Forecasting the Benefits of Performance Based Standards for the Australian Road Transport Industry, 2011 to 2030

Industrial Logistics Institute

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Executive Summary

This report details the costs and benefits associated with the implementation options proposed within the Performance Based Standards (PBS) draft regulatory impact statement. The analysis presents the benefits of an ordered implementation of PBS under three scenarios:

1. continuing with the scheme as it is currently administered as national assessment with state based access permits,
2. assessing the capacity for greater improvement in freight productivity through state or regional assessment and access schemes, given the significant differences in operating environments, community attitudes and existing infrastructure in each state,
3. changing the scheme to a national assessment and access framework.

The timeframe for the analysis was taken as 20 years. This timeframe was chosen as it is very similar to the timeframe for adoption and existing integration of the B-Double in Australia, from its initial operational trials to the last Australian Bureau of Statistics “Survey of Motor Vehicles” report in 2007. In 1986 just seven of these vehicles were being trialled but by 2006 there were approximately 10,000 such vehicles operating in Australia servicing a tonne-kilometre task equivalent to all other lower levels of articulated vehicles.

The report examined three PBS options, and these were:

Option 1 – The status quo scenario for PBS implementation. The appropriate infrastructure would exist to match the small number of applications being approved by a current style of PBS regulatory framework that would still be operating between 2011 to 2030. Generally this would see the majority of applications coming through the hire and reward sector, and generally followed by an almost equivalent number of applications from the larger ancillary sector. This mechanism will exclude all Level 4 vehicles.

Option 1 was analysed on the premise that there will still be one annual application for each of the nine truck types, and one bus type, that have been considered as being likely to continue to submit individual fleet applications for PBS. The financial outcome from Option 1 is a net present value of $1.04 billion. This option is predicted to save an estimated 23.8 fatalities and avoids 1.0 million tonnes of carbon dioxide.

Option 2 – The scheme is wholly undertaken by State or regional assessment for access with PBS approvals being granted through State permits. This scenario would see a State and Territory based "shadow PBS" process being introduced. This would see access considerations handled exclusively by each States, without necessarily being uniform. The financial benefit is comparatively restricted as it might only see some 20% of B-triple use eventuate, and these would be for long distance vehicles performing intrastate operations in the larger geographic States. The outcome from Option 2 is a net present value of $0.95 billion. This option is predicted to save an estimated 20 fatalities and avoids 0.72 million tonnes of carbon dioxide.

Option 3 – A national assessment and access framework exists with assured access for compliant PBS vehicles. Under this scenario the appropriate infrastructure is assumed to evolve to match the need for more productive vehicles on a gradual basis, as a consequence of the normal cycle of maintaining and improving infrastructure. This will mean that a workable skeleton network of Level 3 roads will be provided for high productivity vehicles. Again Level 4 vehicles are not expected to be approved under this option. This option delivers a financial benefit of $3.33 billion dollars in Net Prevent Value terms.
Some 56% of the direct operational benefits of this economic saving will be through an appropriate Level 3 B-triple network. This option will save 87 fatalities and save 3.75 million tonnes of carbon dioxide. The option is significantly more attractive than the other two options from an economic, safety and environmental perspective.

The costs of PBS implementation, from an infrastructure perspective, was considered a being planned for and contained within State budgets so that a limited number of key and strategic routes would become available for level 2b and level 3 vehicle classes. Further routes would become available over the period 2011 to 2030 just as B-double network did some 25 years ago. States are currently defining these networks. It is also assumed that the current administrative capability for PBS is in place and will not be augmented from an approvals or enforcement perspective. From this perspective the study was a net incremental benefits analysis as PBS is currently being incrementally undertaken.

Table E1: Selected Major Benefits of PBS 2011 – 2030

Selected PBS Metrics	Option 1	Option 2	Option 3
1. Fatality Savings to 2030	23.8	20.4	87.3
1A, Fatality Savings ($ nominal)	$0.083B	$0.071B	$0.305B
1B. NPV Value Fatality Savings ($ NPV)	$0.06B	$0.05B	$0.22B
2. Total CO2 Savings Million tonnes	0.99Mt	0.72Mt	3.75 Mt
2A. Total CO2 Savings ($ nominal)	$0.023B	$0.017B	$0.086B
2B.NPV Value CO2 Savings (NPV) [1.]	$0.023B	$0.017B	$0.086B
3.PBS Kilometre Savings 2011 - 2030	1.06B kms	0.95B kms	3.7B kms
3A. Direct Financial Savings 2011 – 2030 ($ nominal)	$1.79B	$1.74B	$5.45B [2.]
3B. Direct Financial Savings ($) 2011 – 2030 (NPV)	$1.01B	$0.97B	$3.09B
Total Savings (1A+2A+3A) Nominal	$1.90B	$1.83B	$5.84B
Total Savings (1B+2B+3B) NPV	**$1.093B**	**$1.037B**	**$3.396B**
4. Compliance Costs ($ Nominal)	$-0.084B	$-0.136B	$-0.112B
5. Administration Costs ($ Nominal)	$-0.011B	$-0.029B	$-0.016B
Total Costs (4+5) Nominal	$-0.095B	$-0.165B	$-0.128B
Total Costs (4+5) NPV	**$-0.0505B**	**$-0.0876B**	**$-0.0675B**
Savings PBS 2011-2030 (nominal)			
Savings PBS 2011 -2030 (NPV)	**$1.04B**	**$0.95B**	**$3.33B**

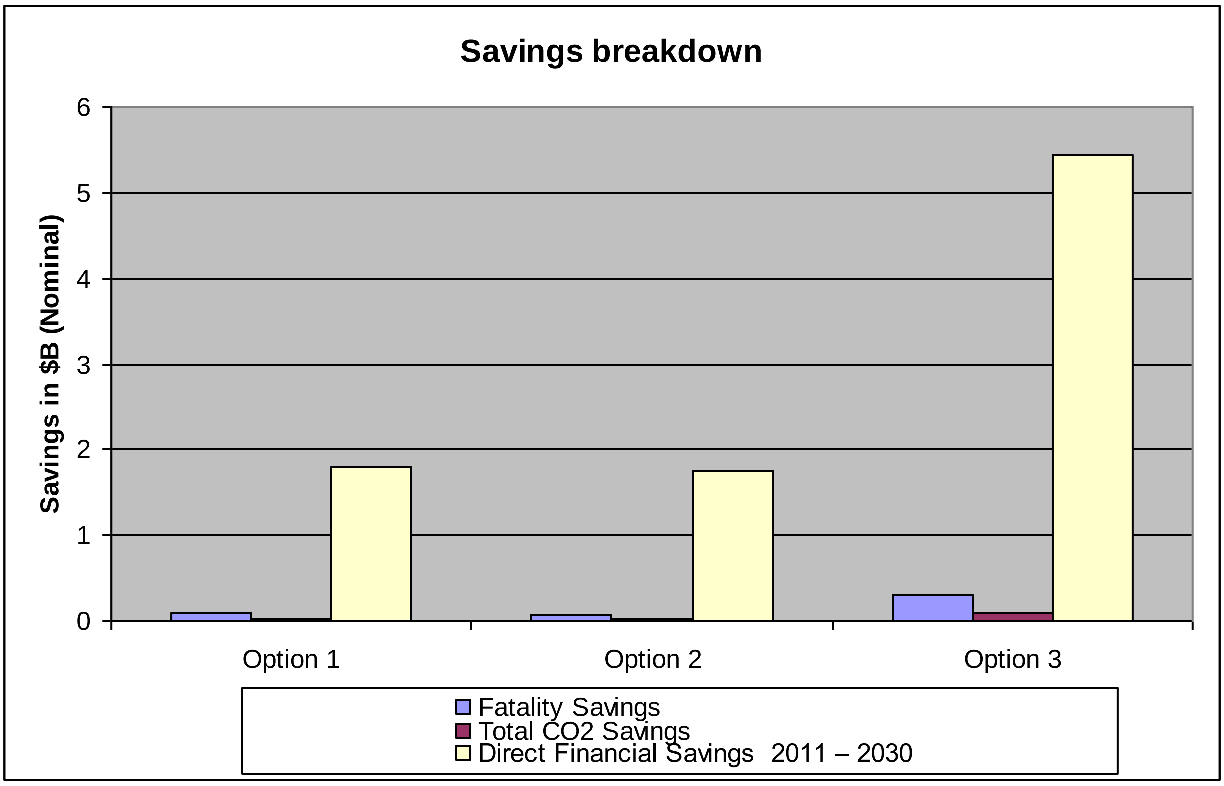
Source: Industrial Logistics Institute and ESAC 2009

Note 1: Escalation market rate equals discount rate. 2: Used in direct cost sensitivity analysis.

Conclusion:

The implementation of Performance Based Standards will generate benefits through each of the three considered options can be seen in Table E1. However, by 2030 Option 3 will deliver $7 billion nominal dollars more than the status quo, Option 1, and $7.1 billion more than Option 2 which could see significant limitations on the emergence of an appropriate national level 3 network. Although there are significant benefits arising from larger articulated, long distance vehicles, urban operations can also deliver short term benefits from eight of the ten vehicle combinations examined in the study. The nominal, non discounted) benefits of PBS, by Option, are presented in Figure 1 which shows the relative contributions of direct operational, economic flow-on and the combined safety and environmental benefits.

Figure 1: Comparative Direct PBS Benefits ($ billion nominal)



Source: Industrial Logistics Institute and ESAC 2009

The safety benefits of 87 lives is perhaps even conservative for Option 3 in the light of both Dutch forecasts for their triple combinations when appropriate infrastructure matches the specific PBS vehicle types thus facilitating less collisions. Recent National Truck Insurance data indicates the significant comparative safety benefits of B-doubles for the task they perform compared to other articulated combinations. Also noting the Dutch estimates their triple combination will be a quantum level of safety better than even their B-double combinations. Environmental benefits arising from Option 3 are significant being equivalent to of 3.75 million tonnes of CO_2. This is equivalent to a saving of 29,800 light commercial diesel vehicles operating over the twenty year analysis period.

The administrative and compliance costs for all PBS options is small compared to the benefits. Depending on the Option selected administrative and compliance costs range between 1% to 5% of the industry benefits of PBS.

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SUMMARY STUDY FINDINGS

For a full national PBS regime to be implemented, which is reflected in this report as Option 3, Australia's road transport industry would realise a $3.33B Net Present Value to its own industry with possible further flow-on benefits to other sectors of the economy. The loss of 87 lives would be avoided, and some 3.7 million tonnes of Carbon Dioxide would not be emitted into the atmosphere, all by 2030. The community would also see some 2,833 less heavy vehicles on the road compared to Option 1, the continuing of existing PBS arrangements. There would be 9,040 safer PBS vehicles on the road under Option 3 compared to Option 1.

Because of the economic standout nature of Option 3, which is higher than Option 1 and Option 2 by more than $2 billion, a detailed description of where these benefits lie with this Option are examined. Option 1 and Option 2 are often used comparatively against Option 3.

Option 1, the continuation of similar PBS arrangements for handling PBS applications will still achieve some 31% of Option 3 benefits achieved. Option 1 still produces a $1.04B, NPV in productivity savings, 23.8 fatalities avoided and a saving of 0.99 million tonnes of carbon dioxide.

Table 1: Summary Benefits of PBS 2011 - 2030

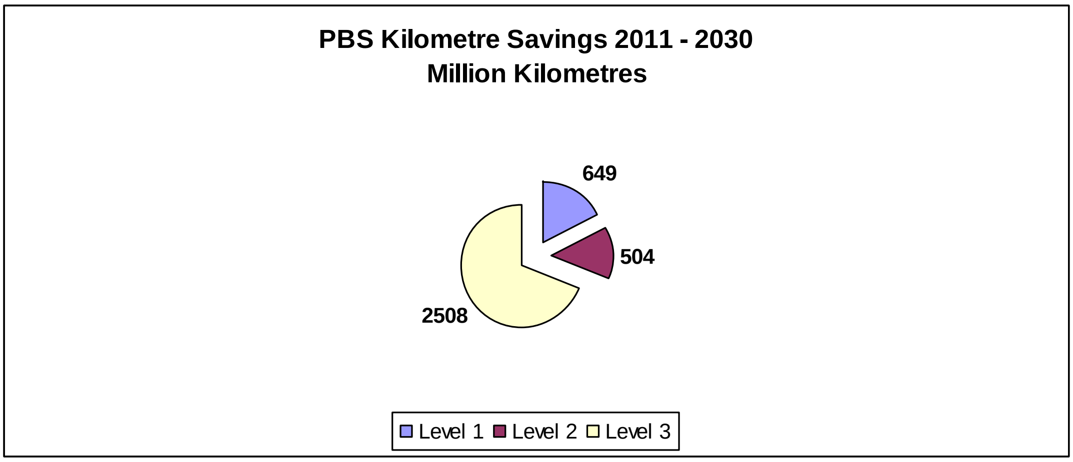
PBS Metrics	Option 1	Option 2	Option 3
PBS Vehicles at 2030	4,808	7,772	13,848
PBS Vehicle Savings at 2030	1,529	1,888	4,362
PBS Vehicle Savings % of fleet at 2030	0.38%	0.47%	1.1%
PBS Vehicle as % Fleet at 2030	1.2%	1.9%	3.5%
PBS Kilometre Savings 2011 - 2030	1.06 B kms	0.95 B kms	3.7 B kms
PBS Kilometres at 2030	0.39 B kms	0.53 B kms	1.44 B kms
% PBS Kilometres at 2030	1.9%	3.4%	6.60%
Fatality Savings to 2030	23.8	20.4	87.3
Total Fuel Savings to 2030	0.37 B Ltrs	0.27 B Ltrs	1.398 B Ltrs
% Fuel Savings fm PBS 2011 - 2030	0.27%	0.19%	1.02%
Total CO_2 Savings Million tonnes	0.99 Mt	0.72 Mt	3.75 Mt
PBS % total CO_2 Savings at year 2030	0.5%	0.3%	1.90%
Direct Financial Savings ($ nominal) 2011 - 2030	$1.79B	$1.74B	$5.45B

Industrial Logistics Institute and ESAC Estimates

Option 2, decentralization of control to the States, is similar in order of magnitude to Option 1 and achieves a $0.95B NPV benefit.

Under Option 3, refer Figure 2, some 68% of the kilometre savings are from Level 3 vehicles, 14% from Level 2 vehicles and 18% from Level 1 vehicles. In dollar terms, refer Figure 3, some 56% of the financial benefits are attributed to Level 3 vehicles, 19% to level 2 vehicles, and 24% to Level 1 vehicle types. Level 1 vehicles include rigid trucks, with and without trailers, and single articulated vehicles.

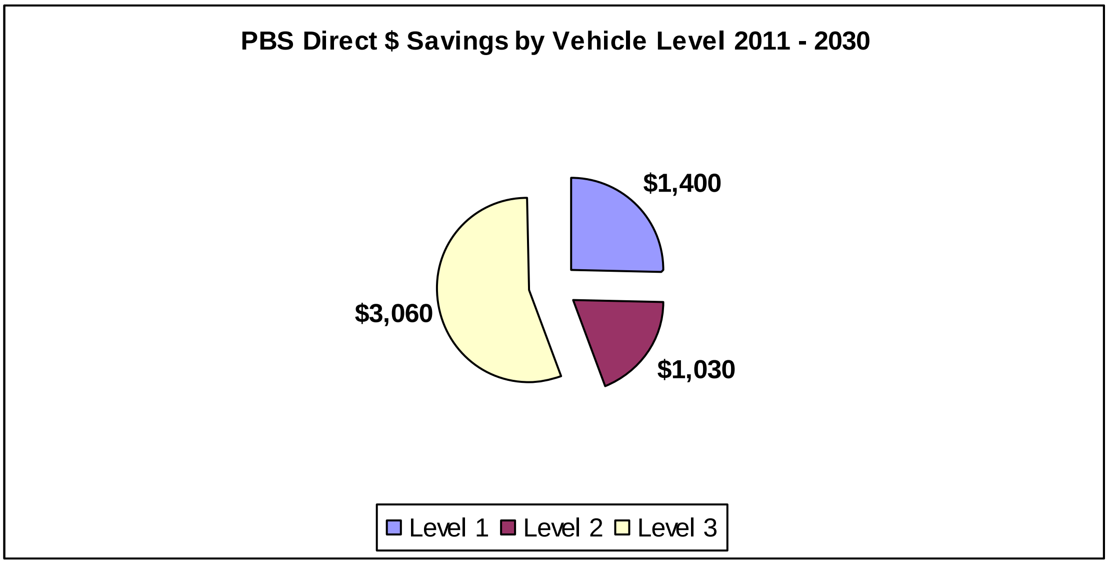
Figure 2: PBS Kilometre Savings by PBS Vehicle Level



Source: Industrial Logistics Institute, 2009.

For Option 3, 82% of the kilometre savings will be generated from articulated vehicles and 18% from rigid vehicles. Financially 90% of the benefits will emerge from articulated combinations and 10% for rigid trucks and rigid trucks in combination.

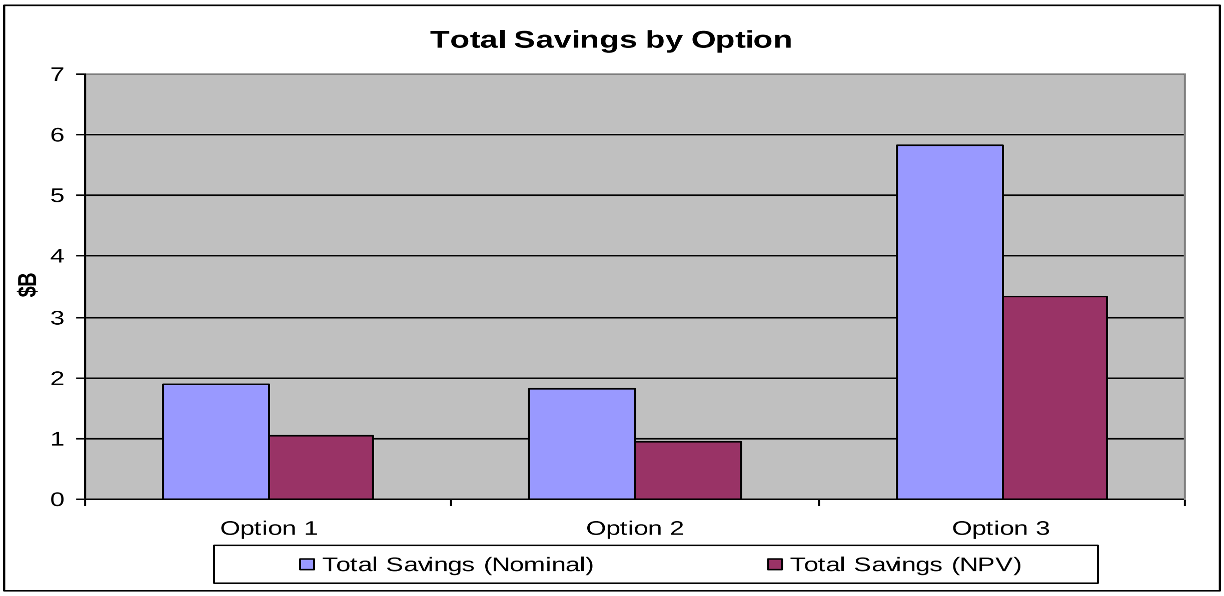
Figure 3: PBS Direct Operational Saving by Vehicle Types 2011 – 2030 ($ million nominal)



Source: Industrial Logistics Institute, 2009

Option 2, which is adopting a State based access acceptance framework, might see significant benefits in some larger geographic States and Territories for the rigid truck applications but less so for the very important national level 3 vehicles as the networks to support the inter-state running of vehicles such as B triples are not expected to emerge as a priority. Most linehaul operators would barely consider a 20% take-up of B triple (Level 3) technology if restricted to a limited intra-State basis only with no cross border access to strategic freight corridors.

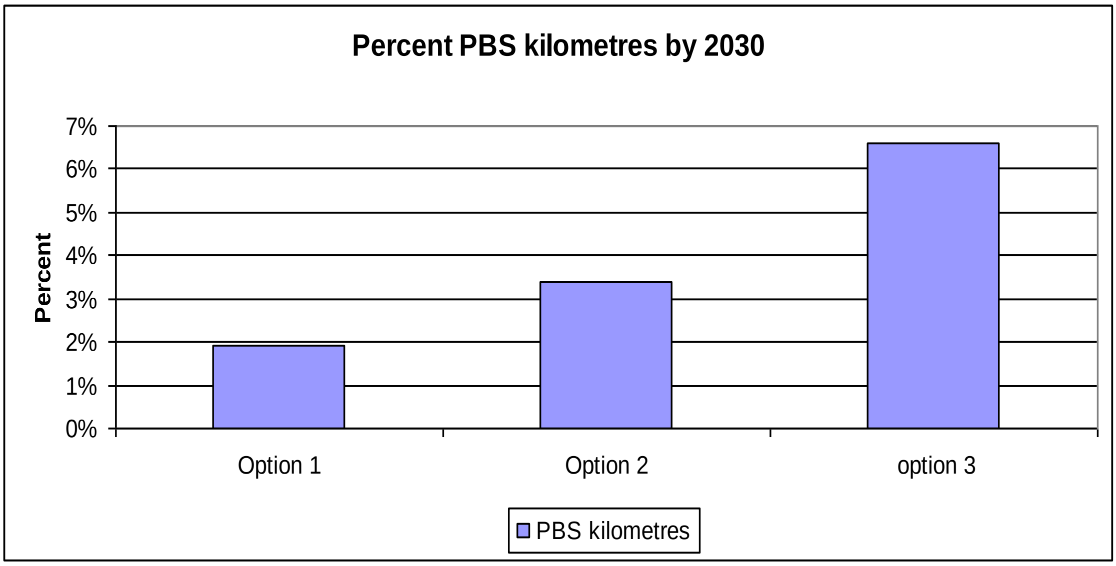
Figure 4: Impact of Full PBS Options, 2011-2030 (Median Options)



Industrial Logistics Institute, 2009

Figure 5 reflects the impact of the take-up rate in kilometre terms by PBS vehicles to 2030. Again Option 3 reflects a 6.6% rate by 2030.In lay terms the PBS performed kilometres will be slightly higher than 1/16 of all heavy truck kilometres performed. Option 1 and Option 2 would see a 1.9% and a 3.4% kilometre performance respectively by PBS vehicles.

