

Trial Vehicle Scrappage Report

July 2008

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REPORT



TABLE OF CONTENTS

Table of contents	1
Background	3
Sample of print advertising	4
Summary of findings about the scrapped vehicles	5
Data sources used in the report	6
Specific findings about the scrapped vehicles	7
Decision to scrap vehicles	7
Map of location of people who scrapped vehicles	8
Who took part in the scheme?	8
Age profile of vehicles being scrapped	8
What were vehicles being used for before being scrapped?	12
Reason given for scrapping vehicle	12
Exhaust emissions	14
Mileage and age predictors of emissions	14
Would the scrapped vehicles pass an emissions test?	17
Presence of a catalytic converter as a guide to emissions	21
Japanese in-service tests	24
Removal of catalytic converters	25
Presence of a carburettor as a guide to emissions	27
Visible smoke as an indicator of emissions	28
Did the scrapped vehicles have a current WoF or Registration?	31
Presence or absence of WoF as reason to scrap vehicle	32
WoF as an indicator for emissions	32
Vehicle brand as an indicator of emissions	33
Diesel vehicles	34
Findings from follow up survey on outcomes from scrappage scheme	35
Ease of taking part in the trial	36
Response to public transport passes as an inducement	36
Ongoing use of public transport by participants	39
Purchase of another vehicle by participants	41
General comments on the scheme	41

Cost benefit of the scheme	42
Budget	42
Effectiveness of the scheme	42
Health benefits	42
Social costs	43
Co-benefits	44
Did the trial achieve its stated objectives?	45
How effective was the incentive as an inducement for people to trade in their end-of-life vehicles?	45
What type of vehicles would this trial remove from the vehicle fleet?	45
What impact would it have on air quality?	45
What impact would this trial have on fleet turnover?	45
Appendix 1	46
Health effects of reducing CO emissions in Auckland	46
Appendix 2	47
Scenarios used to assess social costs from the scheme.	47
Appendix 3	48
Questionnaire used when vehicles were surrendered	48

BACKGROUND

The Ministry of Transport (MoT), in conjunction with the Auckland Regional Council (ARC), Auckland Regional Transport Authority (ARTA) and the Broken Car Collection Company (BCCC), ran a trial vehicle-scrappage scheme in Auckland during the period 14 May to 30 June 2007.

The project was intended to provide vehicle owners with an incentive to trade in their vehicles that were nearing the end of their useful economic lives. New Zealand has one of the oldest vehicle fleets in the developed world and, as older vehicles are generally more polluting and less safe than newer vehicles, their voluntary removal is considered to be a priority. This is recognised in the New Zealand Energy Efficiency and Conservation Strategy which recommended the investigation of a nationwide scrappage scheme.

The original proposal for the scheme came from the BCCC which became actively involved in its design and implementation. The BCCC were already collecting a large number of vehicles (30,000 per year). This included a large number which had been abandoned or had been un-used for a considerable period before disposal. The BCCC therefore approached the Ministry and ARC in late 2006 regarding a trial vehicle-scrappage scheme to see if an incentive would increase the collection of newer vehicles.

THE SCRAPPAGE SCHEME OFFER

Those targeted for the trial were owners of vehicles that were likely to fail or had just failed a Warrant of Fitness inspection. Often, repairs are too costly for the owner to undertake, and there is concern that some people in these circumstances continue to drive their vehicle without a Warrant of Fitness because they cannot afford to upgrade or repair the vehicle. It was a condition of the scheme that the vehicles collected had to be running and to have had a current Warrant of Fitness or one that had expired for less than three months prior to being collected.

Under the trial scheme members of the public were offered two months' free passage on all of Auckland's bus and train services in return for handing in their vehicles. The passes each had a retail value of \$400, although they were purchased at half the face value for this scheme.

OBJECTIVES

The objective of this project was to acquire information about vehicles at the 'tail end of the fleet'.

More specifically, the project attempted to assess:

- how effective the incentive was as an inducement for people to trade in their end-of-life vehicles
- what type of vehicles this trial would remove from the vehicle fleet
- what impact it would have on air quality
- what impact the trial would have on fleet turnover.

COMMUNICATIONS

The scheme was launched by the Associate Minister of Transport, Hon Judith Tizard, at a large media event in Auckland on 14 May 2007. The event was well attended by both print and TV journalists and received nationwide media coverage.

The trial was then advertised to the public via press and radio advertisements. Print advertisements were run in twelve of Auckland's local newspapers and a separate advertisement was played on a range of radio stations.

Aside from the cost of the passes, media costs, including the development of the advertising material, were the largest item. At \$46,000 the publicity costs amounted to almost half the total direct costs of the project.

SAMPLE OF PRINT ADVERTISING

PROJECT PARTNERS

Four organisations formed the project group that managed the trial.

The Ministry of Transport (MoT) is the government's principal transport adviser. It both leads and generates policy within the framework of the *New Zealand Transport Strategy*. The strategy outlines how the transport system can respond to the social, economic and environmental needs of the nation. The Ministry assisted in the development of the advertising campaign and was responsible for analysing the results of the trial.

