

City of Melbourne

**Greenhouse Footprint
for Transport**

Draft Report

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Draft

City of Melbourne

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for Transport**

Draft Report

May 2008

Draft

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Executive Summary

The *Greenhouse Footprint for Transport Report* and accompanying model assess and where necessary, discuss various transport emission scenarios; quantifying emission levels and assessing the impact of suggested solutions.

The modelling and subsequent reporting process revealed a series of issues to consider.

Firstly, that if transport emissions were to continue to grow at current rates with no policy or strategic actions, transport emissions would increase to be 28.9% per annum above 2001 levels by 2020. This is particularly significant as the transport calculations do not include freight which is projected to grow rapidly up to 2020.

Secondly, an assessment of a series of policies and actions from the *Melbourne Transport Strategy, Moving People and Freight 2006-2020* revealed that they will most likely not affect the significant change required to mitigate the City of Melbourne's transport emissions. Policies to enhance tram priority and restrict long term parking have some impact; however, in isolation their potential to affect large scale emission reductions is limited.

Finally and conversely, a study of the three suggested emission reduction solutions in the *Zero Net Emissions by 2020 - Strategy Update*, indicate that decarbonisation of the public transport system, and institution of a congestion charge could potentially have a significant impact on emissions.

Decarbonisation of the public transport and the introduction of a congestion charge will most likely have immediate emission reduction impacts. The first reducing the carbon intensity of public transport, and the second providing a potentially strong financial signal which has the potential to affect immediate behavioural change on car users within the City of Melbourne.

Importantly the Report and more specifically the accompanying model, provides the City of Melbourne with a tool to assess the ongoing emission impacts of various transport scenarios thereby supporting policy and strategy development.

1 Introduction

When the City of Melbourne completed its *Zero Net Emissions by 2020* strategy in 2002, transport was mostly excluded from the calculations and policy solutions. The Strategy considered that transport's contribution to the City of Melbourne's emissions was relatively small, and that the Council had little potential to influence transport emissions in comparison to active state and federal government programs¹. Since this time, the City of Melbourne has developed a series of policies and actions which directly address the transport sector contribution to the Local Government Area's (LGA) total emissions.

In this context, the *Greenhouse Footprint for Transport Report* provides a series of transport scenarios for comparison and discussion including a business as usual (BaU) scenario and the relative impact of various policies and actions outlined in the *Melbourne Transport Strategy, Moving People and Freight 2006-2020*.

An additional part of the Report is the consideration of the three transport emission reduction solutions which were highlighted as part of the *Zero Net Emissions by 2020 - Strategy Update*.

By understanding the greenhouse footprint baseline and the impacts of suggested policy and regulatory levers, the Report will assist the City of Melbourne to reconcile its rapidly growing transport requirements with the need to manage the City's emissions in line with existing and developing policies, and community expectations.

¹ Zero Net Emissions by 2020: A Roadmap to a Climate Neutral City, City of Melbourne, 2002, p.5

2 Project Objective

In line with the *Melbourne Transport Strategy*, the initial project objective was to determine the greenhouse footprint of transport associated with the City of Melbourne *to* and *within* the City of Melbourne. This would broadly involve

- Establishing a baseline figure representing the emissions produced to and within the City in a year
- Determining the emissions produced per day in a business under a business as usual scenario
- Assessing the emissions impact of the successful implementation of the Melbourne Transport Strategy, and
- Defining actions to achieve an appropriate modal split for the City which will complement the strategy of zero net emissions by 2020, although this point is not of great emphasis as outlined in the Consultant's Brief

Due to a lack of data at the project inception stage, the Report was not to include an assessment of freight although this remains an option as other data sets become available.

As the analysis process continued, it became apparent that there was appropriate information to also include the journeys *from* Melbourne thereby providing a more complete and robust assessment of emissions.

2.1 Broad Project Parameters

Fundamental to achieving a successful project outcome is the importance of appropriately defining the project scope – both geographically and temporally.

For the purposes of the project the key broad assumptions were that

- The geographic scope will be defined as the City of Melbourne and include the Docklands and the areas of Kensington / North Melbourne which have recently been incorporated into the LGA.
- Emissions will be calculated for transport
 - Originating outside the City of Melbourne LGA and terminating at a destination inside the City of Melbourne LGA
 - Originating and terminating within the City of Melbourne LGA, and additionally
 - Originating in the City of Melbourne LGA and terminating at a destination outside the City of Melbourne LGA.
- Emissions will be calculated on an annual basis.

2.2 Notes on the Report and Model

The transport emissions model which underpins the results detailed in the Report is based on

- Data sets provided by the City of Melbourne and detailed in Appendix A, and
- Assumptions which have been agreed in whole or in part by the City of Melbourne, and are also listed in Appendix B.

All calculations within the model are correct at the date of the final report submission.

In addition to providing the emission results for discussion in the Report, the transport emissions model is released to the City of Melbourne as a tool to assess the emission impacts of various transport scenarios thereby supporting ongoing policy and strategy.

3 Relation to the Zero Net Update

3.1 Zero Net Update Findings and Initiatives

As briefly discussed in the Introduction, the *Greenhouse Footprint for Transport Report* and associated model is planned to be used by the City of Melbourne as an internal policy and strategy tool and to supplement the transport considerations within the *Zero Net Emissions by 2020 Strategy Update (Zero Net Update)*.

Figure 1 represents the current position of transport within the context of the *Zero Net Update*². A complete carbon strategy for the City of Melbourne requires transport emissions to be better understood and quantified so they can contribute to the overall emissions reduction program by 2020.

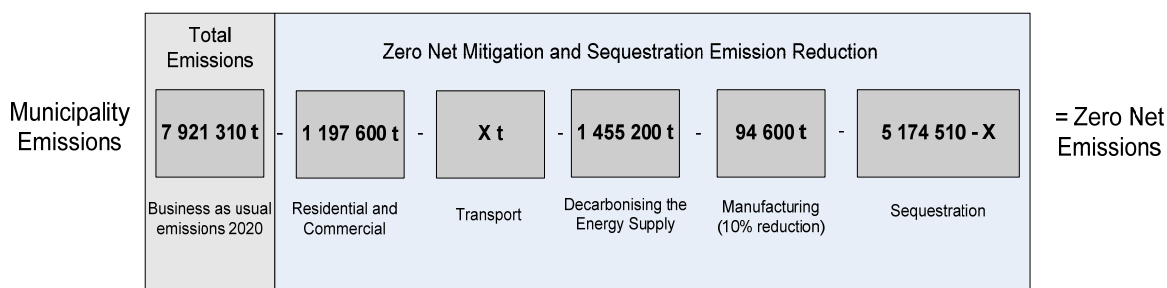


Figure 1: City of Melbourne Zero Net Emissions by 2020 Strategy Update – Emissions business strategy map

The initial high level transport findings from the *Zero Net Update* calculations³ were that

- o Transport emissions accounted for 20 per cent of all emissions associated with the City of Melbourne in 2005–06
- o Transport emissions are predicted to grow by 61 per cent by 2020
- o Passenger transport (road and rail) accounts for 12 per cent of total emissions, and
- o Freight emissions account for eight per cent of total emissions.

With these projections in mind, the *Zero Net Update* suggested three high level transport emission reduction initiatives reflecting the City of Melbourne’s spheres of influence over the transport sector and the availability of data for analysis and comparison. The transport solutions focus on short to medium term passenger transport measures that affect modal shift and the carbon intensity of the transport system. They are

- o **Decarbonisation** of the public transport system through the introduction of low-carbon or clean source energy to the public transport network
- o Implementation of a **congestion charge** for emitting vehicles entering the City of Melbourne with consideration of a scale of tariffs for vehicles with high-emission levels, and
- o Introduction of an integrated **Cycle Melbourne** scheme combining bicycle hire, expanded end-of-trip facilities and cycling network throughout the city, and supported by revenue raised by the congestion charge.

Decarbonising the public transport system is direct and strategically separate from the last two measures, which are predicated on the realisation of an underlying mode shift away from cars to public transport and cycling options.

² *Zero Net Emissions by 2020 - Strategy Update 2008*, p.12

³ *Zero Net Emissions by 2020 - Strategy Update 2008*, p.34

These % changes were then subsequently applied to the *Greenhouse Footprint for Transport* model, and the emission impacts recorded and discussed in Section 7.

3.2 Comparison Limitations

Whereas transport calculations for the *Greenhouse Footprint for Transport Report* were made on the basis of emissions factors and travel data provided by the City of Melbourne, the emission calculations for the *Zero Net Update* utilised Australian Bureau of Agricultural and Resource Economics (ABARE) information⁴ at the Victorian scale and then apportioned to a Melbourne scale.

The different calculation methods, bottom-up versus top-down respectively, in addition to the inclusion of freight in the *Zero Net Update* calculations, means that the tonnes CO₂e pa figures for each study will not be equal.

To allow for this understandable disconnect, both the Report and the *Zero Net Update* have applied the same % changes to the transport emissions solutions outlined in Section 7.

The inclusion of freight into the Report model would further reduce the difference between the two approaches.

⁴ *Zero Net Emissions by 2020 - Strategy Update 2008*, p.iii

4 Transport Emissions - 2001, 2006 and 2020 BaU

The calculation of emissions for 2001, 2006 and 2020 assuming a BaU scenario allows a basic emission trend to be mapped for total emissions and by transport mode. The trend lines provide a basis to discuss the emissions mitigation aspects of the ongoing transport strategy.

The assumptions for the emission calculations are located in Appendix B.

4.1 2001 Baseline Emissions

Total emissions for the baseline year of 2001 are calculated to be **1,072,809 tonnes CO2e pa**. Key features of the assessment include

- Cars contributed nearly 43% of total transport emissions in 2001.
- Combined emissions from public transport modes (train, tram and bus) made up 54.5% of total transport emissions in 2001
- Emissions associated with visitor journeys contributed 76% of total transport emissions in 2001, and
- Journey to work (JTW) events contributed 24% of total transport emissions in 2001.

Mode	Annual JTW GHG (tonnes CO2e/yr)	Annual Visitor GHG (tonnes CO2e/yr)	Annual GHG Produced (tonnes CO2e/yr)	Annual GHG Produced (Percent)
Car	186,333	273,973	460,306	42.9%
Train	47,163	358,073	405,235	37.8%
Tram	6,656	134,173	140,829	13.1%
Bus	2,843	36,225	39,069	3.6%
Motorbike	666	168	834	0.1%
Taxi	406	14,081	14,487	1.4%
Other	6,938	5,112	12,049	1.1%
Total	251,005	821,804	1,072,809	100%

Table 1: Emissions by transport mode pa, JTW and visitors, 2001

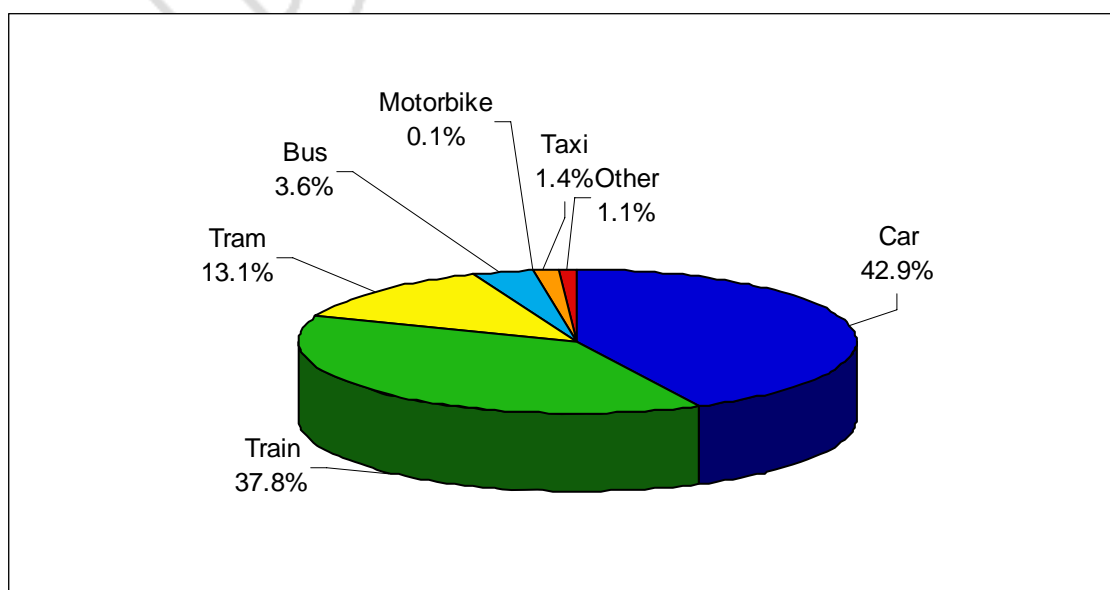


Figure 2: % Emissions by transport mode pa, 2001

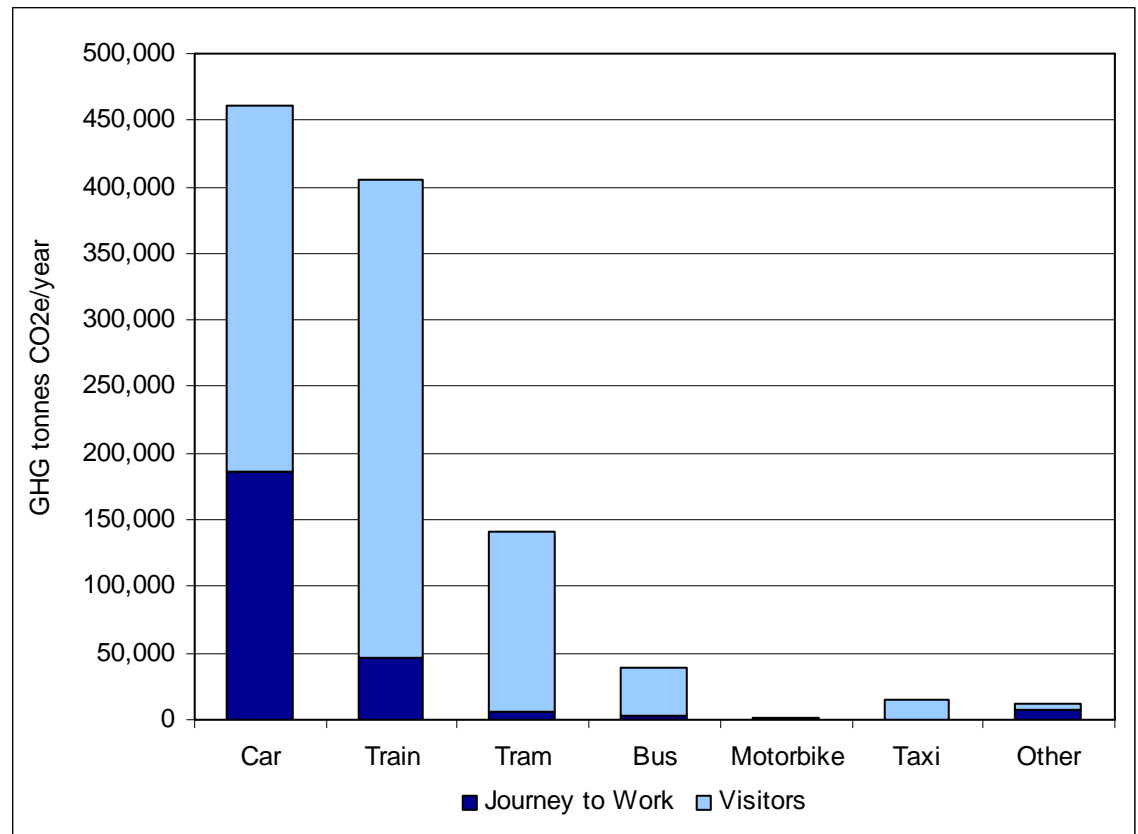


Figure 3: Emissions by transport mode pa - JTW and visitors, 2001

4.2 2006 Emissions

Total transport emissions for 2006 are calculated to be **1,072,921 tonnes CO2e pa**. Key features of the assessment include

- Cars contributed nearly 40% of total transport emissions in 2006.
- Combined emissions from public transport modes (train, tram and bus) made up 58.1% of total transport emissions in 2006.
- Emissions associated with train transport were 2% higher than emissions associated with cars in 2006, with the greatest contribution to train emissions being visitor journeys.
- The relative emission contribution from JTW and visitor journeys remains constant from 2001, at 24% and 76% respectively.

Mode	Annual JTW GHG (tonnes CO2e/yr)	Annual Visitor GHG (tonnes CO2e/yr)	Annual GHG Produced (tonnes CO2e/yr)	Annual GHG Produced (Percent)
Car	171,568	252,585	424,154	39.5%
Train	61,919	371,971	433,889	40.4%
Tram	7,350	141,683	149,033	13.9%
Bus	2,942	37,710	40,652	3.8%
Motorbike	1,239	1,655	2,894	0.3%
Taxi	652	13,283	13,935	1.3%
Other	8,346	17	8,363	0.8%
Total	254,016	818,905	1,072,921	100%

