INFORMATION TO SUPPORT THE UPTAKE OF CLEANER VEHICLES IN NSW

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for

NSW ENVIRONMENT PROTECTION AUTHORITY

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Contents

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Introduction

As part of a NSW Government initiative to encourage the purchase of cleaner motor vehicles, the EPA proposes to categorise light vehicles (cars, light trucks and four-wheel-drives) into several levels of environmental performance. In order to develop the proposed categories a range of environmental and market information is needed about current vehicles on the Australian market.

The purpose of the consultancy was to provide information about environmental emissions, fuel consumption, selling price and sales quantities for at least 95% of the NSW/Australian market volume for light vehicles. Information was also sought about low emission vehicles that are available overseas and which have potential for sales in NSW. Issues associated with the feasibility of an environmental assessment were also investigated. These included:

- fuel quality issues
- matching Australian and overseas models
- compliance of matched Australian models with more stringent overseas standards
- appropriate weighting for different types of emissions

Sources of data

Five main sources of data have been used for the project:

1. The fuel consumption database maintained by the Australian Green House Office (AGO)
2. Make and Model statistics from the NSW Roads and Traffic Authority (RTA) "Drives" vehicle registration records.
3. Vehicle model information (prices, vehicle categories) available from the VFACTS subscription service.
4. The environmental performance database for UK vehicles maintained by the UK Vehicle Certifications Authority
5. The environmental performance database maintained by the US EPA

When matched with Australian models, the latter two databases provide an indication of the possible compliance of the equivalent Australian models with more stringent overseas standards. A major difficulty, however, is confirming that the Australian specifications are the same as those of the overseas model. For a very small number of Australian-marketed models the local distributor has claimed, in brochures, that the vehicle complies with stricter US or European standards. For the other vehicles it may be difficult to obtain a statement from the manufacturers.

Although, in theory, the above sources provided all of the information necessary for the project several difficulties were encountered with using the data, as described below.

The main difficulty is the lack of a common system for identifying models. In each case a substantial amount of manual reconciliation was needed to match records to the AGO database.

AGO Fuel Consumption database

This is an electronic version of the booklet "Fuel Consumption Guide", published by AGO. For each unique combination of make, model, body style, engine size and transmission type the database lists the city and highway fuel consumption, in litres per 100km, based on AS2877 tests. It is understood that the data is provided to AGO by vehicle manufacturers, on a voluntary basis.

AGO provided the electronic data on the basis that, at this stage, it would only be used for research purposes and that details of individual models results would not be released to the public. It will be necessary to approach AGO to seek formal permission to include the data in a public document.

Some inconsistencies and errors with current model information were found in a few cases. For several dozen models the database did not include fuel consumption for the highway cycle. In these cases the "average" fuel consumption was based on the city cycle results. In all other cases the "average" was based on equal weighting of the city and highway results.

A further difficulty is that the electronic database did not include vehicle classification (small car, medium car etc).

NSW Drives registration data

Numerous inconsistencies and errors were found with model coding. Several codes appeared to refer to the same model. Records needed to be reconciled before they could be applied in the analysis. It was found that the Drives records did not reliably discriminate model changes. For example, if a model changes mid-way through the year then it is not easy to determine whether a particular vehicle from that year is a new or old model.

A further difficulty is the lack of variant information for most Drives models (a "variant" is the same model but may have a different body style, such as hatch or sedan, or a different engine). Several AGO records are likely to refer to the same Drives records but there is no indication of the proportion that should be assigned to each variant. It was therefore decided to distribute the Drives quantities evenly between all matched AGO records. For example, if the Drives records indicated there were 300 Ford Festivas on the register but there were 3 variants of Festiva on the AGO database then a total of 100 was assigned to each variant in the AGO database.

Finally the Drives database contains thousands of "models" with less than 20 vehicles on the register for any one year. These records were discarded to simplify data processing.

For the purpose of this project the Drives data should be regarded as indicative only. If the market share of each model stays roughly the same over the next two years then the "snapshot" of 2000/2001 vehicles obtained from

Drives should give a reasonable indication of the composition of the fleet by the end of 2002.

VFACTS

VFACTS provides price and options information about each model sold on the Australian market. It also provides year to date sales data for each make, but only has monthly sales data for models. It may be possible to use year-to-date values from VFACTS for estimating models numbers, instead of the DRIVES data used in this report.

Price and vehicle classification information were derived from VFACTS and assigned to the AGO database. Prices for some variants were not available so the price for the closest variant was used.

UK VCA database

This can be downloaded in Excel format from the VCA website. It contains fuel consumption and Euro emissions standard for many models sold in the UK. A considerable amount of manual reconciliation was needed to match it to AGO records. The results of the matching exercise are set out later in this report. Key information from the VCA database is set out in Appendix A. In brief, out of 2148 models listed, 12% comply with the stringent Euro IV standards and 74% comply with either Euro III or Euro IV.

US EPA database

The US EPA database is similar to the UK VCA database. It can be downloaded in Excel format from the US EPA website. The rating for emissions standards is based on the system used by the California Air Resources Board. Key information from the US EPA database is set out in Appendix B. In brief, of the 1010 models listed by US EPA, 0.3% were Zero Emissions Vehicles (ZEV - electric cars), 0.7% were Super Ultra Low Emissions Vehicles (SLEV or SULEV), 3.5% were Ultra Low Emissions Vehicles (ULEV), 41.8% were Low Emissions Vehicles (LEV), 9.2% were Transitional Low Emission Vehicles (TLEV) and 44.2% complied with the Federal Tier 1 emissions levels.

Surprisingly, the Honda Insight hybrid vehicle was listed as an ULEV rather than an SULEV in the US EPA database and the Toyota Prius did not appear at all. Further research revealed that both vehicles are now available in California and are listed by the California Air Resources Board (CARB) as SULEVs, as is the Honda Accord, Honda Civic (CNG only) and Nissan Sentra. Further details about low emission vehicles are provided later in this report.

