Cash for Clunkers

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Reducing Emissions by Early Scrapping of Australian Motor Vehicles

Vehicle Design & Research

Report P184

Prepared by
Michael Paine, B.E (Mech), MIEAust, MSAEAust
Vehicle Design and Research Pty Limited

for

Vehicle Engineering
Engineering and Environment Team
NRMA Limited
151 Clarence St Sydney NSW Australia

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INTRODUCTION

One possible method for controlling overall vehicle emissions is to encourage early scrappage of older vehicle, which are known to generate a disproportionate share of vehicle emissions. One option is for an authority (or company seeking emission "credits") to buy certain older vehicles from their owners. These vehicles are then scrapped in an environmental friendly manner. Several such schemes have been trialed in the USA, where they are known as "cash for clunkers". This term is a little misleading because one of the criteria for selection is that the vehicle can be expected to remain in service for at least three more years.

The NSW Environmental Protection Agency has undertaken a cost-effectiveness analysis of several methods for controlling vehicle emissions (Moore,1994). Based on USA data, vehicle scrappage was the third preference for reducing both hydrocarbon (HC) and Nitrogen Oxide (NOx) emissions. Moore estimated the cost effectiveness of vehicle scrappage to be in the range $4,200 to $14,100 per tonne of HC & NOx removed. The first preferred option was adoption of current USA emission standards for new vehicles in Australia ($500 to $3,200 per tonne) and the second preferred option was adoption of a USA style inspection/maintenance program for in-service vehicles ($2,300 to $6,600 per tonne).

Vehicle Design and Research Pty Limited was engaged by the NRMA to gather data about Australian vehicles and to undertake a cost effectiveness analysis using these data. The aims were:

- to apply the USA method of analysis to the Australian vehicle fleet
- to determine whether any particular groups of vehicles were worth targeting
- to comment of possible methods of implementing a cash-for-clunkers scheme

SOURCES OF DATA

The cost effectiveness equation is based on

1. BP- The "bounty" price for the vehicle
2. TEPV - The actual (or typical) emissions for the vehicle, in grams per kilometre
3. TERV - The emissions for a replacement vehicle, in grams per kilometre
4. ARL - The estimated remaining service life for the vehicle
5. VKTY - The estimated kilometres to be travelled each year, if the vehicle remained in service.

The equation is set out in the Illinois EPA draft report (Illinois 1993):

Cost effectiveness = BP / (ARL*VKTY*(TEPV-TERV))

The methods for determining, or estimating these values are set out below.

Bounty Price

This is the price that an authority could expect to offer to the owner of a target vehicle in order to be successful in buying the vehicle. Where possible, the trade-in value for a vehicle in "fair" condition, as recommended in Glass's Guide, has been used in the analysis. On average, the trade-in value for a pre-1980 vehicle in "good" condition is about twice the fair price (see Table 1) and this could be used as an upper bound for the estimate of cost effectiveness. In some cases, where a model is not listed in the guide the values for more recent models have been used to extrapolate to the older models. Finally a "best guess" has been used for models where no reliable data on pricing are available. As a general rule, and in accordance with Glass's Guide, no vehicle has been valued at under $1,000, on the assumption that it is in running condition and has an average six months registration (one of the selection criteria is that the vehicle should be expected to remain in service for at least three more years).

Table 1 - Ratio of "Good Price" to "Fair Price" for Pre-1980 Vehicles

Year Model	Multiplier
69 or less	2.3
70	2.36
71	2.46
72	2.33
73	2.31
74	2.4
75	2.53
76	2.42
77	2.43
78	2.53
79	1.57
Overall	2.22

It is assumed that the administrative costs for organising the purchase are recovered through the scrap value of the vehicle (this assumption is based on the results of the Illinois study). It has been pointed out in US studies that a major scrappage scheme could increase the value of older vehicles through the unnatural demand it creates. Also it is evident that some very old vehicles appreciate in value.

Vehicle Emission Levels

NSW and Victorian emission test results were combined to obtain estimates of emission levels for popular makes and models of vehicles in the vehicle fleet. The results for the "one bag/cycle1/ADR27" test method, which applied prior to 1986 have been used in order that pre and post 1986 results can be compared.

The NSW and Victorian test data used different nomenclature and, particularly different model abbreviations. These were substantially resolved using Open Access 4 database programming language so that a combined database was available for analysis.

The test results cover a range of different types of tests, including new vehicles, in-service vehicles and some retesting. In the absence of better data on emissions from "old" in-service vehicles, it was decided to use the mean emission values for each year within each model of vehicle. For some vehicle models very good sample sizes were available for a given year-model whereas many models had one or no tests for a given year. The main analysis therefore concentrates on vehicle model/years with five of more tests. A problem was that this criterion (five or more tests for a given year) eliminated all of the pre-74 vehicles and therefore further analysis was performed on this group, with the precaution that the emission estimates are less reliable.

No allowance has been made for in-service deterioration of vehicles. Reliable data on Australian vehicles is not available (Munro, 1992). The effect of this assumption is that the cost effectiveness estimates can be expected to be conservative - the actual benefits should be higher than those predicted from tests of relatively new vehicles.

The NSW and Victorian tests measured tailpipe HC emissions. Older cars tend to have other sources of HC emissions such as diurnal and hot soak emissions. By convention, these are converted to g/km equivalents and are added the tailpipe HCs. The values derived by the Victorian EPA (Carnovale 1991) are:

Table 2 - Estimates of Non-exhaust HC g/km

Vehicle Age Group	Equivalent g/km
pre 70	4.53
70 to 75	1.97
76	1.5
77 to 85	1.04
Post 85	0.33

Replacement Vehicle

The Illinois study followed up the owners of many of the purchased vehicles to determine the model and year of the replacement vehicle. The average year model of the scrapped vehicles was 1976 and the average year model for the replacement vehicles was 1984. 15 of the 104 respondents had purchased new vehicles and 6 had purchased vehicles older than the scrapped vehicle.

For the purpose of an analysis of the *overall* effects of a vehicle scrappage scheme, the actual replacement vehicles are not important. If it is assumed that the overall vehicle population remains unchanged then the early scrappage of old vehicles will ultimately be balanced by a increase in purchase of new vehicles. In other words, the analysis should be on the basis that the "replacement" vehicle is a new vehicle. For the current analysis it has been assumed that the replacement vehicle is an average 1989 vehicle - the last year for which an adequate number of emission test results were available.

Estimated remaining life of vehicle

The Illinois study estimated that the average remaining life of the purchased vehicles was 2.1 years. The planning for the Illinois study (and several other US studies) was on the basis that all vehicles older than ten years would have a remaining life of three years. This assumption has been used in the current analysis.