Table 2: Emissions by transport mode pa, JTW and visitors, 2006

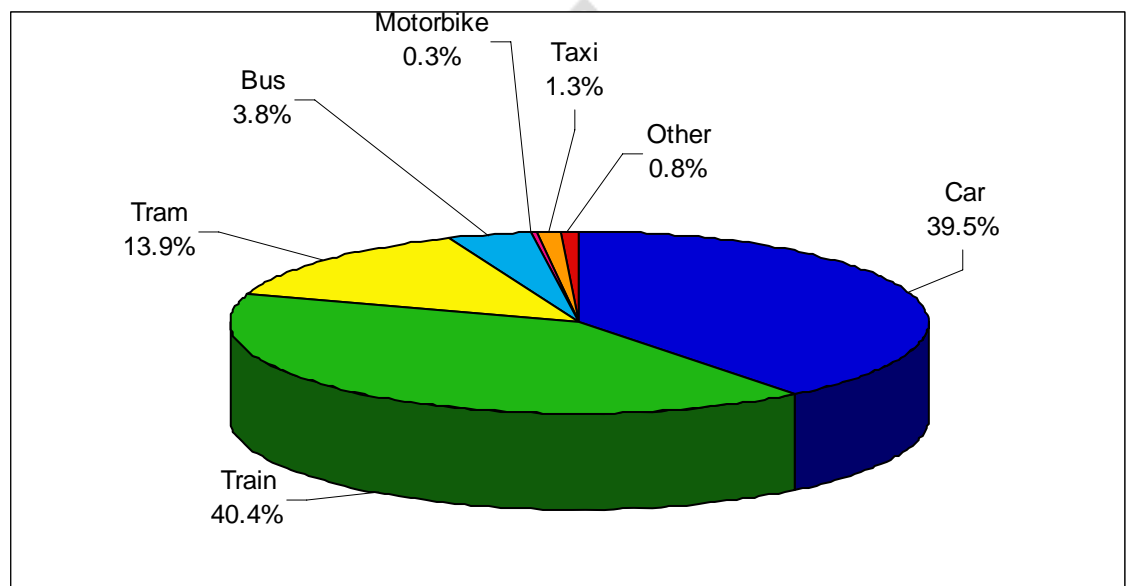


Figure 4: % Emissions by transport mode pa, 2006

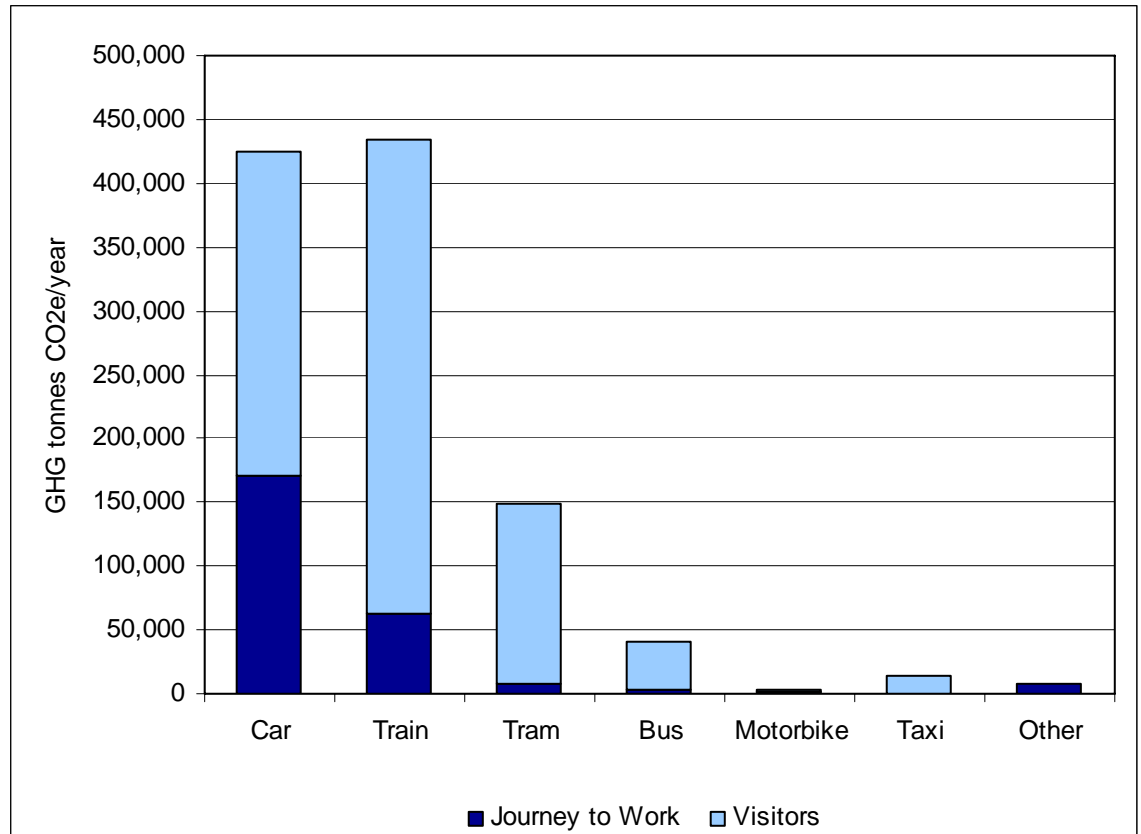


Figure 5: Emissions by transport mode pa - JTW and visitors, 2006

4.3 2020 Business as Usual Scenario

Total emissions for 2020 presuming a BaU approach to transport, are calculated to be **1,383,034 tonnes CO2e pa**. Key features of the assessment include

- o Cars are calculated to contribute 48.6% of total transport emissions in 2020 presuming a BaU scenario
- o Combined emissions from public transport modes (train, tram and bus) are calculated to make up 49.1% of total transport emissions in 2020
- o Emissions associated with visitor journeys are calculated to contribute 79% of total transport emissions in 2020, and
- o JTW are calculated to contribute 21% of total transport emissions in 2020.

Mode	Annual JTW GHG (tonnes CO2e/yr)	Annual Visitor GHG (tonnes CO2e/yr)	Annual GHG Produced (tonnes CO2e/yr)	Annual GHG Produced (Percent)
Car	194,898	476,724	671,622	48.6%
Train	68,163	399,781	467,944	33.8%
Tram	8,037	160,915	168,952	12.2%
Bus	3,218	39,198	42,416	3.1%
Motorbike	1,409	4,108	5,517	0.4%
Taxi	741	16,465	17,207	1.2%
Other	9,330	45	9,376	0.7%
Total	285,796	1,097,237	1,383,034	100%

Table 3: Emissions by transport mode pa, JTW and visitors, 2020 BaU

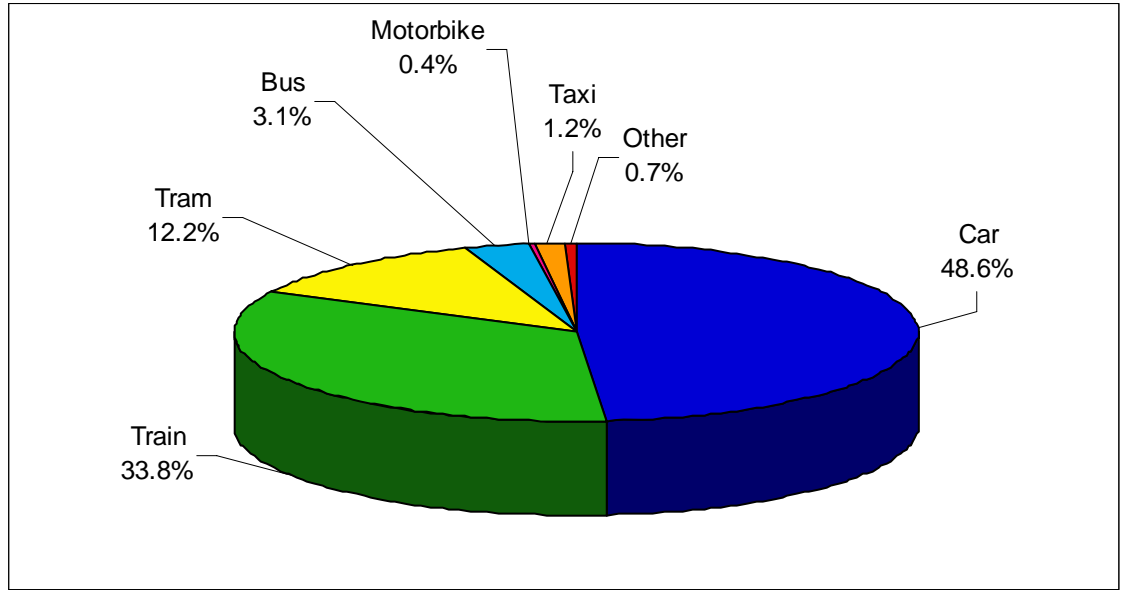


Figure 6: % Emissions by transport mode pa – 2020 BaU

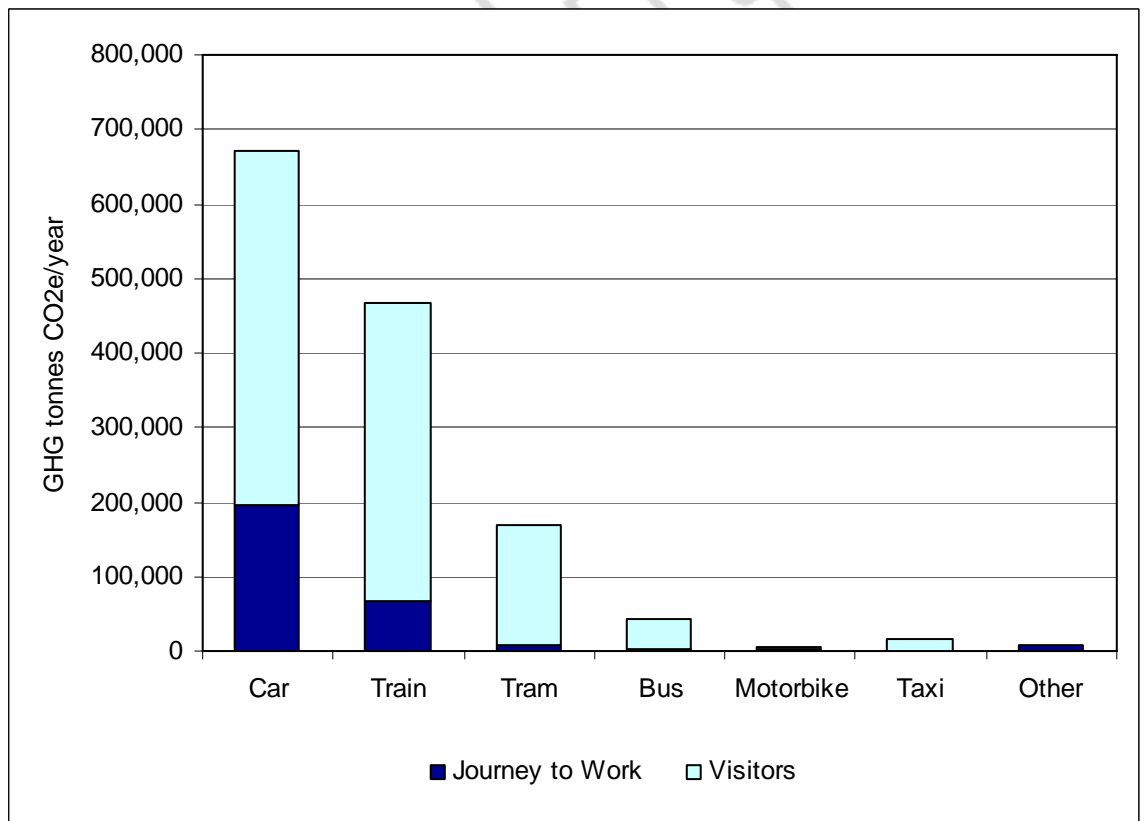


Figure 7: Emissions by transport mode pa, JTW and visitors, 2020 BaU

4.4 Key Trends from 2001 to 2020 BaU

Between the calculation points of 2001 and 2020 (presuming business as usual), transport emissions are calculated to **increase by 310,215 tonnes CO₂e pa**. This is the equivalent of a predicted 28.9% pa increase in total transport related emissions from 2001.

Key features of the temporal assessment for each mode are as follows.

Car

- Between 2001 and 2020 (BaU), emissions from cars are calculated to increase 211,316 tonnes CO₂e pa; a 45.9% pa increase over the period, and
- The relative contribution of cars to total emissions is calculated to increase from 42.9% to 48.6% over the period.

Train

- Between 2001 and 2020 (BaU), emissions from trains are calculated to increase 62,709 tonnes CO₂e pa; a 15.4% pa increase over the period, and
- The relative contribution of trains to total emissions is calculated to decrease from 37.8% to 33.8% over the period.

Trams

- Between 2001 and 2020 (BaU), emissions from trams are calculated to increase 29,123 tonnes CO₂e pa; a 20.6% pa increase over the period, and
- The relative contribution of trams to total emissions is calculated to decrease from 13.1% to 12.22% over the period.

Bus

- Between 2001 and 2020 (BaU), emissions from buses are calculated to increase 3,347 tonnes CO₂e pa; a 8.5% pa increase over the period, and
- The relative contribution of buses to total emissions is calculated to decrease from 3.64% to 3.07% over the period.

Between 2001 and 2020 (BaU), the annual contribution of all public transport modes (train, tram and bus) to total emissions declined from 54.5% to 49.1%. This decrease in public transport's relative contribution does not reflect a decline in public transport emission volumes, but a significant relative increase in emissions from cars over the same period.

Taxis

- Between 2001 and 2020 (BaU), emissions from taxis is calculated to increase 2,720 tonnes CO₂e pa; a 18.7% pa increase over the period, and
- The relative contribution of taxis to total emissions is calculated to decrease from 1.35% to 1.24% over the period.

Mode	2001		2006		2020	
	Annual GHG Produced (tonnes CO2e/yr)	Annual GHG Produced (Percent)	Annual GHG Produced (tonnes CO2e/yr)	Annual GHG Produced (Percent)	Annual GHG Produced (tonnes CO2e/yr)	Annual GHG Produced (Percent)
Car	460,306	42.91%	424,154	39.53%	671,622	48.56%
Train	405,235	37.77%	433,889	40.44%	467,944	33.83%
Tram	140,829	13.13%	149,033	13.89%	168,952	12.22%
Bus	39,069	3.64%	40,652	3.79%	42,416	3.07%
Motorbike	834	0.08%	2,894	0.27%	5,517	0.40%
Taxi	14,487	1.35%	13,935	1.30%	17,207	1.24%
Other	12,049	1.12%	8,363	0.78%	9,376	0.68%
Total	1,072,809	100%	1,072,921	100%	1,383,034	100%

Table 4: Emissions by transport mode pa, JTW and visitors, 2001, 2006, and 2020 BaU

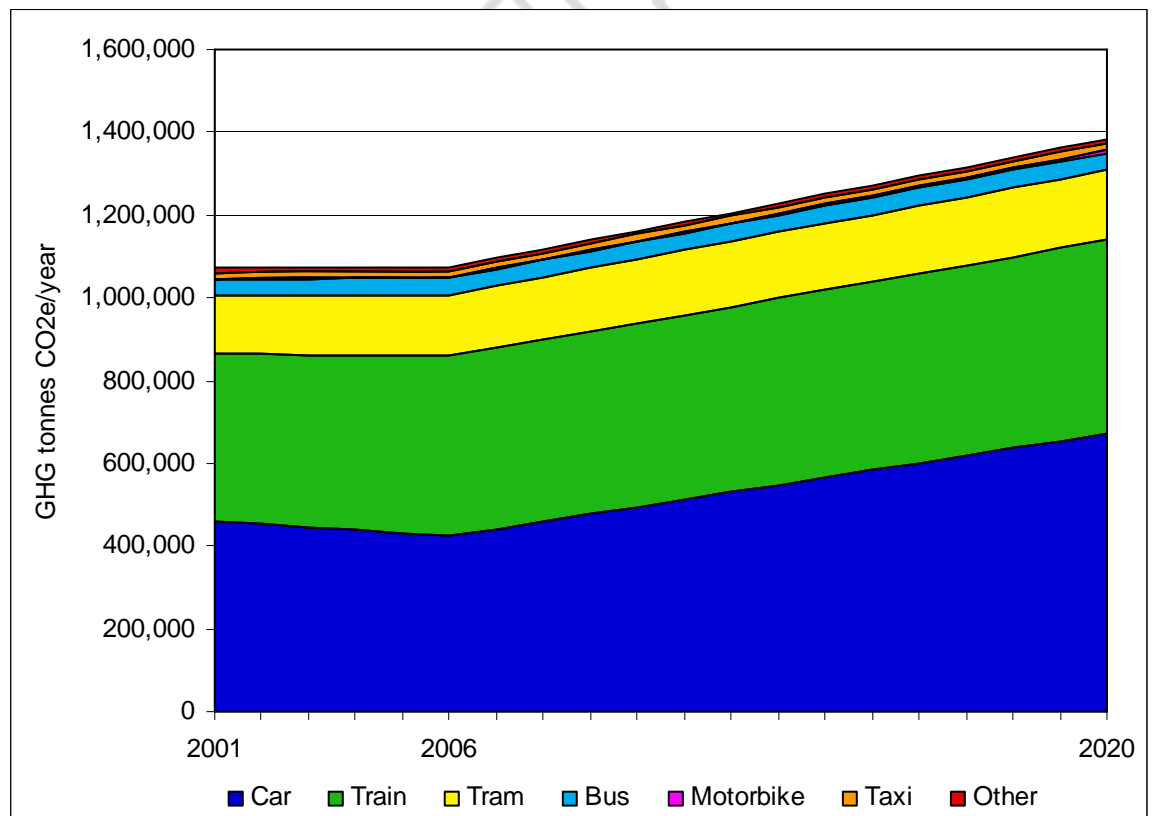


Figure 8: Cumulative emissions by transport mode pa – 2001, 2006, and BaU 2020

5 Transport Emissions – Impact of Policies and Actions

The City of Melbourne's Transport Strategy, *Moving People and Freight 2006-2020* outlines approximately 130 inter-related policy and actions to improve the LGA's transport impacts. The Strategy aligns with the Council's planning strategy, *City Plan 2010*, and with *Melbourne 2030, Linking Melbourne: Metropolitan Transport Plan* and the *Transport and Liveability Statement, Meeting Our Transport Challenges*. Increasingly, the *Transport Strategy* will be interlinked with the *Zero Net Emissions by 2020 - Strategy Update*.

The Strategy's policies and actions seek to drive transport efficiencies associated with getting into and around the city, as well as the issue of freight transport which has been excluded from this particular study.

One type of efficiency which the Strategy seeks to achieve is the improved management of transport emissions. To assess the Strategy's effectiveness in addressing transport emissions, a number of the policies and actions have been selected to assess their individual and cumulative contributions to managing transport emissions.

The following report and assessment utilises the 2020 BaU emission calculations in Section 4 where no transport initiatives were implemented, and models selected policies and actions to provide an adjusted level of 2020 transport emissions for comparison.

Select policies and actions were considered for each transport mode and several particular transport aspects as follows:

- Rail - three railway extensions
- Tram – improved priority
- Bus – dedicated road space
- CBD Parking – less long term parking
- Pedestrians – improved routes
- Speed Limits – 40km/h in the CBD and surrounds
- Cycling – improved facilities, and
- Car Sharing

5.1 High Level Findings and Observations

The key findings of the cumulative and individual assessment of the emissions impacts of selected policies and actions are that

- Individually, many of the transport policies and actions would have a minimal effect (if any) on reducing the potential annual transport emissions by 2020 in comparison to a 2020 BaU scenario
- The relative exceptions are policies to *enhance tram priority* and *restrict long term car parking* in the CBD
- That if all selected policies and actions were implemented by 2020, City of Melbourne transport emissions would be 5% or **69,205 tonnes CO₂e pa less** than the comparable 2020 BaU scenario.
- That a reasonable mode shift from cars to public transport can be achieved with the current strategy, but a more significant mode shift will require severe state and local government intervention such as car quotas, levies or a significant increase in public transport investment and service.
- That such a mode shift may inadvertently be driven by price signals and macroeconomic variables unrelated to the City of Melbourne's Transport Strategy such as the continued, rapid increase of petrol prices.

- That the City of Melbourne's power to bring many of these policies and actions to fruition by 2020 remains limited, thereby reducing its role in the transport debate to 'enthusiastic bystander' as it remains constrained by available resources, levels of authority, and the relative balance between state and local government responsibilities.

5.2 Policy and Action Assessments

5.2.1 Rail Policy 1

Policy

- Council recommends the Victorian Government establish a high capacity fixed rail service to link the Doncaster/Donvale area (the most substantial Melbourne catchment) to the City as soon as possible.⁵

The calculations indicated that the establishment of a high capacity fixed rail service to link Doncaster/Donvale to the City by 2020 would have minimal impact on reducing total City of Melbourne transport emissions when compared with 2020 BaU. In summary

- If the rail link was completed by 2020, the City of Melbourne's total transport emissions would be **reduced by 1,380 tonnes CO₂e pa** when compared with 2020 BaU levels; effectively a rounding error when it is considered that total transport emissions would remain more than 1.38 million tonnes CO₂e pa, and
- Car-related emissions would be **reduced slightly by 2358 tonnes CO₂e pa** reflecting a small mode shift away from cars as public transport options are enhanced for the area.

Given the small changes, the associated *Cumulative* and *Transport Mode Figures* do not demonstrate any emissions impacts and have been omitted from this report, but are available in the model.

Mode	Annual Emissions (tonnes CO ₂ e/year)							
	2001		2006		2020 BaU		2020 with Rail Policy or Action	
Car	460,306	42.9%	424,154	39.5%	671,622	48.6%	669,264	48.4%
Train	405,235	37.8%	433,889	40.4%	467,944	33.8%	469,515	34.0%
Tram	140,829	13.1%	149,033	13.9%	168,952	12.2%	168,952	12.2%
Bus	39,069	3.6%	40,652	3.8%	42,416	3.1%	41,824	3.0%
Motorbike	834	0.1%	2,894	0.3%	5,517	0.4%	5,517	0.4%
Taxi	14,487	1.4%	13,935	1.3%	17,207	1.2%	17,207	1.2%
Bicycle	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Walk	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Other	12,049	1.1%	8,363	0.8%	9,376	0.7%	9,376	0.7%
Total	1,072,809	100%	1,072,921	100%	1,383,034	100%	1,381,654	100%

Table 5: Rail Policy 1 - Emission impact by transport mode pa – 2001, 2006, 2020 BaU and 2020 with policy implemented

A full list of assumptions is detailed in Appendix B and the accompanying model. The basic assumptions utilised for the above calculations are as follows:

- A 5% additional growth in trips from the City of Manningham to the City of Melbourne.

