IPART
New South Wales

Independent Pricing and Regulatory Tribunal

Review of external benefits of public transport

Transport — Draft Report
December 2014

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Invitation for submissions

IPART invites written comment on this document and encourages all interested parties to provide submissions addressing the matters discussed.

Submissions are due by 23 March 2015.

We would prefer to receive them electronically via our online submission form <www.ipart.nsw.gov.au/Home/Consumer_Information/Lodge_a_submission>.

You can also send comments by fax to (02) 9290 2061, or by mail to:

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If you would like further information on making a submission, IPART's submission policy is available on our website.

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1 Executive summary

The Independent Pricing and Regulatory Tribunal of NSW (IPART) is responsible for determining maximum fares for public train, bus and ferry services in Sydney and surrounding areas each year. These fares recover only a small proportion of the total cost of providing the services. The NSW Government pays the bulk of the cost. Given this, our key decision in determining fares is how much of the total cost should be paid by the people who use public transport (through fares) and how much by the NSW community as a whole (through the Government subsidy).

For the past five years, we have made this decision by estimating the value of the 'external benefits' associated with each mode of public transport, as well as the efficient costs of providing the services. We then set the Government subsidy broadly in line with the estimated value of the external benefits, and set fares to generate the difference between the Government subsidy and the estimated efficient costs.

We use this approach because one of the main reasons governments subsidise public transport services is that having these services benefits the whole community, not only the people who use them. For example, using public transport leads to lower road congestion, and lower air pollution and greenhouse gas emissions than if these journeys had been taken by private vehicle. Therefore, we considered it appropriate to set the Government subsidy broadly in line with the estimated value of these community-wide or external benefits.

We still think this broad approach is appropriate. However, we are conducting a periodic review of the detail of our approach, in line with good regulatory practice. In particular, we are reviewing how we estimate the value of the net external benefits of each mode of public transport – including which external benefits and costs we include in this estimate, and the methodologies we use to measure the value of each benefit and cost.

The objective of this review is to establish the approach we will use to determine the value of the net external benefits of bus, train and ferry services for our next round of fare reviews.[1] We have applied our draft approach to estimate the current values of these benefits but we will not use these specific estimates for the fare reviews. We intend to reapply our final approach during the fare reviews using the most up-to-date and consistent inputs and assumptions.

This report describes our draft approach and the decisions and analysis that underpin it, as well as our draft findings on the current value of the net external benefits derived from this approach. We invite all interested parties to provide feedback on this draft report.

1.1 Our revised approach would produce more consistent and reliable estimates

After considering the submissions received in response to our issues paper and undertaking extensive analysis, we have revised our approach to estimating the net external benefits of public transport. While the revised approach does not differ significantly from our current approach, we consider it includes refinements that improve its consistency and would give us more confidence in the estimates it produces.

One key difference is that the revised approach includes a wider set of external benefits and costs associated with using public transport, not only those related to road congestion and pollution (see section 1.2). In addition, this approach:

- uses our own in-house model for estimating the value of the net external benefits of public transport, and better, more consistent inputs than we have previously used
- estimates the value of the net external benefits associated with one extra passenger journey, or an extra kilometre travelled on the existing public transport network, and
- if possible, adjusts this value to take account of external benefits and costs associated with likely changes to the current network in line with forecast expenditure on public transport capacity.

1.1.1 Using our in-house model and better, more consistent inputs

Under our revised approach, we propose to continue to use the Sydney Strategic Travel Model (SSTM) developed by the Bureau of Transport Statistics (BTS) to estimate how people would travel if they did not use public transport, and the resulting impact on the level of congestion and pollution. However, we have developed our own in-house model that uses these outputs to estimate the external benefits of public transport (available on our website).

1 We anticipate undertaking these in 2015 with new fares to commence on 1 July 2016.

We propose to use outputs from the SSTM as inputs to our model. The SSTM outputs we intend to use are based on moderate fare changes – rather than scenarios where public transport services are 'switched off' within the SSTM, as we have used in the past. We consider this would provide more reliable, consistent results that better capture the external benefits of passengers who switch between different modes of transport – including alternative modes of public transport, cycling and walking.

We also propose to use data from the Transport for NSW *Principles and Guidelines for Economic Appraisal of Transport Investment and Initiatives* as inputs to our model. These inputs include estimates for environmental costs, the value of time, and vehicle-related congestion costs. We consider that these are better, more consistent estimates than we have used in the past.

While we have aimed to make our approach consistent across all modes of public transport, we have had to modify the approach for estimating the net external benefits of ferry services for practical reasons. The SSTM does not have the capability to separately adjust ferry fares – it effectively includes ferry routes as additional train lines. This means that we are unable to use the same approach for ferries as we have to estimate the external benefits for buses and trains.

There are some aspects of the external benefit calculation – such as the pollution emitted by ferries – that can be modelled specifically for ferries. We have used ferry-specific information where it is available. For the remaining estimates we have based our ferry estimates on the SSTM outputs for train services. However, we have varied the outputs in some instances to account for known differences between train and ferry services.

1.1.2 Focusing on the external benefits of an extra passenger journey on the existing network

The estimates of external benefits derived under our current approach reflect each existing passenger's share of the external benefits associated with each mode of public transport. However, under our revised approach, we focus on estimating the external benefits associated with an extra passenger using an existing service (that is, based on the current network, scope and frequency of services).

1.1.3 Adjusting to account for additional external costs and benefits associated with likely changes to the current network

One shortcoming of focusing on the external benefits of an extra passenger journey on the existing network is that this assumes, as more people use public transport and services fill up, any additional passengers can be carried on existing services at no extra cost. In practice, there are likely to be additional external costs and benefits associated with changes to the number of people who use public transport. There will also potentially be changes to the cost of providing services.

The size and nature of these external benefits and costs will depend on how Transport for NSW (TfNSW) responds to changes in patronage. For example:

- If TfNSW responds to increased demand by increasing the scope and frequency of services, there will be additional benefits to existing passengers which should be taken into account in setting fares (the external benefit of 'scale'). However, it also adds to the cost of providing services, some of which is off-set by additional fare revenue.
- If TfNSW does not change the number of services as demand for them increases, there will be additional costs for existing passengers as their journeys become less comfortable, less productive and slower (the external cost of 'crowding').

We have not been able to estimate the value of the external benefits of scale and crowding at this review, as we don't have sufficient information on TfNSW's future expenditure on public transport. However, we intend to reassess the external benefits, taking these factors into account, during our next round of fare reviews when we might have better data on TfNSW's plans. This would enable us to ensure that we have a consistent set of external benefits and costs that are based on a consistent set of patronage forecasts for our determination.

1.2 Our revised approach includes a wider range of relevant external benefits and costs

In our current approach, we include only a limited set of external benefits and costs in our estimates – the avoided cost of road congestion, avoided pollution, and road user charges. After considering submissions to our issues paper and conducting extensive analysis, we propose to continue to include these benefits and costs. In addition, we propose to:

- expand the number of ways we measure the value of avoided road congestion, so we also take account of avoided vehicle operating costs and avoided reliability costs
- include two additional external benefits – avoided road accidents and the health benefits associated with walking or cycling to or from public transport
- include one additional external cost – the costs of raising funds to subsidise public transport.

However, we propose not to include an estimate of the external benefits of social inclusion, agglomeration and wider economic benefits (see Chapter 11 for more explanation).

1.2.1 Continue to include avoided road congestion and expanding how we measure this external benefit

Avoided road congestion is still by far the largest single external benefit associated with public transport use. We propose to continue to include the external benefit measured in terms of the value of time saved for existing drivers when people who would otherwise drive instead of using public transport. However, to improve the estimates we also propose to include:

- Avoided vehicle operating costs – as vehicles move more slowly when roads are congested, vehicle operating costs such as fuel, typically increase.
- Avoided reliability cost – as roads become more congested, travel times become less reliable and this imposes a cost on existing road users.

1.2.2 Continue to include avoided pollution and road user charges

We propose to continue to include the external benefits of avoided air pollution and greenhouse gas pollution, as every litre of fuel consumed by motorised transport contributes to air pollution and carbon emissions. High levels of these pollutants are associated with adverse health effects, such as respiratory and cardio-vascular problems, and carbon emissions impact climate change.

We propose to use TfNSW's *Principles and Guidelines for Economic Appraisal of Transport Investment and Initiatives* as the basis for car, rail and bus pollution cost estimates. Unfortunately, these guidelines do not currently provide estimates for ferry pollution costs so we engaged a consultant with suitable marine expertise to provide these estimates. Our consultant's report is available on our website. While we investigated whether we could also include an estimate for noise pollution, we found there is insufficiently reliable data available at this stage.

We intend to revise our estimates of the net costs of pollution avoided by public transport at each fare review.[2] This includes both the car related emissions avoided by public transport and, when estimating the total value of external benefits, the pollution created by public transport itself (which offsets some of the benefit of the avoided car pollution). This would ensure that we have up-to-date information and that our estimates are consistent across modes, and with the mix of vehicles we expect over the determination period.

2 We intend to undertake our next round of reviews for all modes at the same time with new determinations to commence on 1 July 2016.

In addition, we propose to continue to include the external costs of road user charges, as these charges offset some of the external costs driving imposes on the community.[3] These charges add to the cost of driving relative to public transport and are considered by people when they decide how to travel. If we didn't adjust the public transport external benefit to account for these external costs, we would be overstating the external benefits of public transport.

1.2.3 Include avoided road accidents and health benefits

We propose to include the external benefits of avoided road accidents. We propose to measure these benefits as the avoided cost of taxpayer-funded services (such as ambulance and police services) that increase with the absolute number of accidents associated with more cars on the road. However, we expect the value of the benefits to be small. We also propose to include the health benefits associated with walking/cycling to and from public transport – this is referred to as active transport in our external benefit estimates.

1.2.4 Include the cost of distortions created by raising funds to subsidise public transport

As our Issues Paper discussed, we have not previously made an adjustment for the distortionary costs of raising funds to subsidise public transport. However, we propose to do so as part of our revised approach.

These costs are the costs of taxes in terms of economic efficiency, which are over and above the amount of the taxes themselves. Taxes distort the economic decisions of labour, consumers, investors and producers by changing the incentives to work or invest, and influencing consumption and production patterns. These distortions reduce economic efficiency and lead to a loss in consumer welfare, referred to as the deadweight loss or excess burden of taxation. The excess burden, or deadweight loss of a tax, is a measure of the economic costs associated with these distortions.

We consider it is appropriate to take account of the economic efficiency losses associated with the funds used to subsidise public transport in estimating the net value of the external benefits.

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3 Or, to put it another way, road user charges increase the private cost of driving, and internalise some of the external costs driving imposes on society.

1.2.5 Not include social inclusion, agglomeration or other wider economic benefits

In submissions to this review and past fare reviews, many stakeholders argued we should include the benefit public transport creates by facilitating improved mobility and social inclusion. Many argued that these benefits are particularly significant for those on lower incomes (as they tend to live further away from jobs and have fewer transport options) and as such, justify significant taxpayer subsidy of public transport fares.

Similarly, some stakeholders have submitted we should include agglomeration benefits and other wider economic benefits associated with public transport services. These are related to the role public transport plays in enabling co-location in cities and freeing up movement between customers, workers, businesses and services, which leads to improvements in productivity, lower welfare and higher consumption.

We have not included any of these in our external benefit estimate. We accept that some portion of each of these benefits is external (although a significant portion is private). However, we consider that:

- The external benefit portion is difficult to measure with any degree of confidence.
- The value of the external benefit is more closely linked with the availability of services (scope and frequency of services) than it is with the level of fares. As a result, the necessary link between the value of the benefit and the level of fares has not been demonstrated.

1.3 Our draft findings on current net external benefits using our revised approach

We have applied our revised approach to derive indicative estimates of the current net external benefits of each mode of transport. Table 1.1 presents these estimates on per passenger journey basis and a per passenger kilometre travelled basis. The range of estimates results from different assumptions regarding the price elasticity of demand (that is, how responsive people's demand for public transport is to a change in fares). The price elasticity of demand affects our estimate of the excess burden of taxation. The higher the elasticity, the more price sensitive demand is, and for a given change in patronage a smaller subsidy is required, and consequently there is a smaller deadweight loss. Demand elasticity is higher in the long run (resulting in a smaller excess burden of taxation) than it is in the short run (see Appendix A). We have used both long and short run estimates to form the range.

Please note that, as discussed above, in applying the revised approach for this review we have focused on estimating the external benefits associated with one extra passenger using an existing service. We have not yet taken account of how TfNSW is likely to respond to changes in patronage – and thus whether we need to include additional external benefits and costs associated with scale and crowding – as we intend to do under our revised approach. We intend to take these factors into account in applying our revised approach during the next round of fare reviews, when we expect to have better information on TfNSW's proposed expenditure on public transport.

Table 1.1 Draft findings on the current estimated value of net external benefit per passenger kilometre and per passenger journey ($2014/15)

	Rail	Bus	Ferry
$ per passenger kilometre	$0.12 to $0.20	$0.12 to $0.20	$0.01 to $0.21
$ per passenger journey	$3.37 to $5.60	$1.43 to $2.49	$0.12 to $2.08

Note: Although the $ per passenger kilometre values for rail, bus and ferry are similar, the $ per passenger journey values reflect differences in journey length between each of the modes.

The range is based on different estimates of the price elasticity of demand for public transport, which affects the estimate of the excess burden of taxation.

Table 1.2 presents our draft findings on the total net external benefit for all modes of public transport (rail, bus and ferry). These findings clearly show that the avoided cost associated with road congestion (including time saved, reduced operating costs and reliability) is the largest component.

Table 1.2 Draft findings on the current estimated value of total net external benefits from Sydney's public transport network ($ million, $2014/15)

Externality	
Congestion cost (time)	2407.2
Congestion cost (vehicle operating cost)	66.3
Congestion cost (reliability)	490.3
Congestion total	2963.8
Environmental externalities - avoided car use	177.3
Environmental externalities - created by public transport	-128.4
Net environmental externalities	48.9
Accidents	6.5
Active transport	83.3
Excess burden of taxation	-214.0 to -1387.2
Road user charges	-322.0
Scale benefits	Not included at this stage
Crowding costs	Not included at this stage
Total	**1393.2 to 2566.4**

Note: The range for excess burden of taxation reflects different estimates of the price elasticity of demand for public transport.

1.4 How these draft findings compare to existing estimates of net external benefits

Table 1.3 compares our draft findings on the net external benefits derived using our revised approach with our previous estimates, which we used in making our current fare determinations.

Table 1.3 Current estimated value of external benefits per passenger journey compared to previous estimates ($2014/15)

	Rail	Bus	Ferry
Previous estimate	6.82	1.58	0.09
Current estimate	3.37 to 5.60	1.43 to 2.49	0.12 to 2.08

Note: The range reflects different estimates of the price elasticity of demand for public transport, which results in a range of estimates for the excess burden of taxation.

Source: IPART reports.

Our current estimates for rail are below what we have previously used. For buses, the low end of our current estimated range is in line with our previous estimates. For ferries, the current estimates are higher than our previous estimates.[4] As discussed above, these are our current estimates which will be revised in our final report and during the fare reviews using the most up-to-date and consistent inputs and assumptions.

1.5 We intend to update the external benefit estimates during the next round of fare reviews

As discussed above, we intend to apply our revised approach to estimate the net external benefits to inform our next round of fare determinations for trains, buses and ferries. While we have applied our draft approach to estimate the current values of these benefits we will not use these specific estimates for the fare reviews. We intend to reapply our final approach during the fare reviews using the most up-to-date and consistent inputs and assumptions – including data on the Government's planned expenditure on public transport. This would ensure that we derive a consistent set of external benefits and costs that are based on a consistent set of patronage forecasts for our determination. It would also allow us to consider whether there are additional external benefits associated with scale and/or costs associated with crowding.

In addition, for the next round of fare reviews we propose to consult on a range of issues, including how we can best consider whether efficiency will be improved as a result of fare changes.

We are proposing to begin the next round of public transport reviews in 2015 encompassing all modes at once. We expect new fare determinations to take effect from 1 July 2016. This involves bringing forward our bus and ferry reviews and delaying our rail review by around 6 months.

Conducting our next rail, bus and ferry reviews concurrently would allow us to:

- consider how the different methods of valuing external benefits and costs should be used for setting fares and ensure that all modes reflect the most up-to-date estimates
- ensure that a consistent set of data and assumptions are used to inform forecast external benefits and costs both within and across all modes
- consider the impact on the external benefits across modes, including the impact of changes to the scope and frequency of public transport and the impact of crowding.

4 We note that had we used an estimate of external benefits of around $1.10 per passenger journey (in line with the mid-point of our current estimates) in our 2012 Sydney Ferries review, the average fare increases included in the current determination would still not reach the point where fares are high enough to recover passenger's full share of costs during the determination period in NPV terms.

1.6 IPART seeks comment on this draft report

We are now seeking submissions on this draft report and invite comments from interested parties. Submissions are due by 23 March 2015. Late submissions may not be accepted. All submissions accepted will be published on our website after the closing date. Details on how to make a submission can be found on page iii at the front of this report.

After the close of submissions, we intend to hold a public hearing for interested parties. Our proposed timetable for completing this review is provided below:

Table 1.4 Indicative timetable

Event	Expected date
Submissions on draft report due	23 March 2015
Public hearing (workshop)	April 2015
Release final report	May 2015

1.7 How this paper is structured

The rest of this paper discusses our draft decisions and draft findings for this review in more detail:

- Chapter 2 explains our draft decisions on which external benefits and costs of public transport we propose to include in estimating the net value of the external benefits.
- Chapter 3 provides an overview of the revised approach we propose to use to estimate the net external benefits for the next round of fare reviews.
- Chapters 4 to 10 discuss our draft findings on the current estimated value of each external benefit and cost, derived using the revised approach.
- Chapter 11 provides more detail on our draft decisions not to include the external benefits associated with social inclusion, agglomeration and wider economic benefits in our approach.

2 Which external benefits are relevant for setting fares?

One of the key aspects of our current approach for estimating the net external benefits of public train, bus and ferry services in the greater Sydney area[5] is the individual benefits and costs we include in calculating this estimate. Public transport services provide a broad range of benefits to the individuals who use them and to the broader community. However, not all of these benefits are relevant to our purpose – that is, to deciding how much of the total efficient cost of providing the services should be:

- funded through Government subsidies (to reflect the external benefits), and
- funded through fares (to recover the remaining efficient costs).

In addition, public transport services impose some costs on the wider community, which offset their benefits.

Under the approach we have used for previous fare reviews, we included only a limited set of external benefits in our estimates – the avoided cost of road congestion; and avoided air pollution and greenhouse gas emissions. We also included only one external cost – the road user charges drivers pay, such as tolls, fuel excise and the parking space levy.

As part of this review, we considered whether we should include a wider set of external benefits and costs. As indicated in our issues paper, we considered a range of additional external benefits – including additional ways of measuring the value of avoided road congestion, plus avoided road accidents, health benefits associated with walking or cycling, social inclusion, agglomeration and wider economic benefits. We also considered one additional external cost – the cost of raising funds to subsidise public transport.

The sections below discuss our key considerations and draft decisions, including:

- why we consider the value of external benefits of public transport in setting fares
- whether these external benefits justify full subsidisation of public transport

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5 Specifically, these include train services provided by Sydney Trains and NSW TrainLink (formerly CityRail), metropolitan and outer metropolitan bus services, and Sydney Ferries services.

- our criteria for assessing whether an external benefit or cost should be included in our estimate for future fare reviews
- our draft decisions on these external benefits and costs.

2.1 Why do we consider the value of external benefits in setting fares?

As Chapter 1 noted, one of the main reasons governments subsidise public transport is because it provides external benefits to the community as a whole. In line with the 'beneficiary pays' principle, this means it is reasonable for the community to contribute to the efficient costs of providing public transport services.

In general, the existence of external benefits justifies government subsidy of public transport if:

- the subsidy leads to an increase in the use of public transport services, and thus an increase in the external benefits, and
- the value of this increase in external benefits exceeds the net cost of providing the subsidy.

