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Two Case Studies on Road vs. Rail Freight Costs

Prepared By:

CRA International

Level 7, 107 Pitt Street

Sydney NSW 2000, Australia

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CRA Project No: D09396-00

Authors: Mike Smart, Simon Game

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1. PURPOSE

This report is intended to provide the Productivity Commission with quantitative data comparing the economic costs of performing specific freight tasks by road and by rail. This comparison is made by means of case studies for particular types of freight on two corridors: intermodal freight between Sydney and Brisbane and forestry products between Penola, S.A. and Portland, Vic. Emphasis is given to costs that vary directly with mass-distance, to external costs, and to non-traffic-sensitive costs relating to the provision of the necessary transport capacity.

2. METHODOLOGY

Raw data on cost, capacity and usage is sourced primarily from accounting records and engineering estimates. These figures are derived both from public sources and private sources accessible to Pacific National (PN). This data set is then used to generate estimates of costs that are most relevant to an economic inquiry into the future possible performance of road and rail modes.

The key economic cost estimates derived here include marginal resource costs, marginal social costs, and non-traffic sensitive (NTS) costs. To a significant degree, particularly with land transport infrastructure, there is a trade-off between investment options which may offer on one hand relatively low levels of NTS costs but relatively high marginal costs, and on the other hand relatively high NTS costs coupled with lower marginal costs.

For the corridors considered here, other traffic flows than those we examine may contribute to the recovery of NTS infrastructure costs. Often these other traffic flows are differentially available to road or rail. The most obvious example is the fuel excise revenue associated with private automobile use, which contributes to recovery of the NTS costs of road infrastructure. We do not attempt to quantify the cost recovery from these other sources.

It is convenient to think of costs as falling broadly into ‘usage’ and ‘availability’ categories. The former consist of costs that would be directly avoidable if usage were reduced. The latter are costs that are necessarily incurred in providing transport capacity (either vehicular or infrastructure-related). The availability costs are treated here as non-traffic-sensitive in the sense that once the capacity commitment is made, provided actual usage does not exceed that capacity, the availability costs are unaffected by usage. The capital cost component of infrastructure availability costs is generally sunk, but the non-capital cost component may be avoidable if the infrastructure capacity increment is removed from service.

2.1. USAGE COSTS

Usage costs can be presented in terms of dollars per unit of mass-distance ($/'000 ntk), where "ntk" refers to net-tonne-kilometres. An alternative measure "gtk" refers to gross-tonne-kilometres. The former is the mass of the freight itself multiplied by the distance it travels. The latter is the combined mass of the freight, container (if any), and vehicle multiplied by the distance it travels.

In order to derive usage costs per ntk, a "reference vehicle" is selected. For intermodal road freight, that reference vehicle is the most efficient available: a B-double with nine or more axles. For intermodal rail freight on the Sydney – Brisbane corridor, that "vehicle" is a standard superfreighter with two NR-class locomotives hauling 36 wagons, with a gross loaded mass of 2,700 tonnes and a length of approximately 1100m. This train type was chosen on advice from PN's Intermodal Division as it represents a typical train configuration on the route.

Avoidable round trip journey costs are estimated separately for each cost type, of which the major categories are linehaul, termination, and externalities. The linehaul cost categories are fuel, driver labour, vehicle wear and tear, infrastructure wear and tear, and equipment rental (containers for rail).

Vehicle-related linehaul costs of usage for road and rail were estimated using corridor-specific experience within PN's Intermodal Division concerning fuel consumption, travel times, labour rates, vehicle repair rates per kilometre, and equipment rental rates.

At the bowser, road and rail pay different fuel prices per litre because rail freight attracts the full 38.54c/litre rebate on fuel excise, whereas road freight attracts only the 18.54c/litre diesel rebate. This difference is a tax, not a genuine resource cost differential. For this reason, in our modelling we have assumed that both road and rail pay the current price of diesel less the entire 38.54c/litre fuel excise. This choice puts the comparison on a more proper resource cost basis, particularly given that part of the fuel excise is intended to pay for road wear and tear costs associated with heavy vehicles. Treating the fuel cost per litre as if it were equal between road and rail eliminates any double counting that might otherwise occur with road usage costs.

Usage costs for rail linehaul infrastructure were estimated using what limited published information is available, supplementing that with industry experience within PN derived from various activity-based costing exercises conducted over the past few years. One such exercise has been conducted recently by PN's Network and Access Division for the Victorian broad-gauge network. Admittedly, the data on rail infrastructure usage costs is sketchy, and relatively broad ranges of uncertainty should be applied to the results.

Usage costs for road linehaul infrastructure were estimated based on information contained in the NTC's Third Heavy Vehicle Determination Technical Paper. Arterial road costs that were allocated by ESA-km or by AGM-km according to the NTC's methodology are taken to be usage-related costs. In our analytical base case we depart from the NTC choice of allocators insofar as we treat 100% of the road rehabilitation and pavement component costs as separable, and allocate these according to ESA-km. We examine a sensitivity case that employs the NTC allocators, under which only 45% of these two cost types are allocated by ESA-km.The proportion of these types of cost that is allocated to B-doubles is divided by the annual mass-distance (AGM-km, which is equivalent to the measure 'gtk' used for rail freight) for B-doubles to obtain an average wear-related cost rate for arterial road infrastructure of $6.43 per '000 gtk ($3.54 using the NTC methodology). Performing a similar calculation for local roads yields the higher figure of $10.33 per '000 gtk ($5.76 using the NTC methodology). It is to be expected that local roads, being constructed generally to a lower standard strength, would be more susceptible than arterial roads to usage-related damage.

Termination costs consist of handling costs at rail terminals where the containers are transferred between train and local road vehicles, and pick up and delivery costs (PUD) by road. Where road transport is the linehaul mode, PUD costs are not avoided, but economies are possible relative to rail because the same vehicle is usually used for linehaul and PUD.

Usage costs for rail terminals were estimated by CRA from industry sources. We have assumed that the labour costs are traffic sensitive and all other costs are non-traffic sensitive. Estimated labour cost were expressed as an average usage cost per container processed at a terminal. Terminal costs are avoided when road is the linehaul mode.

The external costs considered here are greenhouse gas emissions and the externally borne portion of accident costs. These are treated as usage costs because they are driven by actual freight transport activity. The figures employed here are based on previously published work. Greenhouse gas costs are based on fuel consumption, which we estimate directly here for each mode. We then employ a range of possible values for the external cost associated with emitting one tonne of CO_2 to derive the usage-driven external unit cost. Accident costs are presented as a range of dollars of external cost per thousand ntk.

Usage costs determined per vehicle round trip are then divided by the number of ntk in one vehicle round trip (assuming current typical average utilisation of vehicle capacity in each direction) to obtain usage cost rates expressed as dollars per thousand ntk.

2.2. AVAILABILITY COSTS

Three types of transport capacity are needed for freight: vehicles, linehaul infrastructure, and terminal infrastructure. For each type, we have identified the minimum increment needed to perform the given freight task, then calculated the annualised cost of providing that capacity increment. There are two parts to the annualised cost: the capital cost, expressed as an annuity, and the non-traffic-sensitive component of non-capital costs.

2.2.1. Costs of providing capacity

For each of these capacity increments, we calculate the capital cost annuity as the constant annual payment necessary to fully amortise the current replacement cost over the estimated life of the asset at the nominated discount rate. This approach is somewhat simpler than the method normally used within the trucking industry for calculating lease costs for B-doubles, but it is equivalent and yields a similar annuity.[1]

For road and rail infrastructure we have assumed an economic life of 50 years.[2] Current replacement costs for road infrastructure are estimated as a range expressed as dollars per lane kilometre, based on data from the NSW RTA on the capital costs and lengths of work for upgrades to the Pacific Highway. Current replacement costs for rail infrastructure are estimated as a range expressed as dollars per track kilometre, based on rail industry experience.

For the NTS non-capital costs of rail infrastructure, we have adopted a value from within a fairly wide range, expressed as dollars per kilometre of single track per annum (which can be doubled approximately for dual track). The types of activities driving this cost are track inspections, replacement of timber sleepers on straight track, renewal of structures (bridges, culverts), signalling renewal, and other maintenance tasks that are performed to a fixed schedule irrespective of traffic levels. For all but the most heavily trafficked (usually bulk mineral) rail lines in Australia, these NTS costs exceed the traffic-sensitive or ‘wear and tear’ costs in absolute dollar terms.

1 While we present a simple annuity calculation for truck capital costs, the asset life has been selected in order to match the annual lease payments calculated using the more exact truck leasing cost formula. This approach results in relatively short assumed economic lives for the trucks (i.e., approximately 4.6 years), but the annuity that results is consistent with actual lease payment levels that currently prevail in the trucking industry.

2 The choice of 50 years is somewhat arbitrary. Given the allowance for major periodic maintenance, involving all cyclic renewals, contained in the usage and NTS costs, the technical life of these infrastructure assets is likely to be considerably longer. Changing this life to 100 years would make the annuity almost trivially small in both the road and rail infrastructure cases. Nevertheless, we have retained the 50 year life assumption because experience has shown that freight mode shifts can be very significant over such a time period. We consider the 50 years to be more an indication of economic life than of engineering life.

For the NTS costs of road infrastructure, we have adopted an approximation based on information in the NTC's Third Heavy Vehicle Determination, Technical Paper. Treating arterial roads separately from local roads, we sum the Australian total expenditure that is either non-separable, allocated by VKT or by PCU-km.[3] In our analytical base case, as noted earlier, we depart from the NTC choice of allocators by treating all of the road rehabilitation and pavement component costs as allocable by ESA-km—traffic-sensitive, in other words. In all other respects, the base case conforms to the NTC methodology. This sum of non-separable, VKT or PCU-km allocated represents the NTS costs of road infrastructure, to the extent that the NTC's PAYGO methodology reasonably approximates average annual total economic costs. For arterial roads, this sum is divided by the number of kilometres of arterial road in Australia to obtain an average NTS cost per kilometre of arterial road per annum. The same calculation is performed for local roads. Note that, unlike the rail NTS cost calculation, the road NTS cost calculation includes road capital costs. Because the PAYGO method rolls capital and maintenance costs together, it is not possible to separate them within the NTC numbers.