⁵ City of Melbourne Moving People and Freight – Transport Strategy 2006-2020, 2006, p.17

- o No additional growth in trips from the City of Melbourne to the City of Manningham.

5.2.2 Rail Policy 2

Policy

- o *Council recommends the Victorian Government plan for rail extensions and associated infrastructure in the following corridors: from Sunshine to Melton, Sydenham to Sunbury, Upfield to Roxburgh Park, Epping to South Morang, Cranbourne to East Cranbourne, Frankston to Mornington, Broadmeadows to Craigieburn, and CBD to Melbourne Airport.*⁶

As there are eight separate rail extension options within this single policy, a full analysis would require considerable resource. As a result, it was agreed to undertake modelling and analysis of two rail extension options; the Sunshine to Melton route and a potential Glen Waverley to Rowville (including Monash University) route. The latter option is not part of the policy but, like the Sunshine to Melton route, was selected due to the geographic locations and the nature of the surrounding urban development which would potentially support a large urban residential population.

Similar to the assessment results for the Doncaster/Donvale rail link, the construction of the Sunshine to Melton and Glen Waverley to Rowville rail extensions had limited impact on the City of Melbourne's total emission reductions when pursued as isolated policies. In summary

- o If both extensions were completed by 2020, the City of Melbourne's total transport emissions would be **reduced by 3376 tonnes CO₂e pa** when compared with the 2020 BaU scenario.
- o Reflecting the increased number of train services associated with the two rail extensions, train emissions will be **5220 tonnes CO₂e pa more** than in the calculated 2020 BaU scenario.
- o Car-related emissions would be slightly **less (8596 tonnes CO₂e pa)** than the calculated 2020 BaU levels reflecting a mode shift away from cars as public transport options are enhanced for the two areas.
- o There is no calculable emission savings associated with other transport modes.

Similar to the first rail policy study, the associated *Cumulative* and *Transport Mode Figures* only demonstrate a small emissions impact and have been omitted, but are available in the model.

⁶ *City of Melbourne Moving People and Freight – Transport Strategy 2006-2020*, 2006, p.17

Mode	Annual Emissions (tonnes CO ₂ e/year)							
	2001		2006		2020 BaU		2020 with Rail Policy or Action	
Car	460,306	42.9%	424,154	39.5%	671,622	48.6%	663,026	48.1%
Train	405,235	37.8%	433,889	40.4%	467,944	33.8%	473,164	34.3%
Tram	140,829	13.1%	149,033	13.9%	168,952	12.2%	168,952	12.2%
Bus	39,069	3.6%	40,652	3.8%	42,416	3.1%	42,416	3.1%
Motorbike	834	0.1%	2,894	0.3%	5,517	0.4%	5,517	0.4%
Taxi	14,487	1.4%	13,935	1.3%	17,207	1.2%	17,207	1.2%
Bicycle	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Walk	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Other	12,049	1.1%	8,363	0.8%	9,376	0.7%	9,376	0.7%
Total	1,072,809	100%	1,072,921	100%	1,383,034	100%	1,379,658	100%

Table 6: Rail Policy 2 - Emission impact by transport mode pa – 2001, 2006, 2020 BaU and 2020 with policy implemented

A full list of assumptions is detailed in Appendix B and the accompanying model. The basic assumptions utilised for the above calculations are as follows:

- Additional growth in trips from the Shire of Melton to the City of Melbourne of 3%.
- No additional growth in trips from the City of Melbourne to the Shire of Melton.
- Additional growth in trips from the City of Brimbank to the City of Melbourne of 3%.
- No additional growth in trips from the City of Melbourne to the City of Brimbank.

5.2.3 Tram

Policy

- *Council recommends the Victorian Government further pursue tram and bus priority measures to increase frequency, punctuality and service improvements simultaneously.⁷*

Arup undertook modelling for only the tram measures as bus measures were to be considered as part of policy calculations in Section 5.2.4.

If this particular policy was implemented by 2020, the summary emission impacts would be as follows.

- City of Melbourne total transport emissions would be **24,271 tonnes CO₂e pa less** than emissions associated with a 2020 BaU scenario. This decrease represents nearly a 2% reduction in total expected emissions by 2020
- Emissions associated with trams are calculated to be **17,961 tonnes CO₂e pa more** than the 2020 BaU reflecting the direct impact of the policy
- Car emissions would be **42,350 tonnes CO₂e pa less** than those calculated in a 2020 BaU context; 6% less than 2020 BaU levels, and
- Emissions from trains, buses and taxis are all marginally higher than in the 2020 BaU scenario.

⁷ City of Melbourne Moving People and Freight – Transport Strategy 2006-2020, 2006, p.18

Mode	Annual Emissions (tonnes CO2e/year)							
	2001		2006		2020 BaU		2020 with Tram Policy or Action	
Car	460,306	42.9%	424,154	39.5%	671,622	48.6%	629,272	46.3%
Train	405,235	37.8%	433,889	40.4%	467,944	33.8%	468,019	34.4%
Tram	140,829	13.1%	149,033	13.9%	168,952	12.2%	186,913	13.8%
Bus	39,069	3.6%	40,652	3.8%	42,416	3.1%	42,422	3.1%
Motorbike	834	0.1%	2,894	0.3%	5,517	0.4%	5,522	0.4%
Taxi	14,487	1.4%	13,935	1.3%	17,207	1.2%	17,238	1.3%
Bicycle	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Walk	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Other	12,049	1.1%	8,363	0.8%	9,376	0.7%	9,376	0.7%
Total	1,072,809	100%	1,072,921	100%	1,383,034	100%	1,358,763	100%

Table 7: Tram - Emission impact by transport mode pa – 2001, 2006, 2020 BaU and 2020 with policy implemented

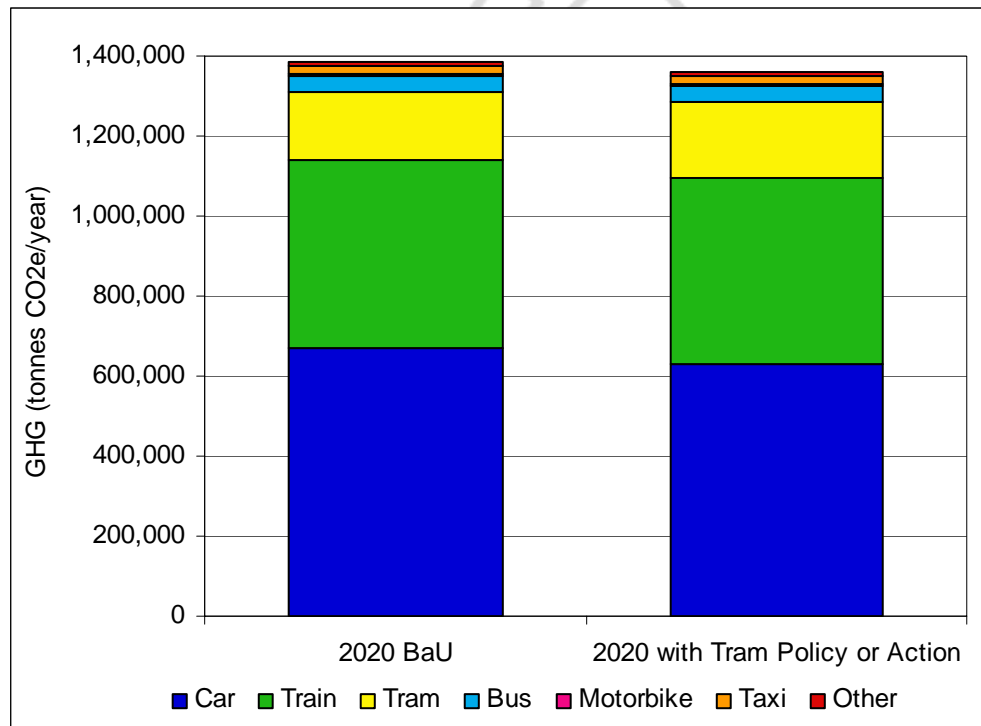


Figure 9: Tram – Cumulative emission impact by transport mode pa – 2020 BaU and 2020 with policy implemented

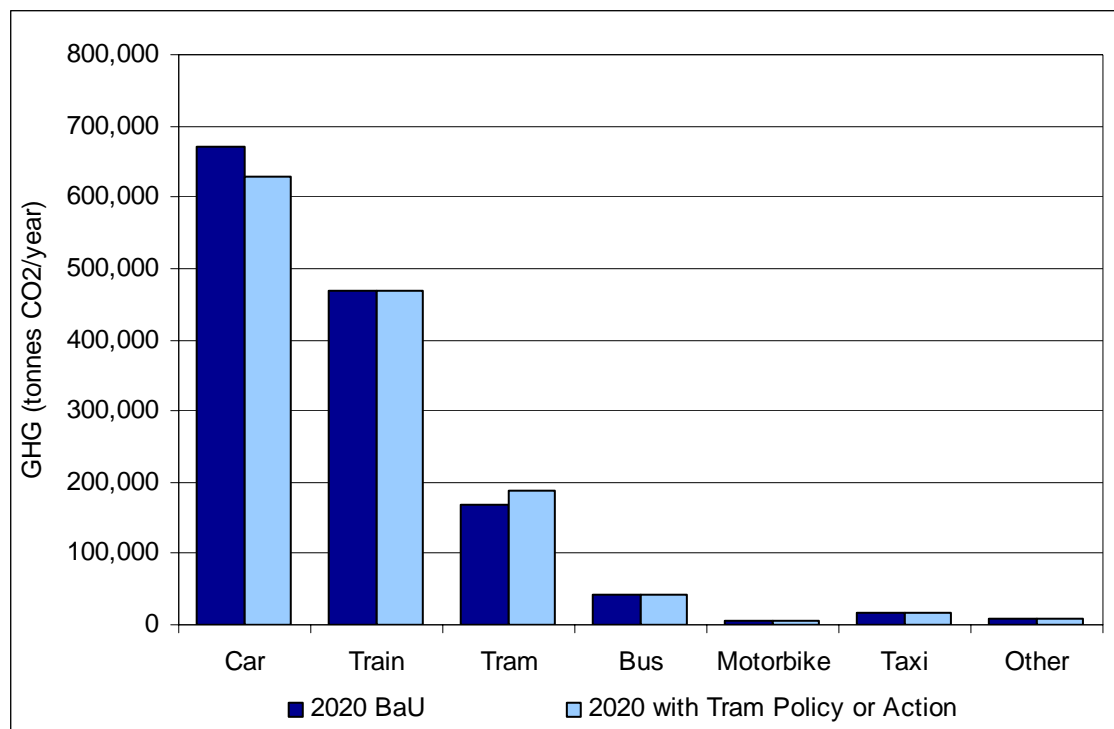


Figure 10: Tram - Emission impact by transport mode pa – 2020 BaU and 2020 with policy implemented

A full list of assumptions is detailed in Appendix B and the accompanying model. The basic assumptions utilised for the above calculations are as follows:

- An average number of 6 services per hour per route in the AM peak.
- Length of the AM peak period is 2.5 hours.
- An average of 8 services per hour per route in the AM peak following tram improvements.

5.2.4 Bus

Action

- *With the Department of Infrastructure, reorganise bus routes in the CBD and providing dedicated road space and priority on key routes, particularly Lonsdale and Queen Streets. 2006-2008⁸*

The calculated bus scenario was identified as an *Action* in the City of Melbourne Transport Strategy. Key features of the analysis include

- If implemented by 2020, the action would result in total transport emissions being **479 tonnes CO2e pa less** when compared with the 2020 BaU scenario.
- Such an action would **increase bus emissions marginally (230 tonnes CO2e pa)** when compared with a 2020 BaU scenario; a bus emissions increase of 1%.
- Car emissions would be **678 tonnes CO2e pa less** if the action was completed when compared with a 2020 BaU scenario.
- Train and tram emissions would also be marginally higher in comparison with the 2020 BaU scenario.

⁸ City of Melbourne Moving People and Freight – Transport Strategy 2006-2020, 2006, p.18

The associated *Cumulative* and *Transport Mode Figures* only demonstrate a small emissions impact and have been omitted, but are available in the model.

Mode	Annual Emissions (tonnes CO ₂ e/year)							
	2001		2006		2020 BaU		2020 with Bus Policy or Action	
Car	460,306	42.9%	424,154	39.5%	671,622	48.6%	670,944	48.5%
Train	405,235	37.8%	433,889	40.4%	467,944	33.8%	467,944	33.8%
Tram	140,829	13.1%	149,033	13.9%	168,952	12.2%	168,938	12.2%
Bus	39,069	3.6%	40,652	3.8%	42,416	3.1%	42,646	3.1%
Motorbike	834	0.1%	2,894	0.3%	5,517	0.4%	5,517	0.4%
Taxi	14,487	1.4%	13,935	1.3%	17,207	1.2%	17,188	1.2%
Bicycle	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Walk	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Other	12,049	1.1%	8,363	0.8%	9,376	0.7%	9,376	0.7%
Total	1,072,809	100%	1,072,921	100%	1,383,034	100%	1,382,554	100%

Table 8: Bus - Emission impact by transport mode pa – 2001, 2006, 2020 BaU and 2020 with policy implemented

A full list of assumptions is detailed in Appendix B and the accompanying model. The basic assumptions utilised for the above calculations are as follows:

- A 10% increase in bus trips to Melbourne.
- A 10% increase in bus trips from Melbourne.
- No increase in visitor bus trips to or from Melbourne.

5.2.5 CBD Parking

Policy

- *Council planning policy will continue to discourage long-term parking, particularly commuter parking, in the Central City and in all other activity centres.*⁹

The impact of this policy would have a relatively significant impact on the City of Melbourne's transport-related emissions; reducing total emissions by encouraging a sizeable mode shift from cars to various forms of public transport. Key features of the analysis include

- If implemented by 2020, it is calculated that the policy would result in total transport emissions being **36,060 tonnes CO₂e pa less** than when compared with the 2020 BaU scenario. This represents potential mitigation impact of 2.6%.
- Emissions specifically associated with cars would be **47,827 tonnes CO₂e pa less** than when compared with a 2020 BaU scenario; 7% less than the 2020 BaU scenario.
- The proportion of car emissions relative to the total transport emissions associated with the City of Melbourne will be comparatively less than with the 2020 BaU scenario - 46.3% versus 48.6%.

⁹ City of Melbourne *Moving People and Freight – Transport Strategy 2006-2020*, 2006, p.24

- **Combined public transport emissions (train, bus and tram) would be 9,621 tonnes CO₂e pa more** than the 2020 BaU scenario representing a greater relative proportion of total transport emissions (51.1% v 49.1%).
- The public transport emissions calculations comprise
 - Train emissions calculated to be **6,923 tonnes CO₂e pa more** than the 2020 BaU scenario.
 - Bus emissions calculated to be **1,648 tonnes CO₂e pa more** than the 2020 BaU scenario.
 - Tram emissions calculated to be **1,049 tonnes CO₂e pa more** than the 2020 BaU scenario.

Mode	Annual Emissions (tonnes CO ₂ e/year)							
	2001		2006		2020 BaU		2020 with Parking Policy or Action	
Car	460,306	42.9%	424,154	39.5%	671,622	48.6%	623,795	46.3%
Train	405,235	37.8%	433,889	40.4%	467,944	33.8%	474,868	35.3%
Tram	140,829	13.1%	149,033	13.9%	168,952	12.2%	170,600	12.7%
Bus	39,069	3.6%	40,652	3.8%	42,416	3.1%	43,465	3.2%
Motorbike	834	0.1%	2,894	0.3%	5,517	0.4%	6,506	0.5%
Taxi	14,487	1.4%	13,935	1.3%	17,207	1.2%	18,364	1.4%
Bicycle	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Walk	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Other	12,049	1.1%	8,363	0.8%	9,376	0.7%	9,375	0.7%
Total	1,072,809	100%	1,072,921	100%	1,383,034	100%	1,346,973	100%

Table 9: CBD Parking - Emission impact by transport mode pa – 2001, 2006, 2020 BaU and 2020 with policy implemented

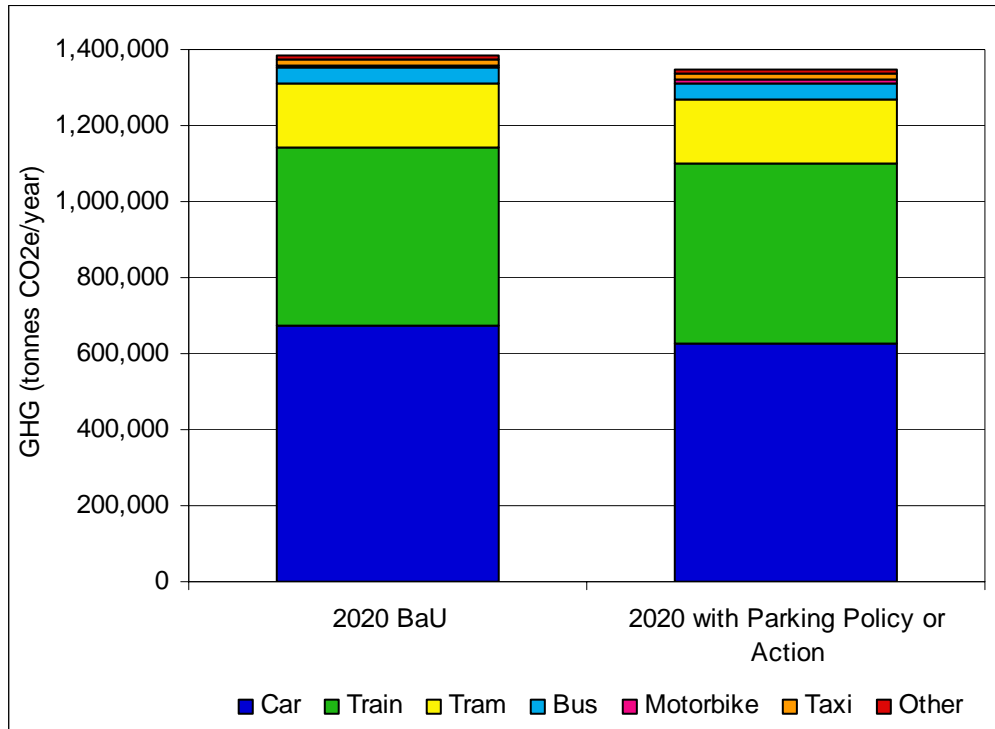


Figure 11: CBD Parking – Cumulative emission impact by transport mode pa – 2020 BaU and 2020 with policy implemented

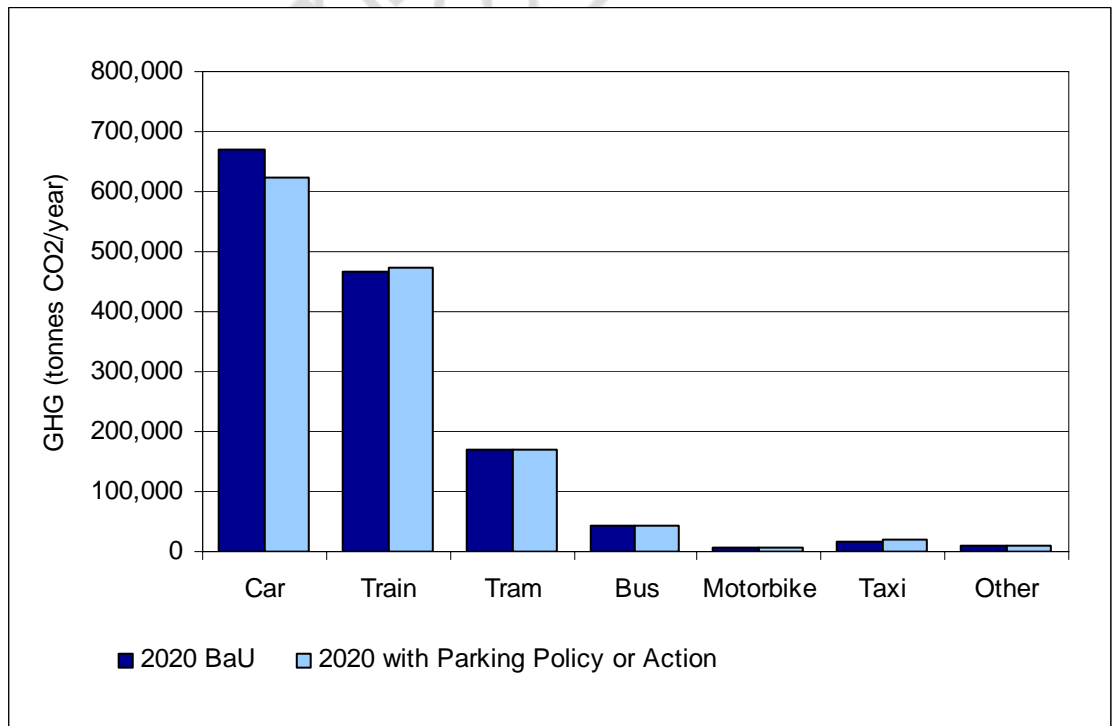


Figure 12: CBD Parking - Emission impact by transport mode pa – 2020 BaU and 2020 with policy implemented

A full list of assumptions is detailed in Appendix B and the accompanying model. The basic assumptions utilised for the above calculations are as follows:

- A 20% decrease in Car Trips to Melbourne.
- A 10% decrease in Car Trips from Melbourne.
- A 5% decrease in visitor car trips to and from Melbourne.