Figure 5: Proportion of Kilometres that are PBS by 2030

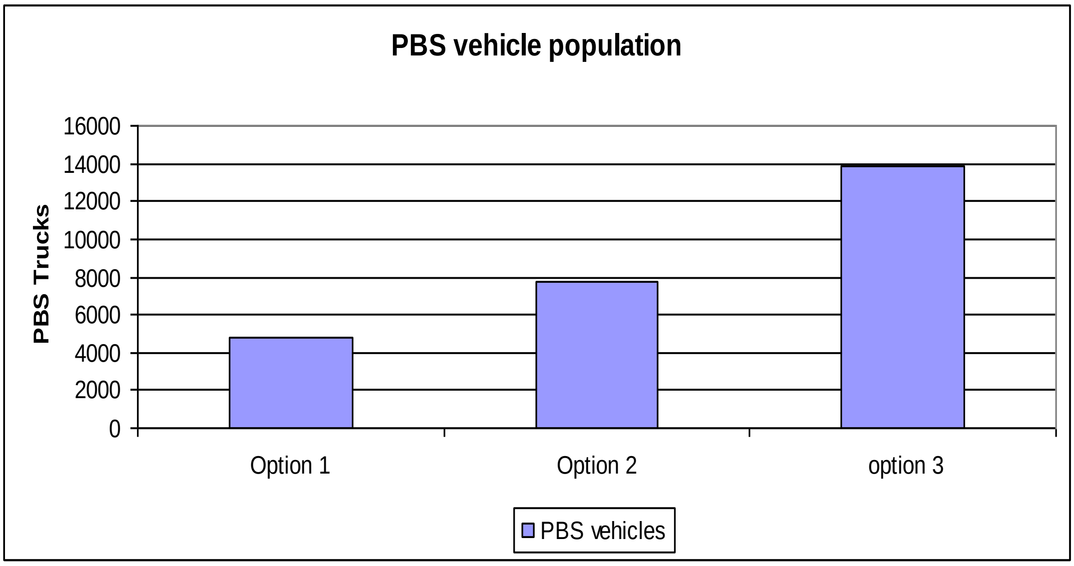


Industrial Logistics Institute, 2009

The numbers of vehicles that are expected to exist by 2030 are reflected in Figure 6. Option 3 would see 13,848 PBS vehicles, whilst Option 2 would expect some 56% of this total, with Option 1 realising only 35% of the Option 3 total.

Across most measures Option 3 would seem to be a very significant and advantageous option when compared to the existing status quo, or for a more State based regulatory environment for the future of PBS.

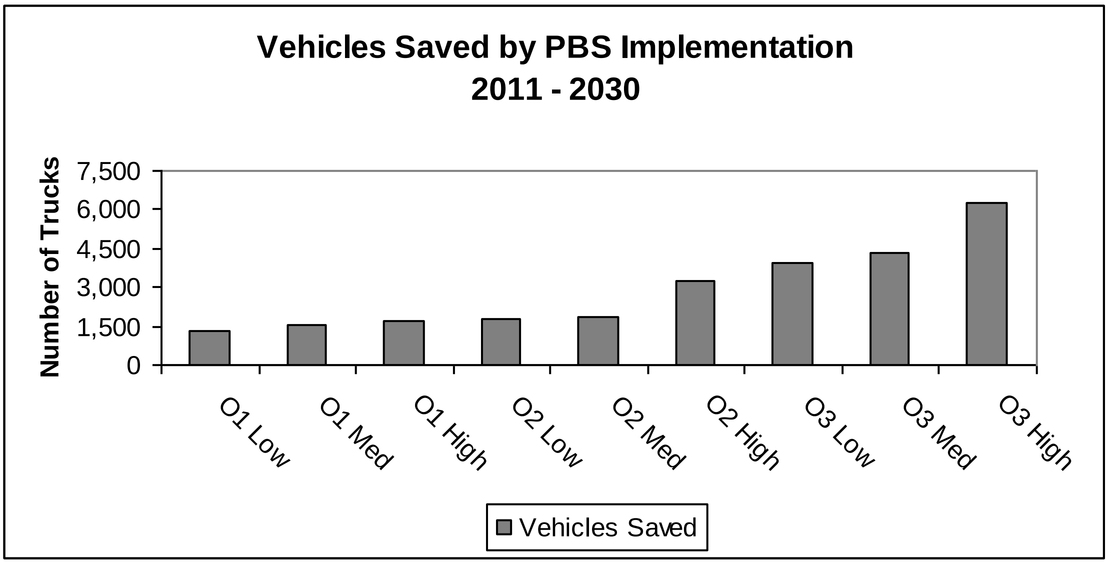
Figure 6: Population of PBS Vehicles by 2030



Industrial Logistics Institute, 2009

PBS also dampens the growth in truck populations. Under the low, median and high growth Options for PBS Figure 7 presents the savings in trucks to 2030 under each scenario. Again Option 3 reflects considerable truck savings approximately 4,000 (O3 high) 4,400 (O3 median) and 6,300 (O3 high) for the period to 2030.

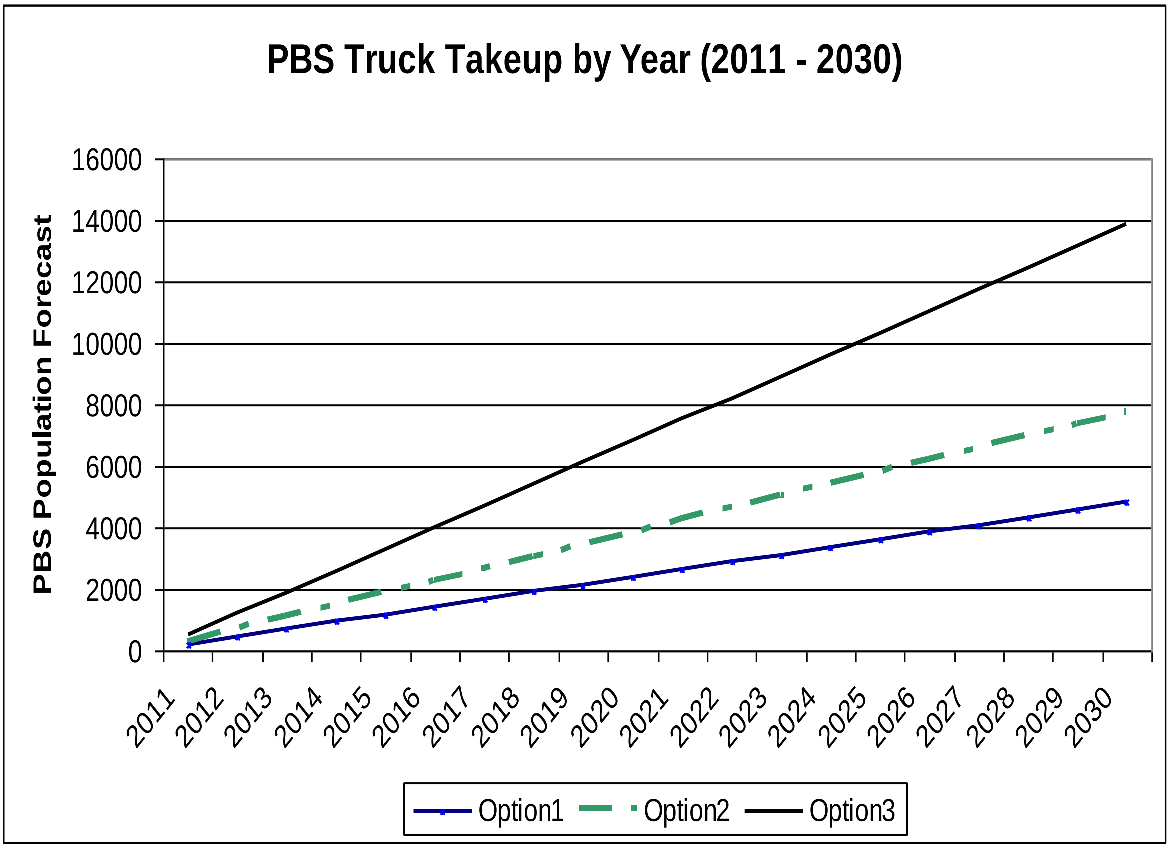
Figure 7: PBS Generated Number of Vehicle Savings



Source: Industrial Logistics Institute, 2009

The growth in PBS vehicle take-up is presented in Figure 8. This reflects the median Option scenarios for the three Options. PBS approvals range from 4,800 vehicles for Option 1, 7,800 for Option 2 and 13,800 for Option 3.

Figure 8: Growth in PBS Vehicles by Year



Source: Industrial Logistics Institute, 2009

This growth sees 240 PBS vehicles being approved on a continuing basis each year under Option1, 388 per annum for Option 2, and 692 per annum under Option 3.

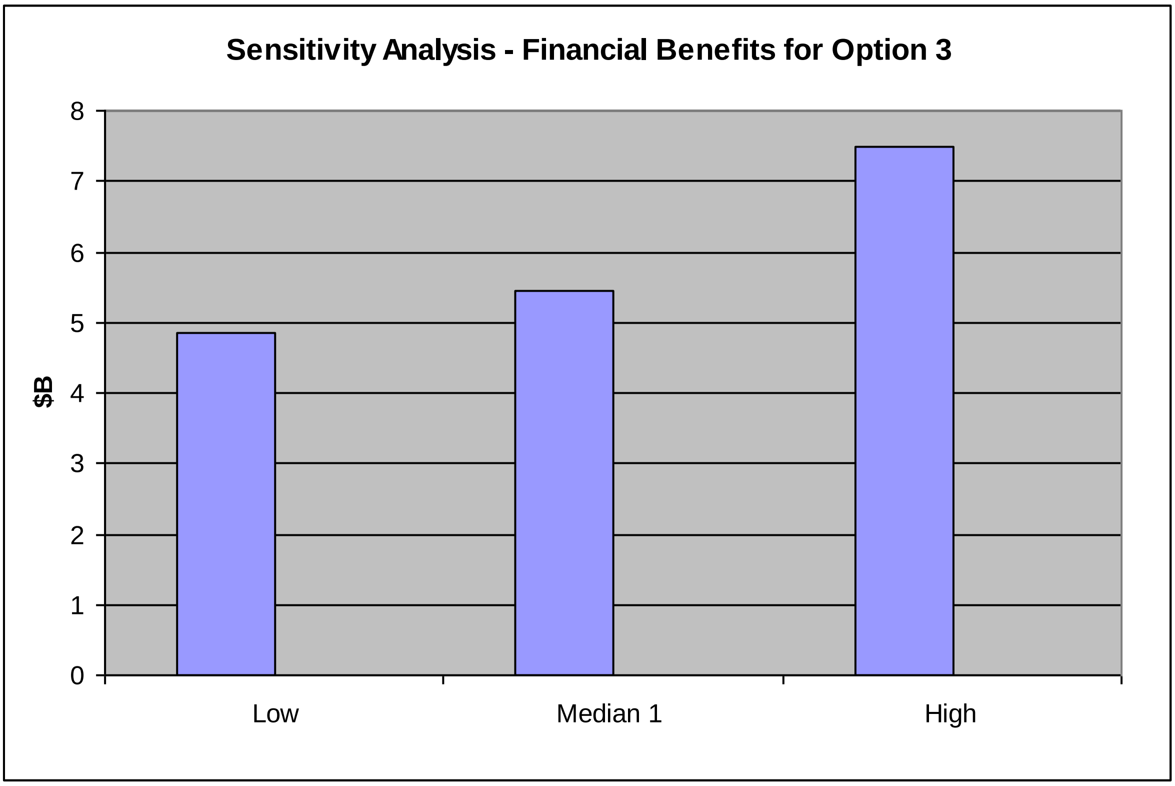
Sensitivity of Results:

Sensitivity analysis was also undertaken on Option 3 (Figure 9). A detailed description is also presented in Appendix 6 for all Options.

In brief, the report uses the 'median' sensitivity scenarios although a Low and a High scenario are calculated. For example the benefits for Option 3 are $5.45 billion dollars (nominal), although the high scenario value of $7.48 billion could potentially be achieved and is not in the realms of the hypothetical. The Low scenario of $4.86 billion in direct and flow-on benefits is generally closer to the median scenario value as each of the median values are not ambitious targets.

Figure 9: Hi-Low Sensitivity for PBS Option 3

(Nominal dollars billion)



Source: Industrial Logistics Institute, 2009

Safety, Environmental and Discounted Benefits

The safety and environmental benefits are examined in Sections 5 and 6 of the report respectively. In brief the reduction of kilometres will save lives and greenhouse gases. Lives were valued at $3.5 million per fatality. CO2 for this analysis was valued at $23 per tonne of emissions. The safety, environmental, direct and flow-on savings were all subject to a net present value analysis with a 7% nominal discount rate, which can be considered as a long term infrastructure investment return rate rather than a policy discount rate.

PART A – ESTIMATING THE BENEFITS OF PBS OPTIONS FROM 2011 TO 2030

1 Background

The Australian road transport industry is divided into two major sectors, the 'hire and reward' sector, often known as 'for hire', and the 'ancillary' or also known as the 'own account' sector. As the name suggests, the for-hire sector moves other customers' goods for money whilst the ancillary sector moves freight generated by its own industry with a range of internal payment systems. The farmer with a truck, the small manufacturer that delivers his own goods are examples of ancillary operators. However, all ancillary operators are not small: Australia Post, Fonterra, as well as elements of the fleets operated by companies such as Boral and Safeway are examples. Even some chemical and tanker companies will be owned by their parent manufacturing corporations, and only carry company generated freight. These larger ancillary operators will also often avail themselves of hire and reward sub-contractors. The truck population breakdown between ancillary and for hire operators is presented in Table 2, which also reflects the rigid and articulated split between these two areas of control.

Of the 160,000 fleets re-estimated in Australia as at 2005 some 30% or, 49,000 are hire and reward fleets with the remaining 70% ancillary fleet operators numbering 111,000.

Table 2: Segmentation of the Australian truck fleet > 4.5 T GVM

Truck Type	Ancillary	For Hire	Sub-Total	%
Rigid	159,926	82,707	**242,633**	**79.4**
Articulated	16,422	46,540	**62,962**	**20.6**
Sub-Total	**176,348**	**129247**	**305,595**	
%	**57.7%**	**42.3%**		

Source: SMVU 2006 (detailed)

Table 3 also reflects the fleet structure by ANZSIC grouping. Although this analysis has examined, and used, specific vehicle populations split by hire and reward and ancillary operations, some further data was not available to allow more precise kilometre averages by vehicle types and by hire and reward and ancillary operations. However, vehicle populations could be grouped by the classifications of hire and reward and ancillary operations, and by rigid and articulated vehicle numbers within these same classifications. It is very likely that the fleets with 20 or more vehicles might well consider a PBS option in the future.

Table 3: Australian Road Fleet Structure re-estimated for 2005

	Number of Vehicles in Fleet							
Industry Segments	**1**	**2 to 4**	**5 to 9**	**10 to 19**	**20 to 49**	**50 to 99**	**100+**	**TOTAL**
Transport Hire & Reward	**28503**	**14032**	**3508**	**2157**	**615**	**175**	**42**	**49 033**
Agriculture Fishing Forestry Hunting	72795	16040	714	102	11	1	0	89 663
Building and Construction	4156	1326	256	82	27	16	1	5 864
Electricity, Gas Water and Communications	82	46	15	5	5	0	5	158
Manufacturing	2801	1677	344	141	66	35	11	5 076
Mining and Quarrying	380	257	51	11	11	5	0	715
Wholesale and Retail	4301	2973	595	223	16	38	11	8 158
Public Admin, Property, Recreational etc	1514	498	95	36	14	8	8	2 173
Total	**114532**	**36850**	**5578**	**2758**	**766**	**279**	**78**	**160 840**

Source: Hassall, 2009, Unpublished Estimates, (based on NRTC 1996, and ABS 2005 data cubes)

The makeup Australia Road transport fleet was based on the detailed Australian Bureau of Statistics Survey of Motor Vehicle Use (SMVU) data cubes for 2005 and 2006, which were provided by the NTC. This data is somewhat different to the macro SMVU data as there are about 40,000 fewer vehicles. Excluded have been vehicles which were not used in the quarter leading up to the SMVU being completed by the survey applicants. This ‘active’ population of trucks formed the base population for which the simulations, growth rates, and PBS take-up rates were targeted. Table 4 shows the growth estimated up to 2030 by individual vehicle categories.

Table 4: Estimated Vehicle Populations 2006 to 2030

(Bold indicates PBS simulation groups)

PBS Level		Simulation Group	Vehicles 2006	Ave Kms Per Vehicle	Vehicles 2030
	Rigid trucks: 2 axle: no trailer: GVM 4.5 to 7.0 tonne	1	45230	17,092	54762
	Rigid trucks: 2 axle: no trailer: GVM 7.0 to 12.0 tonne	2	80926	23,708	97981
1	**Rigid trucks: 2 axle: no trailer: GVM over 12.0 tonne**	**3**	39246	28,606	47517
1	**Rigid trucks: 2 axle: with trailer: GCM to 42.5 tonne**	**4**	13924	28,784	16858
	Rigid trucks: 3 axle: no trailer: GVM 4.5 to 18.0 tonne	5	2106	13,485	2550
1	**Rigid trucks: 3 axle: no trailer: GVM over 18.0 tonne**	**6**	40973	27,985	49608
	Rigid trucks: 3 axle: with trailer: GCM to 42.5 tonne	7	5953	36,671	7208
1	**Rigid trucks: 3 axle: with trailer: GCM over 42.5 tonne**	**8**	8127	68,307	9840
	Rigid trucks: 4 axle: no trailer: GVM 4.5 to 25.0 tonne	9	532	19,957	644
	Rigid trucks: 4 axle: no trailer: GVM over 25.0 tonne	10	4621	45,973	5595
	Rigid trucks: 4 axle: with trailer: GCM to 42.5 tonne	11	108	77,477	131
1	**Rigid trucks: 4 axle: with trailer: GCM over 42.5 tonne**	**12**	887	72,061	1074
	Articulated trucks: single trailer: 3 axle rig	13	1597	24,108	2692
	Articulated trucks: single trailer: 4 axle rig	14	3673	40,627	6192
	Articulated trucks: single 3 axle trailer: 5 axle rig	15	1389	39,977	2342
	Articulated trucks: single 2 axle trailer: 5 axle rig	16	4883	45,937	8232
	Articulated trucks: single 4 axle trailer: 6 axle rig	17	103	0	174
1	**Articulated trucks: single 3 axle trailer: 6 axle rig**	**18**	34279	83,177	57790
	Articulated trucks: B-double: to 8 axle rig	19	1878	79,086	3940
	Articulated trucks: B-double: over 8 axle rig	**20**	8108	224,439	16921
2b	**Super B-double**	**A**	0	Estimate	Estimate
3a	**B-triple**	**B**	0 (SMVU)	Estimate	Estimate
	Articulated trucks: Road train: 2 trailers	21	3240	135,679	5462
	Articulated trucks: Road train: 3 trailers	22	1164	232,819	1962
	Articulated trucks: single 2 axle trailer: over 6 axle rig	23	14	98,500	24
	Articulated trucks: single 3 axle trailer: over 6 axle rig	24	1726	69,079	2910
	Articulated trucks: single 4 axle trailer: over 6 axle rig	25	516	33,798	870
	Articulated trucks: to 6 axle rig (not elsewhere classified)	26	392	31,857	661
2b	**A-double**	**27**	0	Estimate	Estimate
2b	**Articulated Buses**	**28**	277	50,744	335
			305872		404274

2 Calculating the Benefits of PBS

The Australian Bureau of Statistics reports in the very detailed data cubes the activity of specific vehicle configurations through the former annual Survey of Motor Vehicle Use. This visible classification of vehicles is useful but how they are used will depend significantly on what commodities are carried, and the usual types of delivery networks the vehicles are used for. For example, forestry trucks bringing logs back from the harvest site and returning for another load is very different to the delivery pattern of a small express parcel truck delivering several bags of express articles to several clients in a CBD setting. Similarly a livestock carrier moving animals several hundred kilometres for processing is not comparable to a petroleum tanker delivering to several service stations per delivery run. Comparing a farmer delivering his grain to a rail head over several days and almost ceasing to use the truck again for most of the year, perhaps averaging only 5,000 kilometres per annum, is different to a sub-contract linehaul operator performing some 300,000 kilometres per annum.