Due to lack of relevant capacity information, we have not attempted to infer a terminal availability cost, as we have done for vehicles and linehaul infrastructure.

2.2.2. Estimating quantum of capacity provided

The capacity of reference vehicles is readily established, but for linehaul infrastructure, capacity estimation is somewhat more involved. For the minimum increment of road infrastructure in each of our case studies, a two-lane highway, the maximum freight capacity is estimated by considering how much freight could be transported by fully laden B-doubles (or semi-trailers in the case of the Penola – Portland case study) travelling at the applicable speed limit, separated by the minimum safe stopping distance of 200m.[4]

The minimum increment of rail infrastructure is a single track railway with crossing loops at which opposing trains (trains travelling in opposite directions on the same track) may pass each other safely. The bidirectional nature of the single track creates the need for crossing loops. The number of trains that may occupy a single-track corridor at one time depends directly on the number, spacing, and length of crossing loops. The freight capacity of the single track railway depends on how much freight can be transported by fully laden trains of a maximum length which is determined by the length of the crossing loops, the number of such trains depending on the number of crossing loops.

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3 The other allocation categories, by ESA-km and by AGM-km, formed the basis of our estimate of 'wear and tear' - related costs of road infrastructure usage, and are therefore excluded from the availability cost calculation.

4 Minimum separation distance of 200m is mandated by the Australian Road Rules for long vehicles (greater than 7.5m length) travelling on an approved B-Double route unless driving on a multi-lane road or overtaking. See "Information Guide for B-Doubles", South Australian Department for Transport, Energy and Infrastructure MR 415 06/05, June 2005, p. 22.

2.2.3. Presentation of availability costs

Subject to directionality and seasonality of demand, the capacity of reference vehicles is likely to be highly utilised. As the capacity of a train is considerably greater than that of a B-double, there is a degree of lumpiness in rail freight capacity that could result in somewhat lower vehicle capacity utilisation on average than for road. This effect is reflected in our calculations for the Sydney – Brisbane intermodal operation. For the Penola – Portland woodchip haulage, we assume that the more continuous nature of forestry operations results in fully utilised trains (and trucks) travelling to Portland. An empty return to Penola is assumed for both modes.

In contrast, the capacity of the minimum increments of road and rail infrastructure is not highly utilised by freight. For road, there are also scope economies available as a consequence of the shared production of passenger car and truck journeys, which are relevant to any efficiency comparison between modes. These factors make a direct comparison of total or average freight costs difficult.

The approach taken here is to compare the sum of usage, vehicle availability, and infrastructure availability costs for rail to the sum of usage and vehicle availability costs only for road freight. Usage costs include infrastructure wear and tear for both modes. For both modes, the vehicle availability cost is estimated per unit mass-distance assuming typical utilisation for each type of vehicle.

For rail, the infrastructure availability costs are estimated per unit mass-distance assuming that the particular freight task at issue here must meet the entire availability cost. Another way of putting it is that the unit infrastructure availability cost for rail is the average availability cost at the level of utilisation that is implied by the task.

While this comparison is not a true 'apples to apples' comparison, it does permit us to examine whether the upper bound to rail costs is below a lower bound to road costs for the same freight task. We also calculate a critical level of utilisation for rail infrastructure below which the upper bound for rail would no longer be below the lower bound of average costs for road. This part of the calculation highlights the criticality of rail infrastructure utilisation, which in turn depends very much on infrastructure investment, to rail's economics.

Any quality of service differentials between road and rail that might be relevant to this comparison are not able to be taken into account because of the lack of a suitable analytical framework and the requisite quality data.

3. DATA SOURCES

Operating and capital costs for reference vehicles on the Sydney – Brisbane corridor have been estimated by PN's Intermodal Division, based on its current understanding of the commercial environment. Operating and capital costs for reference rail vehicles on the Penola – Portland corridor have been estimated with assistance from PN's Rural and Bulk Division, again based on the currently tentative understanding of the proposed freight task.[5] Estimation of costs is somewhat more theoretical in this corridor as the railway line has been closed for twelve years. The anticipated forestry product task is potentially large, but the eventual split between road and rail, assuming the rail line is recommissioned, is difficult to determine at this early stage. Operating and capital costs for reference road vehicles on the Penola – Portland corridor have been roughly estimated by making adjustments to the road vehicle unit costs established in other geographic regions. We assume that the standard road vehicle is a semi-trailer, rather than the B-double assumed for Sydney – Brisbane.

Road infrastructure data, general road traffic data, and road cost allocation information is sourced primarily from the NTC's Third Heavy Vehicle Determination, Technical Report, October 2005. While some of the NTC's cost allocation decisions have proven controversial, we have reflected them in the first sensitivity analysis undertaken later in this report. For that sensitivity case, we have simply applied the NTC methodology as if it accurately represented cost causality. In so doing, we do not endorse that methodology. In fact, our preferred approach to allocation of road costs, used in the analytical base case is more reflective of the views of Engineers Australia (in its May 2006 Submission to the Productivity Commission review, pp. 4-7) and BTRE (in Working Paper 40, 1999, pp. 41-44) regarding allocation of road costs to heavy vehicles.

5 This understanding is necessarily tentative because the task itself is expected to grow rapidly, if somewhat unpredictably, as hardwood plantations in the 'Green Triangle' area of South Australia reach maturity and begin woodchip production on a large scale. Further, the existing broad-gauge railway line between Heywood and Mount Gambier has been closed for many years. In order to haul this forestry output by rail, that line would need to be substantially rebuilt and modified to standard gauge. For these reasons there is no rail operating experience to rely on for this specific task.

Supplementary information on road lengths was sourced from the ABS Yearbooks for 2005 and 1974. The 2005 Yearbook does not provide separate lengths for arterial and local roads, whereas the 1974 Yearbook does. Given that the total road length cited in each Yearbook has hardly changed over the 31 year period that these Yearbooks span, we have assumed that the split between arterial and local road lengths is the same in 2005 as it was in 1974. Information on capital costs of highway construction was inferred from data presented on the website for the NSW Government Roads and Traffic Authority, in particular its web page on Pacific Highway upgrading. The underlying public information consisted of capital cost estimates to convert stretches of the Pacific Highway from dual-lane highway to dual carriageway. Taking a range of projects, we divided the capital cost by the length of road treated in each project, and divided by four lanes. The resulting capital cost per lane kilometre varied over a large range. The high-end estimates often involved major structures such as river crossings, or interchanges. We took the lower range figures, but it should be noted that the error tolerance associated with this approach is necessarily large.

Rail infrastructure cost data has been sourced from PN's Network and Access unit, which has responsibility for the broad-gauge Victorian rail infrastructure network, and publicly available information on rail wear and tear costs, including the QCA's analysis of Queensland Rail's 2001 Access Undertaking. Supplementary cost benchmarks have been established relying on commercial experience of PN staff who have worked within rail infrastructure organisations, and on historical cost estimates such as the NRC standard cost benchmarks (upon which many of the NRC establishment funding agreements were based). Unfortunately, but unavoidably, this information is subject to significant measurement error. This problem has been compounded by the recent rises in the price of steel which, anecdotally appears to have led to a 60% increase in the price of steel rails in the past 18 months. We have tried to compensate for measurement error by applying a range to the most uncertain figures. In many cases, the result is not particularly sensitive to variations within this range.

Rail terminal costs are estimated from industry sources. Terminal capacity information was not available, preventing us from including terminal availability costs in the calculations.

External cost estimates are sourced primarily from BTRE publications, notably working paper 40, and more recently from the NTC-commissioned "Freight and Mode Share Forecasts: A Review of 'The Future of Freight'", Maunsell Australia, March 2006. We have adopted a relatively conservative range of values for Greenhouse Gas and externally-borne accident costs.

The approach for Greenhouse Gas externality costs was to estimate the quantity of fuel consumed to carry out a given transport task by a particular mode, adopt accepted figures for the numbers of tonnes of CO2 injected into the atmosphere per litre of diesel consumed, then apply a range of accepted externality cost rates per tonne of CO2. The lower range figure of $10/tonne of carbon[6] corresponds to $2.73/tonne of CO2.[7] The higher range figure of $0.77/’000 ntk adopted in our report corresponds to the ATC AusLink appraisal guideline figure for greenhouse gas externality value for heavy vehicles as reported in the NTC March 2006 report.[8]

The approach for the lower bound estimate of the external component of accident costs is taken from the BTRE Working Paper 40. Following the BTRE’s approach (explained in detail on p. 61 of that report), the value we have used represents the accident cost net of insurance premia. The upper bound estimate of $2.5/’000 ntk is obtained by making the adjustments suggested by NTC in its March 2006 report (p. 26 suggests a reduction by 20-50%) to the externality estimate of $5.1/’000 ntk contained in the report which it critiques.[9]

We have not included provisions for noise pollution or congestion because of the concerns held in many quarters that any road/rail differential on these externalities is confined to metropolitan areas, making quantification difficult and raising a question-mark over materiality.

4. RELEVANT TRENDS AND CONSTRAINTS

In presenting the case studies, we have strived for transparency and a level of disaggregation that will permit other parties to perform their own analyses. Given recent concern about fuel price increases and the more intense use of fuel by road transport for a given freight task, it is important to be able to revisit the modal comparisons as the prices of fuel and other inputs change.

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6 Specified in the AusLink appraisal guidelines, and consistent with the upper bound of the cost to government of abatement purchased under round 1 of the Australian Government’s Greenhouse Gas Abatement Program. These points are noted in the NTC’s “Freight and Mode Share Forecasts: a review of ‘The Future of Freight’”, March 2006, at page 27.