For the public transport services where we set maximum fares, we consider that some government subsidy is justified. Ideally, this subsidy should be provided up to the level where it no longer meets the above criteria. There is no economic justification for continuing to subsidise fares for public transport above this point because the net benefits to the community (external benefits plus fare revenue minus efficient costs) would no longer be positive.

2.2 Do the external benefits justify full subsidisation of public transport?

In the past, some stakeholders have argued that the external benefits of public transport mean that it should be fully subsidised by government – as is the case with other public goods, like public health, law enforcement and public schools. However, we don't accept this argument for two main reasons.

First, in our view the external benefits provided by Sydney public transport services are not comparable to those provided by these other public goods. All NSW citizens receive substantial benefits from public health, public education and law enforcement activities. In contrast, citizens' access to Sydney's public transport services varies depending on where they live, and a relatively small proportion of all citizens use the services. For example, even for citizens who live in the Sydney area, access to Sydney Trains (formerly CityRail) services depends on proximity to a train station. Past studies have shown that only around 21% of

Sydney residents can be considered 'regular users' of rail services (where 'regular user' is defined as someone who travelled by rail at least once in the last week).[6]

Table 2.1 shows that on an average weekday, only around 12% of all trips undertaken in the Sydney region are by public train, bus or ferry. In contrast, around 68% are by private vehicle, either as driver or passenger. We consider it appropriate that those who benefit most from public transport, namely those who use its services, contribute towards the cost of providing it.

Table 2.1 Proportion of trips by mode (average weekday) 2011/12

Mode	Proportion %
Vehicle driver	46.9
Vehicle passenger	21.1
Train	5.5
Bus[a]	5.9
Ferry	0.3
Walk only	18.2
Bicycle	0.5
Other (includes taxi)	1.4

a Includes public and private buses.

Note: Percentages do not add to 100 due to rounding.

Source: BTS, *2011/12 Household Travel Survey Summary Report, 2013 Release*, p 31.

Second, we don't consider that full subsidisation would necessarily lead to significantly greater benefits for the community, even though it may provide greater personal benefits to those who use public transport. As indicated above, providing a subsidy may be justified if it creates an incentive for people to behave in a way that is beneficial to the community – in this case, using public transport instead of driving.[7] However, it is only worthwhile if:

- people would not undertake as much of the beneficial activity without that subsidy, and
- the external benefits society receives as a result of people undertaking more of the beneficial activity exceeds the net cost of providing the subsidy.

6 Bureau of Transport Statistics, *Compendium of Sydney Rail Travel Statistics, 8th Edition, v1.1,* November 2012, p 27.

7 The external benefits we have included to date are those associated with avoiding the congestion and pollution associated with driving.

Based on our analysis, these conditions would not be met if Sydney's public transport services were fully subsidised. These services are already heavily subsidised, to a level that represents a significant amount of taxpayer funding. For example, in 2011/12, the level of Government funding for transport Public Trading Enterprises[8] was $3.7 billion, or around $25 per week from each household in NSW.[9]

Given a particular level of service, increasing the subsidy to 100% (so passengers do not contribute anything to the cost of providing the services) would not necessarily result in large numbers of people switching from driving to public transport. This is because fare levels are only one factor in a person's decision to use these services. Factors such as convenience, accessibility, frequency, reliability and comfort of service also influence this decision. On the other hand, many people may be willing to use public transport even if the current subsidy was reduced or removed – for example, if a return journey fare doubles. This is because even at the higher cost, the fare reflects the benefits to them of using the service. That is, it may still be cheaper or more convenient than making the journey by car.

For these reasons, while we do agree that some Government subsidy of public transport is justified, we consider that the level of the subsidy should be linked to the value of the external benefits that public transport provides.

2.3 Criteria used to decide which external benefits or costs should be included

In our issues paper we suggested four criteria for assessing whether an external benefit or cost should be included in our estimate for future fare reviews. These criteria were:

1. **It needs to be external** – not a private cost or benefit that goes directly to the user, as those are already taken into account when making a decision on how to travel.
2. **It should not be available only to a particular subset of people** – benefits that are only available to some people (such as, benefits to those who own property close to a train station) do not provide justification for lowering fares for everyone.

8 In 2011/12, transport Public Trading Enterprises included RailCorp, the State Transit Authority and Sydney Ferries, but not agencies such as Transport for NSW or Roads and Maritime Services that also contribute to providing public transport services, or private bus operators who receive Government contract payments.

9 IPART calculations; the ABS census data on number of dwellings in NSW was used to calculate weekly household cost in NSW (from the ABS's Table Builder); net Budget funding to transport agencies is taken from *NSW Budget Statement 2014-15, Budget Paper No. 2*, Table 9.3. The Budget funding figure does not include capital funding for new buses which is allocated through Transport for NSW.

3. **It needs to be measurable** – we need to be able to estimate the value of the benefit; it would be enough that we could determine a reasonable range.
4. **It needs to change materially in response to changes in public transport use, brought about by changes in fares** – the value of the net benefits of public transport use to society (external benefits + fare revenue - the cost of providing the services) should change in response to changes in fares.[10]

In response to our Issues Paper, submissions were generally supportive of criterion 1, 3 and 4. However, criterion 2 was considered contentious with six of the submissions objecting to its inclusion or suggesting it be modified. The main arguments were that a direct benefit to one group or individual did not mean that there wasn't also a wider indirect benefit to society. In particular, that the benefits of improved social mobility and inclusion, such as access to jobs, education and training, and the health benefits of physical activity accrued to society, the economy and the environment.[11]

We acknowledge that the existence of private benefits, such as those to do with increased physical activity, do not necessarily mean there aren't also wider external benefits. In light of the submissions and our further analysis, we have removed criterion 2 and consider that the three remaining criteria are sufficient to assess whether a particular external benefit or external cost should be included. Box 2.1 sets out our revised proposed criteria.

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10 It is important that the benefit increases as the usage of public transport increases because the purpose of subsidising fares is to increase the use of public transport by lowering its price (relative to not having a subsidy) in order to realise greater benefits for society.

11 Action for Public Transport (NSW) submission to IPART's Issues Paper, 7 October 2014; Mori Flapan submission to IPART's Issues Paper, 30 September 2014l Bus Industry Confederation submission to IPART's Issues Paper, 15 October 2014; Mike Smart submission to IPART's Issues Paper, 30 September 2014.

Box 2.1 Proposed criteria for assessing whether external benefits should be included in the new 'best estimate'

1. **It needs to be external** – not a private cost or benefit that goes directly to the user, as those are already taken into account when making a decision on how to travel.
2. **It needs to be measurable** – we need to be able to estimate the value of the benefit; it would be enough that we could determine a reasonable range.
3. **It needs to change materially in response to changes in public transport use, brought about by changes in fares** – the value of the net benefits of public transport use to society (external benefits + fare revenue - the cost of providing the services) should change in response to changes in fares.[a]

[a] It is important that the benefit increases as the usage of public transport increases because the purpose of subsidising fares is to increase the use of public transport by lowering its price (relative to not having a subsidy) in order to realise greater benefits for society.

2.4 Draft decisions on which external benefits and costs to include

To reach our draft decisions, we considered stakeholder responses to our issues paper, and assessed each of the external costs and benefits identified in that paper against the three criteria listed above. The sections below summarise these draft decisions.

2.4.1 Externalities to be included

Our draft decision is that the following external costs and benefits (externalities) should be included:

- **Congestion cost.** This is the external benefit associated with avoided road congestion when people use public transport. For future fare reviews, we intend to measure this benefit in three ways:
  - **Time** – the value of time saved by existing drivers when people use public transport instead of adding to road congestion.
  - **Vehicle operating cost** – the value of vehicle operating costs, such as fuel, avoided by existing drivers when people use public transport instead of adding to road congestion.
  - **Reliability** – the benefit of more predictable travel times for existing drivers when people use public transport instead of adding to road congestion.

- **Environmental externalities**. This includes the external benefits of avoided air pollution and greenhouse gas pollution when people use public transport instead of driving. In estimating a total benefit from the public transport network we have netted off the external costs associated with the pollution created by the public transport services themselves.
- **Accidents.** This is the external benefit associated with avoided road accidents when people use public transport instead of driving.
- **Active transport.** This is the external health benefits that arise because public transport encourages greater levels of physical activity – primarily when people walk or cycle to and from public transport.
- **Deadweight loss of taxation.** This is the external costs associated with the taxes used to subsidise public transport – that is, the costs taxes have in terms of economic efficiency, which are over and above the amount of the tax.
- **Road user charges.** This adjustment is made to recognise the fact that road user charges – such as tolls, the fuel excise and parking levy – offset some of the external costs that driving imposes on the community. Because they also form part of the cost people consider when deciding whether to drive or use public transport, not including these would overstate the external benefits of public transport.
- **Scale and crowding.** These are the external benefit for existing passengers if service frequency increases in response to increased patronage, and the external cost to those passengers if the level of services doesn't increase, leading to crowding. While we haven't estimated the value of these externalities for this review, we intend to do so during our next round of fare reviews when we expect to have better information on the Government's proposed expenditure on public transport.

2.4.2 Externalities not to be included

We decided not to include an estimate of the **social inclusion, agglomeration or wider economic benefits.** After carefully considering each of these externalities, we found that:

- While some of the benefit is external, this external component is difficult to measure with any degree of confidence. This means these externalities are not consistent with criterion 2.
- The value of the external component is more closely linked with the availability of services (eg, their scope and frequency of services) than it is with the level of fares. This means these externalities are not consistent with criterion 3.

Our considerations of these externalities are discussed in more detail in Chapter 11.

3 Overview of our revised approach and draft findings

After considering the submissions received in response to our issues paper and undertaking extensive analysis, we have revised our approach to estimating the net external benefits of public transport. While the revised approach does not differ significantly from our current approach, we consider it includes refinements that improve its consistency and give us more confidence in the estimates it produces.

As Chapter 2 discussed, the revised approach includes a wider set of external benefits and costs associated with using public transport than the current approach. In addition, the revised approach:

- uses our own in-house model for estimating the value of the net external benefits of public transport, and better, more consistent inputs than we have previously used
- estimates the value of the net external benefits associated with one extra passenger journey, or an extra kilometre travelled on the existing public transport network, and
- if possible, will take account of external benefits and costs associated with likely changes to the current network.

We have applied our revised approach to estimate the current value of the net external benefits. Our findings provide an indication of net external benefits we will consider in our next round of fare reviews. However, we intend to reapply our final approach during these reviews, to ensure our estimates reflect the most-up-to-date inputs and are consistent with the other elements of the fare reviews.

The sections below provide overviews of our revised approach and our draft findings on the current value of the net external benefits estimated using this approach, and discuss how we intend to update these estimates for our next fare reviews.

3.1 Overview of our revised approach

We asked the Bureau of Transport Statistics (BTS) to model a number of different fare scenarios using SSTM. Those scenarios involved a number of different fare changes (up and down) for both one mode at a time and all modes at the same time.

To estimate the external benefit associated with changing fares for each mode, we constructed a model that uses the SSTM outputs for each scenario and other relevant data (for example, the value of time). This model estimates the total change in the external benefit when fares are changed:

- for each additional passenger trip made on that mode of public transport, and
- for each additional kilometre travelled (called marginal external benefits).

3.1.1 We use two types of information as inputs to our model

Our revised approach uses two main types of information as the basis for our estimates – the SSTM outputs discussed above, and other input data.

SSTM outputs

The SSTM outputs are based on a number of different fare changes modelled for us by BTS. The fare changes modelled ranged from 10% to 30% both up and down, for each of the modes individually and for all modes together. The SSTM predicts the impact of each scenario on:

- road congestion (vehicle trips, hours and kilometres travelled)
- tolls and parking levies paid
- walking and cycling (number of trips and kilometres)
- public transport use (passenger trips and kilometres travelled for each mode and fare revenue received).

For the draft report estimates, we used the SSTM results from the 20% fare change. Which fare change is used makes little difference to the overall outcome. This is because the SSTM outputs show little variation between fare changes, suggesting that most of the changes are linear (for example, when the fare change is twice as high, the SSTM outputs are twice as high). Because we have estimated external benefits for an additional passenger trip and passenger kilometre this results in only small variations between the results of the different fare changes modelled.

Other input data

The other input data comes from a range of sources but predominantly from information provided to us by Transport for NSW (TfNSW) and from publicly available sources.

TfNSW publishes guidelines for the appraisal of transport projects, which it uses to guide investment decisions in NSW.[12] These guidelines cover many of the items that we require as inputs to our analysis including a comprehensive set of values of time, estimates of congestion costs, environmental externalities and active transport. TfNSW updates the guidelines annually in consultation with state and federal agencies, consultants and academics and as a result they are fairly consistent with other approaches adopted in Australia. We have used data from the TfNSW guidelines wherever there were applicable estimates available.

3.1.2 We use rail fare estimates as the basis for the ferry estimates

The SSTM does not have the capability to separately adjust ferry fares – it effectively includes ferry routes as additional train lines. This means that we were unable to use the same approach for ferries as we did to estimate the external benefits for buses and trains.

In the past we estimated ferry external benefits by asking BTS to 'switch off' ferry services one route at a time within the SSTM. As our issues paper discussed, we are concerned that under such a significant change the results obtained from the SSTM are not sufficiently reliable.

There are some aspects of the external benefit calculation, such as the pollution emitted by ferries that can be modelled specifically for ferries. We have used ferry specific information where it is available. For the remaining estimates we have based our ferry estimates on the SSTM outputs for train services. This means that each of the external benefit estimates for ferries (apart from the excess burden of taxation) is set equal to those of trains in terms of $ per passenger kilometre as the starting point.

However, we have applied a multiplier to the congestion factor for ferries and applied different usage characteristics for ferry services to adjust for differences in rail and ferry related travel. For example, we recognise that a greater proportion of ferry travel occurs in the off-peak period compared with rail travel. This results in a different weighted average value of avoided congestion for ferries than for rail.

Why we use rail estimates as the basis for the ferry estimates

The estimates of avoided congestion per passenger kilometre are almost the same for rail and bus. However, the estimates of other externalities differ, particularly those:

- Active transport – these are affected by how far people walk to and from public transport.

12 Transport for NSW, *Principles and Guidelines for Economic Appraisal of Transport Investment and Initiatives*, March 2013.

- Road user charges – these are higher on a per kilometre basis for buses than for rail. This is because for each bus passenger kilometre change, there is a larger change in car kilometres than there is for rail (by 25%) – that is, more bus users are switching to car than are rail users.

In terms of active transport estimates, ferry is more like rail than bus. People walk further to ferry wharves on average than they do to both bus stops and train stations. When you consider the distance from the ferry wharf at the other end, the amount of walking to and from public transport is fairly similar for rail and ferry travel but less for bus travel.

Table 3.1 Average distances walked to and from public transport

Mode	Average access distance (km)	Average egress distance (km)	Total (access + egress) average distance (km)
Train	0.77	0.76	1.53
Bus	0.61	0.54	1.15
Ferry	0.98	0.64	1.62
Total	0.70	0.75	1.45

Source: BTS, *Household Travel Survey*, 5 years pooled data from 08/09 to 12/13.

In the absence of ferry-specific data, we consider that it is appropriate to take the more conservative approach for road user charges that is implied by using the rail estimate. This assumes that the switch between ferry use and car travel is the same as for rail. We consider that it is plausible that a greater proportion of ferry users may switch to bus travel as there are alternative bus routes for many ferry routes, similar to trains where there are often bus alternatives.

There is also likely to be more switching between ferry and bus than between ferry and rail. As a result, we consider that the rail figures provide a better proxy for ferry external benefits than the bus figures. This is also consistent with their treatment within the SSTM where they are modelled as train lines.

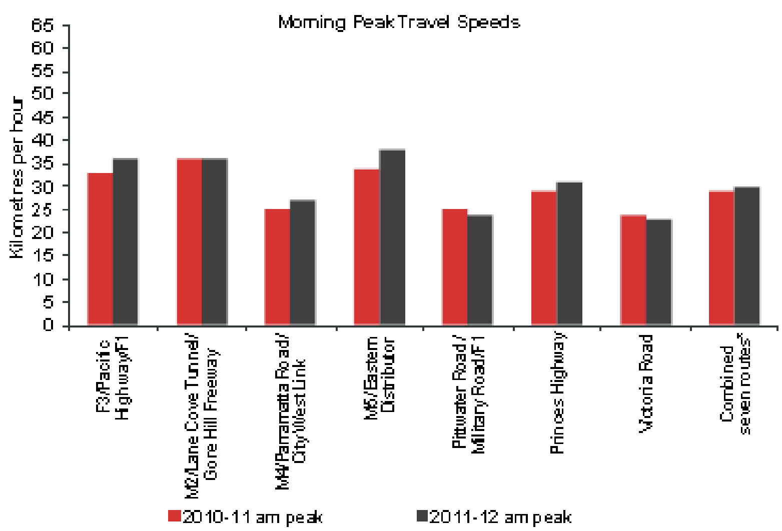
Why we adopted a higher congestion impact for ferries than for trains

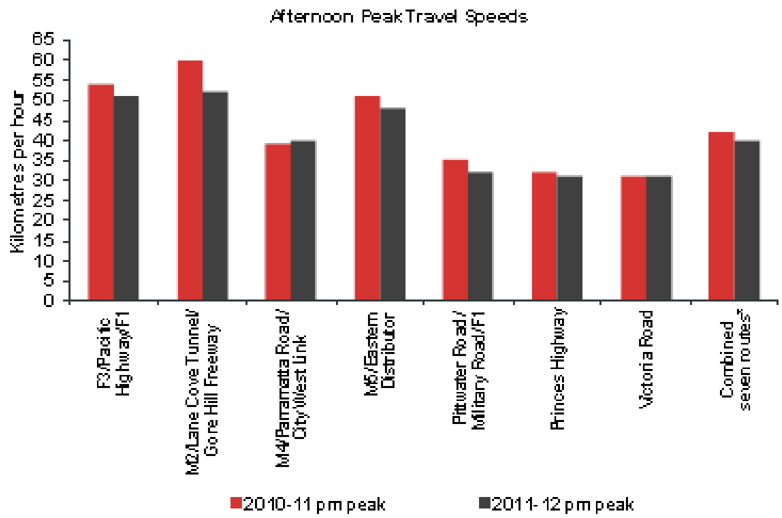
To obtain an estimate of the congestion avoided by ferries we have modelled ferry congestion at a multiple of 1.3 times the congestion impact for rail. This uplift is based on Sapere's previous modelling, which suggests that had a ferry passenger driven instead of catching public transport they would have a 30% greater impact on congestion than a rail passenger.

We did this because we consider that:

- Ferry trips are likely to be more direct than the equivalent road trips between origin and destination due to the geography. This suggests that if ferry users were to drive instead of using the ferry, their road trip would be a greater distance than the ferry trip. In addition, the difference between their road and ferry trips would be greater than the difference between the distance of the average train trip and the distance train users would drive if they did not use the train.
- There is evidence that the roads on which ferry travel relieves congestion are worse than those on which rail and bus travel relieves congestion. We have some information that suggests that the main routes to and from the CBD from areas serviced by ferries do have worse congestion in peak periods than the average of other main roads across Sydney. Information on average peak traffic speeds across Sydney roads suggests that (in 2011/12) the slowest traffice corridors in Sydney are Pittwater Road/Military Road/F1 and Victoria Road (Figure 3.1).

Figure 3.1 Average peak traffic speeds across Sydney roads





Note: Based on two surveys performed each year. Figure based on (unaudited) information obtained by NSW Auditor-General from RMS.

Data source: NSW Auditor-General's Report to Parliament, Volume eight 2012, Transport, Overview, p 19.

3.1.3 We base our estimates on the current network and timetables, and intend to take account of how TfNSW responds to changes in patronage

We asked BTS to provide SSTM outputs based on the current network and timetables. This means these outputs do not capture any future changes to service scope and frequency in response to changes in patronage, which may affect our external benefit estimates.