Estimated annual vehicle kilometres travelled

In 1992 the NRMA arranged for the Australian Bureau of Statistics to perform some further processing of the periodic vehicle usage surveys. Key results for this (unpublished) work are set out in table 3. These values have been used in the current analysis.

Table 3- Vehicle Usage Survey 1991 Results for Cars		
Year Model	**Av. km/year**	**% of fleet**
Pre 70	7200	4
70	9400	2
71	8000	2
72	8900	2
73	10300	2
74	9600	3
75	10500	3
76	10100	4
77	11600	3
78	12300	4
79	12700	5
80	12800	5
81	13900	5
82	12900	6
83	14400	5
84	14400	6
85	14900	7
86	16900	5
87	18700	5
88	21000	6
89	20400	7
90	21300	7
91	21000	2
Total	14600	100

Results

It is important to note that the analysis is based on the number of vehicles tested rather than the number of vehicles in the vehicle population. For example, the mean of HCs emitted for vehicles manufactured in a particular year is based on the sum of HC emissions measured during tests (in g/km) divided by the number of vehicles tested. Further information about vehicle models is being sought so that the consequences of this approach can be determined. An analysis of the sample sizes for each model of vehicle indicates that the proportions tested should be reasonably representative of the overall vehicle population (Appendix D).

The analysis covers several methods by which groups of vehicles could be targeted for inclusion in the scheme (purchase for scrappage). These methods are:

- Year of manufacture
- Make, model and year of manufacture
- Year of manufacture and engine capacity
- Year of manufacture and body type (commercial or passenger)

Further analyses, to look at the effects of screening using an emission test are contained in the next section.

Year of manufacture

Appendix A sets out the details of the analysis by year model. Table 4 sets out the key results.

Table 4 - Results by Year of Manufacture

Year	No. Tested	Tot HC + NOx g/km	Bounty $	Cost Effec. $/tn
Pre 70	38	10.78	1200	5423
70	9	7.19	1200	8881
71	16	8.11	1200	7634
72	12	8.48	1200	6495
73	20	7.3	1100	6202
74	85	7.54	1300	7548
75	136	7.3	1200	6637
76	497	4.96	1700	16502
77	591	4.36	1700	17447
78	478	4.46	1600	14952
79	524	4.47	1900	17137
80	357	4.58	1900	16384
81	469	4.43	2200	18383
82	498	4.3	2400	22633
83	489	4.16	2500	22258
84	575	3.95	3000	29056
85	467	3.64	3800	40871
86	505	1.88	4900	-

Note the small sample sizes for 1970, 71 & 72.

As expected, the cost effectiveness improves (the cost-effectiveness per tonne of HC & NOx removed decreases) with increased age of vehicles. 1976 and 1986 appear to be important years for reductions in total HC and NOx emissions. If year of manufacture is used as a selection criterion then, on the basis of this analysis, it would be appropriate to target pre-1976 vehicles.

Make and Model

Appendix B sets out the results of a cost-effectiveness analysis by make, model and year of manufacture (the latter was necessary due to the changes in emission standards from year to year). The first table only lists makes and models for which there were at least 5 emission test results available- the cost benefit cut-off point for this table was $20,000. The second table lists all makes and models with a cost-effectiveness under $5,000, irrespective of the number of emission tests conducted. As stated earlier, the second table is a less reliable indicator of the cost effectiveness for a given model.

Table 5 - "Top ten" car models for cost-effectiveness
See Appendix B for further details & models

Make, Model & Year	No. Tested	Tot HC + NOx g/km	Bounty $	Cost Effec. $/tn
Models with 5 or more tests				
Ford Falcon 75	13	8.47	1100	5054
Ford Cortina 74	6	7.67	1000	5683
Ford Cortina 75	34	6.88	1000	5967
Toyota Corolla 75	9	7.39	1150	6262
Chrysler Galant 75	9	6.33	1000	6655
Ford Falcon 74	5	7.28	1100	6677
Holden Kingswood 75	8	8.04	1400	6859
Holden Torana 74	8	8.28	1400	7234
Holden Torana 75	15	7.63	1400	7322
Chrysler Valiant 75	13	7.13	1300	7409
All models, irrespective of number of tests				
Chrysler Valiant 68	1	20.19	1100	2460
Ford Falcon 66	1	12.01	1000	3987
Chrysler Valiant 73	1	9.92	1100	4258
Ford Falcon 65	1	11.21	1000	4318
Mazda R100 71	1	11.54	1100	4593
Holden Torana 72	3	10.44	1100	4639
Chrysler Valiant 63	1	12.84	1300	4802
Volvo 145 74	1	11.59	1400	4847
Leyland Mini 74	1	9.88	1200	5008
Volvo 164 72	1	9.41	1050	5010

Many of the pre-1970 models have total emissions (HC + NOx) around 10 grams per kilometre. Assuming that the bounty price for these vehicles is the $1,000 used as a minimum for vehicles in working order then it appears that there is little to be gained by selecting pre-1970 vehicles on the basis of make and model. The cost effectiveness for this group is estimated to be between $5,400 and $10,800 (see Table 4 - the upper bound is based on a "good" price twice the fair price).

Selection by Engine Size

Table 6 summarises an analysis of cost-effectiveness by engine size for year models 1970 to 1975. There do not appear to be any useful trends with results by engine size.

Table 6 - Cost-effectiveness by Engine Size $/t of HC+NOx (Mean cost-effectiveness for all models within group)						
Engine size	**70**	**71**	**72**	**73**	**74**	**75**
Under 1500	-	6567	-	8234	8431	8395
1500-1999	10412	8926	7561	7236	7821	9044
2000-2499	-	9739	-	-	-	8457
2500-2999	8316	6676	-	5940	9622	8012
3000-3499	-	-	5753	6292	7069	-
3500-3999	-	-	-	-	-	9128
4000-4499	-	-	-	7456	9988	11254

Body type (Commercial van Vs Passenger vehicle)

The 1991 ABS survey indicated that light commercial vehicles travel slightly different annual kilometres than passenger cars. For example the average kilometres for a 1973 passenger cars was 10,300 compared with 14,400 for light commercial vehicles. In contrast 1970 passenger cars travelled, on average 9,400 kilometres per year whereas light commercial vehicles travelled 7,400. The EPA test results included some light commercial vehicles. The cost-effectiveness calculations included in Appendix B were based on ABS passenger car VKT. Table 7 summarises these models and includes an adjustment for the annual vehicle kilometres.