7 The atomic weight of carbon is 12, and oxygen 16. Thus carbon represents 12/(12+16+16) = 27.27% of the mass of CO2. $10/tonne carbon X 27.27% = $2.73/tonne CO2.

8 Op.cit. NTC, March 2006, p. 27.

9 The higher estimate of $5.1/’000 ntk is contained in Port Jackson Partners’ “The Future of Freight.” The NTC report critiquing it suggests that figure is 20-50% too high (see p. 26). Reducing the PJP figure by 50%, we obtain the $2.5/’000 ntk figure used in our report.

Anecdotally, at least, there are suggestions that the interstate road transport industry is confronting capacity constraints in terms of available drivers and vehicle fleet.[10] While there is insufficient evidence available to us to permit a robust conclusion on this question, it is conceivable that the unit costs employed for road driver labour and B-double capital costs, being based on current costs, may underestimate sustainable prices.

Regarding rail capacity, there are also anecdotal indications that the North Coast Line between Maitland and Brisbane may be suffering from congestion-related problems. Capacity on the North Coast Line is primarily affected by the number, spacing, and length of crossing loops. Crossing loops are relatively inexpensive investments, costing approximately $3m - $4m each. Once the existing crossing loop extension program is completed, there will be approximately 35 crossing loops on the North Coast Line (currently there are approximately 11 sufficiently long to accept a 1500m train), which would permit the current freight capacity to be more than doubled.

5. INFORMATION COMMON TO THE CASES

5.1. ASSUMPTIONS

The table below summarises the general assumptions we have employed in this analysis.

Discount rate 8%

		Capital costs		Wear and tear rates			NTS mtce & renewal		
		$m/'lane' km		$/'000 gtk			$/ km of 'lane' or track		
Infrastructure capital costs		low value	high value	NTC_scen_!	base	scen_2	NTC_scen_!	base	scen_2
road	Pacific Highway	2.5	5	3.54	6.43	7.36	33,159	27,089	24,790
	Penola - Portland	1.2	2.5	3.54	6.43	7.36	33,159	27,089	24,790
rail	SYD-BNE	1.2	2.4	QCA figure 1.67	3.34	3.34	25,000		value adopted 40,000
	Penola - Portland	1.0	1.2	PN N&A figure 2.2	4.4	4.4	12,000		value adopted 25,000

average container hire cost per '000 ntk 2.34 Source: PN advice.

Variable rail infrastructure cost
Source -- QCA working paper 2, December 2000 '*Usage-related infrastructure maintenance costs in railways*'
1.67 per '000 GTK

10 "Driving Australia's Future", Australian Trucking Association, August 2003 notes, at page 25 that "each of the road freight transport occupations had a proportion of 45 to 54 year olds relatively higher than the proportion for all occupations." Analyses such as this have fuelled a concern about the ageing of the truck driving workforce in Australia which is attributed in part to the relative unattractiveness of truck driving as an occupation at current wages and conditions.

5.2. Road Infrastructure Costs

The table below is a modified version of tables presented in the NTC Third Heavy Vehicle Determination Technical Report. This table represents the base case road cost allocations, which differ somewhat from those made by the NTC. The allocations that differ from NTC choices are highlighted. The emphasis is on arterial roads in this study since the freight tasks considered in the case studies are expected to travel principally by arterial roads.

%cost by allocator								Arterial	Estimated Local	$m arterial road cost per annum allocated by				
VKT	PCU-I	ESA-	AGM-	Non - Separable	unalloca			($million)	($million)	VKT	PCU-km	ESA-km	AGM-km	Non Separable
100	0	0	0	0	0	A	Servicing and Operating Expenses	629	265	629	-	-	-	-
0	37	0	37	26	0	B1	Routine Maintenance	400	160	-	148	-	148	104
0	10	0	60	30	0	B2	Periodic Surface Maintenance of Seale	286	116	-	29	-	172	86
0	0	0	33	67	0	C	Bridge Maintenance and Rehabilitation	152	63	-	-	-	50	102
0	0	100	0	0	0	D	Road Rehabilitation	465	189	-	-	465	-	-
80	20	0	0	0	0	E	Low Cost Safety/Traffic Improvements	290	124	232	58	-	-	-
0	0	100	0	0	0	F1	Pavement Components	935	221	-	-	935	-	-
0	15	0	0	85	0	F2	Bridges	286	69	-	43	-	-	243
0	10	0	0	90	0	F3	Land Acquisition, Other Extension/Improvement Expenditure	1537	356	-	154	-	-	1,383
0	0	0	0	100	0	G1	Corporate Services	226	0	-	-	-	-	226
0	0	0	0	0	100	G2	Enforcement of Heavy Vehicle Registra	0	0	-	-	-	-	-
0	0	0	0	0	100	G3	Vehicle Registration	0	0	-	-	-	-	-
0	0	0	0	0	100	G4	Driver Licensing	0	0	-	-	-	-	-
0	0	0	0	0	100	G5	Loan Interest	0	0	-	-	-	-	-
							TOTAL	5206	1563	861	431	1,400	370	2,144

	VKT	PCU-km	ESA-km	AGM-km	Total
UNITS FOR UNIT COST	(m)	(m)	(m)	(m)	
UNIT COST ALLOCATION RATE	0.0067	0.00293	0.07522	0.001186	
B-double units	950.4	3800.7	3429.9	49223.7	
All vehicle units	128951	147055	18612.2	311707.1	
Costs allocated to B-doubles ($m)	6.35	11.14	258.00	58.39	333.88
Wear-related costs alloc to B-doubles			258.00	58.39	316.39
Average wear-related cost $/'000gtk					6.43

Road system NTS availability charge estimation

Length of Australian roads	810,000	km	ABS 1301.0 Year Book Australia 2005, data at 30 June 200
Length of arterial roads	126,850	km	ABS 1301.0 Year Book Australia 1974, data at June 1972
Length of local roads	683,150	km	Subtraction. Note the total length of roads varied only From that, we infer that the proportion of arterial to local
Arterial roads	5,206	$m	NTC 3rd heavy vehicle determination, technical paper
Wear-related	1,770	$m	
NTS	3,436	$m	
Avg NTS cost/km arterial road	27,089	$/route km	
Local roads	1,563	$m	NTC 3rd heavy vehicle determination, technical paper
Wear-related	560	$m	
NTS	1,003	$m	
Avg NTS cost/km local road	1,469	$/route km	

5.3. Infrastructure Capacity

In the table below, a rough estimate of the maximum transport capacity of the road and rail infrastructure for each case study is presented. Of these estimates, only the rail figures are used in the case studies to determine an average availability charge at the level of utilisation implied by the task.

	SYDNEY - BRISBANE		PENOLA - PORTLAND	
RAIL INFRASTRUCTURE FREIGHT CAPACITY	**Minimum**	**Likely future**	**Minimum**	**Likely future**
Vehicle carrying capacity (net tonne)	2000	2000	3150	3150
Transit time - one way (hrs)	16	16	8.5	8.5
Route length - one way (km)	975.5	975.5	170	170
No directions freight travels	2	2	1	1
No. vehicles infrastructure can support at any one time (one-way)	3.8	12	3	3
No Trips - one way (per day/ vehicle)	1.5	1.5	3	3
Infrastructure freight capacity (mntk/p.a.)	8,057	25,636	1,656	1,656
ROAD INFRASTRUCTURE FREIGHT CAPACITY				
Vehicle carrying capacity (net tonne)	38	38	40	40
Corridor speed limit (km/hr)	100	100	100	100
Transit time - one way (hrs)	12	12	2	2
Route length - one way (km)	1030	1030	157	157
No directions freight travels	2	2	1	1
Min separation distance (m)	200	100	200	200
No. vehicles infrastructure can support at any one time (one-way)	5150	10300	785	785
No Trips - one way (per day/ vehicle)	2	2	12	12
Infrastructure freight capacity (mntk/p.a.)	294,294	588,587	21,593	21,593

6. CASE STUDY 1: SYDNEY – BRISBANE

6.1. DISTINGUISHING FEATURES OF FREIGHT ON CORRIDOR

The Sydney – Brisbane corridor carries freight originating or terminating in Sydney as well as freight originating or terminating in Melbourne. The freight is generally non-bulk, although there is some break-bulk steel traffic carried mainly on rail. The non-bulk freight consists of low density cubic (high volume), palletised, and denser containerised elements. Freight on this corridor is directionally imbalanced, with larger volumes travelling north.

Our analysis focuses on the denser, usually containerised component of the non-bulk freight, which is the most contestable between road and rail. Note that when this freight goes by road it is usually not containerised.

The key assumptions concerning the quantum of the freight task and reference vehicles for both road and rail on the Sydney – Brisbane route are provided in the table below.

		SYDNEY - BRISBANE	
		ROAD	RAIL
Task			
	Net tonnes northbound	1,500,000	1,500,000
	Net tonnes southbound	1,050,000	1,050,000
	Distance (km)	1030	975.5
	mntk northbound	1,545	1,463
	mntk southbound	1,082	1,024
	Total mntk for task	2,627	2,488
	NOTE: Total corresponds roughly to BTRE estimate of task expected to be on rail Syd-Bne and Mel-Bne in 2014.		
Reference vehicles		B-double	Superfreighter
	Cargo capacity		
	TEU	3	154.8
	Net tonnes	38	1,703
	Maximum gross mass	62.5	2,659
	Tare mass (tonnes)	24.5	956
Average load factor			
	northbound	100%	80%
	southbound	70%	56%
Average payload (tonnes)			
	northbound	38.0	1,362.2
	southbound	26.6	953.6
Average gross mass			
	northbound	62.5	2,318.2
	southbound	51.1	1,909.6
'000 ntk			
	northbound	39.1	1,328.9
	southbound	27.4	930.2
	Round trip	66.5	2,259.1
'000 gtk			
	northbound	64.4	2,261.4
	southbound	52.6	1,862.8
	Round trip	117.0	4,124.2
	Round trip gtk/ntk	1.76	1.83
	Avg # TEU on train		123.8
	Avg # 48' containers on train		52
Round trips required to perform task		39,474	1,101
# possible round trips per vehicle/yr		135	107
# vehicles needed to perform task		292	10
Round trip mntk per vehicle per year		8.98	240.97

6.2. Foreseeable developments on corridor that may affect cost relativity

Both the NSW and Commonwealth Governments have proposed substantial outlays to make the Pacific Highway dual carriageway between Sydney and Brisbane. At present, roughly one third of the distance is dual carriageway. The full cost of this upgrade program is several billion dollars, and it will take many years to complete.