In particular, this limitation may affect our estimates of the environmental externality and the externalities that relate to scale and crowding. Each of these externalities is closely related to the way that service planning is done. For example, the pollution created by public transport itself is zero in our estimate of the change in the external benefit per passenger journey and per kilometre travelled. This is because our assumption to use the existing network means that the additional passengers are accommodated on existing services and do not create any increase in the amount of pollution created by public transport itself. (Chapter 5 discusses this issue in further detail.)

For this review, we have focused on the external benefits associated with an extra passenger using an existing service (that is, based on the current network, scope and frequency of services). We have assumed that as more people use public transport and services fill up, any additional passengers can be carried on existing services at no extra cost. In practice, there are likely to be additional external costs and benefits associated with changes to the number of people who use public transport. There will also potentially be changes to the cost of providing services.

What these external benefits and costs are depends on how TfNSW responds to changes in patronage. For example:

- If TfNSW responds to increased demand by increasing the scope and frequency of services this creates additional benefits to existing passengers which should be taken into account in setting fares (the external benefit of 'scale'). However, it also adds to the cost of providing services, some of which is off-set by additional fare revenue.
- If TfNSW does not change the number of services as demand for them increases this creates additional costs for existing passengers as their journeys become less comfortable, less productive and slower (the external cost of 'crowding').

Without knowing in advance what TfNSW's plans are regarding service changes it is not possible to value the external benefits of scale and crowding, or even to know which is relevant for each mode of public transport. Therefore, we propose to reassess the external benefits, taking these factors into account, during our next round of fare reviews when we expect to have better data on TfNSW's proposed expenditure on public transport. This would enable us to ensure that we have a consistent set of external benefits and costs that are based on a consistent set of patronage forecasts for our determination.

3.1.4 We do not attempt to model time-of-day differences in the externalities

In our issues paper, we indicated that we would consider whether to separately estimate external benefits at peak and off-peak times. Most submissions did not support separately estimating external benefits in peak and off-peak periods for varying reasons, including that it would over-complicate an already difficult assessment without any obvious benefit.

Most submissions acknowledged that most external benefits accrue in the peak. However, they argued that this should not be a reason to increase fares in the off-peak, as it would further disadvantage non-commuters such as older people and people on low incomes. One submission suggested that location could also be a consideration rather than (just) time of day or nature of travel, noting that the 'point of locational analysis would be to support efficient allocation of resources to 'solve problems' where they occur…'.[13]

Although we do consider there would be value in trying to separately identify peak and off-peak external benefits we have not done this. We do not currently have enough data to enable us to do this. For example, the SSTM is not able to accurately capture the impacts of changes in public transport demand at different times of the day.

13 J Austen submission to IPART's Issues Paper, 25 September 2014, p 8.

3.2 Summary of our draft findings on net external benefits

We have applied our draft revised approach to derive estimates of the value of:

- the net external benefits of each mode of public transport per passenger kilometre (Table 3.2)
- the net external benefits of each mode per passenger journey (Table 3.3), and
- the net external benefits of Sydney's total public transport network (Table 3.4).

These estimates provide an indication of the net external benefits we propose to consider in making our next fare determinations. However, as noted above, we intend to reapply our final revised approach during these reviews to ensure we use up-to-date information and we have a consistent set of external benefits and costs over the determination period. Section 3.3 provides more information on how we intend to do this.

Our current estimates indicate a range for the excess burden of taxation, which results in a range of results overall. The range results from different assumptions regarding the price elasticity of demand (that is, how responsive people's demand for public transport is to a change in fares). The price elasticity of demand affects our estimate of the excess burden of taxation. The higher the elasticity, the more price sensitive demand is, and for a given change in patronage a smaller subsidy is required, and consequently there is a smaller deadweight loss. Demand elasticity is higher in the long run (resulting in a smaller excess burden of taxation) than it is in the short run (see Appendix A). We have used both long and short run estimates to form the range.

Table 3.2 Draft findings on the current estimated value of net external benefits per passenger kilometre ($2014/15)

Externality	Rail	Bus	Ferry
Congestion cost – time	0.18	0.19	0.20
Congestion cost – vehicle operating cost	0.005	0.005	0.006
Congestion cost – reliability	0.04	0.04	0.04
Environmental externalities[a]	0.01	0.01	0.01
Accidents	0.0004	0.0005	0.0004
Active transport	0.01	0.01	0.01
Excess burden of taxation	-0.01 to -0.10	-0.02 to -0.11	-0.04 to -0.23
Road user charges	-0.02	-0.03	-0.02
Scale benefits	Not included at this stage		
Crowding costs	Not included at this stage		
Total net value	**0.12 to 0.20**	**0.12 to 0.20**	**0.01 to 0.21**

a Air pollution and greenhouse gas emissions

Notes: The excess burden for each mode is based on current fares. Ferries have a higher excess burden per passenger kilometre than other modes because they have a higher fare per passenger kilometre. This means that for a given change in fares, there is a larger dollar change in the revenue generated relative to the change in passenger kilometres. Under our current approach, fare levels are linked to the costs of service and the amount of costs recovered from users. Therefore, the level of excess burden is a function of the cost per passenger kilometre (as well as the elasticity of public transport). We will review costs as part of our fare reviews next year.

The range for excess burden of taxation reflects different estimates of the price elasticity of public transport.

Table 3.3 Draft findings on the current estimated value of external benefits per passenger journey ($2014/15)

	Rail	Bus	Ferry
$ per passenger kilometre	$0.12 to $0.20	$0.12 to $0.20	$0.01 to $0.21
$ per passenger journey	$3.37 to $5.60	$ 1.43 to $2.49	$0.12 to $2.08

Note: The range is based on different estimates of the price elasticity of demand for public transport, which affects the estimate of the excess burden of taxation.

Table 3.4 Draft findings on the current estimated value of total external benefits from Sydney's public transport network ($ million, $2014/15)

Share for externality types	
Congestion cost (time)	2407.2
Congestion cost (vehicle operating cost)	66.3
Congestion cost (reliability)	490.3
Congestion total	2963.8
Environmental externalities - avoided car use	177.3
Environmental externalities - created by public transport	-128.4
Net environmental externalities	48.9
Accidents	6.5
Active transport	83.3
Excess burden of taxation	-214.0 to -1387.2
Road user charges	-322.0
Scale benefits	Not included at this stage
Crowding costs	Not included at this stage
Total	**1393.2 to 2566.4**

Note: The range for excess burden of taxation reflects different estimates of the price elasticity of demand for public transport.

3.2.1 We have estimated the external benefit on a per trip and per kilometre basis for each mode of public transport

We estimated the additional external benefit that would result from one extra passenger trip, or one extra kilometre travelled, on each mode of public transport when fares are changed for that mode only.

Examining the external benefits on a mode by mode basis provides good information about the implications of changing fares. Modelling what happens when fares are changed for one mode at a time allows us to look at the costs and benefits that change has on other modes of public transport – for example:

- How many additional train trips would there be if we raise fares for buses but not trains?
- Would this result in additional costs in the form of crowding or create the need for additional rail services, which would affect the cost of providing rail services?

To the extent that it is Government policy to have mode-specific fares and for those fares to signal differences in the costs and benefits associated with each mode of transport, it is important to be able to consider each mode individually.

However, as indicated in our issues paper, we were concerned that the approach we have used in the past did not adequately capture all of the implications of people shifting between all of the different modes of transport because for each separate mode of public transport we only measured the external benefits and costs associated with switching between it and driving. Under our revised approach, the change in the external benefit when an extra passenger uses public transport, or travels an extra kilometre, now includes the external benefits (and costs) associated with switching between each mode of public transport and all of the other transport options (driving, walking, cycling and other modes of public transport). For example, when bus users faced with a fare increase switch to rail they walk further on average to and from a train station than they used to walk to their bus stop. The external benefit associated with the increase in walking to railway stations is captured in the external benefit estimate for buses.

Because the marginal external benefit includes all of the implications of switching between different transport options, we consider that it fully captures the external benefit associated with changing fares for each mode. As a result, we are satisfied that looking at the external benefit outcomes when fares are changed for each mode individually is still appropriate.

3.2.2 We have also estimated the total external benefit of public transport

The most relevant external benefit for setting fares is the estimate of how much external benefits change on a passenger trip or kilometre travelled basis in response to a change in fares. However, we have also estimated the total value of the external benefits created by the public transport network in the greater Sydney area. We estimated this by:

- quantifying the external benefit of an extra passenger kilometre when fares for all modes of public transport are changed at once
- multiplying this by the total number of kilometres travelled on the current network,[14] and
- deducting the cost of pollution created by public transport itself.

Deducting the cost of pollution created by public transport itself from the value of the pollution it avoids is an additional step that is only relevant for estimating the total value of the external benefit. Under our revised approach we have not done this in estimating the current value of the external benefit from an additional passenger trip, or kilometre travelled, because we assume that the extra trip can be accommodated on existing services (that is, we assume that it does not increase the amount of pollution created by public transport).

14 This approach assumes that the external benefit of each passenger trip is equal irrespective of how many trips are made.

In estimating the current value of the total external benefit, we have considered the network as a whole (when public transport fares are all changed at the same time), as this means there are fewer people who switch between the different public transport options. When fares are changed for each mode in isolation, the pollution associated with the car use avoided by both bus and ferry is outweighed by the pollution created by buses and ferries themselves (that is, the environmental externalities for these modes are negative overall).[15] This is because so many people who use these modes switch to other modes of public transport in preference to driving when their fares rise. This suggests fewer avoided car trips than there would be if all modes were considered together and in our view does not provide a good reflection of the value of the total external benefit.

As a result, we propose to estimate the total value of the external benefit by moving fares for all modes at the same time. The estimate from changing fares for all modes at the same time is greater than the sum of the individual mode estimates.

3.3 We intend to update the external benefit estimates during the next round of fare reviews

Over the past five years we have been using a building block approach to set public transport fares. Under this approach, we have deducted the value of the total external benefits from the total efficient cost of providing services in order to obtain the revenue that should be recovered through fares.

However, as part of our next round of fare reviews, we propose to consult on whether this is the appropriate way to use the value of total external benefits. For example, we consider the current approach does not take into account whether a subsidy equal to this value would lead to increased use of public transport, and thus is efficient from an economic perspective. To assess this, we would need to estimate the demand response to the fare changes implied by such a subsidy (and the resulting impacts on costs, revenue, and external benefits).

We propose to begin the next round of public rail, bus and ferry reviews in 2015, and review all modes concurrently. We expect to make new fare determinations to take effect from 1 July 2016. This would mean we bring forward our bus and ferry reviews, and delay our rail review by around six months.[16]

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15 This is consistent with our past findings for ferries.

16 Our rail determination is due to be replaced in January 2016, while our bus and ferry determinations are due to be replaced in January 2017.

Conducting our next rail, bus and ferry reviews concurrently would allow us to:

- consider how the different methods of valuing external benefits and costs should be used for setting fares and ensure that all modes reflect the most up-to-date estimates
- ensure that a consistent set of data and assumptions are used to inform forecast external benefits and costs
- quantify additional externalities associated with scope and crowding based on up-to-date information on TfNSW's planned changes to public transport services, and incorporate these into our estimates.

We consider this would ensure that we use external benefits values that are as reliable as possible and are consistent with the other elements of our fare reviews.

4 External benefit from less road congestion

The availability of public transport services reduces the number of cars on the road. Fewer cars on the road mean less road congestion, which benefits road users. This is an external benefit of public transport, as it is a benefit external to those using public transport.

Our previous estimates of the value of the external benefit from less road congestion was measured in terms of the value of time saved for existing drivers when people who would otherwise drive instead used public transport. In addition to this external benefit, we intend to include vehicle operating costs and reliability as external benefits which increase as people switch from driving to public transport, thereby reducing traffic congestion.

The section below sets out our draft findings on the estimated value of each of these components. The following sections discuss the components in more detail, including what they are, why they are a benefit and how they meet our criteria for inclusion. We also compare them to our previous estimates.

4.1 Overview of draft findings

IPART finding

1 The current estimated value of the external benefit from avoided road congestion is as shown in Table 4.1.

Table 4.1 Draft findings on the current estimated value of external benefit associated with avoided road congestion ($2014/15)

	Rail	Bus	Ferry	Total
Congestion cost (time)				
$ per passenger trip	4.88	2.33	1.98	
$ per passenger km	0.18	0.19	0.20	
$m				2,407.2
Congestion cost (vehicle operating cost)				
$ per passenger trip	0.14	0.06	0.06	
$ per passenger km	0.005	0.005	0.006	
$m				66.3
Congestion cost (reliability)				
$ per passenger trip	1.01	0.46	0.41	
$ per passenger km	0.04	0.04	0.04	
$m				490.3

4.2 The external benefit from reduced congestion

As people move to public transport instead of driving, congestion is reduced for existing road users. This is an external benefit of public transport use, as the benefit is outside the decision to use public transport. Reduced congestion saves time, reduces vehicle operating costs, and increases the reliability of journey times for existing road users.

Most people decide between driving themselves and using public transport based on the costs and benefits of each option to them, without considering the external costs and benefits each option imposes on the community. One way to encourage more people to make the socially efficient decision is to ensure that the cost of car travel reflects its true costs, which includes road congestion and air pollution.

From an economic perspective, this could be done via a system of road use pricing that makes the internal cost of car travel equal to both the internal and external costs it imposes on the community (see Box 4.1). If this were the case, there would be no need to take into account the external costs of car travel (ie, the external benefits of public transport) in setting public transport fares. However, without such a system, lowering public transport prices is another way to encourage better travel choices that benefit everyone.

Box 4.1 Road pricing

Road users currently do not pay the full cost that their road use imposes on society as a whole, including the economic and social costs of road congestion. Motorists pay fixed costs related to motor vehicle ownership such as registration, and charges related to use such as the fuel excise and various tolls. However, most of these charges do not provide price signals that encourage drivers to modify their patterns of road use to allow scarce road space to be allocated to those who place the highest value on this space.

Road congestion pricing on the other hand, is intended to signal the differing congestion-related costs that people's decisions to use the road at particular times and particular parts of the network impose. By charging more to travel at certain times of the day or in particular areas, congestion pricing seeks to internalise the external congestion costs such as increased travel time and reduced trip reliability that each additional driver imposes on other drivers. This will encourage drivers to consider congestion costs when making travel choices.

Road congestion pricing can also influence road users to modify their travel patterns. For some trips, they may choose to change how, when or where they travel. For other trips, they may have less flexibility and so decide to continue to travel by road at the congested time.

Road congestion pricing also tends to allocate scarce road space to the most productive use. Where there is no road congestion pricing, scarce road space is allocated by queuing, which imposes congestion-related costs indiscriminately on all road users. However, with congestion pricing, road users who place a higher value on scarce road space. For instance, drivers of freight or commercial vehicles who have little discretion about when and how they travel, and for whom shorter trip times and greater trip reliability are particularly important will generally be willing to pay a higher price to access the road. Those who place a lower value on scarce road space (such as those travelling for discretionary purposes) are likely to be less willing to pay a higher price. As a result, congestion pricing is likely to discourage low value road use during peak periods so the scarce road space can be allocated to higher value use. By improving the efficiency of road use, this can result in wider economic, social and environment benefits.

Efficient road congestion pricing would reflect the actual congestion costs imposed by drivers' use of roads at particular times. To do this, tolls would need to be updated in real time, and would increase rapidly as a road approaches its capacity.

An example is in San Diego, California on the I-15 motorway, which allows single occupancy vehicles the opportunity to pay a toll to access high occupancy vehicle lanes. These tolls range from 50 cents to a maximum of $8 depending how far you are travelling and the congestion in the express lanes at the time of entry. Signs display the minimum toll for entering the express lanes and the maximum possible toll.[a]

a http://fastrak.511sd.com/san-diego-toll-roads/i-15-express-lanes accessed 5 December 2014.

4.3 Congestion cost – time

Congestion cost (time) is the external benefit associated with the avoided time (or additional time) for car users to travel as a result of the change in public transport fares. The external benefit associated with avoided road congestion is based on the value of time saved for existing drivers when people who would otherwise drive use public transport instead. When increased public transport patronage reduces the number of cars on the road it results in a benefit external to those who use public transport. In our previous estimates of the value of external benefits, the time savings from avoided cost of road congestion were the most significant component.

4.3.1 Value of travel time

In order to calculate the cost of the congestion avoided when more people use public transport, it is necessary not only to quantify the change in travel time but also to put a value on it.

In the past we have used a value of time that represented half the average wage rate. We did not use separate estimates for business and private travel time. The latest value of time consistent with this approach is $18.35 per hour.[17]

We are now proposing to use the Transport for NSW (TfNSW) appraisal guidelines for estimating the value of travel time. These guidelines are based on the Austroads guidelines which attempt to harmonise the values used in Australian project evaluations.[18]

Where we have previously applied the same value of time to all types of travel, the TfNSW estimates separately value time for private travel and business travel based on the following principles:

- Private travel time is valued at 40% of the average hourly earnings, applicable for travel modes of private car, motorcycle, bicycle, pedestrian, and public transport for commuting and recreational trip purposes.
- Business travel time is valued at 128% of the average hourly earnings, for all business trips. This includes on costs of 35%less payroll tax of 7%.[19]

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17 The ABS's most recent figure for the average hourly earnings (from May 2012) is $34.30 from the latest figures of average hourly cash earnings for ordinary work of full-time non-managerial adult employees in NSW ABS 6306.0, Table 1.2, 23 January 2013. Half of this is $17.15 which we have escalated to $2014/15 to give $18.37.

18 Transport for NSW, *Principles and Guidelines for Economic Appraisal of Transport Investment and Initiatives*, March 2013; Austroads, *Guide to Project Evaluation – Part 4: Project Evaluation Data*, 2012.

19 Transport for NSW, *Principles and Guidelines for Economic Appraisal of Transport Investment and Initiatives*, March 2013, Appendix 4, p 218.

Escalated to $2014/15, this gives the following values of travel time:

- $15.50 per hour for all private travel
- $49.61 per hour for business travel.

We have used the TfNSW Guidelines recommended escalation factor of 0.75%pa above the annual change in CPI. This is based on the Guidelines estimate of the growth in real productivity of 1.5%pa multiplied by an elasticity of 0.5 to allow for the fact that not all travel time savings will be used in productive activities.[20]

We propose to use a weighted average value of travel time in our external benefits calculation. Consistent with the TfNSW and Austroads approach, we have valued trips to and from work at the private value of travel time. The latest BTS Household Travel Survey indicates that around 8% of trips were made for the purpose of work related business.[21] Valuing all other travel at the private value of travel time, this gives a weighted average value of travel time in $2014/15 of $18.19 per hour.

Could we use a peak value of time?

Most submissions to our issues paper did not comment on value of time. One submission recommended that we use different values of time for peak and off-peak periods.[22] We have considered whether it is possible to do this by using the business value of time as a proxy for peak travel and the private value of time as a proxy for off-peak travel. This would mean valuing trips to and from work at the higher business value of travel.

Using the business value of time as a proxy for peak travel suggests that external benefits of avoided road congestion would be greater in peak periods than at other times. However, the reason that the external benefit of avoided congestion is higher in peak periods is not because the people who travel in the peak value their time more highly than people who travel in the off-peak. In fact, to value peak period travel at the business valuation would be inconsistent with the approach taken in cost benefit analyses. Both the TfNSW guidelines and the Austroads approach (which is well accepted nationally) consider that the appropriate value of time for people travelling to and from work (peak travel) is the private value of time.

20 Transport for NSW, *Principles and Guidelines for Economic Appraisal of Transport Investment and Initiatives*, March 2013, Appendix 4, pp 222-223.

21 Bureau of Transport Statistics, *2011/12 Household Travel Survey, Summary Report 2013 Release*, Table 4.2.2, p 30.

22 Mike Smart submission to IPART's Issues Paper, 30 September 2014, p 4.

It is the higher level of congestion on the roads at peak times that drives the higher external benefit. The higher level of congestion means that the delay caused by additional road users is greater than in off-peak periods (when in many cases additional cars can be added without slowing the traffic at all).