Table 7 - Commercial Vehicles See Appendix B for further details & models						
Make, Model & Year	**No. Tested**	**Tot HC + NOx g/km**	**Bounty $**	**Cost Effec. $/tn**	**VKT factor**	**Revised Cost Eff $/tn**
Models with 5 or more tests						
Nissan 720 Dual Cab 81	5	5.37	1000	6294	1	6294
Nissan Urvan 81	13	4.97	1200	8439	1	8439
Toyota Hiace 79	9	5.36	1500	10361	1.2	8634
Ford Econovan 82	7	4.69	1500	12383	1	12383
Ford Econovan 84	7	3.93	1500	14651	1.4	10465

The results suggest that light commercial vehicles emit more pollutants per year than passenger cars of the same year. Due to small sample sizes, it was not possible to conduct the analysis on older light commercial vehicles. It is expected that the cost-effectiveness of this group would compare favourably with passenger cars of the same year, due to higher emissions and lower bounty prices. Generally commercial vehicles have a lower "fair" price than cars of the same year model although "good" trade-in prices can be substantially higher (for example a 1981 Nissan 720 in "good" condition might attract $4,000).

Screening vehicles for scrappage

In order to improve the cost effectiveness of the program consideration could be given to conducting emissions tests of the target vehicles. One of the difficulties with this approach is the lack of a reliable, simple test to detect gross polluters. A full "ADR27" test can take more than a day for vehicle preparation and testing and costs in excess of $1,000 per test. Clearly such tests could not be used for screening - the cost of the test is more than a typical bounty price for the target vehicles. A Federal Government-funded project recently commenced to determine if a simple, cheap emission test, with the vehicle under load, can be developed. Such a test would correlate with on-road emissions and allow the measurement of NOx as well as HC (NOx is only produced when the engine is under load). Idle testing, which is often advocated for emissions screening, is not a good discriminator of high polluting vehicles and cannot be used to measure NOx.

Appendix C contains an analysis of the distribution of total emissions (HC + NOx) for 36 models of vehicles (with 40 or more tests per model). If a normal distribution is assumed then the analysis indicates that 85% of the tested vehicles were within one-third of the mean for the model. It could be expected that 7.5% would have total emissions more than 1.33 times the mean for the group. Only 13 out of the 2,206 vehicles in the analysis exceeded twice the mean for the respective group.

As a hypothetical exercise, assume that we decide to select for scrappage only vehicles which exceed the mean for their group by more than one third. We could expect that about 7.5% of the vehicles subjected to an emission test would meet this criterion - that is, one in thirteen tests.

If a screening test costing $10 was available (this is not unrealistic, given improved testing technology and systems available in the USA), it would cost $10x13= $130 to conduct all of the tests in order to find, on average, one vehicle meeting the criterion. This vehicle would typically exceed the mean emissions for the group by about 50% so the cost effectiveness, not including the cost of testing, is improved by about 50%. For a group with a cost effectiveness of $6,000/ tonne of HC+NOx, screening would improve the cost effectiveness to about $4,000/tonne, due to the higher total emissions of the screened vehicles. If the cost of screening tests, at $10 per test, is added to this figure then the net cost effectiveness would be $4,130/tonne of HC+NOx removed.

The effects of deterioration in service could be expected to improve these figures but reliable data about deterioration are not available.

Conclusion

Subject to uncertainty about in-service deterioration of vehicles and bounty prices which will attract vehicle owners, the results of this analysis are in general agreement with those derived from USA data, in the EPA-NSW report "Cost Effectiveness of Motor Vehicle Emission Controls". In that report vehicle scrappage is the third best option for controlling combined HC and NOx emissions, with a cost-effectiveness in the range $4,200 to $14,100 per tonne of HC & NOx removed.

Selection of groups of vehicles can improve the cost effectiveness. Table 8 summarises the most promising options. The high estimate is based on the average trade-in price for vehicles in "good" condition.

Table 8 - Summary of Scrappage Options			
Selection Method	**Comment**	**Low Est $/t**	**High Est $/t**
Pre-1976 vehicles subjected to a screening test. Only gross polluters selected for scrappage.	Based on the assumption that an emissions test costing $10 becomes available and, on average, 13 vehicles must be tested to detect one gross polluter	$4500	$8800
Vehicles manufactured prior to 1970	Diverse range of vehicles and years of manufacture. Probably large difference in annual VKT	$5400	$10800
Vehicles manufactured prior to 1976	Big improvement in emissions from 1976	$6500	$13000
Selected vehicle models prior to 1976	Sample sizes are too small for drawing conclusions for most models	$6000	$12000

Selection of commercial vehicles might prove worthwhile but there are insufficient data to draw any conclusions about this class of vehicle.

Current emission tests are much too expensive to be used for screening vehicles to be scrapped. The best option listed above is based on the assumption that a suitable low cost emissions test becomes available.

Safety Spin-offs

In addition to removing pollutants, a vehicle scrappage scheme would have safety benefits. The mid 1970's saw the introduction of several important safety features on motor vehicles, including inertia reel seat belts. Vaughan (1992) estimated that if the total annual kilometres driven by pre-1975 cars in 1988 had been halved and the kilometres driven instead in new vehicles, then there would have been a 6% reduction in occupant fatalities (all other factors being equal). In terms of a cash-for-clunkers scheme, this is equivalent to one life saved for every 7,000 pre-1975 vehicles scrapped. In addition, approximately 13 serious injuries would be saved for every 7,000 vehicles scrapped (based on the ratio of fatalities to serious injuries for car occupants in NSW in 1993).

Concern about the safety of older vehicles was also raised at the Road Safety 2000 conference held by the NSW Road Safety Bureau in 1994. Griffiths (1994) describes work by the RACV which indicates that the probability of severe injury in a pre-1974 vehicle is about twice that for a post-1989 vehicle.

Implementation Issues

The Illinois Study provides useful information for developing a cash-for-clunkers scheme in Australia. Table 9 sets out the steps which could be taken to implement a scheme.

Table 9 - Implementation in Australia		
Item	**Description**	**Comment**
1	Refine selection criteria, based on latest available data.	Monitor results of current Federal emissions study. Monitor development of cheap & simple emission testing.
2	Refine bounty estimates and prepare a budget for the scheme	Surveys of potential participants. Pilot program.
3	Prepare systems, paperwork and PR material	
4	Select vehicle owners from registration records. Send letters inviting participation.	Selection criteria will probably be based on information available on registration records.
5	Assess vehicles (e.g. expected three year life) and offer bounty to owners	A method of setting the bounty needs to be established. Should it be set for a particular group of vehicles or determined on an individual basis?
6	Purchase suitable vehicles.	Some could be tested for monitoring purposes. Compare results with predictions.
7	Scrap vehicles & monitor disposal	Ensure that disposal does not cause more environmental damage than the vehicle remaining in service.
8	Review program	Follow-up participants.

