURE

Option	PV of Capital Expenditure	PV of Operational Expenditure	Total PV of Expenditures
	$m	$m	**$m**
Option_A	$12 576	$1 983	**$14 559**
Option_B	$12 985	$1 983	**$14 968**
Option_C	$8 550	$1 644	**$10 194**
Option_D	$6 353	$1 544	**$7 897**

1.4 Benefits of options

The information provided to the economic consultants allowed the estimation of the following direct benefits directly attributable to the transport interventions contained within the four options:

1. Travel time savings for private vehicle operators, commercial vehicle operators and public transport users
2. Reduced private and commercial vehicle operating costs
3. Reduced crash costs incurred by private and commercial vehicles
4. Reduced externality costs from reductions in greenhouse gas and other emissions from private and commercial vehicles
5. Increased public transport revenue.

1.4.1 Present value of time savings

The present value of time savings for private vehicle operators, commercial vehicle operators and public transport users is presented in Table 8.

TABLE 8 PRESENT VALUE OF TIME SAVINGS

Option	PV of Time Savings
	$m
Base Case	0
Option_A	$9 182
Option_B	$9 495
Option_C	$7 773
Option_D	$6 547

Calculating value of time

Value of time is dependant on the opportunity costs involved. Estimates for 2006 of value of time per occupant for cars (being used for private and business purposes) and for commercial vehicles in urban areas were provided to the economic consultants by the Department of Infrastructure. These are outlined in the Table 9.

TABLE 9 DEPARTMENT OF INFRASTRUCTURE VALUES OF TIME BY MODE 2006 ($/HOUR)

Mode	Descriptor	Per occupant cost
Car	Private	$11.09
	Business	$35.47
Rigid trucks	light - 2 axle 4 tyre	$23.21
	medium - 2 axle 6 tyre	$23.66
	heavy - 3 axle	$24.30
Articulated truck	4 axle	$25.16
	5 axle	$25.16
	6 axle	$25.16
Public Transport	Bus	$11.09
	Tram	$11.09
	Train	$11.09

Dollar values for 2008 value of time per hour for business and non-business travel were derived by inflating these values using the long term annual inflation rate parameter. The median value of the per occupant cost for commercial vehicles was inflated in the same manner. These values are outlined in Table 10.

TABLE 10 DOLLAR PER HOUR TIME SAVING VALUES BY MODE AND PURPOSE OF TRAVEL

Type of time savings	$/hr
Non-business travel time savings private vehicle occupant	$11.54
Business travel time savings private vehicle occupant	$36.90
Non-business travel time savings public transport occupant	$11.54
Business travel time savings private vehicle occupant	$36.90
Non-business travel time commercial occupant	$11.54
Business travel time savings commercial vehicle occupant	$26.18

Parameter values of the proportion of modal travel time dedicated to business and non-business travel were determined by Steer Davies Gleave who utilised more detailed origin-destination information and purpose of trips provided by Veitch Lister. These proportions are outlined in Table 11.

TABLE 11 PROPORTIONS OF BUSINESS AND NON-BUSINESS TRAVEL

	Commercial vehicles	Passenger car	Public transport
Business travel	100%	22%	38%
Non-business travel	0%	78%	62%

The parameter values detailed in Table 10 and Table 11 were utilised to determine travel time savings for each option through the following method:

1. For the base case and for each option assessed, the respective performance indicators in the Veitch Lister model were extended to each year of the analysis period through the process outlined in section 1.2.1.
2. Private, commercial and public transport average trip time per annum was calculated by dividing person hours / by number of trips for the base case and each option for each year of the study period (in the case of public transport the number of boardings was used for number of trips).
3. Time savings per trip were determined by taking the output of the first step in the base case from each option.
4. To determine the number of hours saved in each option the time savings per trip were multiplied by the number of trips.
5. This output was then multiplied by 1.5 to take into account 'the rule of half'.
6. To determine travel time savings in million of dollars per annum for each option this output was multiplied by the proportion of travel by private commercial and public transport undertaken for business and non-business purposes (Table 11). These proportions had als been apportioned their respective value of travel time for leisure commuting/ business / commercial purposes (Table 10).

1.4.2 Present value of vehicle operating costs

The present value of total vehicle operating costs savings for each option is listed in Table 12.

TABLE 12 PRESENT VALUE OF VEHICLE OPERATING COST SAVINGS

Option	PV of Vehicle Operating Cost Savings
	$m
Base Case	0
Option_A	$353
Option_B	$418
Option_C	$62
Option_D	$63

The present value of vehicle operating cost savings for each option was determined by:

1. Operating costs per day for private and commercial vehicles for the base case and options were derived from the Veitch Lister model and extended using the method outlined in section 1.2.1.
2. These costs were divided by the number of kilometres travelled per day (sourced from the Veitch Lister model) to derive an operating cost per kilometre travelled.
3. The operating cost per kilometre travelled for the base case was taken from the equivalent daily figure in each option to determine a vehicle operating cost saving per day.

1.4.3 Present value of reduction in crash costs

The present value of crash cost savings for each option is listed in Table 13.

TABLE 13 PRESENT VALUE OF CRASH COSTS SAVINGS

Option	PV of Crash Cost Savings
	$m
Base Case	0
Option_A	$261
Option_B	$274
Option_C	$306
Option_D	$244

The Veitch Lister performance indicators provide data on the number of crashes per day and the cost of road crashes.

To determine the present value of reduction in crash costs as a result of the interventions the following steps were undertaken:

1. For the base case and for each option assessed, the dollar value of crash costs per day for each year of the analysis period was determined through the process outlined in section 1.2.1.
2. To determine an annual figure in millions of dollars, the per day figure was multiplied by the number of days in the year.
3. For each option, the yearly value of crash cost savings equalled the crash costs for that year of the option less the crash costs in the base case for that year.
4. Finally this profile of difference between crash costs in the option less the base case was summed to derive the present value.

1.4.4 Present value of reduction in externality costs

The present value of reduced externality costs for each option is listed in Table 12.

TABLE 14 PRESENT VALUE OF EXTERNALITY COST SAVINGS

Option	PV of Savings in Externality Costs
	$m
Base Case	0
Option_A	$ 668
Option_B	$ 660
Option_C	$ 973
Option_D	$ 689

The Veitch Lister transport model provides summary indicators for private and commercial vehicle emissions (tonnes per day) for NO_x, NMVOC, SO_x, CO_2, CH_4, N_2O, CO and particulate emissions.

To determine externality cost savings, the following steps were involved:

1. Tonnes per day for emissions from the Veitch Lister model were multiplied by the number of days and the respective externality valuations outlined in Table 3.
2. The base case valuations were taken from the option valuations to determine externality savings for each option.

1.4.5 Present value of public transport revenue

TABLE 15 PRESENT VALUE OF PUBLIC TRANSPORT REVENUE

Option	PV of public transport revenue
	$m
Base Case	0
Option_A	$ 249
Option_B	$ 252
Option_C	$ 310
Option_D	$ 364

The present value of public transport revenue accrued by each option is determined by:

1. For the base case and for each option assessed the public transport revenue in million dollars per day figure for each year of the analysis period was determined through the process outlined in section 1.2.1.
2. To determine an annual figure the per day figure was multiplied by the number of days in the year.
3. Each yearly figure was discounted using the relevant discount factor outlined in Table 4.
4. For each option the yearly value of increased public transport revenue is the public transport revenue for that year of the option less that accrued in the base case for that year.
5. Finally this profile of difference between public transport revenue in the option less the base case is summed to derive the present value.

1.4.6 Total benefits of options

The benefits outlined above were summed to determine the total benefits of each option. These total benefits are outlined in Table 16.

TABLE 16 PRESENT VALUE OF BENEFITS

Option	PV of Time Savings	PV of Vehicle Operating Cost Savings	PV of Crash Cost Savings	PV of Externality Cost Savings	PV of public increased transport revenue	PV of benefits
	$m	$m	$m	$m	$m	**$m**
Option_A	$ 9,182	$ 353	$ 261	$ 668	$ 249	**$ 10,714**
Option_B	$ 9,495	$ 418	$ 274	$ 660	$ 252	**$ 11,100**
Option_C	$ 7,773	$ 62	$ 306	$ 973	$ 310	**$ 9,425**
Option_D	$ 6,547	$ 63	$ 244	$ 689	$ 364	**$ 7,906**

1.5 Benefit cost ratios

Benefit cost ratios were determined by dividing the present value of benefits by the present value of the capital expenditure for each option as outlined in Table 17.

TABLE 17 BENEFIT COST RATIO

Option	PV of benefits	PV of Costs	Benefit cost ratio
	$m	**$m**	
Option_A	$ 10,714	$ 14,559	**0.7**
Option_B	$ 11,100	$ 14,968	**0.7**
Option_C	$ 9,425	$ 10,194	**0.9**
Option_D	$ 7,906	$ 7,897	**1.0**

2. IMPACT ON THE VICTORIAN ECONOMY: CGE ANALYSIS

2.1 Introduction

The economic analysis for the East–West transport link project involved the identification and quantification of the indirect impacts of the identified options on the Melbourne and Victorian economies using an equilibrium modelling framework. Economic impact analysis based on an input-output approach takes into account the direct impact of the project on regional economic activity, and some of the downstream effects of the induced demand for goods and services elsewhere in the economy. But it does not take into account structural adjustments brought about by the project. For this, the project team has developed a Computable General Equilibrium (CGE) model to examine the flow-on effects arising from transport development on the broader economy. Estimates of indirect impacts of all options have been made for key economic indicators including gross state product/gross regional product and employment.

Flow-on impacts to other industries at the regional and state levels, where significant, have been estimated using the CGE modelling framework. This has provided the best approach to directly estimate the indirect impacts arising from improving the transport sector through investment in the East–West link. Further, developing the modelling framework in this way has enabled the project team to better link the various components and phases of the project to ensure a comprehensive analysis of the options.

2.1.1 Region definition

The multi-region CGE model, developed from an input-output database, has three regions:

- Melbourne
- Rest of Victoria
- Rest of Australia.

The boundaries of the Melbourne region are those of the Melbourne Statistical Division (SD) as defined by the Australian Bureau of Statistics (ABS). The SD is comprised of 17 Statistical Subdivisions (SSD) of which the following seven form the outer boundary of the SD: Melton–Wyndham, Hume City, Northern Outer Melbourne, Yarra Ranges Shire Part A, South Eastern Outer Melbourne and Mornington Peninsula Shire.

The Rest of Victoria is comprised of the remaining ten SDs in the State, namely: East Gippsland, Gippsland, Ovens–Murray, Goulburn, Loddon, Central Highlands, Barwon, Mallee, Wimmera and Western District.

The Rest of Australia is comprised of the balance of states (NSW, Qld, SA, WA and Tas) and the two territories (NT and ACT).

2.1.2 Sector definition

The aggregation of industries from the 109 sector national sector definitions to the 30 commodities/industries is provided in Appendix C.