The role of the Auckland Regional Council (ARC) is to protect the region's air, soil and water resources from pollution and to ensure their sustainable use as Auckland develops and its population grows. The council also manages the growing demands on the region's transport systems, and supports public transport services.

The Auckland Regional Transport Authority (ARTA) is a subsidiary organisation of ARC, and is responsible for implementing the goals set out in the Auckland Regional Land Transport Strategy. This strategy outlines the requirements for an effective and efficient transport system that is able to cope with the demands of an increasing number of people living and working in the region.

The Broken Car Collection Company (BCCC) is a subsidiary of Strong for Honda and specialises in the removal of unwanted and abandoned vehicles. The BCCC was responsible for all of the day-to-day elements of the project, including collection and disposal of the vehicles and the issuing of passes.

SUMMARY OF FINDINGS ABOUT THE SCRAPPED VEHICLES

Two hundred and fifty-three vehicles were scrapped as part of the project and of these, 162 were tested for emissions.

The average vehicle being scrapped was manufactured in 1988, had travelled 195,000km, had a valid Warrant of Fitness, was reported as having been driven around 200km per week, and was described as being used for “getting to work” and for “household chores”. Vehicles were used mainly by the driver only, although about 40% said that others regularly used the vehicle. Vehicles being scrapped came from all over the greater Auckland region.

There were no trends that could be identified that vehicles being scrapped came from particular socio-economic groups (as measured using meshblock data from the 2006 census) or that vehicles from particular locations had any specific properties. People from wealthy suburbs were as likely to take part and were as likely to be disposing of older and/or high-polluting cars as any other group in the sample.

Nearly three-quarters of those people who answered said they had made the decision to scrap the car, because of the scheme. This was to be expected, as logically, people would not have taken part if they saw the offer as poor value.

Of the reasons given for scrapping their vehicles, the most common fault was with tyres or wheels. Mechanical faults and rust were not commonly cited as the main reason, but were mentioned as a secondary consideration.

Results from the vehicles that were emissions-tested varied widely and can be viewed as either “glass half empty” or “glass half full”. As would be expected from vehicles nearing the end of their mechanical life, some of the tested vehicles had very high emissions and it was clearly beneficial to the environment for these vehicles to be taken off the road. According to Emissions Testing New Zealand Ltd (ETNZ) which carried out the testing, some vehicles were quite literally “off the scale”. However, the reported emissions of others were extremely low and many vehicles would have had no difficulty passing a modern emissions test. Forty-seven percent of the petrol vehicles that were emissions-tested would have passed the United Kingdom (UK)¹ idle emissions test for pre-1992 vehicles (3.5% carbon monoxide, 1200ppm hydrocarbons).

Only nine diesel vehicles were collected and seven of these were smoke- tested. The average smoke test values² of $K = 6.2m^{-1}$ were almost twice those reported as average for a set of 21 diesel vehicles tested in 2005 for the Pilot Project³. While this is certainly of concern, the very small sample size means that it is not appropriate to consider this as a sample of the wider diesel-vehicle fleet. It would also be interesting to find out why so few diesel vehicles were disposed of.

Distance travelled (taken from odometer readings) and vehicle age were not found to be good indicators of emissions. This is consistent with previous studies but, as these were vehicles at the end of their mechanical life, some relationship with age or distance travelled had been expected.

As was expected from previous studies, the presence (or absence) of a carburettor (rather than a modern electronic engine-management system) and the presence or absence of an exhaust catalytic converter (‘cats’) were good predictors of emissions⁴. Vehicles with carburettors had much higher average emissions than those without. Similarly, vehicles that were still fitted with their ‘cat’, regardless of the year of manufacture or year of importation into New Zealand, were likely to have lower emissions. Vehicles without carburettors and with ‘cats’ had the lowest overall emissions.

Used vehicles imported from Japan generally had lower emissions than those registered as New Zealand-new. This was because these vehicles were much more likely to have a catalytic converter present and were less likely to have a carburettor. There were no significant trends for emissions to increase with the age of the vehicle, with increased odometer reading or, in the case of Japanese-used vehicles, with their date of entry into the New Zealand fleet (which is generally 8 -10 years after the date of manufacture). These findings are consistent with other studies and indicate that emissions-control equipment is continuing to function long after its official ‘design life’ (generally 100,000km) has been reached.

¹ Technically, this reference should be to ‘Great Britain’, as the United Kingdom includes Northern Ireland which has a slightly different test regime from that used in the rest of the UK. However, for simplicity, this paper refers to these as the ‘UK’ tests and test limits as the term UK is likely to be more familiar to readers than GB.

² K is a measurement of light absorption. The higher the K value, the more light has been absorbed and hence the more dense the smoke.