Recommendations

Several of the assumptions made in this report will affect the cost-effectiveness estimates for a cash-for-clunkers scheme in Australia. The main areas of uncertainty are:

- Bounty prices which will be attractive to vehicle owners
- In-service deterioration (the average age, at the time of testing, of vehicles in the 1970 to 1975 year model range was 4 years - these vehicles are now over 20 years old)
- Lack of data about commercial vehicles such as small vans

The NSW and Victorian EPAs are currently conducting emission tests on about 600 in-service vehicles.. It is anticipated that these tests will include a reasonable sample of older vehicles and the results could therefore be used to revise the estimates contained in this report.

It would be appropriate to conduct a small pilot of a cash-for-clunkers scheme to further improve the accuracy of the estimates. In particular, the level of bounty which attracts suitable vehicles to the program, compared with the "fair" or "good" trade in values, needs to be established. Consideration should be given to the inclusion of a pilot cash-for-clunkers scheme in the NSW/Victorian survey. For example, owners of older, gross polluting vehicles participating in the survey could be offered a bounty for their vehicle.

It recommended that elements of a cash-for-clunkers scheme be incorporated in the current emission testing program being conducted by the NSW and Victorian EPAs so that the estimates of cost-effectiveness for such a scheme can be improved and public reaction evaluated.

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Appendix A

Results by Year of Manufacture

SUMMARY OF SCRAPPAGE ANALYSIS BY YEAR

Sorted by Year

MAKE, MODEL & YEAR	No. Tested	Av. Age	Est. VKT /yr/veh	Remain Life Yrs	Cycle 1 Emis. Exh g/km HC	NOX	CO	Rep Veh Yr	Non Exh HC	# Tot HC+NOX g/km	Total Emissions Saved g/veh (vehicle life) HC	NOX	CO	Bounty Price	Cost Effect. $/tonne
ALL.69 or less	38	12	8000	3	3.96	2.29	39.98	89	4.53	10.78	186480	34800	831120	$1200	$5423
ALL.70	9	7	8000	3	2.80	2.42	32.33	89	1.97	7.19	97200	37920	647520	$1200	$8881
ALL.71	16	6	8000	3	4.51	1.63	49.60	89	1.97	8.11	138240	18960	1062000	$1200	$7634
ALL.72	12	6	8900	3	4.27	2.24	51.94	89	1.97	8.48	147384	37380	1243953	$1200	$6495
ALL.73	20	4	10300	3	3.09	2.24	37.84	89	1.97	7.30	134106	43260	1003941	$1100	$6202
ALL.74	85	3	9600	3	3.18	2.39	31.30	89	1.97	7.54	127584	44640	747360	$1300	$7548
ALL.75	136	3	10500	3	2.75	2.58	28.74	89	1.97	7.30	126000	54810	736785	$1200	$6637
ALL.76	497	1	10100	3	1.88	1.58	21.72	89	1.50	4.96	80598	22422	496011	$1700	$16502
ALL.77	591	1	11600	3	1.85	1.47	19.52	89	1.04	4.36	75516	21924	493116	$1700	$17447
ALL.78	478	1	12300	3	1.81	1.61	20.13	89	1.04	4.46	78597	28413	545382	$1600	$14952
ALL.79	524	1	12700	3	1.91	1.52	21.62	89	1.04	4.47	84963	25908	619887	$1900	$17137
ALL.80	357	1	12800	3	1.96	1.58	21.32	89	1.04	4.58	87552	28416	613248	$1900	$16384
ALL.81	469	1	13900	3	1.85	1.54	20.54	89	1.04	4.43	90489	29190	633423	$2200	$18383
ALL.82	498	0	12900	3	1.67	1.59	16.50	89	1.04	4.30	77013	29025	431505	$2400	$22633
ALL.83	489	0	14400	3	1.62	1.50	15.83	89	1.04	4.16	83808	28512	452736	$2500	$22258
ALL.84	575	0	14400	3	1.52	1.39	13.95	89	1.04	3.95	79488	23760	371520	$3000	$29056
ALL.85	467	0	14900	3	1.34	1.26	13.60	89	1.04	3.64	74202	18774	368775	$3800	$40871
ALL.86	505	1	16900	3	0.55	1.00	8.45	89	0.33	1.88	8112	8112	157170	$4900	$302022
ALL.87	535	0	18700	3	0.50	0.82	6.93	89	0.33	1.65	6171	-1122	88638	$5800	$1148742
ALL.88	399	0	21000	4	0.46	0.83	6.07	89	0.33	1.62	5880	-840	60480	$6300	$1250000
ALL.89	191	0	20400	5	0.42	0.89	5.80	89	0.33	1.64	3060	5100	45900	$6700	$821078
ALL.90	62	0	21300	6	0.42	1.09	7.16	89	0.33	1.84	3834	31950	231318	$7200	$201207

Notes:1.HC for subject vehicle is for exhaust only & is derived from SPCC & VEPA tests
2.HC for replacement vehicle includes non-exhaust emissions (default 1989 average)
3."NON_EX_HC" is the estimated HC non-exhaust sources (g/km) (based on VEPA data)
4.Bounty price is based on trade-in value for a vehicle in fair condition
5.Cost effectiveness is (BOUNTY PRICE)/(tonnes of HC & NOX saved)

Appendix B

Results by Make and Model

The first table shows results for models with at least five tests, up to a cost-effectiveness of $30,000 per tonne of HC+NOx removed. The average of these tests should be reasonably representative of model.

The second table shows the results for all models, irrespective of the number of tests conducted, up to a cost-effectiveness of $10,000 per tonne of HC+NOx removed. In many cases only one test was conducted therefore these results might not be representative of the model.