5.2.6 Pedestrians

Policies

- *In conjunction with adjoining municipalities, reinforce the City of Melbourne's key regional walking routes through appropriate design treatment, signage, surface treatment, and road management.*
- *Review and reduce pedestrian signal wait times on key pedestrian routes, in the CBD, and on regional walking links and pedestrian priority areas.¹⁰*

The emissions impact of this pedestrian-related policy is relatively insignificant, primarily because those who would be encouraged to walk by the policy would mostly be drawn from those living in close proximity to the city and most likely currently utilising public transport or cycling. The secondary impact of the policy is that increased public transport capacity would potentially encourage a mode shift from car journeys.

The associated *Cumulative* and *Transport Mode Figures* only demonstrate a small emissions impact and have been omitted, but are available in the model.

Mode	Annual Emissions (tonnes CO2e/year)							
	2001		2006		2020 BaU		2020 with Pedestrian Policy or Action	
Car	460,306	42.9%	424,154	39.5%	671,622	48.6%	671,597	48.6%
Train	405,235	37.8%	433,889	40.4%	467,944	33.8%	467,924	33.8%
Tram	140,829	13.1%	149,033	13.9%	168,952	12.2%	168,898	12.2%
Bus	39,069	3.6%	40,652	3.8%	42,416	3.1%	42,370	3.1%
Motorbike	834	0.1%	2,894	0.3%	5,517	0.4%	5,517	0.4%
Taxi	14,487	1.4%	13,935	1.3%	17,207	1.2%	17,146	1.2%
Bicycle	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Walk	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Other	12,049	1.1%	8,363	0.8%	9,376	0.7%	9,363	0.7%
Total	1,072,809	100%	1,072,921	100%	1,383,034	100%	1,382,815	100%

Table 10: Pedestrians - Emission impact by transport mode pa – 2001, 2006, 2020 BaU and 2020 with policy implemented

A full list of assumptions is detailed in Appendix B and the accompanying model. The basic assumptions utilised for the above calculations are as follows:

- A 5% increase in pedestrian trips to Melbourne.
- A 5% increase in pedestrian trips from Melbourne.

¹⁰ City of Melbourne Moving People and Freight – Transport Strategy 2006-2020, 2006, p.33

5.2.7 Speed Limits

Policy

- o Council will apply a 'blanket' 40 km/h speed limit in the CBD (including the Queen Victoria Markets) and local areas to help reduce pedestrian injuries, improve the walking and cycling environment, and simplify speed zones for motorists.

Similar to the emissions impacts associated with the pedestrian initiatives, reductions in speed limits in the City of Melbourne are calculated to have a very small impact on total transport emissions associated with the City of Melbourne.

As such, the associated *Cumulative* and *Transport Mode Figures* do not demonstrate any emissions impacts and have been omitted from this report, but are available in the model.

Mode	Annual Emissions (tonnes CO ₂ e/year)							
	2001		2006		2020 BaU		2020 with Speed Limit Policy or Action	
Car	460,306	42.9%	424,154	39.5%	671,622	48.6%	671,618	48.6%
Train	405,235	37.8%	433,889	40.4%	467,944	33.8%	467,900	33.8%
Tram	140,829	13.1%	149,033	13.9%	168,952	12.2%	168,890	12.2%
Bus	39,069	3.6%	40,652	3.8%	42,416	3.1%	42,378	3.1%
Motorbike	834	0.1%	2,894	0.3%	5,517	0.4%	5,517	0.4%
Taxi	14,487	1.4%	13,935	1.3%	17,207	1.2%	17,184	1.2%
Bicycle	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Walk	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Other	12,049	1.1%	8,363	0.8%	9,376	0.7%	9,376	0.7%
Total	1,072,809	100%	1,072,921	100%	1,383,034	100%	1,382,862	100%

Table 11: Speed Limit - Emission impact by transport mode pa – 2001, 2006, 2020 BaU and 2020 with policy implemented

A full list of assumptions is detailed in Appendix B and the accompanying model. The basic assumptions utilised for the above calculations are as follows:

- o A 5% increase in bicycle trips to Melbourne.
- o A 2% increase in bicycle trips from Melbourne.
- o A 3% increase in visitor bicycle trips to and from Melbourne.

5.2.8 Cycling

Policies

- Council planning policy will require the provision of secure, undercover bike storage, lockers and showers in offices, institutions and major developments.
- Council will, in association with neighbouring municipalities, complete the regional cycle network.

Action

- Investigate the viability of a 'Cycling Superstation' and alternatives which would provide accessible end-of-trip facilities for all CBD cyclists. 2006-2007

As indicated in the following tables and figures, the cycling-related policies and actions are calculated to have a minimal impact on transport emissions when compared to 2020 BaU.

As such, the associated *Cumulative* and *Transport Mode Figures* do not demonstrate any emissions impacts and have been omitted from this report, but are available in the model.

Mode	Annual Emissions (tonnes CO ₂ e/year)							
	2001		2006		2020 BaU		2020 with Cycling Policy or Action	
Car	460,306	42.9%	424,154	39.5%	671,622	48.6%	669,150	48.5%
Train	405,235	37.8%	433,889	40.4%	467,944	33.8%	467,771	33.9%
Tram	140,829	13.1%	149,033	13.9%	168,952	12.2%	168,729	12.2%
Bus	39,069	3.6%	40,652	3.8%	42,416	3.1%	42,263	3.1%
Motorbike	834	0.1%	2,894	0.3%	5,517	0.4%	5,519	0.4%
Taxi	14,487	1.4%	13,935	1.3%	17,207	1.2%	17,051	1.2%
Bicycle	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Walk	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Other	12,049	1.1%	8,363	0.8%	9,376	0.7%	9,376	0.7%
Total	1,072,809	100%	1,072,921	100%	1,383,034	100%	1,379,859	100%

Table 12: Cycling - Emission impact by transport mode pa – 2001, 2006, 2020 BaU and 2020 with policy implemented

A full list of assumptions is detailed in Appendix B and the accompanying model. The basic assumptions utilised for the above calculations are as follows:

- A 25% increase in JTW bicycle trips to Melbourne.
- A 25% increase in JTW bicycle trips from Melbourne.
- A 25% increase in visitor bicycle trips to and from Melbourne.

5.2.9 Car Sharing

Policies

- Council will support car sharing as a viable alternative to car ownership in the City of Melbourne.
- Council will provide, wherever appropriate, on-street spaces, special permits or access to off-street spaces for car sharing activities throughout the City of Melbourne.

The policy of car sharing also has a minimal impact on emissions when compared with the 2020 BaU. There is marginal total emissions **reduction of 75 tonnes CO₂e pa** when compared with the 2020 BaU.

As such, the associated *Cumulative* and *Transport Mode Figures* do not demonstrate any emissions impacts and have been omitted from this report, but are available in the model.

Mode	Annual Emissions (tonnes CO ₂ e/year)							
	2001		2006		2020 BaU		2020 with Car Sharing Policy or Action	
Car	460,306	42.9%	424,154	39.5%	671,622	48.6%	671,518	48.6%
Train	405,235	37.8%	433,889	40.4%	467,944	33.8%	467,951	33.8%
Tram	140,829	13.1%	149,033	13.9%	168,952	12.2%	168,965	12.2%
Bus	39,069	3.6%	40,652	3.8%	42,416	3.1%	42,422	3.1%
Motorbike	834	0.1%	2,894	0.3%	5,517	0.4%	5,518	0.4%
Taxi	14,487	1.4%	13,935	1.3%	17,207	1.2%	17,208	1.2%
Bicycle	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Walk	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Other	12,049	1.1%	8,363	0.8%	9,376	0.7%	9,376	0.7%
Total	1,072,809	100%	1,072,921	100%	1,383,034	100%	1,382,959	100%

Table 13: Car Sharing - Emission impact by transport mode pa – 2001, 2006, 2020 BaU and 2020 with policy implemented

A full list of assumptions is detailed in Appendix B and the accompanying model. The basic assumptions utilised for the above calculations are as follows:

- A 5% decrease in JTW Car Trips within Melbourne.
- A 3% decrease in JTW Car Trips from Melbourne.

5.3 Cumulative Emission Impact

A summary of the cumulative emission calculations are as follows

- Transport-related emissions for the City of Melbourne would be **1,383,034 tonnes CO₂e pa** in 2020 presuming a business as usual scenario.
- If all the selected policies and actions were implemented by 2020, transport-related emissions would be reduced to **1,313,829 tonnes CO₂e pa**.
- This represents a **reduction in emissions of 5% or 69,205 tonnes CO₂e pa** by 2020 if the selected policy and action solutions are implemented.
- Emission reductions were derived from mode shifts from cars to public transport, particularly to trains and trams.

Emission changes for particular transport modes are as follows.

Cars

- With the implementation of the selected policies and actions, annual emissions from cars will be 15% or **104,414 tonnes CO2e pa less** than when compared to the 2020 BaU scenario.
- This represents a potential reduction of the relative share of total transport emissions from 48.6% in a 2020 BaU scenario, to 43.2% with policies and actions implemented.

Train

- With the implementation of the selected policies and actions, annual emissions from trains will be nearly 3% or **13,558 tonnes CO2e pa higher** than when compared to the 2020 BaU scenario.
- This represents a potential increase in the relative share of total transport emissions from 33.8% in a 2020 BaU scenario, to 36.6% with policies and actions implemented.

Tram

- With the implementation of the selected policies and actions, annual emissions from trams will be 11.4% or **19,272 tonnes CO2e pa higher** than when compared to the 2020 BaU scenario.
- This represents a potential increase in the relative share of total transport emissions from 12.2% in a 2020 BaU scenario, to 14.3% with policies and actions implemented.

The cumulative impact on emissions associated with other transport modes was minimal.

Mode	Annual Emissions (tonnes CO2e/year)							
	2001		2006		2020 BaU		2020 Implementing All Actions	
Car	460,306	42.9%	424,154	39.5%	671,622	48.6%	567,208	43.2%
Train	405,235	37.8%	433,889	40.4%	467,944	33.8%	481,502	36.6%
Tram	140,829	13.1%	149,033	13.9%	168,952	12.2%	188,224	14.3%
Bus	39,069	3.6%	40,652	3.8%	42,416	3.1%	42,877	3.3%
Motorbike	834	0.1%	2,894	0.3%	5,517	0.4%	6,515	0.5%
Taxi	14,487	1.4%	13,935	1.3%	17,207	1.2%	18,138	1.4%
Bicycle	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Walk	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Other	12,049	1.1%	8,363	0.8%	9,376	0.7%	9,364	0.7%
Total	1,072,809	100%	1,072,921	100%	1,383,034	100%	1,313,829	100%

Table 14: Emissions impact by transport mode pa – 2001, 2006, 2020 BaU and 2020 with all policies and actions implemented

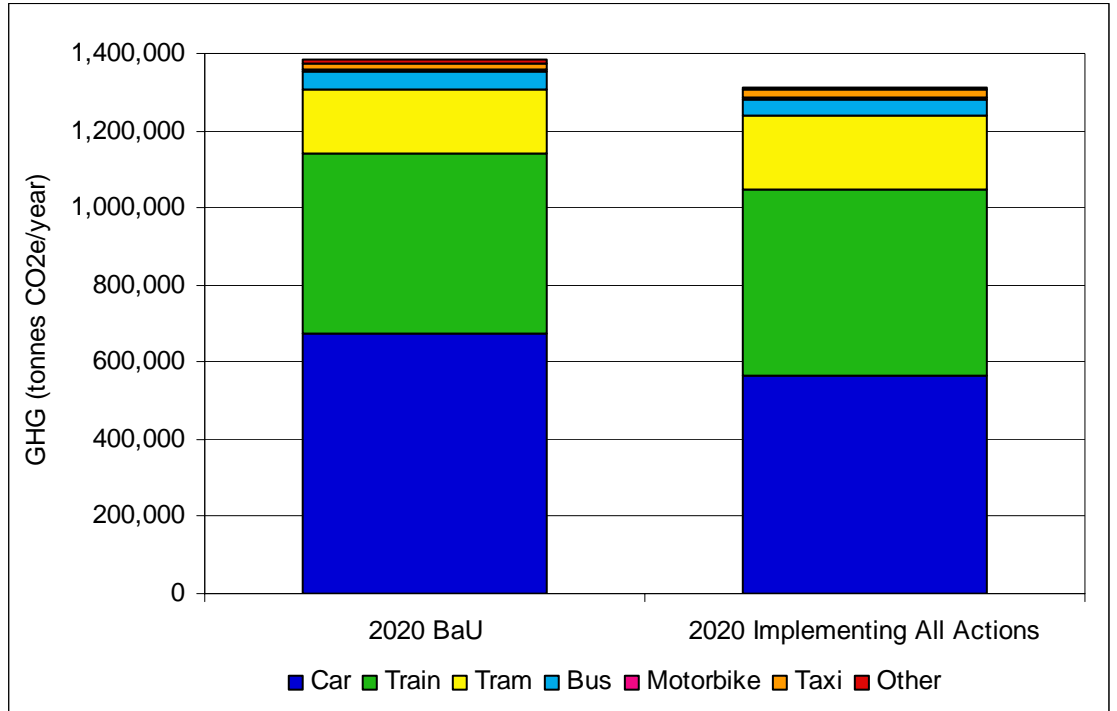


Figure 13: Cumulative emissions impact by transport mode pa – 2020 BaU and 2020 with all policies and action implemented

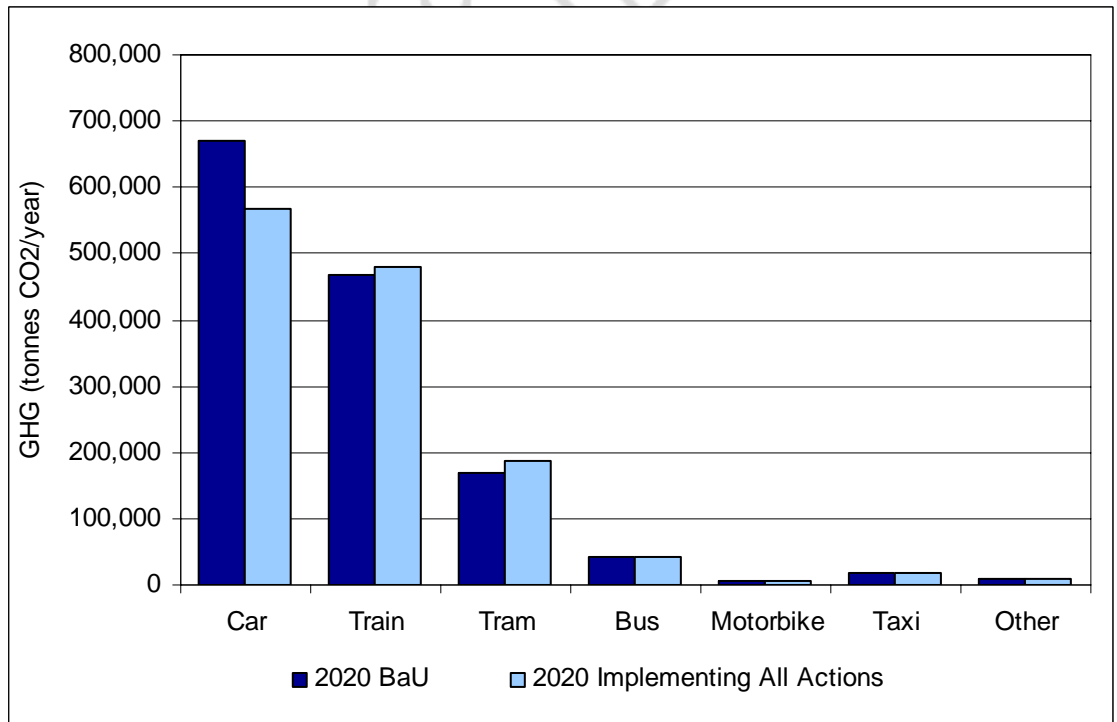


Figure 14: Emissions impact by transport mode pa – 2020 BaU and 2020 with all policies and actions implemented

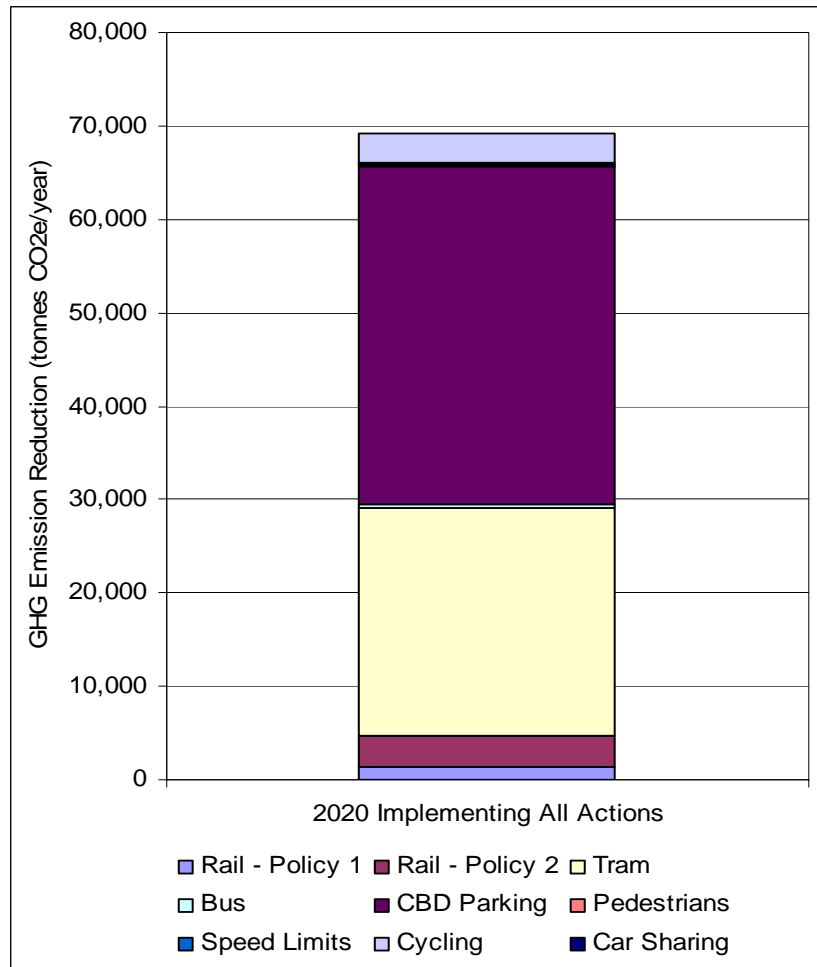


Figure 15: Emissions contribution by transport mode pa – 2020 with all policies and actions implemented

6 Select Scenarios

The City of Melbourne wished for an assessment of five individual emission reduction scenarios to be modelled and discussed to better understand how each may contribute to the overall reduction in transport emissions.