- 30 Sectors: Uniform definition of sectors for all regions.
- 109 Sectors: National input-output table sectors. The base data and control data for the input-output database have been collected and collated at this level of disaggregation.

2.1.3 Transport sectors

As detailed in Appendix 1, there are five transport sectors specified in the model:

- Road transport
- Rail transport
- Water transport
- Air transport
- Services to transport and storage.

2.2 General model structure

The model recognises:

- producers classified by industry and domestic region
- investors similarly classified
- multiple region-specific household sectors
- aggregate foreign purchaser of the domestic economy's exports.

The model contains explicit representation of intraregional and interregional trade flows based on the EconSearch in-house input-output database. As each region has been modelled separately, the model captures the changes in economic activity resulting from a reduction in transport costs. Second and subsequent round effects are captured via the model's input-output linkages and account for economy-wide and international constraints.

The core input-output database of the three region CGE model is presented in Figure 1. It is based on the Monash MRF model (MMRF), a multi-region model of the Australian economy. Figure 1 shows the basic structure of the model using the MMRF notation. The seven columns identify the principal categories of demand:

1. Domestic producers – there are 30 industries (I) in each of the 3 regions (R)
2. Investors – there are 30 industries (I) in each of the 3 regions (R)
3. Households – there is one aggregate household sector in each of the 3 regions (R)
4. Purchaser of exports – a single aggregate foreign entity
5. Regional government demand – one set of regional government demands in each of the 3 regions (R)
6. Federal government demand – one set of federal government demands in each of the 3 regions (R)
7. Change in stocks – inventory accumulation in each of the three regions (R).

FIGURE 1 THE THREE REGION CGE INPUT-OUTPUT DATABASE

		ABSORPTION MATRIX						
		1	2	3	4	5	6	7
		Producers	Investors	Households	Exports	Regional Govt	Federal Govt	Stocks
	Size	I x R	I x R	R	1	R	R	R
Basic Flows	C x S	V1BAS	V2BAS	V3BAS	V4BAS	V5BAS	V6BAS	V7BAS
Margins	C x S x M	V1MAR	V2MAR	V3MAR	V4MAR	V5MAR	V6MAR	
Taxes: Regional	C x S	V1TAXS	V2TAXS	V3TAXS	V4TAXS			
Taxes: Federal	C x S	V1TAXF	V2TAXF	V3TAXF	V4TAXF			
Taxes: GST	C x S	V1GST	V2GST	V3GST	V4GST			
Labour	O	V1LAB						
Capital	1	V1CAP						
Land	1	V1LND						
Other Costs	1	VIOCT						

C = Number of commodities = 30
I = Number of Industries = 30
O = Number of occupation types = 8
M = Number of commodities used as margins = 9
R = Number of regions = 3
S = Number of sources = R+1: Domestic regions plus foreign imports = 4

	MAKE MATRIX	
Size	I x R	Total
C x R	MAKE	Sales
Total	Costs	

Source: Derived from CoPS (2007, Figure 4.1)

The nine rows show the supply of commodities to each category of demand, the margins associated with those sales, various forms of taxes applied to those sales and the supply of primary inputs to the production sector. These are specified as:

(1) Basic flows – each of the 30 commodities (C) identified in the model can be obtained from the four sources (S), i.e. the region itself, the other two regions or imported from overseas. The commodities are used as inputs into current production (V1BAS), inputs to capital formation (V2BAS), consumed by households (V3BAS), are exported (V4BAS), consumed by governments (V5BAS and V6BAS) and accumulate as inventories (V7BAS).

(2) Margins – there are nine domestically produced 'goods' (M) that are defined as margin services. These services are necessary to transfer commodities from their sources to the various users (V1MAR, V2MAR, etc.). The most significant margins specified in the model are the services provided by the trade and transport sectors.

(3 - 5) Taxes – there is a range of commodity taxes that are payable on the purchase of commodities from each source. These include regional and federal commodity taxes, as well as GST. For example, the cell V3GST represents a 3-dimensional array showing the cost of GST paid on the flows of 30 goods (C), from four sources both domestically and imports (S), in three regions (R).

(6 – 8) Primary factors – as well as intermediate inputs and the margins and taxes paid on those inputs, current production requires three types of primary inputs: labour (V1LAB), capital (V1CAP) and land (V1LND).

(9) Other costs – this category covers various miscellaneous industry expenses.

The equations that comprise the core of the three region CGE model are based on the Monash MRF model and can be classified according to the following broad sets:

- producers' demands for intermediate inputs and primary inputs
- demands for inputs to capital creation
- household demand
- export demands
- government demands
- demands for margins
- zero pure profits in production and distribution
- indirect taxes
- market clearing conditions for commodities and primary factors
- regional and national macroeconomic variables and price indices (CoPS 2007, p. 21).

2.3 Aggregate outputs

The types of economic stimulus that are expected to result from the options were divided into the following categories:

- operating costs associated with the options
- productivity improvements in form of time savings
- improved net revenue for the rail system
- reduced vehicle operating costs
- reduced crash costs.

Operating expenses are assumed to consist entirely of expenditure on the transport industry. The impacts of capital expenditure have been excluded from this analysis as the CGE analysis attempted to focus on the long term impacts on the economy.

Productivity improvements in the form of commercial time savings are assumed to reduce labour costs in the road transport sector. This is measured as labour costs per unit of output. Private time savings are ignored as they are assumed to have no significant economic impact (increased leisure time).

Improved net revenue for the rail system (compared to the base case) is modelled as total productivity improvement in the rail transport sector.

Reduced vehicle operating costs (which includes reduced fuel consumption), reduced crash costs and reduced depreciation are modelled as reduced inputs for the machinery and equipment (includes cars and car parts), trade (includes motor vehicle repairs), financial and business services and capital costs.

The drivers of the economic impacts, derived directly from the cost benefit analysis, are shown in Table 18. These data show the dollar value (2008 dollars) of operational expenditure and each category of productivity change.

TABLE 18 DIRECT IMPACT OF OPTIONS B AND D, 2021 AND 2031, $ MILLION

	Difference from Base Case - 2021		Difference from Base Case - 2031	
	Option B	Option D	Option B	Option D
Operational Expenditure	$176	$145	$187	$145
Road T'port Labour Productivity	$38	$14	$66	$26
Public T'port Productivity	$15	$22	$32	$44
Road T'port Op Cost Savings	$22	$4	$44	$9
Reduced Crash Costs	$10	$10	$19	$17

The economic drivers shown in Table 18 are represented in CGE model (Table 19) as percentage changes in various activities and productivity measures. These changes are simulated in combination as shocks to the economy to estimate the difference between the base case and the options in terms of a number of key economic indicators.

The results generated for each model simulation (option) are presented at both the regional and state levels for a range of key economic indicators (GSP, employment, consumption) in Table 20.

TABLE 19 DIRECT IMPACT OF OPTIONS B AND D, 2021 AND 2031, % CHANGE

	2021		2031	
	Option B	**Option D**	**Option B**	**Option D**
State gov final cons exp: t'port	16.342%	13.477%	17.382%	13.477%
Road t'port labour productivity	1.718%	0.623%	3.020%	1.183%
Rail transport productivity	3.058%	4.611%	6.590%	9.197%
Trade sector cost saving	0.126%	0.088%	0.249%	0.154%
Petroleum sector cost saving	1.072%	0.216%	2.150%	0.451%
Mv & parts sector cost saving	0.033%	0.007%	0.066%	0.014%
Fin & bus. Sector cost saving	0.034%	0.007%	0.069%	0.014%
Capital cost saving	0.326%	0.066%	0.654%	0.137%

TABLE 20 SUMMARY CGE MODELLING RESULTS, DIFFERENCE FROM BASE CASE

	2021		2031	
	Option B	**Option D**	**Option B**	**Option D**
Victorian Economic Effects:				
Gross State Product ($m)	$362	$295	$624	$493
Gross State Product (%)	0.15%	0.12%	0.26%	0.21%
Real consumption ($m)	$188	$135	$328	$222
Real consumption (%)	0.13%	0.09%	0.22%	0.15%
Employment (no. FTE)	2,438	1,901	4,200	3,089
Employment (%)	0.12%	0.09%	0.20%	0.15%
Melbourne Economic Effects:				
Gross Regional Product ($m)	$332	$269	$577	$456
Gross Regional Product (%)	0.18%	0.15%	0.32%	0.25%
Real consumption ($m)	$171	$123	$302	$204
Real consumption (%)	0.15%	0.11%	0.27%	0.18%
Employment (no. FTE)	2,219	1,730	3,864	2,842
Employment (%)	0.13%	0.10%	0.23%	0.17%
Rest of Victoria Economic Effects:				
Gross Regional Product ($m)	$31	$25	$47	$37
Gross Regional Product (%)	0.05%	0.04%	0.08%	0.07%
Real consumption ($m)	$17	$12	$26	$18
Real consumption (%)	0.05%	0.04%	0.08%	0.05%
Employment (no. FTE)	219	171	336	247
Employment (%)	0.04%	0.03%	0.06%	0.04%

The analysis assumes that the increase in the demand for labour in Victoria will not impact national employment levels. It was also assumed that labour is mobile and can move between states. Together these assumptions imply that the increased employment in Victoria will be offset by falls in other states and territories.

As detailed in Table 22, Option B is projected to generate over 2 400 jobs in 2021 and 4 200 jobs in 2031. This is equivalent to a 0.12 per cent increase in 2021 relative to the baseline and a 0.20 per cent increase in 2031. Option D is expected to have a smaller impact, with projections of 1 900 jobs in 2021 and just under 3 100 jobs in 2031. The majority of the employment impact is expected to occur in the Melbourne region, although positive impacts are projected for the rest of Victoria.

The impacts of options B and D on gross state product are also presented in Table 22. Under option B, gross state product is projected to increase from $362 million above the baseline in 2021 to $624 million above the baseline in 2031. For option D, the corresponding projections are $295 million in 2021 and $493 million in 2031.

The level of consumer spending (on goods and services) is determined by income and the level of saving. It is a broad measure of individual welfare. For Victoria as a whole, consumer spending is projected to be 0.13 per cent higher under Option B in 2021 and 0.22 per cent higher in 2031(both measures relative to the base case). For option D, the corresponding projections are 0.09 per cent in 2021 and 0.15 per cent in 2031. As for both employment and GSP the bulk of the impacts will be felt in the Melbourne metropolitan area.

2.4 Detailed outputs

The modelling results are presented in detailed industry form in terms of GSP and employment. These are presented in Appendix D.

3. THE WIDER ECONOMIC BENEFITS OF TRANSPORT

3.1 Background

Transport appraisal is a relatively mature discipline. For some 40 years transport professionals have been using economic and modelling techniques to estimate the contribution of transport schemes to society.

The current UK appraisal framework is based on the UK Department for Transport's 'New Approach to Transport Appraisal', or NATA. This framework aims to capture the full set of benefits that society derives from a scheme under five objectives; the economy, environment, safety, interchange and accessibility.