³ <http://www.transport.govt.nz/vehicle-emissions-pilot-project-reports-1/>

⁴ The range of emissions-reduction equipment on a vehicle is far wider than just the presence or absence of catalyst or carburettor. However, because these items are easily identified visually, these were the only two items considered during the survey of the vehicle at time of scrappage. The survey did not attempt to identify the level of other technologies on the vehicles.

In most cases, vehicles that showed visible smoke had higher emissions (especially of hydrocarbons) than those without. However, some vehicles reported as having smoke had very low measured levels of emissions and some with very high emissions, especially of carbon monoxide (CO), showed no smoke.

A finding of concern was the apparent very high rate of removal of catalytic converters from Japanese-used vehicles. The removal rate may be as high as 60% although was more likely to be around 40%. This is in contrast to earlier studies suggesting removal rates of less than 10%. There was a trend for vehicles that had arrived in New Zealand more recently to still have their 'cats', but even vehicles imported in the late 1990s were found to have had their 'cats' removed.

DATA SOURCES USED IN THE REPORT

There are several sources of data used in this analysis:

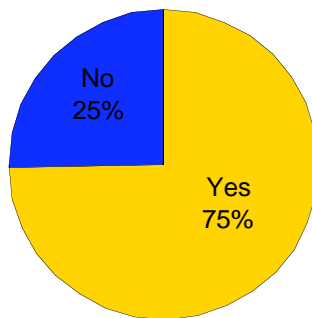
1. When the Broken Car Collection Company (BCCC) accepted a vehicle they recorded the key features of the vehicle, along with details about the person who scrapped the vehicle and their reasons for doing so. There are 253 records for vehicles that were scrapped.
2. Before the vehicles were dismantled, 162 were emissions-tested by the firm Emissions Testing New Zealand (ETNZ). The results were tabulated in a spreadsheet. Of these, nine could not be linked to the scrapped vehicles because of incomplete recording of vehicle details.
3. Using number plate data recorded by BCCC, MoT requested from Land Transport New Zealand the information held on each of the vehicles. There are 245 of these records. Some vehicles did not have number plates and some number plates were wrongly recorded and did not identify the vehicles being scrapped.
4. Approximately four months after the vehicles were scrapped participants were contacted by telephone in a follow-up survey to see how they had found the process and to collect data on their usage of public transport passes. There were 143 responses.