The scenarios selected are

- Restricting car access
- Greater numbers of cyclists
- Greater numbers of pedestrians
- Greater numbers of people using public transport
- Reallocation of road space

It should be noted that the scenarios overlap considerably with the assessment of individual policies and actions in Section 5, and the assessment of the three suggested Zero Net transport scenarios in section 7.

Each of the five transport scenarios was modelled with a particular set of assumptions based on the premise that each will be tested to the most extreme extent before 'forcing' other transport modes into 'negative' or unreasonable levels of use, such as negative levels of bus use. The calculations have been made with only a limited 'reasonableness' test and are provided as a basis for discussion within City of Melbourne which can be further enhanced by utilising the accompanying model which allows users to adjust the assumptions and parameters to test an infinite number of further scenarios.

6.1 Restricting Car Access

Car access restrictions in the City of Melbourne may be promoted by a series of initiatives such as

- Congestion charges
- Road space reallocation from cars to cyclists and pedestrians
- Traffic calming
- Reduced numbers and sizes of car parks
- Speed reductions
- Prioritisation of public transport, cycling and pedestrians, and
- Low emissions zones to restrict heavy emissions vehicles

Key findings of the scenario analysis include

- Total transport emissions reduced by **110,381 tonnes CO₂e pa** when compared to the 2020 BaU scenario; an 8% decrease
- Car emissions **reduced by 131,645 tonnes CO₂e pa** when compared to the 2020 BaU scenario; nearly a 20% decrease
- Train emissions **increased by 9,713 tonnes CO₂e pa** when compared to the 2020 BaU scenario; nearly a 2% increase
- Tram emissions **increased by 3,267 tonnes CO₂e pa** when compared to the 2020 BaU scenario; nearly a 2% increase
- Bus emissions **increased by 1,773 tonnes CO₂e pa** when compared to the 2020 BaU scenario; nearly a 4% increase
- Motorbike emissions **increased by 2,950 tonnes CO₂e pa** when compared to the 2020 BaU scenario; nearly a 53% increase, and

- Taxi emissions **increased by 3,562 tonnes CO2e pa** when compared to the 2020 BaU scenario; nearly a 21% increase

Mode	Annual Emissions (tonnes CO2e/year)							
	2001		2006		2020 BaU		2020 with restricted car access	
Car	460,306	42.9%	424,154	39.5%	671,622	48.6%	539,977	42.4%
Train	405,235	37.8%	433,889	40.4%	467,944	33.8%	477,658	37.5%
Tram	140,829	13.1%	149,033	13.9%	168,952	12.2%	172,218	13.5%
Bus	39,069	3.6%	40,652	3.8%	42,416	3.1%	44,189	3.5%
Motorbike	834	0.1%	2,894	0.3%	5,517	0.4%	8,467	0.7%
Taxi	14,487	1.4%	13,935	1.3%	17,207	1.2%	20,769	1.6%
Bicycle	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Walk	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Other	12,049	1.1%	8,363	0.8%	9,376	0.7%	9,375	0.7%
Total	1,072,809	100%	1,072,921	100%	1,383,034	100%	1,272,653	100%

Table 15: Restricted Car Access – Emission impact by transport mode pa – 2001, 2006, BaU 2020 and 2020 with restricted car access

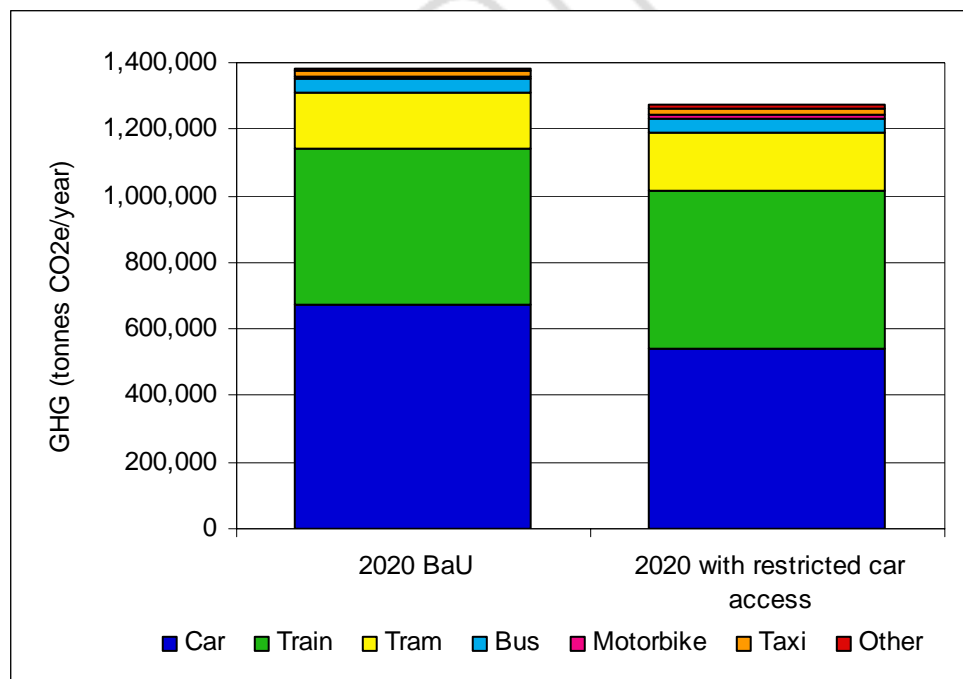


Figure 16: Restricted Car Access – Cumulative emission impact by transport mode pa – 2020 BaU and 2020 with restricted car access

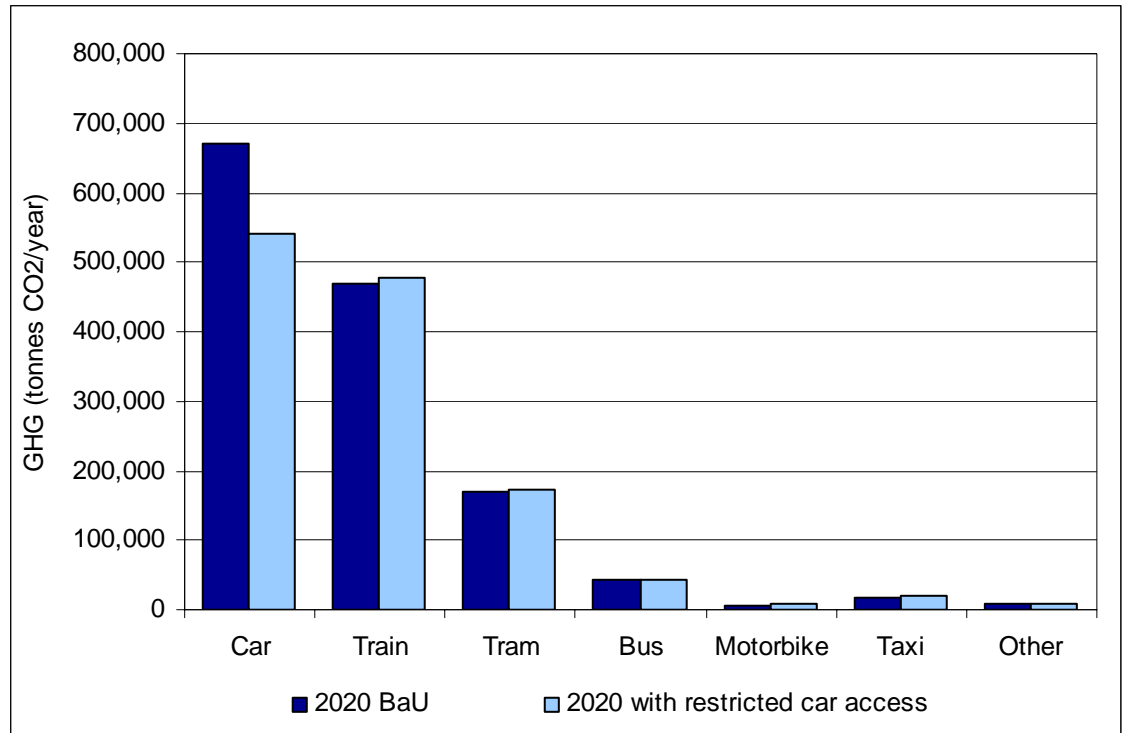


Figure 17: Restricted Car Access - Emission impact by transport mode pa – 2020 BaU and 2020 with restricted car access

A full list of assumptions is detailed in Appendix X and the accompanying model. The basic assumption for the above calculation is that all types of car trips have been reduced by 20% as car access is restricted.

6.2 Greater Number of Cyclists

Similar to the findings of the cycling assessment in section 5, a greater number of cyclists do not provide a significant reduction in total emissions, or emissions by individual transport mode, even with a 100+% increase in the number of bicycle journeys. Total emissions and car emissions are **reduced by 4,509 tonnes CO2e pa and 3,384 tonnes CO2e pa** respectively when compared to the 2020 BaU scenario, but other transport modes are barely impacted.

The minimal impact means that the associated *Cumulative* and *Transport Mode Figures* do not demonstrate any emissions impacts and have been omitted from this report, but are available in the model.

Mode	Annual Emissions (tonnes CO ₂ e/year)							
	2001		2006		2020 BaU		2020 with a greater number of cyclists	
Car	460,306	42.9%	424,154	39.5%	671,622	48.6%	668,238	48.5%
Train	405,235	37.8%	433,889	40.4%	467,944	33.8%	467,155	33.9%
Tram	140,829	13.1%	149,033	13.9%	168,952	12.2%	169,089	12.3%
Bus	39,069	3.6%	40,652	3.8%	42,416	3.1%	42,181	3.1%
Motorbike	834	0.1%	2,894	0.3%	5,517	0.4%	5,517	0.4%
Taxi	14,487	1.4%	13,935	1.3%	17,207	1.2%	16,969	1.2%
Bicycle	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Walk	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Other	12,049	1.1%	8,363	0.8%	9,376	0.7%	9,376	0.7%
Total	1,072,809	100%	1,072,921	100%	1,383,034	100%	1,378,525	100%

Table 16: Greater Number of Cyclists - Emission impact by transport mode pa – 2001, 2006, BaU 2020 and 2020 with a greater number of cyclists

A full list of assumptions is detailed in Appendix B and the accompanying model. The basic assumptions utilised for the above calculations are that

- JTW bicycle trips to and from Melbourne increase by 100%.
- JTW bicycle trips to and from Melbourne on the weekend increase by 100%.
- Visitor bicycle trips to and from Melbourne increase by 50%.

6.3 Greater Number of Pedestrians

Similar to the findings of the pedestrian assessment in section 5, a greater number of pedestrians does not provide a significant reduction in total emissions, or emissions by individual transport mode.

- Total emissions are **reduced by 8,476 tonnes CO₂e pa** when compared to the 2020 BaU scenario; less than a 1% reduction
- Car emissions are **reduced by 4,831 tonnes CO₂e pa**
- Train emissions are **reduced by 1,383 tonnes CO₂e pa**, and
- Tram emissions are **reduced by 1,873 tonnes CO₂e pa**.

Other transport modes are barely impacted

The minimal impact means that the associated *Cumulative* and *Transport Mode Figures* do not demonstrate any emissions impacts and have been omitted from this report, but are available in the model.

Mode	Annual Emissions (tonnes CO ₂ e/year)							
	2001		2006		2020 BaU		2020 with a greater number of pedestrians	
Car	460,306	42.9%	424,154	39.5%	671,622	48.6%	666,791	48.5%
Train	405,235	37.8%	433,889	40.4%	467,944	33.8%	466,562	33.9%
Tram	140,829	13.1%	149,033	13.9%	168,952	12.2%	167,078	12.2%
Bus	39,069	3.6%	40,652	3.8%	42,416	3.1%	42,295	3.1%
Motorbike	834	0.1%	2,894	0.3%	5,517	0.4%	5,458	0.4%
Taxi	14,487	1.4%	13,935	1.3%	17,207	1.2%	17,207	1.3%
Bicycle	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Walk	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Other	12,049	1.1%	8,363	0.8%	9,376	0.7%	9,167	0.7%
Total	1,072,809	100%	1,072,921	100%	1,383,034	100%	1,374,558	100%

Figure 18: Greater Number of Pedestrians - Emission impact by transport mode pa – 2001, 2006, BaU 2020 and 2020 with a greater number of pedestrians

A full list of assumptions is detailed in Appendix B and the accompanying model. The basic assumptions utilised for the above calculations are that pedestrian trips to and from Melbourne increase 150%.

6.4 Greater Public Transport Utilisation

Greater public transport utilisation may be facilitated by a series of initiatives such as

- Ticket price restructuring
- Improved standard and frequency of services.

Key findings of the scenario analysis include

- Total transport emissions reduced by **120,460 tonnes CO₂e pa** when compared to the 2020 BaU scenario; a nearly 9% decrease
- Car emissions **reduced by 155,241 tonnes CO₂e pa** when compared to the 2020 BaU scenario; a 23% decrease
- Train emissions **increased by 28,169 tonnes CO₂e pa** when compared to the 2020 BaU scenario; a 6% increase
- Tram emissions **increased by 4,934 tonnes CO₂e pa** when compared to the 2020 BaU scenario; nearly a 3% increase, and
- Bus emissions **increased by 1,451 tonnes CO₂e pa** when compared to the 2020 BaU scenario; a 3.5% increase.

Other transport modes were not greatly impacted by the scenario.

Mode	Annual Emissions (tonnes CO2e/year)							
	2001		2006		2020 BaU		2020 with greater public transport utilisation	
Car	460,306	42.9%	424,154	39.5%	671,622	48.6%	516,381	40.9%
Train	405,235	37.8%	433,889	40.4%	467,944	33.8%	496,114	39.3%
Tram	140,829	13.1%	149,033	13.9%	168,952	12.2%	173,886	13.8%
Bus	39,069	3.6%	40,652	3.8%	42,416	3.1%	43,868	3.5%
Motorbike	834	0.1%	2,894	0.3%	5,517	0.4%	5,532	0.4%
Taxi	14,487	1.4%	13,935	1.3%	17,207	1.2%	17,424	1.4%
Bicycle	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Walk	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Other	12,049	1.1%	8,363	0.8%	9,376	0.7%	9,369	0.7%
Total	1,072,809	100%	1,072,921	100%	1,383,034	100%	1,262,573	100%

Table 17: Greater Public Transport Utilisation - Emission impact by transport mode pa – 2001, 2006, BaU 2020 and 2020 with a greater public transport utilisation

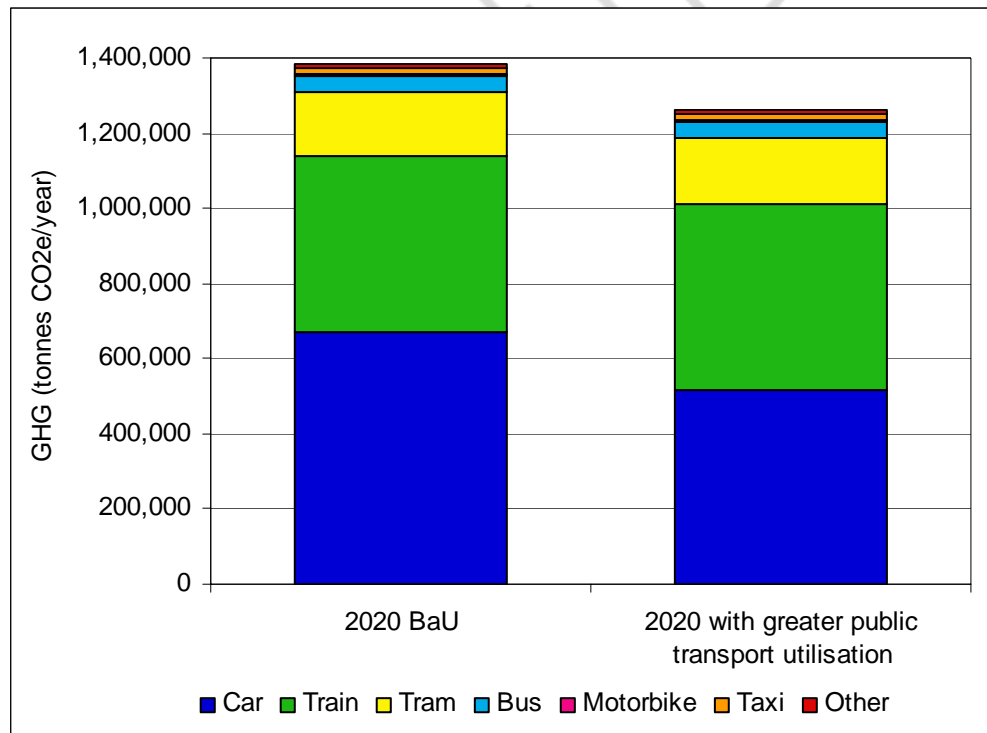


Figure 19: Greater Public Transport Utilisation – Cumulative emission impact by transport mode pa – 2020 BaU and 2020 with greater public transport utilisation

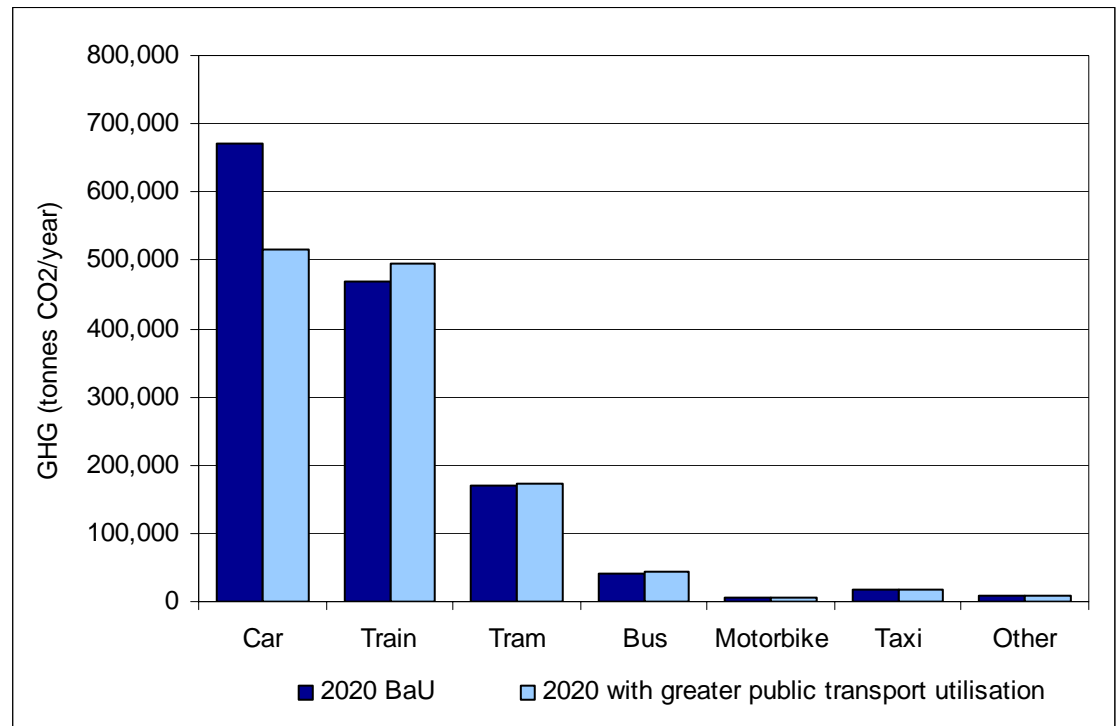


Figure 20: Greater Public Transport Utilisation - Emission impact by transport mode pa – 2020 BaU and 2020 with greater public transport utilisation

A full list of assumptions is detailed in Appendix B and the accompanying model. The basic assumptions utilised for the above calculations are

- 45% increase in JTW journeys by public transport to Melbourne.
- 85% increase in JTW journeys by public transport from Melbourne.
- 5% increase in weekend visitor public transport journeys to and from Melbourne.
- 5% increase in weekend visitor public transport journeys.
- 55% increase in weekend JTW public transport journeys.