Other sources of information

Further information about environmental performance of vehicles was sought from CARB, American Council for an Energy Efficient Economy (ACEEE), Nutech, NRMA Technical Library, manufacturer's brochures and manufacturer's websites.

Comparison of Emissions Standards

The US and European emissions standards are conducted using different test cycles, test fuels and procedures. Subject to caution about these differences, it is necessary to compare these standards with those of ADR37/01, which applies to Australian vehicles. Each of the standards sets limits to the tailpipe emissions of Carbon Monoxide (CO), Non-methane hydrocarbons (HC) and Nitrous Oxides (NOx), expressed in grams per kilometre.

Table 1 Comparison of emissions standards (petrol passenger cars)

All limits in g/km

REGION	STD	FUEL	VEHICLES	HC	NOx	CO
AU	ADR27A	PETROL	MA,MB,MC	2.1	1.9	24.2
AU	ADR37	PETROL	MA,MB,MC	0.93	1.93	9.3
AU	ADR37/01MC	PETROL	MC,NA	0.5	1.4	6.2
AU	ADR37/01MA	PETROL	MA,MB	0.26	0.63	2.1
EU	EURO2	PETROL	MA,MB	0.2	0.22	2.2
US	TIER1	PETROL	MA,MB	0.15	0.25	2.1
EU	EURO3	PETROL	MA,MB	0.2	0.15	2.3
US	TLEV	PETROL	MA,MB	0.075	0.25	2.1
US	TIER2	PETROL	MA,MB	0.08	0.12	1
EU	EURO4	PETROL	MA,MB	0.1	0.08	1
US	LEV	PETROL	MA,MB	0.045	0.125	2.1
US	ULEV	PETROL	MA,MB	0.0225	0.125	1.05
US	SULEV	PETROL	MA,MB	0.006	0.0125	0.63

Notes:

ADR27A was superseded by ADR 37 but is included here for comparison purposes. ADR37/01 sets less stringent limits for four-wheel-drive vehicles, as indicated by the row ADR37/01 MC.

Test cycles and procedures vary between standards so this comparision is indicative only.

For the purpose of comparing the standards, it is necessary to assign a weight to each pollutant. This is because the health impacts of CO are much less than those of HC and NOx. A methodology for weighting pollutants was developed for the Green Car Guide project (Paine 2000). This, in turn, was based on health impacts set out in the Federal RIS "New Australian Design Rules for Control of Vehicle Emissions". In brief, the relative weights assigned were: HC=190 : NOx=180 : CO=2. These weights have been applied to the limits in the above table and normalised to give a value of 1 to the ADR37/01 score.

The results are set out in Table 2 and Figure 1. Also shown are proposed breakpoints for rating vehicles, based on this analysis.

Table 2 - Weighted Scores for Emissions

STD	WEIGHTED SCORE	PROPOSED	
		GROUP	CATEGORY
ADR27A	4.727	POOR	D
ADR37	3.250	POOR	D
ADR37/01MC	2.152	POOR	D
ADR37/01MA	1.000	BASIC	C
EURO2	0.491	MODERATE	B
TIER1	0.465	MODERATE	B
EURO3	0.417	MODERATE	B
TLEV	0.380	MODERATE	B
TIER2	0.232	GOOD	A
EURO4	0.212	GOOD	A
LEV	0.211	GOOD	A
ULEV	0.173	GOOD	A
SULEV	0.028	GOOD*	A

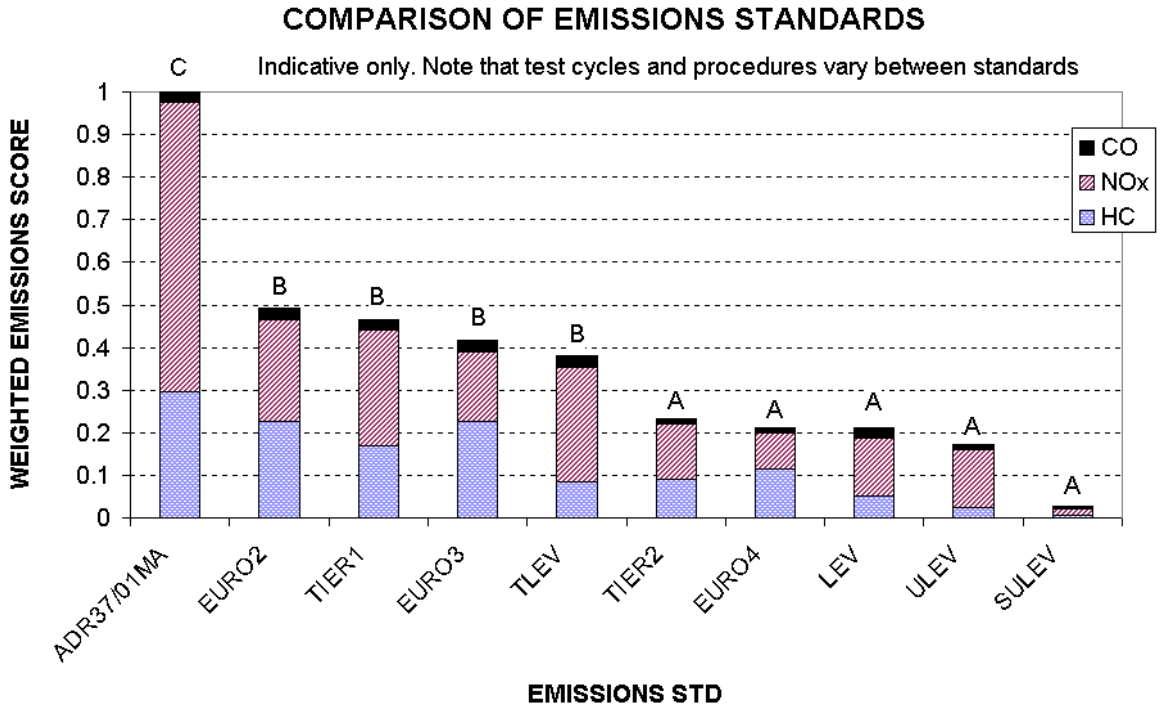

Figure 1 - Comparison of Emissions Standards (ADR 37 and better)

These differ from groupings suggested in the project brief. For example, the CARB LEV is significantly better than Euro 3 and should be in the good category. There does not appear to be much between Euro 2, Euro 3 and US Tier 1 and it is proposed they be assigned the "moderate" category.