SPECIFIC FINDINGS ABOUT THE SCRAPPED VEHICLES

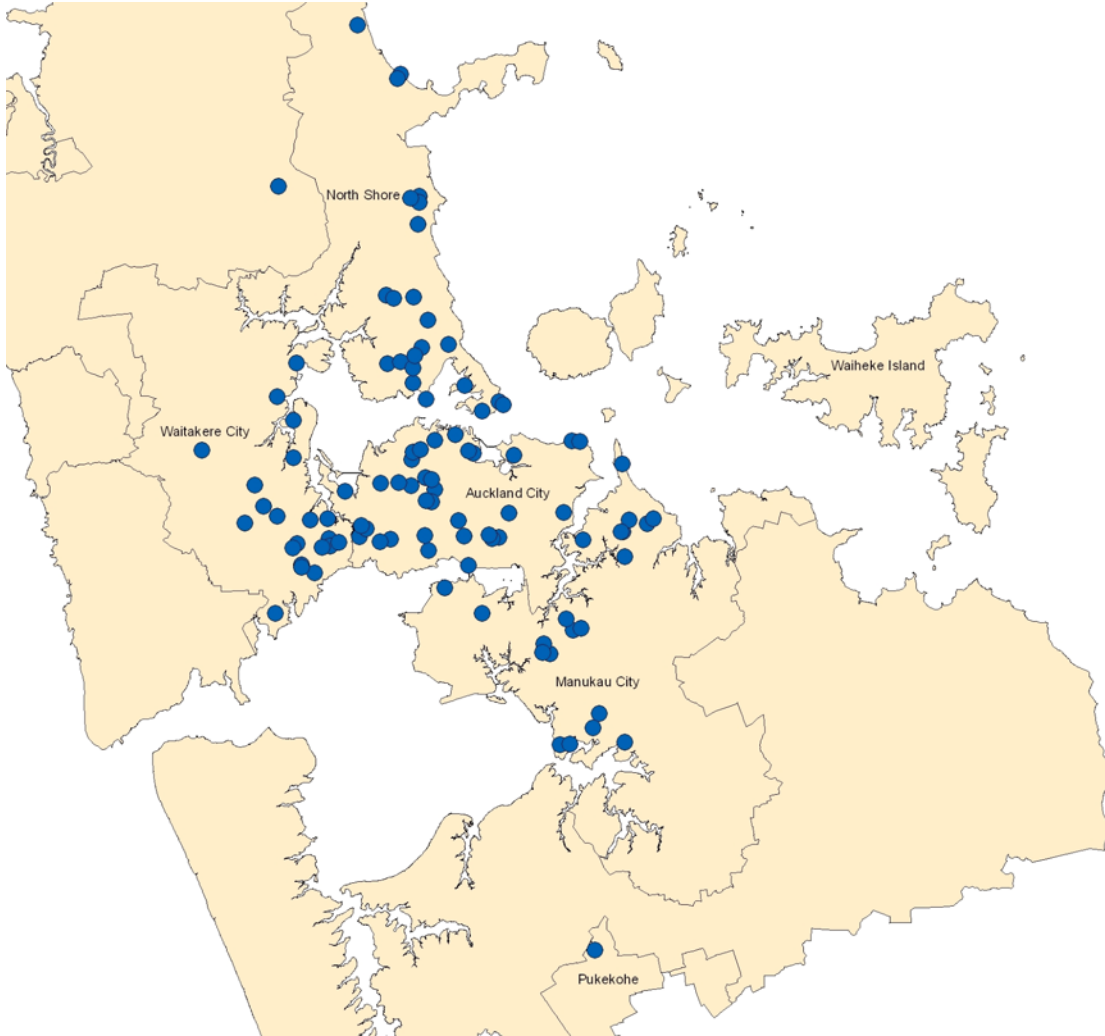
DECISION TO SCRAP VEHICLES

Most people (75%) said the decision to scrap their vehicle was because of the offer of a public transport pass. This suggests that, in the absence of the scheme, the vehicles would not have been scrapped at that time, although it is not possible to determine just how much earlier the vehicles were scrapped than would otherwise have happened. Of those who gave comments, most said they were intending to scrap their vehicle anyway, usually citing mechanical concerns.

Was the decision to scrap the vehicle made because of the voucher offer?



MAP OF LOCATION OF PEOPLE WHO SCRAPPED VEHICLES



WHO TOOK PART IN THE SCHEME?

The scheme was successful in attracting vehicles from all over the greater Auckland region. There were no identifiable trends that vehicles being scrapped came from any specific part of Auckland or from any particular socio-economic group (as measured using meshblock data from the 2006 census). People from wealthy suburbs were as likely to be disposing of older and/or high-polluting cars as any other group in the sample.

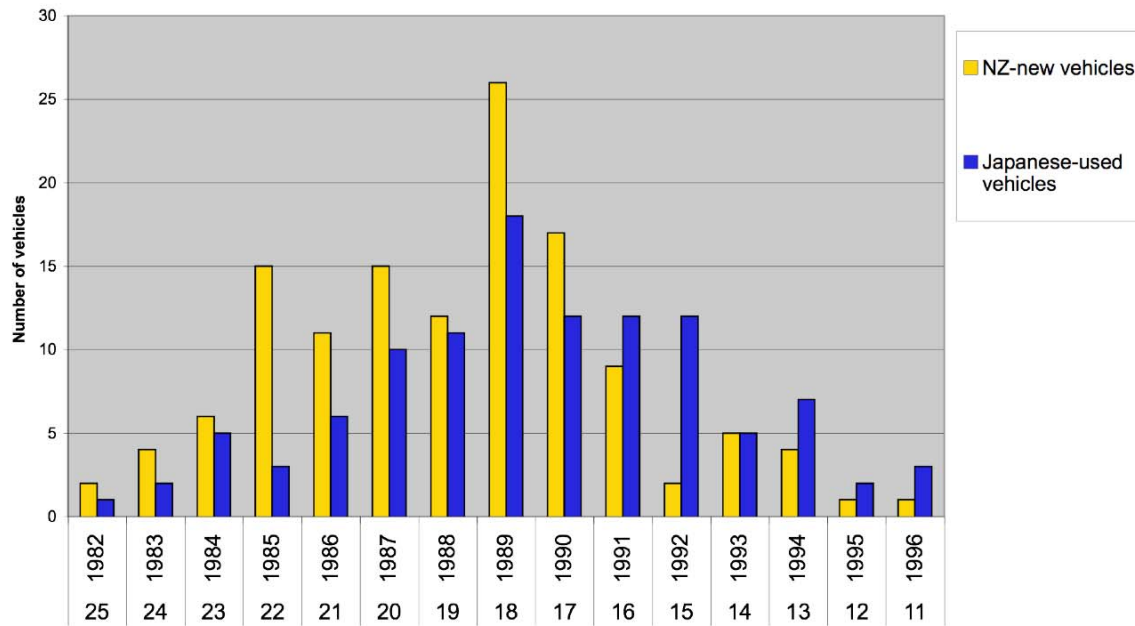
AGE PROFILE OF VEHICLES BEING SCRAPPED

The average age of a vehicle being scrapped in this survey was 18.2 years (ie, manufactured in 1989). Of those vehicles, where the import status could be identified, New Zealand-new vehicles were an average of 18.8 years old and Japanese-used imports were an average age of 17.6 years old. The oldest vehicle scrapped was from 1982 and the youngest was from 1996.

A previous analysis by the Ministry⁵ showed that in 2006, on average, Japanese-used vehicles were scrapped at 16.1 years old, whereas New Zealand-new vehicles were 18.4 years old when scrapped. These figures suggest that the vehicles being scrapped under this scheme were slightly older than the national average. This was unexpected as, on average, Auckland's vehicles are younger than those in other parts of New Zealand. The significance, if any, of this finding is not clear.