The equivalent framework in Australia is the *National Guidelines for Transport System Management in Australia*. Based around the same theoretical underpinnings and aiming to measure the same impacts, the Australian and UK frameworks are, for all practical purposes, consistent.

The main component of the appraisal framework, and almost always the most important contributor to the Benefit Cost Ratio, is the economic assessment. Ideally this should measure what we may call final impacts, e.g. changes to real wages and consumer prices. For instance, reducing the time it takes for an accountant to reach clients will mean increased productivity as less time is 'wasted' travelling. As a result the accounting firm may increase wages, cut prices or increase its profits. Accurately tracing the indirect impacts of a scheme, such as time and cost savings to users, as they work through the economy, is a very complex task.

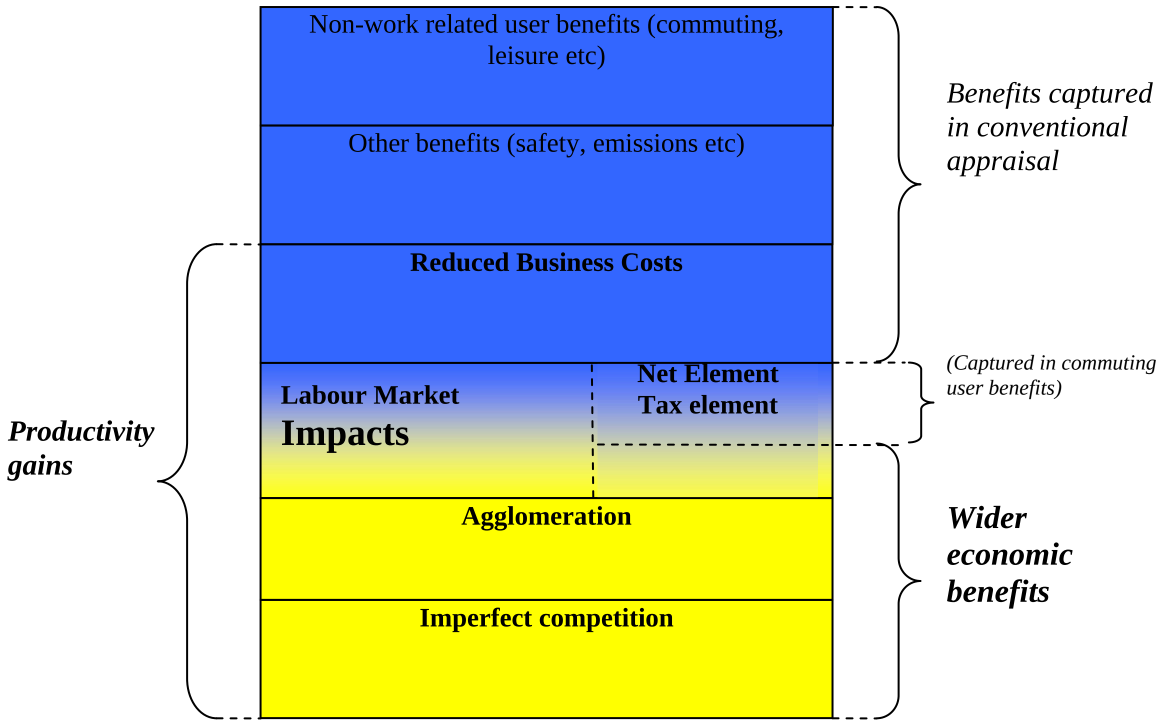
Transport appraisal therefore seeks to measure the direct economic impacts. Given certain assumptions, crucially the existence of perfect competition in all markets, this approach is valid. The direct benefits neither magnify nor diminish as they pass through the economy. So the sum of the increase in wages, the reduction in prices and any increased profit margin should be exactly identical to the value of the time initially saved by the accountant.

However, over recent years there has been a growing feeling that transport appraisal does not adequately represent the impacts that schemes have on the wider economy. Firstly, concerns have been growing that the appraisal assumption of perfect competition is too strict. A significant amount of literature over recent years has addressed the potential for transport to deliver wider economic benefits – that is, benefits on the wider economy which the current approach to appraisal fails to capture. These additional benefits may arise where market failures cause the direct transport impacts to be magnified as they pass through the economy. Draft guidance from the UK Department for Transport (DfT 2005) enables the quantification of wider economic benefits caused by agglomeration economies, imperfect competition and labour market inefficiencies. Typically, these have been found to add between five per cent and 40 per cent to the conventionally measured appraisal benefits.

Secondly, benefit–cost assessments often do not express benefits from transport improvements in terms that are relevant for many stakeholders. Travel time reductions and cost savings are clearly important, but scheme promoters invariably have other objectives – for instance in terms of accessibility, jobs, employment and productivity.

To understand the full set of economic impacts of transport schemes, additional analysis going beyond the conventional BCA is therefore needed. Figure 2 below seeks to illustrate the sources of, and relationship between, conventional appraisal benefits, wider appraisal benefits and productivity impacts. We then explain each of the wider economic benefits identified by the DfT's guidance in turn.

FIGURE 2 RELATIONSHIP BETWEEN CONVENTIONALLY MEASURED BENEFITS, WIDER ECONOMIC BENEFITS AND PRODUCTIVITY GAINS



3.2 Agglomeration economies

Agglomeration simply means the geographic clustering of firms and workers. Cities are one type of agglomeration. In cities we often find that wages, rents, transport costs and other prices are higher than elsewhere. The explanation for the desire to locate in cities despite the additional costs must be that firms in a wide range of economic sectors are more productive when they are clustered.

Typically, firms are more productive when near other firms because they have access to a wider range of necessary inputs. It is also often argued that proximity to other similar firms increases the chance of acquiring new knowledge and of building connections and networks which support or increase productivity. Research shows, for instance, that face-to-face contact is very important in some business environments.

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When we talk about density of a city, we really mean the number of firms or workers that are accessible. Rather than number of jobs or worker per square kilometre, it is more intuitive to consider the number of jobs or workers located within X generalised minutes[1]. In this context, the role of transport in supporting accessibility, and therefore agglomeration, is important. If transport is made cheaper or quicker, more firms and workers will be located within reach and, according to the literature on agglomeration, productivity will increase. Importantly, these agglomeration benefits are additional to those already captured in appraisal.

The DfT's guidance outlines how agglomeration benefits of a transport scheme can be calculated. The methodology uses detailed transport model outputs, economic data (such as employment and productivity) and specific evidence on agglomeration derived for this purpose.

3.3 Time and cost savings to travel in the course of work

This element of appraisal focuses on the assumption that travel in the course of work is usually not productive in itself and reducing the time taken in transit frees up time for additional productive activity. When an individual saves one hour travelling whilst in work, appraisal values this time at the gross cost to the firm of the worker's time (i.e. hourly wages plus national insurance contributions and other labour related costs). Identifying the productivity gains from business cost savings is therefore simple – they are identical to the business impacts, as identified in the conventional transport appraisal.

3.4 Imperfect competition

Notwithstanding the above, the main reason for measuring time savings in the course of work is to identify the additional value to society of the activity a worker can undertake once their travel time has been reduced. Under the assumption of perfect competition the two values determining this overall gain (hourly labour cost and hourly productivity) are identical, so the reduction in labour costs is a good approximation of the productivity benefit.

However, in a real economy firms are typically able to charge more for their products and services than what they cost to produce. This means that the value society places on the worker's output from one hour's work (i.e. the price of whatever the worker makes in one hour) is higher than the cost of the worker's time to the firm.

[1] Generalised time is a composite measure of the perceived distance between locations, which takes into account journey time, waiting time and money costs converted into time units.

By valuing workers' saved time at the level of costs to the firm rather than the value to society, current transport appraisal underestimates the benefits of in-work travel time savings Research has shown that these 'missing' benefits are equivalent to some 10 per cent of conventionally measured user benefits to freight and business travel.

3.5 Labour market impacts

Productivity gains of commuting cost reductions

When individuals make decisions about whether to work, how much to work and where to work, they take many factors into account. Importantly they balance the financial gains against what we may call personal costs (e.g. giving up spare time). If the financial returns to work increase or the personal costs decrease, more individuals are likely to choose to work, while some of those who already do will decide to work more or in more productive (and more demanding) jobs. The result is increased productivity.

The monetary costs of travelling to work reduce the financial gains from working, whilst commuting time increases the personal costs. Both therefore tend to reduce productivity, and we can measure the productivity impacts of changing commuting costs by assessing the resulting employment changes:

- The impact of more people working is assessed using evidence on labour supply responses to changing wages.
- The impact of more people working in more productive jobs can be assessed using land use – transport interaction (LUTI) models or by a simpler approach treating model forecasts of travel to work as proxy for employment.

This effect is distinct from any impact that a scheme may have on the rate of unemployment. It is generally accepted among economists that long term unemployment rates are determined by structural and macroeconomic factors – in particular the flexibility of the labour market. There is a concept of a 'natural' rate of unemployment that keeps the macroeconomic instruments balanced. A lower rate of unemployment would create wage and inflationary pressures, which would force the Reserve Bank to increase interest rates until unemployment rate returns to its natural level. At a higher rate of unemployment, the Reserve Bank would lower interest rates in order to encourage increased activity levels. Within such a framework it is hard to see how transport improvements could have anything but a passing impact on unemployment rates[2].

[2] In theory, reduced transport costs could reduce the natural rate of unemployment by shifting the labour supply curve, but the impact of any one scheme will be small.

Wider welfare gains of commuting cost reductions

Transport appraisal counts the welfare benefits of commuting time savings by measuring individuals' willingness to pay. For those individuals who, following the introduction of improved transport services, decide to work or to work longer, the welfare benefits will be lower than the productivity gains. This is because welfare gains are net of the increased personal costs of giving up spare time.

But there is another reason why these individuals' willingness to pay for commuting time savings is lower than the productivity gains, which is not taken account of in appraisal. Because of labour related taxation (income tax, national health insurance contributions, etc), the return to the worker as a result of extra effort (i.e. net wage) is lower than the value to society (i.e. gross wage). For this reason, where individuals change labour market decisions because of a transport scheme, the consequent tax changes are additional to the benefits currently captured in appraisal. These additional benefits amount to about 25 per cent to 35 per cent of the labour market productivity gains.

3.6 Estimation of wider economic impacts

The UK developed methodology provides a framework that enables all the above effects to be quantified, given the availability of the required inputs and parameters. However, certain elements of the evidence underlying the relationships in the approach are UK-specific, notably the agglomeration elasticities, labour supply elasticities and productivity differentials. As part of this study we have sought to estimate values appropriate for Victoria wherever possible. Where the evidence was insufficient to enable us to make robust estimates for the state, we have used UK-based findings as a proxy.

3.7 Methodology

3.7.1 Agglomeration economies

As noted above, agglomeration economies are derived from the clustering of economic activity. Better access to other firms and to workers enables many sectors to be more efficient. We measure this type of accessibility by reference to 'effective density' – a metric that weighs the activity (jobs, workers etc) accessible to a location by proximity measured in terms of journey costs, with nearby activity receiving a higher weight than activity further away.