Being able to separately model the impact of fare changes in peak and off-peak times would help with estimating external benefits by time of day, but the SSTM is currently not able to do this. There is also not sufficient data available that would allow us to estimate this outside the SSTM process.

Given these limitations, and consistent with the TfNSW and Austroads approach, we intend to use the private value of travel time for all travel except business travel and not use a peak value of time.

4.3.2 Estimating the value of the external benefit of avoided road congestion - time

For each modelled fare change, the SSTM calculates the total vehicle kilometres travelled, the change in vehicle kilometres by speed, and the in-vehicle time savings. We use these inputs to calculate the external benefits of reduced congestion, as below in Table 4.2.

Table 4.2 Current estimated value of external benefit associated with avoided road congestion – time saving ($2014/15)

	Rail	Bus	Ferry	Total
$ per passenger trip	4.88	2.33	1.98	
$ per passenger km	0.18	0.19	0.20	
$m				2,407.2

The above estimates of the external benefit from congestion time savings are different on a $ per passenger trip basis compared with our previous estimates.

Notably, on a $2014/15 basis, for rail the external benefit of the congestion time saving has decreased from $6.86 to $4.88 while for buses has risen from $1.30 to $2.33. These variations highlight how refinements to our methodology since we started estimating external benefits have led to slightly different approaches over time for each public transport review.

Conducting this review of external benefits has allowed us to reconsider our methodology and inputs on a consistent basis across all public transport modes.

4.4 Congestion cost - vehicle operating costs

With increased congestion, vehicle operating costs increase as vehicles move more slowly. For example, at 20km per hour the vehicle operating cost is 39.5 cents per kilometre, while at 80km per hour it is 34.1.[23] This indicates the higher costs of travelling at slower speeds, particularly in congestion.

We are proposing to include the decrease in vehicle operating costs for existing drivers as a new component of the external benefit related to less road congestion. As with the external benefit associated with congestion time savings, this external benefit arises when drivers switch to using public transport and there is a reduction in congestion. We consider these costs should be included, for similar reasons as why we have included the time savings associated with reduced congestion. Namely, as people move to public transport instead of driving, congestion is reduced for existing drivers, and in this way is an external benefit for these drivers.

In order to estimate the external benefit associated with vehicle operating costs, we have used the TfNSW guidelines which have estimates for vehicle operating costs at different speeds. These operating costs include resource costs such as fuel, oil, tyre, vehicle capital costs, repair and maintenance.[24] Our model uses these vehicle operating costs and changes in car vehicle kilometres at each speed across Sydney under various fare scenarios to estimate the external benefit.

In comparison to the external benefit associated with the time saving of reduced congestion, the external benefit associated with vehicle operating costs is quite small, as shown in Table 4.3 below.

Table 4.3 Current estimated value of external benefit associated with avoided road congestion - vehicle operating costs ($2014/15)

	Rail	Bus	Ferry	Total
$ per passenger trip	0.14	0.06	0.06	
$ per passenger km	0.005	0.005	0.006	
$m				66.3

4.5 Congestion cost – reliability

We are also proposing to include a third component to the external benefit from reduced congestion that occurs when more drivers switch to using public transport. This is the reliability cost impact that increases with traffic volume.

23 Transport for NSW, *Principles and Guidelines for Economic Appraisal of Transport Investment and Initiatives*, March 2013, Appendix 4, Table 11, p 228; escalated to $2014/15.

24 Transport for NSW, *Principles and Guidelines for Economic Appraisal of Transport Investment and Initiatives*, March 2013, Appendix 4, Table 11, pp 227-228.

Consistent with the UK Department for Transport's *Transport Analysis Guidance*, we use the term 'reliability' to refer to variation in journey times that individuals are unable to predict. Such variation could come from recurring congestion at the same period each day or from non-recurring events, such as vehicle accidents, bad weather or major events. It excludes predictable variation relating to varying levels of demand by time of day, day of week, and seasonal effects which travelers are assumed to be aware of.[25]

This is in addition to the 'standard' congestion cost associated with time savings discussed above under section 0 and includes the travel delay component of accident congestion costs. It is also separate to the external benefit included in Chapter 6 for accidents such as the taxpayer funded emergency services.

Reliability is different from congestion. For example, a traveler may face average congestion of 10 minutes for a car trip. This has a cost of 10 minutes multiplied by their value of time. However, if the delay varies from no congestion to 20 minutes congestion, then this (unpredictable) variability imposes additional costs beyond the average level of congestion. This has been widely acknowledged as imposing a cost additional to congestion.[26]

Reliability is measured by the standard deviation of travel time. In the context of our review, we are concerned with the change in the standard deviation of travel time that occurs when there is a change in vehicle kilometres travelled. As vehicle kilometres travelled increases, the standard deviation of travel time increases. In other words, travel time becomes less reliable at the same time as roads become more congested.

Our model estimates the change in the standard deviation of travel time using an equation developed by Hyder Consulting, Ian Black and John Fearon (see Box 4.2). We apply this equation to an average journey – that is, with an average distance at average speeds for the particular fare scenario.

Changes in variability of journey time (measured by the standard deviation) are then expressed in monetary terms by applying the reliability ratio defined as:

Reliability Ratio = Value of standard deviation of travel time / Value of travel time

We use a reliability ratio of 0.8, based on the UK TAG Guidelines and also consistent with the Bureau of Transport and Regional Economics.[27]

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25 UK Department for Transport, *Transport Analysis Guidance - User and Provider Impacts,* January 2014, p 10.

26 For example, Bureau of Transport and Regional Economics 2007, *Estimating urban traffic and congestion cost trends for Australian cities,* Working paper 71, pp 93-95.

27 Bureau of Transport and Regional Economics 2007, *Estimating urban traffic and congestion cost trends for Australian cities*, Working paper 71, p 93; and UK Department for Transport, *Transport Analysis Guidance (TAG) - TAG Unit A1.3 User and Provider Impacts*, January 2014, p 12.

Box 4.2 Change in the standard deviation of travel time

The change in the standard deviation of travel time is derived by:

$$\Delta\sigma_{ij} = 0.0018(t_{ij2}{}^{2.02} - t_{ij1}{}^{2.02})d_{ij}{}^{-1.41}$$

where:

$\Delta\sigma_{ij}$	is the change in standard deviation of journey time from i to j (seconds)
t_{ij1} and t_{ij2}	are the journey times, before and after the change, from i to j (seconds)
d_{ij}	is the journey distance from i to j (km).

Note: Our model generates changes in journey time and distance for desired scenarios.

Source: Hyder Consulting, Ian Black and John Fearon (2007) in UK Department for Transport, *Transport Analysis Guidance (TAG) - TAG Unit A1.3 User and Provider Impacts,* January 2014, pp 11-12.

Similar to the other two components of the external benefit associated with congestion, reliability increases as more drivers switch to using public transport. That is, there is an external benefit for existing drivers as roads become less congested and travel times become more predictable.

Our current estimates of the reliability congestion cost are:

Table 4.4 Current estimated value of external benefit associated with avoided road congestion - reliability ($2014/15)

	Rail	Bus	Ferry	Total
$ per passenger trip	1.01	0.46	0.41	
$ per passenger km	0.04	0.04	0.04	
$m				490.3

5 Environmental externalities

Every litre of fuel consumed by motorised transport contributes to air pollution and carbon emissions. High levels of these pollutants are associated with adverse health effects, such as respiratory and cardio-vascular problems,[28] and carbon emissions impact climate change. This imposes a cost on society.

Under our revised approach (and our current approach) we have estimated how much more air pollution and greenhouse gas pollution is avoided by public transport and quantified the benefit of this. We have also deducted from this the estimated pollution that is emitted by public transport.

The section below sets out our draft findings on the current value of environmental externalities associated with public transport use. The following sections discuss in more detail what these externalities are and how we have valued them.

5.1 Overview of draft finding

IPART finding

2 The current estimated value of the environmental externalities associated with public transport is as shown in Table 5.1.

Table 5.1 Draft findings on the current estimated value of environmental externalities ($2014/15)

	Rail	Bus	Ferry	Total
$ per passenger trip	0.34	0.17	0.12	
$ per passenger km	0.01	0.01	0.01	
$m				177.3

5.2 Which environmental externalities are included?

We propose to continue to include estimates of avoided air pollution and greenhouse gas pollution in our analysis but not to expand our estimate to include other sources of pollution at this stage.

[28] Watkiss, *Fuel Taxation Inquiry: The air pollution costs of transport in Australia,* March 2002, p 1.

For car, bus and ferry services we have not included the cost of emissions associated with upstream activities (eg, pollution emitted by the oil refinery used to make the diesel used by buses). It would be difficult to fully value the relevant upstream and downstream pollution associated with the different modes of transport and as such, we have decided not to include them. However, for rail we have estimated the air pollution and greenhouse gas emissions associated with the production of the electricity used to drive the trains. In our view, it would be inconsistent to leave this out of our estimates and to treat the pollution from the rail network itself as zero, simply because of the type of energy used to drive the vehicles.

Three submissions argued that we should include noise pollution in our definition of environmental externalities.[29] One stakeholder dealt with this issue in more detail, submitting that we have taken a very narrow view of pollution by not including noise pollution in the evaluation of ferry externalities submitting that noise pollution is higher for people living on land transport corridors than for those living on the waterfront, ie, the impact from the ferry corridor is lower.[30]

We agree that noise pollution is similar to air pollution in the sense that it is created by all modes of transport – fewer cars should reduce noise pollution, but more buses and trains would add to it. In theory we agree that this should be taken into account in our estimates to the extent that it is affected by public transport use. However, estimates of other forms of pollution, particularly noise pollution, are more subjective[31] and we do not have access to a good dataset for these at this stage. As a result, we have not quantified the costs avoided by other types of pollution.

We also consider that some of the other forms of pollution caused by transport are less closely related to the level of usage of public transport and so may not meet the criteria for inclusion even if we were able to obtain consistent and reliable data on the costs associated with them. However, if this data becomes available in future we will consider including it into our estimate.

29 Action for Public Transport (NSW) submission to IPART's Issues Paper, 7 October 2014; Varley Group Pty Ltd and the Tom Farrell Institute of the University of Newcastle submission to IPART's Issues Paper, 30 September 2014; Mori Flapan submission to IPART's Issues Paper, 30 September 2014.

30 Mori Flapan submission to IPART's Issues Paper, 30 September 2014, p 5.

31 For example, estimates may be based on a number of different approaches including willingness to pay surveys.

5.3 How did we value the external benefit of emissions avoided?

We estimated the additional external benefit that would result from one extra passenger trip, or one extra kilometre travelled, on each mode of public transport when fares are changed for that mode only. To do this, we have focused on the external benefits associated with an extra passenger using an existing service (that is, based on the current network, scope and frequency of services). We have assumed that as more people use public transport and services fill up, any additional passengers can be carried on existing services at no extra cost. This means that the environmental externalities avoided by this additional passenger journey, or additional kilometre travelled, is equal to the cost of the emissions from the car travel it avoids.

We estimated the cost of emissions avoided for each mode using SSTM results regarding how much driving is avoided by public transport and using estimates of the cost of car emissions from the Transport for NSW appraisal guidelines.[32]

We also estimated the total value of pollution avoided by the existing network based on the existing number of service kilometres and passenger journeys. We estimated this by quantifying the external benefit of an extra passenger kilometre when fares for all modes of public transport are changed at once and multiplying this by the total number of kilometres travelled on the current network.[33] We then deducted the cost of pollution created by public transport itself to get an estimate of the total value of external benefits associated with Sydney's public transport system.

As well as the cost of pollution associated with car travel, the Transport for NSW appraisal guidelines also include estimates for air pollution and greenhouse gas emission costs for buses and trains. However, the guidelines do not currently include estimates for the pollution created by Sydney Ferries and light rail services, which we also require. Therefore, we engaged a consultant, Arup, to provide us with suitable estimates for these modes using the unit costs for different types of pollution from Transport for NSW's appraisal guidelines in order to ensure consistency with the estimates for other modes. We received one submission on this issue arguing that any emissions analysis should be conducted by a competent and independent transport engineer, and not by an economist.[34] Arup has experience in similar projects and the team responsible for delivering the estimates included specialist transport engineers. The reports provided by Arup are available from our website.[35]

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32 TfNSW, *Principles and Guidelines for Economic Appraisal of Transport Investment and Initiatives* March 2013.

33 This approach assumes that the external benefit of each passenger trip is equal irrespective of how many trips are made.

34 Mori Flapan submission to IPART's Issues Paper, 30 September 2014, p 5.

35 Arup, *Cost of emissions for NSW Ferry Networks*, Final Report, 19 November 2014 and Arup, *Cost of emissions for NSW Light Rail*, Final Report, 19 November 2014.

We used the cost of emissions created by buses from TfNSW's guidelines.[36] However, the rail estimates in the Transport for NSW appraisal guidelines do not include the pollution associated with the electricity used to drive the trains (and as a result, appear to be well below the Arup estimates of the cost of greenhouse gas emissions for light rail). We adopted Arup's light rail estimates for the Sydney train network instead, as we consider this is likely to provide a better estimate of the pollution associated with trains than Transport for NSW's appraisal guidelines.

The estimates we used are in Table 5.2. As noted above these are based on the estimates in the TfNSW guidelines supplemented by estimates we commissioned from Arup.

Table 5.2 Environmental externalities (cents per vehicle kilometre, $2014/15)

	Car[a]	Bus[a]	Rail[b]	Ferry[b]
Air pollution	3.11	35.07	38.59	890.18
GHG emissions	2.45	14.45	30.47	87.46

a These estimates are from Transport for NSW's appraisal guidelines, updated from $2012/13 to $2014/15.

b These estimates are from Arup, updated from $2012/13 to $2014/15. The rail estimates are based on Arup's estimate for light rail.

Source: Transport for NSW, *Principles and Guidelines for Economic Appraisal of Transport Investment and Initiatives*, March 2013, p 261; Arup, *Cost of emissions for NSW Ferry Networks, Final Report*, 19 November 2014, p 1 and *Cost of emissions for NSW Light Rail, Final Report*, 19 November 2014, p 1.

The unit values of emissions that these costs are based on are set out in Table 5.3.

Table 5.3 TfNSW guidelines unit values for emissions ($/tonne, $2014/15)

Carbon dioxide equivalent (CO2-e)	58.5
Carbon monoxide (CO)	3.7
Oxides of nitrogen (Nox)	2,332.1
Particulate matter (PM10)	371,166.5
Total hydrocarbons (THC)	1,168.5

Source: Transport for NSW, *Principles and Guidelines for Economic Appraisal of Transport Investment and Initiatives*, March 2013, Table 54, p 263.

Our previous estimate of the environmental externalities for ferry services was negative – in other words, we found that Sydney Ferries create more pollution than they avoid. The main reasons for this were that Sydney Ferries services are relatively polluting compared with other modes of transport, on average they run at low rates of utilisation and many passengers who currently use them would travel by bus if ferry services were unavailable (meaning the amount of car use they avoid is not that high).[37]

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36 Transport for NSW, *Principles and Guidelines for Economic Appraisal of Transport Investment and Initiatives*, March 2013.

37 Sapere Research Group, *External benefits of Sydney Ferry services - Final report to IPART*, 23 August 2012, p iii.

We received a submission concerned with our previous approach.[38] The submission outlined a number of concerns including that we previously used average fleet utilisation in the calculation, which meant that Manly commuters were worse off and that allowing competition on ferry routes further lowers utilisation, which would make the estimates of avoided pollution even lower.

Our draft decision estimates are based on the external benefits associated with an extra passenger journey, or an extra kilometre travelled, on the existing public transport network, which does not include any of the pollution emitted by public transport itself. This is a significant change in methodology compared with our previous approach, which allocated a share of the pollution created by public transport to each of the existing passengers.[39] This change in methodology leads to a significant difference in the cost of emissions avoided per passenger journey, particularly for ferry services as they have relatively high emissions compared with other modes of transport.

We consider that the approach we have taken in this draft report for estimating the avoided pollution for an additional passenger trip provides a good indication of the implications of changing fares on the value of the external benefit from public transport than our previous approach. However, we have also estimated a total value of external benefits from the current network that does take the cost of pollution created by public transport into account. Using the approach from this draft report, the inclusion of own-source pollution leads to a significantly lower external benefit (Table 5.4).

Table 5.4 Total environmental externalities ($ million, $2014/15)

Share for externality types	All modes
Avoided pollution from cars	177.3
Pollution from public transport	-128.4
Net pollution externalities	48.9

Note: Based on pollution associated with current ferry fleet.

The information we have suggests that public transport is the most environmentally efficient means of transportation if it is well utilised. However, public transport services that are not well utilised are not very environmentally friendly. This is especially important for ferry services which are relatively polluting compared with train and bus services. The implication of this is that the most environmentally efficient means of pricing public transport is the one that maximises utilisation of existing services but does not result in the introduction of additional services with poor levels of utilisation. This is an issue we will consider in more detail as part of our upcoming fare reviews.

38 Mori Flapan submission to IPART's Issues Paper, 30 September 2014, p 5.
39 IPART, *Estimating the external benefits of public transport – Issues Paper*, August 2014, p 26.

5.4 How we have incorporated changes in technology

Over time, the external costs of pollution have diminished as vehicle standards have led to major improvements to air quality, particularly, in the last 10 years.[40] As such, the information used to estimate the costs of pollution avoided can change relatively quickly. In our issues paper we noted that because the outcome of this calculation is heavily dependent on the efficiency of vehicles and the costs associated with pollution, it is important that the inputs reflect best available information and current estimates of these.[41]

We have used up-to-date estimates from Transport for NSW's appraisal guidelines, supplemented by the Arup work, to establish the current costs. However, we have decided not to make any changes to the estimates we include to account for improvements in technology that have not yet occurred. We will revise our estimates of the costs of pollution avoided by public transport at each fare review in order to ensure that we have up-to-date information and that our estimates are consistent across the modes of transport for which we determine fares, and with the mix of vehicles we expect over the determination period.

Our past assessments of external benefits found that the pollution created by ferries is significant.[42] One of the reasons for this is the age of the existing ferry fleet. Cars and buses have both been subjected to increasingly stringent emission standards and the vehicles tend to be replaced relatively frequently. In Sydney, the trains are also relatively new. However, ferries have not been replaced as frequently and the current Sydney Ferries fleet is quite polluting.

One submission argued that our external benefit calculations should be made using an efficient ferry fleet and should not take into account the pollution created by 25-year old ferries.[43] There are plans to replace the Sydney Ferry fleet progressively commencing in 2016 and we expect that the new vessels coming on will be less polluting than the existing fleet. We engaged a consultant, Arup, to estimate the costs associated with air pollution and greenhouse gas pollution of Sydney Ferries current fleet. We also asked them to advise on what the pollution estimates would look like if the fleet was replaced with fuel efficient vehicles of the same seating capacity. They estimated a reduction in emissions of 6% to 10%.[44]

40 Australian Government, Department of Infrastructure and Regional Development, *Vehicle Emissions Standard*. <https://www.infrastructure.gov.au/roads/environment/emission/index.aspx> accessed 21 August 2014.

41 IPART, *Estimating the external benefits of public transport – Issues Paper*, August 2014, p 27.

42 Sapere Research Group, *External benefits of Sydney Ferry services - Final report to IPART*, 23 August 2012.

43 Mori Flapan submission to IPART's Issues Paper, 30 September 2014, p 5.

44 Arup, *Cost of emissions for NSW Ferry Networks, Final Report*, 19 November 2014, p 10.

We note that currently TfNSW anticipates that the first new vessels due to commence operation in 2016 and will replace existing First Fleet ferries. The new vessels will be introduced with additional capacity, with around 90 more seats than the vessels they will replace.[45] At this stage we have based our estimates on the existing ferry fleet. The reasons for this are:

- We aim to have a consistent set of estimates across modes.
- The First Fleet ferries are not the most polluting ferries – a 6-10% reduction in the emissions associated with replacing some of these ferries from 2016 does not result in a significant reduction in the amount of pollution created by Sydney Ferries services in total. In addition, the planned increase in vessel capacity may increase the fuel consumption, and hence emissions, relative to a fuel efficient vessel of the same size as the existing fleet so the expected reduction in emissions would be less than it would otherwise be.
- We consider that it is very important that, when we come to set fares, there is a consistent basis between the cost estimates and the external benefits – in the case of ferries, we note that at our last review we factored in costs associated with some level of fleet replacement using vessels with reduced capacity.[46] Both the fuel efficiency of the new fleet and the size of the vessels would be expected to affect the pollution created by the fleet.