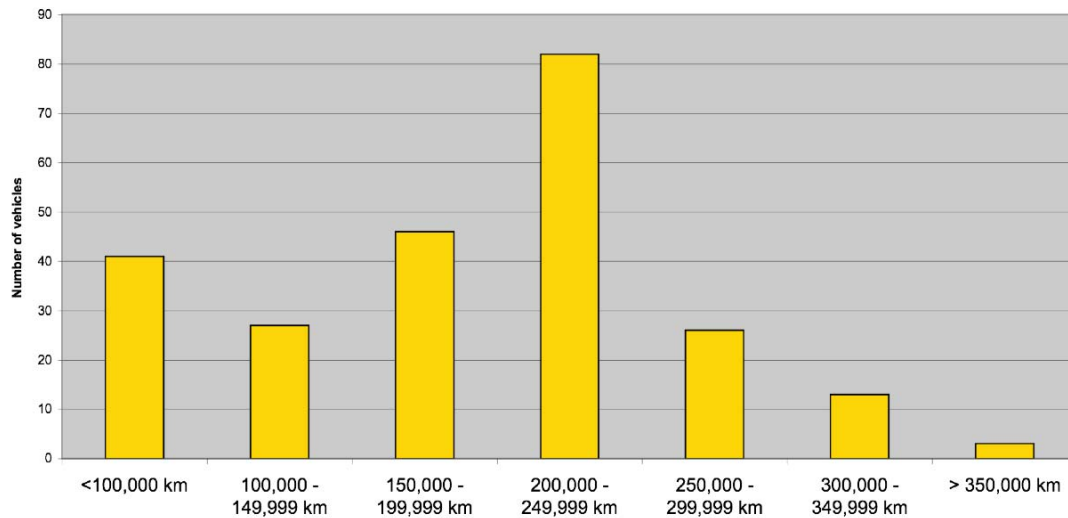
⁵ The New Zealand Light Vehicle Fleet 2006, Ministry of Transport. <http://www.transport.govt.nz/assets/NewPDFs/NZ-Light-Vehicle-Fleet-7.pdf>

Age of vehicles being scrapped



As would be expected for vehicles being scrapped, the odometer readings were high. The average was around 184,000km. Forty one vehicles were reported as having odometer readings of less than 100,000km and it is assumed that these vehicles had gone 'round the clock' or had been wound back and had travelled more than 100,000km. If the vehicles reported with odometer readings of less than 100,000km are excluded, the average distance travelled rises to 214,000km.