SUMMARY OF SCRAPPAGE ANALYSIS BY MODEL & YEAR

Sorted by cost effectiveness - Models with 5 or more test results

MAKE, MODEL & YEAR	No. Tested	Av. Age	Est. VKT /yr/veh	Remain Life Yrs	Cycle 1 Emis. Exh g/km HC	Cycle 1 Emis. g/km NOX	Cycle 1 Emis. g/km CO	Rep Veh Yr	Non Exh HC	Tot HC+NOX g/km	Total Emissions Saved g/veh (vehicle life) HC	NOX	CO	Bounty Price	Cost Effect. $/tonne
FORD.FAL.75	13	2	10500	3	3.42	3.08	39.11	89	1.97	8.47	147105	70560	1063440	$1100	$5054
FORD.COR.74	6	3	9600	3	3.07	2.63	36.13	89	1.97	7.67	124416	51552	886464	$1000	$5683
FORD.COR.75	34	3	10500	3	2.81	2.10	36.15	89	1.97	6.88	127890	39690	970200	$1000	$5967
TOYOTA.CLA.75	9	3	10500	3	2.77	2.65	18.31	89	1.97	7.39	126630	57015	408240	$1150	$6262
NISSAN.DUA.81	5	1	13900	3	2.47	1.86	18.26	89	1.04	5.37	116343	42534	538347	$1000	$6294
CHRYS.GAL.75	9	2	10500	3	1.51	2.85	15.45	89	1.97	6.33	86940	63315	318150	$1000	$6655
FORD.FAL.74	5	3	9600	3	2.71	2.60	31.89	89	1.97	7.28	114048	50688	764352	$1100	$6677
HOLDEN.KIN.75	8	2	10500	3	2.96	3.11	26.04	89	1.97	8.04	132615	71505	651735	$1400	$6859
HOLDEN.TOR.74	8	5	9600	3	4.12	2.19	42.78	89	1.97	8.28	154656	38880	1077984	$1400	$7234
HOLDEN.TOR.75	15	2	10500	3	2.61	3.05	22.89	89	1.97	7.63	121590	69615	552510	$1400	$7322
CHRYS.VAL.75	13	3	10500	3	2.03	3.13	25.32	89	1.97	7.13	103320	72135	629055	$1300	$7409
TOYOTA.CLA.74	7	4	9600	3	2.26	2.49	19.26	89	1.97	6.72	101088	47520	400608	$1150	$7738
FORD.COR.76	12	2	10100	3	2.04	1.97	26.19	89	1.50	5.51	85446	34239	631452	$1000	$8355
NISSAN.URV.81	13	1	13900	3	1.73	2.20	19.92	89	1.04	4.97	85485	56712	607569	$1200	$8439
FORD.F10.82	5	2	12900	3	2.63	2.45	32.78	89	1.04	6.12	114165	62307	1061541	$1500	$8500
DATSUN.120.74	8	3	9600	3	1.89	2.48	11.37	89	1.97	6.34	90432	47232	173376	$1250	$9080
FORD.ECO.80	7	3	12800	3	2.88	1.93	42.96	89	1.04	5.85	122880	41856	1444224	$1500	$9105
CHRYS.GAL.76	27	2	10100	3	1.57	2.09	14.10	89	1.50	5.16	71205	37875	265125	$1000	$9168
CHRYS.CEN.76	7	1	10100	3	3.24	1.07	38.31	89	1.50	5.81	121806	6969	998688	$1200	$9319
FORD.COR.78	66	1	12300	3	1.68	1.94	19.04	89	1.04	4.66	73800	40590	505161	$1100	$9616
FORD.ESC.79	9	1	12700	3	2.33	1.90	22.76	89	1.04	5.27	100965	40386	663321	$1400	$9904
DATSUN.180.74	6	3	9600	3	2.89	1.74	22.75	89	1.97	6.60	119232	25920	501120	$1500	$10334
TOYOTA.HIA.79	9	2	12700	3	1.63	2.69	15.18	89	1.04	5.36	74295	70485	374523	$1500	$10361
FORD.COR.77	18	2	11600	3	2.10	1.47	25.87	89	1.04	4.61	84216	21924	714096	$1100	$10364
MAZDA.929.76	7	1	10100	3	1.87	1.61	22.24	89	1.50	4.98	80295	23331	511767	$1100	$10615
RNAULT.R12.76	7	1	10100	3	1.79	1.37	20.49	89	1.50	4.66	77871	16059	458742	$1000	$10646
MAZDA.808.78	8	1	12300	3	3.12	1.20	36.26	89	1.04	5.36	126936	13284	1140579	$1500?	$10697
CHRYS.SIG.79	12	1	12700	3	2.01	2.27	23.30	89	1.04	5.32	88773	54483	683895	$1550	$10820
FORD.ESC.76	6	2	10100	3	2.05	1.55	23.77	89	1.50	5.10	85749	21513	558126	$1200	$11188
MAZDA.808.76	5	1	10100	3	2.03	1.57	16.81	89	1.50	5.10	85143	22119	347238	$1200	$11188
CHRYS.LAN.76	6	0	10100	3	1.44	1.54	10.34	89	1.50	4.48	67266	21210	151197	$1000	$11303
TOYOTA.CRN.76	9	0	10100	3	1.95	1.31	23.55	89	1.50	4.76	82719	14241	551460	$1100	$11345
TOYOTA.CLA.78	92	1	12300	3	1.78	1.60	18.94	89	1.04	4.42	77490	28044	501471	$1200	$11371
CHRYS.VAL.80	5	1	12800	3	2.35	1.65	28.55	89	1.04	5.04	102528	31104	890880	$1550	$11599

Notes:1.HC for subject vehicle is for exhaust only & is derived from SPCC & VEPA tests
2.HC for replacement vehicle includes non-exhaust emissions (default 1989 average)
3."NON_EX_HC" is the estimated HC non-exhaust sources (g/km) (based on VEPA data)
4.Bounty price is based on trade-in value for a vehicle in fair condition
X-extrapolated from 79-86 prices, ?-Best guess, otherwise based on Glass"s Guide
5.Cost effectiveness is (BOUNTY PRICE)/(tonnes of HC & NOX saved)