What does PBS do for these operators? Vehicles deliver their goods to points in their respective types of networks. As discussed these could be quite dense urban networks with several hundred customers or a simpler linehaul network between four cities. The fleet operations manager decides to start incorporating PBS vehicles into the fleet. Because of the enhanced capability of these vehicles, extra volume and/or extra mass can be uplifted usually allowing fewer trips, thus fewer kilometres and fewer trucks to deliver the payloads. It is almost certain that seeding PBS vehicles into the fleet will have a reduction in total network kilometres and the number of vehicles needed to undertake the deliveries. Typically the metrics that reflect the physical productivity of PBS adoption are: a reduction in total kilometres, a reduction of total operational hours, a reduction in individual fleet vehicle numbers, and a statistically probable reduction in total severe accidents. The accident rates for PBS vehicles as a specific group are expected to be lower than for non PBS vehicles because of their higher engineered performance and improved stability. Similarly the reduction in network kilometres will see a proportional reduction in total fuel use although individual PBS vehicles will usually be slightly more fuel consumptive than their older non PBS counterparts. However, PBS take-up may have a flow on benefit to the wider ancillary sector and the second hand vehicle market.

2.1 PBS Case Study Simulations

Over the period, from 2006 to 2008, some 16 PBS case studies were undertaken by simulating different truck types carrying different commodities across different types of operational networks. A limited number of these case studies were made available to the NTC at the time.

The case studies were a first stage in the examination of the impact of PBS vehicles operating on different commodity networks. Further simulations were undertaken for this study. These 16 case studies are referred to as Data Set 1. Although some of these simulations might represent an ANZSIC Class, over 50 simulations would be needed to generate a better national industry wide simulation database. For this analysis the averages of these 16 case studies were used but in order to supplement these simulations access was also made of the Victorian Freight and Logistics Council data (VFLC,2008), which is referred to as Data Set number 2.

Data Set number 3 was derived from actual PBS applications for the Truck and Dog class of vehicles.

Table 5: Simulation Reduction factors for Longer Distance PBS Vehicles

Area/Simulation	Commodity	KMs	Capacity	Vehicles
Linehaul1	Inter Capital Parcels	0.7840	0.3300	0.700
Linehaul2	Furniture	0.8000	0.3300	0.800
Linehaul3	Livestock	0.7545	0.3300	0.800
Regional1	Forestry	0.6250	0.3300	0.534
Regional2	Mineral Sands	0.7600	0.3300	0.750
	Average			
	Linehaul / Regional	**0.7450**		**0.7167**

Source: Industrial Logistics Institute Simulations

The averages from the simulation data output are presented in Table 5 and Table 6 for long distance and urban operations respectively. It should be noted that the massive impact of container related Super B-doubles, urban case 11, was excluded from the average of the other 10 urban case averages, however, the results were used for that specific vehicle type in the financial benefits estimation. Excluding urban case 11 reflects a conservative approach to the benefits estimation derived from the simulation approach. The kilometre and vehicle reduction factors represent that level that kilometres and vehicle numbers will reduce through the introduction of PBS vehicles into a freight transport operation.

Table 6: Simulation Reduction factors for Urban PBS Vehicles

Area/Simulation	Commodity	KMs	Capacity	Vehicles
Urban1	Concrete	0.5590	1.0000	0.620
Urban2	Parcels	0.7390	0.4286	0.640
Urban3	Containers	0.7490	1.0000	0.750
Urban4	Intra Port	0.7500	0.3300	0.750
Urban5	Steel Urban	0.8040	0.4800	0.670
Urban6	Parcels	0.8490	0.4280	0.778
Urban7	City Ops	0.8500	0.1590	0.889
Urban8	Urban Tanker	0.9170	0.5100	0.875
Urban9	Waste	0.8200	0.3300	0.720
Urban10	Mini Skips	0.7400	1.0000	0.750
Urban11	Container SBD	0.4450	1.0000	0.4440
	Average[1]	**0.7780**		**0.7440**

Source: Industrial Logistics Institute Simulations

Note 1: Average Excludes the Level 2b Container Super B-double(Urban11)

2.2 The Victorian Freight and Logistics Council Case Studies

The simulation case studies were also supplemented by the results of the Victorian Freight and Logistics Council study in 2009. This study examined the productivity, and vehicle capacity changes for a basket of articulated and some rigid vehicles. This data set is referred to as Data Set 2.

Equation 1 became useful for estimating the vehicle reduction factors for this data set and the relationship

Equation 1

$$\textbf{Kilometre reduction factor} \quad = \quad \textbf{(1 – productivity)}$$

was used to estimate the kilometre reduction factors for this same data. The averaging of these two data sets provided the percentage savings used in the financial analysis and these factors are presented in Table 10. With some exceptions these Table 10 results were applied against each of the operational vehicle classes in Table 4 which then produced the kilometre and vehicle reduction estimates upon which the PBS fleet impact were based. Data set 3 was produced from NTC supplied productivity data specifically for Truck/Dog combinations.

Table 7: VFLC Rigid PBS Vehicles (km and vehicle factors)

Rigid	Productivity	Case	Est kilometre Reduction Factor	Capacity change	Est Vehicle reduction factor
Urban	0.20	F	0.800	0.4200	0.789
Urban	0.12	K	0.880	0.3300	0.884
	Average		**0.840**		**0.837**

Source: VFLC, 2008 (adapted)

Table 8 and Table 9 generated their respective kilometre and vehicle reduction factors and is described in Appendix 1. In brief, the relationship in Equation 1 was statistically significant in estimating the kilometre reduction factor from the productivity estimates alone. The re-arrangement of regression equation 2, equation 3, was then used to estimate the vehicle reduction factor given that the kilometre reduction factor was estimated from Equation 1. . The same methodology was also used against data set 3 for estimating of these reduction factors.

Table 8: VFLC Articulated PBS Vehicles (Km and Vehicle factors)

Vehicle Type	Productivity	VFLC Case	Est Kms Factor KMs	Capacity change	Forecast Vehicles
Articulated	0.30	A	0.7000	0.5000	0.667
Articulated	0.22	B	0.7800	0.2200	0.736
Articulated	0.25	C	0.7500	0.4000	0.720
Articulated	0.15	D	0.8500	0.2300	0.831
Articulated	0.25	E	0.7500	0.3400	0.712
Articulated	0.15	G	0.8500	0.2500	0.833
Articulated	0.30	H	0.7000	0.5000	0.667
Articulated	0.25	I	0.7500	0.3000	0.707
Articulated	0.20	J	0.8000	0.2500	0.767
Articulated	0.33	M	0.6700	0.5000	0.627
Articulated	0.33	N	0.6700	0.5000	0.627
	Average		0.7518		0.7175

Source: VFLC, 2008 (adapted)

Equation 2

New Kilometres = 0.75 x New Vehicles – (0.10 x Capacity Change) + 0.25 (constant)

Equation 3

New Vehicles = (New Kilometres +(0.10 x Capacity Change) - 0.25) / 0.75

Equation 2 was generated by running regression analysis on Data set 1. The calculation of the reduction factors for kilometres and vehicle numbers three data sets were used. Data set 1 was the 15 commodity based simulations which examined the relationship between kilometres, change in vehicle capacity and change in vehicle numbers. Because of the 15 elements in this data set several statistical regressions were run against this data. These regressions yielded a simplistic business rule that was useful in the application for data set 2, and data set 3.

2.3 The PBS Averaged Truck/Dog Combinations

This data set was extracted and transformed into a similar style of data template to Data Sets 1 and 2. For Confidentially reasons individual fleets data has not been shown.

Table 9: Data Set 3: Averaged Truck Dog Reduction Factors

Area	Commodity	Estimated kilometre Reduction Factor	Capacity Change	Estimated Vehicles Reduction Factor
Urban	Quarry/Building	0.114	Varies	0.092

Source PBS Applications Database, 2009. Excludes some application cases where the productivity was too low when checked with major company estimates.

2.4 Averaging the Data Sets

So that no bias was directed to any particular data set both data sets 1 and 2 were averaged, and data set 3 was used for truck and dog classes of application.

Table 10: PBS Percentage Savings: Kilometres and Vehicles by Area of Operation

Area	Kilometres	Kilometres	Kilometres	Saving %	Kilometres Savings %
	Data Set 1 Ave	Data Set 2 Ave*	Average	Average	Truck/Dog Data Set
Linehaul/Regional	74.5%	75.2%	74.8%	25.2%	NA
Urban	77.8%	84.0%	80.9%	19.1%	11.4%
	Vehicles	**Vehicles**	**Vehicles**	**Saving %**	**Vehicle savings %**
	Data Set 1 Ave	Data Set 2 Ave	Average		Truck/Dog Data Set
Linehaul/Regional	71.7%	71.8%	71.7%	28.3%	Confidential
Urban	74.4%	83.7%	79.1%	21.0%	9.2%

Note Data Set 2 excludes Case L

The savings for the longer distance operations, the urban operations and the truck and dog operations were mostly used in the financial analysis. The exception being for the Super B-double which used simulation results across a 15% subset of the total urban articulated road transport task, which represented the container kilometre task for Melbourne, including vehicle operations being full, partly loaded or empty. It is certain that Super B doubles will also carry other commodities besides containers, so this was again a conservative assumption.

3 Take-up of PBS within Existing Fleets by Vehicle Type

As well as being benefits of diffusing PBS vehicles into a particular type of fleet there also needs to be estimates of the fraction that PBS vehicles that will populate of a particular vehicle class in the future. Table 11 presents these estimates for the Hire and Reward sector and the Ancillary sectors. It is expected that the take-up fraction for the Ancillary sector will be significantly less than for the for hire sector, and this has generally been estimated as a ratio of 1 in 5 with some exceptions, namely B-triples, Super B-doubles and A-doubles. In fact this ancillary take-up rate may be higher after the first 10 or 15 years of an enhanced PBS regime as many hire and reward operators will sell their second-hand PBS vehicles to ancillary operators. So the fraction reflecting the PBS take-up within the ancillary sector, is possible a large under-estimate for the period 2020 to 2030.

3.1 Descriptions of Potential PBS Vehicle Operations

3.1.1 2 Axle and 3 axle Rigid Trucks not in combination (Level 1)

Rigid trucks that can add 1 metre to their body length for volumetric operations, as well as 3 axle rigids extending dimension to under 15 metres with a fourth axle. These vehicles were modelled as simulation Class 3 and Class 6. The potential take up rate of 10% over the 20 year period to 2030 was set at 10% and from operator feedback is conservative.

3.1.2 B Triple (Level 3a)

Modelled as a long distance vehicle only. The vehicle numbers will gradually emerge from the existing B-double market for large fleets only. Small operators will probably not take-up B-triples. Preferred work will be long distance to outer suburban freight parks, and long distance depot to depot trips. By 2030 30% of the forecast growth in the B-double task will be handled by B-triples. This figure is a weighted average and some specialist fleets will be much higher than this figure. The take-up factor excludes B-triples doing Regional to

Regional work which some operators will take-up B-triple options over shorter PBS available vehicles. No modelling was undertaken of B-triples taking work from existing small B-double operators, and this is very likely to happen.
Not all B-triples will be 36.5m in length and probably half will be volumetric operations not requiring an 82.5 tonne GCM.

3.1.3 Super B Doubles (Level 2b)

This vehicle was modelled as an urban vehicle only. This was a conservative assumption, as some regional work will also be undertaken by these vehicles. It is not a preferred long distance vehicle and certainly not a substitute for a B-triple. Super B-doubles will emerge from the existing single semi-trailer population. It was modelled for only container work and again this was a very conservative assumption, as other commodities will use this vehicle type. For this analysis the Super B-double was focused on attacking 15% of the intra capital city single articulated kilometre task. High take-up is expected from both hire and reward and big ancillary operators.

3.1.4 A Doubles (Level 2b)

The vehicle is modelled as coming from the existing B-double market, but it may also make an impact on the single articulated fleet population especially in both regional and urban use where it may be an alternative to a Super B-double. It was modelled on only 2.5% of the existing B-double market and this is considered conservative. Take-up will occur from both hire and reward and the big ancillary operators. A-Doubles were less than 30 metres in length for this analysis.

3.1.5 Single Semi-Trailer 19m to 20m (Level 1)

This technologically simple advance will have significant benefits across the whole area of single semi operations. This includes the 30% of the urban capital city operation of these vehicles and also long distance and regional operations. Ancillary operators will gradually acquire these hand down trailers and this has been modelled in the ratio of one in five compared to the for hire operator. The take-up will come out of the existing basket of single semi trailer operators.

3.1.6 Rigid Trucks in Combination (Level 1)

Simulation classes 4, 8 and 12 were modelled for higher mass uptake. They will come from existing 2, 3 and 4 axle rigid truck and trailer combinations. Take-up by 2030 could range between 10% to 15% of existing rigid truck and dog fleets and this is considered as a conservative assumption..

3.1.7 Rigid Trucks not in Combination (Level 1)

Simulation group 3, 2 axle rigid volumetric trucks taking on additional length and simulation Class 6, 3 axle rigid trucks rigid trucks taking on extra length with possibilities of an addition axle group becoming a four axle volumetric rigid vehicle. Any new developments to these vehicles would come from their existing 2 and 3 axle rigid classes.

3.1.8 Articulated Buses (Level 2b)

According to the ABS there are only some 277 of these vehicles in Australia. Modelling an extra 30 seats would see a conservative productivity benefit of some 6% in the existing articulated bus fleet mix and kilometres run by these vehicles. However, this is a great under estimate as it would be likely that this newer class of bus would also emerge from the current non articulated bus fleets which would significantly boost both kilometre benefits through trip reduction and fleet saving within the current non articulated bus fleets.

3.1.9 Pocket Double Road Trains (Level 3a)

Various industry operators were almost as passionate about the use of Double Road Trains as others were about the potential take-up of B-triples. However, pocket road trains of type 3a will emerge generally from fleet operations that use both B-Doubles and Double Road Trains. Existing Double Road Train operators may switch, at the margin, to pocket Road Trains for a proportion of their operation when access becomes available to outer urban freight parks when they are connected to appropriate road networks. However, for this analysis the emerging market from which pocket road trains would emerge was considered to be primarily from the B-double population.

3.1.10 Other Configurations

These above vehicle type and configurations have been selected in the modelling as prime PBS candidates. However, PBS configurations are not exhausted and there are several configurations and combinations that have not been examined here. Generally this analysis is based on existing vehicle combinations that have, or have had, submitted applications through PBS processes. Again the benefit calculations for PBS are more than likely understated in this analysis.

The PBS reduction factors and hence savings calculations by vehicle class are presented in Table 10. The take-up rates by option type are presented in Table 11. Option 1 is based on a specific number of hire and reward applications and a business as usual rule for supplementary ancillary operators.

Table 11: PBS Take-up by 2030 by Vehicle Class

(Vehicle Numbers or Fraction of Vehicle Class)

PBS Level / Simulation Class	Option 1 by 2030 % Take-up **H & R**	Option 1 by 2030 % Take-up **Ancillary**[1]	Option 2 by 2030 % Take-up **H & R**	Option 2 by 2030 % Take-up **Ancillary**	Option 3 by 2030 % Take-up **H & R**	Option 3 by 2030 % Take-up **Ancillary**
Level 1/Class 3 (2AR>12T)	2.67%	2.00%	6.20%	1.24%	10.00%	2.00%
Level 1 / Class 4 (2AR+T)	10.78%	3.00%	9.30%	1.86%	15.00%	3.00%
Level 1/ Class 6 (3AR>18T)	1.86%	2.00%	6.20%	1.24%	10.00%	2.00%
Level 1/ Class 8(3AR+T>42.5T)	6.79%	2.00%	6.20%	1.24%	10.00%	2.00%
Level 1/ Class 12(4AR+T>42.5T)	43.59%	3.00%	9.30%	1.86%	15.00%	3.00%
Level 1/Single Articulated (19M-20M)	1.20%	2.00%	10.00%	2.00%	10.00%	2.00%
Level 2b /Super B-double(<=30M)	4.53%	15.00%[2]	6.60%	6.60%	15.00%	15.00%
Level 3a /B-triple(<=36.5M)[3]	3.53%	30.00%[2]	2.64%	2.64%	30.00%	30.00%
Level 2b / A-double(<=30M)	2.56%	2.50%	1.10%	1.10%	2.50%	2.50%
Level 2b / Articulated Bus(<=30M)	15.0%	NA	15.0%	NA	15.0%	NA

Note1 equals Ancillary Option 3.

Note 2.- For ancillary SBDs and BT fleets these numbers are small although the percentage seems high.

Note 3: Percentage equate to proportion of the natural growth in the existing B Double class to 2030 that will become B Triples..

Option 2 is a damped version of option 3 whereby there is a diminished approval level for several vehicle types especially for level 3 interstate access. Option 3 reflects the full expectations for PBS take-up, although still perhaps conservative, represented as a percentage of vehicle activity arising from the current vehicle class performing the non PBS freight task.

3.2 Explaining the PBS Fleet Take-up Rates for Option 3

By 2030 it was estimated that a fraction of the ten vehicle classes presented in Table 11 would be PBS vehicles. This would range between 2.5% of the existing B-double fleet becoming A-doubles, to 30% of the growth in B-double fleet becoming B-triples by 2030. These estimates were drawn from 11 operator phone or personal interviews conducted after the 1st July 2009, and drawing on a decade of consultation with industry which has generated several peer reviewed research papers prior this date.

- Generally the hire and reward sector would be the first movers for many PBS innovations although the large ancillary companies would not lag behind in the adoption of B-triples, Super B-doubles and A-doubles.
- The take-up of B-triples varies markedly from 15% to 100%, for some national operators, all ATA members, suggesting that between 30% to 70% would be easily achieved over the 20 year period.
- Two operators commented that B-triples would take at least 50% of the B-double work off owner drivers, and this task would be taken over by the larger fleets. The assertion that B-triples would not be an owner driver vehicle was consistent amongst both large and smaller operators..
- Rigid vehicle uptake could be as high as 20% generally, and higher for some configurations, however;
- some higher mass applications for truck and dogs would probably be at least 15%. Again for some large fleet operators in this area 100% take-up could become the norm.

The B-triple take-up rates were considered as moderate from fleets slightly greater than 20 vehicles. However, significantly greater uptake for the larger fleets with greater than 100 vehicles would see much higher percentage holdings of B-triples.

Table 12: Interview Summaries for Some PBS Vehicle Types

Interview	Area	Vehicle Type	Comments
Operator 1	LH National Fleet	B-triple	Loss of Owner Driver BDs to BTs
Operator 2	LH Small Fleet	B-triple	Large Owner Driver Loss fm BDs
Operator 3	Linehaul./Local	Super BD	60% to 70% to Container work
Operator 4	Linehaul	B-triple	15% maybe for some contracts
Operator 5	Urban	Quad Axle	Significant Mass work> 10%
Operator 6	Linehaul/Urban	B-triple, 4 Axle Rigids	BT 30% - 40%, 2AR > 50%,4AR >20%
Operator 7	Linehaul	B-triple, Pocket RT	BT 40% PRT 40%
Operator 8	Linehaul	B-triple	60% to 70% Uptake from BDs
Operator 9	Linehaul	B-triple	100% of BD Operations
Operator 10	Urban	Truck/Dog	Much greater than 1 in 7 with higher mass
Regulator Domestic	State	A-double Vehicles	Small Regional use, and some Urban
Regulator Foreign	National	BDs and Mini BTs	Take-up range 7% to 30%

Legend: BD = BDouble, BT = B triple,RT = Rpad Train, PRT = Pocket Road Train, 2AR = 2 axle rigid, 4AR = 4 Axle Rigid, Dom = Domestic, Int = No Domestic

Source: Industrial Logistics Institute, 2009

The A-double was estimated as emerging from existing B-double operators, and for this analysis it was considered as a regional vehicle, however, within the urban area a significant number could emerge from the existing single articulated truck market. This was not modelled which, again, is a conservative assumption. For every 12 B-doubles that would switch to B-triples it was considered that 1/12th of this number would opt for an A-double instead.

4 The Financial Analysis Methodology

The financial benefits of PBS were generated from applying the vehicle class take-up rate, divided by the total 20 year period, to estimate the number of PBS vehicles likely to emerge in that year. The PBS vehicle reduction factor is applied to a fraction of the vehicle population that will take up PBS. A reduction comes about as fewer PBS vehicles will be required to undertake a proportion of the task that would have been done by non PBS vehicles.

The expected number of new PBS vehicles will also generate kilometre savings when the PBS kilometre factor is applied to the expected number of kilometres generated by that group of PBS vehicles.

This reduction in kilometres is the basis for the benefits of PBS. The saved kilometres times the $/per kilometre rate for hire and reward and for ancillary operators is applied to their respective sectoral vehicle populations in each vehicle class for that year. It should be noted that generally ancillary operator costs are lower than the for hire operators as labour need not be fully paid against an award, eg a farmer, and generally trucks are older and therefore the operating cost profiles will also have a lower capital component.

This process is repeated by vehicle class, each year, with the costs being escalated by the adjusted TransEco cost index. The growth in vehicles – rigid, articulated, or B-double class, is applied to the next year's vehicle population, and the process of new PBS vehicles is re-estimated, and the kilometre savings generated by these vehicles recalculated.