6.5 Reallocation of Road Space

Road access reallocation in the City of Melbourne may be facilitated by a series of initiatives such as

- Methods to reallocate road space to cyclists and pedestrians
- Road narrowing and increase verge and median strip sizes, and
- Changes in road status such as the creation of pedestrian and cyclist thoroughfares

The associated emissions reductions are a result of the significant assumptions detailed below and in the assumptions. Key findings of the scenario analysis include

- Total transport emissions reduced by **507,761 tonnes CO2e pa** when compared to the 2020 BaU scenario; an 37% decrease
- Car emissions **reduced by 580,354 tonnes CO2e pa** when compared to the 2020 BaU scenario; nearly a 86% decrease
- Train emissions **increased by 54,104 tonnes CO2e pa** when compared to the 2020 BaU scenario; nearly a 11% increase
- Tram emissions **increased by 13,662 tonnes CO2e pa** when compared to the 2020 BaU scenario; nearly a 8% increase

- Bus emissions **increased by 3,264 tonnes CO₂e pa** when compared to the 2020 BaU scenario; nearly an 8% increase, and
- Taxi emissions **increased by 1,423 tonnes CO₂e pa** when compared to the 2020 BaU scenario; nearly a 8% increase

Mode	Annual Emissions (tonnes CO ₂ e/year)							
	2001		2006		2020 BaU		2020 with a reallocation of road space	
Car	460,306	42.9%	424,154	39.5%	671,622	48.6%	91,269	10.4%
Train	405,235	37.8%	433,889	40.4%	467,944	33.8%	522,049	59.6%
Tram	140,829	13.1%	149,033	13.9%	168,952	12.2%	182,613	20.9%
Bus	39,069	3.6%	40,652	3.8%	42,416	3.1%	45,680	5.2%
Motorbike	834	0.1%	2,894	0.3%	5,517	0.4%	5,629	0.6%
Taxi	14,487	1.4%	13,935	1.3%	17,207	1.2%	18,630	2.1%
Bicycle	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Walk	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Other	12,049	1.1%	8,363	0.8%	9,376	0.7%	9,404	1.1%
Total	1,072,809	100%	1,072,921	100%	1,383,034	100%	875,273	100%

Table 18: Reallocation of Road Space - Emission impact by transport mode pa – 2001, 2006, BaU 2020 and 2020 with reallocation of road space

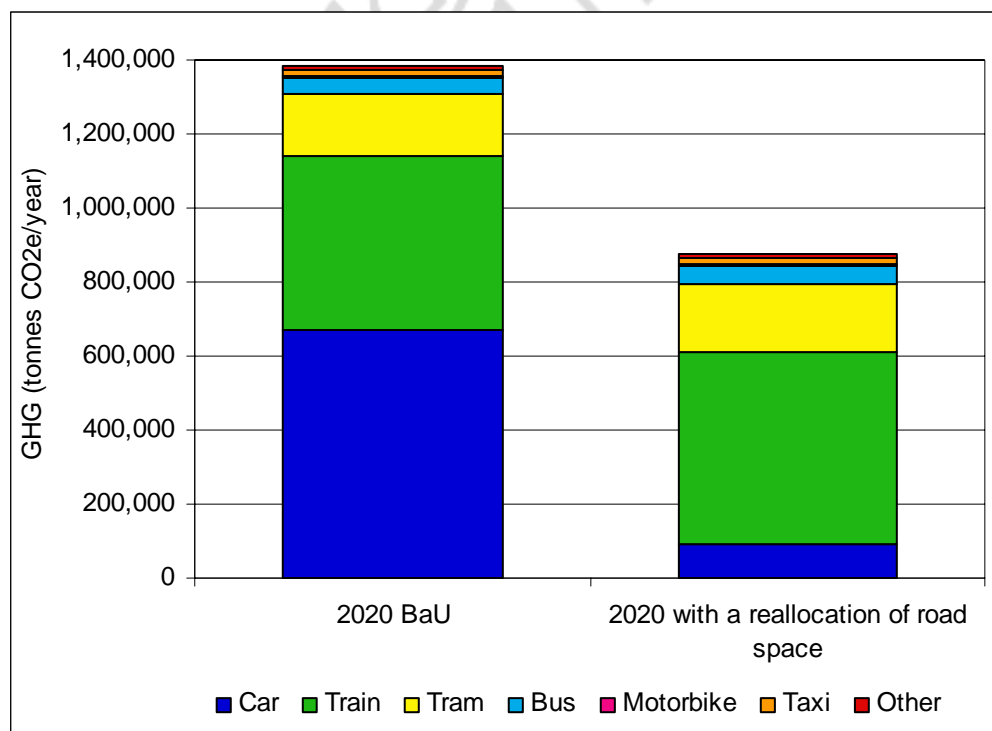


Figure 21: Reallocation of Road Space – Cumulative emission impact by transport mode pa – 2020 BaU and 2020 with reallocation of road space

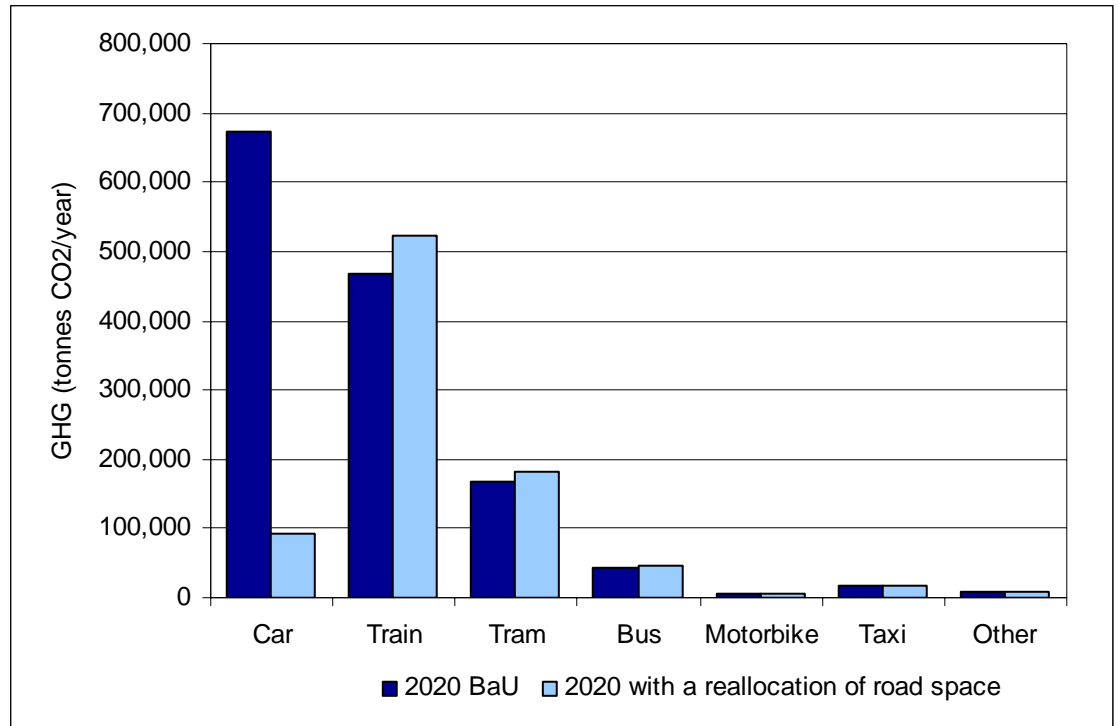


Figure 22: Reallocation of Road Space - Emission impact by transport mode pa – 2020 BaU and 2020 with reallocation of road space

A full list of assumptions is detailed in Appendix B and the accompanying model. The basic assumptions utilised for the above calculations are

- A 70% increase in JTW public transport, cycling and pedestrian trips to Melbourne.
- A 150% increase in JTW public transport, cycling and pedestrian trips from Melbourne.
- A 20% increase in visitor public transport, cycling and pedestrian trips to and from Melbourne.
- A 25% increase in weekend visitor public transport, cycling and pedestrian trips to and from Melbourne.
- A 75% increase in weekend JTW public transport, cycling and pedestrian trips to and from Melbourne.

7 Zero Net Transport Scenarios

7.1 Transport Scenarios

As detailed in the *Zero Net Emissions by 2020 - Strategy Update 2008*¹¹, solutions to manage Melbourne's transport emissions focus on short to medium term passenger transport measures that address the carbon intensity of the transport system and encourage modal shift. The three discussed solutions are:

- **Decarbonisation** of the public transport system through the introduction of low-carbon or clean source energy to the public transport network. The associated emission **reduction target is 20% of public transport emissions by 2020**
- Implementation of a **congestion charge** for vehicles entering the City of Melbourne with consideration of a tariff scale based on the emission levels. The charge is targeted to **reduce car emissions by 15% by 2012 maintained to 2020**.
- The introduction of an integrated **Cycle Melbourne scheme** combining bicycle hire, expanded end-of-trip facilities and a cycling network throughout the city. The scheme would aim to facilitate a **100% increase in cycling by 2015 to be maintained to 2020**.

The following sections detail the modelling results for each of the scenarios, before providing a cumulative analysis.

7.2 Decarbonising Public Transport

Melbourne's public transport system is predominantly supported by energy intensive electricity and petroleum based fuels. Beyond policy solutions which encourage transport mode shifts, the City of Melbourne has the opportunity to support the direct reduction of emissions by reducing the carbon intensity of public transport.

The *Zero Net Emissions by 2020 - Strategy Update 2008* solutions suggested to support the decarbonisation of public transport include¹²:

- The establishment of a gas-fired power plant specifically for public transport energy supply, and
- That by 2012, all public buses entering the City of Melbourne will be required to use low-carbon or clean fuel sources such as clean-source hydrogen, hybrid electric and Compressed Natural Gas (CNG).

Furthermore, to realise these solutions, the *Strategy Update* indicates that the City of Melbourne will need to consider:

- Site options for large-scale gas-fired power station(s)
- The potential to meet heat and cooling demand in the residential, commercial and manufacturing sectors by utilising the gas-fired plant
- Options to finance, build, own and operate the gas-fired power station including private-public partnerships
- Spatial and regulatory conditions required to support the establishment of refuelling centres for CNG and clean-sourced hydrogen to be used by public buses inside a 'congestion zone', and
- Potential partnership arrangements with neighbouring councils to initiate an investment strategy for base-load solar power in wider Victoria.

By partially decarbonising the public transport system (train, tram and bus) by 20%, total transport emissions for the City of Melbourne are calculated to **reduce by 135,862 tonnes**

¹¹ *Zero Net Emissions by 2020 - Strategy Update 2008*, p.34

¹² *Zero Net Emissions by 2020 - Strategy Update 2008*, p.35

CO₂e pa by 2020 when compared with a 2020 BaU scenario; a reduction in total emissions of 9.8%.

The 20% reduction is applied equally to all three types of public transport in the City of Melbourne and leads to a calculated emissions reduction of

When compared with the 2020 BaU scenario,

- Train emissions would be **93,589 tonnes CO₂e pa less**
- Tram emissions would be **33,790 tonnes CO₂e pa less**, and
- Bus emissions would be **8,483 tonnes CO₂e pa less**.

Mode	Annual Emissions (tonnes CO ₂ e/year)							
	2001		2006		2020 BaU		2020 with decarbonisation of public transport	
Car	460,306	42.9%	424,154	39.5%	671,622	48.6%	671,622	53.9%
Train	405,235	37.8%	433,889	40.4%	467,944	33.8%	374,356	30.0%
Tram	140,829	13.1%	149,033	13.9%	168,952	12.2%	135,161	10.8%
Bus	39,069	3.6%	40,652	3.8%	42,416	3.1%	33,933	2.7%
Motorbike	834	0.1%	2,894	0.3%	5,517	0.4%	5,517	0.4%
Taxi	14,487	1.4%	13,935	1.3%	17,207	1.2%	17,207	1.4%
Bicycle	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Walk	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Other	12,049	1.1%	8,363	0.8%	9,376	0.7%	9,376	0.8%
Total	1,072,809	100%	1,072,921	100%	1,383,034	100%	1,247,171	100%

Table 19: Decarbonising Public Transport - Emissions changes by transport mode pa – 2001, 2006, BaU 2020 and 2020 with the decarbonisation of public transport

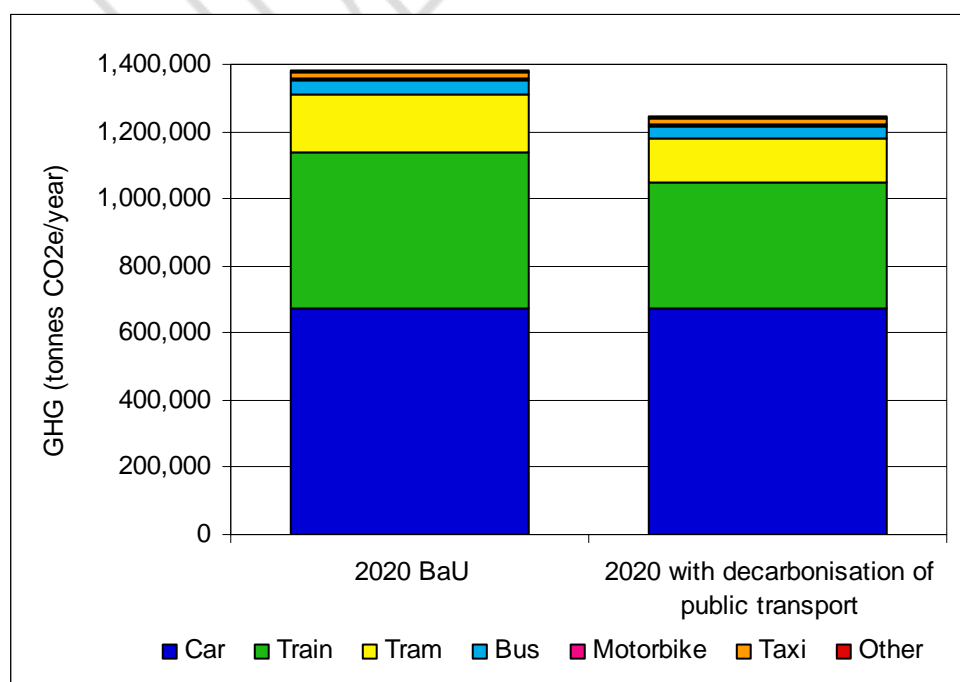


Figure 23: Decarbonising Public Transport – Cumulative emission impact by transport mode pa – 2020 BaU and 2020 with the decarbonisation of public transport

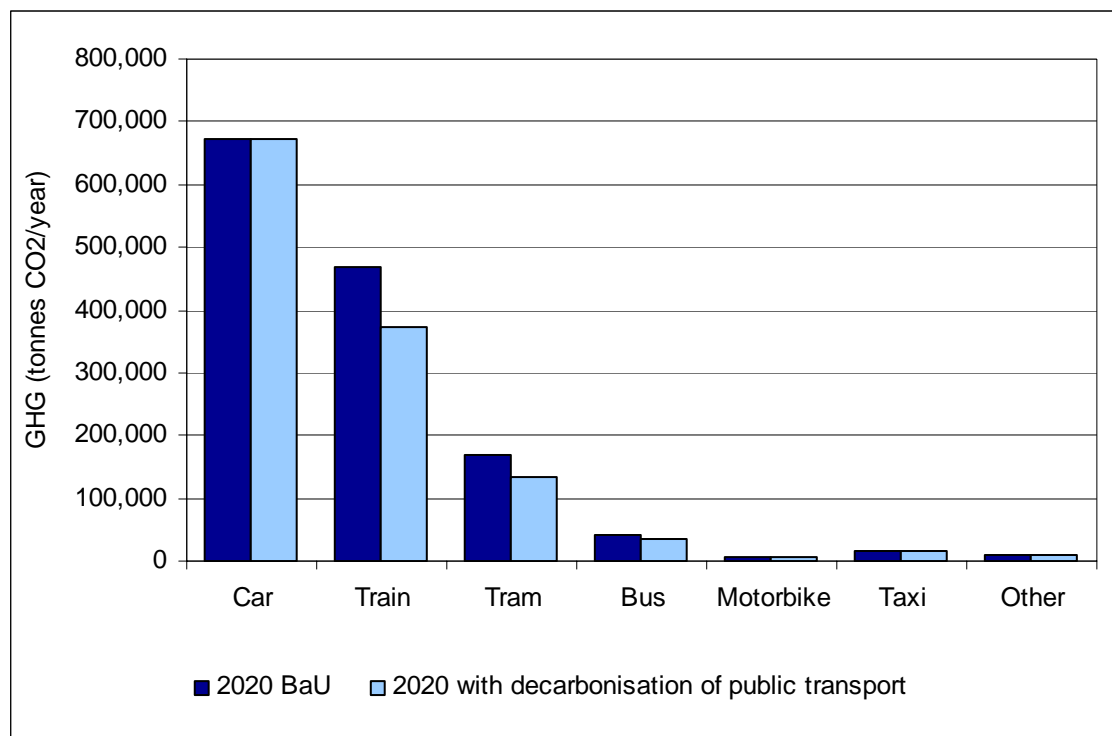


Figure 24: Decarbonising Public Transport - Emission Impact by Transport Mode pa – 2020 BaU and 2020 with the decarbonisation of public transport

A full list of calculations assumptions is detailed in Appendix B and the accompanying model. The basic assumption utilised for the above calculation is that public transport emissions are reduced by 20% by 2020.

7.3 Congestion Charge

The *Zero Net Emissions by 2020 - Strategy Update 2008*¹³ proposes that, after a consultation process and the construction of appropriate infrastructure, a congestion charge be levied on all emitting vehicles entering the City of Melbourne during working hours from Monday to Saturday. The charge will be structured to have a sliding scale for vehicles of different emission capacities – the greater the emission capacity, the greater the charge.

The Strategy Update indicates two possible mode impacts

- A reduction in car usage associated with the City of Melbourne, and
- A mode shift toward public transport of all types.

Consideration of a congestion charge will include

- Improvements in public transport to accommodate a projected mode shift
- Identification of a timeline for consultation
- Economic analysis of the impact of a congestion charge on City of Melbourne residents and businesses, and
- Feasibility studies into the spatial, temporal and technical options for implementation.