Sorted by cost effectiveness - Models with 5 or more test results

MAKE, MODEL & YEAR	No. Tested	Av. Age	Est. VKT /yr/veh	Remain Life Yrs	Cycle 1 Emis. Exh HC g/km	Cycle 1 Emis. NOX g/km	Cycle 1 Emis. CO g/km	Rep Veh Yr	Non Exh HC	Tot HC+NOX g/km	Total Emissions Saved g/veh (vehicle life) HC	NOX	CO	Bounty Price	Cost Effect. $/tonne
SUBARU.160.77	5	2	11600	3	1.82	1.27	16.77	89	1.04	4.13	74472	14964	397416	$1050	$11740
NISSAN.200.81	5	1	13900	3	1.64	2.14	13.46	89	1.04	4.82	81732	54210	338187	$1600	$11770
TOYOTA.CLA.77	32	2	11600	3	1.77	1.75	15.34	89	1.04	4.56	72732	31668	347652	$1237X	$11849
FORD.ESC.78	5	1	12300	3	1.70	1.79	21.17	89	1.04	4.53	74538	35055	583758	$1300	$11862
CHRYS.SIG.80	16	1	12800	3	2.22	1.69	26.84	89	1.04	4.95	97536	32640	825216	$1550	$11907
TOYOTA.CLA.76	8	1	10100	3	2.04	1.29	18.14	89	1.50	4.83	85446	13635	387537	$1200	$12111
FORD.FMT.76	9	1	10100	3	2.63	1.62	24.23	89	1.50	5.75	103323	23634	572064	$1550	$12209
MITSU.SIG.80	6	2	12800	3	2.56	1.58	41.50	89	1.04	5.18	110592	28416	1388160	$1700	$12230
FORD.COR.79	25	1	12700	3	1.76	1.94	20.47	89	1.04	4.74	79248	41910	576072	$1500	$12381
FORD.ECO.82	7	1	12900	3	1.75	1.90	25.60	89	1.04	4.69	80109	41022	783675	$1500	$12383
FORD.COR.81	9	1	13900	3	1.87	1.74	19.21	89	1.04	4.65	91323	37530	577962	$1600	$12417
CHRYS.VAL.78	5	1	12300	3	2.17	1.60	20.00	89	1.04	4.81	91881	28044	540585	$1500	$12508
FORD.FAL.76	20	2	10100	3	2.07	1.93	23.61	89	1.50	5.50	86355	33027	553278	$1500	$12565
CHRYS.SIG.77	6	0	11600	3	1.82	1.62	23.34	89	1.04	4.48	74472	27144	626052	$1300	$12793
CHRYS.SIG.78	10	1	12300	3	1.79	1.88	26.00	89	1.04	4.71	77859	38376	761985	$1500	$12905
FORD.SCT.76	52	0	10100	3	1.55	1.66	24.49	89	1.50	4.71	70599	24846	579942	$1238X	$12971
TOYOTA.CNA.77	8	1	11600	3	1.43	2.19	16.04	89	1.04	4.66	60900	46980	372012	$1400	$12977
NISSAN.STA.81	32	1	13900	3	2.24	1.23	25.78	89	1.04	4.51	106752	16263	851931	$1600	$13007
HOLDEN.SUN.79	8	0	12700	3	2.16	1.35	21.97	89	1.04	4.55	94488	19431	633222	$1500	$13167
NISSAN.200.78	9	1	12300	3	1.57	1.99	15.53	89	1.04	4.60	69741	42435	375642	$1500	$13372
DATSUN.260.76	7	0	10100	3	1.86	1.65	22.29	89	1.50	5.01	79992	24543	513282	$1400	$13393
NISSAN.STA.80	13	2	12800	3	2.33	1.30	26.07	89	1.04	4.67	101760	17664	795648	$1600	$13398
HOLDEN.KIN.76	75	1	10100	3	1.93	1.57	19.03	89	1.50	5.00	82113	22119	414504	$1400	$13432
DATSUN.200.80	14	1	12800	3	2.11	1.51	18.82	89	1.04	4.66	93312	25728	517248	$1600	$13441
NISSAN.STA.82	7	2	12900	3	1.99	1.60	19.36	89	1.04	4.63	89397	29412	542187	$1600	$13467
FORD.FAI.77	5	1	11600	3	2.67	1.67	24.94	89	1.04	5.38	104052	28884	681732	$1800	$13540
HOLDEN.SUN.78	11	1	12300	3	2.03	1.09	24.77	89	1.04	4.16	86715	9225	716598	$1300	$13550
HOLDEN.SUN.77	18	2	11600	3	2.17	1.10	30.83	89	1.04	4.31	86652	9048	886704	$1300	$13584
SUBARU.160.76	5	3	10100	3	1.35	1.26	10.09	89	1.50	4.11	64539	12726	143622	$1050	$13590
FORD.FAL.77	69	1	11600	3	1.91	1.78	19.21	89	1.04	4.73	77604	32712	482328	$1500	$13597
FORD.FAL.78	56	1	12300	3	1.98	1.52	24.60	89	1.04	4.54	84870	25092	710325	$1500	$13641
NISSAN.200.77	7	1	11600	3	2.07	1.56	31.40	89	1.04	4.67	83172	25056	906540	$1500	$13860
NISSAN.200.79	33	1	12700	3	1.99	1.55	21.68	89	1.04	4.58	88011	27051	622173	$1600	$13906
TOYOTA.CLA.79	50	2	12700	3	1.60	1.56	18.13	89	1.04	4.20	73152	27432	486918	$1400	$13919

Notes:
1. HC for subject vehicle is for exhaust only & is derived from SPCC & VEPA tests
2. HC for replacement vehicle includes non-exhaust emissions (default 1989 average)
3. "NON_EX_HC" is the estimated HC non-exhaust sources (g/km) (based on VEPA data)
4. Bounty price is based on trade-in value for a vehicle in fair condition
   X-extrapolated from 79-86 prices, ?-Best guess, otherwise based on Glass"s Guide
5. Cost effectiveness is (BOUNTY PRICE)/(tonnes of HC & NOX saved)