This process is continued for the 11 vehicle classes that have been targeted for PBS take-up, over the 20 year period 2001 to 2030. The vehicle operating costs are presented in Appendix B. The highest dollars per kilometre rates are not necessarily for the largest vehicles but can also be incurred by low, or very low, average kilometre vehicles.

The full PBS benefits for all three median PBS Options are presented in Table 13.

Table 13: Direct Operating Benefits of PBS Options, by Vehicle Class

PBS Vehicle type	Total PBS Direct $ Benefits (nominal)		
	Option 1	Option 2	Option 3
Rigid trucks: 2 axle: no trailer: GVM over 12.0 tonne	$103,045,774	$167,417,409	$270,028,079
Rigid trucks: 2 axle: with trailer: GCM to 42.5 tonne	$101,020,453	$79,637,635	$128,447,799
Rigid trucks: 3 axle: no trailer: GVM over 18.0 tonne	$108,567,298	$261,083,657	$421,102,673
Rigid trucks: 3 axle: with trailer: GCM over 42.5 tonne	$92,028,430	$80,782,787	$130,294,818
Rigid trucks: 4 axle: with trailer: GCM over 42.5 tonne	$105,429,713	$14,966,244	$24,139,103
Articulated trucks: single 3 axle trailer: 6 axle rig	$66,042,978	$425,947,589	$425,947,589
Super B-double	$322,921,615	$310,073,080	$704,711,545
B-triple	$540,167,804	$269,298,553	$3,060,210,825
A-double	$340,158,434	$123,204,481	$280,010,185
Articulated Buses	$7,881,125	$7,881,125	$7,881,125
Total	$1,787,263,625	$1,740,292,561	$5,452,773,742
Total NPV	$1,013,141,729	$986,515,357	$3,091,100,043

Industrial Logistics Institute estimates

Equation 4

$ Savings = $\sum_{PBSv}\sum_{n}$ **[**(Kms saved)* ($/km Orig Veh) – PBS Kms * (PBS $/km – Orig Veh $/km)**]**

The above equation suggests that there are kilometre savings in the original vehicle kilometres but this is offset somewhat by the extra cost of running PBS vehicles. This calculation is performed across each year from 2011 to 2030 and across all potential PBS vehicle types. To obtain the NPV equivalents for the three scenarios in Table 13, the annual savings were escalated by TransEco cost escalator of 2.99% (Appendix C) and discounted by the nominal discount rate of 7%.

5 Estimating the Safety Benefits of PBS

PBS vehicles by 2030 are expected to number 3.4% of active freight carrying vehicles greater than 4.5 tonnes Gross Vehicle Mass. For the period 2011 to 2030 there is estimated to be PBS generated kilometre savings of 0.38 billion kilometres for rigid vehicles and almost 3.3 billion kilometres saved by articulated PBS vehicles. If the crash rates per 100 million truck kilometres are applied to the respective vehicle types for the kilometre savings generated by PBS, then the number of fatal crashes and fatalities can be estimated. Table 14 crash rate times the kilometre savings in Table 15 produce the two fatality estimates.

Table 14: Fatal Crash and Fatalities rates by vehicle type

Truck Type	Fatal Crashes per 100m kms	Fatalities per 100m kms
Rigid Trucks	0.90	0.96
Articulated	2.09	2.55

Source: NTC

Table 15: Fatal Crash and Fatalities Savings through PBS, 2011 to 2030

	PBS Kms Savings	Expected Fatal Crash	Expected Fatalities
PBS Rigids Trucks	378,989,282	3.40	3.60
PBS Articulated	3,282,577,533	68.6	83.7
Total		**72.0**	**87.3**

Source: NTC

In brief the 3.6 billion kilometres not travelled will on face value avoid slightly in excess of 87 lives to 2030. However, this is in all probability a conservative estimate based on the average for all articulated trucks. According to recent National Truck Insurance (NTI, 2009) data, B-doubles are exhibiting lower tonne-km crash rates than single articulated trucks, although their tkm task has now passed that of the single semi-trailer.

In 2007 de Kievit and Aarts from the Netherlands Ministry of Transport and Public Works estimated that their mini B-triple combinations, which had significant urban route access, would halve the fatal incidents of their double combinations. Although this was a forecast it would suggest that B-triple combinations, in conflict with perceptions, would be a much safer vehicle than the B-double. In fact this is one of the major arguments for PBS vehicles. The assessment criteria are in place to ensure that these vehicles are as safe as existing vehicles and in some cases safer than specific existing vehicles.

Financial Net Present Value calculation for Fatality Savings

The fatality savings are a function of the kilometres saved from the populations of rigid and articulated vehicles respectively. Each group of trucks have their own fatality crash rates and these are presented in Table 15.

For the base nominal estimate for fatality savings the value of life estimate, refer Appendix 7 for the alternative value, from the Department of Finance and Deregulation's (DFD's) value of $3.5 million dollars. The nominal fatality savings for the PBS Options are

- 3.5 million x 87.3 lives = $305.5 million dollars for Option 3
- 3.5 million x 20.4 lives = $71.4 million dollars for Option 2, and
- 3.5 million x 23.8 lives = $83.3 million for Option 1.

As the savings in kilometres are linear in their behaviour over the 20 year analysis period, then the per annum saving 1/20th of the total saving. The escalators for the fatality savings were 3% per annum and an NPV nominal discount rate of 7%, both advised by DFD.

Equation 5

$$\text{NPV PBS Fatality Savings} = \sum_{20} \left(\left(\text{Nominal Fatality benefit}/20\right) \times (1.03)^n / (1.07)^n\right)$$

where the nominal fatality benefit for each option is used in equation 5 to estimate the NPV of that Option for safety. The respective NPV values for the three main PBS Options are:

- $218 million (Option 3), see Table G1 Appendix 7
- $51 million (Option 2), and
- $59.4 million (Option 1).

6 Estimating the Environmental Benefits of PBS

For the purpose of this analysis only the greenhouse benefits are examined. By 2030 the vast population of PBS vehicles will be Euro V or its next generation replacement technology. This would also suggest that PM_{10} and NOx emissions would be lower than many of the older non PBS vehicles in operation. This would be a benefit however, the population profiles of Australian trucks by their emission standards, as opposed to age is not readily available. How this emissions standard will change by 2030 would be highly subjective calculation. For this reason, only CO2 emissions benefits have been calculated, and the environmental benefit of PBS adoption is possibly understated.

For the 10 modelled generic vehicle types that are likely to take-up PBS each group will generate kilometre savings. However, unlike a flat rate being applied to kilometre savings as is the case for crashes, each PBS group has a different fuel consumption rate to the non PBS vehicle(s) it replaces. Further to this some 40% of trucks, and this will be true of PBS vehicles, will handle volumetric operations, 40% will handle mass operations and 20% will perform both. (NTC, 1994). As well PBS vehicles, usually because of their extra carrying capacity for either mass or cubic operations, will be slightly more fuel intensive than their non PBS counterparts. So the CO_2 saving is not just the saving in CO_2 by fewer kilometres , but this saving must be adjusted downwards by an increment as the PBS vehicle is a little thirstier than the non PBS vehicle(s) it replaces.

Equation 6

CO_2 (savings tonnes) = $\sum_{PBSv} \sum_{n}$ **[**(Kms saved)/100 x (Orig Veh L/100k) – (Kms saved/100*(PBS L/100k – Orig Veh L/100k)**]** x (2.68/1000)

The above equation states that the contribution of each class of PBS vehicle will generate savings through the annual reduction in kilometres, but this will be slightly offset by the higher fuel use for the PBS vehicle.

The net impact across the 10 simulated PBS vehicle classes was estimated at:

- 3.75 million tonnes of CO_2 saved for Option 3
- 0.72 million tonnes of CO_2 saved for Option 2, and
- 0.99 million tonnes of CO_2 saved for Option 1, across the period 2011 to 2030.

Financial Net Present Value calculations for CO_2

The savings in vehicle kilometres will have an associated CO_2 saving. The CO_2 benefit is the smallest of the four benefits arising from PBS in this analysis. At the current time government advice is that a notional price of $23 dollars per tonne for 2011 rising to $30 per tonnes in 2012 onwards could be used. For simplicity purposes the CO_2 tonnages, derived from equation 5 for each PBS Options, was multiplied by $23 but escalated by a risk free long term bond yield of 7% per annum, the average long term bond yield since July 1990, although at the current time the yield is lower than this figure.

The linear nature in the take-up of PBS vehicles allowed that the tonnages could be evenly divided across the 20 year analysis period. For the NPV analysis each of these annual price x tonnes was discounted by the DFD recommended 7% nominal discount rate.

Equation 7

Discounted Total CO_2 value = $\sum_{20}$ ((Total CO_2 tonnes / 20) x 23 x $(1.07)^n$ / $(1.07)^n$

Equation 7 was used to calculate the NPV savings for CO_2. Because in this case the escalator equals the discount rate the discounted benefit of the CO_2 savings for each Option are:

- $\sum_{20}$ (3.75/20) million tonnes x $23 = $86.25 million (Option 3)
- $\sum_{20}$ (0.72/20) million tonnes x $23 = $16.56 million, (Option 2), and
- $\sum_{20}$ (0.99/20) million tonnes x $23 = $22.77 million (Option 1).

Appendix 7, Table G1 presents the NPV calculation (rounded) for Option 3.

7 The Total and Total Net Present Value Benefits

The four components of PBS generated benefits were:

- Direct Operating Benefits
- Flow-on economic benefits
- Safety benefits , through fatality savings, and
- CO2 reduction benefits.

Table T1: Selected Major Financial Benefits of PBS 2011 – 2030

Selected PBS Metrics	Option 1	Option 2	Option 3
1A, Fatality Savings ($m) (nominal)	$0.083	$0.071B	$0.305B
1B. NPV Value Fatality Savings (NPV)	$0.06B	$0.05B	$0.22B
2A. Total CO2 Savings ($m) (nominal)	$0.023B	$0.017B	$0.086B
2B.NPV Value CO2 Savings (NPV)	$0.023B	$0.017B	$0.086B
3A. Direct Financial Savings ($) 2011 – 2030 (nominal)	$1.79B	$1.74B	$5.45B
3B. Direct Financial Savings ($) 2011 – 2030 (NPV)	$1.01B	$0.97B	$3.09B
4A. Flow on Impacts ($) 2011 – 2030 (nominal)	$1.51B	$1.46B	$4.57B
4B. Flow on Impacts ($) 2011 – 2030 (NPV)	$0.65B	$0.63	$1.97B
Total Direct and Flow-on Benefits (Nominal) 3A + 4A	**$3.30B**	**$3.20B**	**$10.02B**
Total Benefits (1A+2A+3A+4A) Nominal	**$3.41B**	**$3.29B**	**$10.41B**
Total Benefits (1B+2B+3B+4B) NPV	**$1.74B**	**$1.67B**	**$5.37B**

Source: Industrial Logistics Institute, 2009

The generation of benefits is through the reduction in vehicle kilometres. Reduced kilometres saves crashes, fuel and operating costs. The four benefit categories listed above were calculated both on a nominal and discounted basis. The total benefits in summary are listed in Table T1. The operational cost savings are the largest component of the benefits followed by the economic flow-on impacts. Safety and environment are smaller in value but dependent on the PBS Option undertaken. For Option 3 the nominal combination of fatality savings, and CO2 reduction is very close to $400 million dollars.

PART B – SELECTED PBS CASE STUDIES

This part sets out three significant case studies illustrating the impacts of PBS vehicles. The second case study is presented as two separate variants, for illustration purposes.

CASE 1:

Vehicle Type: Urban Super B-double: (Level 2b)

Length 30 metres

Area: Heavy Urban use, Capital City only

Commodity Containers only

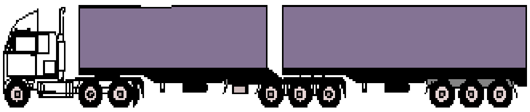


Figure 10: Melbourne's highest geographic freight precincts.

Source: "Freight Futures: Victoria's Freight Network Strategy", Department of Transport Victoria, Australia,2008, December

The following simulation was constructed from a subset of live data. The task was drawn from 33% of container traffic tonnage task between the ten most active origin and destination nodes in the city Melbourne in the State of Victoria.

The initial vehicles effectively operated over four periods a day from early morning to a later off peak evening time. The impact of these vehicles is significant as standard B-doubles have had little impact on the city port container task. At the time that the simulation was undertaken around some 6% of movement around the Port of Melbourne and Dynon precincts were performed B-doubles. The design of this task also allowed a high degree of empty container returns as more consolidated backhaul loads.

Case 1 Findings:

270 Single Articulated Vehicles to 120 Super B-doubles.	**-55.5%** Fleet Reduction
Urban Trips:	
1626 to 724 trips	**-55.4%** Reduction
Load Utilization: Single articulated Vehicles	**65%**
Load Utilization Super B-doubles	**67%**

CASE 2A: National Linehaul B-triple Operation

This case study was presented in 2006. The fleet comprises a mixed singles and B-doubles that phase in the replacement a proportion of B-triples on the major trafficked routes.

Vehicle Type: *Volumetric Pocket B-triple:*
Length 32.95 metres, GCM 68 Tonnes
Area: Capital Cities and one major regional town.
Commodity volumetric parcels.

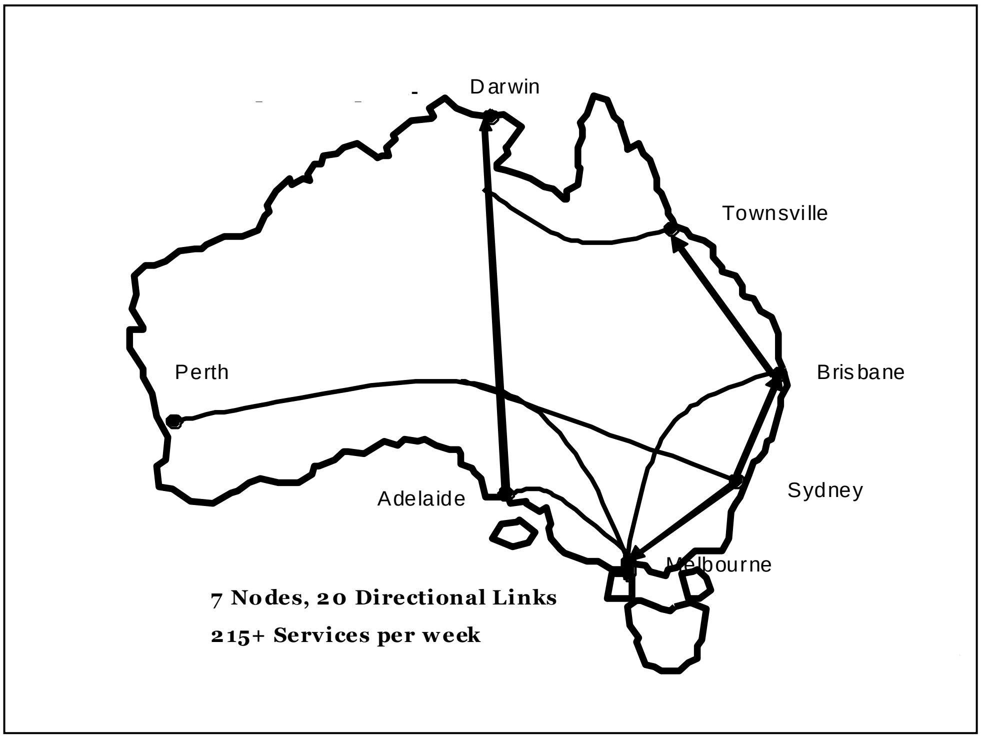
Case 2A Findings:

Vehicle reductions:

60 Single/B-doubles Vehicles to 42 available B-doubles/B-triples	**-30.0%**
Linehaul Trip Reduction	**-24.5%**
% Fleet adoption:	**-42.5%**
Merged timetable operation	

Despite that this case study had high saving the averages of the data sets were used in the national modelling examples were a lower 28% for vehicle savings and 25% for kilometres.

Figure 11: Area of Pocket B-triple Operation



Source Raptour 2006.

CASE 2B: National Linehaul B-triple Operation (fixed timetable)

This case study emerged from a different perspective than saving trips, kilometres and vehicles. This operator is constrained to run a particular set of timetables for their customers. Case study 2A the fixed timetable problem was compressed so that very near dispatch services could be collapsed within very close adjacent time periods. However, when fixed timetables exist the operator does not have this luxury. In such cases operators will need to look towards increasing the productivity of existing assets as opposed to running less schedules.

The following is a multi capital city linehaul operation.

Current fleet: 23 Single Semis, 10 B-doubles = Total 33 Linehaul vehicles.
Services per week: 150
Current stillages: 6290 per week

However, as with Case 2A B-triples become available and operational on an appropriate national network. The Case 2B findings reflect how a slightly reduced fleet can perform at a much higher level of productivity against a fixed timetable. An increase in trip numbers, each with higher freight capacity, can be performed with almost the same number of vehicles in the fleet, in this case one less vehicle.

Case 2B Findings:	
New productive PBS arrangement:	
New fleet 22 B-triples, 10 Singles = Total 32 Vehicles	**-3%**
Services per week 176: Productivity benefit	**+17.3%**
New stillage task 8770 per week: Productivity benefit	**+39.4%**

Although the trailer equipment needs to increase the prime mover numbers can undertake a far more significant task. This example is reflective of what is known as ‘physical productivity’ for the road transport industry, however, there is no such measurement formally adopted in Australia although the concept has been written about from time to time. Case 2B is illustrative and has formed an input into the basket of simulation examples.

PART C - PBS ‘FLOW-ON ECONOMIC EFFECTS’: THE INPUT-OUTPUT METHODOLOGY

8 Application of the Input-Output Method

The input-output system has found extensive use especially in economic forecasting and planning, both in the short and in the long run. It is especially useful in examining the impact of sub-sectors of the economy on the entire economy as a whole. In this case the use of I/O methods was used to estimate the flow on impacts of the savings generated by PBS to the rest of the economy. The method has proved particularly effective in the analysis of sudden and large changes or other far-reaching transformations of an economy.

The I-O method has also been applied in studies of how cost and price changes are transmitted through various sectors of an economy. The usefulness of the input-output technique is indicated by the fact that it is used in forecasting and planning in quite different types of economic systems - decentralized market economies with mainly private enterprise as well as centrally-planned economies dominated by public ownership.

8.1 Outline of Methodology

This section outlines the methodology for estimating the economy wide flow-on effects of various take-up rates of Performance Based Standards for heavy vehicles.

The I/O methodology to be used is drawn from the impact analysis using the 2004-05 Input-Output tables modified to separate out Heavy vehicles as a distinct industry from other road transport industry.

The modification involves:

1. creating a new row and column for the Heavy vehicles industry in the Industry by Industry Flow table (with direct allocation of imports),
2. populating these cells with data estimates of the use by other industries of the output of this industry as well as inputs to the new industry, and
3. adjusting the cells for the remaining road transport industry.

For step 2 it will be necessary to identify the using industries from the ABS Survey of Motor Vehicles Usage data for type of product carried at the macro level.
The modified Flow table can then be used to recalculate the Leontief inverse $(I-A^d)^{-1}$.
The following basic impact equation can then be used to calculate total impacts on gross output, as well as employment, value added, etc, of a change in the demand for the output of a particular industry.

Equation 8

$$cX = (I-A^d)^{-1} \quad cY^d$$

Where:
cX is change in output and
cY^d is change in final demand for domestic products.

The take-up rates and effect of these, in $ terms, on the output of the Heavy vehicles industry will be applied as the stimulus to measure the change in the output of all other industries.
It is proposed to further aggregate the 'Industry by Industry Flow table' to reduce it to 38 industries. This allows Excel matrix functionality to be used to simplify the matrix calculations. A larger table requires the use of Visual Basic.

8.2 Methodology for Estimating Flow-on Effects

This section outlines the method used in Stage 1 of the analysis to estimate the flow on effects of PBS take-up in the heavy vehicle industry.

The method involves the use of input-output tables to calculate the effects of PBS take-up by the industries that employ the vehicle. The input-output tables show the goods and services used and produced by each industry, and the flows from one industry to another. The so-called margin tables show separately the use of the transport industries by using industries. The business in the relevant transport industries are referred as hire and reward businesses and the businesses in other industries that operate such vehicles as a secondary activity are referred to as own businesses.

The savings from the take-up of PBS flow on from those industries to other industries that use their outputs. This study has looked at these flow-on effects on other industries. It has not considered consumption induced effects, because the literature suggests that to do so would be likely to overstate the benefits.

The first stage in the production of the estimates was the quantification of the expected savings for each type of vehicle, in terms of kilometre savings at specified cost per kilometer.

8.3 Methodology for Estimation of Costs

The second stage was the calculation of the estimated cost for each vehicle by type of business by product group carried.

There were three types of vehicles: heavy rigid, heavy articulated, and other.

There were two types of business: hire and reward and own business.

The product groups used were those for which Survey of Motor Vehicle Usage (SMVU) data were it was available. These product groups were:

- Animal and vegetable oils, fats and waxes
- Beverages and tobacco
- Chemicals
- Crude materials inedible except fuels
- Food and live animals
- Minerals, fuels lubricants and related materials
- Manufactured goods
- Machinery and transport equipment
- Miscellaneous manufactured articles
- Tools of trade
- Other
- Not specified

The Input Output Analysis was undertaken by Type of business by Type of vehicle by Product group carried.