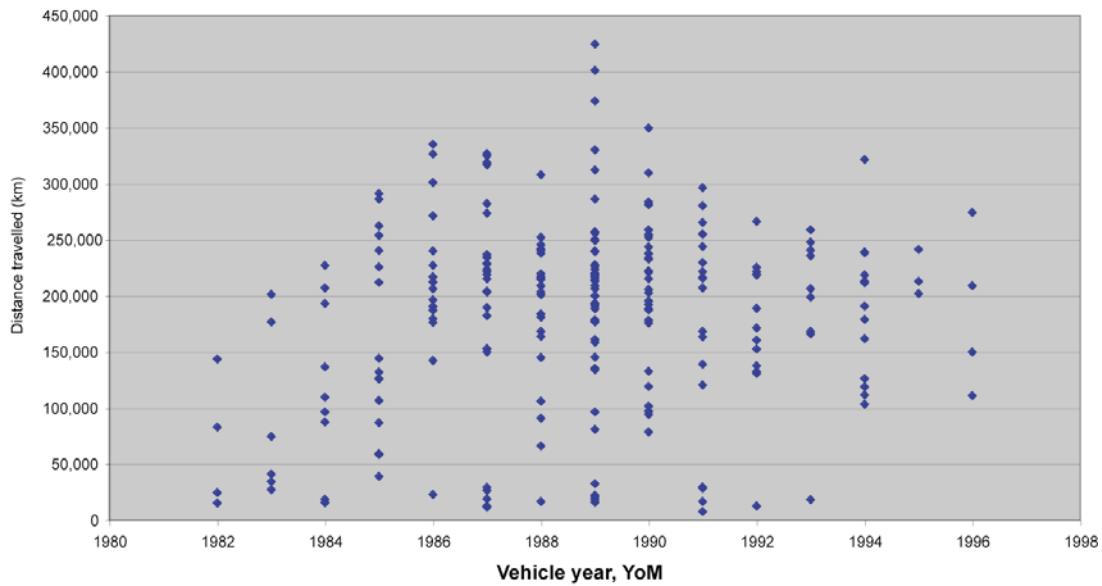
Odometer readings for all vehicles



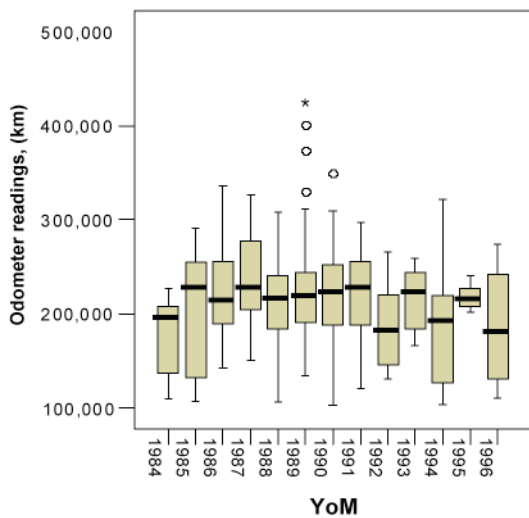
If the reported odometer reading is compared with the vehicle year⁶ recorded on the registration data, there is a wide spread of results. This can be seen in the following graph.

⁶ Note the field 'vehicle year' is usually the same as 'year of manufacture' (YoM), but may also relate to year of first registration.

Vehicle year vs odometer reading



It was found that, regardless of the vehicles' ages, most vehicles scrapped had travelled between 200,000 and 250,000km. This may be important for any future scrappage scheme as it appears that distance travelled is probably more relevant than the age of a vehicle when an owner decides to dispose of a vehicle. The lack of a link between a vehicle's year of manufacture and odometer reading can also be seen in the 'box and whisker'⁷ plot which shows the spread of data visually. For the plot below, vehicles that were recorded as having travelled less than 100,000km were removed from the analysis and those model years for which there was only one vehicle in the sample are not shown.



Any future scheme to remove old vehicles may usefully seek to identify and target vehicles that have travelled over, say, 175,000km rather than vehicles over a specific age.

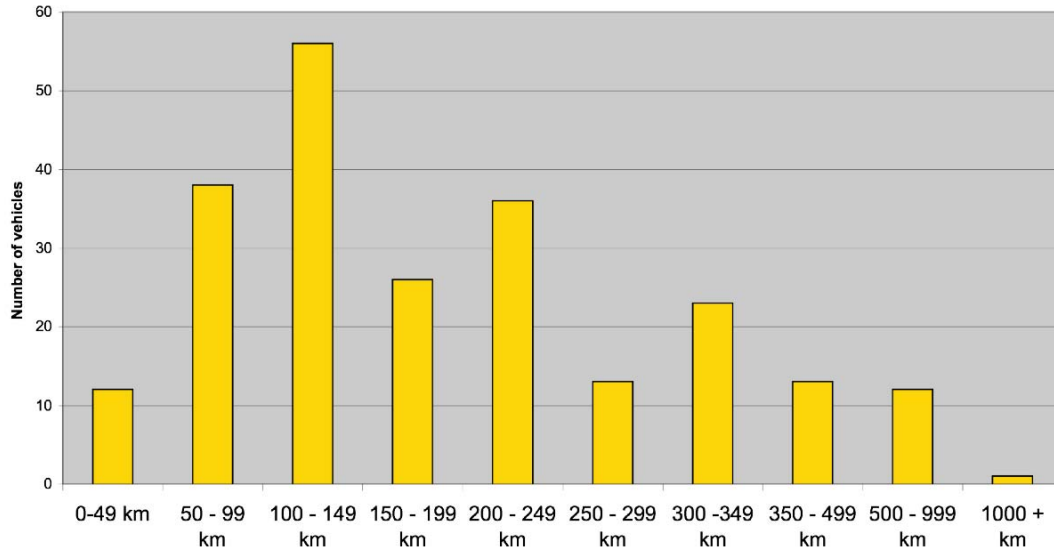
Despite already having relatively high odometer readings, many vehicles were reported by their owners to have been travelling quite long distances each week before they were scrapped. Seven percent of the vehicle owners reported that they were travelling 500km or more per week.

The average reported weekly distance travelled was slightly less than 200km per week (192km per week or 10,000km per year). In 2006 the national average⁸ for distance travelled for all light vehicles was 235km per week (12,250km per year). The data collected for average travel is consistent with the national averages for travel calculated by MoT in 2006.