In a tentative analysis associated with this project, the NSW RTA applied the results of a Federal Government "Comparative Vehicle Emissions Study" to the above values. The Federal study indicated that the Euro 2, Euro 3 and Euro 4 test procedures are more stringent than the US procedures and it might be appropriate to review the ranking when the final performance criteria are being developed.

The SULEV is so much better than the others that consideration should be given to assigning it an "Excellent" category (perhaps with ZEVs). However, the following analysis assumes that SULEVs receive a "good" rating.

Analysis of Australian Vehicles

Emissions Standards

After matching of AGO, VCA and US EPA models it was possible to estimate the number of Australian models that *might* comply with the more stringent overseas emission standards. This is based on the somewhat optimistic assumption that these models could be made available in Australia and that appropriate fuels would be available.

Table 3- Application of VCA and US EPA Data to Australian Models

	BEST POSSIBLE EMISSIONS STANDARD										
MAKE	**ADR 37**	**ADR 37MC**	**II**	**III**	**IV**	**LEV**	**SLEV**	**T1**	**TLEV**	**ULEV**	Total number of *models*
Alfa Romeo			1	9							10
Audi	3			2	6	17			5		33
Bentley								5			5
BMW	4			22		8			1		35
Citroen	5		1	5							11
Daewoo		2		1					12		15
Daihatsu				6							6
Daimler				1							1
Ferrari	2					2		1			5
Ford	56	45	2	5		3			1		112
Holden	27	10		4	17						58
Honda		1		5		18	1	5	5	4	39
Hyundai	4			2		10			4		20
Jaguar				8		5					13
Jeep						5					5
Kia	8	2	6	6		4					26
Land Rover				4							4
Lexus				3	1	2					6
Lotus			1								1
Mazda	4	3	4	11		1		1		6	30
Mercedes Benz	5		3	26		16		1			51
MG			2								2

	BEST POSSIBLE EMISSIONS STANDARD										
MAKE	**ADR 37**	**ADR 37MC**	**II**	**III**	**IV**	**LEV**	**SLEV**	**T1**	**TLEV**	**ULEV**	Total number of *models*
Mitsubishi	32	38				5					75
Nissan	10		4			1			1		16
Peugeot	2		7	16							25
Proton			9	4							13
Rolls-Royce	2							1			3
Saab						14					14
Subaru				5		26					31
Suzuki	4	2		12		8					26
Toyota	8	4				20	1		4	7	44
Volkswagen		7		2	9	16					34
Volvo				8		36					44
Grand Total	**176**	**114**	**40**	**167**	**33**	**217**	**2**	**14**	**33**	**17**	**813**
	21.6%	14.0%	4.9%	20.5%	4.1%	26.7%	0.2%	1.7%	4.1%	2.1%	

Appendix C contains a similar analysis for estimated number of vehicles and also a breakdown by vehicle type.

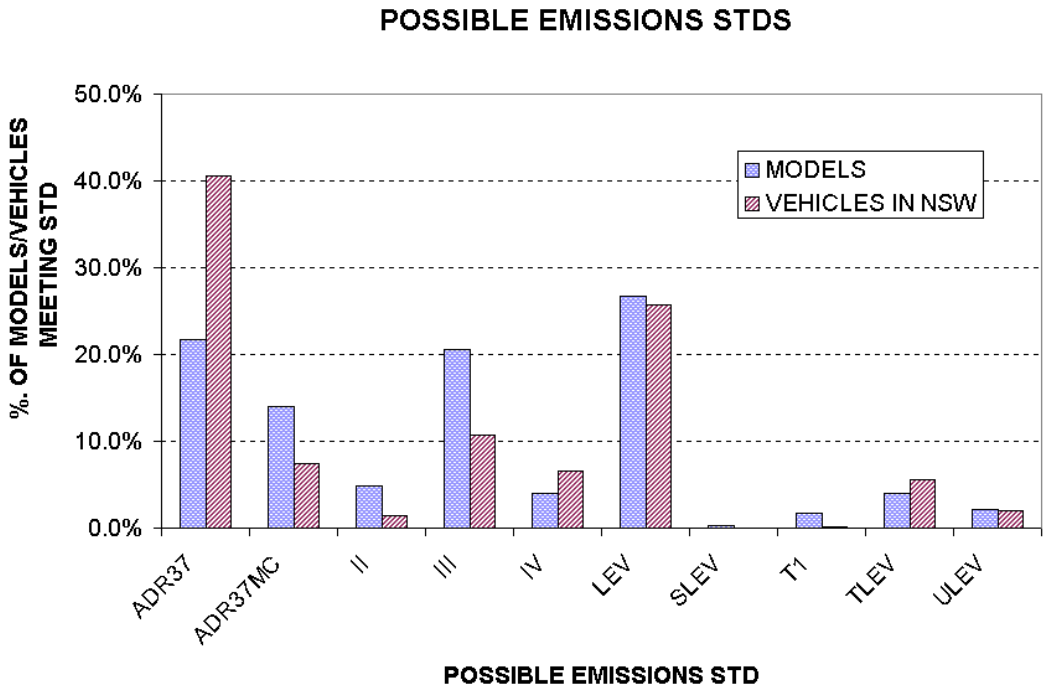

Figure 2 - *Possible* application of Overseas Standards to Australian Models

Based on these estimates about two-thirds of the models listed in the AGO database have overseas versions that comply with stricter overseas standards, and therefore would be rated as "moderate" or "good" under the proposed rating system. One third would receive a "good" rating - mostly due to the large number of matched models meeting US LEV requirements.