The potential impact on environmental externalities from replacing the existing Sydney Ferries fleet with new, more fuel efficient ferries is set out in Table 5.5.

Table 5.5 Total environmental externalities – all modes ($ million, $2014/15)

	Current ferry fleet	6% lower ferry emissions	10% lower ferry emissions
Avoided pollution from cars	177.3	177.3	177.3
Pollution from public transport	128.4	127.3	126.5
Net pollution externalities	48.9	50.0	50.7

Note: Arup estimates of efficiency improvements have been applied to all ferries in the fleet.

Another submission considered that the reduction in noise pollution associated with electric buses compared with diesel buses should be included.[47] The submission notes that there has been considerable investment in the development of new electric drive technologies and that electric buses and ferries would improve the external benefit for these modes over cars as they eliminate particulate emissions and potentially greenhouse gas emissions through improved energy efficiency and green power options. Although such electric

45 Sydney Morning Herald, *New Sydney ferries set to sail from 2016*, 27 November 2014 <http://www.smh.com.au/nsw/new-sydney-ferries-set-to-sail-from-2016-20141127-11v1yz.html> accessed 28 November 2014.

46 IPART, *Review of maximum fares for Sydney Ferries services from January 2013 – Final Report*, November 2012, p 27.

47 Varley Group Pty Ltd and the Tom Farrell Institute of the University of Newcastle submission to IPART's Issues Paper, 30 September 2014, pp 2-3.

buses and ferries are not currently in the NSW public transport service, they argue that these could be built into the external benefit calculation to 'future proof' it.

As noted above, we have not currently included noise pollution in our estimates but we have included the emissions associated with producing the electricity to drive trains. Consistent with our decision not to incorporate changes that have not yet occurred, this is based on the current mix of electricity generation in NSW and not on 'green power'.[48] We have also not considered the implications of other types of vehicles moving to electric drive. The assumptions we make regarding the public transport network should be consistent for our cost and external benefit estimates. This means that if electric drive trains and buses were incorporated into the external benefits calculation that the costs associated with converting the fleet to electric drive would also need to be incorporated when we determine maximum fares.

48 Arup, *Cost of emissions for NSW Light Rail*, Final Report, 19 November 2014, pp 6-7.

6 External benefit from fewer road accidents

In our external benefits estimates for previous fare reviews we have not included a value for the benefit associated with fewer road accidents, partly because we considered that such benefits were either not external, or too small to warrant inclusion. As part of this current review we have reconsidered this view.

We have identified several external benefits associated with fewer road accidents, the most significant of which is the cost of increased traffic congestion which occurs when there is an accident. However, this is captured in our measure of reliability, discussed in section 4.5. We also consider there is an external benefit related to the avoided cost of taxpayer funded services, such as ambulance and police services, that increases with the absolute number of accidents associated with more cars on the road.

The section below sets out our draft findings on the estimated value of the external benefit from fewer road accidents. The following sections then discuss how we have estimated it in more detail, and how it meets our criteria for inclusion. We also discuss other potential benefits we have identified but have not attempted to quantify as we consider they are too small or there is insufficient data to make reliable estimates.

6.1 Overview of draft findings

IPART finding

3 The current estimated value of the external benefit associated with fewer car road accidents is as shown in Table 6.1.

Table 6.1 Draft findings on the current estimated value of external benefit associated with fewer road accidents ($2014/15)

	Rail	Bus	Ferry	Total
$ per passenger trip	0.01	0.006	0.004	
$ per passenger km	0.0004	0.0005	0.0004	
$m				6.5

6.2 Approach in previous reviews

In past reviews we have not included a value for any external benefits associated with fewer road accidents in our estimate of the external benefits. As discussed in our issues paper, Sapere's analysis indicated that additional vehicles do not increase the rate or severity of accidents, despite increasing the absolute number of accidents. It also indicated that the vast majority of costs associated with the higher absolute number of accidents are internalised by drivers (that is, taken into account by them when they make the decision to drive). Given this, Sapere found that the estimated external benefit from fewer road accidents that is avoided by public transport was small, and advised that it was too small to warrant inclusion in our total external benefit estimate. We accepted this advice.

However, we undertook to reconsider whether it is appropriate to include a positive external benefit from reduced accident costs as a result of public transport.

Consistent with past input from Sapere, our issues paper distinguished between the cost of single-vehicle accidents and multi-vehicle accidents. In their submission, Action for Public Transport considered this distinction complicated matters without being useful.[49] Our analysis below does not distinguish between single and multi-vehicle accidents.

6.3 What are the external benefits from fewer road accidents?

We now consider that there is a measurable external benefit associated with fewer road accidents. The most significant external benefit of fewer accidents arises from the avoided congestion (reliability) discussed in section 4.5. Other external benefits related to fewer accidents are likely to be very small but include the avoided cost of:

- taxpayer funded services, including emergency services
- uninsured and underinsured injury to non-car occupants, including cyclist and pedestrian casualties
- uninsured or unrecovered damage to non-car property
- work place disruption, recruitment and re-training
- non-pecuniary costs.

We consider there is no external benefit of avoided accidents to the marginal driver,[50] their property or their passengers. This is because drivers and passengers consider the likelihood of being in an accident and the cost (to them) of an accident before choosing to travel by car. Therefore the costs are internalised.

49 Action for Public Transport (NSW) submission to IPART's Issues Paper, 7 October 2014, p 5.

50 The marginal driver is the person who decides to drive rather than to use public transport.

We also consider there is no external benefit of avoided injury, death or property damage to existing vehicle occupants. This is because there is not sufficient evidence for increases in the rate and severity of accidents resulting from increased vehicle kilometers traveled (VKT) and therefore the risk to existing vehicle occupants is not impacted. The avoided costs we do classify as external benefits result from an increase in the absolute number of accidents associated with increased VKT.

6.3.1 Cost of taxpayer funded services

Depending on the location and severity of the accident, assistance may be required from police, ambulance and fire and rescue services. For accidents involving fatalities there are also tax payer funded costs of coronial services (if an at-fault driver is convicted) and correctional services.

Except for some recoupment of ambulance costs through user charges, the cost of these services is borne by the NSW Government. We therefore consider that the avoidance of these costs is an external benefit.

6.3.2 Cost of accidents involving non-car occupants

When the victim of an accident is not an occupant of a car (ie, pedestrians and cyclists), there are costs that are external to the car occupant's modal decision.

In our previous ferry review, Sapere argued that driver insurance (CTP and third party property) premiums and victim compensation payments internalise the cost of non-car occupant casualties but that the internalisation is incomplete because victims of accidents are under-compensated.[51] We agree.

6.3.3 Cost of accidents involving non-car property

For accidents involving non-car property, we consider that some costs of damage to non-car property, often referred to as street furniture, are external. These external costs would be the uninsured or unrecovered value of repairs to or replacement of crash damaged items such as telephone poles, sign or signal poles, buildings or structures, kerbs or guard rails, signs, guide posts and other items including rubbish bins.

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51 Sapere Research Group, *Response to peer review of ferry externality report – prepared for IPART, 26 September 2013*, pp 5-6.

6.3.4 Cost of workplace expenses

When a person is seriously injured or killed in an accident, that person's employer will incur costs associated with work place disruption and, in the case of the person being unable to return to their job, costs of recruitment and retraining.

6.3.5 Non-pecuniary costs

Non-pecuniary costs are the costs of pain and suffering inflicted on accident casualties, their friends and families. We consider that some portion of these costs – the uninsured detriment to non-car occupants – is external.

6.4 How do we estimate the external benefit associated with fewer road accidents?

We consider that the cost of increased traffic congestion is the most significant of the avoided costs relating to accidents and that this is taken into account as part of the avoided congestion (reliability) estimate. We consider the remaining benefits are of a much smaller magnitude. With the exception of taxpayer funded services, we have not attempted to quantify these costs as we consider they are either too small and/or there is insufficient data to make reliable estimates.

We have estimated the avoided cost of taxpayer funded services, including emergency services, using crash cost data published by the Commonwealth Bureau of Infrastructure, Transport and Regional Economies (BITRE).[52] In their submission to our issues paper, Action for Public Transport suggested these costs be included in our estimated value of external benefits.[53]

We multiplied BITRE's per casualty or per accident costs by the number of accidents per year in Sydney.[54] For ambulance services we assumed user charges cover 50% of the cost and the remainder is taxpayer funded.[55] For all other services, we assumed that 100% of the cost is taxpayer funded. We also assumed that police attended 22% of reported property damage only crashes.[56]

52 Bureau of Infrastructure, Transport and Regional Economics (BITRE), *Cost of road crashes in Australia 2006*, Report 118, November 2009.

53 Action for Public Transport (NSW) submission to IPART's Issues Paper, 7 October 2014, p 5.

54 Transport for NSW, Road Traffic Crashes in NSW - Statistical Statement for the year ended 31 December 2012, Table 24, p 49.

55 From 1 July 2008, residents of NSW and any other Australian state or territory that is party to a reciprocal arrangement will be charged at the rate of 51% of the actual cost of the provision of primary emergency ambulance services. See <http://www.ambulance.nsw.gov.au/Accounts--Fees/Frequently-Asked-Questions.html>.

56 Bureau of Infrastructure, Transport and Regional Economics (BITRE), *Cost of road crashes in Australia 2006*, Report 118, November 2009, p 9.

We then divided the resulting taxpayer funded accident cost by VKT per year in Sydney.[57] Adjusting for inflation, this equates to around $0.002 per vehicle kilometre.

57 IPART calculations based on BTS Household Travel Survey 2011/2012.

7 External health benefits of active transport

Physical activity has beneficial effects on many chronic diseases including cardiovascular disease, stroke, diabetes, mental diseases and some cancers.

The external health benefit from active transport is related to the idea that public transport encourages greater levels of physical activity (primarily associated with walk/cycle to access or egress from public transport).

Several submissions to our issues paper recommended including the health benefits associated with the increase in physical activity in our calculations of external benefits.[58] We consider that most of this benefit accrues to the user of public transport and is therefore a private benefit. However, there are external benefits related to the health care costs saved by society, which we now propose to include.

The section below sets out our draft findings on the estimated value of the external health benefits associated with public transport use. The following sections then discuss in more detail what these externalities are and how we have valued them.

7.1 Overview of draft findings

IPART finding

4 The current estimated value of the external health benefits associated with active transport is shown in Table 7.1.

Table 7.1 Draft findings on the current estimated value of external health benefits of public transport ($2014/15)

	Rail	Bus	Ferry	Total
$ per passenger trip	0.17	0.07	0.06	
$ per passenger km	0.01	0.01	0.01	
$m				83.3

58 For example: NCOSS submission to IPART's Issues Paper, 29 September 2014, p 6; Combined Pensioners Superannuants Association of NSW submission to IPART's Issues Paper, 9 October 2014, p 3; NRDSC submission to IPART's Issues Paper, 30 September 2014, p 5.

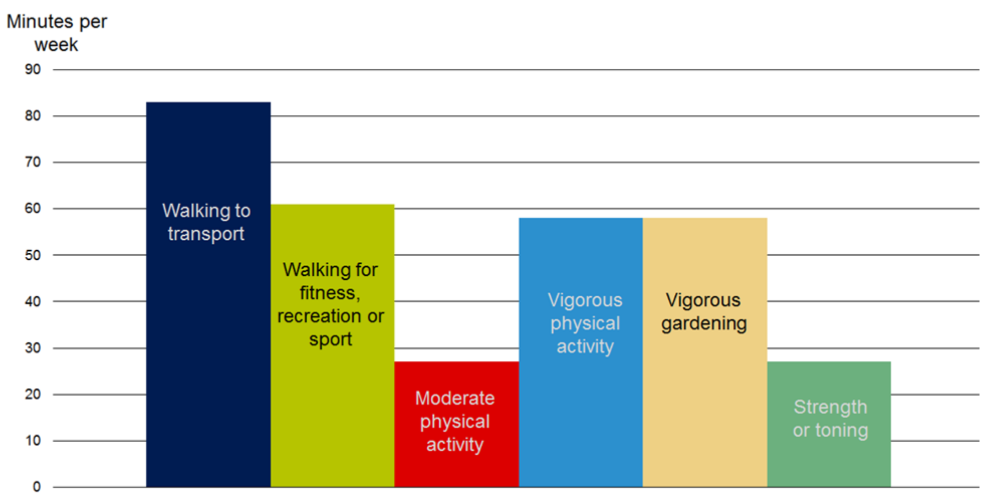
7.2 Public transport's impact on physical activity

We consider that public transport has two impacts on physical activity:

- an increase in physical activity for those who would have driven but choose to travel by public transport instead, and
- a decrease in physical activity for those who would have walked or cycled but choose to travel by public transport instead.

Walking to public transport is an important source of physical activity for Australians. According to the Australian Bureau of Statistics, Australians over 18 spend more time walking for transport than walking for fitness, participating in moderate or vigorous exercise, or any other exercise category (see Figure 7.1).

Figure 7.1 Average time spent on physical activity



Note: Excludes work activities.

Data source: Australian Bureau of Statistics, Australian Health Survey: Physical Activity, 2011-12, Table 1.1

Data collected through the Household Travel Survey indicates that the average distance to access and egress from (walk to and from) public transport is around 1.1km per trip (600 metres access and 500 metres egress), as shown in Table 7.2.

Table 7.2 Average distance walked to and from public transport

	Rail	Bus	Ferry
Distance to access public transport (m)	770	610	980
Proportion of passengers who walk to public transport	76%	76%	76%
Average access distance (m)	**585**	**464**	**745**
Distance of egress from public transport (m)	760	540	640
Proportion of passenger who walk to their destination after catching public transport	77%	77%	77%
Average egress distance (m)	**585**	**416**	**493**

Note: This data relates to journeys where the passenger walked to or from public transport. If the passenger walked less than 100 metres this is not recorded. 5 years pooled data from 2008/09 to 2012/12, weighted to June 2012 population.

Source: BTS, *Household Travel Survey*, data reference year 2012/13 and IPART calculations.

When we average out the reduction in physical activity from those who would have walked or cycled, SSTM modelling suggests that each additional public transport trip is associated with a reduction of around 80 metres of biking and 150 meters of walking.[59]

This means that each public transport trip increases the distance walked by around 950 metres, while decreasing the distance cycled by around 80 metres.

7.3 What is the external health benefit of active transport?

Physical activity has a positive impact to health and wellbeing. According to the World Health Organisation, physical activity has beneficial effects on coronary heart disease, stroke, diabetes, some types of cancer, musculoskeletal health, energy balance and aspects of mental health (including anxiety and depression) and improving functional health in elderly people.[60]

However, we consider that the external benefit is only that related to the reduction in healthcare costs that are borne by society, which is only a small proportion of the total health benefit. In addition, only the public health sector costs are external. As for accident related externalities, some portion of the non-pecuniary costs (pain and suffering for the individuals involved, their friends and families) may also be external.

The rest of the benefit to health, related to people living longer and higher quality lives with reduced disability, is a direct private benefit to users of public transport.

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59 This is relatively small because only a portion of public transport travellers would have otherwise engaged in active transport.

60 World Health Organization, *Health economic assessment tools (HEAT) for walking and for cycling – economic assessment of transport infrastructure and policies – Methods and user guide, 2014 update*, p 6.

7.3.1 External health benefit calculation

While TfNSW's appraisal guidelines include estimates for the health benefit of walking and bicycling, these estimates are not suitable for estimating the *external* benefit of active transport. This is because they rely on evidence which aggregates the private benefits to reduced mortality and morbidity and do not consider the healthcare costs at all.

However, there is quality data on the benefits of physical activity on mortality. Notably, the World Health Organisation has a Health Economic Assessment Tool (HEAT) for valuing the health benefit of active transport that focuses on the reduction in mortality risk. We have used this to estimate the external benefits of active transport.

In order to estimate the impact of active travel on the health care system, we compare the annual health care costs related to physical inactivity with the annual costs of physical inactivity to mortality. We then apply this ratio to an estimate of the reduced mortality risk per additional kilometre of physical activity, as shown below.

$$Healthcare\ cost\ \ per\ km = \frac{Annual\ healthcare\ costs}{Annual\ \ increased\ mortality\ cost} \times decreased\ mortality\ risk\ per\ km$$

Annual mortality costs and health care costs

To calculate the total annual cost of physical inactivity on mortality risk, we estimate the number of deaths per year that are a result of physical inactivity, and apply the statistical value of life.[61]

The statistical value of life is a common approach used in welfare economics to evaluate how much society is willing to pay for a reduced risk of death. Transport for NSW's appraisal guidelines recommend using $6.5m for the statistical value of life for cost-benefit analysis.[62]

Using ABS data and an estimate for the increase in life expectancy from participating in moderate to vigorous levels of physical activity, we estimate that there is around 2,550 additional deaths per year as a result physical inactivity. This translates to a total annual cost of around $16.5 billion ($2014/15).

61 Statistical value of life is an estimate of the cost of reducing the average number of deaths in society by one.

62 Transport for NSW, *Principles and Guidelines for Economic Appraisal of Transport Investment and Initiatives*, pp 258-259.

In comparison, Econtech estimated in 2007 that the total health sector costs in Australia which were a result of physical inactivity were $1.5 billion. After indexation, we estimate the annual healthcare cost is around 13% of the annual cost to reduced mortality. Our workings and sources for this calculation are outlined in Table 7.3.

Table 7.3 Comparison of health care costs and mortality risk

	Estimates and calculations	Source
Average life expectancy	82.2 years	ABS – 3302.0 Deaths, Australia Table 1.9 Death rates, Summary, States and territories – 2003 - 2013
Prevalence of insufficient activity in society	57.0%	ABS - 4364.0.55.004, Australian Health Survey: Physical Activity, 2011-12, Table 1
Increase in life expectancy from participating in moderate to vigorous levels of physical activity	2.5 years	For example: http://www.medibank.com.au/Client/Documents/Pdfs/pyhsical_inactivity.pdf (2.5 years) and Moore et al, *Leisure time physical activity of moderate to vigorous intensity and mortality: A large pooled cohort analysis*, November 2012 (1.8 – 4.5 years)
Number of deaths per year (2013)	147,678	ABS – 3302.0 Deaths, Australia Table 1.9, Death rates, Summary, States and territories – 2003 - 2013
Number of deaths per year as a result of physical inactivity	**2,560**	Calculation
Value of statistical life ($2014/15)	$6,614,130	TfNSW Appraisal Guidelines, p 259
Total annual cost of mortality risk from physical inactivity	**$16.9 billion**	Calculation
Total cost of physical inactivity to the health care system ($2014/15)	$2.2 billion	Econtech, *Economic Modelling of the Net Costs Associated with Non-Participation in Sport and Physical Activity* as outlined at http://www.medibank.com.au/Client/Documents/Pdfs/pyhsical_inactivity.pdf
Annual health care costs/annual cost of additional risk of death	**13%**	Calculation

Note: The value of statistical life was indexed forward by ABS all groups CPI, Sydney, and the health costs of physical inactivity were indexed forward by ABS Health CPI, Australia.

External costs per kilometre of active transport

According to the World Health Organisation's Health Economic Assessment Tool, an additional kilometre of walking every day results in an annual benefit of $1,819[63] a year, which we applied to the proportion of society that is insufficiently active. This is equivalent to $2.84 benefit per additional kilometre of walking in society.[64] By applying the above ratio of health sector costs to reduced mortality risk, the reduction in health sector costs per additional kilometre of walking is around $0.36.