When this upgrade has been completed, journey times will be reduced and the accident rate is expected to be substantially improved. These changes may not strongly influence road freight costs, however. Apart from driver labour costs and perhaps vehicle capital costs,[11] most costs of road transport are conventionally calculated on a per distance basis, irrespective of the time taken. A more likely outcome is that the reduced travel time increases road's modal share by permitting an improved quality of service. We do not specifically model the effects on road freight costs of this expected reduction in travel times, partly because the magnitude of the time savings is unknown.

An improvement to the accident rate would be expected to have some influence over the accident-related externality costs estimated here. Unfortunately, the base accident externality data available to us is not corridor-specific. Furthermore, it is far from straightforward to estimate the likely reduction in accident rate resulting from the planned highway upgrades and then to translate that probability into an expected savings in accident-related costs. Given these uncertainties and difficulties, we do not attempt to quantify this effect of upgraded infrastructure on the accident externality rate here.

Rail infrastructure improvements, albeit of a far more modest type, are also planned for the Sydney – Brisbane corridor. Those most likely to be completed in the foreseeable future are the lengthening of crossing loops, to permit a greater number of 1500m and 1800m trains to run on the line. While the cost of this crossing loop program is relatively modest (approximately $100m for completion of work to 35 loops), the capacity improvement that will result is significant. More than three times as many long trains would be able to operate on the line once the program is complete. In this study we examine capacity costs both before and after this crossing loop investment program is undertaken.

6.3. Usage costs

For road, the table below provides our estimates of the usage costs. On each line, the physical quantum of each input needed for a vehicle round trip (litres of diesel fuel, hours of driver time, etc.) was calculated. Current unit prices for these inputs were applied to obtain a round trip cost for each factor input. The factor cost was then divided by the number of ntk in one round trip to obtain a usage rate per '000 ntk for each factor.

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11 A two hour time savings on a 1000 km journey would only translate to B-double capital cost savings per ntk if it permitted the vehicle to undertake a larger number of journeys per year. Given logistical scheduling constraints, it may not be possible to realise this potential gain.

SYDNEY - BRISBANE CORRIDOR CASE STUDY

REQUIRED INFRASTRUCTURE CAPACITY	Road	
	one-way route length	average # 'lanes'
Minimum infrastructure for task	1030	2
Current actual infrastructure	1030	2.67
Likely future infrastructure	1030	4

USAGE COSTS	Road					
	resource units	resource consumption	unit price	resource cost	resource cost/ traffic unit('000ntk)	data sources
LINEHAUL		per roundtrip		per roundtrip	per '000 ntk	
Fuel consumption (litres)	(litres diesel)	1,211.76	0.74	896.71	13.48	PN intermodal
Vehicle crew labour (person km)	(truck km)	2060	0.44	906.96	13.63	PN intermodal
Vehicle wear, tear, and consumables (veh km)	(truck km)	2060	0.21	432.60	6.50	PN intermodal
Infrastructure wear and tear ('000 gtk)	('000 gtk)	117.01	6.43	752.07	11.30	NTC 3rd HVD
Equipment cost (e.g., container hire)				NA		
SUBTOTAL					44.91	
TERMINATION						
Handling costs				NA		
PUD				193.82	2.91	PN intermodal
TOTAL CASH USAGE COSTS					**47.82**	
EXTERNALITIES						
Air pollution (esp. GHG) - lower bound	(tonne C02)	3.23	2.73	8.80	0.13	Auslink
- upper bound		3.23	15.87	51.23	0.77	ATC Auslink
Accident-related - lower bound					1.6	BTRE WP 40
- upper bound					2.5	Maunsell

For rail, usage cost estimates are presented in the table below. As with road, on each line, the physical quantum of each input needed for a vehicle round trip (litres of diesel fuel, hours of driver time, etc.) was calculated. Current unit prices for these inputs were applied to obtain a round trip cost for each factor input. The factor cost was then divided by the number of ntk in one round trip to obtain a usage rate per '000 ntk for each factor.

SYDNEY - BRISBANE CORRIDOR CASE STUDY

REQUIRED INFRASTRUCTURE CAPACITY	Rail		
	one-way route length	average # 'lanes'	# crossing loops
Minimum infrastructure for task	975.5	1	11
Current actual infrastructure	975.5	1	11
Likely future infrastructure	975.5	1	35

USAGE COSTS	Rail					
	resource units	resource consumption	unit price	resource cost	resource cost/ traffic unit('000ntk)	data sources
LINEHAUL		per roundtrip		per roundtrip	per '000 ntk	
Fuel consumption (litres)	(litres diesel)	19,098	0.74	14,132.24	6.26	PN intermodal
Vehicle crew labour (person km)	(person hrs)	79.2	117.71	9,322.72	4.13	PN intermodal
Vehicle wear, tear, and consumables (veh km)	(train km)	1951	3.22	6,282.22	2.78	PN intermodal
Infrastructure wear and tear ('000 gtk)	('000gtk)	4,124.23	3.34	13,774.92	6.10	QCA, PN
Equipment cost (e.g., container hire)					2.34	PN
SUBTOTAL					21.60	
TERMINATION						
Handling costs				6,865.75	3.04	Industry sources
PUD				21,996.59	9.74	PN intermodal
TOTAL CASH USAGE COSTS					**32.04**	
EXTERNALITIES						
Air pollution (esp. GHG) - lower bound		50.88	2.73	138.76	0.06	
- upper bound		50.88	15.87	807.46	0.36	
Accident-related - lower bound					0.2	BTRE WP 40
- upper bound						

The pure linehaul component of rail usage costs is less than half that for road on this corridor. When termination-related usage costs are included, rail maintains a significant cost advantage per ntk. Including accident and greenhouse gas externalities makes the comparison slightly more favourable to rail.

6.4. AVAILABILITY COSTS

Road availability costs for Sydney – Brisbane are presented in the table below. The total annual cost of providing the minimum increment of vehicle and infrastructure capacity respectively is calculated by summing NTS costs and capital costs. In the case of road infrastructure, the NTC-derived NTS costs already include a provision for capital costs, so we do not add the capital cost estimate, which is provided for information, in that case. The capacity of that minimum capital item (vehicle or stretch of infrastructure) is also calculated. For road vehicle availability, we present the availability cost per unit of capacity in terms of dollars per '000 ntk, assuming typical vehicle utilisation (which is less than 100%). The road infrastructure availability cost data is presented for information only. It is not used in the comparison of average costs with rail.

AVAILABILITY COSTS	Road					
	Capacity increment	Capital cost	Asset life	Discount rate	Annuity	NTS costs (incl. road capital)
Vehicle (mntk/vehicle/yr)	8.98	365,000	4.6	8%	68,741	
Linehaul infrastructure (mntk/yr)						
Minimum infrastructure for task	294,294	5.15E+09	50	8%	8,975,720	27,901,673
Current actual infrastructure						
Likely future infrastructure	588,587					
Terminal infrastructure (mntk/terminal/yr)						
TOTAL annualised NTS cost/capacity						
Vehicle ($/'000 ntk at typical utilisation)					9.00	
Utilisation of infrastructure capacity					N/A	
Infrastructure ($/'000 ntk at current utilisation)					N/A	

Note: Road infrastructure annuity is excluded from capacity calculation because, under PAYGO n

Average total cost comparison using lower bound estimates for externalities assuming typical vehicle utilisation and, for rail only, assuming infrastructure utilisation implied by task. Note that this comparison assumes free road availability to freight.	($/'000 ntk)	Average costs: usage+vehicle avail only	58.56

Rail availability costs for Sydney – Brisbane are presented in the table below. As for road, the vehicle availability cost is estimated based on typical utilisation, taking account of seasonal and directional factors, rather than maximum theoretical utilisation. The rail infrastructure availability unit charge is set at a level that will recover the full infrastructure availability cost over the quantum of freight implied by the task studied here. It is, in effect, an average infrastructure availability charge based on actual utilisation. The rail infrastructure utilisation figure of 9.7% relates to the capacity that will be available once the programme of extending all 35 crossing loops to 1500m length is completed. Current usage represents a considerably higher proportion of the capacity that is available today. The annualised capital cost of completing the crossing loop extensions is very modest compared to the overall availability costs on the corridor.

AVAILABILITY COSTS	Rail					
	Capacity increment	Capital cost	Asset life	Discount rate	Annuity	NTS non-capital costs
Vehicle (mntk/vehicle/yr)	240.97	14,220,000	16	8%	468,931	
Linehaul infrastructure (mntk/yr)						
Minimum infrastructure for task	8,057	2.34E+09	50	8%	4,080,380	39,020,000
Current actual infrastructure	8,057	2.34E+09	50	8%	4,080,380	39,020,000
Likely future infrastructure	25,636	2.34E+09	50	8%	4,080,380	39,020,000
Terminal infrastructure (mntk/terminal/yr)	Terminal capacity unknown, terminal availability charge not included					
TOTAL annualised NTS cost/capacity						
Vehicle ($/'000 ntk at typical utilisation)					2.86	
Utilisation of infrastructure capacity	9.7%					
Infrastructure ($/'000 ntk at current utilisation)	(Likely future rail infrastructure)				17.33	
Average total cost comparison using lower bound estimates for externalities assuming typical vehicle utilisation and, for rail only, assuming infrastructure utilisation implied by task.	Average costs: usage+vehicle avail+infra avail				52.49	
	Critical rail infra. Utilisation 7.2%					

Note that this comparison assumes free road availability to freight.