The distance traveled by each vehicle type was available from Australian Bureau of Statistics data cubes available to the NTC. These were multiplied by the number of vehicles for each vehicle type in each of the product group categories. This was multiplies by the average cost to get the estimated cost by vehicle type by type of business by product group.

8.4 Assumptions Used in Estimating Costs

For each vehicle type, it was assumed that the average distance traveled is same for Ancillary and Hire and Reward. This is not true and assuming that the average is true dampens the Hire and Reward flow on contribution. This would mean that this is a somewhat conservative estimate of flow on benefits.

For each vehicle type, it was assumed that the average distance traveled is same for all goods carried. This stage uses a national average which may over or understate different business segments.

For Number of vehicles and Distance traveled, it was assumed the difference between Total and Table total is fully accounted for in "Other" vehicle categories.

It was also assumed the average cost per kilometre is same for all goods carried. This is not true as volumetric operators may have lower cost profiles for many of their operations. If the averages are close to a national average then there is significant reliability in the estimates. Currently the estimates are perhaps low which leads to the possibility that the flow-on benefits are at least $4.5 billion for Option 3, and proportional for Option 1 and Option 2.

8.5 Obtaining an Estimate of the Total H & R Vehicle Margin

The Road Margin, as published by ABS for 2004-05, was collapsed to 38x38 broad industry groups. The hire and reward (H&R) heavy vehicle use ratio from the SMVU product groups were applied by product industry to estimate a H & R Heavy vehicle 'road margin use matrix' in the analysis. This assumes that most H&R Heavy vehicle use is margin on goods produced. Non-heavy vehicle use and other road transport were also estimated as residuals from the I/O table data.

This analysis provides an estimate of Total H & R Heavy Vehicle Road margin of $14.6b (see Table 18) which is higher than the estimate from the SMVU and cost data ($11.3b using Product group data black.

The $14.6b estimate was used for the subsequent calculations as it appears plausible compared with the total Road margin in the 2004-2005 I/O tables and the over all H&R heavy vehicle to H&R Other ratios. There is also an ABS adjustment (SNA68) in the ABS I-O tables that shifts from basic price to margin the value of third party transport services which are not separately invoiced – that may justify a higher estimate.

Note: A feature of the SMVU data was that, in all tables used, components did not add precisely to the table totals as published.

8.6 Estimation of Cost Savings

The next stage (Stage 4) was to collapse the published 109 industry by 109 industry flow table 2004-2005 to ultimately a 38 industry by 38 industry broad industry groups flow table. In addition, the original Road transport industry was split into Heavy vehicle road transport margin, Other road transport margin and Other road transport rows and columns. These new rows and columns were populated using the estimates in the sheet Road Margin 38x38.

From this new flow table the Direct requirements coefficients matrix and the Total requirements coefficients matrix (Leontief Inverse) were derived using standard input-output methodology. Consumption induced effects were not estimated.

Note. This was done originally using a flow table with Direct allocation of imports as per the UN 1999, in order to apply the impact analysis equation as specified. However, as imports attract road margin, it was decided to use the Indirect allocation of imports approach.

The initial savings impacts for each using industry were estimated by allocating the total savings for each year (estimated elsewhere in the report) to using industries via the Heavy vehicle road transport margin row values from the Flow table.

The assumption was made that savings on transport inputs will generate an equivalent amount of increased output for each using industry.

The flow-on effects were calculated by two ways: one using the impact equation – again see UN 1999, (initial savings is equivalent to final demand); and the other using the value added multiplier (initial savings are equivalent to value added.)

For the first method one multiplies the inverse matrix by the savings vector and for the second approach one multiplies the savings vector by the inverse matrix. In both methods, the original savings are then deducted *to avoid double counting*. This second approach was considered preferable for this analysis.

Table 16 shows the resultant flow-on impacts of the direct savings for PBS by individual year from 2011 to 2030. Figure 12 also reflects the cumulative benefit over this same 20 year period.

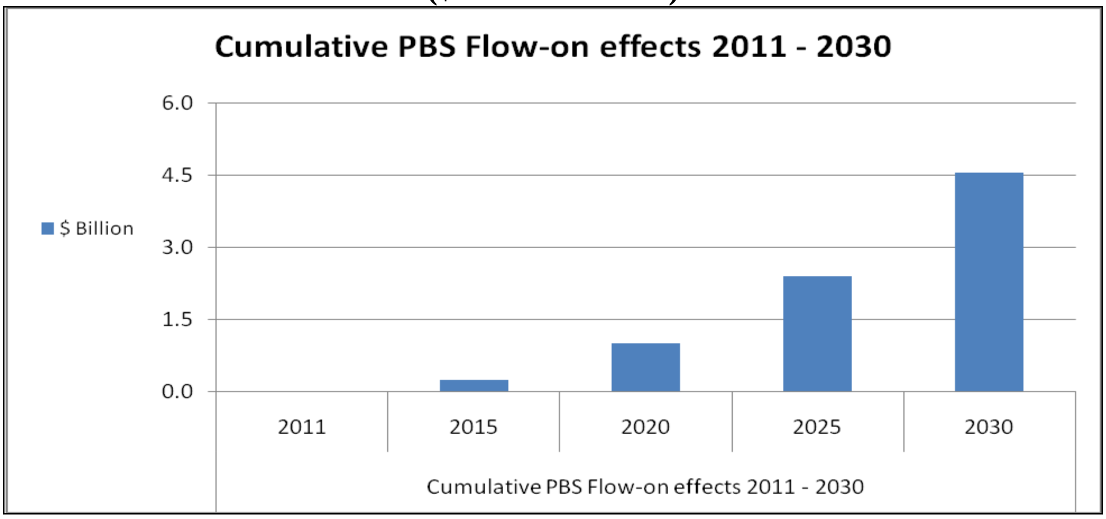
Table 16: Cumulative Direct and Flow on Savings through PBS Option 3, 2011 to 2030 ($million)

Year	Cumulative Initial Effect ($m)	Cumulative Flow On Effect ($m)
2011	19	16
2012	58	49
2013	117	99
2014	199	167
2015	303	254
2016	431	361
2017	584	489
2018	764	639
2019	970	812
2020	1,206	1,010
2021	1,471	1,232
2022	1,768	1,481
2023	2,097	1,757
2024	2,461	2,062
2025	2,860	2,396
2026	3,297	2,762
2027	3,773	3,161
2028	4,290	3,594
2029	4,849	4,063
2030	5,453	4,569

Industrial Logistics Institute and ESAC Estimates, 2009

Figure 12: Cumulative Option 3 Flow-on Effects to Other Industries

($ billion nominal)



Source: ESAC 2009

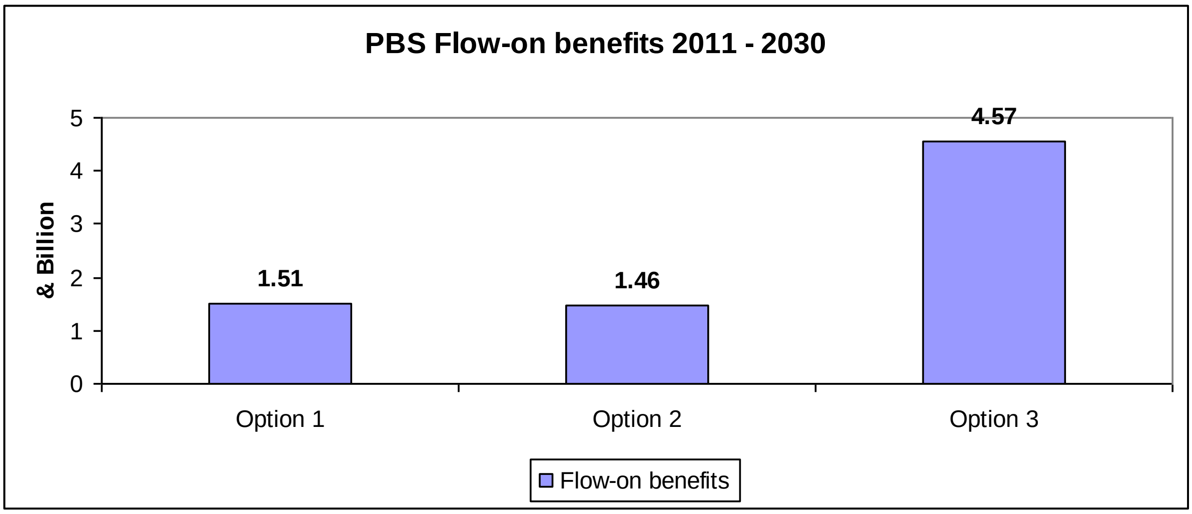
It can be noted that the results are more simply obtained by multiplying the initial savings by a constant factor for each year. Given the assumptions made in Stage 2, that factor is close to 1. The only reason it is lower than 1 is that the initial Total Intermediate Usage (TIU) savings were set to be less than the initial total savings per year. Both these results would be higher if the initial TIU savings were set to be the same as the total initial savings for each year, but that would not allow for margins on exports, and capital expenditure. The heavy vehicle margin on household consumption was assumed to be zero, as few heavy vehicles deliver the groceries, although in some instances this not untrue, with such services as 'Coles on Line' being performed with 2 axle rigid trucks.

8.7 Calculating the Flow-On Impacts for Options 1 and Option 2

The degree of analysis that is undertaken with I/O analysis is both data intensive and time consuming. Using the results of the I/O flow-on analysis for Option 3, then the flow-on estimates for Option 1 and Option 2 were derived proportionally to their ratio of direct benefits when compared to Option 3. For example for Option 1 the direct PBS industry benefit was $1.79 billion over the 2011 to 2030 period. The flow-on benefit was therefore estimated as (1.79/5.45) x (4.569) = $1.50 billion. Similarly for Option 2 the flow-on benefits was calculated as (1.74/5.45) x (4.569) = $1.46 billion dollars. Relative "relative flow-on" impacts are presented in Figure 13.

Figure 13: Cumulative Flow-on Effects to Other Industries, all Options

($ billion nominal)



Source: Industrial Logistics Institute based on ESAC 2009

8.8 Conclusion

In summary, this I/O method suggests that, although the underlying assumptions are reasonable, but certainly not perfect, PBS still delivers a considerable benefit to the other non road transport sectors of the economy. Improved data allowing better ‘vectors of final demand’ if produced would offer more precise long term analysis to be undertaken. Also the benefits from the analysis are low as only the Hire and Reward flow-on benefits have been modeled. Ancillary operations could only be calculated with significant survey work to estimate the dependence on the 38 way classification system for its respective ancillary transport operators. This is a very large task and so only the Hire and Reward flow-on has been estimated. For Option 3 (median) resulted in a $4.5 billion flow-on benefit to 2030.

Table 17: Cumulative Flow on Savings through PBS, by Sector by Year, 2011 to 2030

	PBS Savings by Sector (Total $m)													
Year	Grain	Lstock	Other Agric	Forestry Fishing	Mining	Meat Dairy	Other Food	Beverages Tobacco	Clothing Fware	Wood Prod	Paper Printing	Petrol and Coal	Chem	Rubber Plastics
2011	0	0	0	0	0	1	1	0	0	0	0	1	1	0
2012	1	1	0	1	1	1	1	1	1	1	1	1	1	1
2013	1	1	1	1	1	2	2	1	1	1	1	2	2	2
2014	1	1	1	1	1	3	3	2	2	2	1	2	2	2
2015	2	2	1	2	1	4	3	2	2	2	2	3	3	3
2016	2	2	2	2	2	5	4	3	3	2	2	4	4	3
2017	2	3	2	3	2	6	5	3	3	3	3	5	4	4
2018	3	3	2	3	3	7	6	4	4	3	3	5	5	5
2019	3	4	2	3	3	8	7	4	4	4	4	6	6	5
2020	4	4	3	4	3	9	8	5	5	5	4	7	7	6
2021	4	5	3	4	4	10	9	6	6	5	5	8	8	7
2022	4	5	4	5	4	11	10	6	6	6	5	9	9	7
2023	5	6	4	5	5	12	11	7	7	6	6	10	9	8
2024	5	7	4	6	5	13	12	8	8	7	7	11	10	9
2025	6	7	5	7	6	15	13	8	9	8	7	12	11	10
2026	7	8	5	7	6	16	14	9	9	8	8	13	13	11
2027	7	9	6	8	7	17	16	10	10	9	9	14	14	12
2028	8	9	6	8	7	19	17	11	11	10	9	15	15	13
2029	8	10	7	9	8	21	18	12	12	11	10	17	16	14
2030	9	11	7	10	9	22	20	13	13	12	11	18	17	15

Source: ESAC 2009

Table 18: Cumulative Flow on Savings through PBS, by Sector by Year, 2011 to 2030 (Continued)

	PBS Savings by Sector (Total $m)														
	Chem	Rubber Plastics	Cement Concrete	Non Metals Minerals	Iron Steel	Non iron metals	Fab metal Products	Transport Equip	Other Equip	Furnitute Pre Fab	Misc Manu	Elect,Gas Water	Constn	W'sale	Retail
2011	1	0	0	0	1	1	0	0	0	0	1	0	1	0	0
2012	1	1	1	1	1	1	1	1	1	1	1	1	2	1	1
2013	2	2	1	1	2	2	1	1	1	1	2	1	3	1	1
2014	2	2	2	2	2	2	2	2	2	2	2	2	4	2	2
2015	3	3	2	2	3	3	3	3	3	3	3	2	6	2	2
2016	4	3	3	3	3	3	3	3	3	3	3	3	7	2	2
2017	4	4	4	3	4	4	4	4	4	4	4	3	8	3	3
2018	5	5	4	4	5	5	4	4	4	4	5	4	10	3	3
2019	6	5	5	4	6	6	5	5	5	5	6	4	11	4	4
2020	7	6	6	5	6	6	6	6	6	6	6	5	13	4	5
2021	8	7	6	5	7	7	6	7	6	6	7	5	14	5	5
2022	9	7	7	6	8	8	7	7	7	7	8	6	16	6	6
2023	9	8	8	7	9	9	8	8	8	8	9	7	18	6	6
2024	10	9	9	8	10	10	9	9	9	9	10	7	20	7	7
2025	11	10	9	8	11	11	10	10	10	10	11	8	22	8	8
2026	13	11	10	9	12	12	11	11	10	11	12	9	24	8	8
2027	14	12	11	10	13	13	12	12	11	12	13	10	26	9	9
2028	15	13	12	11	14	14	13	13	12	13	14	11	28	10	10
2029	16	14	13	12	15	15	14	14	13	14	15	11	30	11	11
2030	17	15	14	12	16	16	15	15	14	15	16	12	33	11	12

Source: ESAC 2009

Table 19: Cumulative Flow on Savings through PBS, by Sector by Year, 2011 to 2030 (Continued)

	PBS Savings by Sector (Total $m)											
	Repairs	Accommodation Restaurants	Heavy Vehicle	Other Freight	Other Road Trans	Other Trans	Comms	Finance Insurance	Property Business Services	Admin	Other services	Intermediate Consumption
2011	0	1	0	0	0	0	0	0	0	0	0	**16**
2012	1	1	1	1	1	1	1	0	1	1	0	**33**
2013	1	2	1	1	1	1	1	0	1	1	1	**50**
2014	2	2	1	1	1	2	2	0	1	2	1	**68**
2015	2	3	2	2	2	2	2	1	2	2	1	**87**
2016	2	3	2	2	2	3	2	1	2	3	2	**107**
2017	3	4	3	3	3	3	3	1	2	3	2	**128**
2018	3	5	3	3	3	4	3	1	3	4	2	**150**
2019	4	6	4	4	4	4	4	1	3	4	2	**173**
2020	5	6	4	4	4	5	5	1	3	5	3	**197**
2021	5	7	5	5	5	6	5	1	4	6	3	**222**
2022	6	8	5	5	5	6	6	2	4	6	4	**249**
2023	6	9	6	6	6	7	6	2	5	7	4	**276**
2024	7	10	6	6	6	8	7	2	5	8	4	**305**
2025	8	11	7	7	7	8	8	2	6	8	5	**335**
2026	8	12	8	8	8	9	8	2	6	9	5	**366**
2027	9	13	8	8	8	10	9	3	7	10	6	**399**
2028	10	14	9	9	9	11	10	3	8	11	6	**433**
2029	11	15	10	10	10	12	11	3	8	12	7	**469**
2030	12	16	11	11	11	13	12	3	9	13	7	**506**
Total												**4569**

Source: ESAC 2009

Table 20: Cumulative Flow of Direct PBS Benefits ($m nominal)

Commodity	HVR margin	Ave pa PBS saving	2011	2012	2013	2014	2015
Grains	178	3	0.2	0.5	0.7	1.0	1.3
Livestock	361	6	0.5	1.0	1.5	2.0	2.6
Other agriculture	222	4	0.3	0.6	0.9	1.2	1.6
Forestry & fishing	67	1	0.1	0.2	0.3	0.4	0.5
Mining	250	4	0.3	0.7	1.0	1.4	1.8
Meat & dairy products	1,034	18	1.3	2.7	4.2	5.8	7.4
Other food products	721	13	0.9	1.9	2.9	4.0	5.1
Beverages & tobacco products	204	4	0.3	0.5	0.8	1.1	1.5
Textiles, clothing & footwear	89	2	0.1	0.2	0.4	0.5	0.6
Wood and wood products	287	5	0.4	0.8	1.2	1.6	2.0
Paper, printing and publishing	138	2	0.2	0.4	0.6	0.8	1.0
Petroleum and coal products	51	1	0.1	0.1	0.2	0.3	0.4
Chemicals	312	6	0.4	0.8	1.3	1.7	2.2
Rubber and plastic products	88	2	0.1	0.2	0.4	0.5	0.6
Cement, lime and concrete slurry	227	4	0.3	0.6	0.9	1.3	1.6
Other non-metallic mineral products	175	3	0.2	0.5	0.7	1.0	1.3
Iron & steel	310	5	0.4	0.8	1.3	1.7	2.2
Basic non-ferrous metal & products	230	4	0.3	0.6	0.9	1.3	1.6
Fabricated metal products	160	3	0.2	0.4	0.7	0.9	1.1
Transport equipment	141	2	0.2	0.4	0.6	0.8	1.0
Other machinery and equipment	196	3	0.3	0.5	0.8	1.1	1.4
Pre-fab buildings & furniture	196	3	0.3	0.5	0.8	1.1	1.4
Miscellaneous manufacturing	97	2	0.1	0.3	0.4	0.5	0.7
Electricity, gas and water	176	3	0.2	0.5	0.7	1.0	1.3
Construction	1,322	23	1.7	3.5	5.4	7.4	9.4
Wholesale trade	141	2	0.2	0.4	0.6	0.8	1.0
Retail trade	300	5	0.4	0.8	1.2	1.7	2.1
Repairs	82	1	0.1	0.2	0.3	0.5	0.6
Accommodation, cafes & restaurants	421	7	0.5	1.1	1.7	2.3	3.0
Heavy vehicle road margin	83	1	0.1	0.2	0.3	0.5	0.6
Other road margin	42	1	0.1	0.1	0.2	0.2	0.3
Other road transport	69	1	0.1	0.2	0.3	0.4	0.5
Other transport	239	4	0.3	0.6	1.0	1.3	1.7
Communication services	107	2	0.1	0.3	0.4	0.6	0.8
Finance and insurance	11	0	0.0	0.0	0.0	0.1	0.1
Property & business services	264	5	0.3	0.7	1.1	1.5	1.9
Government administration & defence	124	2	0.2	0.3	0.5	0.7	0.9
Other services	482	9	0.6	1.3	2.0	2.7	3.4
Intermediate Consumption	**9,597**	**170**	**12.4**	**25.5**	**39.2**	**53.5**	**68.5**
HFCE	0	0	0.0	0.0	0.0	0.0	0.0
GFCE	0	0	0.0	0.0	0.0	0.0	0.0
GFCF Private	983	17	1.3	2.6	4.0	5.5	7.0
GFCF Public	27	0	0.0	0.1	0.1	0.1	0.2
GFCF Govt	87	2	0.1	0.2	0.4	0.5	0.6
Inventories	0	0	0.0	0.0	0.0	0.0	0.0
Exports	3,914	69	5.1	10.4	16.0	21.8	27.9
Final Use	**5,011**	89	6.5	13.3	20.4	27.9	35.8
Total Use	**14,608**	**258.6**	**18.94**	**38.80**	**59.60**	**81.40**	**104.22**

Table 21: Cumulative Flow of Direct PBS Benefits ($m) (continued)