¹³ *Zero Net Emissions by 2020 - Strategy Update 2008*, p.35

By implementing a congestion charge and achieving an associated 15% reduction in car emissions total transport emissions for the City of Melbourne are calculated to **reduce by 110,381 tonnes CO2e pa** by 2020 when compared with a 2020 BaU scenario; a reduction in total emissions of nearly 8%.

Mode	Annual Emissions (tonnes CO2e/year)							
	2001		2006		2020 BaU		2020 with a congestion charge	
Car	460,306	42.9%	424,154	39.5%	671,622	48.6%	539,977	42.4%
Train	405,235	37.8%	433,889	40.4%	467,944	33.8%	477,658	37.5%
Tram	140,829	13.1%	149,033	13.9%	168,952	12.2%	172,218	13.5%
Bus	39,069	3.6%	40,652	3.8%	42,416	3.1%	44,189	3.5%
Motorbike	834	0.1%	2,894	0.3%	5,517	0.4%	8,467	0.7%
Taxi	14,487	1.4%	13,935	1.3%	17,207	1.2%	20,769	1.6%
Bicycle	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Walk	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Other	12,049	1.1%	8,363	0.8%	9,376	0.7%	9,375	0.7%
Total	1,072,809	100%	1,072,921	100%	1,383,034	100%	1,272,653	100%

Table 20: Congestion Charge - Emissions changes by transport mode pa – 2001, 2006, BaU 2020 and 2020 with the introduction of a congestion charge

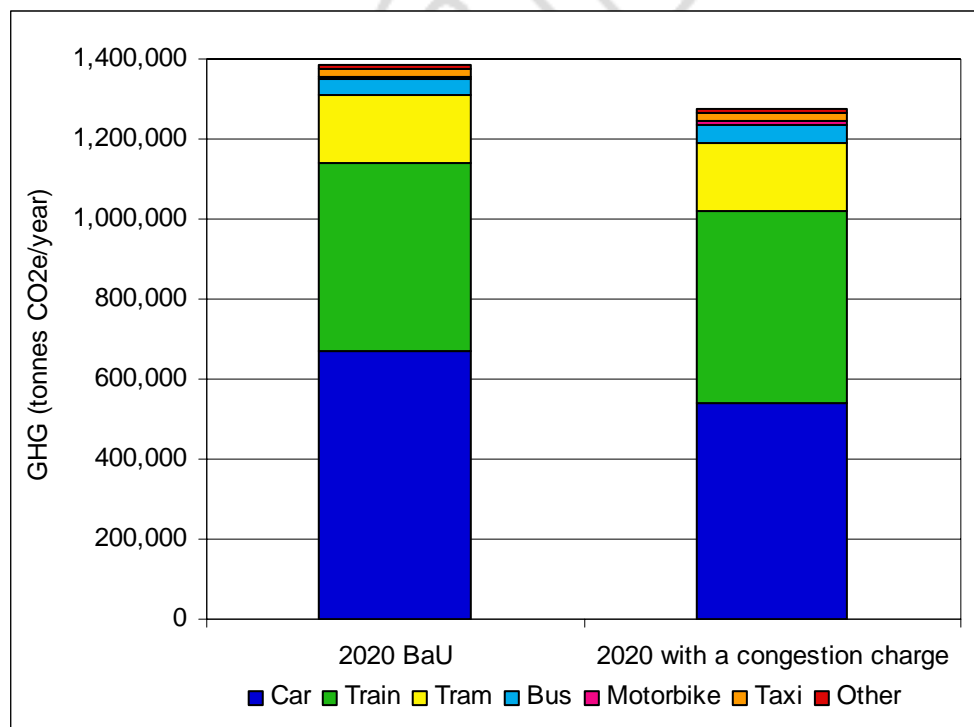


Figure 25: Congestion Charge – Cumulative emission impact by transport mode pa – 2020 BaU and 2020 with the introduction of a congestion charge

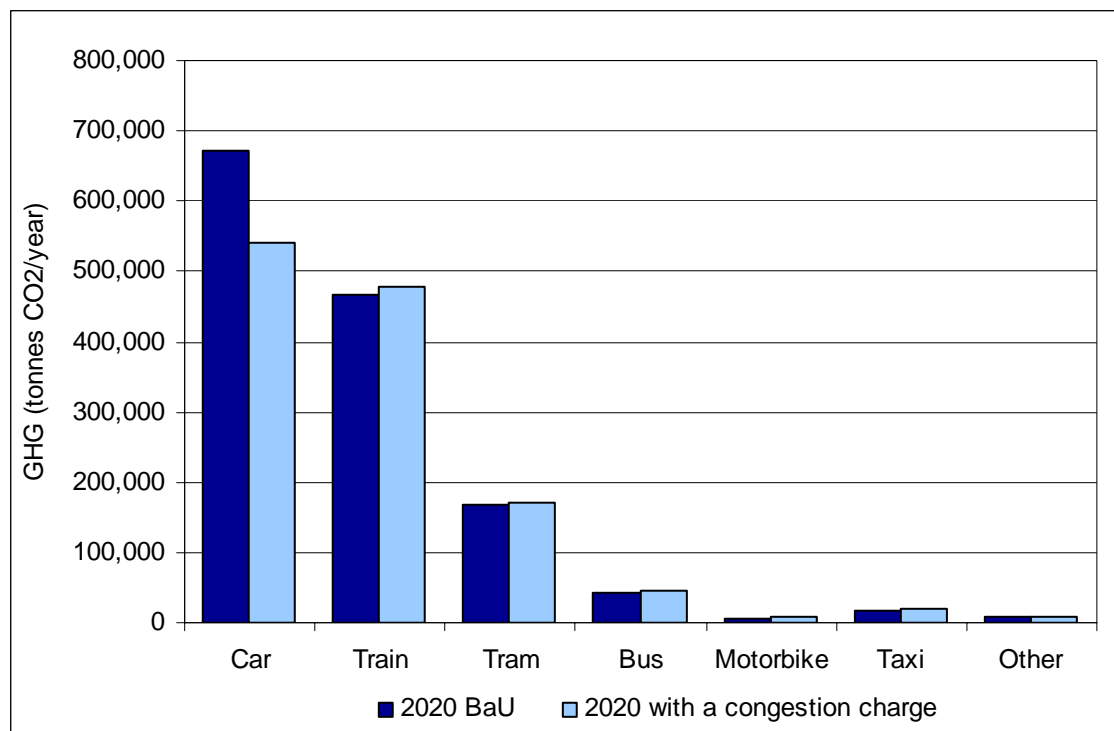


Figure 26: Congestion Charge - Emission impact by transport mode pa – 2020 BaU and 2020 with the introduction of a congestion charge

A full list of calculations assumptions is detailed in Appendix B and the accompanying model. The basic assumption utilised for the above calculation is that a congestion charge will facilitate a 15% reduction in car emissions

7.4 Cycle Melbourne

The *Zero Net Emissions by 2020 - Strategy Update 2008*¹⁴ proposes that developing and planned cycling—specific initiatives outlined in documents such as the Melbourne Transport Strategy be combined into a Cycle Melbourne scheme, and their implementation accelerated.

The Strategy Update highlights several particular features including:

- Integrated bicycle hire schemes supported by appropriate technology
- The expansion and improvement of existing bicycle networks, and
- Improved end-of-trip facilities facilitated by statutory requirements for city buildings and the creation of ‘super bicycle stations’.

The required investment shall be directly financed from revenue generated from the aforementioned congestion charge.

By implementing a scheme which increases cycling in the City of Melbourne by 100% by 2015, total transport emissions are calculated to only **reduce by a small amount of 4,509 tonnes CO2e pa** by 2020 when compared with a 2020 BaU scenario. This reduction is primarily derived from a mode shift away from cars which contributes a reduction of **3,384 tonnes CO2e pa**. Emission reductions dues to a mode shift away from trains is **789 tonnes CO2e pa**, and from buses **236 tonnes CO2e pa**

As the calculated emission reductions are so small, the associated *Cumulative* and *Transport Mode Figures* do not demonstrate any emissions impacts and have been omitted from this report, but are available in the model.

¹⁴ *Zero Net Emissions by 2020 - Strategy Update 2008*, p.36

Mode	Annual Emissions (tonnes CO ₂ e/year)							
	2001		2006		2020 BaU		2020 with a <i>Cycle Melbourne</i> strategy	
Car	460,306	42.9%	424,154	39.5%	671,622	48.6%	668,238	48.5%
Train	405,235	37.8%	433,889	40.4%	467,944	33.8%	467,155	33.9%
Tram	140,829	13.1%	149,033	13.9%	168,952	12.2%	169,089	12.3%
Bus	39,069	3.6%	40,652	3.8%	42,416	3.1%	42,181	3.1%
Motorbike	834	0.1%	2,894	0.3%	5,517	0.4%	5,517	0.4%
Taxi	14,487	1.4%	13,935	1.3%	17,207	1.2%	16,969	1.2%
Bicycle	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Walk	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Other	12,049	1.1%	8,363	0.8%	9,376	0.7%	9,376	0.7%
Total	1,072,809	100%	1,072,921	100%	1,383,034	100%	1,378,525	100%

Table 21: Cycle Melbourne Strategy - Emissions changes by transport mode pa – 2001, 2006, BaU 2020 and 2020 with a Cycle Melbourne strategy

A full list of assumptions is detailed in Appendix B and the accompanying model. The primary assumption that bicycle use will increase by 100% focuses upon JTW participants however, to add depth to the assessment, the calculations also incorporate a 50% increase in bicycle use by visitors to the City of Melbourne over the same period.

7.5 Cumulative

The impact associated with the implementation of all three Zero Net Update scenarios is a transport emission **reduction of 250,752 tonnes CO₂e pa** when compared with the 2020 BaU scenario; an 18% decrease .

Key findings of the cumulative analysis

- Decarbonisation of the public transport system (train, tram and bus) by 20% is calculated to **reduce total emissions by 135,862 tonnes CO₂e pa** by 2020 when compared with a 2020 BaU scenario. This represents **54% of the cumulative emissions reduction** if all three transport initiatives are implemented.
- A congestion charge which facilitates a 15% reduction in car emissions is calculated to **reduce total emissions by 110,381 tonnes CO₂e pa** by 2020 when compared with a 2020 BaU scenario. This represents **44% of the cumulative emissions reduction** if all three transport initiatives are implemented.
- Implementing a scheme which increases cycling in the City of Melbourne by 100% by 2015, is calculated to **reduce total emissions by 4,509 tonnes CO₂e pa** by 2020 when compared with a 2020 BaU scenario. This represents only **1.8% of the cumulative emissions reduction** if all three transport initiatives are implemented.

A breakdown of the cumulative emissions impact by transport mode follows.

Cars

- Total car emissions are **reduced by 135,029 tonnes CO₂e pa**, representing a **20%** reduction when compared to the 2020 BaU scenario.

Train

- Total train emissions are **reduced by 84,665 tonnes CO₂e pa**, representing an **18%** reduction when compared to the 2020 BaU scenario.

Tram

- Total tram emissions are **reduced by 30,386 tonnes CO₂e pa**, representing an **18%** reduction when compared to the 2020 BaU scenario.

Bus

- Total bus emissions are **reduced by 6,946 tonnes CO₂e pa**, representing a **16%** reduction when compared to the 2020 BaU scenario.

Motorbike

- Total motorbike emissions are calculated to **increase by 2,950 tonnes CO₂e pa**, representing a **16%** increase when compared to the 2020 BaU scenario.

Taxi

- Similarly, total taxi emissions are calculated to **increase by 3,324 tonnes CO₂e pa**, representing a **19%** increase when compared to the 2020 BaU scenario.

Mode	Annual Emissions (tonnes CO ₂ e/year)							
	2001		2006		2020 BaU		2020 with all Zero Net Transport Scenarios implemented	
Car	460,306	42.9%	424,154	39.5%	671,622	48.6%	536,593	47.4%
Train	405,235	37.8%	433,889	40.4%	467,944	33.8%	383,280	33.9%
Tram	140,829	13.1%	149,033	13.9%	168,952	12.2%	138,566	12.2%
Bus	39,069	3.6%	40,652	3.8%	42,416	3.1%	35,470	3.1%
Motorbike	834	0.1%	2,894	0.3%	5,517	0.4%	8,467	0.7%
Taxi	14,487	1.4%	13,935	1.3%	17,207	1.2%	20,531	1.8%
Bicycle	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Walk	0	0.0%	0	0.0%	0	0.0%	0	0.0%
Other	12,049	1.1%	8,363	0.8%	9,376	0.7%	9,375	0.8%
Total	1,072,809	100%	1,072,921	100%	1,383,034	100%	1,132,282	100%

Table 22: All Zero Net Scenarios Implemented - Emissions changes by transport mode pa – 2001, 2006, BaU 2020 and 2020 with all Zero Net transport scenarios implemented

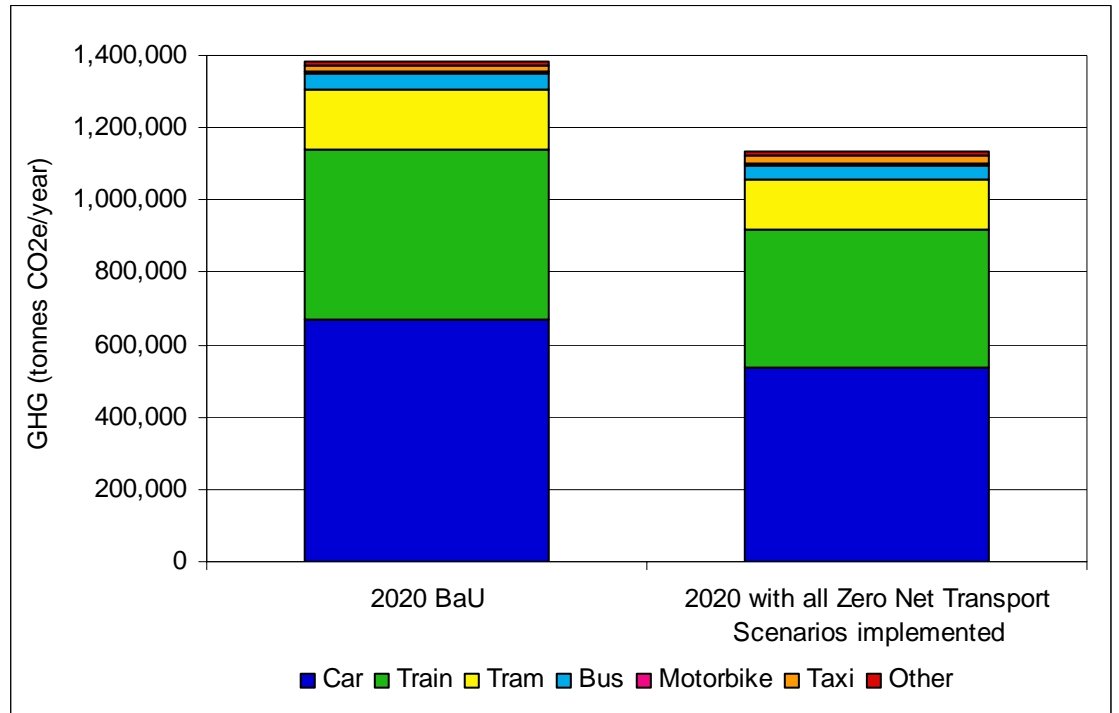


Figure 27: All Zero Net Scenarios Implemented – Cumulative emission impact by transport mode pa – 2020 BaU and 2020 with all Zero Net transport scenarios implemented

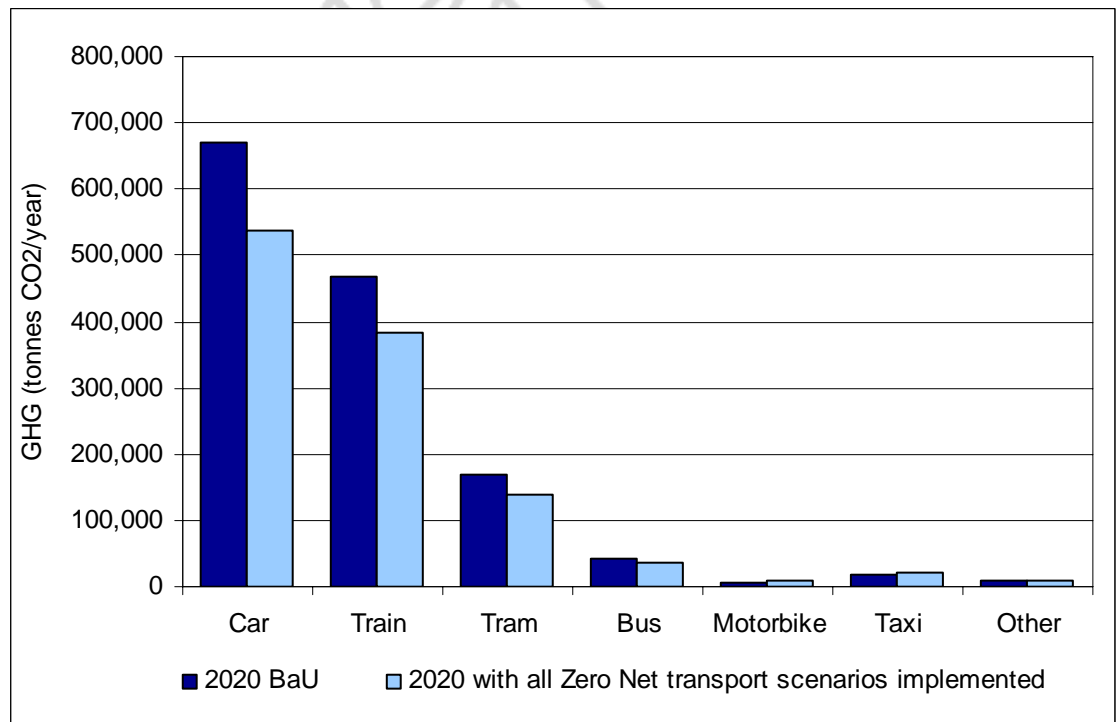


Figure 28: All Zero Net Scenarios Implemented - Emission impact by transport mode pa – 2020 BaU and 2020 with all Zero Net transport scenarios implemented

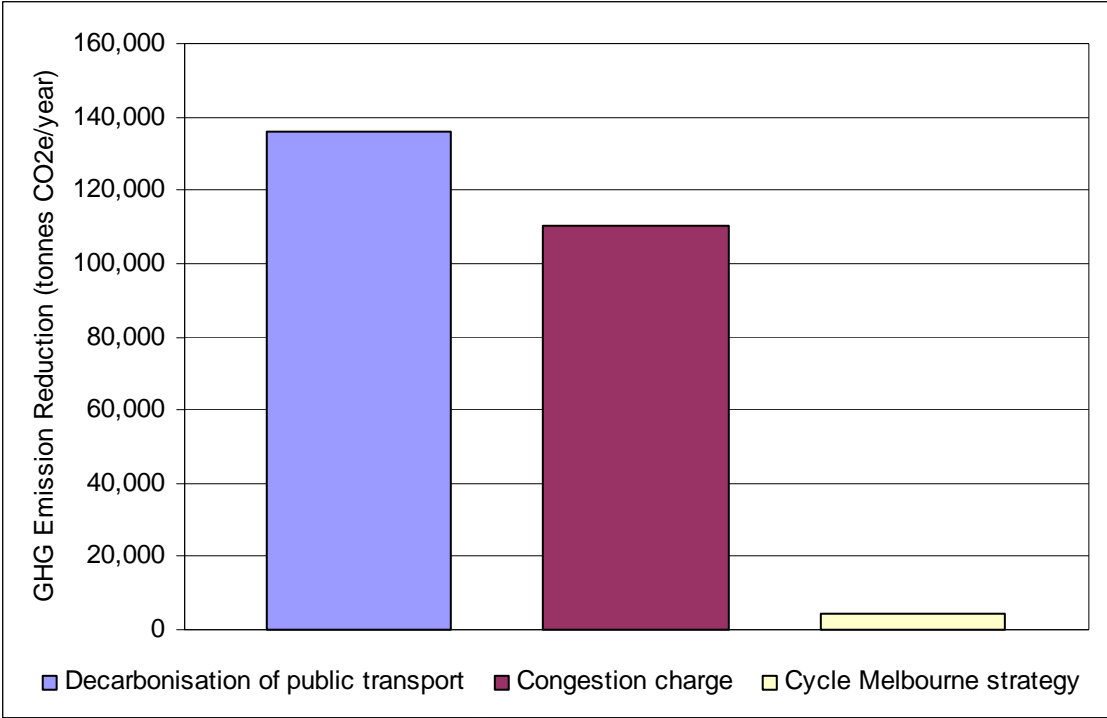


Figure 29: Relative contribution to emissions reductions for each Zero Net transport scenario

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Appendix A

Data

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A1 Data

A1.1 Core Data

The three core data sets for the project were as follows:

- Central City Users Surveys for 2004 and 2006.
- Australian Bureau of Statistics (ABS) data for 2001 and 2006.
- Department of Infrastructure: Calculation of greenhouse gas intensities of transport modes, 2007.