An increase in the effective density of a location can, according to evidence, lead to an increase in productivity. Recent advances in the research have provided us with detailed elasticities that enable us to convert changes in effective density into change in productivity for different locations and individual sectors.

We calculate effective density for each location in a study area using evidence on average Generalised Costs (across all modes) for work-related journeys from and to all other locations. These data is extracted from transport models. For the application to Melbourne East–West Study we have used a zoning system based on SLAs and transport cost data that have been extracted from VLCs transport model.

Data on employment by location are also required, and we have extracted ABS data on employment by SLA for this purpose.

After calculating the effective densities for each scenario (i.e. the reference scenario AND each of the intervention scenarios) we can calculate relative changes in effective density for each location.

Evidence available internationally on agglomeration economies enables us to translate such increases in effective density into productivity gains. These 'agglomeration elasticities' can be quantified by individual sectors and locations. Jobs in a particular sector, in a location where a transport project leads to a five per cent increase in effective density, (and where the agglomeration elasticity is 0.1), will become 0.5 per cent more productive (5%*0.1) because of increased integration. The impact is summed across sectors and locations and the total agglomeration benefits are reported as an additional benefit attributable to the project.

3.7.2 Imperfect competition

Based on recent research, DfT's guidance suggests that, for a typical developed economy, the missing elements of appraisal due to imperfect competition are of the order of 10 per cent of user benefits to in-work travel normally quantified in appraisal. We have no reason to believe that this proportion is different in Melbourne/ Victoria as compared with the UK and have calculated the effect accordingly.

3.7.3 Increased labour supply

This effect arises from increased output caused by higher participation in the labour market (a labour market participant is one that is either in work or seeking work). The labour supply is normally considered to be sensitive to changes in wage rates. Each individual has a 'reservation wage' – the lowest wage that they are prepared to accept in order to sacrifice leisure. From the perspective of the individual, this reservation wage must be considered net of taxes on income as well as commuting costs. A reduction in the cost of commuting will therefore increase the 'take-home' wage offer and this may encourage more individuals to join the labour market.

The labour supply response to changes in wages is typically modelled using labour supply elasticities. There is extensive literature attempting to quantify this elasticity, but the area is fraught with problems of estimation and the range of elasticities is therefore wide. Dandie and Mercante (2007) review the evidence for Australia and their results suggest a labour supply elasticity that is larger than the -0.1 found in the UK. However, due to the large spread of elasticities we have chosen to use -0.1 as a conservative estimate.

The labour supply effect is then calculated by considering the average change in commuting costs for workers in a location against the average wage earned by them. Making the calculation for both the reference and intervention scenarios gives us an understanding of the relative change in take-home pay caused by the intervention. The labour supply elasticity is then used to convert the change in wages to a change in the number of people in work.

The output produced by new entrants to the labour market is likely to be lower than that of existing workers. Gregg et al (1999) provide evidence that new entrants are 31 per cent less productive than the average established worker. We therefore consider each new entrant to increase output by 69 per cent of the average output per worker.

As described in the previous chapter, the labour supply effect is already captured within the benefits covered by conventional transport appraisal, but the proportion of the additional output that is captured in taxation is outside the usual calculation. For the UK, the tax authority captures on average 30 per cent of marginal output in taxation (taxes on income, production and profits plus contribution to pensions and insurances). In addition, new entrants to the labour market give up government support worth in the order of 10 per cent of average output (such as job seeker's allowance and incapacity benefits). Since the market only receives 60 per cent of the output of a new entrant, the remaing 40 per cent is not considered by individuals when making decisions and is additional to benefits normally included in transport appraisal. The difference between gross and net earnings is often called the 'tax wedge'.

However, the tax wedge in Australia is significantly lower than in the UK. Evidence from the Australian Treasury[3] finds the average UK and Australian tax wedges to be 33 per cent and 28 per cent, respectively. The effective tax wedge for individuals joining the labour market is higher than for those already working because new entrants would typically forego benefit payments. Since the relevant tax wage for increased labour supply in the UK has been found to be 40 per cent, we apply a tax wedge for our analysis of 35 per cent to reflect the lower average taxation level in Australia.

Productivity impacts of employment redistribution

Just as there are productivity gains and additional appraisal benefits arising from increased output from new workers, a change in output from existing workers would have a similar impact. This could arise in two ways: less time spent commuting may lead to more time spent working; or better commuting conditions could enable workers to take up more desirable jobs further away. In an urban context, the latter typically means an increase in local labour supply to city centres, which drives an increase in jobs. Since city centre jobs tend to be more productive than those outside, there is potential for increased output overall.

To assess this impact we need to understand how each scenario to be tested affects employment by location. For the purposes of this study, we have derived estimates of employment effects from the modelling work undertaken by SGS.

As argued above, any increase in output will only have been considered by individuals to the extent that they receive compensation in the form of an after-tax salary or wage. The taxed element is also a benefit, but is not currently counted in transport appraisal.

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[3] http://comparativetaxation.treasury.gov.au/content/report/html/06_Chapter_4-08.asp

The average tax wedge for workers in the UK found by DfT's research is 30 per cent. Again we adjusted downwards the UK tax rate by five per cent, to reflect the lower average tax wedge in Australia. We therefore applied a tax wedge for the Melbourne analysis of 25 per cent.

3.8 Data sources and assumptions and parameters used

Table 21 lists the data used for our analysis and their sources.

TABLE 21 WIDER ECONOMIC BENEFIT DATA SOURCES

Parameter	Source
Origin – Destination journey costs	**Veitch Lister model**
Origin – Destination travel demand	Veitch Lister model
Employment by sector	EconSearch
Employment by location	Veitch Lister model
Employment forecasts	Veitch Lister model
Employment demographic impact of options	SGS
Agglomeration elasticities	Dan Graham/ UK guidance
Labour supply elasticity	UK guidance, Australian literature
Productivity of new entrants	Gregg (et al)/ UK guidance
Values of Time	Meyrick and Associates benefit cost model
Productivity by location and sector	EconSearch
Wages by location	ABS
Tax wedges	UK guidance, and Australian literature
Imperfect competition up-rate	UK guidance

3.9 Results

Table 22 below shows summary results for options B and D for the year 2031.

TABLE 22 WIDER ECONOMIC BENEFITS SUMMARY RESULTS

	Option B		**Option D**	
	Welfare	**GDP**	**Welfare**	**GDP**
	$m	$m	$m	$m
Conventional				
Business User Benefits	$196	$196	$79	$79
Commuting User Benefits	$255		$226	
Other	$383		$282	
Total Conventional	**$833**		**$587**	
Wider/Additional				
Agglomeration	$229	$229	$96	$96
Imperfect Competition	$17	$17	$6	$6
Labour productivity	$43	$170	-	-
Labour Supply	$16	$46	$13	$ 36
Total Wider	**$304**		**$115**	
Total scheme impacts	**$1 137**	**$658**	**$703**	**$ 218**

The top part of the table in the columns titled ‘welfare’ shows the conventional user benefits for the two options in A$ for the year 2031 (2006 prices, current values). Option D delivers nearly $600 million worth of time and cost savings to users, most of it going to commuters and those travelling for other purposes. Option B, which includes the same public transport packages as D but also road network improvements, delivers more than 40 per cent more benefits than D. Half of the additional $250 million goes to business travellers and commercial vehicle users.

The bottom half of the table shows the Wider Economic Benefits. These are benefits that are additional to the user benefits normally included in benefit cost analysis. For both options, these additional benefits are significant. But importantly, option B results in a much larger uplift than option B (35 per cent compared to 20 per cent). This is explained by the much greater significance of the cost of car travel, and in particular business and commercial travel, in generating these additional economic impacts.

The most significant wider benefit is that associated with agglomeration. This is not surprising, as evidence from the UK suggests that agglomeration benefits are particularly important for major projects in large cities.

It should be noted when comparing the two schemes that we have been unable to include an assessment of labour productivity impacts for option D because the required data on land use impacts were not available. For a like-for-like comparison of the two options, we have also run the model for option B without land use impacts, which results in total wider economic benefits of $248 million – or 29 per cent over and above the conventional benefits.

Transport interventions are normally assessed in terms of the economic welfare that they generate. However, it can also be instructive to present the results in terms of the impact on the traded economy. The second set of columns headed ‘GDP’[4], give the impact that the two options have on productivity and output. Whilst option D delivers an increase in economic output of just above $200 million, option B results in economic gains three times this level. Again, this illustrates the relative importance for the economy of road versus public transport.

3.10 Additionality of benefits

It is clear from how the results have been presented in the above table that the wider economic benefits are additional to the benefits estimated using conventional benefit cost analysis. However, it is not immediately clear to what extent the ‘GSP’ impact double counts the findings of the CGE modelling.

We can be confident that the CGE modelling does not represent the economies of increased agglomeration. This is because agglomeration benefits are derived from reducing the perceived distance between locations within an urban area, which the CGE modelling does not take into account.

[4] Although this table does not distinguish between impacts on output within Victoria and the rest of Australia, the spatial level of the analysis means that for all practical reasons the impacts can be taken to represent impacts on Victorian Gross State Product.

The labour productivity impacts are also largely additional to the CGE results, although we cannot say for certain to what extent. Again this uncertainty arises because of the different spatial scopes of the two models. The WEBs approach largely treats the productivity impacts of the redistribution of employment within the Melbourne urban area, while the CGE model covers similar type of impact but concerns redistribution between Melbourne, Victoria and the rest of Australia.

The labour supply effects captured as part of the WEBs assessment arise from reducing the cost to potential workers of accessing jobs. The CGE modelling also estimates labour supply impacts, but these are second round impacts caused by the expansion of the Victoria economy. It therefore seems fair to assume that the two labour supply impacts are additive.

The productivity gains from time and cost savings to business and commercial vehicles are taken into account in both set of results. This is also likely to be the case for imperfect competition effects.

Hence, summing those economic impacts that are additional to the CGE analysis, Wider Economic Benefits would bring just above $130 million in increased output from option D and $445 million from option B in addition to the gains presented by the CGE modelling.

4. OUTCOME OF ECONOMIC ANALYSIS

The summary results of these economic assessments for two options (options B and D) are outlined in Table 23. All monetary values in this table are in 2008 dollars.

The present value of expenditure (Row A) incorporates capital and operating expenditure, as calculated in the benefit cost analysis, for the options.

The most significant contributor to the direct economic benefits (Row B) of the interventions results from travel time savings. The interventions also result in vehicle operating cost benefits, reduced externalities, as well as enabling savings in vehicle crash costs.

Row C details the conventional benefit cost ratio (BCR) calculations.

The wider economic benefits that are omitted in a conventional BCR are estimated in Row D. The most significant contributor to this increased benefit is what is known as 'agglomeration economies'. The wider economic benefits add around 35 per cent to the conventional transport user benefits of the combined road and public transport solutions and 20 per cent to the public transport only solutions. After including these benefits (Row E), the BCRs increase to 1.0 and 1.2 respectively (Row F).