Equivalently, the World Health Organisation's Health Economic Assessment Tool estimates an additional kilometre of cycling per day results in an annual benefit of $955,[65] which we applied to the proportion of society that is insufficiently active. This is equivalent to $1.49 benefit per additional kilometre of cycling in society.[66] By applying the above ratio of health sector costs to reduced mortality risk, the reduction in health sector costs per additional kilometre of cycling is around $0.19.

Finally, a large proportion of these additional health care costs will be met by individuals (through private health insurance). Given that around 50% of Australians have some sort of private health insurance, we consider that the external public benefits of active transport are around $0.18 per kilometre of walking and $0.09 per kilometre of cycling. Our workings and sources for this calculation are outlined below in Table 7.4.

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63 This is an output of the World Health Organisation's Heath Economic Assessment Tool. It is calibrated for a population that previously walked 1km a day and now walks 2km per day, applies the value of life above and a crude death rate of 6.4 deaths per 1000 population consistent with ABS figures for 2013.

64 This is equivalent to a reduction in all-cause mortality of around 6% for someone who is insufficiently active (HEAT).

65 This is an output of the World Health Organisation's Heath Economic Assessment Tool. It is calibrated for a population that previously cycled 2km a day and now cycles 3km per day, applies the value of life above and a crude death rate of 6.4 deaths per 1000 population consistent with ABS figures for 2013.

66 This is equivalent reduction in all-cause mortality of around 3% for people who are insufficiently active (HEAT).

Table 7.4 Calculation of public health sector cost reductions per additional kilometre of physical activity

	Estimates and calculations	Source
Prevalence of insufficient activity in society	57.0%	ABS - 4364.0.55.004, Australian Health Survey: Physical Activity, 2011-12, Table 1
Annual personal benefit from reduced mortality risk from an additional kilometre of walking per day for someone who is insufficiently active	$1,819	Output of the WHO's Health Economic Assessment Tool
Annual personal benefit from reduced mortality risk from an additional kilometre of cycling per day for someone who is insufficiently active	$955	Output of the WHO's Health Economic Assessment Tool
Personal benefit from reduced mortality risk per additional kilometre of walking (whole population)	**$2.84**	**Calculation**
Personal benefit from reduced mortality risk per additional kilometre of cycling (whole population)	**$1.49**	**Calculation**
Proportion of Australians with private health insurance	51%	ABS - 4815.0.55.001, Private Health Insurance: A snapshot, 2004-05
Health sector costs as a proportion of reduced mortality risk	13%	Previous Calculation
Reduced public health sector costs form an additional kilometre of walking	**$0.18**	**Calculation**
Reduced public health sector costs form an additional kilometre of cycling	**$0.09**	**Calculation**

8 Reduction in benefit to account for road user charges

Our external benefits calculation includes an adjustment for road user charges. As discussed in our issues paper, road user charges offset some of the external costs that driving imposes on the community. These charges increase the private cost of driving and internalise some the external costs imposed on society.

In our previous external benefit estimates we only included the proportion of road user charges that did not contribute to the costs imposed by the motorist as we considered these were the values that close the gap between the private and social cost of car use. As part of this review, we have reconsidered the marginal cost of an additional car on the road. As a result, we have included the full fuel excise and all tolls as well as the parking levy as part of the road user charges calculation.

The section below sets out our draft findings on the estimated value of the road user charges adjustment. The following sections then discuss why we make this adjustment for road user charges, which ones we include, and the changes to our approach from previous fare reviews.

8.1 Overview of draft findings

IPART finding

5 The current estimated value of the road user charges adjustment is as shown in Table 8.1.

Table 8.1 Draft findings on the current estimated value of the road user charges adjustment ($2014/15)

	Rail	Bus	Ferry	Total
$ per passenger trip	-0.54	-0.33	-0.19	
$ per passenger km	-0.02	-0.03	-0.02	
$m				-322.0

8.2 Why do we make an adjustment for road user charges?

We deduct the road user charges that increase the price on roads above the private cost of a trip from the external benefit calculation. This is because these charges internalise some of the external costs of driving that are imposed on society. By increasing the cost of driving relative to other modes of transport, some of the external costs of driving are taken into account when people decide to drive.

Only four submissions commented on this, of those that did, two strongly opposed including road user charges at all, and a third wasn't convinced by our methodology.[67] Only one agreed with including road user charges and the proposal to expand the number of tolls included.[68]

Objections included that road user charges go nowhere near capturing the external costs of car use and that including them artificially dampens the external benefits of public transport.[69] Also, that the tolls and excise don't cover the cost of current road infrastructure, let alone do anything tangible to offset motor vehicle emissions and congestion.[70]

Despite the objections raised, we continue to consider that road user charges should be included in our net external benefit calculation. Road user charges which are above the private costs of driving, such as fuel, and the marginal impact that each additional car has on road condition, internalise some of the external costs of driving. These charges also increase the price of driving relative to other modes of transport and are taken into account when people decide to drive, and in this way modify the congestion and pollution caused by cars.

Government subsidisation of public transport is largely justified on the grounds that road use is not priced to reflect the full social cost of driving, which includes increased congestion and pollution. However, although drivers do not pay the full marginal external cost they impose, they do make some contribution. By imposing an excise on fuel, a parking space levy and tolls which increase the cost of driving above the marginal cost of these trips, some of the external costs of driving are captured. If we did not adjust the public transport external benefit to account for these external costs, then we would be overstating the external benefits of public transport.

67 J Austen submission to IPART's Issues Paper, 30 September 2014, p 8.
68 Mike Smart submission to IPART's Issues Paper, 30 September 2014, p 4.
69 Action for Public Transport (NSW) submission to IPART's Issues Paper, 7 October 2014, p 18.
70 Mori Flapan submission to IPART's Issues Paper, 30 September 2014, p 6.

8.3 What road user charges are included?

In previous fare reviews as part of the road user charges calculation we included:

- the portion of the fuel excise not spent on road maintenance and construction (19c/L on average)
- the parking space levy
- the toll on the Sydney Harbour Bridge and Harbour Tunnel.

In our previous external benefit estimates we only included the proportion of road user charges that did not contribute to the costs imposed by the motorist as these were the values that we considered close the gap between the private and social cost of car use. Therefore, we only included the proportion of the fuel excise collected by the Commonwealth Government that is not apportioned to road maintenance and construction.

As part of this review, we have reconsidered the costs imposed by an additional motorist in terms of what impact they have. We now consider that the marginal cost of an additional car on the road is practically zero. This is consistent with how we have treated the costs imposed by the public transport user in estimating the environmental costs associated with public transport (as discussed in Chapter 5). The implication of this decision is that the full amount of the fuel excise (currently 38.143c/L) should be included in the road user charges adjustment as it increases the price of driving relative to other modes of transport and encourages drivers to make socially efficient decisions. Treating the entire fuel excise as a user contribution toward the marginal external cost of driving is a change to our existing approach.

The second component of the road user charge adjustment is the parking space levy collected by the NSW Government. This levy, worth $104m in 2013/14,[71] applies to off-street commercial and office parking spaces in two categories in Sydney:

- Category 1 applies to the City of Sydney, North Sydney and Milsons Point business districts at a rate of $2,260 per liable space per annum.
- Category 2 applies to Bondi Junction, Chatswood, Parramatta and St Leonards business districts at a rate of $800 per liable space per annum.[72]

We are not proposing a change in methodology compared to what we have done previously but the estimates we now include are higher than those we previously captured. The key reason for this is that we have obtained updated and more detailed data from BTS.

71 NSW Government, *Budget Statement 2014-15, Budget Paper No. 2*, Chapter 6, p 13.
72 NSW Government Office of State Revenue, Parking Space Levy Fact sheet, July 2014, p 1.

The third component in the road user charges adjustment is tolls. Previously we only included the toll on the Sydney Harbour Bridge and Tunnel based on advice from Sapere.[73] This was consistent with our view that we should not capture any portion of road user charges that are designed to contribute to costs imposed by driving. We now consider that all tolls should be included, not just the Sydney Harbour Bridge and Tunnel, for the same argument used for the inclusion of the total fuel excise. That is, that the marginal cost imposed by an additional car on the road is practically zero and as a result, all tolls represent a tax on driving and should be included. Also as discussed above, by increasing the price of driving relative to other modes of transport, tolls can influence whether people decide to drive and in this way modify the congestion and pollution caused by cars.

How the current road user charge estimate varies from our previous reviews

Our new estimates that include the total amount of fuel excise, all tolls and increases in the parking levy results in a road user charge adjustment that is much larger than we have included previously, as shown in Table 8.2 below.

Table 8.2 Comparison of road user charges adjustment in IPART's current fare determinations and current modelling ($ per passenger trip) $2014/15

	Rail	Bus	Ferry
Current fare determinations	-0.16	-0.15	-0.17
Proposed	-0.54	-0.33	-0.19

Source: Current estimates are from current fare determinations; see IPART, *Estimating the external benefits of public transport – Issues Paper*, August 2014, p 17, escalated to $2014/15.

As shown in Table 8.1 above in the draft findings, road user charges are higher on a per kilometre basis for buses than for rail because for each bus passenger kilometre there is a larger change in car kilometres than there is for rail (by 25%). That is, more bus users switch to car than rail users when fares increase.

8.4 How have we estimated the value of road user charges?

By using the outputs from the SSTM under various fare scenarios, our model is able to calculate the change in vehicle kilometres travelled on Sydney's roads. From this it calculates changes in fuel consumption (and hence excise paid) based on the average fuel economy rate, and changes in the proportion of trips ending in areas with the parking space levy and using toll roads.

73 For example, Sapere Research Group, *External benefits of CityRail services – Final report to IPART, 31 October 2012*, pp 24-28.

9 Reduction in benefit to account for the excess burden of taxation

As discussed in our issues paper, we have not previously made an adjustment for the cost of raising funds to subsidise public transport. That is, we have not accounted for the costs taxes have in terms of economic efficiency, which are over and above the amount of the tax. On a beneficiary pays argument we have previously considered that taxpayers (as a proxy for road users) should bear the cost.[74]

We now consider that we should include an estimate of the excess burden of taxation in our calculation of the net external benefits to reflect the economic efficiency losses associated with the funds used to subsidise public transport.

We recommend using the marginal excess burden estimate for the GST, of eight cents per dollar of revenue required, as this is the most efficient applicable tax. Using an efficient tax is consistent with our approach to calculating the efficient cost of delivery of public transport services in our fare determinations.

The section below sets out our draft findings on the estimated value of the marginal excess burden of taxation. The following sections then discuss why we have included it in our external benefit estimate, how we have valued it, and how the price elasticity of demand directly impacts on the marginal excess burden of taxation.

9.1 Overview of draft findings

IPART finding

6 The current estimated value of the external cost of the marginal excess burden of taxation is as shown in Table 9.1.

[74] IPART, *Estimating the external benefits of public transport – Issues Paper*, August 2014, pp 39-41.

Table 9.1 Draft findings on the current estimated value of the external cost of the marginal excess burden of taxation ($2014/15)

	Rail	Bus	Ferry	Total
$ per passenger trip	-2.64 to -0.41	-1.34 to -0.27	-2.32 to -0.36	
$ per passenger km	-0.10 to -0.01	-0.11 to -0.02	-0.23 to -0.04	
$m				-1,387.2 to -214.0

Note: The excess burden for each mode is based on current fares. Ferries have a higher excess burden per passenger kilometre than other modes because they have a higher fare per passenger kilometre. This means that for a given change in fares, there is a larger dollar change in the revenue generated relative to the change in passenger kilometres. Under our current approach, fare levels are linked to the costs of service and the amount of costs recovered from users. Therefore, the level of excess burden is a function of the cost per passenger kilometre (as well as the elasticity of public transport). We will review costs as part of our fare reviews next year.

9.2 What is the marginal excess burden of taxation?

Most taxes impose an excess burden by changing the behaviour of households and businesses. Taxes distort the economic decisions of labour, consumers, investors and producers by changing the incentives to work or invest, and influencing consumption and production patterns. These distortions lead to a reduction in economic efficiency and loss in consumer welfare, referred to as the deadweight loss or excess burden of taxation. This burden or loss is a measure of the economic costs associated with these distortions.

The inefficiencies created by taxes can be explained mainly by the following two principles:

- The mobility principle - which recognises that the deadweight loss of a tax is higher, the more mobile its tax base. When a tax is applied to a highly mobile tax base, that tax base will shrink in response to being taxed by moving to jurisdictions where it won't be affected. For example, in response to business taxes, capital may move to jurisdictions where the business tax rate is lower. This distorts economic activity.
- The narrowness principle – which recognises that the deadweight loss of a tax is likely to be higher, the narrower the tax base. A narrow tax base makes it easier to respond to the tax by switching to untaxed close substitutes. This adds to economic inefficiency and reduces revenue yield.[75]

These two principles move society away from the optimal allocation of resources.

The marginal excess burden (MEB) measures the deadweight loss from a small increase in the tax. The average excess burden (AEB) measures the efficiency of introducing the whole tax. Both are expressed in cents per dollar of additional revenue.[76]

75 KPMG Econtech, *CGE Analysis of Current Australian Tax System, Final Report*, 26 March 2010, p 2.
76 KPMG Econtech, *CGE Analysis of Current Australian Tax System, Final Report*, 26 March 2010, p 4.

9.3 Why should we include the marginal excess burden of taxation?

The NSW Government funds the difference between the cost of providing public transport services and the fares people pay for using those services. It raises these funds through taxes and other sources of revenue. There is a cost associated with raising funds to subsidise public transport as taxes have incentive effects and are distortionary.

As discussed in our issues paper, we have previously not accounted for the deadweight loss of the funds used to subsidise public transport.[77] Under a beneficiary pays approach, we considered that taxpayers, as a proxy for road users, should bear this cost, reflecting the fact that road users do not pay the full marginal cost of driving.

However, we no longer think this is appropriate. As the government subsidy of public transport is largely justified on the grounds of the external benefits it generates, ignoring the economic costs of the subsidy potentially overstates these benefits. Therefore, failing to account for the deadweight loss associated with the funds used to subsidise public transport potentially may result in subsidies that are too large or fares that are too low.

It is becoming more common practice in cost benefit analysis to include the excess burden, or the deadweight loss associated with taxation. For example, the recently released *Independent cost-benefit analysis of broadband and review of regulation* included a deadweight loss of taxation to capture the cost of raising government revenue to fund high-speed broadband infrastructure. The report argues that "the losses associated with these excess burdens should be included where there is a substantial net government contribution."[78]

In response to our issues paper, only two submissions addressed the question regarding the excess burden of taxation, one in favour and one against its inclusion. The Council of Social Service of New South Wales (NCOSS) considered that we should not include the excess burden of funding the public transport system unless the same approach is also applied to the cost of car travel. They argued that to do so would "distort the relative cost of public transport unless the same approach is also applied to the cost of car travel."[79]

However, Mike Smart considered it very important that excess burden be included and notes "that it is now conventional to include estimates of excess burden in cost benefit analyses."[80]

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77 IPART, *Estimating the external benefits of public transport – Issues Paper*, August 2014, pp 39-41.

78 Australian Government, Department of Communications, *Independent cost-benefit analysis of broadband and review of regulation, Volume II – The costs and benefits of high-speed broadband,* August 2014, p 41.

79 NCOSS submission to IPART's Issues Paper, 30 September 2014, pp 3-4.

80 Mike Smart submission to IPART's Issues Paper, 30 September 2014, pp 6-7.

9.4 What estimate of excess burden is appropriate for NSW?

Estimates of the excess burden associated with different taxes vary, however, those generated by KPMG Econtech as part of the Henry Review into Australia's tax and transfer system are the most recent and comprehensive. For this, the economic inefficiencies, or excess burdens of 19 major taxes at the federal, state and local level were estimated using a computable general equilibrium model. The Econtech estimates are the most detailed available, and they are broadly consistent with results from other studies.

The abovementioned broadband cost benefit analysis used the KPMG Econtech estimates of a deadweight loss of taxation of 24 cents per dollar of revenue required. This is the estimated marginal excess burden associated with labour income tax.[81]

In order to determine what marginal excess burden was appropriate for us to include in our external benefits calculation, we considered the sources of funding available to the NSW Government.

NSW Government total revenue comprises funding from the Commonwealth as well as state own-source taxation and other non-tax revenue, such as the sale of goods and services. As shown in Table 9.2 below, for 2014/15, state taxation and GST are forecast to comprise 38% and 25% of NSW's total revenue respectively.

81 Australian Government, Department of Communications, *Independent cost-benefit analysis of broadband and review of regulation, Volume II – The costs and benefits of high-speed broadband,* August 2014, p 42.

Table 9.2 Composition of NSW Total Revenue, 2014/15

Source of revenue	% share of total revenue	MEB cents/$ revenue raised	AEB cents/$ revenue raised
State taxation (see Table 9.3 below for components)	38	41	29
Cmth General Purpose Payments (GST)	25	8	6
Cmth National Agreements (SPP)	12		
Cmth National Partnerships (SPP)	4		
Sale of goods and services	9		
Dividends, income tax equivalents and other distributions	4		
Fines, fees, interest and other revenue	4		
Royalties	2		
Other grants and contributions	2		
Total Revenue	**100**		

Source: NSW Government, *Budget Statement 2014-15, Budget Paper No. 2*, Chapter 6, p 9, KPMG Econtech, *CGE Analysis of Current Australian Tax System, Final Report*, 26 March 2010, p 5 and IPART calculations.

Table 9.3 below shows the components of state taxation with the estimates of marginal and average excess burden for each.

Table 9.3 Composition NSW Taxation Revenue, 2014/15

State Tax	% share of NSW taxation	MEB	AEB	Wtd MEB	Wtd AEB
		cents/$ revenue raised			
Payroll tax	30	41	22	12.3	6.6
Transfer duty	24	34	31	8.2	7.4
Other stamp duties	7	18	18	1.3	1.3
Land tax	10	8	6	0.8	0.6
Motor vehicle ownership and operation[a]	9	37	32	3.3	2.9
Gambling and betting	8	92	54	7.4	4.3
Other tax revenue[b]	12	67	47	8.0	5.6
Weighted average				**41.3**	**28.7**

[a] KPMG Econtech has different values for motor vehicle stamp duty and registration, estimate used above is registration.

[b] Other tax revenue includes Health Insurance Levy, Parking Space Levy, Emergency Services Contributions, Waste and Environment Levy, Government Guarantee Fee, and others, many of which were not included in KPMG Econtech's estimates. The excess burden estimates used are those modelled for insurance taxes.

Source: NSW Government, *Budget Statement 2014-15, Budget Paper No. 2*, Chapter 6, pp 12-13, KPMG Econtech, *CGE Analysis of Current Australian Tax System, Final Report*, 26 March 2010, p 5, and IPART calculations.

Using these estimates, if we take a weighted average of NSW's own-source state taxation (predominately comprising payroll tax and transfer duty) the marginal excess burden is 41.3, that is, for every dollar of state tax collected, there is a deadweight loss of 41.3 cents.

Alternatively, GST which comprises virtually all of the Commonwealth Government's General Purpose Payments to NSW, is estimated to have a marginal excess burden of eight cents per dollar of revenue. GST has a relatively low excess burden as it has a broad base applying to close to 70% of consumer spending.[82]

Commonwealth Specific Purpose Payments (SPP), comprising 16% of total NSW revenue, are tied to National Agreements and National Partnerships, and are not used for public transport. These can therefore be excluded from our calculations of the excess burden of NSW revenue.

We have estimated the weighted average marginal excess burden of the remainder of NSW Government revenue available for funding public transport (that is total revenue minus the Commonwealth SPPs) to be 21 cents per dollar of revenue. This assumes that there is no deadweight loss associated with non-tax revenue, and does not exclude revenue which may be hypothecated for other uses (apart from the Commonwealth SPPs).

We consider it is more reasonable to use the marginal excess burden associated with the GST rather than the weighted average of NSW state taxes or NSW total revenue. Using the most efficient tax for the estimate of excess burden is consistent with our current approach to fare setting of calculating the efficient cost for delivery of public transport services, and deducting the government subsidy from this.