Based on Appendix C, about half of vehicles on the NSW register (year models 2000 and 2001) have overseas versions that comply with stricter emissions standards and one third would receive a "good" rating - again mostly due to LEV models in the USA.

Fuel Efficiency

Note that the project brief indicated that fuel efficiency should be expressed in terms of either kg of fuel per 100km or grams of CO_2 per km. The conversions from litres per 100km have not been performed at this stage but this will not affect the results since only petrol vehicles have been analysed. One litre of petrol produces 2260 grams of CO_2 (Paine 2000) therefore to convert Fuel Consumption (FC) in litres per 100km to grams of CO2 per km:

CO2 = 2260xFC/100

Other conversion factors apply to different fuels such as diesel and LPG.

Considerable effort went into matching Drives model information with the AGO data. This was done to ensure that the analysis took into account the estimated number of each model on the register in NSW. Only vehicles recorded as being built in 2000 or 2001 were included in the analysis. A total of 325045 vehicle were matched with AGO records. Average fuel consumption for each model was obtained from the city and highway consumption (or city only, in the few cases where a highway value was not available). This average was multiplied by the number of vehicles on the register to give a weighted average fuel consumption for the fleet. This was found to be 9.20 l/100km. This was close to the unweighted average of 9.41 l/100km and suggests that analysis based on models rather than numbers of vehicles would be adequate for most purposes.

The distribution of fuel consumption for the models listed in the AGO database was analysed to determine possible breakpoints for the proposed rating system.

Based on this distribution, a possible rating system might be:

Table 4 - Tentative Fuel Consumption Breakpoints

Fuel Consumption l/100km	Group	Category	Cumulative %
<=6.0	GOOD	A	2%
> 6.0, <=7.5	MODERATE	B	15%
>7.5, <=9.0	BASIC	C	57%
> 9.0	POOR	D	100%

As is evident in the following graph, the proportions are quite sensitive to the breakpoints due to the steepness of the cumulative distribution curve.

Note that in this analysis equal weighting was applied to city and highway fuel consumption. It may be appropriate to weight the values based on vehicle usage surveys (that is, greater weight would apply to the city cycle). This would affect the choice of breakpoints.

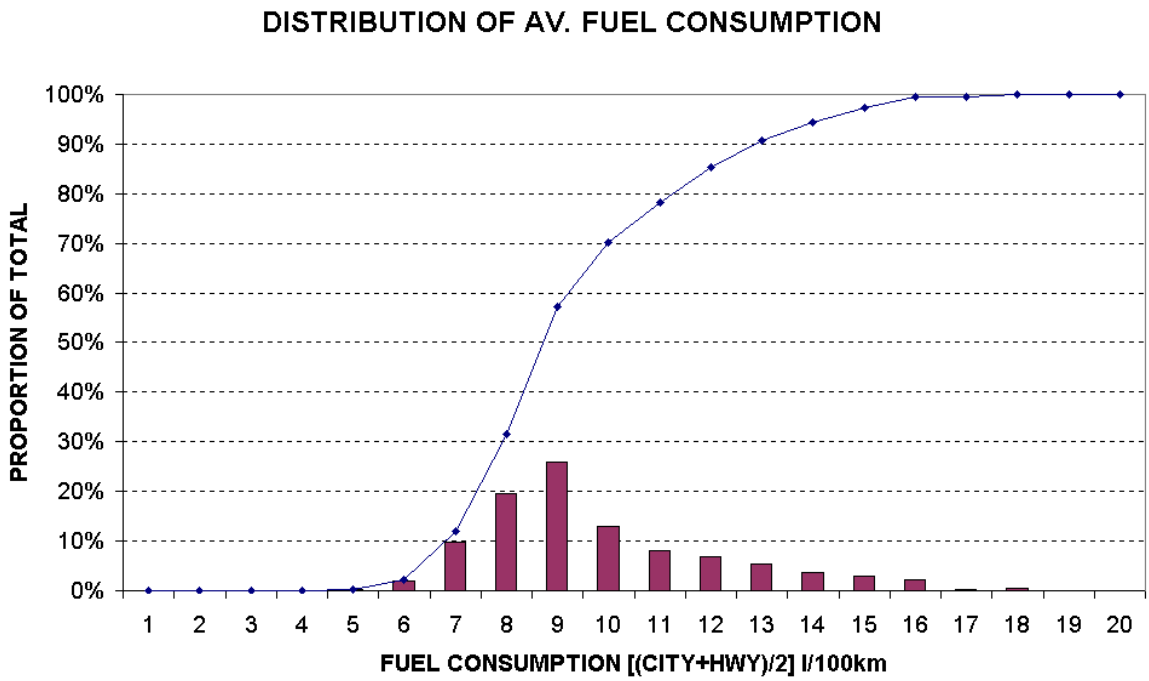

Figure 3 - Distribution of Fuel Consumption for Australian Models

Combined rating

There is a need for a method of deriving a combined rating that takes into account the emissions performance and fuel efficiency of vehicles.

One option is to simply take the lowest rating from the two categories, so that to obtain a good overall rating the vehicle must obtain a good rating for both emissions and fuel efficiency.

Applying this scenario gives the following rating matrix.