It is notable that the rail vehicle availability costs at typical utilisation are significantly lower than for road vehicles. The difference is large enough that it would not be counteracted by any ability of road vehicles to operate at higher average utilisation than trains. This difference is attributable in part to the greater capital cost efficiency of rail vehicles (more carrying capacity per dollar of capital cost), but also to the longer effective asset lives for rail vehicles.

Rail's advantage in usage and vehicle availability costs is large enough that inclusion of the rail infrastructure availability cost is not sufficient to make the upper bound to rail costs as high as the lower bound to road costs. The figure presented for road is a lower bound because it makes no provision at all for road infrastructure availability costs.

Note that the task implies a rail infrastructure utilisation of 9.7% of capacity. Were the rail capacity utilisation reduced to the critical value of 7.2%, then the rail upper bound would just equal the road lower bound.

6.5. SENSITIVITY ANALYSIS

Given the immediacy of the debate concerning the most appropriate allocation of road costs to heavy vehicles, we present in this section two sensitivity studies which examine the overall impact on relative road and rail costs of a different proportional allocation of road costs to heavy vehicles. In the first sensitivity study, the costs of road rehabilitation and pavement components are allocated in the manner chosen by the NTC: that is, only 45% of these cost types are treated as non-separable and allocated by ESA-km.

In the second sensitivity study, in addition to the costs allocated by ESA-km in the base case, costs considered by the NTC to be non-separable associated with routine maintenance, periodic surface maintenance of sealed roads, and bridge maintenance and rehabilitation are allocated by AGM-km.

For the first sensitivity case, the effect on attributed road costs is shown in the table below.

%cost by allocator								Arterial	Estimated Local	$m arterial road cost per annum allocated by					
VKT	PCU-k	ESA-	AGM-	Non - Separable	unalloca			($million)	($million)	VKT	PCU-km	ESA-km	AGM-km	Non Separable	
100	0	0	0	0	0	A	Servicing and Operating Expenses	629	265	629	-	-	-	-	-
0	37	0	37	26	0	B1	Routine Maintenance	400	160	-	148	-	148	104	-
0	10	0	60	30	0	B2	Periodic Surface Maintenance of Seale	286	116	-	29	-	172	86	-
0	0	0	33	67	0	C	Bridge Maintenance and Rehabilitation	152	63	-	-	-	50	102	-
0	0	45	0	55	0	D	Road Rehabilitation	465	189	-	-	209	-	256	-
80	20	0	0	0	0	E	Low Cost Safety/Traffic Improvements	290	124	232	58	-	-	-	-
0	0	45	0	55	0	F1	Pavement Components	935	221	-	-	421	-	514	-
0	15	0	0	85	0	F2	Bridges	286	69	-	43	-	-	243	-
0	10	0	0	90	0	F3	Land Acquisition, Other Extension/Improvement Expenditure	1537	356	-	154	-	-	1,383	-
0	0	0	0	100	0	G1	Corporate Services	226	0	-	-	-	-	226	-
0	0	0	0	0	100	G2	Enforcement of Heavy Vehicle Registra	0	0	-	-	-	-	-	-
0	0	0	0	0	100	G3	Vehicle Registration	0	0	-	-	-	-	-	-
0	0	0	0	0	100	G4	Driver Licensing	0	0	-	-	-	-	-	-
0	0	0	0	0	100	G5	Loan Interest	0	0	-	-	-	-	-	-
							TOTAL	5206	1563	861	431	630	370	2,914	-

UNITS FOR UNIT COST	(m)	(m)	(m)	(m)	
UNIT COST ALLOCATION RATE	0.0067	0.00293	0.03385	0.001186	
B-double units	950.4	3800.7	3429.9	49223.7	
All vehicle units	128951	147055	18612.2	311707.1	
					Total
Costs allocated to B-doubles ($m)	6.35	11.14	116.10	58.39	191.98
Wear-related costs alloc to B-doubles			116.10	58.39	174.49
Average wear-related cost $/'000gtk					3.54

Road system NTS availability charge estimation

Length of Australian roads	810,000	km	ABS 1301.0 Year Book Australia 2005, data at 30 June 2004
Length of arterial roads	126,850	km	ABS 1301.0 Year Book Australia 1974, data at June 1972
Length of local roads	683,150	km	Subtraction. Note the total length of roads varied only slightly From that, we infer that the proportion of arterial to local
Arterial roads	5,206	$m	NTC 3rd heavy vehicle determination, technical paper
Wear-related	1,000	$m	
NTS	4,206	$m	
Avg NTS cost/km arterial road	33,159	$/route km	
Local roads	1,563	$m	NTC 3rd heavy vehicle determination, technical paper
Wear-related	334	$m	
NTS	1,229	$m	
Avg NTS cost/km local road	1,799	$/route km	

The impact on the road usage and availability costs of this changed road cost allocation is shown in the table below.

SYDNEY - BRISBANE CORRIDOR CASE STUDY

REQUIRED INFRASTRUCTURE CAPACITY

	Road	
	one-way route length	average # 'lanes'
Minimum infrastructure for task	1030	2
Current actual infrastructure	1030	2.67
Likely future infrastructure	1030	4

USAGE COSTS

	Road					
	resource units	resource consumption	unit price	resource cost	resource cost/ traffic unit('000ntk)	data sources
LINEHAUL		per roundtrip		per roundtrip	per '000 ntk	
Fuel consumption (litres)	(litres diesel)	1,211.76	0.74	896.71	13.48	PN intermodal
Vehicle crew labour (person km)	(truck km)	2060	0.44	906.96	13.63	PN intermodal
Vehicle wear, tear, and consumables (veh km)	(truck km)	2060	0.21	432.60	6.50	PN intermodal
Infrastructure wear and tear ('000 gtk)	('000 gtk)	117.01	3.54	414.77	6.23	NTC 3rd HVD
Equipment cost (e.g., container hire)	NA					
SUBTOTAL					39.84	
TERMINATION						
Handling costs	NA					
PUD				193.82	2.91	PN intermodal
TOTAL CASH USAGE COSTS					**42.76**	
EXTERNALITIES						
Air pollution (esp. GHG) - lower bound	(tonne C02)	3.23	2.73	8.80	0.13	Auslink
- upper bound		3.23	15.87	51.23	0.77	ATC Auslink
Accident-related - lower bound					1.6	BTRE WP 40
- upper bound					2.5	Maunsell

AVAILABILITY COSTS

	Road					
	Capacity increment	Capital cost	Asset life	Discount rate	Annuity	NTS costs (incl. road capital)
Vehicle (mntk/vehicle/yr)	8.98	365,000	4.6	8%	68,741	
Linehaul infrastructure (mntk/yr)						
Minimum infrastructure for task	294,294	5.15E+09	50	8%	8,975,720	34,153,939
Current actual infrastructure						
Likely future infrastructure	588,587					
Terminal infrastructure (mntk/terminal/yr)						
TOTAL annualised NTS cost/capacity						
Vehicle ($/'000 ntk at typical utilisation)					9.00	
Utilisation of infrastructure capacity					N/A	
Infrastructure ($/'000 ntk at current utilisation)					N/A	

Note: Road infrastructure annuity is excluded from capacity calculation because, under PAYGO n

Average total comparison using lower bound estimates for externalities assuming typical vehicle utilisation and, for rail only, assuming infrastructure utilisation implied by task. Note that this comparison assumes free road availability to freight.	($/'000 ntk)	Average costs: usage+vehicle avail only	53.49

By reducing the lower bound estimate for unit road freight costs, this sensitivity case leads to an increase to the critical rail infrastructure utilisation level from 7.2% in the base case to 9.2% here. This change makes the actual infrastructure utilisation of 9.7% significantly closer to the critical threshold value, at which the upper bound to rail unit costs would equal the lower bound to road unit costs.

For the second sensitivity case, the effect on attributed road costs is shown in the table below. The altered allocations are shown in highlight.

%cost by allocator								Arterial	Estimated Local	$m arterial road cost per annum allocated by				
VKT	PCU-k	ESA-	AGM-	Non - Separable	unalloca			($million)	($million)	VKT	PCU-km	ESA-km	AGM-km	Non Separable
100	0	0	0	0	0	A	Servicing and Operating Expenses	629	265	629	-	-	-	-
0	37	0	63	0	0	B1	Routine Maintenance	400	160	-	148	-	252	-
0	10	0	90	0	0	B2	Periodic Surface Maintenance of Seale	286	116	-	29	-	257	-
0	0	0	100	0	0	C	Bridge Maintenance and Rehabilitation	152	63	-	-	-	152	-
0	0	100	0	0	0	D	Road Rehabilitation	465	189	-	-	465	-	-
80	20	0	0	0	0	E	Low Cost Safety/Traffic Improvements	290	124	232	58	-	-	-
0	0	100	0	0	0	F1	Pavement Components	935	221	-	-	935	-	-
0	15	0	0	85	0	F2	Bridges	286	69	-	43	-	-	243
0	10	0	0	90	0	F3	Land Acquisition, Other Extension/Improvement Expenditure	1537	356	-	154	-	-	1,383
0	0	0	0	100	0	G1	Corporate Services	226	0	-	-	-	-	226
0	0	0	0	0	100	G2	Enforcement of Heavy Vehicle Registra	0	0	-	-	-	-	-
0	0	0	0	0	100	G3	Vehicle Registration	0	0	-	-	-	-	-
0	0	0	0	0	100	G4	Driver Licensing	0	0	-	-	-	-	-
0	0	0	0	0	100	G5	Loan Interest	0	0	-	-	-	-	-
							TOTAL	5206	1563	861	431	1,400	661	1,852