Using a higher marginal excess burden estimate, such as that associated with NSW state taxes or a weighted average of total revenue, would significantly reduce the total external benefit. This would reduce the government subsidy for public transport, and increase the level to be recovered through fares.

9.5 How we have estimated the excess burden associated with the public transport subsidy

As discussed above, the excess burden of taxation measures the economic efficiency costs associated with raising funds. Our model measures the change in the excess burden of taxation as a result of changes in fares.

The excess burden is calculated as a percentage of the Government contribution, which we have set to 8% in line with the estimated marginal excess burden of the GST. The size of the Government contribution changes with fare revenue received from public transport, and changes in revenue received from the car parking levy, tolls and fuel excise.

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82 KPMG Econtech, *CGE Analysis of Current Australian Tax System, Final Report*, 26 March 2010, p 65.

9.6 Elasticities

The price elasticity of demand measures the responsiveness of quantity demanded for a good or service to a change in its price (see Box 9.1). We have found that the price elasticity of demand for public transport does not have much impact on any of the external benefits we are currently estimating, except for the marginal excess burden of taxation. For all the other external benefits estimates, the marginal external benefit in dollars per passenger kilometre or dollars per passenger journey that occur in response to a given elasticity is almost the same under all of the fares changes we have modelled. This is because it measures the benefit associated with people who alter their travel behaviour when fares are changed, divided by the change in the amount of usage on the mode for which the fare is changed.

However, the price elasticity of demand for public transport has a direct impact on the marginal excess burden of taxation because it centres on the effectiveness of using Government subsidisation of fares to motivate people to use public transport. The higher the elasticity, the more price sensitive demand is, and for a given change in patronage a smaller subsidy is required, and consequently there is a smaller deadweight loss.

The excess burden of taxation is also heavily affected by the elasticity used in estimating it. We recommend using a reasonable range of elasticities based on the short-run SSTM behavioural model outputs (low-end), a recent study of observed elasticities for Sydney public transport by Tsai, Mulley and Clifton[83] (mid-range) and a long term elasticity estimate equal to twice the value of the mid-range estimate (high-point).

83 Tsai, Mulley and Clifton, *A Review of Pseudo Panel Data Approach in Estimating Short-run and Long-run Public Transport Demand Elasticities*, *Transport Reviews*, 2014 Vol 34, No 1, pp 102-121.

Box 9.1 Price elasticity of demand

The price elasticity of demand measures the responsiveness of quantity demanded for a good or service to a change in its price. A price elasticity of -0.5, for example, means that for a 1% increase in price there will be a 0.5% decrease in demand.

Price elasticities are almost always negative, as there is an inverse relationship between price and the quantity demanded. For almost all goods and services the elasticity of demand is between 0 and -1. The smaller the elasticity (in absolute value), the more inelastic demand is, that is less responsive to a change in price. A higher absolute value indicates demand is relatively more elastic, that is more responsive to changes in price.

The short run price elasticity of demand for public transport is relatively inelastic. That is, for a given change in fares, there will be a relatively small demand response. Over the long run elasticities are larger (in absolute value) indicating that in time demand is more responsive to fare changes.

The SSTM is a disaggregated choice model which uses Household Travel Survey to build up people's behavioral preferences. As discussed earlier, it estimates the travel decisions of Sydney residents and the consequent impact to travel time under different infrastructure and pricing policies. By changing fare levels and observing the demand response, the SSTM can be used to estimate public transport's price elasticity. Based on a literature review of elasticity studies, we consider that the SSTM estimates are likely to be at the lower end of a reasonable range of elasticities for public transport in Sydney. The SSTM's modelled response to a price change is lower than both local and international estimates of elasticity (see Appendix A).[84]

The most recent estimate of elasticity of public transport in Sydney (i.e. based on the biggest sample size and applying advanced statistical techniques) is by Tsai, Mulley and Clifton. Like the SSTM, this study uses data from the Household Travel Survey. It found that the short run elasticity with respect to all public transport fares is -0.22[85] (the SSTM's figure is -0.11). Tsai, Mulley and Clifton's study is an empirical estimate of elasticity. This means that it applies statistical techniques to *directly* estimate the elasticity based on available information.

84 As noted above, this does not affect the estimates of the remaining marginal external benefits as they are done on a per passenger kilometre and per passenger journey basis, and the results of this are consistent over the different fare changes considered (an elasticity that is twice the value of the SSTM elasticity is equivalent to modelling a fare change of 5% rather than 10%).

85 Tsai, Mulley and Clifton, *A Review of Pseudo Panel Data Approach in Estimating Short-run and Long-run Public Transport Demand Elasticities*, *Transport Reviews*, p 120.

There have also been many literature surveys which aggregate estimates of public transport elasticities internationally. These studies consistently find that the average estimate of short run price elasticities is between -0.3 and -0.4 (with variation around the mean).[86] Other Australian estimates have tended to be between -0.2 and -0.4. However, we note that there are fewer reliable local estimates and these estimates are based on a small range of fare changes. The National Guidelines for Transport System Management published by the Australian Transport Council recommend applying mode specific elasticities of -0.35 for all public transport modes, consistent with the higher end of this range.[87]

The elasticities estimated by the SSTM and those discussed in the literature are estimates of the short run price elasticity of demand. It is generally accepted that long run elasticities of public transport demand are substantially higher than short run elasticities.[88] Most studies suggest that long run elasticity is around twice the short run elasticity, see Appendix A.

This is in large part related to changes to the level of vehicle ownership, which take some time to adjust. The number of vehicles a household owns has a large effect on the level of public transport use (Figure 9.1). However, vehicles have long asset lives of around 20 years,[89] so vehicle ownership levels respond slowly as the fleet gets worn down.

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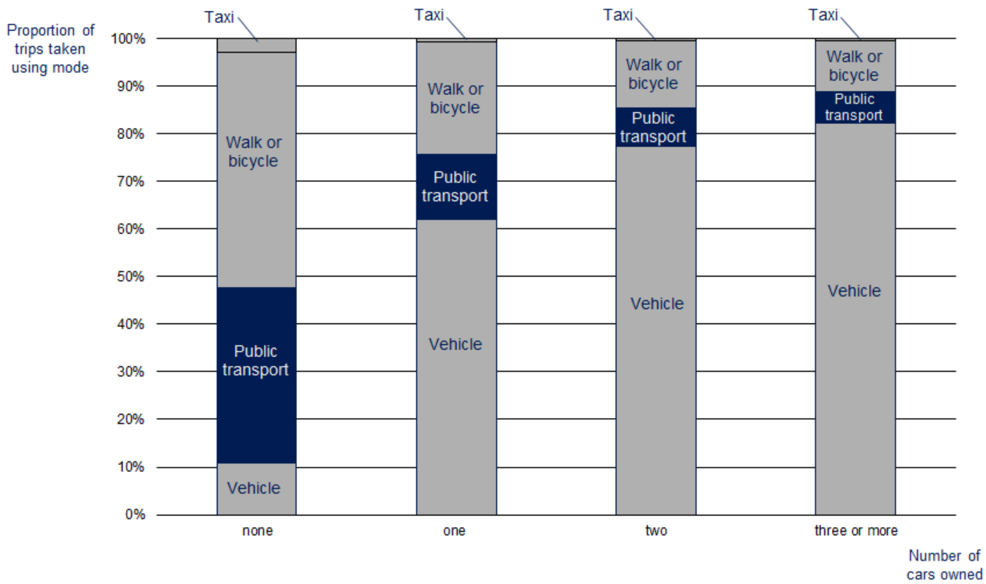
86 Note that these estimates are mode specific and should be compared with the equivalent estimates above.

87 Australian Transport Council, *National Guidelines for Transport System Management in Australia – volume 4*, 2006, p 53.

88 For example, see Victorian Transport Policy Institute, *Transit Price Elasticities and Cross-Elasticities*, April 2014, p 5. Also, for more estimates of long run elasticity, see Appendix A.

89 The average age of vehicles in Australia is 10 years, assuming a uniform distribution then cars have an asset life of around 20 years – ABS, *Motor Vehicle Census*, Australia, 31 January 2014, p 11.

Figure 9.1 Impact of vehicle ownership on public transport use



Data source: BTS, *Household Travel Survey*, 2011/12 pooled numbers.

Whether we adopt estimates based on short or long run elasticities depends on how we estimate the external benefits in fare setting. Over time the level of external benefits will increase/decrease (depending on fare adjustments) compared to the level of deadweight loss of taxation, until the level of car ownership reaches equilibrium.

As part of our next fare determinations we will consider which elasticity estimates we will use. We will ensure we have a consistent approach to patronage forecasts, elasticities, costs and external benefits.

9.6.1 Recommended range of elasticities for excess burden of taxation

Table 9.4 below shows the range of marginal excess burden of taxation under the three different elasticity estimates. As discussed above, the low range elasticity reflects the current SSTM estimates; the mid-range is an estimate consistent with short run elasticity in Australian and international literature; and the high range is an estimate consistent with long run elasticity, which is around twice as large as the short run (our mid-range).

Table 9.4 Value of excess burden and external benefits for our recommended range of elasticities ($2014/15)

	Low	Mid-range	High
Excess burden rail ($/pJ)	-2.64	-1.15	-0.41
Excess burden bus ($/pJ)	-1.34	-0.57	-0.27
Excess burden ferry ($/pJ)	-2.32	-1.01	-0.36
Excess burden (total $m)	-1,387.2	-606.1	-214.0
External benefits ($m)	1,393.2	2,174.4	2,566.4

10 Scale benefits and crowding costs

We discussed in our issues paper that there may be an external benefit for existing passengers if service frequency increased in response to increased patronage.[90] Alternatively, there may an external cost related to crowding if the level of services didn't grow with increased patronage.

The extent of any external scale benefits or crowding costs depends on the interactions between fares, patronage, service frequency and cost. The NSW Government is responsible for transport planning, investment and service levels. Any external benefit from increased service frequency or external cost from increased crowding is related to the Government's response to a change in patronage.

The following sections discuss the complexities involved in estimating the external benefits of scale and crowding without knowing in advance what the Government's plans are regarding specific service changes. We also discuss how we propose to reassess the external benefits during our next round of fare reviews when we will have better information on the Government's proposed expenditure on public transport.

10.1 Overview of draft findings

IPART finding

7 External benefits from increasing scale and external costs associated with crowding are proposed to be included in our estimates of the external benefit of public transport when we have better data on what the Government's plans are regarding specific service changes.

90 IPART, *Estimating the external benefits of public transport – Issues Paper*, August 2014, pp 32-33.

10.2 What are the external benefits and costs of scale and crowding?

Increased patronage may result in an external benefit if service frequency is increased in response to this higher patronage. As service frequency increases, average waiting times for services decrease. As waiting time is a major component of the total journey time of public transport this leads to travel time savings for public transport users. If there is a strong link between the level of public transport services and demand, each new public transport passenger increases the frequency of the service and thus has an effect on waiting times.

This effect, known as the Mohring effect, basically means that the user's costs of waiting for or accessing public transport decrease as service frequency or route density increases (ie, there are increasing returns to scale). This provides an external benefit to existing users, as each new passenger that uses public transport creates a benefit to those existing passengers who now have to wait less time for their bus, train or ferry.

Alternatively, if transport services are not increased in response to increases in demand, there may be an external cost as a result of an increase in public transport crowding. When a bus, train or ferry is crowded, services become less comfortable and, in some cases, waiting times will rise as passengers are forced to wait for the following bus, train or ferry. An increase in the number of passengers using public transport in peak times imposes a cost on other users that is not currently taken into account.

10.3 Public transport service planning and issues estimating scale and crowding

The extent of scale benefits depends on the interactions between fares, patronage, service frequency and cost. These interactions are complex. The Government is responsible for transport planning, investment and service levels and the existence and quantum of scale benefits depends heavily on these factors. Any external benefit from increased service frequency or external cost from increased crowding is related to the Government's response to a change in patronage.

Government service planning occurs as part of the Long Term Transport Master Plan. Services are implemented to align with customer demand, government priorities and funding availability, and are planned years in advance of delivery.[91] This means there may not be changes to service delivery in response to patronage changes over the short run. However, Governments can plan around fare changes and how service delivery responds to both increases and decreases in patronage as part of the wider long term planning of the public transport system.

91 Transport for NSW, *Integrated Public Transport Service Planning Guidelines, Sydney Metropolitan Area*, December 2013, p 3.

The SSTM is not able to model changes in service frequency in response to changes in patronage so we are not able to isolate and quantify changes in service frequency that occur as a response to a change in patronage. Furthermore, as discussed above, the interactions between fares and service frequency are complex and as Mike Smart stated in his submission, 'modest fare reform is unlikely to generate sufficient extra patronage to meaningfully alter service frequencies.'[92]

Notwithstanding these complexities, we included a proxy in our external benefits model for estimating the external benefit of scaling by assuming services increase in the same proportion as patronage. That is, for a 1% increase in patronage it assumes a 1% increase in services. Although this is an oversimplification which does not reflect the lumpiness of any changes in service frequency, we could possibly use it as a guide to estimate scale benefits. By calculating the change in waiting times, we could then measure the value of this external benefit in terms of reduced waiting and travel time. TfNSW's guidelines include a multiplier for waiting time equal to 1.5 times the value of travel time.[93]

However, there are other complexities that exist when scale is switched on in our model that have implications for the way we would use the external benefit to set fares. For example, when service kilometres increase with marginal changes in patronage this introduces a positive value for the environmental externalities associated with public transport. Currently we have a value of zero as the model assumes that additional patronage is carried on existing services. We consider this is a fairly realistic assumption in most cases given the current average load factors.

Our model also has the capacity to include a proxy for calculating crowding based on different multipliers applied to the value of travel time for sitting and standing under different loadings. TfNSW's guidelines also include values for these multipliers.[94]

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92 Mike Smart submission to IPART's Issues Paper, 30 September 2014, p 5.

93 Transport for NSW, *Principles and Guidelines for Economic Appraisal of Transport Investment and Initiatives*, March 2013, Appendix 4, p 224.

94 Transport for NSW, *Principles and Guidelines for Economic Appraisal of Transport Investment and Initiatives*, March 2013, Appendix 4, pp 271-272.

10.4 Incorporating scale and crowding in future fare reviews

Without knowing in advance what the Government's plans are regarding specific service changes it is not possible to value the external benefits of scale and crowding. Therefore, we are not proposing to include either scale or crowding in the external benefit calculation at this stage. We propose to reassess the external benefits, taking these factors into account, during our next round of fare reviews when we may have better data on what the Government's plans are. This will enable us to ensure that we have a consistent set of external benefits and costs that are based on a consistent set of patronage forecasts for our determination.

We consider that it is likely either scale benefits or crowding costs will dominate for individual modes. For example:

- For rail, it is likely that the external cost of crowding will be more dominant than any scale external benefits as the infrastructure required to increase capacity is very expensive with long lead times. Stations, especially in the Sydney CBD, are particularly constrained with limited capacity to accommodate more trains in the peak.
- For buses, it is possible to run additional services to alleviate crowding so while individual buses may get full, crowding is likely to be less of a problem than it is on the rail network. Therefore, scale benefits are more likely to dominate as more buses are added to the fleet and frequency and route density increases.
- For ferries, similar to buses, scale benefits are more likely to dominate as it is possible to run additional services to alleviate crowding.

11 Social inclusion, agglomeration and wider economic benefits

One of the main external benefits stakeholders put to us during fare reviews is the benefit public transport creates by facilitating improved mobility and social inclusion. Many argue that these benefits are particularly significant for those on lower incomes (as they tend to live further away from jobs and have fewer transport options) and as such, justify significant taxpayer subsidy of public transport fares.

Other potential external benefits raised by stakeholders are agglomeration and wider economic benefits. Agglomeration refers to the benefits associated with people locating near each other. The benefits include better matching of skilled workers with jobs (division of labour), knowledge transfers between firms, and sharing infrastructure and inputs. Related to agglomeration are other wider economic benefits such as stimulating demand in the economy, greater tax receipts/lower welfare payments and improved productivity from competition among service providers.

The benefits of social inclusion, agglomeration and wider economic benefits come from the improved access to jobs, education, leisure and entertainment that is enabled by the transport network. The main argument for their inclusion in our external benefits estimate is that lower public transport fares improves access to these things and that this improved access has benefits that accrue to all of society and not just the individuals who use public transport.

This chapter sets out our draft findings on these issues. It then discusses the benefits of social inclusion, followed by agglomeration and wider economic benefits, and our views of whether they should be included in our estimates.

11.1 Overview of draft findings

IPART findings

8 An estimate of the external benefits of social inclusion should not be included in our estimates of the external benefit of public transport because these benefits are mainly private, and those that are public either cannot be measured or are very small and are likely to be more closely linked with the availability of transport services than with the level of fares.

9 An estimate of the external benefits from agglomeration and wider economic benefits should not be included in our estimates of the external benefit of public transport because these benefits are mainly private, and those that are public either cannot be measured or are very small and are likely to be more closely linked with the availability of transport services than with the level of fares.

11.2 Social inclusion

In past reviews we have said that the benefit of improved mobility and social inclusion can only be used to justify government subsidy of public transport fares for the identifiable groups that receive this benefit.[95] That is, the benefit of improved mobility and social inclusion justifies the provision of concessional fares only – not greater subsidisation of the full fares paid by passengers outside these groups. For this reason, we have not quantified and included a value for social inclusion in past fare reviews.

In our issues paper, we sought comment from stakeholders on whether they agreed with this approach. We received many submissions on this issue with all except one critical of our approach:

- The arguments put by stakeholders critical of our approach focused on the wider benefits accruing to society from increased mobility and social inclusion, such as increased employment participation, improved health, reduced crime and welfare payments, and that concession fares did not cover all those facing lower mobility and social inclusion, for example lower paid workers.[96]
- The argument put in favour of our approach was that general fare policy is an inappropriate instrument to deal with distributional equity issues – reducing fares across the board to help a small group of disadvantaged potential travellers would distort modal choices of the majority, greatly increase the need for transport subsidies and thereby cause significant deadweight losses through taxation.[97]

While we still consider that this latter argument is valid, we accept that concession fares do not cover all people facing lower mobility and social inclusion. A targeted concession program is an important tool for improving social inclusion but concession fares are only part of the picture. With this in mind, and taking into account the arguments put to us in submissions, we have assessed the benefit of social inclusion against our criteria for inclusion (see Chapter 2).

95 IPART, *Estimating the external benefits of public transport – Issues Paper*, August 2014, pp 35-36.

96 For example, Council of Social Service of New South Wales (NCOSS) submission to IPART's Issues Paper, 29 September 2014 and Combined Pensioners and Superannuants Association of NSW submission to IPART's Issues Paper, 9 October 2014.

97 Mike Smart submission to IPART's Issues Paper, 30 September 2014, p 6.

11.2.1 Why we do not consider social inclusion should be included in our external benefit estimate

A submission to the issues paper argues that the benefits of increased mobility and social inclusion are private benefits primarily enjoyed by the person who becomes more mobile and included.[98] We agree that many of the benefits associated with social inclusion are private. The ability of people to access resources such as education, employment, health and other services (eg, cultural, sporting activities) improves a person's well-being. These well-being benefits are not external to the user and so not appropriate to include in our new estimate of external benefits.

A number of submissions provided examples of benefits that accrue to society more broadly and argued that these benefits should be quantified and included in our estimate of external benefits. For example:

- Action for Public Transport considers 'workforce capacity and participation are vitally important to the health and functioning of our cities, our society and the economy.'[99]
- The Bus Industry Confederation argues that 'Benefits flowing from social inclusion generated by bus trips include improved health, increased employment participation, a reduced crime rate and lower welfare benefit payments'.[100]

We agree that there are some benefits associated with improved mobility and social inclusion that are external. These include those discussed above such as lower crime and welfare payments, and a potentially lower burden on the public health system resulting from greater health and well-being. Other benefits include having access to education, which provides benefits to society as well as to the individual. This external component of the benefit is difficult to measure. We do not consider that we could determine a reasonable range for these benefits.