In parallel to estimating the wider economic benefits, the CGE model took the outputs of the benefit cost analysis to determine the flow-on impact of the proposed solutions on the broader economy of Victoria. From this analysis it was determined that output of the economy, as measured by Gross State Product, would rise significantly as a result of the proposed solutions. The estimated increase in GSP as a result of the proposed solutions is outlined in Row G.

As with the benefit cost analysis, the impact of some of the wider economic benefits is currently excluded from conventional CGE modelling techniques. In particular, the CGE modelling does not incorporate the economies of increased agglomeration nor some labour supply impacts. By incorporating the GSP impact of agglomeration and labour supply (Row H) the GSP impact of the intervention rises considerably (Row I).

TABLE 23 SUMMARY ECONOMIC ASSESSMENT

	Combined Road and Public Transport Solution (Option B)	Public Transport Only Solution (Option D)
A. Present Value of Costs	$15.0 billion	$7.9 billion
B. Present Value of Benefits	$11.1 billion	$7.9 billion
C. Benefit Cost Ratio	0.7	1.0
D. Wider Economic Benefits (WEB)	$3.3 billion	$1.3 billion
E. Present Value of all Benefits (incorporating WEB)	$14.4 billion	$9.2 billion
F. Benefit Cost Ratio incorporating WEB	1.0	1.2
G. Computable General Equilibrium (CGE) Increased Output (GSP) for 2031	$624 million	$493 million
H. Agglomeration and Labour Supply GSP Impact for 2031	$275 million	$132 million
I. Adjusted increased GSP for 2031	$852 million	$589 million

REFERENCES

Australian Bureau of Statistics (ABS) 1991, 1996, 2001, 2006 Census data.

Australian Government 2004, *AusLink White Paper*, Canberra.

Australian Government 2007a, Budget Paper No 1 – Budget Strategy and Outlook 2007-08, Canberra.

Australian Government 2007b, *Intergenerational Report - Revised*, Canberra.

Australian Transport Council 2007, *National Guidelines for Transport System Management In Australia,* Australian Government, Canberra.

Bureau of Transport and Regional Economics (BTRE) 2007, Working Paper 71: *Estimating Urban Traffic and Congestion Cost Trends for Australian Cities*, Canberra.

----- 2006, *Freight Measurement and Modelling in Australia*, Canberra.

----- 2005, *Greenhouse Gas Emissions from Australian Transport*, Canberra

Centre of Policy Studies (CoPS) 2007, 'A Dynamic Multi-regional Applied General Equilibrium Model of the Australian Economy', documentation prepared for the Regional GE Modelling Course, Monash University, 16-21 July.

Cosgrove, D 2003, *Urban Pollutant Emissions from Motor Vehicles*

Dandie, S and Mercante, J 2007, 'Australian labour supply elasticities: comparison and critical review', *Treasury Working Paper 2007*, 4 October.

Department for Transport (DfT) 2005, *Transport, Wider Economic Benefits and Impacts on GDP*, United Kingdom.

Eddington, R. 2006, 'Transport's role in sustaining UK's Productivity and Growth: The Case for Action', United Kingdom.

Gregg, P, Johnson, P. and Reed H. 1999 'Entering work and the British tax and benefit system' IFS Reports, R59

Victorian Department of Treasury and Finance (DTF) 2007, *2007-08 Budget Update*, Melbourne.

Victorian Government 2007, 2007-08 Budget Paper No 2 - *Strategy and Outlook*, Melbourne.

Watkiss, P 2002, *Fuel Taxation Inquiry: the Air Pollution Costs of Transport in Australia*, Report No. ED44525 to Commonwealth of Australia, AEA.

A. VEITCH LISTER TRANSPORT MODEL PERFORMANCE INDICATORS

A.1. Base case

Year / Option	2006 Base	2011 Base	2021 Base	2031 Base
Public Transport				
Total Public Transport System Patronage (per day)				
Bus	480,199	555,598	642,870	699,167
Rail-Suburban	603,563	712,999	829,963	885,763
Rail - V/Line	23,274	36,581	43,330	49,546
Tram	283,657	353,312	452,311	491,706
Total	**1,390,693**	**1,658,490**	**1,968,474**	**2,126,182**
Passenger Kilometres (per day)				
Bus	1,766,712	1,946,976	2,182,601	2,346,194
Rail-Suburban	7,713,849	9,517,121	11,554,531	12,444,051
Rail - V/Line	1,138,663	1,869,230	2,348,292	2,739,191
Tram	1,753,306	2,360,686	3,162,110	3,463,320
Total	**12,372,530**	**15,694,013**	**19,247,533**	**20,992,757**
Passenger Hours (per day)				
Bus	86,137	94,300	106,283	114,823
Rail-Suburban	218,147	267,888	323,532	348,124
Rail - V/Line	17,167	28,783	35,826	41,525
Tram	58,379	77,801	105,082	115,116
Total	**379,830**	**468,772**	**570,722**	**619,589**
No. of Passenger Interchanges (per day)	440,729	532,853	648,093	707,911
No. of Passenger Trips (per day)	949,964	1,125,637	1,320,381	1,418,271
Revenue (per day)				
Bus	$534,236	$620,790	$717,295	$776,112
Rail-Suburban	$852,563	$930,616	$1,081,839	$1,150,372
Rail - V/Line	$79,038	$123,761	$153,447	$177,562
Tram	$333,444	$372,966	$479,105	$518,145
Total	**$1,799,281**	**$2,048,133**	**$2,431,686**	**$2,622,191**
Private/Commercial Vehicles				
Person Trips (per day)				
Private Vehicle **	12,102,547	13,331,872	14,646,927	15,774,913
Commercial Vehicle **	509,346	603,282	690,178	760,974
Vehicle Trips (per day)				
Private Vehicle **	8,535,074	9,384,317	10,288,176	11,065,251
Commercial Vehicle **	509,346	603,282	690,178	760,974
Person Kilometres (000's per day)				
Private Vehicle ^	142,423.3	164,189.7	182,283.0	198,063.1
Commercial Vehicle ^	11,489.1	13,846.8	16,151.6	17,974.6
Vehicle Kilometres (000's per day)				
Private Vehicle ^	100,491.1	115,672.4	128,101.9	139,028.3
Commercial Vehicle ^	11,489	13,847	16,152	17,975
Person Hours (per day)				
Private Vehicle ^	2,886,752	3,296,452	3,734,101	4,134,062
Commercial Vehicle ^	193,616	232,186	277,960	317,915
Vehicle Hours (per day)				
Private Vehicle ^	2,039,595	2,325,515	2,627,814	2,905,632
Commercial Vehicle ^	193,616	232,186	277,960	317,915
Operating Costs ($000's per day)				
Private Vehicle ^	$24,915.9	$28,579.5	$31,631.6	$34,302.9
Commercial Vehicle ^	$7,737.6	$9,268.1	$10,795.8	$12,003.9
Accident Rate (Crashes per day)				
Number of Accidents (Total per Day) ^	31.24	34.87	38.62	41.58
Accidents Costs ($ per Day) ^	$5,187,606	$5,845,103	$6,484,203	$7,000,455
Fuel Consumption (Litres per Day)				
Private Vehicle	11,314,563	13,085,215	14,463,269	15,683,987
Commercial Vehicle	3,631,909	4,391,041	5,089,328	5,640,854
Sub-Total	14,946,472	17,476,256	19,552,597	21,324,841

Year / Option	2006 Base	2011 Base	2021 Base	2031 Base
Sub-Total	14,946,472	17,476,256	19,552,597	21,324,841
NO_x (tonnes per Day)				
Private Vehicle	125.10	142.98	154.90	164.58
Commercial Vehicle	55.79	67.20	77.41	85.26
Sub-Total	180.89	210.18	232.31	249.84
NMVOC (tonnes per Day)				
Private Vehicle	74.19	78.21	72.46	63.42
Commercial Vehicle	34.96	41.94	47.99	52.50
Sub-Total	109.14	120.15	120.45	115.92
SO_x (tonnes per Day)				
Private Vehicle	3.822	4.333	4.628	4.845
Commercial Vehicle	6.235	7.494	8.601	9.439
Sub-Total	10.057	11.827	13.229	14.284
CO_2 (tonnes per Day)				
Private Vehicle	24,965.3	28,678.3	31,341.5	33,599.5
Commercial Vehicle	8,621.0	10,363.3	11,896.2	13,057.6
Sub-Total	33,586.3	39,041.7	43,237.6	46,657.1
CH_4 (tonnes per Day)				
Private Vehicle	9.856	11.050	11.571	11.850
Commercial Vehicle	1.917	2.288	2.596	2.814
Sub-Total	11.773	13.338	14.166	14.664
N_20 (tonnes per Day)				
Private Vehicle	2.062	2.472	2.893	3.311
Commercial Vehicle	0.327	0.395	0.458	0.508
Sub-Total	2.389	2.867	3.351	3.819
CO (tonnes per Day)				
Private Vehicle	1,023.73	1,097.53	1,053.94	970.28
Commercial Vehicle	337.22	403.36	459.11	499.55
Sub-Total	1,360.95	1,500.89	1,513.05	1,469.84
Particulate Emissions (tonnes per Day)				
Private Vehicle	5.025	5.784	6.405	6.951
Commercial Vehicle	4.366	3.908	2.584	2.876
Sub-Total	9.390	9.691	8.989	9.827
Person Trip Statistics				
PT Passenger Trips (per day)				
AM Peak **	225,950	262,581	310,140	317,027
Off-Peak **	549,434	654,294	757,675	841,310
PM Peak **	174,580	208,762	252,566	259,934
Total Vehicle Trips (per day) **	9,044,420	9,987,599	10,978,354	11,826,225
Passenger Trips Categorised (per day)				
Total Persons in Cars **	12,102,547	13,331,872	14,646,927	15,774,913
Total Persons in Comm. Vehicles **	509,346	603,282	690,178	760,974
Total Persons on PT **	949,964	1,125,637	1,320,381	1,418,271
Total Persons Walking/Cycling **	2,219,024	2,539,054	2,913,766	3,200,770
Total	**15,780,881**	**17,599,845**	**19,571,252**	**21,154,928**
Mode Splits (per day)				
Total Persons in Cars **	79.25%	78.44%	77.57%	77.35%
Total Persons in CV **	-	-	-	-
Total Persons on PT **	6.22%	6.62%	6.99%	6.95%
Total Persons Walk/Cycle **	14.53%	14.94%	15.43%	15.69%
Total	**100.00%**	**100.00%**	**100.00%**	**100.00%**