	VKT	PCU-km	ESA-km	AGM-km	Total
UNITS FOR UNIT COST	(m)	(m)	(m)	(m)	
UNIT COST ALLOCATION RATE	0.0067	0.00293	0.07522	0.002122	
B-double units	950.4	3800.7	3429.9	49223.7	
All vehicle units	128951	147055	18612.2	311707.1	
Costs allocated to B-doubles ($m)	6.35	11.14	258.00	104.45	379.93
Wear-related costs alloc to B-doubles			258.00	104.45	362.44
Average wear-related cost $/'000gtk					7.36

Road system NTS availability charge estimation

	Value	Unit	Source / note
Length of Australian roads	810,000	km	ABS 1301.0 Year Book Australia 2005, data at 30 June 20
Length of arterial roads	126,850	km	ABS 1301.0 Year Book Australia 1974, data at June 1972
Length of local roads	683,150	km	Subtraction. Note the total length of roads varied only From that, we infer that the proportion of arterial to local
Arterial roads	5,206	$m	NTC 3rd heavy vehicle determination, technical paper
Wear-related	2,061	$m	
NTS	3,145	$m	
Avg NTS cost/km arterial road	24,790	$/route km	
Local roads	1,563	$m	NTC 3rd heavy vehicle determination, technical paper
Wear-related	678	$m	
NTS	885	$m	
Avg NTS cost/km local road	1,295	$/route km	

The impact on the road usage and availability costs of this changed road cost allocation is shown in the table below.

SYDNEY - BRISBANE CORRIDOR CASE STUDY

REQUIRED INFRASTRUCTURE CAPACITY	Road	
	one-way route length	average # 'lanes'
Minimum infrastructure for task	1030	2
Current actual infrastructure	1030	2.67
Likely future infrastructure	1030	4

USAGE COSTS	Road					
	resource units	resource consumption	unit price	resource cost	resource cost/ traffic unit('000ntk)	data sources
LINEHAUL		per roundtrip		per roundtrip	per '000 ntk	
Fuel consumption (litres)	(litres diesel)	1,211.76	0.74	896.71	13.48	PN intermodal
Vehicle crew labour (person km)	(truck km)	2060	0.44	906.96	13.63	PN intermodal
Vehicle wear, tear, and consumables (veh km)	(truck km)	2060	0.21	432.60	6.50	PN intermodal
Infrastructure wear and tear ('000 gtk)	('000 gtk)	117.01	7.36	861.55	12.95	NTC 3rd HVD
Equipment cost (e.g., container hire)				NA		
SUBTOTAL					46.56	
TERMINATION						
Handling costs				NA		
PUD				193.82	2.91	PN intermodal
TOTAL CASH USAGE COSTS					**49.47**	
EXTERNALITIES						
Air pollution (esp. GHG) - lower bound	(tonne C02)	3.23	2.73	8.80	0.13	Auslink
- upper bound		3.23	15.87	51.23	0.77	ATC Auslink
Accident-related - lower bound					1.6	BTRE WP 40
- upper bound					2.5	Maunsell

AVAILABILITY COSTS	Road					
	Capacity increment	Capital cost	Asset life	Discount rate	Annuity	NTS costs (incl. road capital)
Vehicle (mntk/vehicle/yr)	8.98	365,000	4.6	8%	68,741	
Linehaul infrastructure (mntk/yr)						
Minimum infrastructure for task	294,294	5.15E+09	50	8%	8,975,720	25,533,607
Current actual infrastructure						
Likely future infrastructure	588,587					
Terminal infrastructure (mntk/terminal/yr)						
TOTAL annualised NTS cost/capacity						
Vehicle ($/'000 ntk at typical utilisation)					9.00	
Utilisation of infrastructure capacity					N/A	
Infrastructure ($/'000 ntk at current utilisation)					N/A	

Note: Road infrastructure annuity is excluded from capacity calculation because, under PAYGO n

Average total cost comparison using lower bound estimates for externalities assuming typical vehicle utilisation and, for rail only, assuming infrastructure utilisation implied by task. Note that this comparison assumes free road availability to freight.	($/'000 ntk)	Average costs: usage+vehicle avail only	60.21

In this second sensitivity case, the increase in road unit costs has the effect of reducing the critical level of rail infrastructure utilisation from 7.2% in the base case to 6.7% here.

7. CASE STUDY 2: PENOLA – PORTLAND

7.1. DISTINGUISHING FEATURES OF FREIGHT ON CORRIDOR

The so-called ‘Green Triangle’ region of South Australia and Western Victoria, centred around Mount Gambier, contains numerous softwood plantations that have been producing woodchips and timber for many years. Additionally, hardwood plantations established within the past two decades are expected to begin producing woodchips, logs, and sawn timber in large quantities from about 2009. Much of this new produce, including pulp to be produced from the woodchips, is likely to be exported. There are established wood processing facilities in the region, a new pulp mill at Heywood, Victoria, and the possibility of a new pulp mill at Penola.

It is projected that several million net tonnes per annum of woodchips, logs, sawn timber, and pulp may need to be transported to Portland, Vic. for export from 2009. Given the magnitude of this task, serious consideration is being given to rail as a complementary transport mode to road, which would continue to play an important and increased role in any case.

The table below quantifies the freight task on this corridor and presents key parameters for the road and rail reference vehicles.

		PENOLA - PORTLAND	
		ROAD	RAIL
Task			
	Net tonnes northbound	-	-
	Net tonnes southbound	2,000,000	2,000,000
	Distance (km)	157	170
	mntk northbound	-	-
	mntk southbound	314	340
	Total mntk for task	314	340
Reference vehicles		Dog and trailer	Forest product train
	Cargo capacity		
	TEU		
	Net tonnes	40	3,150
	Maximum gross mass	65	5154
	Tare mass (tonnes)	25	2004
Average load factor			
	northbound	0%	0%
	southbound	100%	100%
Average payload (tonnes)			
	northbound	-	-
	southbound	40.0	3,150.0
Average gross mass			
	northbound	25.0	2,004.0
	southbound	65.0	5,154.0
'000 ntk			
	northbound	-	-
	southbound	6.3	535.5
	Round trip	6.3	535.5
'000 gtk			
	northbound	3.9	340.7
	southbound	10.2	876.2
	Round trip	14.1	1,216.9
	Round trip gtk/ntk	2.25	2.27
Round trips required to perform task		50,000	635
# possible round trips per vehicle/yr		660	330
# vehicles needed to perform task		76	2
Round trip mntk per vehicle per year		4.14	176.72

7.2. Foreseeable Developments on Corridor that May Affect Cost Relativity

The main rail infrastructure facility in the region is a closed, broad gauge line linking Mt. Gambier to Heywood. Consideration is being given to reopening that line and converting it to standard gauge. This gauge conversion is necessary to permit trains to continue on to the port of Portland, which is close to Heywood. This study evaluates the costs associated with reopening the line in a state adequate for the projected traffic demand. We assume that approximately half of the forestry produce headed for Portland is contestable by rail.

7.3. Usage Costs

Road usage costs are presented in the table below. On each line, the physical quantum of each input needed for a vehicle round trip (litres of diesel fuel, hours of driver time, etc.) was calculated. Current unit prices for these inputs were applied to obtain a round trip cost for each factor input. The factor cost was then divided by the number of ntk in one round trip to obtain a usage rate per ‘000 ntk for each factor.

PUD costs are not cited for either mode because they are believed to be approximately equivalent, in the sense that a truck must bring the containerised woodchips from the chipper to the forest edge whichever linehaul mode is used. In the case of rail, there is an additional handling cost as the container must be transferred from the truck at forest edge by forklift. The capital costs associated with the forklift and with a tipping skel vehicle to take woodchips from the train and dump them at the port are included in the rail availability cost calculation. An additional labour cost is involved in the transfer to and from rail. We have assumed that the train crew of two persons would perform that task at each end of the journey, and that doing so would require four hours per person at each end. This labour cost is reflected in the termination handling costs for rail.

PENOLA - PORTLAND CORRIDOR CASE STUDY

REQUIRED INFRASTRUCTURE CAPACITY	Road	
	one-way route length	average # 'lanes'
Minimum infrastructure for task	157	2
Current actual infrastructure	157	2
Likely future infrastructure	157	2

USAGE COSTS	Road					
	resource units	resource consumption	unit price	resource cost	resource cost/ traffic unit('000ntk)	data sources
LINEHAUL		per roundtrip		per roundtrip	per '000 ntk	
Fuel consumption (litres)	(litres diesel)	184.71	0.75	138.53	22.06	PN intermodal
Vehicle crew labour (person km)	(truck km)	314	0.39	122.46	19.50	PN intermodal
Vehicle wear, tear, and consumables (veh km)	(truck km)	314	0.17	53.38	8.50	PN intermodal
Infrastructure wear and tear ('000 gtk)	('000 gtk)	14.13	6.43	90.82	14.46	NTC 3rd HVD
Equipment cost (e.g., container hire)	NA					
SUBTOTAL					64.52	
TERMINATION						
Handling costs	NA					
PUD	NA					
TOTAL CASH USAGE COSTS					**64.52**	
EXTERNALITIES						
Air pollution (esp. GHG) - lower bound	(tonne C02)	0.49	2.73	1.34	0.21	Auslink
- upper bound		0.49	9.83	4.84	0.77	ATC Auslink
Accident-related - lower bound					1.6	BTRE WP 40
- upper bound					2.5	Maunsell

Rail usage costs.