Transport for NSW's appraisal guidelines consider the issue of social inclusion/exclusion and indicate that there is limited experience in valuing it for transport projects.[101] The guidelines refer to an Australian valuation from Stanley et al of around $20 per journey. This study was also discussed in a submission to our issues paper, which indicated that the social transit value (the value of trips that would not be undertaken if public transport services did not exist) is likely to be high compared with other external benefit components.[102] However, we have some concerns with adopting the Stanley et al valuation for

98 Mike Smart submission to IPART's Issues Paper, 30 September 2014, p 6.

99 Action for Public Transport (NSW) submission to IPART's Issues Paper, 7 October 2014, p 22.

100 Bus Industry Confederation submission to IPART's Issues Paper, 15 October 2014, p 5.

101 Transport for NSW, *Principles and Guidelines for Economic Appraisal of Transport Investment and Initiatives*, March 2013, pp 295-298.

102 Bus Industry Confederation submission to IPART's Issues Paper, 15 October 2014, pp 5 and 11.

our purposes. This value is found by estimating a proxy for the willingness to pay for an additional trip of a representative individual. As a result, some or even most of this value is likely to be a private benefit. In addition, we consider that preventing social exclusion is more likely to be about having the ability to make trips rather than being related to the number of trips made.

A submission to the issues paper considered that service level, rather than fare level, may be a more significant issue for mobility and social inclusion.[103] The Transport for NSW appraisal guidelines (see Box 11.1) describe seven dimensions of transport related exclusion – economic exclusion, related to the cost of using transport, is only one of these. We remain of the view that the availability of concession fares mitigates the impact of economic exclusion for many people who may otherwise be at risk of social exclusion as a result of fares being too high. Most of the other dimensions are more relevant to the availability and accessibility of services.

Similarly Stanley et al refers a number of key factors that can mitigate the risk of social exclusion.[104] One of these factors is household income. The other factors include age, a number of personality and well-being variables, indicators of a person's social capital, a person's attachment to the community, perception of personal safety and a person's travel activity. They also note that while it may be possible to mount a qualitative argument about the importance of mobility in improving social inclusion, valuation is another matter. We are not aware of any studies that have isolated and quantified the impact of transport fares, or even transport more generally, on the external benefits of mobility and social inclusion.

11.2.2 Social inclusion and the scope and frequency of services offered

Our current fare setting approach determines fares by looking at the efficient cost of supplying the suite of services that the Government decides to offer and the external benefits associated with them. Decisions that are made to try to reduce the incidence of social exclusion by increasing the scope and frequency of public transport services have an impact on the general level of fares under our framework because they affect the efficient cost of providing services.

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103 J Austen submission to IPART's Issues Paper, 25 September 2014, p 9.

104 Stanley, D. Hensher, D. Stanley J. Currie, G. Greene, W. and Vella-Brodrick, D. Social exclusion and the value of mobility, *Journal of Transport Economics and Policy*, Vol 45, Part 2, May 2011, (2010), pp 197-222, and 201.

The Government currently chooses to offer many services at a level of Government subsidy that would not be justified by the external benefits that relate only to the external cost of car use they avoid. For example, services that operate in the middle of the day, in less populated outer suburbs, early morning and/or late night services are likely to have very low levels of utilisation, which means they have high costs on a per passenger basis and avoid very few car trips.

While it may not be clearly articulated, ensuring social inclusion for groups that rely on public transport is likely to be a reason for Government choosing to provide these services.

This is primarily an issue for buses where the focus is on providing local transport within communities. The Government has a stated aim of providing local bus services within a short walk of home for a high proportion of Sydneysiders:

> For almost 90 per cent of Sydneysiders, the local bus routes that run during the day are within 400 metres of home and offer connections to neighbourhood shops and services, major centres and the wider public transport system, including other buses, trains, light rail and ferries.[105]

To date, we have not attempted to value the costs associated with this policy and as a result, we have not explicitly considered the implications of these policies on fares. However, we have set bus (and ferry) fares based on the costs and external benefits of bus services based on only a sub-set of services.[106] Under this approach we have not included the costs associated with many of the lower patronised, lower benefit routes. Instead, we allocated the cost of these to be paid for by Government subsidy. We will reconsider whether this is the most appropriate way of setting fares and how to deal with the cost associated with policies to ensure social inclusion in our next round of fare reviews.

105 Transport for NSW, *Sydney's Bus Future*, December 2013, pp 3 and 17.

106 For bus fares we used the 4 largest contract regions and for ferry services we used the inner harbour services only. See IPART, *Maximum fares for metropolitan and outer metropolitan buses from January 2014 – Final Report*, November 2013, pp 17-18.

Box 11.1 Social inclusion in Transport for NSW's appraisal guidelines

The TfNSW guidelines state that social inclusion refers to people's ability to participate adequately in society, including education, employment, public service, social and recreational activities. Social exclusion describes the existence of barriers which make this difficult or impossible.

Research indicates links between mobility, accessibility and the prospects of a person being socially excluded. Inadequate transport may contribute to social exclusion, particularly for people who live in a car dependent community and are physically disabled, have low incomes and/or do not have access to a car or are unable to drive. It is likely that improved public transport service levels might reduce the risks of social exclusion in these areas.

The guidelines outline the following dimensions of transport-related exclusion:

- Physical exclusion – based on physical, cognitive and linguistic barriers. Some people lack the mental and physical capabilities to use the available means of mobility.
- Geographical exclusion – based on shortcomings in spatial coverage of transport provision.
- Exclusion from facilities – based on location and/or nature of the facilities themselves.
- Economic exclusion – based on cost of transport services.
- Time-based exclusion – based on scheduling conflicts and incompatibilities between the schedules of transport services and temporal.
- Fear-based exclusion – based on concerns regarding personal safety and security associated with the use of transport services.
- Space exclusion – based on inappropriate design of transport interchanges and related public spaces.

Source: Transport for NSW, *Principles and Guidelines for Economic Appraisal of Transport Investment and Initiatives*, March 2013, Appendix 9, pp 295-298.

11.3 Agglomeration and wider economic benefits

Transport creates economic benefits in addition to those that accrue to direct users. The UK, in particular, has been a leader in developing techniques to estimate the value of transportation projects to the wider economy. For appraisal purposes, the UK Department for Transport considers the following wider economic benefits:[107]

- agglomeration (which is the most significant of these benefits)
- output changes from lower transport prices

[107] UK Department for Transport, *Transport Analysis Guidance - Wider Impacts*, January 2014, p 1. Note that the UK Department for Transport no longer considers increased competition (point four above) as a wider benefit of better transport as the UK has well developed transport systems so transport is unlikely to be a significant constraint to competition.

- taxation revenue from labour supply impacts
- improved productivity from competition amongst service providers.

In our issues paper we put forward a preliminary view that we did not consider these benefits should be included in our analysis because many of the benefits of agglomeration, in particular, are private benefits, those that are external benefits are difficult to quantify and in our view there is unlikely to be a strong link between the subsidisation of public transport fares and the realisation of agglomeration benefits.

In response to this we received two comments from stakeholders that did not agree with this proposition[108] and one that noted that although agglomeration mostly meets the criteria for inclusion 'it is likely to be transport infrastructure investments rather than fare changes that stimulate agglomeration'[109]. We also received a number of other suggested external benefits that we consider are either part of the wider economic benefits listed above, or related benefits.[110]

11.3.1 Agglomeration benefits

Agglomeration refers to the benefits associated with people locating near each other. The benefits include better matching of skilled workers with jobs (division of labour), knowledge transfers between firms, and sharing infrastructure and inputs. These factors attract people to cities as they are drawn to the higher wages and profits.[111]

Agglomeration provides a private or internal benefit to firms but the broader benefits to society it provides are less obvious. Nevertheless, we accept that there is some portion of agglomeration benefit that is external. The main argument for including agglomeration benefits when setting fares is that subsidising public transport facilitates travel to job clusters by reducing transportation costs. This promotes improved productivity and leads to economic growth – that is, higher profits, land values and wages, the benefits of which accrue to society in general.

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108 Action for Public Transport (NSW) submission to IPART's Issues Paper, 7 October 2014, p 6 and J Austen submission to IPART's Issues Paper, 25 September 2014, p 9.

109 Mike Smart submission to IPART's Issues Paper, 30 September 2014, p 6.

110 See for example, Action for Public Transport (NSW) submission to IPART's Issues Paper, 7 October 2014, p 26; Bus Industry Confederation submission to IPART's Issues Paper, 15 October 2014, p 6.

111 See for example Paul Krugman, Increasing returns and economic geography, *The Journal of Political Economy*, Vol 99, Issue 3 (June 1991), pp 483-499.

We have previously considered whether to include agglomeration benefits in our estimate of external benefits and decided not to because, on balance, we found that the external benefits of agglomeration 'are not readily quantifiable and the role of public transport services in attaining agglomeration benefits is not established'.[112] We consider that agglomeration may provide an argument for public investment in transport infrastructure but not necessarily for subsidising public transport fares.

A number of submissions to this review argued that agglomeration benefits should be included in our estimates. For example, Action for Public Transport (NSW) considers that public transport, in particular, promotes agglomeration by allowing greater numbers of people to be carried into congested areas.[113]

In order to meet our criteria for inclusion, the external benefit must be able to be measured (or at least that we could determine a reasonable range) and the benefit must change materially in response to changes in fares. We still consider that agglomeration does not satisfy either of these requirements. Many of the benefits of agglomeration are private benefits and not external. The parts of these types of benefits that can be considered external are not easy to measure. They are also difficult to attribute to the provision of public transport. It is even more difficult to discern the importance of the level of fares to the value of these external benefits.

One submission supported this view arguing that 'it is likely to be transport infrastructure investments rather than fare changes that stimulate agglomeration' because fare changes are unlikely to cause businesses and residents to change locations.[114] However, another suggested that agglomeration would be included if different, 'better' criteria were applied.[115] We consider that if an external benefit cannot be quantified in a reasonably robust way and/or there is no, or a very weak, relationship between the value of the benefit and the level of fares then it should not be taken into account when determining the level of fares.

112 IPART, *Review of CityRail fares 2009-2012 - Final Report*, December 2008, p 102.

113 Action for Public Transport (NSW), *Submission to IPART's review of external benefits of public transport – Issues Paper*, 7 October 2014, p 21.

114 Mike Smart submission to IPART's Issues Paper, 30 September 2014, p 6.

115 J Austin submission to IPART's Issues Paper, 25 September 2014, p 9.

11.3.2 Other wider economic benefits

There are a number of wider economic benefits associated with improved and/or lower cost transport. These are basically benefits that flow to the rest of the economy as a result of changes to transport arrangements. They encompass benefits associated with stimulating demand in the economy, greater tax receipts/lower welfare payments and improved productivity from competition among service providers. These benefits are predominantly external by definition. However, at this stage they are not widely considered in either fare-setting or cost benefit analysis for transport projects in other jurisdictions.

Other benefits suggested in submissions that we consider would fall into the category of wider economic benefits are:

- land use impacts including reduced urban sprawl[116]
- improved workplace participation and productivity[117]
- the geo-political and economic benefit of reduced oil dependence.[118]

We remain of the view that none of these benefits should be included in our external benefit estimates. These benefits are extremely difficult to quantify. It is even more difficult to obtain an estimate of the benefit that is specifically associated with changes in the cost of using public transport. In addition, we consider that these benefits are more likely to be linked to the availability of transport in general than to the level of public transport fares and may not change materially in response to changes in public transport fares.

116 Action for Public Transport (NSW) submission to IPART's Issues Paper, 7 October 2014, p 26.

117 Action for Public Transport (NSW) submission to IPART's Issues Paper, 7 October 2014, p 6 and Bus Industry Confederation submission to IPART's Issues Paper, 15 October 2014, p 5.

118 Bus Industry Confederation submission to IPART's Issues Paper, 15 October 2014, p 6.

Appendices

A Further information on public transport elasticities

There have been many surveys which aggregate estimates of public transport elasticities. These studies consistently find that the average estimate of short run price elasticities of demand is between -0.3 and -0.4 (with variation around the mean). Other key findings from these studies include that:

- price elasticities are around two times larger in the long run than short run
- estimates of price elasticities can be affected by the approach used to measure elasticity.

Australian estimates of elasticity have tended to be slightly lower than international estimates; between -0.2 and -0.4. However, there are far fewer reliable local estimates to base these estimates from.

International surveys

In a landmark study from 1968, Simpson and Curtin studied the impact to demand of 77 public transport fare changes. This led to many American transport agencies adopting an estimate of transport elasticity based on the paper's findings. This rule equates to an elasticity of around -0.4 (though it was often misapplied by transport planners to -0.3).[119]

In 1980, the Transport and Road Research Laboratory published a collaborative report on the demand for public transport, which became the seminal piece of work on demand evaluation in the UK (commonly known as the "black book" study).[120] The price elasticities in this report ranged from -0.1 to -0.6 and averaged around -0.3.[121]

In 1991, the American Public Transportation Association (APTA) published updated bus fare elasticity estimates for use in transport planning, based on the short run effects of a transport fare change. APTA's estimates are outlined in Table A.1 below.

119 Transportation Research Board, *Transit Pricing and Fare: Traveler response to transportation system changes*, 2000, p 12-9.

120 Balcombe et al., *The demand for public transport: a practical guide*, 2004, p 1.

121 Webster and Bly, *The demand for public transport, part II: supply and demand factors of public transport*, Transport Reviews: A Transnational Transdiciplinary Journal, p 24.

Table A.1 Bus fare elasticities (APTA)

	Large cities (more than one million population)	Small cities (less than one million population)
Off-peak	-0.39	-0.46
Peak	-0.18	-0.27
Average	-0.36	-0.43

Source: Victoria Transport Policy Institute, *Transit Price Elasticities and Cross-Elasticities*, April 2014, p 7.

In 1992, Goodwin calculated average elasticities based heavily on European estimates of bus and rail elasticities.[122] Goodwin differentiated between short and long run, and noted that short run elasticities were lower than longer run elasticities. This conclusion is consistent with other studies, which found that long-run elasticity is two to three times larger than short-run elasticity.[123] Goodwin's estimates are outlined below.

Table A.2 Public transport elasticities (Goodwin)

	Short-run	Long-run	Average
Bus elasticity	-0.28	-0.55	-0.41
Rail elasticity	-0.65	-1.08	-0.79

Source: Goodwin, *A review of new demand elasticities with special reference to short and long run effects of price changes*, Journal of Transport Economics and Policy, May 1992, pp 160-161.

In 1992, Oum et al. conducted a survey of public transport elasticity estimates.[124] (Despite being contemporaneous with Goodwin's study, few of the estimates used in the two studies overlapped).[125] Oum et al. found that most public transport elasticity estimates fell in the range from -0.1 to -0.6.[126] They also demonstrated that the approach and functional form of the econometric study resulted in widely different elasticity estimates, even with the same set of data.[127]

122 Goodwin, *A review of new demand elasticities with special reference to short and long run effects of price changes,* Journal of Transport Economics and Policy, May 1992, pp 160-161.

123 For example, see Victoria Transport Policy Institute, *Transit Price Elasticities and Cross-Elasticitie,* April 2014, p 5.

124 Oum, Waters and Yong, *Concepts of Price Elasticities of Transport Demand and Recent Empirical Estimates: An Interpretative Survey,* Journal of Transport Economics and Policy, May 1992.

125 Goodwin, *A review of new demand elasticities with special reference to short and long run effects of price changes,* Journal of Transport Economics and Policy, May 1992, p 149.

126 Oum, Waters and Yong, *Concepts of Price Elasticities of Transport Demand and Recent Empirical Estimates: An Interpretative Survey*, Journal of Transport Economics and Policy, May 1992, p 153.

127 Ibid, p 153.

In 2006, a group of major English universities collaborated to produce a guidance manual on the demand for public transport for use by public transport operators and planning authorities in the UK.[128] This was meant as an update to the estimates of elasticities in the "black book" study, but with greater detail around the short/long run and taking advantage of more advanced econometric techniques to understand how transport demand changes over time.[129] This study found slightly higher elasticity estimates than the previous study, see Table A.3 below.

Table A.3 Public transport elasticities in the United Kingdom

	Short-run	Medium-run	Long-run	Peak short-run	Off-peak short-run
Public transport	-0.44	NA	NA	NA	NA
Bus	-0.42	-0.56	-1.01	-0.26	-0.48
Metro	-0.30	NA	-0.65	-0.26	-0.42
Suburban rail	-0.58	NA	NA	-0.34	--0.79

Source: Paulley, Balcombe, Mackett, Titheridge, Preston, Wardman, Shires and White, *The demand for public transport: The effects of fares, quality of service, income and car ownership*, Transport Policy 2006.

Local estimates of public transport elasticities

In 1993, Luk and Hepburn surveyed Australian elasticity estimates,[130] and compared them to the international estimations by Goodwin (discussed in the previous section). From five bus estimates and five urban rail estimates, Luk and Hepburn estimated the elasticities outlined in Table A.4.

Table A.4 Short run public transport elasticity (Luk and Hepburn)

Mode of transport	Luk and Hepburn (Australian review)	Goodwin (International review)
Bus	-0.29	-0.28
Rail	-0.35	-0.65

Source: Luk and Hepburn, *New review of Australian demand elasticities – research report*, Australia Road Research Board, p 19.

[128] Paulley, Balcombe, Mackett, Titheridge, Preston, Wardman, Shires & White, *The demand for public transport: The effects of fares, quality of service, income and car ownership*, Transport Policy 2006.

[129] Paulley, Balcombe, Mackett, Titheridge, Preston, Wardman, Shires & White, *The demand for public transport: The effects of fares, quality of service, income and car ownership*, Transport Policy 2006, p 296.

[130] Luk and Hepburn, *New review of Australian demand elasticities – research report*, Australia Road Research Board.

In 1996, we engaged the Institute of Transport Studies to estimate price elasticties of Sydney transport for all ticket types. This study is one of the few to estimate elasticities for ferries. Much of the individual ticket's elasticity derives from "within mode" transfers, ie, customers who substitute one ticket type for another but remain on the same mode. When we attempted to find aggregate estimates – by calculating a weighted average of all cross and direct elasticities - the results were unreliable and in some cases positive (a positive elasticity means that raising fares would raise demand, which is unrealistic).

In 2006, we engaged Booz Allen Hamilton to forecast patronage of ferries. Booz estimated an elasticity estimate of -0.22 by taking a weighted average of the Sydney Transport Authority's (STA's) ticket type fare elasticities (similar to the Institute of Transport Studies's report above).[131]

In 2008, we engaged Booz&Co to estimate the elasticities of CityRail. Booz estimated that a price elasticity of CityRail of -0.29,[132] focusing on stated preference surveys. In addition, Booz performed a literature review of rail elasticity estimates. They found a median short run rail elasticity of -0.28 and a long run median of -0.36.

RailCorp also estimates elasticity of rail fares. Its estimates for 2010 are outlined in Table A.5.

Table A.5 Rail elasticity (RailCorp)

	Peak	Off-peak	Overall
Price elasticity	-0.35	-0.42	-0.38

Source: Transport for NSW, *Principles and guidelines for economic appraisal of transport initiatives*, March 2013, p 269.

Finally, in 2014, Tsai, Mulley and Clifton estimated the elasticity of public transport fares in Sydney using Household Travel Survey data.[133] They found a short run elasticity of all mode public transport with respect to the fare paid of -0.22 and a long run elasticity of -0.29.

131 Booz Allen Hamilton, *Review of patronage trends and projections for Sydney Ferries*, October 2006, p 14.

132 Booz&Co, *CityRail Fare Elasticities - Final report to Independent Pricing and Regulatory Tribunal*, May 2008, p ii.

133 Tsai, Mulley and Clifton, *A Review of Pseudo Panel Data Approach in Estimating Short-run and Long-run Public Transport Demand Elasticities*, *Transport Reviews*, p 120.