Table 5 – Matrix of Fuel Efficiency Rating and Emissions Rating

	Emissions Rating				
% OF VEHICLES	A	B	C	D	ALL
A-fuel	2.30%	0.36%	0.00%	0.00%	2.66%
B-fuel	13.57%	5.69%	9.67%	0.00%	28.94%
C-fuel	8.33%	7.35%	7.25%	0.21%	23.15%
D-fuel	10.00%	4.41%	23.70%	7.15%	45.26%
ALL	34.20%	17.81%	40.62%	7.37%	100.00%

Under this scenario, the proportions for the overall ratings would be:

- Good 2.3%
- Moderate 19.6%
- Basic 32.6%
- Poor 45.5%

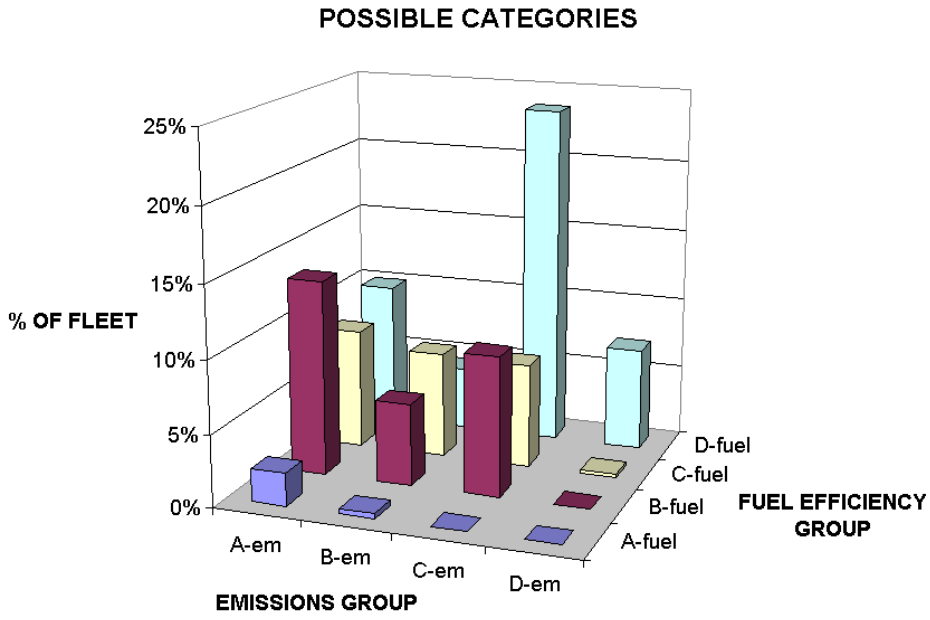

Figure 3 Combined Rating

It could be argued that this system disadvantages a vehicle that does exceptionally well in one performance measure but average in another. In particular, some large vehicles might achieve good emissions performance but still have poor fuel efficiency. It is estimated that about 10% of vehicles might fall into this category. If this is a valid concern then consideration could be given to giving an overall rating of "basic" where fuel efficiency is poor but emissions are good. Similarly, perhaps a combination of basic fuel efficiency and good emissions could be rated "moderate" overall.

In effect such adjustments give more weight to the emissions performance. A similar result could be achieved through a scoring system that gave greater weight to emissions. However, it may be difficult to implement a scoring system for emissions standards, given the variation between test procedures.

Low Emissions Vehicles

Appendix D contains extracts from the CARB website. This is one of the best sources of information about low emission vehicles. For 2002 year models it lists 5 SULEV models, including one CNG-fuelled vehicle and two hybrids. CARB lists 87 ULEV models, although many are variants of the same model.

The College of Engineering, University of California Riverside (www.nutech.org) provides information about the status of low emission vehicles. The website has some bugs at present but the following data was able to be extracted and combined with data from CARB, ACEEE (green score) and Edmunds (US car pricing).

* Where available, the ACEEE "Green Score" is shown in square brackets. This combines emissions and fuel efficiency ratings and scales them exponentially to give a score between zero and 100 (DeCicco 1999). A perfect (unattainable) vehicle would receive a Green Score of 100. An average US

passenger car scores 20 and one of the worst performers, the Chevrolet Suburban, scores 9. ACEEE predicts that a future hydrogen fuel cell car might score about 90.

Table 6 - Status of Low Emission Vehicles

Make & Model **[fuel, emissions]**	**Description**	**Status**	**Price (US$)**	**MPG (l/100km)** **[ACEEE*]**
HYBRID VEHICLES				
Honda Insight [A, A]	2 seat coupe, petrol-electric hybrid	Available for purchase	$18,800	70 (3.4) [57]
GM Hybrid EV1 [A, ?]	5 seat sedan, petrol-electric hybrid	Research only	NA	80 (2.9)
Warsitz Hydrogen Spirit	2 seat coupe/ sports, fuel-call electric hybrid	Prototype	NA	NA
Dodge Intrepid ESX2 [A, ?]	5 seat sedan, diesel-electric hybrid	Research only	NA ("too expensive for market")	70 (3.4)
Dodge ESX3 [A, ?]	5 seat sedan, diesel-electirc hybrid	Research only	"$7,500 more than a vehicle of same class"	72 (3.3)
GM Precept [A, ?]	5 seat sedan diesel-electric hybrid	Research only	NA (5 to 10 years before production)	80 (2.9)
Ford P2000 Prodigy [A, ?]	5 seat sedan, diesel-electric hybrid	Prototype ("may never go into production")	NA	70 (3.4)
GM EV1 (gas turbine)	4 seat sedan, gas turbine+electric hybrid	Research only	NA	?
Toyota Prius [A, A]	5 seat hatch, petrol-electric hybrid	Available in US, Japan	$20,450	50 (4.7) [51]
Volvo Hybrid	Small petrol-electric hybrid	Research only	NA	40% reduction
Electric Vehicles (ZEV)				
Nissan Altra EV	5 seat wagon, electric vehicle	Available in California	Not stated	NA [52]
Toyota E-Com	2 seat electric vehicle	Prototype	NA	NA
Dodge EPIC	7 seat (Voyager) electric vehicle	Available for purchase	Not stated	NA
GM EV1	2 seat coupe, electric vehicle	Only available for lease	$34,000	NA [57]
Toyota RAV4-EV	5 seat SUV, electric vehicle	Available to US fleets	$42,000	NA [50]
(Ford) Th!nk	2 seat hatch, electric vehicle	Available in Norway and	Not stated	NA