A.2. Options A and B

Year Option	2021 OptionA	2031 OptionA	2021 OptionB	2031 OptionB
Public Transport				
Total Public Transport System Patronage (per day)				
Bus	635,899	704,141	636,024	704,073
Rail-Suburban	888,560	972,448	890,418	972,504
Rail - V/Line	58,570	67,685	58,812	67,570
Tram	458,549	502,565	458,955	502,695
Total	**2,041,578**	**2,246,839**	**2,044,209**	**2,246,842**
Passenger Kilometres (per day)				
Bus	2,014,809	2,198,859	2,016,166	2,198,300
Rail-Suburban	12,089,011	13,345,488	12,106,246	13,340,318
Rail - V/Line	2,578,533	3,064,084	2,592,785	3,059,427
Tram	3,194,224	3,526,247	3,194,487	3,527,110
Total	**19,876,578**	**22,134,678**	**19,909,684**	**22,125,155**
Passenger Hours (per day)				
Bus	98,226	107,876	98,350	107,859
Rail-Suburban	319,787	352,482	320,282	352,365
Rail - V/Line	39,776	47,121	40,001	47,042
Tram	105,412	116,409	105,505	116,413
Total	**563,200**	**623,888**	**564,138**	**623,679**
No. of Passenger Interchanges (per day)	699,285	774,906	700,921	774,909
No. of Passenger Trips (per day)	1,342,293	1,471,933	1,343,288	1,471,933
Revenue (per day)				
Bus	$698,787	$771,529	$699,281	$771,471
Rail-Suburban	$1,120,464	$1,224,769	$1,122,349	$1,224,260
Rail - V/Line	$174,001	$203,888	$174,629	$203,538
Tram	$484,167	$528,101	$484,246	$528,130
Total	**$2,477,420**	**$2,728,286**	**$2,480,506**	**$2,727,398**
Private/Commercial Vehicles				
Person Trips (per day)				
Private Vehicle **	14,627,031	15,723,861	14,625,941	15,723,861
Commercial Vehicle **	690,178	760,974	690,178	760,974
Vehicle Trips (per day)				
Private Vehicle **	10,272,392	11,027,947	10,271,450	11,027,947
Commercial Vehicle **	690,178	760,974	690,178	760,974
Person Kilometres (000's per day)				
Private Vehicle ^	182,283	197,125.0	181,746.3	197,231.4
Commercial Vehicle ^	16,152	18,013.9	16,190.2	18,026.9
Vehicle Kilometres (000's per day)				
Private Vehicle ^	127,760	138,311.7	127,725.8	138,386.4
Commercial Vehicle ^	16,180	18,014	16,190	18,027
Person Hours (per day)				
Private Vehicle ^	3,683,323	4,053,948	3,685,234	4,051,647
Commercial Vehicle ^	273,616	310,799	274,051	310,865
Vehicle Hours (per day)				
Private Vehicle ^	2,591,992	2,848,253	2,593,316	2,846,743
Commercial Vehicle ^	273,616	310,799	274,051	310,865
Operating Costs ($000's per day)				
Private Vehicle ^	$31,526.6	$34,094.7	$31,520.6	$34,104.5
Commercial Vehicle ^	$10,781.1	$11,977.4	$10,791.3	$11,981.7
Accident Rate (Crashes per day)				
Number of Accidents (Total per Day) ^	38.32	41.10	38.36	41.06
Accidents Costs ($ per Day) ^	$6,444,739	$6,934,224	$6,448,719	$6,930,493
Fuel Consumption (Litres per Day)				
Private Vehicle	14,430,382	15,607,847	14,423,323	15,615,587
Commercial Vehicle	5,103,349	5,656,410	5,105,193	5,657,463
Sub-Total	19,533,731	21,264,257	19,528,516	21,273,050

Year / Option	2021 OptionA	2031 OptionA	2021 OptionB	2031 OptionB
NO_x (tonnes per Day)				
Private Vehicle	154.55	163.78	154.47	163.86
Commercial Vehicle	77.62	85.50	77.65	85.52
Sub-Total	232.17	249.28	232.12	249.38
NMVOC (tonnes per Day)				
Private Vehicle	72.30	63.11	72.26	63.14
Commercial Vehicle	48.12	52.65	48.14	52.66
Sub-Total	120.42	115.76	120.40	115.80
SO_x (tonnes per Day)				
Private Vehicle	4.618	4.821	4.615	4.823
Commercial Vehicle	8.625	9.465	8.628	9.467
Sub-Total	13.242	14.286	13.243	14.290
CO_2 (tonnes per Day)				
Private Vehicle	31,270.2	33,436.4	31,254.9	33,453.0
Commercial Vehicle	11,928.9	13,093.6	11,933.2	13,096.1
Sub-Total	43,199.1	46,530.0	43,188.1	46,549.0
CH_4 (tonnes per Day)				
Private Vehicle	11.544	11.793	11.539	11.798
Commercial Vehicle	2.603	2.822	2.604	2.822
Sub-Total	14.147	14.615	14.142	14.621
N_20 (tonnes per Day)				
Private Vehicle	2.886	3.295	2.885	3.297
Commercial Vehicle	0.459	0.509	0.459	0.509
Sub-Total	3.345	3.804	3.344	3.806
CO (tonnes per Day)				
Private Vehicle	1,051.54	965.57	1,051.03	966.05
Commercial Vehicle	460.37	500.93	460.54	501.02
Sub-Total	1,511.92	1,466.50	1,511.57	1,467.07
Particulate Emissions (tonnes per Day)				
Private Vehicle	6.388	6.916	6.386	6.919
Commercial Vehicle	2.589	2.882	2.590	2.884
Sub-Total	8.977	9.798	8.977	9.804
Person Trip Statistics				
PT Passenger Trips (per day)				
AM Peak **	312,497	342,687	312,739	342,687
Off-Peak **	773,500	845,265	773,857	845,265
PM Peak **	256,296	283,981	256,692	283,981
Total Vehicle Trips (per day) **	10,962,570	11,788,921	10,961,628	11,788,921
Passenger Trips Categorised (per day)				
Total Persons in Cars **	14,627,031	15,723,861	14,625,941	15,723,861
Total Persons in Comm. Vehicles **	690,178	760,974	690,178	760,974
Total Persons on PT **	1,342,293	1,471,933	1,343,288	1,471,933
Total Persons Walking/Cycling **	2,911,750	3,198,158	2,911,846	3,198,158
Total	**19,571,252**	**21,154,926**	**19,571,253**	**21,154,926**
Mode Splits (per day)				
Total Persons in Cars **	77.47%	77.10%	77.46%	77.10%
Total Persons in CV **	-	-	-	-
Total Persons on PT **	7.11%	7.22%	7.11%	7.22%
Total Persons Walk/Cycle **	15.42%	15.68%	15.42%	15.68%
Total	**100.00%**	**100.00%**	**100.00%**	**100.00%**

A.3. Options C and D

Year / Option	2021 OptionC	2031 OptionC	2021 OptionD	2031 OptionD
Public Transport				
Total Public Transport System Patronage (per day)				
Bus	638,604	708,426	640,912	712,019
Rail-Suburban	893,815	982,088	901,651	992,298
Rail - V/Line	59,145	68,961	60,254	70,416
Tram	459,625	504,111	461,102	506,003
Total	**2,051,189**	**2,263,586**	**2,063,919**	**2,280,736**
Passenger Kilometres (per day)				
Bus	2,028,698	2,215,063	2,033,001	2,221,607
Rail-Suburban	12,192,826	13,521,719	12,298,287	13,664,949
Rail - V/Line	2,601,454	3,123,596	2,653,461	3,184,944
Tram	3,198,684	3,535,886	3,209,336	3,550,736
Total	**20,021,662**	**22,396,264**	**20,194,085**	**22,622,236**
Passenger Hours (per day)				
Bus	98,920	108,688	99,363	109,240
Rail-Suburban	322,494	356,993	325,375	360,950
Rail - V/Line	40,156	48,068	40,980	49,062
Tram	105,668	116,890	106,053	117,393
Total	**567,238**	**630,639**	**571,771**	**636,645**
No. of Passenger Interchanges (per day)	703,790	782,680	709,748	791,765
No. of Passenger Trips (per day)	1,347,399	1,480,906	1,354,171	1,488,971
Revenue (per day)				
Bus	$701,313	$775,791	$703,165	$778,114
Rail-Suburban	$1,127,557	$1,236,731	$1,137,130	$1,247,679
Rail - V/Line	$175,136	$207,360	$178,248	$211,499
Tram	$485,641	$530,488	$486,750	$531,711
Total	**$2,489,648**	**$2,750,369**	**$2,505,293**	**$2,769,003**
Private/Commercial Vehicles				
Person Trips (per day)				
Private Vehicle **	14,621,535	15,714,154	14,614,060	15,704,919
Commercial Vehicle **	690,178	760,974	690,178	760,974
Vehicle Trips (per day)				
Private Vehicle **	10,267,726	11,019,770	10,261,387	11,011,991
Commercial Vehicle **	690,178	760,974	690,178	760,974
Person Kilometres (000's per day)				
Private Vehicle ^	181,494.2	196,652.3	181,247.0	196,395.1
Commercial Vehicle ^	16,154.5	17,977.1	16,154.8	17,978.2
Vehicle Kilometres (000's per day)				
Private Vehicle ^	127,533.1	137,962.4	127,356.5	137,779.1
Commercial Vehicle ^	16,155	17,977	16,155	17,978
Person Hours (per day)				
Private Vehicle ^	3,695,986	4,069,902	3,695,441	4,070,333
Commercial Vehicle ^	276,263	314,671	276,898	315,603
Vehicle Hours (per day)				
Private Vehicle ^	2,600,554	2,859,027	2,600,090	2,859,233
Commercial Vehicle ^	276,263	314,671	276,898	315,603
Operating Costs ($000's per day)				
Private Vehicle ^	$31,482.8	$34,026.7	$31,441.7	$33,984.1
Commercial Vehicle ^	$10,791.7	$11,992.7	$10,794.0	$11,996.5
Accident Rate (Crashes per day)				
Number of Accidents (Total per Day) ^	38.40	41.20	38.41	41.21
Accidents Costs ($ per Day) ^	$6,451,755	$6,943,306	$6,448,651	$6,939,833
Fuel Consumption (Litres per Day)				
Private Vehicle	14,392,889	15,555,103	14,374,310	15,537,183
Commercial Vehicle	5,089,663	5,639,068	5,090,569	5,641,220
Sub-Total	19,482,552	21,194,171	19,464,879	21,178,403