Sorted by cost effectiveness - Models with 5 or more test results

MAKE, MODEL & YEAR	No. Tested	Av. Age	Est. VKT /yr/veh	Remain Life Yrs	Cycle 1 Emis. Exh HC	g/km NOX	CO	Rep Veh Yr	Non Exh HC	Tot HC+NOX g/km	Total Emissions Saved g/veh (vehicle life) HC	NOX	CO	Bounty Price	Cost Effect. $/tonne
CHRYS.VAL.79	48	0	12700	3	2.08	1.26	24.43	89	1.04	4.38	91440	16002	726948	$1500	$13961
DATSUN.180.76	7	0	10100	3	1.99	1.81	14.90	89	1.50	5.30	83931	29391	289365	$1600	$14119
MAZDA.808.77	15	1	11600	3	1.78	1.16	22.79	89	1.04	3.98	73080	11136	606912	$1200	$14249
NISSAN.200.80	44	1	12800	3	1.67	1.77	19.14	89	1.04	4.48	76416	35712	529536	$1600	$14269
HOLDEN.GEM.81	49	1	13900	3	1.70	1.67	17.74	89	1.04	4.41	84234	34611	516663	$1700	$14304
HOLDEN.GEM.76	19	1	10100	3	1.69	1.53	17.94	89	1.50	4.72	74841	20907	381477	$1400	$14622
FORD.ECO.84	7	0	14400	3	1.44	1.45	16.81	89	1.04	3.93	76032	26352	495072	$1500	$14651
TOYOTA.CNA.78	5	0	12300	3	1.62	1.47	19.70	89	1.04	4.13	71586	23247	529515	$1400	$14763
FORD.SCT.80	15	1	12800	3	1.67	1.48	27.69	89	1.04	4.19	76416	24576	857856	$1500	$14853
NISSAN.BLU.82	49	2	12900	3	1.60	2.38	17.09	89	1.04	5.02	74304	59598	454338	$2000	$14936
HONDA.CIV.76	5	0	10100	3	1.24	1.14	18.15	89	1.50	3.88	61206	9090	387840	$1050	$14937
FORD.COR.80	7	1	12800	3	1.76	1.37	22.28	89	1.04	4.17	79872	20352	650112	$1500	$14966
DATSUN.VNE.83	7	0	14400	3	1.41	1.41	12.79	89	1.04	3.86	74736	24624	321408	$1500	$15097
SUBARU.4WD.82	12	1	12900	3	2.20	1.72	13.38	89	1.04	4.96	97524	34056	310761	$2000	$15200
MITSU.SIG.83	48	0	14400	3	1.60	1.63	12.75	89	1.04	4.27	82944	34128	319680	$1800	$15375
NISSAN.BLU.83	26	1	14400	3	1.69	1.84	19.35	89	1.04	4.57	86832	43200	604800	$2000	$15381
FORD.FAI.81	5	1	13900	3	1.12	4.07	5.67	89	1.04	6.23	60048	134691	13344	$3000	$15405
HOLDEN.GEM.77	18	1	11600	3	1.40	1.67	12.30	89	1.04	4.11	59856	28884	241860	$1400	$15776
MITSU.SIG.81	16	0	13900	3	1.58	1.50	14.54	89	1.04	4.12	79230	27522	383223	$1700	$15925
MAZDA.323.77	5	0	11600	3	1.60	1.23	12.27	89	1.04	3.87	66816	13572	240816	$1281X	$15935
HOLDEN.TOR.76	49	1	10100	3	1.83	1.12	20.78	89	1.50	4.45	79083	8484	467529	$1400	$15988
SUBARU.4WD.83	5	1	14400	3	1.98	1.58	13.55	89	1.04	4.60	99360	31968	354240	$2100	$15990
DATSUN.STA.81	10	1	13900	3	1.93	1.35	18.38	89	1.04	4.32	93825	21267	543351	$1850	$16074
HOLDEN.CAM.83	15	1	14400	3	1.69	1.41	13.98	89	1.04	4.14	86832	24624	372816	$1800	$16150
TOYOTA.CLA.80	12	1	12800	3	1.83	1.85	18.51	89	1.04	4.72	82560	38784	505344	$2000	$16482
HOLDEN.GEM.80	51	1	12800	3	1.60	1.60	15.37	89	1.04	4.24	73728	29184	384768	$1700	$16519
MITSU.SIG.82	36	1	12900	3	1.65	1.52	15.30	89	1.04	4.21	76239	26316	385065	$1700	$16576
TOYOTA.CRN.77	11	0	11600	3	1.67	1.10	18.84	89	1.04	3.81	69252	9048	469452	$1300	$16603
DATSUN.180.77	6	3	11600	3	1.75	1.53	18.74	89	1.04	4.32	72036	24012	465972	$1600	$16658
DATSUN.120.76	8	1	10100	3	1.49	1.54	9.95	89	1.50	4.53	68781	21210	139380	$1500	$16668
CHRYS.GAL.77	28	1	11600	3	0.93	1.65	12.33	89	1.04	3.62	43500	28188	242904	$1200	$16739
NISSAN.BLU.81	15	0	13900	3	1.51	1.84	13.89	89	1.04	4.39	76311	41700	356118	$2000	$16948
TOYOTA.CLA.83	35	1	14400	3	1.72	1.52	13.38	89	1.04	4.28	88128	29376	346896	$2000	$17021
HOLDEN.GEM.83	33	1	14400	3	1.47	1.74	11.08	89	1.04	4.25	77328	38880	247536	$2000	$17211

Notes:1.HC for subject vehicle is for exhaust only & is derived from SPCC & VEPA tests
2.HC for replacement vehicle includes non-exhaust emissions (default 1989 average)
3."NON_EX_HC" is the estimated HC non-exhaust sources (g/km) (based on VEPA data)
4.Bounty price is based on trade-in value for a vehicle in fair condition
X-extrapolated from 79-86 prices, ?-Best guess, otherwise based on Glass"s Guide
5.Cost effectiveness is (BOUNTY PRICE)/(tonnes of HC & NOX saved)