Commodity	2016	2017	2018	2019	2020	2021	2022	2023
Grains	1.6	1.9	2.2	2.5	2.9	3.2	3.6	4.0
Livestock	3.2	3.8	4.4	5.1	5.8	6.6	7.3	8.1
Other agriculture	1.9	2.3	2.7	3.1	3.6	4.0	4.5	5.0
Forestry & fishing	0.6	0.7	0.8	0.9	1.1	1.2	1.4	1.5
Mining	2.2	2.6	3.1	3.5	4.0	4.5	5.1	5.6
Meat & dairy products	9.1	10.8	12.7	14.6	16.7	18.8	21.0	23.3
Other food products	6.3	7.6	8.9	10.2	11.6	13.1	14.6	16.3
Beverages & tobacco products	1.8	2.1	2.5	2.9	3.3	3.7	4.1	4.6
Textiles, clothing & footwear	0.8	0.9	1.1	1.3	1.4	1.6	1.8	2.0
Wood and wood products	2.5	3.0	3.5	4.1	4.6	5.2	5.8	6.5
Paper, printing and publishing	1.2	1.4	1.7	1.9	2.2	2.5	2.8	3.1
Petroleum and coal products	0.4	0.5	0.6	0.7	0.8	0.9	1.0	1.2
Chemicals	2.7	3.3	3.8	4.4	5.0	5.7	6.3	7.0
Rubber and plastic products	0.8	0.9	1.1	1.2	1.4	1.6	1.8	2.0
Cement, lime and concrete slurry	2.0	2.4	2.8	3.2	3.7	4.1	4.6	5.1
Other non-metallic mineral products	1.5	1.8	2.2	2.5	2.8	3.2	3.6	4.0
Iron & steel	2.7	3.3	3.8	4.4	5.0	5.6	6.3	7.0
Basic non-ferrous metal & products	2.0	2.4	2.8	3.3	3.7	4.2	4.7	5.2
Fabricated metal products	1.4	1.7	2.0	2.3	2.6	2.9	3.3	3.6
Transport equipment	1.2	1.5	1.7	2.0	2.3	2.6	2.9	3.2
Other machinery and equipment	1.7	2.1	2.4	2.8	3.2	3.6	4.0	4.4
Pre-fab buildings & furniture	1.7	2.1	2.4	2.8	3.2	3.6	4.0	4.4
Miscellaneous manufacturing	0.8	1.0	1.2	1.4	1.6	1.8	2.0	2.2
Electricity, gas and water	1.5	1.8	2.2	2.5	2.8	3.2	3.6	4.0
Construction	11.6	13.9	16.2	18.7	21.3	24.0	26.8	29.8
Wholesale trade	1.2	1.5	1.7	2.0	2.3	2.6	2.9	3.2
Retail trade	2.6	3.1	3.7	4.2	4.8	5.5	6.1	6.8
Repairs	0.7	0.9	1.0	1.2	1.3	1.5	1.7	1.8
Accommodation, cafes & restaurants	3.7	4.4	5.2	6.0	6.8	7.6	8.5	9.5
Heavy vehicle road margin	0.7	0.9	1.0	1.2	1.3	1.5	1.7	1.9
Other road margin	0.4	0.4	0.5	0.6	0.7	0.8	0.8	0.9
Other road transport	0.6	0.7	0.8	1.0	1.1	1.2	1.4	1.5
Other transport	2.1	2.5	2.9	3.4	3.9	4.3	4.9	5.4
Communication services	0.9	1.1	1.3	1.5	1.7	2.0	2.2	2.4
Finance and insurance	0.1	0.1	0.1	0.2	0.2	0.2	0.2	0.3
Property & business services	2.3	2.8	3.2	3.7	4.3	4.8	5.4	6.0
Government administration & defence	1.1	1.3	1.5	1.8	2.0	2.2	2.5	2.8
Other services	4.2	5.1	5.9	6.8	7.8	8.8	9.8	10.9
Intermediate Consumption	84.2	100.6	117.8	135.8	154.6	174.3	194.9	216.4
HFCE	-	-	-	-	-	-	-	-
GFCE	-	-	-	-	-	-	-	-
GFCF Private	8.6	10.3	12.1	13.9	15.8	17.9	20.0	22.2
GFCF Public	0.2	0.3	0.3	0.4	0.4	0.5	0.5	0.6
GFCF Govt	0.8	0.9	1.1	1.2	1.4	1.6	1.8	2.0
Inventories	-	-	-	-	-	-	-	-
Exports	34.3	41.0	48.1	55.4	63.1	71.1	79.5	88.3
Final Use	44.0	52.5	61.5	70.9	80.7	91.0	101.8	113.0
Total Use	128.1	153.1	179.3	206.7	235.4	265.3	296.7	329.4
					1,205.6			

Source: ESAC 2009

Table 22: Cumulative Flow of Direct PBS Benefits ($m) (continued)

Commodity	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**
Grains	4.4	4.9	5.3	5.8	6.3	6.8	7.3
Livestock	9.0	9.9	10.8	11.8	12.8	13.8	14.9
Other agriculture	5.5	6.1	6.6	7.2	7.9	8.5	9.2
Forestry & fishing	1.7	1.8	2.0	2.2	2.4	2.6	2.8
Mining	6.2	6.8	7.5	8.2	8.9	9.6	10.3
Meat & dairy products	25.7	28.3	30.9	33.7	36.6	39.6	42.7
Other food products	18.0	19.7	21.6	23.5	25.5	27.6	29.8
Beverages & tobacco products	5.1	5.6	6.1	6.6	7.2	7.8	8.4
Textiles, clothing & footwear	2.2	2.4	2.7	2.9	3.1	3.4	3.7
Wood and wood products	7.1	7.8	8.6	9.3	10.1	11.0	11.9
Paper, printing and publishing	3.4	3.8	4.1	4.5	4.9	5.3	5.7
Petroleum and coal products	1.3	1.4	1.5	1.7	1.8	2.0	2.1
Chemicals	7.8	8.5	9.3	10.2	11.0	11.9	12.9
Rubber and plastic products	2.2	2.4	2.6	2.9	3.1	3.4	3.6
Cement, lime and concrete slurry	5.7	6.2	6.8	7.4	8.0	8.7	9.4
Other non-metallic mineral products	4.4	4.8	5.2	5.7	6.2	6.7	7.3
Iron & steel	7.7	8.5	9.3	10.1	11.0	11.9	12.8
Basic non-ferrous metal & products	5.7	6.3	6.9	7.5	8.1	8.8	9.5
Fabricated metal products	4.0	4.4	4.8	5.2	5.7	6.1	6.6
Transport equipment	3.5	3.9	4.2	4.6	5.0	5.4	5.8
Other machinery and equipment	4.9	5.4	5.9	6.4	6.9	7.5	8.1
Pre-fab buildings & furniture	4.9	5.4	5.9	6.4	6.9	7.5	8.1
Miscellaneous manufacturing	2.4	2.6	2.9	3.2	3.4	3.7	4.0
Electricity, gas and water	4.4	4.8	5.3	5.7	6.2	6.7	7.3
Construction	32.9	36.1	39.5	43.1	46.8	50.6	54.6
Wholesale trade	3.5	3.8	4.2	4.6	5.0	5.4	5.8
Retail trade	7.5	8.2	9.0	9.8	10.6	11.5	12.4
Repairs	2.0	2.2	2.4	2.7	2.9	3.1	3.4
Accommodation, cafes & restaurants	10.5	11.5	12.6	13.7	14.9	16.1	17.4
Heavy vehicle road margin	2.1	2.3	2.5	2.7	2.9	3.2	3.4
Other road margin	1.0	1.1	1.2	1.4	1.5	1.6	1.7
Other road transport	1.7	1.9	2.1	2.2	2.4	2.6	2.8
Other transport	5.9	6.5	7.1	7.8	8.5	9.2	9.9
Communication services	2.7	2.9	3.2	3.5	3.8	4.1	4.4
Finance and insurance	0.3	0.3	0.3	0.4	0.4	0.4	0.5
Property & business services	6.6	7.2	7.9	8.6	9.3	10.1	10.9
Government administration & defence	3.1	3.4	3.7	4.0	4.4	4.7	5.1
Other services	12.0	13.2	14.4	15.7	17.0	18.5	19.9
Intermediate Consumption	**238.9**	**262.4**	**287.0**	**312.7**	**339.5**	**367.4**	**396.7**
HFCE	0.0	0.0	0.0	0.0	0.0	0.0	0.0
GFCE	0.0	0.0	0.0	0.0	0.0	0.0	0.0
GFCF Private	24.5	26.9	29.4	32.0	34.8	37.6	40.6
GFCF Public	0.7	0.7	0.8	0.9	0.9	1.0	1.1
GFCF Govt	2.2	2.4	2.6	2.8	3.1	3.3	3.6
Inventories	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Exports	97.5	107.0	117.1	127.5	138.5	149.9	161.8
Final Use	124.8	137.0	149.9	163.3	177.3	191.9	207.1
Total Use	**363.68**	**399.46**	**436.85**	**475.91**	**516.71**	**559.31**	**603.80**
Cumulative Total (nominal)							**4,569**

8.9 Technical Note on I/O double Counting

In some cases there exists the possibility of double counting of flow-on effects (see note 1) which can occur if **Output multipliers** are used in I/O analysis. However , in this analysis, **Value added multipliers** have been used in the analysis to eliminate this deficiency (see note 2). In addition, an open model was used in the analysis which does not take account of possible consumption induced flow-on effects. Consequently the total impact is likely to be understated. The flow-on effects can represent additional financial benefits because of the way the impacts are measured using the traditional Input-Output model. This was eloquently put by Prof Guy West - “Secondly, generally speaking, the conventional input-output multipliers are not used to calculate total impacts. Rather, it is the other way around; an "impact" multiplier can be constructed only after the total impacts have been calculated.” Having estimated the total impact, the initial and direct effects are deducted to measure the flow-on (or indirect) effects. See reference in Note 2.

Note 1 This interpretation arises from (broadly valid) criticisms of the application of the Input-Output model which are expressed in papers such as the following.

Rama,I and Lawrence,P, (20 Jan 2009), Partial multipliers – when more is less, Vic. Dept. of Primary Industries: p5, para.3.1.

Note2 “Output multipliers and the output effects in impact analyses refer to gross expenditure or turnover. Gross output measures are susceptible to multiple counting, because they sum all the intermediate transactions over all stages of production during the production process. Consequently, they substantially overstate economic activity. Therefore while output effects provide a measure of the increase in gross sales throughout the economy following an economic stimulus, they are inappropriate as a measure of the contribution to economic activity. The preferred measure of net impact is **value added**, which is defined as wages and salaries and supplements paid to labour plus gross operating surplus plus indirect taxes less subsidies. The sum of all industry value added is equal to Gross Regional Product (GRP) - or Gross State Product (GSP) at the state level or Gross Domestic Product (GDP) at the national level - so value added impacts refer to the contribution to GRP. This is the preferred and consistent measure of economic activity. Output effects should only be used in exceptional circumstances.”

West, G (Oct 1999) Notes on some misconceptions in Input-Output methodology, The University of Queensland: pp11-12.

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Significant and continuing discussions were conducted with several leading hire and reward, large ancillary transport companies, as well as small operators. Special thanks, also goes to some of the leading PBS technical dynamic experts who gave advice about specific vehicle configurations and their behaviours. Assistance and input was also forthcoming from two road agencies.

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APPENDIX 1: DATA SETS FOR THE CALCULATION OF VEHICLE AND KILOMETRE REDUCTION FACTORS

Table A1: Kilometre and Vehicle Reduction Factors – Data Set 1

VFLC Data Set 2 Productivity	VLFC Case	Estimated Km Reduction Factor (1 – Prod)	Vehicle capacity Change	Estimated Vehicle Reduction Factor (Equation 2)
0.20	F	0.8000	0.4200	0.789
0.12	K	0.8800	0.3300	0.884
0.30	A	0.7000	0.5000	0.667
0.22	B	0.7800	0.2200	0.736
0.25	C	0.7500	0.4000	0.720
0.15	D	0.8500	0.2300	0.831
0.25	E	0.7500	0.3400	0.712
0.15	G	0.8500	0.2500	0.833
0.30	H	0.7000	0.5000	0.667
0.25	I	0.7500	0.3000	0.707
0.20	J	0.8000	0.2500	0.767
0.33	M	0.6700	0.5000	0.627
0.33	N	0.6700	0.5000	0.627

Source: Industrial Logistics Institute: Simulations 2006 to 2009

In Table A2 the estimation of the kilometre reduction factor was calculated by using the formula from **Equation 9.**

Equation 9:

New Kilometre factor = 1 – Productivity

Table A2: Estimation of Kilometre and Vehicle Reduction Factors, Data Set 2

Operation	Commodity	Kilometre Reduction	Capacity Change	Vehicle Reduction
L	Inter Capital Parcels	0.7840	0.3300	0.700
L	Furniture	0.8000	0.3300	0.800
L	Livestock	0.7545	0.3300	1.000
R	Forestry	0.6250	0.3300	0.534
R	Mineral Sands	0.7600	0.3300	0.750
U	Concrete	0.5590	1.0000	0.620
U	Urban Parcels	0.7390	0.4286	0.640
U	Intra Container Port	0.7490	1.0000	0.750
U	Outside Container Port	0.7500	0.3300	0.750
U	Steel Urban	0.8040	0.4800	0.670
U	General Parcels	0.8490	0.4280	0.778
U	Urban Mixed Fleets	0.8500	0.1590	0.889
U	Urban Tanker	0.9170	0.5100	0.875
U	Waste	0.8200	0.3300	0.720
U	Skips	0.7400	1.0000	0.750
U	Outside Container Port	0.5550	1.0000	0.556

Source: Industrial Logistics Institute: Simulations 2006 to 2009

This relationship, equation 9, and its average across the 11 articulated case studies was measured against the mean of the trimmed simulation outputs in Table A1. Statistically these two distributions for kilometre reduction factors were equivalent when compared with a Chi-Square test. The Calculation of the kilometre reduction factors for Data set 2 was done by using Equation 10

Equation 10

New Vehicle Factor = (New Kilometre Factor +(0.10 x Capacity Change) - 0.25) / 0.75

This allowed an estimate of the vehicle reduction factors by using the re arranged regression equation 10.

APPENDIX 2: WEIGHTED UNIT COSTS PER KILOMETRE

Table A1 reflects the weighted averages of vehicle costs in dollars per kilometre. The PBS and non PBS unit costs are a weighted average of for hire unit costs and ancillary unit costs. These two sectors are weighted by the population of vehicles in the class for each sector. In some instances the ancillary operator will have similar operating costs to the for hire operator but in most cases ancillary operating costs are lower than the for hire counterpart as labour is not costed at all against the transport operation, and capital equipment is based on the takeup of a second hand vehicle.

Table B1: Unit Rates by Vehicle Class for PBS and non PBS Vehicles

PBS Level / Simulation Group	Ave Kms	PBS $/km[1]	Non PBS $/Km[1]
Level 1 / Class 3	28,606	2.11	1.92
Level 1 / Class 4	28,784	2.21	2.01
Level 1 / Class 6	27,985	2.68	2.44
Level 1 / Class 8	68,307	3.15	2.86
Level 1 / Class 12	72,061	3.14	3.00
Level 1 / Single Articulated	83,177	1.55	1.54
Level 2b / Super B-double	35,000	3.21	2.69
Level 3a / B-triple	224,439(e)	1.66	1.66
Level 2b / A-double	224,439(e)	1.76	1.76
Level 2b / Articulated Bus	50,744 (e)	3.87	3.60

Source: 1. Translog unpublished databases

(e) Estimated

APPENDIX 3: VEHICLE GROWTH RATES AND DEFLATORS TO 2030

The long term growth rates were calculated by examining the macro vehicle classes from 1971 to 2007 adjusted for rigid trucks below 4.5 tonnes and for non freight carrying articulated and rigid vehicles. The B-double growth rate calculated was not from their beginnings in 1986 which would yield a compound growth rate of 28% per annum, but instead from a stable level since 2004 when B-doubles have been at a steady level of 15.2% of SMVU articulated truck totals. This B-double percentage within the total articulated truck population was carried through till 2030. Many observers may argue that this B-double growth rate may be higher but again this forecast was considered conservative, but it should be noted that any B-triple introduction will also cut into the existing growth in the B-double market.

Table C1: Annual Vehicle Growth Factors and Deflators 2008 to 2030

B-double, A-double, B-triple growth rates p.a	**1.032**
Single Articulated Trucks growth rates p.a	**1.022**
Rigid Trucks growth rates p.a	**1.008**
Road Transport Cost Escalators	**1.0299**
NPV Discount Rate	**1.07**
Cost of Life escalator	**1.03**
CO2 market escalator	**1.07**

Source: Industrial Logistics Institute

The kilometre growth in each vehicle class was obtained by multiplying the long term vehicle growth rate by the 2006 average kilometres undertaken by the populations of vehicles in that class for each year to 2030. Table 4 in the main report, presents the estimates for the growth of non PBS vehicles to 2030.

APPENDIX 4: DATA SET 1: SPECIFIC COMMODITY SIMULATIONS FOR PBS VEHICLES

Table D1: Vehicle Commodities examined in Data Set 1, Simulations

Operational Commodity	Potential for PBS Take-up
Petroleum	Yes
Other Tanker / Chemicals	Yes
Quarry / earth / mining	Yes
Over Dimensional	Yes
Car Carrier	Yes
Volumetric parcels	Yes
Steel	Yes
Grain	Yes
Building Materials	Yes
Logging	Yes
Waste	Yes
Container/wharf	Yes
Agricultural Other	No
Taxi Trucks	Yes
Refrigerated Operations	Yes
General Freight Other	No
Concrete	Yes
Mini Skips	Yes
Furniture	Yes
Horse movements (long trailer)	Yes
General Retail	No
Livestock	Yes
Non Specialised Courier	No
Security Collections	Maybe

Source: Industrial Logistics Institute

APPENDIX 5: BACKGROUND TO INPUT – OUTPUT ANALYSIS

The Input-Output technique examines the relationships between the sectors of the economy. The technique was first created by Wassily Leontief, who also won the Nobel prize for economics in 1973, specifically for this economic analytical framework. The primary work was undertaken in the early 1930s and left society with a production based tool for examining the inter-industry transactions in an economy. The complete methodology was published in 1941 in the book, *The Structure of American Economy, 1919-1929*. An extended supplement was published a decade later.

The input-output analysis describes the interdependence in the production systems as a network of deliveries between the various sectors of production. For every production sector, technical coefficients define the quantities of intermediary products which are required per unit produced for each commodity.

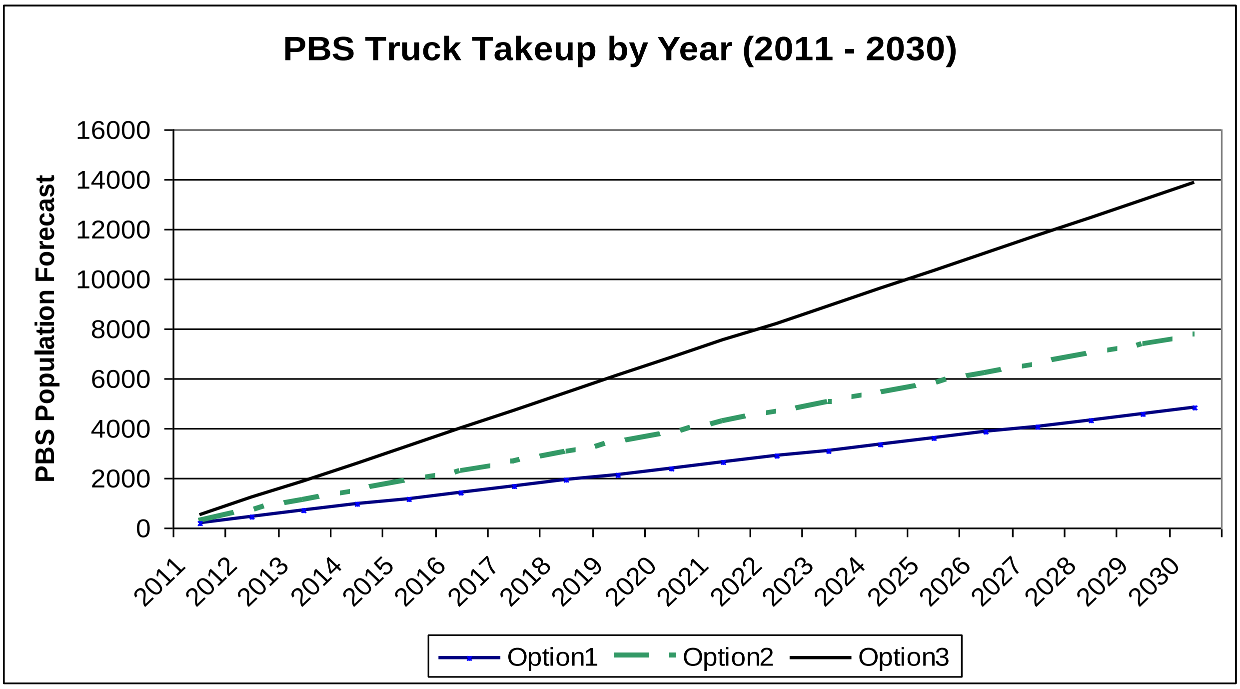
Final demands of products for consumption, investment and exports in the model are usually treated as determined by conditions outside the production system. The purpose of the analysis is then to find out how much production has to be increased in the various sectors of the economy to satisfy a given desired or planned increase in final demand for consumption, investment and exports. The increased production in each sector then has to cover not only the change in final demand, but also the derived changes in demand for intermediary products in the various production sectors.

APPENDIX 6: SENSITIVITY ANALYSIS

Sensitivity analyses were conducted across all of the assumptions of Options 1, 2 and 3. The outcome of the sensitivity analysis is presented in detail in Table F1. The median option for PBS take-up is the default value for that Option in the report although there are high and low scenarios associated with each Option.