Year / Option	2021 OptionC	2031 OptionC	2021 OptionD	2031 OptionD
NO_x (tonnes per Day)				
Private Vehicle	154.15	163.22	153.95	163.04
Commercial Vehicle	77.41	85.24	77.43	85.27
Sub-Total	231.56	248.46	231.38	248.31
NMVOC (tonnes per Day)				
Private Vehicle	72.11	62.89	72.02	62.82
Commercial Vehicle	48.00	52.49	48.00	52.51
Sub-Total	120.10	115.38	120.02	115.33
SO_x (tonnes per Day)				
Private Vehicle	4.606	4.805	4.600	4.799
Commercial Vehicle	8.602	9.436	8.603	9.440
Sub-Total	13.207	14.241	13.203	14.239
CO_2 (tonnes per Day)				
Private Vehicle	31,189.0	33,323.4	31,148.7	33,285.0
Commercial Vehicle	11,896.9	13,053.5	11,899.1	13,058.5
Sub-Total	43,085.9	46,376.9	43,047.8	46,343.5
CH_4 (tonnes per Day)				
Private Vehicle	11.514	11.753	11.499	11.739
Commercial Vehicle	2.596	2.813	2.596	2.814
Sub-Total	14.110	14.566	14.096	14.554
N_20 (tonnes per Day)				
Private Vehicle	2.879	3.284	2.875	3.280
Commercial Vehicle	0.458	0.508	0.458	0.508
Sub-Total	3.337	3.791	3.333	3.788
CO (tonnes per Day)				
Private Vehicle	1,048.81	962.31	1,047.46	961.20
Commercial Vehicle	459.14	499.40	459.22	499.59
Sub-Total	1,507.95	1,461.70	1,506.68	1,460.79
Particulate Emissions (tonnes per Day)				
Private Vehicle	6.377	6.898	6.368	6.889
Commercial Vehicle	2.585	2.876	2.585	2.877
Sub-Total	8.961	9.774	8.953	9.765
Person Trip Statistics				
PT Passenger Trips (per day)				
AM Peak **	314,421	345,942	317,584	349,817
Off-Peak **	774,846	847,768	775,878	848,900
PM Peak **	258,132	287,196	260,709	290,254
Total Vehicle Trips (per day) **	10,957,904	11,780,744	10,951,565	11,772,965
Passenger Trips Categorised (per day)				
Total Persons in Cars **	14,621,535	15,714,154	14,614,060	15,704,919
Total Persons in Comm. Vehicles **	690,178	760,974	690,178	760,974
Total Persons on PT **	1,347,399	1,480,906	1,354,171	1,488,971
Total Persons Walking/Cycling **	2,912,140	3,198,892	2,912,843	3,200,062
Total	**19,571,252**	**21,154,926**	**19,571,252**	**21,154,926**
Mode Splits (per day)				
Total Persons in Cars **	77.44%	77.05%	77.40%	77.01%
Total Persons in CV **	-	-	-	-
Total Persons on PT **	7.14%	7.26%	7.17%	7.30%
Total Persons Walk/Cycle **	15.42%	15.69%	15.43%	15.69%
Total	**100.00%**	**100.00%**	**100.00%**	**100.00%**

B. MATHEMATICAL DESCRIPTION – WIDER ECONOMIC BENEFITS METHODOLOGY

B.1. Agglomeration economies

Agglomeration economies are derived from the clustering of economic activity. Better access to other firms and to workers enables many sectors to be more efficient. We measure this type of accessibility by 'effective density' – a measure that weighs the activity (jobs, workers etc) accessibility to a location by proximity measured in journey costs, where nearby activity gets a higher weighting than activity further away.

An increase in the effective density of a location can, according to evidence, lead to an increase in productivity. Recent advances in the research have provided us with detailed elasticities that enable us to convert changes in effective density into changes in productivity for different locations and individual sectors.

Step 1: Effective Density

Mathematically, the effective density (ED) in location *i* is defined as:

$$ED_i = \sum_j \frac{Empl_j}{GC_{ij}} \quad (1)$$

Where GC_{ij} means the average generalised cost of work-related journeys between locations *i* and *j* (across all modes).

It is clear from equation (1) that a transport project can affect the effective density of a location in two ways:

- By changing the number of jobs in a location – which will increase the density there, but might reduce density elsewhere if the jobs have been displaced.
- By affecting the journey costs between locations – which will bring more activity within reach.

For a full assessment of agglomeration impacts of a scheme, both impacts will need to be considered.

The output of stage one is a set of effective densities by locations for each of the scenarios being tested (for instance do minimum and do something scenarios).

Step 2: Productivity gains

Extensive research has been undertaken in this area of urban economics over the last years. Particularly important contributions from Dr Dan Graham of Imperial College, London have provided agglomeration elasticities for individual sectors of the economy. Table 24 below shows the sectoral elasticities recommended by the DfT guidance. Typically high-level service industries and some manufacturing industries have high elasticities – or propensity to benefit from agglomeration. Many sectors do not benefit from agglomeration at all.

TABLE 24 AGGLOMERATION ELASTICITIES FOR THE UK

Industrial sector	Agglomeration elasticity
Primary industries	0.000
Light Manufacturing	0.040
Heavy Manufacturing	0.055
Electricity, gas & water	0.000
Construction	0.072
Distribution, hotels and restaurants	0.042
Transport, storage & communication	0.168
Financial intermediation	0.116
Real estate & business services	0.020
Public admin, Media & other	0.004
All sectors	0.043

These elasticities enable the conversion of changes to effective density by location into changes in productivity. In other words, an agglomeration elasticity of 0.1 would mean that a 10 per cent increase in effective density would translate into one per cent increase in productivity in that location.

The formula for calculating impacts on productivity for location j in each scenario is therefore:

$$\Delta GSP_j^W = \left[\left[\frac{ED_j^1}{ED_j^0}\right]^{El} - 1\right] GSP_j^W \quad , \qquad (2)$$

where the subscript (j) refers to the location and GSPW is a measure of output per worker. This calculation has been undertaken for each location (j) and sector for each assessment year.

The resulting change in productivity is then aggregated across sectors using data on employment and discounted to a base year consistent with the main appraisal.

B.2. Imperfect competition

DfT's findings were that, for a typical developed economy, the missing elements of appraisal due to imperfect competition are in the order of 10 per cent of user benefits to in-work travel normally quantified in appraisal. We have no reasons to believe this proportion is different in Melbourne, Victoria compared to the UK. We have therefore calculated this effect as 10 per cent of the user benefits to in-work journeys.

B.3. Increased labour supply

This effect relies on increased output caused by higher participation in the labour market (a labour market participant is one that is either in work or seeking work). Typically labour supply is considered to be sensitive to the going wages rates. Each individual has a 'reservation wage' – the lowest wage the person considers taking. It is natural to consider this reservation wage to be net of taxes on income as well as commuting costs. A reduction in the cost of commuting will therefore increase the 'take-home' wage offer and this may encourage more individuals to join the labour market.

Labour supply response to changes in wages is typically modelled using labour supply elasticities. Extensive literature has attempted to quantify this elasticity, but the area is fraught with problems of estimation and the range of elasticities is therefore wide. Dandie and Mercante (2007) review the evidence for Australia and their results suggest a labour supply elasticity that is larger than the -0.1 found in the UK. However, due to the large spread of elasticities we have chosen to use -0.1 as a conservative estimate.

The labour supply effect is then calculated by considering the average change in commuting costs for workers in a location against the average wage earned by these**.** Doing so both for the reference and intervention scenarios gives us an understanding of the relative change in take-home pay caused by the intervention. The labour supply elasticity is then used to convert the change in wage to a change in the number of people in work.

The output produced by new entrants is likely to be lower than that of existing workers. Gregg et al (1999) provide evidence that new entrants are 31 per cent less productive than the average existing worker. We therefore consider each additional worker to increase output by 69 per cent of average output by worker.

Formally the calculation of the labour supply effect is as follows:

$$LS = \sum_i \left[\frac{\sum_j E_{ij} x \Delta GC_{if}}{\sum_j E_{ij} x W_j} x \sum_j E_{ij} x GSP_W^j x 0.69 x E_i \right] x(-0.1) \quad , \qquad (3)$$

where E is the number of workers living in location i and working in location j, dGC is the change in (round trip) commuting costs for journeys from i to j, W is the average wage in j and GSPW is the average output per worker in j.

To simplify we can illustrate equation (3) by components:

$$LS = \sum_i \left[\frac{A_i}{B_i} x C_i x 0.69 x E_i \right] x(-0.1) \quad ,$$

where A is the average change in commuting costs for workers living in location i, B is the average wage earned by workers living in location i and C is the average output per worker produced by workers living in location i. The latter is multiplied by 0.69 to correct for the lower output per worker of new entrants and -0.1 is the labour supply elasticity.

As described in the previous chapter, the labour supply effect is not in itself additional to benefits in transport appraisal, but the proportion of the additional output that is captured in taxation is. For the UK the tax authority captures on average 30 per cent of marginal output in taxation (taxes on income, production and profits plus contribution to pensions and insurances). In addition, new entrants to the labour market give up government support worth in the order of 10 per cent of average output (such as job seeker's allowance and incapacity benefits). Since the market only receives 60 per cent of the output of a new entrant, the remainder is not considered by individuals when making decisions and 40 per cent of the additional output is additional to benefits in transport appraisal.

However, the tax wedge in Australia is significantly lower than in the UK. Evidence from the Australian Treasury[5] finds the UK and Australian tax wedges to be 33 per cent and 28 per cent, respectively. We therefore apply a tax wedge for our analysis of 35 per cent; five per cent lower than in the UK.

B.4. Productivity impacts of employment redistribution

Just as there are productivity gains and additional appraisal benefits arising from increased output from new workers, a change in output from existing workers would have the same impact. This could in principle come about in two ways; less time spent commuting may lead to more time spent working, or simply that better commuting conditions enable worker to take up more desirable jobs further away. In an urban context, the latter typically means an increase in local labour supply to city centres, which drives an increase in jobs. Since city centre jobs tend to be more productivity than outside, there is potential for increased output overall.

To assess this impact we need to understand how each scenario to be tested impact on employment by location. We have used SGS estimates on employment relocation for this purpose.

The formula for assessing this effect is simply:

$$ER = \sum_i \Delta E_i xGSP[I]_i ,$$

where dEi is change in employment in location i and GSP[I] is and index of differences in Gross State Product per worker across locations. The latter needs to reflect differences in GSP per worker due to locational factors only, and must correct for compositional differences in the labour force by location (such as skills, occupational mix, sectoral mix etc).

[5] http://comparativetaxation.treasury.gov.au/content/report/html/06_Chapter_4-08.asp

As argued above, any such increase in output will only have been considered by individuals to the extent they receive compensation in form of after-tax salary. The taxed element is also a benefit, but is not currently counted in transport appraisal.

Again we adjust downwards the UK tax rate used for estimating this effect by five per cent, to reflect the lower average tax wedge in Australia. We therefore apply a tax wedge for the Melbourne analysis of 25 per cent (this is 10 per cent lower than for the labour supply impact as in this case there is no reduction in benefit payments).