Make & Model [fuel, emissions]	Description	Status	Price (US$)	MPG (l/100km) [ACEEE*]
		USA		
Zutter EV	4 seat hatch, electric vehicle	Available in Canada	Not stated	NA
Zebra Z-Roadster	2 seat sports, electric vehicle	Available in US	$19,900	NA
Eco-Motion ION-1	2 seat sports, electric vehicle	Prototype	Expected around $30,000	NA
CONVENTIONAL (PETROL) SULEVs (CARB list)				
Honda Accord [C, A]	5 seat sedan, 2.3 litre petrol engine	Available in California	$20,000	27 (8.7) [35]
Nissan Sentra [C, A]	5 seat hatch, 1.8 litre engine	Available in California (low sulfur fuel only)	$15,000	30 (7.8) [40]

In California some low emissions vehicles are permitted to be used in "Carpool" (Transit) lanes of highways with a single occupant.

Discussion

Application of overseas data to Australia

The estimates of "best possible emissions standard" are based on matching Australian models with those available overseas that apparently have similar engine displacement. There are many other issues to consider in determining whether the Australian model would meet the more stringent overseas emissions standard. In most cases only the vehicle manufacturer could verify that the vehicles are the same specification in regard to emissions. Even then, fuel specification differences between Australia an the Europe/USA may mean that the Australian vehicle would not meet the overseas standard.

In several cases it was found that a model marketed in the USA or Europe could be purchased to different emissions standards. This is particularly the case for vehicles sold in California where, apparently, some low emission models are not readily available for purchase outside of the state. The market size in Australia is probably too small to justify such an approach. Furthermore, California has stricter low-sulfur fuel specifications than elsewhere in the USA and the Nissan Sentra CA is only able to meet the SULEV limits using the low-sulfur petrol.

Price Trends

Table C5 of Appendix sets out the results of an analysis of price trends. For each class of vehicle and each emissions rating group an average price was determined based on the price of each model and the number on the NSW register. This weighting by number of vehicles was necessary to overcome the effects of a few very high-priced vehicle models.

Overall there is no apparent trend for emissions rating group. The overall average price for the "good" group was $28,044 whereas that for the "basic" group (complying with ADR37/01) was $29,929. The average price of the "good" group was substantially higher than the other groups for luxury, medium, people mover and sports classifications. There was very little between emissions groups for the large, light, prestige and small vehicle classifications.

The small and light vehicle classifications have the most vehicles on the register and probably have the least variation in prices. They might give a tentative indication of the extra cost of a vehicle that meets the most stringent emissions standards (subject to uncertainty about the price of models that actually meet these standards). "Good" light vehicles were, on average $1000 more than "basic" ones and "good" small vehicles were, on average, $2300 more than the "basic" ones.

Availability of LEVs

Only a few ZEV and SULEV models are sold in the USA. These are generally only available in California (and perhaps New England). The prices of the hybrid cars (Honda Insight and Toyota Prius around US$20,000 each) are slightly more than a similar sized conventional vehicle (around US$15,000 for a Toyota Corolla). However, the GM EV1 electric vehicle costs about 50% more than a conventional vehicle. In both cases it is suspected that manufacturers subsidise the prices. The Toyota Prius has now been released in Australia and retails for about $40,000. This is considerably more than the conventional Toyota Corolla at around $23,000.

Stricter Australian requirements

Stricter Australian Design Rules for light vehicle emissions are due to be progressively introduced during the coming decade (Euro 2 by 2004 and Euro 3 by 2007) (DTRS 2001). Although these ADRs will set limits that are about half of those of the current ADR it is evident, from overseas performance, that there is the potential for a large proportion of models sold in Australia to comply with the stricter Euro 4 or CARB LEV limits. A scheme that encourages consumers to choose these better performing vehicles therefore has merit.

Conclusions

Australian vehicle models have been approximately matched with models sold in the USA and United Kingdom. Of 813 models listed in the AGO fuel consumption guide a total of 523 were able to matched with overseas models that comply with more stringent emissions standards than ADR37/01. When the number of each model on the NSW register are taken into account it is estimated that about half of the NSW fleet (built in 2000/2001) have overseas versions that comply with these stricter emissions standards. There are, however, uncertainties in applying the overseas results to Australian vehicles and there are also uncertainties about the model information on NSW registration records.

Subject to these uncertainties, and using the assumptions that:

- Australian models could be made to comply with the best possible overseas standard (probably optimistic)
- suitable low sulfur fuel would be available and
- the market share for each model does not change, so that the proportions on the NSW register for 2000 and 2001 vehicles continue for the next few years

then it is estimated that one third of new vehicles might be rated as "good" for emissions performance and a further 17% rated a "moderate" (above average).

If the fuel efficiency breakpoints recommended in this report are applied then about 3% of vehicles would receive a "good" rating and 29% would receive a "moderate" rating for fuel efficiency. The proportions are quite sensitive to the choice of breakpoints.

Combining the emissions rating and the fuel efficiency rating, by taking the worst performance for each, suggests that less than 3% of vehicles would receive a good rating and 20% would receive a moderate rating. Alternative methods of deriving an overall rating (particularly fuel efficiency breakpoints) might result in higher proportions than these estimates.

Analysis of prices suggests that vehicles which are rated "good" for emissions (mostly those complying with LEV requirements) are not necessarily more expensive than basic performers. This could mean that incentives to encourage the purchase of cleaner vehicles may be viable and relatively inexpensive. Encouraging the purchase of vehicles with both good emissions performance and good fuel efficiency would probably involve incentives for hybrid vehicles such as the Toyota Prius. Hybrids are likely to be considerably more expensive than conventional vehicles for several more years.

Major hurdles to this approach may be ensuring that suitable petrol for these vehicles is readily available and encouraging manufacturers either to declare that an existing model on the Australian market does comply with the stricter standards or to upgrade the local model to meet the limits.