The growth in PBS vehicle take-up is presented in Figure 14. This reflects the median Option scenarios for the three Options. PBS approvals range from 4800 vehicles for Option 1, 7,800 for Option 2 to 13,800 for Option 3.

Figure 14: Growth in PBS Vehicles by Year



Source: Industrial Logistics Institute, 2009

This growth sees 240 PBS vehicles being approved per annum under Option1, 388 per annum for Option 2, and 692 per annum under Option 3. This rate would remain constant for each year to 2030.

Table F1: Total PBS Benefits for all PBS Options and Scenarios

PBS Metrics	Option 1 Low	Option 1 Median	Option 1 High	Option 2 Low	Option 2 Median	Option 2 High	Option 3 Low	Option 3 Median	Option 3 High
PBS Vehicles at 2030	4,113	4,808	5,503	6,869	7,772	11,921	13,050	13,848	23,087
PBS Vehicle Savings at 2030	1,324	1,529	1,734	1,786	1,888	3,285	3,955	4,362	6,285
PBS Vehicle Savings % of fleet at 2030	0.33%	0.38%	0.43%	0.44%	0.47%	1.06%	0.98%	1.1%	1.56%
PBS Vehicle as % Fleet at 2030	1.0%	1.2%	1.4%	1.7%	1.9%	2.96%	3.26%	3.5%	5.81%
PBS Kilometre Savings 2011 - 2030	0.90 B kms	1.06 B kms	1.23Bkms	0.88 B kms	0.95 B kms	2.64 B kms	3.3 B kms	3.7 B kms	4.9 B kms
PBS Kilometres at 2030	0,32 B kms	0.39 B kms	0.45 B kms	0.46 B kms	0.53 B kms	1.13 B Kms	1.31 B kms	1.44 B kms	2.1 B kms
% PBS Kilometres at 2030	1.6%	1.9%	2.23%	2,9%	3.4%	5.43%	5.98%	6.60%	9.64%
Fatality Savings to 2030	20.0	23.8	27.6	18.7	20.4	61.7	77.3	87.3	115.3
Total Fuel Savings to 2030	0.31 B Ltrs	0.37 B Ltrs	0.43B Ltrs	0.25B Ltrs	0.27 B Ltrs	0.98 B Ltrs	1.239 B Ltrs	1.398 B Ltrs	1.806 B Ltrs
% Fuel Savings fm PBS 2011 - 2030	0.23%	0.27%	0.31%	0.18%	0.19%	0.71%	0.904%	1.02%	1.32%
Total CO2 Savings Million tonnes	0.84Mt	0.99 Mt	1.13 Mt	0.68 Mt	0.72 Mt	2.62 Mt	3.32.Mt	3.75 Mt	4.84 Mt
PBS % total CO2 Savings at year 2030	0.42%	0.5%	0.57%	0.34%	0.36%	1.32%	1.68%	1.90%	2.45%
Financial Savings ($) 2011 - 2030	$1.48B	$1.79B	$2.09B	$1.628B	$1.74B	$4.03B[1]	$4.864 B	$5.45 B	$7.487 B
Flow on Impacts ($) 2011 - 2030	$1.24B	$1.51B	$1.75B	$1.365B	$1.46B	$3.37B[1]	$4.079 B	$4.57 B	$6,27 B

Note: 1 Based on a 66% implementation of a national level 3 network.

Source: Industrial Logistics Institute, 2009

Tables F2, F3 and F4 present the percentage of PBS vehicles in each class that are expected to populate the Australian trucking fleets by 2030. The percentages are the sum of both the for hire and ancillary segments.

Table F2: PBS Vehicles by percent Option 1

PBS Level / Simulation Class	Option 1 Low by 2030 % Take-up Total	Option 1 Median by 2030 % Take-up Total	Option 1 High by 2030 % Take-up Total
Level 1/Class 3 (2AR>12T)	1.6%	1.8%	1.9%
Level 1 / Class 4 (2AR+T)	3.3%	3.8%	4.2%
Level 1/ Class 6 (3AR>18T)	1.4%	1.5%	1.7%
Level 1/ Class 8(3AR+T>42.5T)	3.5%	4.4%	5.3%
Level 1/ Class 12(4AR+T>42.5T)	22.3%	27.5%	32.0%
Level 1/Single Articulated (19M-20M)	1.0%	1.2%	1.4%
Level 2b /Super B-double(<=30M)	2.9%	3.2%	3.6%
Level 3a /B-triple(<=36.5M)	4.0%	4.6%	5.2%
Level 2b / A-double(<=30M)	1.5%	1.9%	2.3%
Level 2b / Articulated Bus(<=30M)	14.2%	14.2%	14.2%

Source: Industrial Logistics Institute, 2009

Table F3: PBS Vehicles by percent Option 2

PBS Level / Simulation Class	Option 2 Low by 2030 % Take-up Total	Option 2 Median by 2030 % Take-up Total	Option 2 High by 2030 % Take-up Total
Level 1/Class 3 (2AR>12T)	2.3%	2.3%	3.8%
Level 1 / Class 4 (2AR+T)	2.8%	2.8%	3.1%
Level 1/ Class 6 (3AR>18T)	2.8%	2.8%	4.6%
Level 1/ Class 8(3AR+T>42.5T)	3.8%	3.8%	6.2%
Level 1/ Class 12(4AR+T>42.5T)	3.6%	5.4%	5.8%
Level 1/Single Articulated (19M-20M)	5.8%	7.7%	7.7%
Level 2b /Super B-double(<=30M)	3.0%	3.0%	3.5%
Level 3a /B-triple(<=36.5M)	1.9%	1.9%	15.2%
Level 2b / A-double(<=30M)	0.8%	0.8%	1.9%
Level 2b / Articulated Bus(<=30M)	14.2%	14.2%	14.2%

Source: Industrial Logistics Institute, 2009

Table F4: PBS Vehicles by percent Option 3

PBS Level / Simulation Class	Option 3 Low by 2030 % Take-up Total	Option 3 Median by 2030 % Take-up Total	Option 3 High by 2030 % Take-up Total
Level 1/Class 3 (2AR>12T)	3.8%	3.8%	7.6%
Level 1 / Class 4 (2AR+T)	3.8%	4.6%	6.2%
Level 1/ Class 6 (3AR>18T)	4.6%	4.6%	7.0%
Level 1/ Class 8(3AR+T>42.5T)	6.2%	6.2%	9.4%
Level 1/ Class 12(4AR+T>42.5T)	8.8%	8.8%	11.8%
Level 1/Single Articulated (19M-20M)	7.7%	7.7%	15.5%
Level 2b /Super B-double(<=30M)	6.0%	7.3%	8.4%
Level 3a /B-triple(<=36.5M)	21.2%	23.6%	28.8%
Level 2b / A-double(<=30M)	0.7%	1.9%	3.8%
Level 2b / Articulated Bus(<=30M)	14.2%[2]	14.2%[2]	2.8%[1]

Note 1: Population from 2.8% of all 3 axle buses.

2 Population from 14.2% of Articulated Buses

Source: Industrial Logistics Institute, 2009

Table F5 reflects the summary financial benefits for the national option and the option is valued at $10 billion dollars over the period 2011 to 2030. The low scenario option at $9.1 billion and the high scenario option at $13.1 billion.

Table F5: Total PBS Benefits for PBS Option 3 scenarios

Benefits	Low	Median	High
Direct $ B	$4.865	$5.45	$7.478
Flow on $ B	$4.253	$4.57	$6.27
Total $ B	$9.118	$10.02	$13.748

Source: Industrial Logistics Institute, 2009

The difference in direct benefits between the high and the median scenarios is $2 billon dollars and a further flow on benefit of $1.7 billion. Although the high scenario is a stretch target it would not be impossible to reach by 2030, with appropriate PBS access facilitation to obtain the appropriate infrastructure.

APPENDIX 7: CALCULATING THE NET PRESENT BENEFITS OF PBS

Net Present Value Analysis for PBS

The direct operational savings as well as the safety and environmental benefits are summed and discounted over the twenty year analysis period 2011 to 2030. The direct benefits fall into three classes: safety, environmental and vehicle operations and flow-on economic benefits. This forth benefit is described in section 7.

The NPV analysis used a nominal discount rate of 7% as provided by the Office of Best Practice Regulation. This is considered quite high for policy work as opposed to an infrastructure return investment. Otherwise standard procedures were followed. Generally, because of the linearity of the growth in PBS take-up, whose benefits are measured in vehicle kilometre savings, with the ensuing benefits for fatality savings, carbon dioxide and flow-on economic benefits being linearly related.

Values for Life and Carbon Dioxide

For the Net Present Value analysis the value of a life was valued at $3.5 million. This comes from the Department of Finance and Deregulation's (DFD) statistical value of life approach as opposed to the 'cost of accident' approach published by the Bureau of Infrastructure, Transport and Regional Economics, (BITRE.) This cost of life is escalated at 3% per annum, and discounted at the DFD recommended level of 7% per annum.

The value of carbon dioxide was valued at the pre 2012 Federal Treasury level of $23 per tonne, and was keep at this level for the twenty year analysis period. This should rise to $30 per tonne in 2012. Many existing international trading markets have priced CO2 at less than this level. Carbon dioxide was escalated at 7% per annum and similarly discounted at this same level making the NPV and nominal cash flow benefit equivalent.

Infrastructure and Cost treatments in PBS

As with the take-up of PBS by operators infrastructure providers would be targeting specific budget resources to particular proposed PBS routes. Many of these routes effectively exist now and can be strategically targeted for 'improvements' out of existing budgets. How wide the roads network is opened, initially for level 3 and level 2b vehicles, will depend on respective agencies and their performance in prioritising funding for these higher level networks. This same situation was observed with the introduction of B-doubles whereby a skeleton of roads became available and then further routes were added to this initial network. Road authorities will be examining existing routes for PBS expansion now, with existing resources, and initially the same technical engineering teams that both held or developed expertise in PBS over the last decade. Initially pilot trials can be run and monitored, for example, the Ford pocket B-triple trials in Victoria where infrastructure matches operational requirement. Also in Victoria a number of B-triple trials have been undertaken and these have generally been successful. Super B-Double trials will now begin following the B-triple trials in that State. Currently there are an estimated 200 B-triples operating in Australia, however, these vehicles are recorded as 'triple road trains' under ABS data classification. This data classification problem will be fixed in future SMVU detailed data cubes.

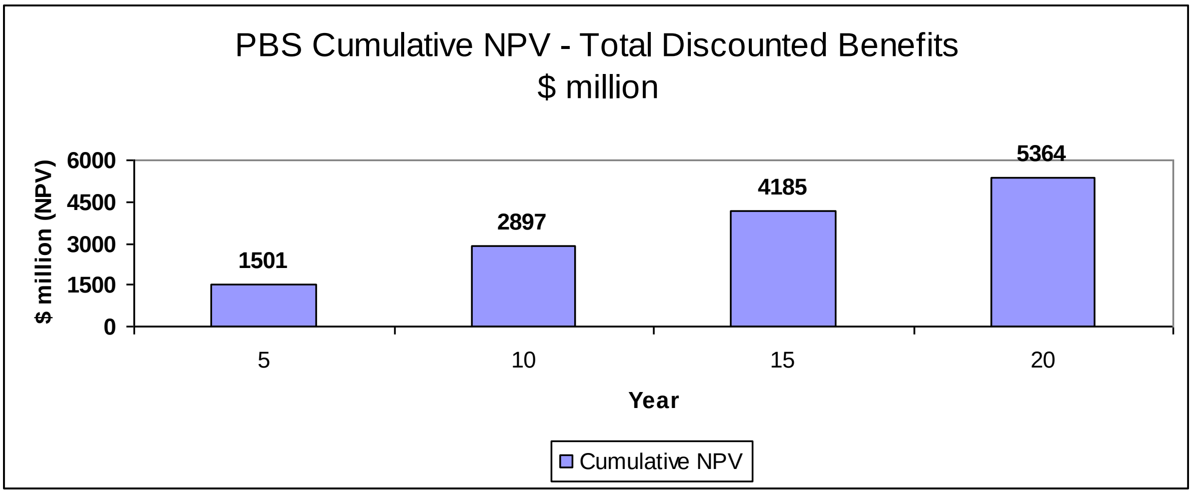
Currently Option 1 is the baseline scenario for PBS. This means that there is no zero Net Present Value scenario, as the current PBS arrangements are producing slow but incremental results. Any large expansion to the costs of administrative assessment staff would be a small percentage of the total benefits generated by PBS. It has been deemed that no net increase in State staffing levels will be required for PBS assessment either at the operational or desktop level. Similarly the cost of applications and modelling for PBS vehicle types is very small compared to the benefits of PBS. However, this could still be made significantly cheaper by a more fluid and flexible modelling and approvals process.

The incremental approach means that no major infrastructure funding will inhibit the opening up higher level PBS networks that have an already have an existing level of suitability for higher level PBS vehicles. This incremental approach suggests that existing deemed suitable routes need not be restricted to PBS vehicles.

This NPV approach suggests that the benefits can be interpreted as being net of the current planned and budgeted costs of infrastructure expansion.

The discounted PBS benefits for Australia are presented in Figure 15. In discounted terms the benefits are some $1.35 billion dollars for every five years of implementation. Nominal benefits are some 49% higher than this level.

Figure 15: Cumulative Discounted PBS Benefits take-up at 5 Year intervals to 2030



Source: Industrial Logistics Institute, 2009. Derived from Table G1.

Table G1 presents the benefits inflow from the implementation of PBS across the period 2011 to 2030. The benefit streams are for safety, environment, direct kilometre operational savings and economic flow-on benefits. The benefit streams are approximately linear with the exception of the economic flow-on benefits which are slightly skewed to the latter decade.

Table G1: Discounted PBS Benefits 2011 – 2030 by Category ($million)

	Year																				
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	Total
Fatalities	15.3	14.7	14.2	13.6	13.1	12.6	12.2	11.7	11.3	10.8	10.4	10.1	9.7	9.3	9.0	8.6	8.3	8.0	7.7	7.4	218
CO_2	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	86
PBS Operating Savings	272.6	254.8	238.1	222.6	208.0	194.4	181.7	169.8	158.7	148.3	138.6	129.5	121.1	113.1	105.7	98.8	92.4	86.3	80.7	75.4	3091
PBS Flow-on	16.0	30.8	43.7	55.5	66.4	76.3	85.3	93.4	100.7	107.7	112.9	118.3	122.5	126.6	129.5	132.7	135.2	137.1	138.8	139.9	1969
Total	308.2	304.7	300.3	296.0	291.8	287.6	283.4	279.2	274.9	271.2	266.2	262.2	257.6	253.3	248.5	244.4	240.1	235.7	231.4	227.0	**5364**
Cumulative NPV $					**1501.0**					**2897**					**4185.2**					**5364**	

Source: Industrial Logistics Institute, 2009

APPENDIX 8: CALCULATING COMPLIANCE COSTS OF PBS

Compliance cost explanation by option

PBS vehicle compliance costs typically include the cost of assessment of the vehicle against the PBS standards and the cost to certify that the vehicle, as built, meets the requirements of the design approval (vehicle assessment). However the way these costs are incurred will be different for each option presented, especially where self certification and modular assessment are adopted.

To demonstrate how costs are incurred under each option the following section utilizes a case study to show the differences. In this case study the operator runs two PBS combination types, (a Super B-double and a quad axle semi-trailer) each with four complete combination vehicles. The effect of modular approval and self certification (See draft regulatory impact statement - Part 2 process improvements) are assessed as a part of Option 3.

Having demonstrated how costs are incurred under each option, this appendix estimates the annualized cost of certification and assessment for the PBS fleet.

Additional business costs incurred by operators as a result of having to obtain permits and local council permissions have not been included in this analysis and are assessed later in this appendix.

Option 1

Under Option 1 (status quo), the operator is required to have each of the combinations assessed against the PBS requirements, this usually takes the form of computer modeling of the vehicle. The cost of modeling is typically between $8,000[1] for fairly common combinations to $15,000 for more complex designs. As the vehicles used in the example are fairly common, it can be assumed that the typical assessment cost will be $8,000. In addition to assessment, each of the vehicles, once built, needs to be certified as meeting the design as modeled, at a typical cost of $5,000 per vehicle. Under the current system the certification of the vehicle is assumed to assess the whole of the vehicle combination.

[1] Typical assessment and certification costs sourced from the PBS Review Panel secretariat, as of August 2009.

These costs are typical start up-costs and, in theory, only apply to the purchase or first use of the equipment as a SMART combination. However to understand what might be expected as ongoing costs, consider the introduction of a different brand of prime mover (with the same specifications) as a substitute prime mover on one of the combinations.

Under the current system this would require the combination with the substitute prime mover to be re-assessed for all tests, once again costing in the order of $8,000. In addition the new prime mover needs to be certified, although this does not require the re-certification of other existing equipment. Therefore the cost to add an additional prime mover to the fleet is $13,000.

Option 1 – Status quo compliance costs (example)

PBS vehicle fleet: 4 x Super B-double (4 prime movers, 4 Super B-double trailer sets)
4 x Quad axle semi (4 prime movers, 4 quad axle trailers)

PBS assessment costs: $8,000 (Super B-double assessment)
$8,000 (Quad axle semi assessment)

Certification costs: 8 x $5,000 (each vehicle combination is certified)

Total start up compliance costs for operator's PBS fleet: $56,000

Cost to add an additional prime mover to one combination

Re-assessment of combination: $8,000

Certification cost: $5,000

Total Cost for additional prime mover: $13,000

NTC Estimates

Option 2

Under an option where individual states are able to set the assessment and access requirements utilizing the PBS principles it is not really possible to predict the cost of compliance as it would vary state by state and possibly even on a vehicle by vehicle basis.

Where a prescriptive notice (based on PBS principles) exists for a high productivity vehicle, the cost of compliance is generally low; however the vehicle type will typically be only able to operate within that state, as harmonization of notices between states has been generally poor. For vehicles which are able to take advantage of prescriptive notices we can assume that compliance costs are insignificant.

States may wish to keep the current arrangement of assessment and certification, at this end of the scale it is expected that compliance costs will be the same as Option 1.

Therefore for this option, compliance costs (to the vehicle operator) are expected to range from zero to full Option 1 costs. It is however far more likely that most states will not be able to carry out or fund assessments of vehicles, particularly if vehicle application numbers increase, and thus for assessment of this option full option 1 costs are assumed.

It must be noted that, as the range of vehicles permitted to access the road network under this option will be at the discretion of the particular jurisdictions, a certain type of vehicle may not be able to be granted access in all states.

Option 3

Under Option 3, assuming that modular certification and self-certification are implemented (see Part 2 sections 1 and 2), the compliance costs would in general be borne by the manufacturer of SMART vehicles. This cost would necessarily be passed on to the consumer of the equipment, the vehicle operators, however the cost may be amortised over the full production run of the vehicle component.

Assessment costs for prime movers, borne by their manufacturers, under the proposed modular assessment system, would be relatively inexpensive as the calculations involved form a normal part of the development of the vehicle. Also, as prime mover manufacturers have existing quality and inspection systems in place, the certification of a prime mover should also form a normal production activity. However there would be PBS specific overheads, such as submitting paperwork to the PBS Review Panel, writing compliance letters or affixing plates to the vehicle. For the purpose of this evaluation it is assumed that these overheads are approximately $500[2] per prime mover. Therefore the cost to an operator utilizing eight PBS compliant prime movers would be in the order of $4,000.

Assessment of trailer sets would usually involve a trailer manufacturer commissioning a third party assessor to complete the PBS assessment. The removal of the powertrain standards from the material to be assessed would be unlikely to have a significant effect on the cost of assessment for the trailers. In addition, if the trailers were to be assessed for a range of prime movers instead of a single prime mover, the cost of assessment would increase due to the additional testing required. This additional testing is assumed to increase the cost of testing by around 20 per cent bringing the cost to around $10,000 for a fairly common combination.

[2] Based on 2-3 hours of engineer time per vehicle, though costs could be less if integrated into normal procedures.

The cost of assessment is able to be borne by all like vehicles that the manufacturer builds. For the purpose of this evaluation, a conservative estimate for a low volume trailer manufacturer would be around ten units per design. This leads to an approximate on-cost of around $1,000 per trailer set for PBS assessment.

Certification of trailer sets by the manufacturer rather than a third party certifier would bring significant cost reductions. For this example, the same on-costs are used as for the prime mover manufacturers, being around $500 per trailer set for certification.

Therefore for the example where an operator uses four Super B-double trailer sets and four quad axle semi-trailers, the on-cost of assessment and certification for each of the trailer sets is likely to be in the order of $1,500.

As with the Option 2 (status quo) compliance cost example, the cost of adding a substitute prime mover into the fleet to investigate likely ongoing costs has been assessed. In this case, if the vehicle meets the boundary conditions used in the modular certification of the trailer set, then the combination does not need re-assessment and the only additional compliance cost is the prime mover assessment and certification on-cost of $500.