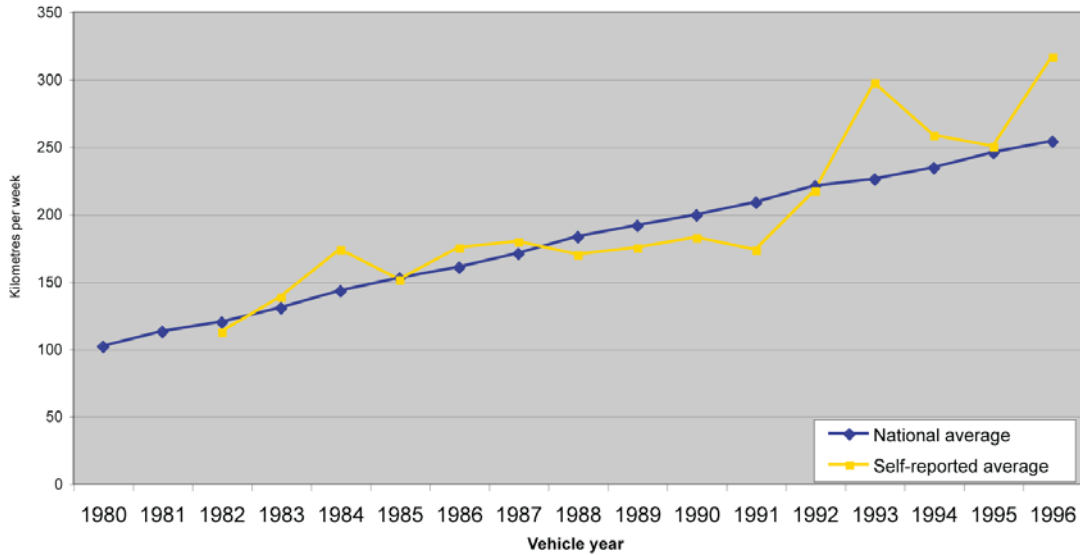
⁷ In a 'box and whisker' plot, the box represents the inter-quartile range (IQR), which contains 50% of the values. The whiskers are lines that extend from the box to the highest and lowest values, excluding out-liers. The thick line across the box indicates the median. An out-lier (labelled as a circle or a star) is a value that lies more than 1.5 IQR to the upper or lower edge of the box.

⁸ The New Zealand Light Vehicle Fleet 2006, Ministry of Transport. <http://www.transport.govt.nz/assets/NewPDFs/NZ-Light-Vehicle-Fleet-7.pdf>

Owners estimate of distance travelled each week



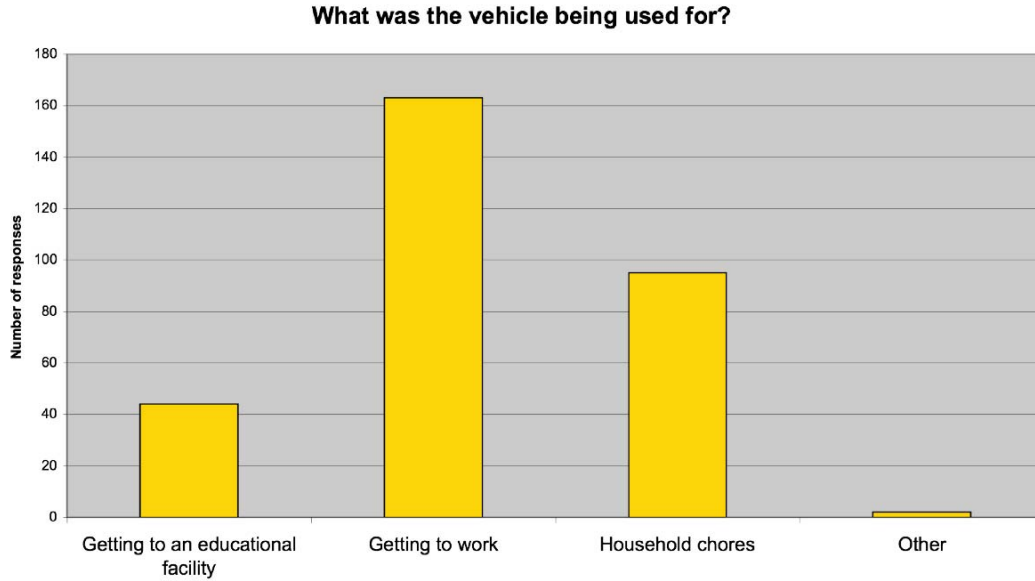
Reported weekly distance travelled for scrapped vehicles compared with national averages



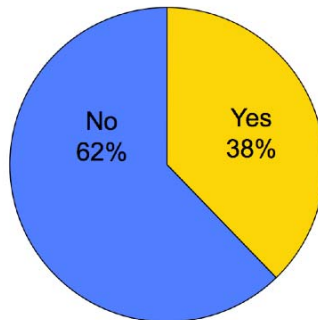
The data collected for average travel is consistent with the national averages for travel calculated by MoT in 2006. Both studies show that older vehicles travel shorter distances than newer vehicles. The consistency with national average figures also suggests that the data can reasonably be used when trying to estimate the benefits of the scheme.

WHAT WERE THE VEHICLES BEING USED FOR BEFORE BEING SCRAPPED?

Most vehicles were reported as being used primarily for transport to work, and usually carried just the driver, although about 40% reported regularly carrying passengers.