The benefits are that such an approach would promote vehicles that have less than one quarter of the current regulated exhaust emissions and one half of the fleet average fuel consumption.

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What Car Magazine (1999) *Green Car Guide.* July 1999.

WWW Links

American Council for an Energy Efficient Economy - Green Guide to Cars and Trucks http://www.greenercars.org/indexplus.html (subscription)

Australian Greenhouse Office http://www.greenhouse.gov.au/

CARB Buyer's Guide to Cleaner Cars
http://arbis.arb.ca.gov/msprog/ccbg/ccbg.htm

Carprice.com http://www.carprice.com/

Edmunds car buying guide http://www.edmunds.com/

European requirements
http://europa.eu.int/comm/environment/guide/part2b.htm

Japan http://www.env.go.jp/en/pol/mv/index.html +
http://www.japanauto.com/jama/library/brochures/enviro%5Ffriendly/enviro%5F03.html

Nutech example (Toyota RAV4 EV)
http://www.nutech.org/onroad/ldt/electric/rav4.html

UK Vehicle Certification Authority http://www.vca.gov.uk/fcb.htm

US EPA Office of Mobile Sources http://www.epa.gov/OMSWWW/

Appendix A Summary of VCA Database

Euro Standard by Make

Manufacturers	Euro Standard			
	II	III	IV	Total
ALFA ROMEO	19	23		**42**
ASTON MARTIN		2		**2**
AUDI		53	61	**114**
BMW		89		**89**
CADILLAC		2		**2**
CHEVROLET	4	4		**8**
CHRYSLER JEEP	3	18		**21**
CITROEN	31	57		**88**
DAEWOO CARS	24	21		**45**
DAIHATSU	11	11		**22**
FERRARI		5		**5**
FIAT	26	33		**59**
FORD	89	56	13	**158**
HONDA		65		**65**
HYUNDAI		30		**30**
ISUZU	4			**4**
JAGUAR CARS		26	4	**30**
KIA	17	13		**30**
LAMBORGHINI	10		3	**13**
LAND ROVER	12	4		**16**
LEXUS		4	2	**6**
LOTUS	9	4		**13**
LTI	2			**2**
MASERATI		2		**2**
MAZDA	26	31		**57**
MERCEDES-BENZ	15	139		**154**
METROCAB	2	2		**4**
MG	19	31		**50**
MICRO COMPACT CAR (MCC)		12		**12**
MINI		2		**2**
MITSUBISHI	2	65	5	**72**
NISSAN	11	27		**38**
PERODUA	2	2		**4**
PEUGEOT	46	70		**116**

Manufacturers	Euro Standard			
	II	III	IV	Total
PORSCHE		14		**14**
PROTON	64	19		**83**
RENAULT	66	61		**127**
ROLLS-ROYCE		7		**7**
SAAB		22		**22**
SEAT		13	13	**26**
SKODA		19	23	**42**
SUBARU	21	20		**41**
SUZUKI	21	43		**64**
TATA	1			**1**
TOYOTA	5	44	6	**55**
VAUXHALL		34	50	**84**
VOLKSWAGEN	7	78	72	**157**
VOLVO		40	10	**50**
Grand Total	**569**	**1317**	**262**	**2148**

Appendix B US EPA database

CARB/Federal Emissions Standard by Make

MAKE	CARB/Federal Standard						
	LEV	SLEV	T1	TLEV	ULEV	ZEV	Total
ACURA (HONDA)	4		2	2	1		**9**
ASTON			2				**2**
AUDI	6			10			**16**
BENTLEY			8				**8**
BMW	13			2			**15**
BUICK	4		5		7		**16**
CADILLAC	5		8				**13**
CHEVROLET	58		77	7	7		**149**
CHRYSLER	17		25	3			**45**
DAEWOO				5			**5**
DODGE	26	2	69	4	3		**104**
EUROPA			2				**2**
FERRARI	2		4				**6**
FORD	65	2	30	7	6	1	**111**
GMC	25		41	4	1		**71**
HONDA	12	2	3	4	4		**25**
HYUNDAI	4		5	2			**11**
INFINITI	2		3	1			**6**
ISUZU	8		5	7			**20**
JAGUAR	4		6	2			**12**
JEEP	5		7	2			**14**
KIA	2						**2**
LAND	3		4				**7**
LEXUS	4		1	4			**9**
LINCOLN	6		2	1			**9**
LOTUS			2				**2**
MAZDA	5		14	5	2		**26**
MERCEDES-BENZ	15		5	2			**22**
MERCURY	8		10	2			**20**
MITSUBISHI	10		13				**23**
NISSAN	6	1	10	4	1	1	**23**
OLDSMOBILE	10		5				**15**
PLYMOUTH	5		9				**14**
PONTIAC	16		12	2	4		**34**

MAKE	CARB/Federal Standard						
	LEV	SLEV	T1	TLEV	ULEV	ZEV	Total
PORSCHE	3		3				**6**
QVALE			2				**2**
ROLLS-ROYCE			2				**2**
SAAB	6		4				**10**
SATURN	14		7	2			**23**
SUBARU	4						**4**
SUZUKI	6		5	2			**13**
TOYOTA	17		18	2	3	1	**41**
VOLKSWAGEN	11		14	4			**29**
VOLVO	11			1			**12**
WINNEBAGO			2				**2**
Grand Total	**422**	**7**	**446**	**93**	**39**	**3**	**1010**

Appendix C Estimates of numbers of NSW vehicles possibly meeting overseas standards