Option 3 – Modular assessment and self certification compliance costs (example)

PBS vehicle fleet: 4 x Super B-double (4 prime movers, 4 Super B-double trailer sets)
4 x Quad axle semi (4 prime movers, 4 quad axle trailers)

Prime mover assessment and certification: $500 x 8 units = $4,000

Quad axle semi assessment and certification: $1,500 x 4 units = $6,000

Super B-double assessment and certification: $1,500 x 4 units = $6,000

Total start up compliance costs for operator’s PBS fleet: $16,000

Cost to add an additional prime mover to one combination

Prime mover assessment and certification: $500 x 1 = $500

Total cost for additional prime mover: $500

NTC Estimates

Comparison of options

Table H1. Comparative compliance costs per option for a given fleet

	Sample fleet compliance cost	Cost to change prime mover
Option 1	$56,000	$17,000
Option 2	As option 1	As option 1
Option 3	$16,000	$500

NTC Estimates

Estimating compliance costs over the fleet

To estimate the direct compliance costs to industry on a per year basis, a sensitivity analysis based on the previous case studies was conducted. This model looks at the costs associate with assessment of designs and certification of vehicles. The main driver of variance within each option is the number of real vehicles built per design assessment and application.

Table H2: Unit approval and certification costs

Option	Vehicles Per year	Cost per approval	Cost per certification	Vehicles per approval (high)	Vehicles per approval (Mid)	Vehicles per approval (Low)	Certifications per vehicle (high)
1	240	$8,000	$5,000	8	4	1	1
2	388	$8,000	$5,000	8	4	1	1
3	692	$10,000	$500	20	10	2	2

NTC Estimates

Table H3: Total yearly approval and certification costs

Option	Total approval cost (high)	Total approval cost (mid)	Total approval cost (low)	Total cert cost (high)	Total (high)	Total (mid)	Total (low)
1	$1,920,000	$480,000	$240,000	$1,200,000	$3,120,000	$1,680,000	$1,440,000
2	$3,104,000	$776,000	$388,000	$1,940,000	$5,044,000	$2,716,000	$2,328,000
3	$3,460,000	$692,000	$346,000	$692,000	$4,152,000	$1,384,000	$1,038,000

NTC Estimates

Under option 1 and 2 each application for assessment is generally made by a vehicle operator. Current numbers of applications and vehicle registrations under the scheme indicate that there are three vehicles built per approval. This is however likely to increase slightly as most approvals are relatively new. The modeling of compliance costs for option 1 and 2 therefore assumes that the average number of real vehicle built per application is four, with a possible high of eight and a minimum of one vehicle per application.

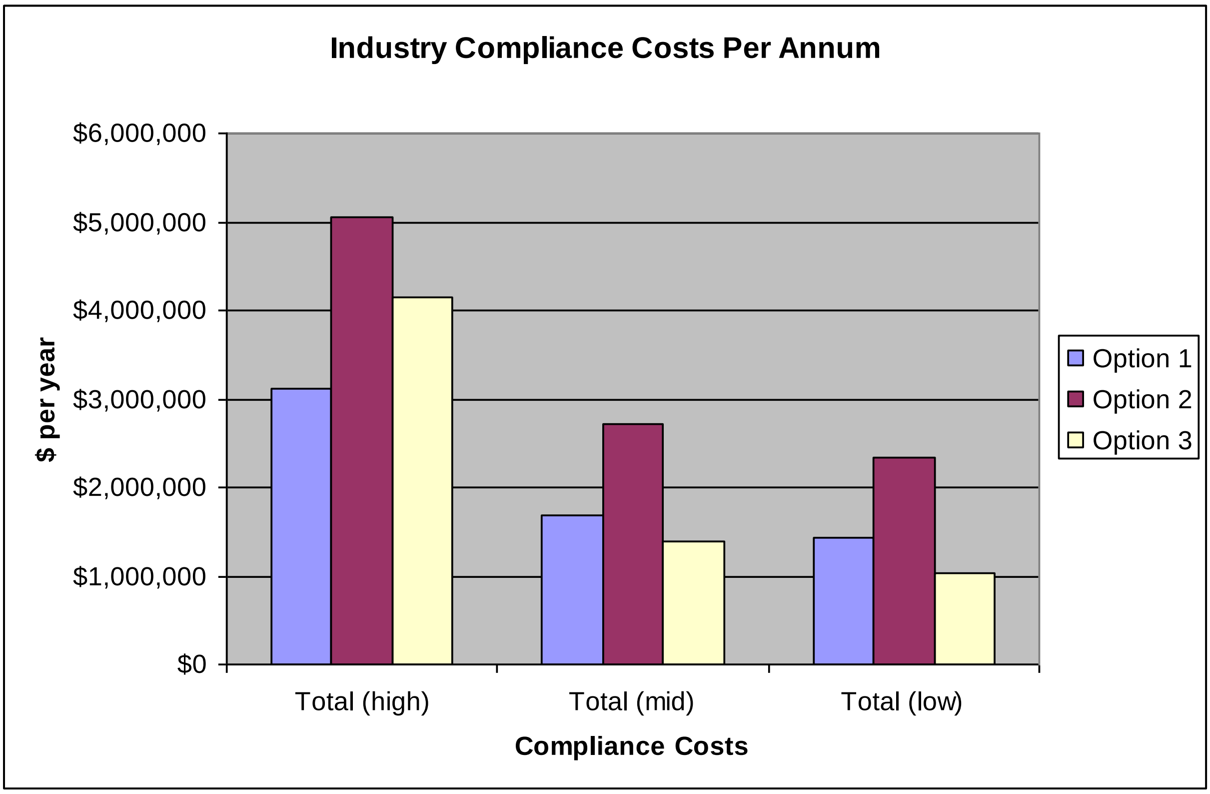
Under a system where the majority of applications are made by a vehicle manufacturer, it is expected that the number of vehicles (trucks or trailers) built per application will be much higher as they are supplied to multiple customers. This is accounted for under option 3 by modeling a high of 20, a medium of ten and a minimum of two vehicles per application. Under the modular approval model each combination vehicle will require two certifications for a combination vehicle, which accounts for certifying the truck separately to the trailer set.

Table H4: Per vehicle approval and certification costs

Option	Vehicles Per Year	Total Cost (high)	Total Cost (mid)	Total Cost (low)	Cost Per Vehicle (high)	Cost Per Vehicle (Mid)	Cost Per Vehicle (Low)
1	$3,120,000	$1,680,000	$1,440,000	$13000	$7000	$6000	$240
2	$5,044,000	$2,716,000	$2,328,000	$13000	$7000	$6000	$388
3	$4,152,000	$1,384,000	$1,038,000	$6000	$2000	$1500	$692

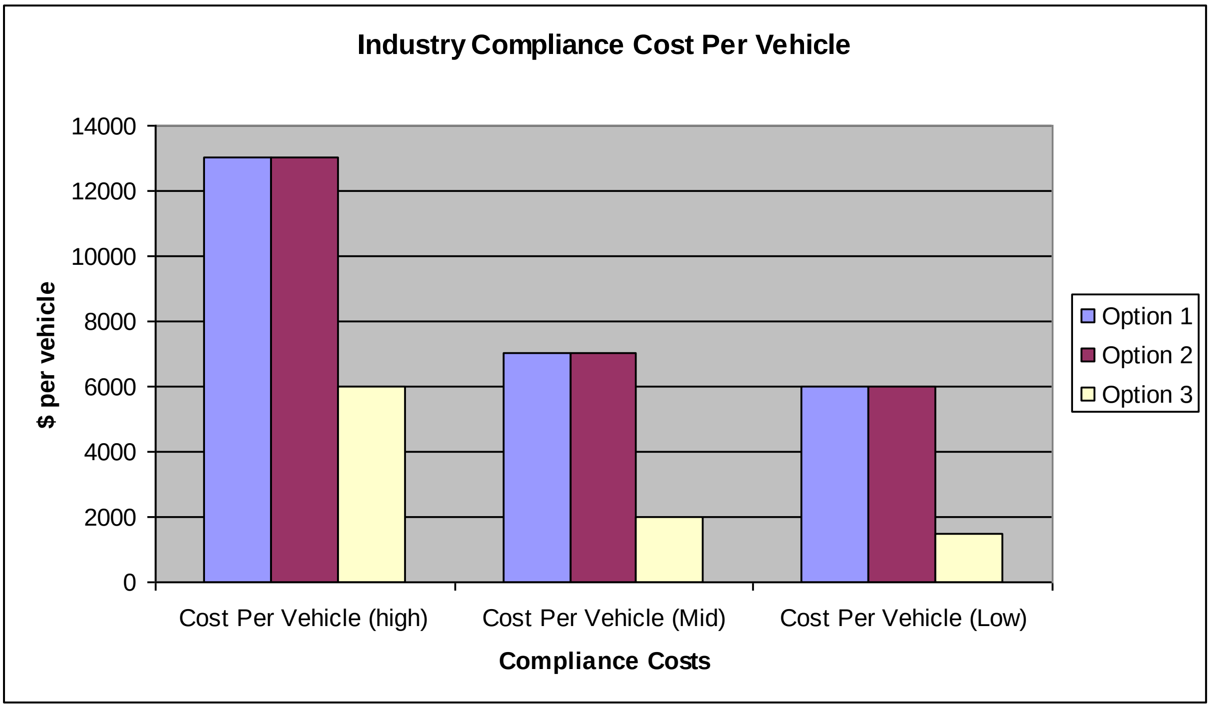
NTC Estimates

Figure H1: Annual Industry Compliance Costs



Source: NTC 2010

Figure H2: Vehicle Compliance Costs



Source: NTC 2010

Additional business costs

Over and above the cash cost of having a vehicle assessed and certified there are additional costs to businesses resulting from the time required to ensure that the assessment is completed, certifications are in order and requesting the appropriate access approvals from state and local council road managers.

The time spent on these activities may vary by a large amount based on the experience of the applicant, the complexity of the vehicle design and the number of access agreements that need to be finalized. As a rough assessment of the time cost, typical activity times were estimated, based on PRP Secretariat feedback, across the three options. The highest cost case for all options is the case where an operator is required to work across states and in many local council areas, (6 states and 20 councils), in addition this case also includes some route assessment activities. The mid case looks at an operator working in two states and four council areas and the lowest cost case is where an operator needs only access from a single state authority. A per hour cost of employee time to conduct these activities was estimated at $50 per hour.

Option 2 is predicted to have possible higher assessment and certification time requirements as an applicant may need to talk to approved assessors and certifiers in multiple states. This is due to assessments and certifications possibly not being acceptable to all states.

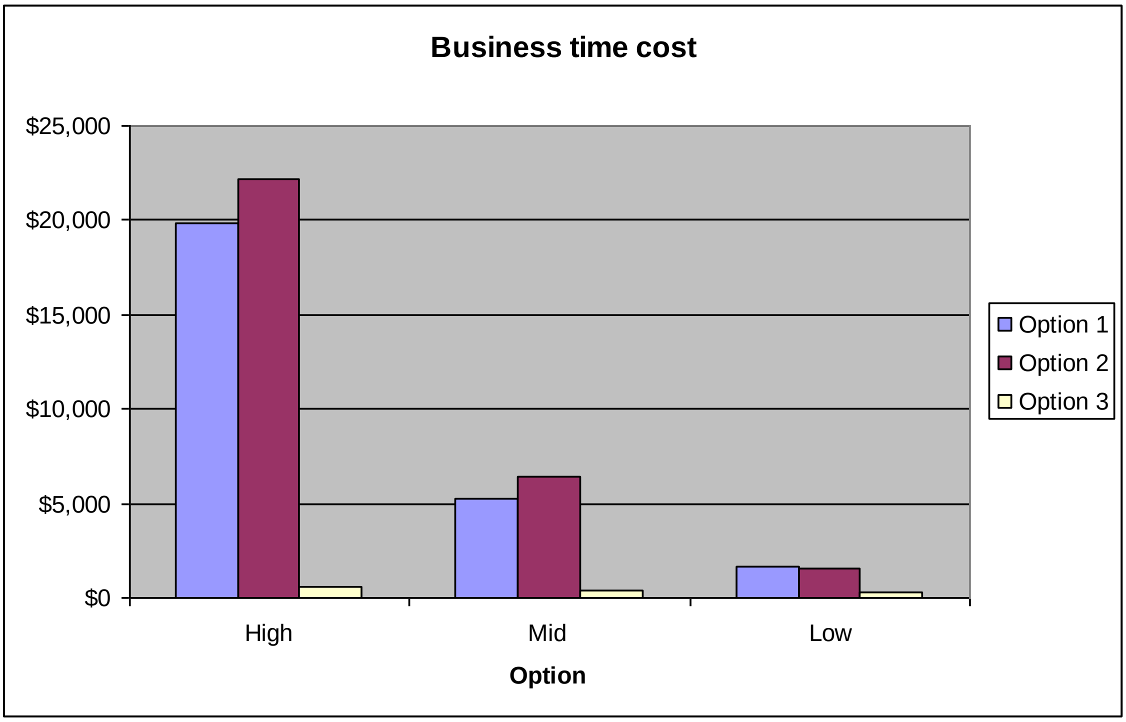
Figures for Option 3 include predictions of the effect of modular assessment and self certification (as explained in part 2 of the draft regulatory impact statement). This has the effect of reducing time spent with an "assessor" as this will likely be completed by the manufacturer of the equipment. Time is allocated however for the additional time that may be required when consulting with a vehicle supplier as to its suitability for PBS applications.

Table H5: Unit Time Costs per Vehicle Approval and Certification

Business time cost elements	**Option 1**			**Option 2**			**Option 3**		
	High	**Mid**	**Low**	**High**	**Mid**	**Low**	**High**	**Mid**	**Low**
Consulting with Assessor	16	16	16	48	32	16	2	2	2
Consulting with Certifier	8	8	8	24	16	8	2	2	2
Consulting with PBS Secretariat	1	1	1	0	0	0	1	1	1
Gaining state jurisdiction approvals for access	52	16	8	52	16	8	6	2	1
Gaining local council approvals for access	320	64	0	320	64	0	0	0	0
Total Hours	397	105	33	444	128	32	11	7	6
$ / Hour	$50	$50	$50	$50	$50	$50	$50	$50	$50
Total Business time cost	**$19,850**	**$5,250**	**$1,650**	**$22,200**	**$6,400**	**$1,600**	**$550**	**$350**	**$300**

NTC Estimates

Figure H3: Sensitivity Analysis for Business Time Costs



The time cost figures relate to a per operator cost for a particular vehicle design. Translating these costs into yearly costs is difficult as an operator may operate for many years without needing to gain additional access approvals, while others may add additional designs and areas of operation to their business on a regular basis.

Administrative costs

Administration of the PBS scheme under the status quo (Option 1) is considered to require no additional resources to what is currently in place. Administration of the scheme is generally carried out on a jurisdictional level by staff who already administer the PBS applications, in addition to any other heavy vehicle permit applications. As each jurisdictions resources and workload in this area are different it is difficult to estimate the exact incremental cost imposed by the PBS scheme. While all states currently assess each PBS application in preparation for PBS review panel voting, some jurisdictions which have a higher number of PBS vehicles operating in their state will incur higher costs through needing to resolve a greater number of access requests. Per year cost estimate have been averaged based on information provided by jurisdictions and estimated below. Staff time cost is estimated at the level of an average market engineer wage.

Table H6: Option 1 Annual Administrative costs

Activity	**Days**	**Number of States**	**Total days**
PBS vehicle application assessment	25	8	200
Processing access requests (high take-up state)	75	3	225
Processing access requests (low take-up state)	20	5	100
Total Days			525
$ / day			$304
Time Cost			$159,600
PRP budget			$260,000
Total Option 1 administrative cost / year			**$419,600**

NTC Estimates

Option 2 could be seen as imposing a higher administrative cost on jurisdictions than any other option, as each jurisdiction would be required to administer a complete system. Costs to run a state based PBS style system have been estimated by jurisdictions as being in the order of $200,000 per annum for a medium sized scheme, which represents one full time senior engineer and adequate administrative resources. States with less applications may be able to reduce this cost as an appropriate engineering resource may be able to be utilised on existing tasks. This reduction has been simply estimated at half of that for a high take up state as the actual time required is unknown.

Table H7: Option 2 Annual Administrative costs

Activity	$/ year / State	Number of States	Total $ / year
State based assessment scheme (high take-up state)	$200,000	3	$600,000
State based assessment scheme (low take-up state)	$100,000	5	$500,000
Total			**$1,100,000**

NTC Estimates

Option 3 utilising the National Heavy Vehicle Regulator is expected to reduce the burden on road authorities by shifting most of the administrative, access negotiation and customer relations tasks to the regulator. Additional savings will be made by having a single point of contact for customers, jurisdictions and local councils. States will still incur the time cost of assessing vehicle applications in order to participate in PBS Review Panel voting.

This option will impose administrative costs on the National Heavy Vehicle Regulator and as such the budgets for staffing should be developed to take this into account when the Regulator is being formed. As the structure and scope of activities of the National Heavy Vehicle Regulator has not yet been considered it is not possible to estimate the incremental costs imposed by the PBS scheme. It is expected that there will be little impact imposed by PBS as the Regulator will be responsible for issuing heavy vehicle permits, and in the absence of the PBS scheme, the large majority of applications would be substituted by other Class 2 and 3 permit applications which may require greater administrative and engineering effort to address. As a rough estimate the current PRP budget has been doubled to allow for the increased scope of work that is expected to be undertaken by the National Heavy Vehicle Regulator in administering the scheme.

Table H8: Option 3 Annual Administrative costs

Activity	Days	Number of States	Total days
PBS vehicle application assessment by states	25	8	200
Total Days			200
$ / day			$304
Time Cost			$60,800
PRP / NHVR budget			$520,000
Total			$580,800

NTC Estimates

Administrative cost comparison

Table H9 presents the administrative costs by Option. From an administration perspective Option 2 at $1.1 million dollars per annum is 160% more expensive than Option 1 and 89% higher than Option 3.

Table H9: Comparison of Administrative Costs by Option

Option	Estimated Administrative Cost
1	$419,600
2	$1,100,000
3	$580,800

NTC Estimates

Total costs

Total costs consist of the administrative, compliance and business time costs, however, as explained in previous sections, it is not appropriate to add the business time costs as annualised costs as these costs are usually start up costs and not incurred annually.

For comparison purposes and to ensure that figures are conservative the costs below utilise the highest cost case for each option.

Table H10: Comparison of Administrative and Compliance Costs by Option

Cost	Option 1	Option 2	Option 3
Compliance cost	$3,120,000	$5,044,000	$4,152,000
Administrative cost	$419,600	$1,100,000	$580,800
Total Costs	**$3,539,600**	**$6,144,000**	**$4,732,800**

NTC Estimates

The discounted administrative and compliance costs over the period 2011 to 2030 are presented in Table H12. Option 2 is the most expensive option at -87.6 million dollars, and Option 1 the cheapest at $50.5 million dollars in Net Present Value terms.

The scale of the administrative and compliance costs are all second decimal place impacts when compared to the benefits analysis.

Table H11: Comparison of Administrative and Compliance Costs by Option

Financial Savings ($) 2011 – 2030 (NPV)	**$1.7400B**	**$1.6700B**	**$5.3700B**
Admin and Compliance ($) 2011 – 2030 (NPV)	**-$0.0505B**	**-$0.0876B**	**-$0.0675B**
Benefit Cost Ratio	**34.45**	**19.07**	**80.15**

Source: Industrial Logistics Institute 2010

In brief all options produce overwhelming results in terms of a benefit cost ratio, however, option 3 in scale terms only delivers a net $5.31 billion net NPV benefit as well as a B/C rati80.

Table H12: Comparison of Discounted Administrative and Compliance Costs by Option

	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	Total NPV
Option1	-3.54	-3.41	-3.28	-3.16	-3.04	-2.93	-2.82	-2.71	-2.61	-2.51	-2.42	-2.33	-2.24	-2.16	-2.08	-2.00	-1.92	-1.85	-1.78	-1.72	**-50.5**
Option2	-6.14	-5.91	-5.69	-5.48	-5.28	-5.08	-4.89	-4.71	-4.53	-4.36	-4.20	-4.04	-3.89	-3.74	-3.60	-3.47	-3.34	-3.21	-3.09	-2.98	**-87.6**
Option3	-4.73	-4.56	-4.39	-4.22	-4.06	-3.91	-3.77	-3.62	-3.49	-3.36	-3.23	-3.11	-3.00	-2.88	-2.78	-2.67	-2.57	-2.48	-2.38	-2.29	**-67.5**

Source: Industrial Logistics Institute based on NTC estimates

APPENDIX 9: ABREVIATIONS

BD   B-double

BT…B-triple

BITRE Bureau of Infrastructure Transport and Regional Economics

AD…A-double

CO_2 Carbon Dioxide

DFD   Department of Finance and Deregulation

ESAC   Economic and Statistical Analysis Canberra

GVM…Gross Vehicle Mass

H&R…Hire and Reward

ILI   Industrial Logistics Institute

I/O…Input-Output

NTC…National Transport Commission

NPV   Nett Present Value

NTC…National Transport Commission

p.a.   Per Annum

SBD   Super B-double

SMVU…Survey of Motor Vehicle Use

PBS   Performance Based Standards

L   Linehaul Operations

R   Regional Operations

U...Urban Operations

2AR…2 Axle Rigid Truck

3AR…3 Axle Rigid Truck

4AR…4 Axle Rigid Truck

2AR + T…2 Axle Rigid Truck plus Trailer

3AR + T…3 Axle Rigid Truck plus Trailer

4AR + T…4 Axle Rigid Truck plus Trailer