Sorted by cost effectiveness - Models with 5 or more test results

MAKE, MODEL & YEAR	No. Tested	Av. Age	Est. VKT /yr/veh	Remain Life Yrs	Cycle 1 Emis. Exh HC g/km	NOX	CO	Rep Veh Yr	Non Exh HC	# Tot HC+NOX g/km	Total Emissions Saved g/veh (vehicle life) HC	NOX	CO	Bounty Price	Cost Effect. $/tonne
HOLDEN.GEM.82	24	1	12900	3	1.48	1.58	12.76	89	1.04	4.10	69660	28638	286767	$1700	$17294
MITSU.CLT.83	14	0	14400	3	1.20	1.59	10.17	89	1.04	3.83	65664	32400	208224	$1700	$17336
NISSAN.180.77	17	2	11600	3	1.72	1.45	19.79	89	1.04	4.21	70992	21228	502512	$1600	$17350
MITSU.CLT.84	15	0	14400	3	1.22	1.68	10.88	89	1.04	3.94	66528	36288	238896	$1800	$17507
DATSUN.200.78	8	0	12300	3	1.63	1.36	16.35	89	1.04	4.03	71955	19188	405900	$1600	$17555
CHRYS.VAL.77	23	1	11600	3	1.64	1.32	25.71	89	1.04	4.00	68208	16704	708528	$1500	$17665
HOLDEN.PMR.76	6	0	10100	3	1.69	1.73	9.63	89	1.50	4.92	74841	26967	129684	$1800	$17680
DATSUN.PUL.82	5	0	12900	3	1.25	1.46	11.40	89	1.04	3.75	60759	23994	234135	$1500	$17698
TOYOTA.L/C.78	6	3	12300	3	3.42	5.12	21.18	89	1.04	9.58	138006	157932	584127	$5300	$17909
CHRYS.VAL.76	26	1	10100	3	1.37	1.42	20.95	89	1.50	4.29	65145	17574	472680	$1500	$18134
HOLDEN.CAM.82	35	0	12900	3	1.61	1.47	15.06	89	1.04	4.12	74691	24381	375777	$1800	$18169
HOLDEN.GEM.79	62	1	12700	3	1.38	1.58	13.69	89	1.04	4.00	64770	28194	317754	$1700	$18287
HOLDEN.HOL.80	11	2	12800	3	2.34	1.30	14.44	89	1.04	4.68	102144	17664	349056	$2200	$18363
MITSU.SIG.84	35	1	14400	3	1.64	1.65	11.76	89	1.04	4.33	84672	34992	276912	$2200	$18385
TOYOTA.CLA.84	33	2	14400	3	1.80	1.36	13.34	89	1.04	4.20	91584	22464	345168	$2100	$18413
DATSUN.BLU.81	13	0	13900	3	1.58	1.54	15.28	89	1.04	4.16	79230	29190	414081	$2000	$18447
FORD.FAR.77	12	0	11600	3	2.51	1.11	23.00	89	1.04	4.66	98484	9396	614220	$2000	$18539
HOLDEN.CAM.84	31	0	14400	3	1.55	1.34	13.67	89	1.04	3.93	80784	21600	359424	$1900	$18558
VOLKSW.KBI.76	12	1	10100	3	2.24	1.37	45.65	89	1.50	5.11	91506	16059	1221090	$2000?	$18593
HOLDEN.KIN.77	74	1	11600	3	1.66	1.33	17.64	89	1.04	4.03	68904	17052	427692	$1600	$18614
HONDA.CIV.77	6	0	11600	3	1.31	0.89	13.88	89	1.04	3.24	56724	1740	296844	$1100	$18815
FORD.FMT.77	15	0	11600	3	2.18	1.39	19.76	89	1.04	4.61	87000	19140	501468	$2000	$18843
HOLDEN.GEM.78	33	0	12300	3	1.41	1.39	14.86	89	1.04	3.84	63837	20295	350919	$1600	$19018
FORD.LAS.83	19	1	14400	3	1.36	1.60	18.92	89	1.04	4.00	72576	32832	586224	$2050	$19448
HOLDEN.KIN.79	94	1	12700	3	2.15	1.33	22.98	89	1.04	4.52	94107	18669	671703	$2200	$19508
DATSUN.BLU.82	17	0	12900	3	1.50	1.65	12.83	89	1.04	4.19	70434	31347	289476	$2000	$19650
HOLDEN.TOR.79	11	1	12700	3	1.76	1.03	21.42	89	1.04	3.83	79248	7239	612267	$1700	$19656
FORD.MET.83	25	0	14400	3	1.36	1.75	12.66	89	1.04	4.15	72576	39312	315792	$2200	$19663
DATSUN.PUL.83	6	0	14400	3	1.20	1.54	11.08	89	1.04	3.78	65664	30240	247536	$1900	$19811
TOYOTA.CLA.81	68	1	13900	3	1.45	1.49	15.89	89	1.04	3.98	73809	27105	439518	$2000	$19819
DATSUN.STA.79	10	1	12700	3	1.75	1.14	17.29	89	1.04	3.93	78867	11430	454914	$1800	$19934
HOLDEN.KIN.78	45	1	12300	3	1.74	1.49	18.94	89	1.04	4.27	76014	23985	501471	$2000	$20000

Notes:1.HC for subject vehicle is for exhaust only & is derived from SPCC & VEPA tests
2.HC for replacement vehicle includes non-exhaust emissions (default 1989 average)
3."NON_EX_HC" is the estimated HC non-exhaust sources (g/km) (based on VEPA data)
4.Bounty price is based on trade-in value for a vehicle in fair condition
X-extrapolated from 79-86 prices, ?-Best guess, otherwise based on Glass"s Guide
5.Cost effectiveness is (BOUNTY PRICE)/(tonnes of HC & NOX saved)

Appendix C

Distribution of Total Emissions (HC+NOx) for Popular Vehicle Models

Results for vehicle models with at least 40 tests have been analysed to determine the distribution of emissions and the likely results of screening tests. Overall the standard distribution was found to be about one third of the mean for a given model. In other words, if a normal distribution is assumed, then 85% of the tests could be expected to be within plus or minus one third of the mean for the vehicle model and 7.5% could be expected to exceed the mean by more than one third. If screening tests selected all vehicles which exceed the mean of their model by more than one third then the mean emissions *of this group* would be approximately 50% higher than the overall mean for the model.

Only 13 vehicles out of the 2,206 tested exceeded the mean of their model by more the twice.

Appendix D

Comparison of Number of Vehicles Tested with Numbers of Vehicles on the Register

In association with other work the NRMA obtains and processes information about vehicles on the NSW Register (Roads and Traffic Authority's DRIVES system). One of the processing tasks is to determine the frequency of each make and model of vehicle by year of manufacture. As the DRIVES data does not have reliable model information fo rolder vehicles this is achieved by using algorithms based on engine and chassis/VIN numbers. Prior to 1977 this algorithm is not very effective and many vehicles are counted as "unknown" model. This makes analysis of test sample sizes very approximate. Given these reservations, for following graphs compare dominant models of vehicles for the years of manufacture 1976 to 1969. The graphs show, for each model, the number of tests, as a percentage of all tests of vehicles manufactured in that year, and the number on the register, as a percentage of all vehicles manufactured in that year on the registered. The two percentages are therefore directly comparable and will give an indication of whether the emission tests give a reasonable indication of overall results for the year, based on numbers of vehicles on the register. Some comments about the results are set out below.

No tests sample sizes are shown for "Unknown" models but they are included in the graphs because they tend to balance specific models which have been tested but the registration data algorithm did not find them. An example in 1976 is the Volvo 245 - they comprised 1% of tests of 1976 vehicles but no Volvo 245s were found using the algorithm. However, registration records indicated 1% of 1976 vehicles were Volvos of unknown models.

"Mitsu.Unknown" can also cover "Chrysler" vehicles.

1975 - Ford Cortinas are over-represented. The emission levels of the Ford Cortina were, however, typical for the year of manufacture and the results should still be representative of the year.

1974 - Holden Kingswood and Toyota Corolla were over-represented. Both are typical for the year.

1973 - Leyland Marina, Holden Kingswood/Belmont and Ford Cortina over-represented. All are typical for the year.

1972 - Holden Torana and Ford Falcon over-represented. The Toranas had higher than average emission level and this could affect the overall result for the year (see Table 4)

Test sample sizes for 1973 and earlier were relatively small (see Table 4).