PENOLA - PORTLAND CORRIDOR CASE STUDY

REQUIRED INFRASTRUCTURE CAPACITY	Rail			
	one-way route length	average # 'lanes'		# crossing loops
Minimum infrastructure for task	170	1		3
Current actual infrastructure	170	0		0
Likely future infrastructure	170	1		3

USAGE COSTS	Rail					
	resource units	resource consumption	unit price	resource cost	resource cost/ traffic unit('000ntk)	data sources
LINEHAUL		per roundtrip		per roundtrip	per '000 ntk	
Fuel consumption (litres)	(litres diesel)	5,232	0.75	3,924.37	7.33	PN R&B
Vehicle crew labour (person km)	(person hrs)	36.95	52.08	1,924.24	3.59	PN R&B
Vehicle wear, tear, and consumables (veh km)	(train km)	340	6.23	2,116.50	3.95	PN R&B
Infrastructure wear and tear ('000 gtk)	('000gtk)	1,216.86	4.4	5,354.18	10.00	PN Net&Access
Equipment cost (e.g., container hire)				NA		
SUBTOTAL					24.87	
TERMINATION						
Handling costs	(person hrs)	16.00	52.08	833.33	1.56	PN R&B
PUD				NA		
TOTAL CASH USAGE COSTS					**26.43**	
EXTERNALITIES						
Air pollution (esp. GHG) - lower bound		13.94	2.73	38.02	0.07	
- upper bound		13.94	9.83	136.99	0.26	
Accident-related - lower bound					0.2	BTRE WP 40
- upper bound						

The pure linehaul component of rail usage costs is less than one half of that for road on this corridor. Including accident and greenhouse gas externalities makes the comparison slightly more favourable to rail.

7.4. AVAILABILITY COSTS

Road availability costs for Penola - Portland are presented in the table below. The total annual cost of providing the minimum increment of vehicle and infrastructure capacity respectively is calculated by summing NTS costs and capital costs. In the case of road infrastructure, the NTC-derived NTS costs already include a provision for capital costs, so we do not add the capital cost estimate, which is provided for information, in that case. The capacity of that minimum capital item (vehicle or stretch of infrastructure) is also calculated. For road vehicle availability, we present the availability cost per unit of capacity in terms of dollars per ‘000 ntk, assuming typical vehicle utilisation (which is less than 100%). The road infrastructure availability cost data is presented for information only. It is not used in the comparison of average costs with rail.

AVAILABILITY COSTS	Road					
	Capacity increment	Capital cost	Asset life	Discount rate	Annuity	NTS costs (incl. road capital)
Vehicle (mntk/vehicle/yr)	4.14	365,000	4.6	8%	68,741	
Linehaul infrastructure (mntk/yr)						
Minimum infrastructure for task	21,593	3.77E+08	50	8%	656,709	4,252,973
Current actual infrastructure						
Likely future infrastructure						
TOTAL annualised NTS cost/capacity						
Vehicle ($/'000 ntk at typical utilisation)					33.17	
Utilisation of infrastructure capacity					N/A	
Infrastructure ($/'000 ntk at current utilisation)					N/A	

Note: Road infrastructure annuity is excluded from capacity calculation because, under PAYGO r

Average total cost comparison ($/'000 ntk) Average costs: usage+vehicle avail only 99.50
using lower bound estimates for externalities
assuming typical vehicle utilisation and, for rail only,
assuming infrastructure utilisation implied by task.
Note that this comparison assumes free road availability to freight.

Rail availability costs for Penola - Portland.

AVAILABILITY COSTS	Rail					
	Capacity increment	Capital cost	Asset life	Discount rate	Annuity	NTS non-capital costs
Vehicle (mntk/vehicle/yr)	176.72	13,650,000	20.00	8%	298,283	
Linehaul infrastructure (mntk/yr)						
Minimum infrastructure for task	1,656	2.04E+08	50	8%	355,543	4,250,000
Current actual infrastructure	-	0.00E+00	50	8%	-	
Likely future infrastructure	1,656	2.04E+08	50	8%	355,543	4,250,000
TOTAL annualised NTS cost/capacity						
Vehicle ($/'000 ntk at typical utilisation)					3.38	
Utilisation of infrastructure capacity	20.5%					
Infrastructure ($/'000 ntk at current utilisation)	(Likely future rail infrastructure)				13.55	

Average total cost comparison Average costs: usage+vehicle avail+infra avail 43.62
using lower bound estimates for externalities Critical rail infra. Utilisation
assuming typical vehicle utilisation and, for rail onl 4.0%
assuming infrastructure utilisation implied by task.
Note that this comparison assumes free road availability to freight.

It is notable that the rail vehicle availability costs at typical utilisation are significantly lower than for road vehicles. The difference is large enough that it would not be counteracted by any ability of road vehicles to operate at higher average utilisation than trains. This difference is attributable in part to the greater capital cost efficiency of rail vehicles (more carrying capacity per dollar of capital cost), but also to the longer effective asset lives for rail vehicles.

Rail's advantage in usage and vehicle availability costs is large enough that inclusion of the rail infrastructure availability cost is not sufficient to make the upper bound to rail costs as high as the lower bound to road costs. The figure presented for road is a lower bound because it makes no provision at all for road infrastructure availability costs.

Note that the task implies a rail infrastructure utilisation of 20.5% of capacity. Were the rail capacity utilisation reduced to the critical value of 4.0%, then the rail upper bound would just equal the road lower bound.

7.5. Sensitivity Analysis

As we did with the Sydney – Brisbane freight, we present in this section two sensitivity studies which examine the overall impact on relative road and rail costs of a higher proportional allocation of road costs to heavy vehicles. In the first sensitivity study, the costs of road rehabilitation and pavement components are allocated according to the NTC approach.

In the second sensitivity study, in addition to the costs reallocated to usage in the base case, costs considered by the NTC to be non-separable associated with routine maintenance, periodic surface maintenance of sealed roads, and bridge maintenance and rehabilitation are allocated by AGM-km.

For the first sensitivity case, for the Penola – Portland corridor, the impact on the road usage and availability costs of this changed road cost allocation is shown in the table below.

PENOLA - PORTLAND CORRIDOR CASE STUDY

REQUIRED INFRASTRUCTURE CAPACITY	Road	
	one-way route length	average # 'lanes'
Minimum infrastructure for task	157	2
Current actual infrastructure	157	2
Likely future infrastructure	157	2

USAGE COSTS	Road					
	resource units	resource consumption	unit price	resource cost	resource cost/ traffic unit('000ntk)	data sources
LINEHAUL		per roundtrip		per roundtrip	per '000 ntk	
Fuel consumption (litres)	(litres diesel)	184.71	0.75	138.53	22.06	PN intermodal
Vehicle crew labour (person km)	(truck km)	314	0.39	122.46	19.50	PN intermodal
Vehicle wear, tear, and consumables (veh km)	(truck km)	314	0.17	53.38	8.50	PN intermodal
Infrastructure wear and tear ('000 gtk)	('000 gtk)	14.13	3.54	50.09	7.98	NTC 3rd HVD
Equipment cost (e.g., container hire)			NA			
SUBTOTAL					58.03	
TERMINATION						
Handling costs			NA			
PUD			NA			
TOTAL CASH USAGE COSTS					**58.03**	
EXTERNALITIES						
Air pollution (esp. GHG) - lower bound	(tonne C02)	0.49	2.73	1.34	0.21	Auslink
- upper bound		0.49	9.83	4.84	0.77	ATC Auslink
Accident-related - lower bound					1.6	BTRE WP 40
- upper bound					2.5	Maunsell

AVAILABILITY COSTS	Road					
	Capacity increment	Capital cost	Asset life	Discount rate	Annuity	NTS costs (incl. road capital)
Vehicle (mntk/vehicle/yr)	4.14	365,000	4.6	8%	68,741	
Linehaul infrastructure (mntk/yr)						
Minimum infrastructure for task	21,593	3.77E+08	50	8%	656,709	5,205,989
Current actual infrastructure						
Likely future infrastructure						
TOTAL annualised NTS cost/capacity						
Vehicle ($/'000 ntk at typical utilisation)					33.17	
Utilisation of infrastructure capacity					N/A	
Infrastructure ($/'000 ntk at current utilisation)					N/A	

Note: Road infrastructure annuity is excluded from capacity calculation because, under PAYGO r

Average total cost comparison	($/'000 ntk)	Average costs: usage+vehicle avail only	93.02

using lower bound estimates for externalities
assuming typical vehicle utilisation and, for rail only,
assuming infrastructure utilisation implied by task.
Note that this comparison assumes free road availability to freight.

By reducing the lower bound estimate for unit road freight costs, this sensitivity case leads to an increase to the critical rail infrastructure utilisation level from 4.0% in the base case to 4.4% here. As the expected rail task represents 20.5% utilisation of infrastructure capacity, this change does not bring the actual infrastructure utilisation significantly closer to the critical threshold value, at which the upper bound to rail unit costs would equal the lower bound to road unit costs.

For the second sensitivity case, the impact on the road usage and availability costs of this changed road cost allocation is shown in the table below.