A1.2 Journey to Work and Visitor Data

Journey to Work

- 2001 Census - Journey to Work, Place of Remuneration Melbourne LGA by Mode of Travel by Place of Usual Residence
- 2001 Census - Journey to Work, Place of Usual Residence Melbourne LGA by Mode of Travel by LGA of Remuneration (by Statistical District for Regional LGAs)
- 2001 Census - Journey to Work, Place of Usual Residence CoM Suburb by Mode of Travel by Place of Remuneration Melbourne LGA
- 2001 Census - Journey to Work Statistical District of Usual Residence (All Destinations)
- 2006 Census - Journey to Work, Place of Remuneration Melbourne LGA by Mode of Travel by Place of Usual Residence
- 2006 Census - Journey to Work, Place of Usual Residence Melbourne LGA by Mode of Travel by LGA of Remuneration (by Statistical District for Regional LGAs)
- 2006 Census - Journey to Work, Place of Usual Residence CoM Suburb by Mode of Travel by Place of Remuneration Melbourne LGA
- Revised City User Estimates and Forecasts Model 2004-2020 (prepared by Melbourne City Research) - Weekend Work Trips and Rate of Growth to 2020

Visitor

- City of Melbourne, 2004 Central City Users Survey (Prepared by Nexus Research)
- City of Melbourne, 2006 Central City Users Survey (Prepared by Nexus Research)
- Revised City User Estimates and Forecasts Model 2004-2020 (prepared by Melbourne City Research)

Appendix B

Model Assumptions

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B1 Model Assumptions

B1.1 Emissions Included

The data analysed to calculate transport associated Green House Gas emissions within the City of Melbourne includes:

Weekdays

- Emissions associated with Employees working in the City of Melbourne travelling to work from outside the Melbourne LGA.
- Emissions associated with City of Melbourne Residents travelling to work within a City of Melbourne Suburb.
- Emissions associated with Employees working in the City of Melbourne travelling home to a City of Melbourne Suburb (this has been calculated by multiplying ""Emissions associated with City of Melbourne Residents travelling to work within a City of Melbourne Suburb"" by a factor of 2").
- Emissions associated with City of Melbourne Residents travelling to work outside the Melbourne LGA.
- Emissions associated with Visitors travelling to the City of Melbourne.
- Emissions associated with Visitors travelling home from the City of Melbourne.

Weekends

- Emissions associated with Employees working in the City of Melbourne travelling to work.
- Emissions associated with Visitors travelling to the City of Melbourne.
- Emissions associated with Visitors travelling home from the City of Melbourne.)

Notes

- Emissions associated with Freight have also not been included in this analysis.
- For an equitable proportion of responsibility associated with Green House Gas Emissions it is considered that the City of Melbourne should not be responsible for the following transport related emissions:
 - Emissions associated with Employees working in the City of Melbourne travelling home outside the Melbourne LGA
 - Emissions associated with Residents of the City of Melbourne returning home from work outside the Melbourne LGA
 - Emissions associated with Visitor trips undertaken by Residents of the City of Melbourne to and from destinations outside the Melbourne LGA.

B1.2 Green House Gas Emission Factors

- Emissions for Taxis have been calculated utilising GHG emissions for a Large Vehicle running LPG + Emissions associated with 1 additional Passenger (i.e. Taxi Driver and Passenger).
- Additional Private Vehicle Passenger Emissions for Taxis and Motorcycles have been calculated utilising the ratio of Additional Passenger Emissions to Base Emissions for a Car.
- Off-Peak Emissions for Taxis and Motorcycles have been calculated utilising the ratio of Off-Peak to Peak for a Car.

- Emissions to apply to 'Other' modes have been calculated as an average of emissions for all known modes.
- Bicycles and Walking are not considered to generate any GHG emissions.

B1.3 Mode Split

- Mode splits have been sourced from Census data for Journey to Work trips and the Central City User Survey for Visitor Trips.
- It has also been assumed that no new works, policy, funding, petrol prices etc. will occur to encourage mode change above 2006 levels and that mode split between 2006 and 2020 as a proportion of trips will remain static (i.e. 2006 JTW mode splits have been adopted for 2020).
- JTW Trips detailed as Bicycle and Walking for Regional LGA Origin have been assigned to Car in calculation of person kilometres (i.e. assumed employees with a regional origin do not walk or cycle to Melbourne)
- With the Exception of Regional Visitors staying in Central Area and Metro Victoria, it has been assumed that walking and tram trips are unlikely. Mode split of Regional Visitors Walking and Tram trips have been assigned to Train.
- Mode splits for students detailed in the Central City User Survey have been applied to all student types (e.g. regional, metro, interstate, etc.).
- Overseas and interstate visitors detailed as 'arriving that day' have been assumed to arrive in Melbourne directly from the airport, due to transport options from Melbourne Airport a separate mode split has been approximated.
- N/A trips have been assumed to represent the average number of people who stay home/work from home / do not go to work each day and accordingly have been assigned 0 km travelled.
- A factor of 2 has been applied to JTW work trips undertaken by City of Melbourne Residents travelling to a City of Melbourne destination to include the journey to work and the journey home.
- Average metropolitan Mode Split has been utilised for 2001 JTW Interstate and Unknown trips as this data was not available.
- Mode split to CoM from Regional SDs was not available for 2001 JTW, mode split has been approximated using the overall JTW mode split (i.e. mode split from SD to all Victorian LGAs) for each SD.
- Mode breakdowns for weekday visitor trips have been adopted for weekend visitors (weekend visitor mode breakdown not available).
- Adopted weekday Census average JTW mode split for Workers Staying in Central Area (Average Melbourne LGA Residents), Staying in Metro Victoria (Average Metro LGA), From Home (Average Metro LGA), From Work (Average Metro LGA), Arrived that Day (Interstate), Other (Average Victoria).

B1.4 Distances Travelled

The distances utilised to calculate person kms are detailed as follows:

- Distance travelled has been approximated as straight line distance between centre of Suburb/LGA/SD to centre of Suburb/LGA/SD.
- Internal suburb distances travelled (e.g. Carlton to Carlton) have been approximated as 1/2 the maximum width of the suburb.
- Distances to/from Statistical Districts (SD) have been calculated as the average of all Distances for the LGAs in that SD to Melbourne CBD.
- Distances to/from Yarra Ranges and Melbourne LGA have been approximated as the distance between 'metro' Yarra Ranges and Melbourne CBD.
- Distances travelled for visitor trips and weekend employee trips to the City of Melbourne have been based on average metropolitan and regional distances (calculated in JTW) and the distance between Melbourne Airport and Melbourne CBD (for international and interstate visitors arriving that day (further details of assumptions for visitor distances are provided in the 'Visitor Calculation Worksheets').
- Distance between Yarra Ranges and Melbourne LGA has been approximated as distance from metro Yarra Ranges for all trips (Yarra Ranges comprises a metro and regional component).

B1.5 Data Manipulation and Forecasting

- In extrapolating the number of trips undertaken to and from the City of Melbourne, it was originally suggested to grow 2006 data to 2020 based on the linear growth calculated from 2001 and 2006 Census Journey to Work Figures for the City of Melbourne. This approach was considered to have a number of flaws (e.g. assumes urban density can continue to grow indefinitely), following a review of various data sets provided by the City of Melbourne, it was decided to use the existing growth figures for 'Workers', 'Students' and 'Visitors to the City of Melbourne' in the report 'Revised City User Estimates and Forecasts Model 2004-2020'.
- In calculating GHG emissions, 2001 has been set as the base year, with all additional trips to 2020 applied with 'Additional Pass/Per GHG Factors' (g CO₂e/km) to calculate GHG emissions.
- For Visitors 2001 data has been extrapolated backwards from 2004 figures utilising average percentage growth detailed in the report 'Revised City User Estimates and Forecast Model 2004-2020'.
- 2020 data extrapolated from 2006 figures applying the same % annual growth as detailed for weekday figures in the 'Revised City User Estimates and Forecasts Model 2004-2020' report.
- Data for Visitors to Melbourne LGA and Weekend JTW have been extrapolated from data for the Central Users Area (CBD, Docklands and Southbank) detailed in Central City User Surveys (2004 & 2006) to calculate total visitors and weekend JTW to Melbourne LGA.

B1.6 Breakdown of Days per Year

- Year calculated as comprising 365.25 days.
- Do to lower traffic over holiday periods, etc. it is assumed that there are an additional 20 'weekend' days per year above the actual 104 weekend days (i.e. 20 less weekdays).
- Below provides a breakdown of weekdays and weekend days in the year. To apply weekday emissions across the whole year, change number of weekdays to 365.25 days.
 - Weekdays = 241.25 days
 - Weekends = 124 days

B1.7 Peak Period Breakdowns

Assumptions have been made into the level of workers and visitors that arrive and/or depart the City of Melbourne during the Peak and Off-Peak Periods.

The assumptions include:

2001

- On a weekday 90% of workers will arrive/depart during the peak with the remaining 10% arriving/departing during the off-peak.
- On a weekday 10% of visitors will arrive/depart during the peak with the remaining 90% arriving/departing during the off-peak.
- On the weekend 100% trips are considered to be off-peak trips.

2006

- On a weekday 90% of workers will arrive/depart during the peak with the remaining 10% arriving/departing during the off-peak.
- On a weekday 10% of visitors will arrive/depart during the peak with the remaining 90% arriving/departing during the off-peak.
- On the weekend 100% trips are considered to be off-peak trips.

2020

- On a weekday 90% of workers will arrive/depart during the peak with the remaining 10% arriving/departing during the off-peak.
- On a weekday 10% of visitors will arrive/depart during the peak with the remaining 90% arriving/departing during the off-peak.
- On the weekend 100% trips are considered to be off-peak trips. These assumptions can be edited as required.

B1.8 Additional Assumptions

- Additional assumptions to those detailed above are included in the various calculation worksheets.

Appendix C

Model Guide

Draft

C1 Model Guide

C1.1 Instructions

All cells shaded green and marked by an arrow are editable by the user, the current values represent the scenario assumptions made in the course of the assessment, but can be adjusted to observe the impact that changing these assumptions/inputs would have of the calculation of the City of Melbourne's Greenhouse Footprint for Transport.

A detailed list of the user editable assumptions is provided below.

TITLE	EDITABLE CELLS
Calculations	
Instructions	
Abbreviations	
Model Summary	Ratio breakdown Peak vs. Off-Peak Trips
Model Assumptions and Data Sets	Breakdown of number of weekdays v number weekend days
Data Analysed	
Distances of Travel	
Green House Gas Intensities	
2001 - JTW Weekday Trips and Person kms to Melbourne LGA	
2006 - JTW Weekday Trips and Person kms to Melbourne LGA	
2020 - JTW Weekday Trips and Person kms to Melbourne LGA	
JTW Mode Splits to/from Melbourne by LGA	
2001 - JTW Weekday Trips and Person kms from Melbourne LGA	
2006 - JTW Weekday Trips and Person kms from Melbourne LGA	
2020 - JTW Weekday Trips and Person kms from Melbourne LGA	
2001, 2006 & 2020 Weekday Visitor Trips and Person kms to Melbourne LGA	Visitor trip rate - visitor trips to include in calculations (self updates all visitor calculations)
2001, 2006 & 2020 Weekend Visitor and JTW Trips and Person kms to Melbourne LGA	
2001, 2006 & 2020 Weekend JTW Trips and Person kms from Melbourne LGA	
2001 Internal CoM to CoM Trips and Person kms	
2006 Internal CoM to CoM Trips and Person kms	
2020 Internal CoM to CoM Trips and Person kms	

Impact of Policies and Actions	
Summary of cumulative emission reductions	Policies to include in Greenhouse Gas Reduction calculations
Policy 01 - Doncaster Rail Link	Additional new trips to City as a result of rail link
Policy 02 - Sunshine to Melton and Rowville to Glen Waverley Rail Links	Additional new trips to City as a result of rail links
Policy 03 - Tram Priority	Data to include in calculation (Weekday JTW, Weekday Visitor Trips)
Policy 03 - Tram Priority	Additional new trips to City as a result of tram improvements
Policy 03 - Tram Priority	Existing average peak tram services per hour
Policy 03 - Tram Priority	Proposed average peak tram services per hour
Policy 03 - Tram Priority	Length of AM peak period (hours)
Policy 04 - CBD Bus Improvements	Data to include in calculation (Weekday JTW, Weekday Visitor Trips)
Policy 04 - CBD Bus Improvements	Percentage increase in bus trips as mode of travel
Policy 04 - CBD Bus Improvements	Which modes the increase in bus trips shifts from
Policy 05 - Reduction in Parking	Data to include in calculation (Weekday JTW, Weekday Visitor Trips)
Policy 05 - Reduction in Parking	Percentage reduction in car trips as mode of travel
Policy 05 - Reduction in Parking	Which modes the decrease in car trips shifts to
Policy 06 - Improved Walking Routes	Percentage increase in tram trips as mode of travel
Policy 06 - Improved Walking Routes	Which modes the increase in tram trips shifts from
Policy 07 - 40km/h Speed Limit	Data to include in calculation (Weekday JTW, Weekday Visitor Trips)
Policy 07 - 40km/h Speed Limit	Percentage increase in bicycle trips as mode of travel
Policy 07 - 40km/h Speed Limit	Which modes the increase in bicycle trips shifts from
Policy 08 - Improved Bicycle Facilities	Data to include in calculation (Weekday JTW, Weekday Visitor Trips)
Policy 08 - Improved Bicycle Facilities	Percentage increase in bicycle trips as mode of travel
Policy 08 - Improved Bicycle Facilities	Which modes the increase in bicycle trips shifts from

Policy 09 - Car Sharing	Percentage reduction in car trips as mode of travel
Policy 09 - Car Sharing	Which modes the decrease in car trips shifts to
Scenario Discussion	
Scenario 01 - Restrict Car Access	Data to include in calculation (Weekday JTW, Weekday Visitor Trips, Weekend JTW, Weekend Visitor)
Scenario 01 - Restrict Car Access	Percentage reduction in car trips as mode of travel
Scenario 01 - Restrict Car Access	Which modes the decrease in car trips shifts to
Scenario 02 - Increase Number of Cyclists	Data to include in calculation (Weekday JTW, Weekday Visitor Trips, Weekend JTW, Weekend Visitor)
Scenario 02 - Increase Number of Cyclists	Percentage increase in bicycle trips as mode of travel
Scenario 02 - Increase Number of Cyclists	Which modes the increase in bicycle trips shifts from
Scenario 03 - Increase Number of Pedestrians	Percentage increase in pedestrians as mode of travel
Scenario 03 - Increase Number of Pedestrians	Which modes the increase in pedestrians shifts from
Scenario 04 - Increase Public Transport Patronage	Data to include in calculation (Weekday JTW, Weekday Visitor Trips, Weekend JTW, Weekend Visitor)
Scenario 04 - Increase Public Transport Patronage	Percentage increase in public transport as mode of travel
Scenario 04 - Increase Public Transport Patronage	Which modes the increase in public transport shifts from
Scenario 05 - Reallocate Road Space	Data to include in calculation (Weekday JTW, Weekday Visitor Trips, Weekend JTW, Weekend Visitor)
Scenario 05 - Reallocate Road Space	Percentage increase in PT, walking & cycling as mode of travel
Scenario 05 - Reallocate Road Space	Which modes the increase in PT, walking & cycling shifts from
Scenario 06 - Desired Mode Split	Data to include in calculation (Weekday JTW, Weekday Visitor Trips, Weekend JTW, Weekend Visitor)
Scenario 06 - Desired Mode Split	User input mode split
Scenario 07 - Decarbonise Fuel Supply	Percentage reduction in CO ₂ e per person/passenger kilometres associated with decarbonising the fuel supply
Zero Net - Input	

Initiative 01 - Decarbonise Public Transport Fuel Supply	Percentage reduction in CO2e per person/passenger kms associated with decarbonising the PT fuel supply
Initiative 02 - Implement Congestion Charging	Data to include in calculation (Weekday JTW, Weekday Visitor Trips, Weekend JTW, Weekend Visitor)
Initiative 02 - Implement Congestion Charging	Percentage reduction in car trips as mode of travel
Initiative 02 - Implement Congestion Charging	Which modes the decrease in car trips shifts to
Initiative 03 - Increase Number of Cyclists	Data to include in calculation (Weekday JTW, Weekday Visitor Trips, Weekend JTW, Weekend Visitor)
Initiative 03 - Increase Number of Cyclists	Percentage increase in bicycle trips as mode of travel
Initiative 03 - Increase Number of Cyclists	Which modes the increase in bicycle trips shifts from
Abbreviations in model	
CoM	City of Melbourne
JTW	Journey to Work (Trip from place of residence to place of work)
LGA	Local Government Area
Pax	Passengers/Person (loading)
PT	Public Transport
SD	Statistical District - Census Collection Area

Appendix D

References

Draft

D1 References

Borough of Woking (UK) 2005, *Think Globally Act Locally – Climate Change Strategy*, Woking Borough Council.

City of Camden (London) 2006, *Climate Change in Camden – a Joint Effort, Camden's Climate Change Action Plan 2006-2009*.

City of Melbourne, *City of Melbourne Moving People and Freight – Transport Strategy 2006-2020*, Melbourne, September 2006

City of Melbourne 2007, *City of Melbourne Annual Report 2006–07*, Melbourne.

City of Melbourne 2002, *City of Melbourne Zero Net Emissions by 2020 Strategy*, Melbourne.

City of Melbourne 2008, *City of Melbourne Zero Net Emissions by 2020 - Strategy Update 2008*, Melbourne

Department of Infrastructure (Victoria) 2007, *Calculation of Greenhouse Gas Intensities (Draft)*.

Department of Primary Industries (Victoria) 2007, 'Victorian Energy Efficiency Target Scheme', Issues Paper, March, <http://www.dpi.vic.gov.au>.

Garnaut Climate Review 2007, *Issues Paper 3, Climate Change and Emissions Stabilisation*, November, accessed from www.garnautreview.org.au/.

Garnaut Climate Review 2008, *Interim Report to the Commonwealth, State and Territory Governments of Australia*, February, accessed from www.garnautreview.org.au/.

Victorian Government 2006, *Energy Efficiency for Victoria Action Plan 2006*.