C. SECTOR DEFINITIONS[6]

Uniform Regional Sectors (30 sectors)	Database Sectors: national input-output table sectors (109 sectors)
1. Animals	0101 Sheep 0103 Beef cattle 0104 Dairy cattle 0105 Pigs 0106 Poultry
2. Crops	0102 Grains 0107 Other agriculture 0200 Services to agriculture; hunting and trapping
3. Forestry and fishing	0300 Forestry and logging 0400 Commercial fishing
4. Coal, oil and gas	1100 Coal, 1201 Oil and gas
5. Mining NEC	1301 Iron ores 1302 Non-ferrous metal ores 1400 Other mining 1500 Services to mining
6. Food, drinks and tobacco	2101 Meat and meat products 2102 Dairy products 2103 Fruit and vegetable products 2104 Oils and fats 2105 Flour mill products and cereal foods 2106 Bakery products 2107 Confectionery 2108 Other food products 2109 Soft drinks, cordials and syrups 2110 Beer and malt 2113 Wine, spirits and tobacco products

[6] Concordance between the national input-output sectors and the Australian and New Zealand Standard Industrial Classification (ANZSIC) 4-digit classification can be found in ABS Cat No. 5209.0.55.001 Australian National Accounts: Input-Output Tables - Electronic Publication, *Input-Output Industry Classification: 2001-02 edition in terms of 1993 ANZSIC*.

Uniform Regional Sectors (30 sectors)	Database Sectors: national input-output table sectors (109 sectors)
7. Textiles, clothing and footwear	2201 Textile fibres, yarns and woven fabrics 2202 Textile products 2203 Knitting mill products 2204 Clothing 2205 Footwear 2206 Leather and leather products
8. Wood products	2301 Sawmill products 2302 Other wood products
9. Paper and publishing	2303 Pulp, paper and paperboard 2305 Paper containers and products 2401 Printing and services to printing 2402 Publishing; recorded media and publishing
10. Petrochemicals	2501 Petroleum and coal products
11. Other chemical products	2502 Basic chemicals 2503 Paints 2504 Medicinal and pharmaceuticals products; pesticides 2505 Soap and other detergents 2506 Cosmetic and toiletry preparations 2507 Other chemical products 2508 Rubber products 2509 Plastic products
12. Non-metallic mineral products	2601 Glass and glass products 2602 Ceramic products 2603 Cement, lime and concrete slurry 2604 Plaster and other concrete products 2605 Other non-metallic mineral products
13. Metals and metal products	2701 Iron and steel 2702 Basic non-ferrous metals and products 2703 Structural metal products 2704 Sheet metal products 2705 Fabricated metal products

Uniform Regional Sectors (30 sectors)	Database Sectors: national input-output table sectors (109 sectors)
14. Machinery and equipment	2801 Motor vehicles and parts; other transport equipment 2802 Ships and boats 2803 Railway equipment 2804 Aircraft 2805 Photographic and scientific equipment 2806 Electronic equipment 2807 Household appliances 2808 Other electrical equipment 2809 Agricultural, mining and construction machinery, lifting and material handling equipment 2810 Other machinery and equipment
15. Manufacturing NEC	2901 Prefabricated buildings 2902 Furniture 2903 Other manufacturing
16. Electricity	3601 Electricity supply
17. Gas and water	3602 Gas supply 3701 Water supply; sewerage and drainage services
18. Construction	4101 Residential building construction 4102 Other construction 4201 Construction trade services
19. Trade services	4501 Wholesale trade 4502 Wholesale mechanical repairs 4503 Other wholesale repairs 5101 Retail trade 5102 Retail mechanical repairs 5103 Other retail repairs
20. Accommodation, cafes and restaurants	5701 Accommodation, cafes and restaurants
21. Road transport	6101 Road transport
22. Rail transport	6201 Rail, pipeline and other transport
23. Water transport	6301 Water transport
24. Air transport	6401 Air and space transport
25. Transport NEC	6601 Services to transport; storage
26. Communication services	7101 Communication services

Uniform Regional Sectors (30 sectors)	Database Sectors: national input-output table sectors (109 sectors)
27. Finance, insurance and business services	7301 Banking 7302 Non-bank finance 7401 Insurance 7501 Services to finance, investment and insurance 7702 Other property services 7801 Scientific research, technical and computer services 7802 Legal, accounting, marketing and business management services 7803 Other business services
28. Ownership of dwellings	7701 Ownership of dwellings
29. Government services	8101 Public administration 8201 Defence 8401 Education 8601 Health services 8701 Community services
30. Services NEC	9101 Motion picture, radio and television services 9201 Libraries, museums and the arts 9301 Sport, gambling and recreational services 9501 Personal Services 9601 Other services

D. INDUSTRY IMPACTS ON THE VICTORIAN ECONOMY: CGE ANALYSIS

GSP IMPACTS OF OPTIONS B AND D ON THE VICTORIAN ECONOMY: DEVIATIONS FROM BASELINE (%)

	Victoria				Melbourne				Rest of Victoria			
	2021		2031		2021		2031		2021		2031	
Industry	Option B	Option D	Option B	Option D	Option B	Option D	Option B	Option D	Option B	Option D	Option B	Option D
Agriculture	0.06%	0.04%	0.14%	0.10%	0.08%	0.05%	0.17%	0.13%	0.02%	0.02%	0.05%	0.04%
Mining	0.13%	0.12%	0.27%	0.24%	0.15%	0.14%	0.32%	0.29%	0.05%	0.05%	0.09%	0.08%
Petroleum	-0.36%	-0.02%	-0.71%	-0.05%	-0.43%	-0.02%	-0.86%	-0.06%	-0.14%	-0.01%	-0.24%	-0.02%
Machinery & equipment	0.10%	0.08%	0.25%	0.19%	0.12%	0.09%	0.30%	0.22%	0.04%	0.03%	0.08%	0.06%
Other manufacturing	0.12%	0.08%	0.25%	0.18%	0.14%	0.10%	0.31%	0.21%	0.04%	0.03%	0.09%	0.06%
Utilities	0.17%	0.15%	0.27%	0.25%	0.20%	0.18%	0.33%	0.30%	0.06%	0.06%	0.09%	0.08%
Construction	0.29%	0.21%	0.49%	0.34%	0.35%	0.26%	0.59%	0.41%	0.11%	0.08%	0.16%	0.12%
Trade	0.02%	0.03%	0.03%	0.05%	0.02%	0.03%	0.03%	0.06%	0.01%	0.01%	0.01%	0.02%
Hotels, Rest	0.15%	0.10%	0.26%	0.17%	0.17%	0.12%	0.31%	0.20%	0.06%	0.04%	0.09%	0.06%
Road transport	0.31%	0.13%	0.55%	0.24%	0.37%	0.15%	0.66%	0.29%	0.12%	0.05%	0.18%	0.08%
Rail transport	6.53%	8.05%	11.60%	14.33%	7.79%	9.61%	14.00%	17.29%	2.52%	3.18%	3.89%	4.93%
Other transport	0.34%	0.28%	0.42%	0.33%	0.41%	0.33%	0.51%	0.39%	0.13%	0.11%	0.14%	0.11%
Communications	0.22%	0.17%	0.37%	0.27%	0.27%	0.20%	0.45%	0.33%	0.09%	0.07%	0.12%	0.09%
Financial, business services	0.18%	0.15%	0.31%	0.24%	0.22%	0.18%	0.37%	0.29%	0.07%	0.06%	0.10%	0.08%
Gov services	0.11%	0.08%	0.19%	0.13%	0.14%	0.10%	0.23%	0.16%	0.04%	0.03%	0.06%	0.04%
Other services	0.13%	0.09%	0.22%	0.15%	0.15%	0.11%	0.27%	0.18%	0.05%	0.04%	0.07%	0.05%
Dwellings	0.23%	0.17%	0.38%	0.27%	0.27%	0.20%	0.46%	0.33%	0.09%	0.07%	0.13%	0.09%
Gross State Product	**0.15%**	**0.12%**	**0.26%**	**0.21%**	**0.18%**	**0.15%**	**0.32%**	**0.25%**	**0.05%**	**0.04%**	**0.08%**	**0.07%**

EMPLOYMENT IMPACTS OF OPTIONS B AND D ON THE VICTORIAN ECONOMY: DEVIATIONS FROM BASELINE (%)

Industry	Victoria				Melbourne				Rest of Victoria			
	2021		2031		2021		2031		2021		2031	
	Option B	Option D	Option B	Option D	Option B	Option D	Option B	Option D	Option B	Option D	Option B	Option D
Agriculture	0.09%	0.03%	0.22%	0.11%	0.11%	0.04%	0.28%	0.14%	0.03%	0.01%	0.07%	0.04%
Mining	0.09%	0.07%	0.24%	0.19%	0.11%	0.09%	0.29%	0.25%	0.03%	0.03%	0.08%	0.07%
Petroleum	-0.38%	-0.05%	-0.72%	-0.09%	-0.46%	-0.06%	-0.89%	-0.12%	-0.14%	-0.02%	-0.23%	-0.03%
Machinery & equipment	0.09%	0.06%	0.24%	0.17%	0.11%	0.08%	0.29%	0.22%	0.03%	0.02%	0.08%	0.06%
Other manufacturing	0.10%	0.06%	0.23%	0.15%	0.12%	0.07%	0.29%	0.20%	0.04%	0.02%	0.07%	0.05%
Utilities	0.21%	0.14%	0.38%	0.23%	0.26%	0.17%	0.46%	0.30%	0.08%	0.05%	0.12%	0.08%
Construction	0.27%	0.21%	0.46%	0.32%	0.33%	0.25%	0.56%	0.42%	0.10%	0.08%	0.14%	0.11%
Trade	0.03%	0.02%	0.05%	0.04%	0.03%	0.02%	0.06%	0.06%	0.01%	0.01%	0.01%	0.01%
Hotels, Rest	0.13%	0.08%	0.24%	0.14%	0.16%	0.09%	0.29%	0.18%	0.05%	0.03%	0.07%	0.05%
Road transport	-1.33%	-0.31%	-2.22%	-0.93%	-1.61%	-0.37%	-2.74%	-1.20%	-0.49%	-0.12%	-0.70%	-0.32%
Rail transport	4.16%	3.07%	5.63%	3.58%	5.03%	3.67%	6.95%	4.61%	1.51%	1.16%	1.77%	1.23%
Other transport	0.50%	0.24%	0.67%	0.14%	0.61%	0.29%	0.83%	0.18%	0.18%	0.09%	0.21%	0.05%
Communications	0.23%	0.16%	0.39%	0.26%	0.28%	0.19%	0.48%	0.33%	0.08%	0.06%	0.12%	0.09%
Financial, bus services	0.17%	0.13%	0.28%	0.22%	0.20%	0.16%	0.34%	0.28%	0.06%	0.05%	0.09%	0.07%
Gov services	0.10%	0.07%	0.18%	0.12%	0.13%	0.09%	0.22%	0.15%	0.04%	0.03%	0.06%	0.04%
Other services	0.12%	0.08%	0.21%	0.13%	0.15%	0.10%	0.26%	0.17%	0.04%	0.03%	0.07%	0.04%
Gross State Product	**0.12%**	**0.09%**	**0.20%**	**0.14%**	**0.14%**	**0.11%**	**0.25%**	**0.18%**	**0.04%**	**0.03%**	**0.06%**	**0.05%**