Table C1 - Make

	BEST POSSIBLE EMISSIONS STANDARD										
MAKE	ADR 37	ADR 37MC	II	III	IV	LEV	SLEV	T1	TLEV	ULEV	Total
Alfa Romeo			77	936							1013
Audi	62			83	480	639			341		1605
Bentley								0			0
BMW	0			5410		400			0		5810
Citroen	0		85	230							315
Daewoo		138		639					7213		7990
Daihatsu				1938							1938
Daimler				0							0
Ferrari	0					0		0			0
Ford	41050	5454	176	752		679			91		48202
Holden	56934	3298		523	20186						80941
Honda		345		861		6156	0	295	7101	1344	16102
Hyundai	384			744		10061			2009		13198
Jaguar				421		26					447
Jeep						1280					1280
Kia	72	1338	288	1854		684					4236
Land Rover				532							532
Lexus				753	100	364					1217
Lotus			0								0
Mazda	1779	1320	584	8441		715		0		2004	14843
Mercedes Benz	0		1159	809		646		0			2614
MG			84								84
Mitsubishi	16577	10612				3095					30284
Nissan	12400		380			481			506		13767
Peugeot	92		730	869							1691
Proton			1142	176							1318
Rolls-Royce	0							0			0
Saab						1465					1465
Subaru				6219		14330					20549
Suzuki	68	62		2209		1128					3467
Toyota	2628	872				35425	0		816	3129	42870
Volkswagen		502		24	529	4505					5560
Volvo				378		1329					1707
Grand Total	**132046**	**23941**	**4705**	**34801**	**21295**	**83408**	**0**	**295**	**18077**	**6477**	**325045**
	40.6%	7.4%	1.4%	10.7%	6.6%	25.7%	0.0%	0.1%	5.6%	2.0%	

Table C2 - Vehicle Classification (based on VFACTS)

% of Vehicles in class	Best Emissions Standard									
CLASS	ADR 37	ADR 37MC	II	III	IV	LEV	SLEV	T1	TLEV	ULEV
4WD		19.0%		24.1%		40.4%			16.5%	
Large	93.4%			0.1%	0.2%	5.4%			0.4%	0.6%
Light	18.8%		2.1%	16.1%	9.6%	42.8%			10.6%	
Luxury	1.8%		11.0%	64.9%	0.9%	18.4%			3.0%	
Medium	0.2%		1.2%	0.8%	30.1%	22.8%			13.1%	31.8%
PeopleMov		32.4%	2.7%	3.7%		61.2%				
Prestige	27.3%		0.1%	16.6%	8.3%	33.8%				13.9%
Small	31.2%		2.1%	10.1%	14.8%	38.1%			3.7%	
Sports	16.9%		12.2%	21.4%		2.9%		7.7%	38.9%	
Utility		100%								
Van		97.7%	2.3%							
Grand Total	40.6%	7.4%	1.4%	10.7%	6.6%	25.7%	0.0%	0.1%	5.6%	2.0%

Table C4 - Vehicle Classifications

CLASS	% OF MODELS (AGO)	% OF VEHICLES (Drives)
4WD	10.6%	13.1%
Large	11.7%	31.5%
Light	8.5%	11.4%
Luxury	20.2%	3.5%
Medium	4.9%	4.4%
PeopleMov	2.7%	2.2%
Prestige	10.8%	3.0%
Small	16.4%	25.7%
Sports	4.2%	1.2%
Utility	7.5%	3.0%
Van	2.6%	1.1%

Table C5. Vehicle Class by Emissions Group - No. of Vehicles

	POSSIBLE EMISSIONS GROUP				
CLASS	A	B	C	D	Class Total
4WD	17222	17285		8105	42612
Large	6311	472	95484		102267
Light	19357	10665	6962		36984
Luxury	2167	8867	204		11238
Medium	12097	2149	22		14268
PeopleMov	4292	445		2274	7011
Prestige	5421	1621	2641		9683
Small	44201	13233	26090		83524
Sports	112	3056	643		3811
Utility				9911	9911
Van		85		3651	3736
Grand Total	111180	57878	132046	23941	325045

Table C6. Average Price by Vehicle Class and Emissions Group
(weighted by number on register)

	EMISSIONS RATING				**Vehicle Class Average**
CLASS	**A**	**B**	**C**	**D**	
4WD	$33,007	$38,521		$42,942	$37,134
Large	$29,837	$26,293	$32,884		$32,666
Light	$16,352	$15,771	$15,406		$16,006
Luxury	$97,073	$70,294	$68,685		$75,429
Medium	$30,028	$24,115	$23,500		$29,127
PeopleMov	$48,020	$31,066		$37,711	$43,600
Prestige	$46,511	$51,384	$50,977		$48,545
Small	$22,783	$20,753	$20,415		$21,722
Sports	$51,050	$41,813	$35,920		$41,090
Utility				$24,272	$24,272
Van		$16,399		$24,538	$24,353
Rating Group Av.	**$28,044**	**$34,944**	**$29,929**	**$31,910**	**$30,323**

Appendix D - Extracts from US Sources

Californian Air Resources Board

How clean are California "Low-emission vehicles"?

California's innovative Low-Emission Vehicle regulations provide several increasingly cleaner emission standards for new cars and light trucks. These standards provide manufacturers the flexibility to phase-in a new generation of clean vehicles for California. Vehicles meeting the cleanest of the "Low-Emission Vehicle" standards have even lower emissions than the tough basic standards all new vehicles must meet to be sold in California For example, passenger cars and light-duty trucks certified to California's low-emission vehicle standards provide the following emissions reductions when compared to the minimum (Tier 1) standard:

Passenger Car Emissions Reductions	HC	CO	NOx
Transitional Low-Emission Vehicle(TLEV)	50%	NR	NR
Low-Emission Vehicle (LEV)	70%	NR	50%
Ultra-Low-Emission Vehicle (ULEV)	85%	50%	50%
Super-Ultra-Low-Emission Vehicle (SULEV)	96%	70%	95%
Zero-Emission Vehicles (ZEV)	100%	100%	100%

Extracts of CARB pages are large. They can be viewed at:

http://arbis.arb.ca.gov/msprog/ccbg/ccbg.htm