PENOLA - PORTLAND CORRIDOR CASE STUDY

REQUIRED INFRASTRUCTURE CAPACITY	Road	
	one-way route length	average # 'lanes'
Minimum infrastructure for task	157	2
Current actual infrastructure	157	2
Likely future infrastructure	157	2

USAGE COSTS	Road					
	resource units	resource consumption	unit price	resource cost	resource cost/ traffic unit('000ntk)	data sources
LINEHAUL		per roundtrip		per roundtrip	per '000 ntk	
Fuel consumption (litres)	(litres diesel)	184.71	0.75	138.53	22.06	PN intermodal
Vehicle crew labour (person km)	(truck km)	314	0.39	122.46	19.50	PN intermodal
Vehicle wear, tear, and consumables (veh km)	(truck km)	314	0.17	53.38	8.50	PN intermodal
Infrastructure wear and tear ('000 gtk)	('000 gtk)	14.13	7.36	104.04	16.57	NTC 3rd HVD
Equipment cost (e.g., container hire)	NA					
SUBTOTAL					66.63	
TERMINATION						
Handling costs	NA					
PUD	NA					
TOTAL CASH USAGE COSTS					**66.63**	
EXTERNALITIES						
Air pollution (esp. GHG) - lower bound	(tonne C02)	0.49	2.73	1.34	0.21	Auslink
- upper bound		0.49	9.83	4.84	0.77	ATC Auslink
Accident-related - lower bound					1.6	BTRE WP 40
- upper bound					2.5	Maunsell

AVAILABILITY COSTS	Road					
	Capacity increment	Capital cost	Asset life	Discount rate	Annuity	NTS costs (incl. road capital)
Vehicle (mntk/vehicle/yr)	4.14	365,000	4.6	8%	68,741	
Linehaul infrastructure (mntk/yr)						
Minimum infrastructure for task	21,593	3.77E+08	50	8%	656,709	3,892,016
Current actual infrastructure						
Likely future infrastructure						
TOTAL annualised NTS cost/capacity						
Vehicle ($/'000 ntk at typical utilisation)					33.17	
Utilisation of infrastructure capacity					N/A	
Infrastructure ($/'000 ntk at current utilisation)					N/A	

Note: Road infrastructure annuity is excluded from capacity calculation because, under PAYGO r

Average total cost comparison	($/'000 ntk)	Average costs: usage+vehicle avail only	101.61

using lower bound estimates for externalities
assuming typical vehicle utilisation and, for rail only,
assuming infrastructure utilisation implied by task.
Note that this comparison assumes free road availability to freight.

In this second sensitivity case, the increase in road unit costs has the effect of reducing the critical level of rail infrastructure utilisation from 4.0% in the base case to 3.9% here.

8. CONCLUSIONS

The purpose of this report has been to provide the Productivity Commission with specific quantitative estimates of the relative costs of transporting particular increments of freight by efficient road and efficient rail operations. Given that purpose, we restrict ourselves here to the immediate factual conclusions that are possible from the quantitative analysis presented.

8.1. SYDNEY – BRISBANE

The pure linehaul component of rail usage costs ($21.60/'000 ntk) is less than half that for road ($44.91/'000 ntk) on this corridor. When termination-related usage costs are included, rail maintains a significant cost advantage per ntk (rail=$32.04/'000 ntk, road=$47.82/'000 ntk). Including accident and greenhouse gas externalities makes the comparison slightly more favourable to rail.

It was noted earlier that there is considerable uncertainty surrounding the estimated wear and tear cost rate for rail infrastructure. If the unit rate used here, $3.34/'000 gtk, were doubled, it would add $6.10/'000 ntk to the rail usage charge, or 26% of the difference between road and rail linehaul usage costs—a figure that is not sufficiently large to make rail haulage more expensive than road haulage in terms of their respective usage charges. Therefore the conclusion that rail haulage offers substantially lower usage costs than road haulage on this corridor is robust.

Sensitivity analysis presented above illustrates that if the NTC allocation of road infrastructure costs were strictly followed, then the reduction in road wear and tear costs would be $5.07/'000 ntk compared to the base case. That reduction is not sufficiently large to alter the conclusion that rail linehaul usage charges are less than half those of road. Taking an approach more in keeping with the suggestion of Engineers Australia in its submission, as was done in the second sensitivity case, then the usage costs associated with road linehaul could be higher than our base case estimates by approximately $1.65/'000 ntk.

It is notable that the rail vehicle availability costs at typical utilisation ($2.86/'000 ntk) are significantly lower than for road vehicles ($9.00/'000 ntk). This difference is attributable in part to the greater capital cost efficiency of rail vehicles (more carrying capacity per dollar of capital cost), but also to the longer effective asset lives for rail vehicles.

The road infrastructure availability cost estimates are provided for information, but do not form part of the overall cost comparison presented here. The comparison that is made is between (1) an upper bound estimate for unit rail costs, which includes usage, vehicle availability and infrastructure availability at current utilisation and (2) a lower bound estimate for unit road costs, which include only usage and vehicle availability. Making the comparison in this way permits us to avoid the contentious issues associated with estimating the component of the common road infrastructure availability costs that particular freight vehicles should bear. This comparison attributes none of those availability costs to road.

In the Sydney – Brisbane base case, the upper bound rail cost estimate is $52.49/'000 ntk at the estimated 9.7% infrastructure utilisation level. The lower bound road cost estimate is $58.56/'000 ntk. In other words, although the total road cost is somewhat uncertain, the rail cost estimate is 10% lower than the lowest possible value for the road cost (which is derived by assuming that road infrastructure is available at zero cost). This comparison is sensitive to the level of rail infrastructure utilisation. If utilisation fell to the critical level of 7.2%, then the rail upper bound cost would equal the road lower bound cost.

In the first sensitivity case, in which the NTC method of allocating road wear and tear costs to heavy vehicles is adopted, the lower bound road unit cost estimate is reduced to $53.49/'000 ntk, which has the effect of increasing the critical rail infrastructure utilisation level to 9.2% -- a figure that is close to the 9.7% utilisation implied by the task studied here. The two figures are close enough together that government policy decisions that affect rail's utilisation could materially affect the cost comparisons made here.

8.2. PENOLA – PORTLAND

The pure linehaul component of rail usage costs ($24.87/'000 ntk) is less than one half of that for road on this corridor ($64.52/'000 ntk). Including accident and greenhouse gas externalities makes the comparison slightly more favourable to rail.

It was noted earlier that there is considerable uncertainty surrounding the estimated wear and tear cost rate for rail infrastructure. If the unit rate used here, $4.40/'000 gtk, were doubled, it would add $10.00/'000 ntk to the rail usage charge—a figure that is not sufficiently large to make rail haulage more expensive than road haulage in terms of their respective usage charges. Therefore the conclusion that rail haulage offers substantially lower usage costs than road haulage on this corridor is robust.

Sensitivity analysis presented above illustrates that if the NTC allocation of road infrastructure costs were strictly adopted, the reduction in road wear and tear costs would be $6.49/'000 ntk. That reduction, representing 16% of the difference between road and rail linehaul usage costs, would not substantially alter the relativity of road and rail usage costs, which would remain very favourable to rail. The second sensitivity case demonstrated that if the base case underestimates true road wear and tear damage attributable to heavy vehicles (as suggested by Engineers Australia in its submission), then the usage costs associated with road linehaul could be higher than our base case estimates by approximately $2.11/'000 ntk.

It is notable that the rail vehicle availability costs at typical utilisation ($3.38/'000 ntk) are significantly lower than for road vehicles ($33.17/'000 ntk). This difference is attributable in part to the greater capital cost efficiency of rail vehicles, but also to the longer effective asset lives for rail vehicles.

The road infrastructure availability cost estimates are provided for information, but do not form part of the overall cost comparison presented here. The comparison that is made is between (1) an upper bound estimate for unit rail costs, which includes usage, vehicle availability and infrastructure availability at current utilisation and (2) a lower bound estimate for unit road costs, which include only usage and vehicle availability. Making the comparison in this way permits us to avoid the contentious issues associated with estimating the component of the common road infrastructure availability costs that particular freight vehicles should bear. This comparison attributes none of those availability costs to road.

In the Penola – Portland base case, the upper bound rail cost estimate is $43.67/'000 ntk at the estimated 20.5% infrastructure utilisation level. The lower bound road cost estimate is $99.50/'000 ntk. In other words, although the total road cost is somewhat uncertain, the rail cost estimate is less than 50% of the lowest possible value for the road cost (which is derived by assuming that road infrastructure is available at zero cost). This comparison is sensitive to the level of rail infrastructure utilisation. If utilisation fell to the critical level of 4.0%, then the rail upper bound cost would equal the road lower bound cost.

In the first sensitivity case, in which the NTC method of allocating road wear and tear costs to heavy vehicles is adopted, the lower bound road unit cost estimate is reduced to $93.02/'000 ntk, which has the effect of increasing the critical rail infrastructure utilisation level to 4.4% -- a figure that is not close to the 20.5% utilisation implied by the task studied here. Nevertheless, as the woodchip task studied here is a hypothetical one, there is considerable uncertainty surrounding these estimates.

8.3. GENERALISATIONS

To the extent that generalisations are justified from this case study material, rail has a decisive advantage with respect to usage costs associated with linehaul. This conclusion is robust to large variations in the assumed infrastructure wear and tear costs for road and rail, meaning that less turns on the outcome of current debates on that question.

Rail also appears to have a significant advantage with respect to vehicle capacity costs for containerised and non-bulk freight, when these are considered on a life-cycle basis, applying the same discount rate to trucks as to trainsets.

One area where rail is believed to suffer a significant cost disadvantage, termination costs including rail terminal operations and PUD, has been evaluated in the two case studies here and found not to be large enough to overcome the linehaul cost superiority of rail. Obviously that conclusion is highly sensitive to context and to the precise logistical details for any given freight task, so caution must be used in generalising from this conclusion.

Externality costs, particularly those associated with accidents and greenhouse gas emissions, slightly improve rail's relative standing, but the effect is not numerically large compared to the cash costs evaluated here.

The comparison of infrastructure capacity costs is difficult conceptually, but the method employed here of comparing the rail unit cost upper bound to the road unit cost lower bound avoids the most serious conceptual problems. We note that it does not overcome the need to correct for quality of service differences between modes, and we acknowledge that it has not been possible to make this correction with the data and analytical tools available.

The comparison between rail upper bound and road lower bound unit costs is obviously sensitive to the level of rail utilisation, which is inversely related to the average infrastructure availability charge rail freight must bear. The comparisons made here, particularly on the Sydney – Brisbane corridor, demonstrate just how sensitive rail's viability is to utilisation. It is the quality of service factors such as transit time, ability to have a late receival cut-off and arrival time reliability that determine utilisation. These factors are critically dependent on new rail infrastructure investment. How these infrastructure capacity costs are funded, whether by user charges, taxation, or other mechanisms may have a strong bearing on the crucial question of whether rail's quality of service can be improved sufficiently to make high utilisation of rail infrastructure possible.