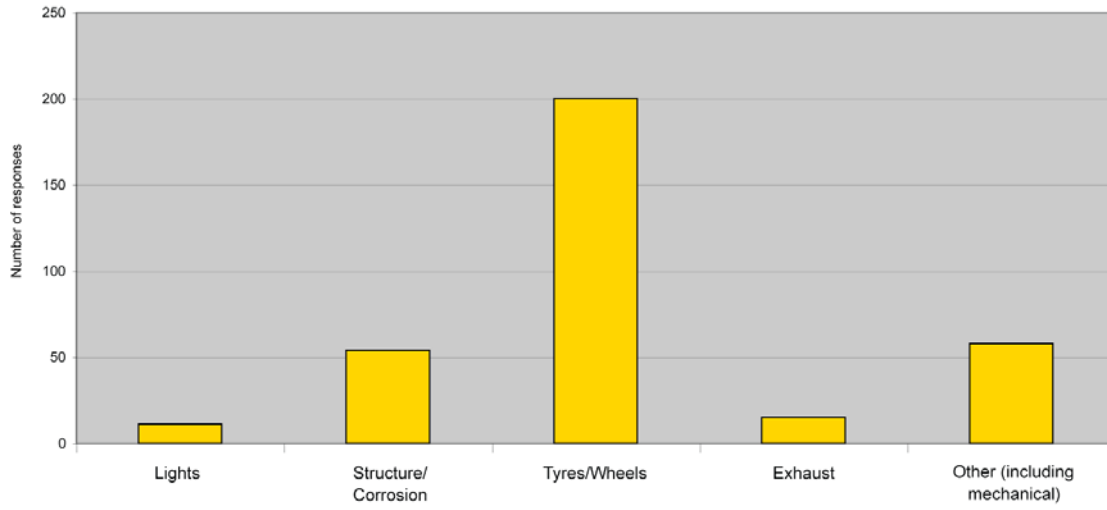
Did the vehicle regularly carry more than just the driver?



REASON GIVEN FOR SCRAPPING VEHICLE

Of the reasons provided to the BCCC for the vehicle being scrapped or failing its Warrant of Fitness (WoF), the most common reason given was for the check box on the survey form of “tyres or wheels”. The very large number of reported failures for tyres suggests that any future campaign to target end-of-life vehicles should include tyre retailers.

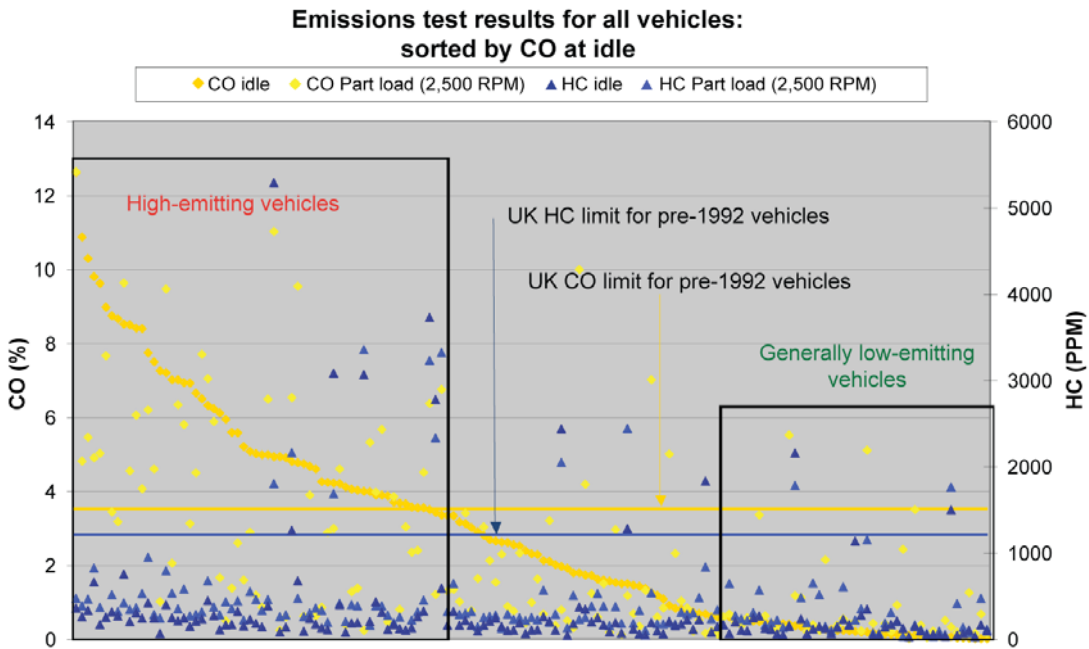
Reason for scrapping the vehicle



EXHAUST EMISSIONS

One hundred and sixty two vehicles were emissions-tested by the private company Emissions Testing New Zealand (ETNZ). It was possible to accurately identify the test results for only 153 of the vehicles that were emissions-tested so that they could be combined with the records from the survey by the BCCC.

Results from the tested vehicles varied widely and can be viewed as “glass half empty” or “glass half full”. As would be expected from vehicles nearing the end of their mechanical life and being scrapped, some of the tested vehicles had very high emissions. In fact, according to ETNZ the readings for some vehicles were quite literally “off the scale” and it was clearly beneficial to the environment for these vehicles to be taken off the road. However, the reported emissions of some were extremely low and many vehicles being scrapped had no difficulty passing a modern emissions test.



MILEAGE AND AGE PREDICTORS OF EMISSIONS

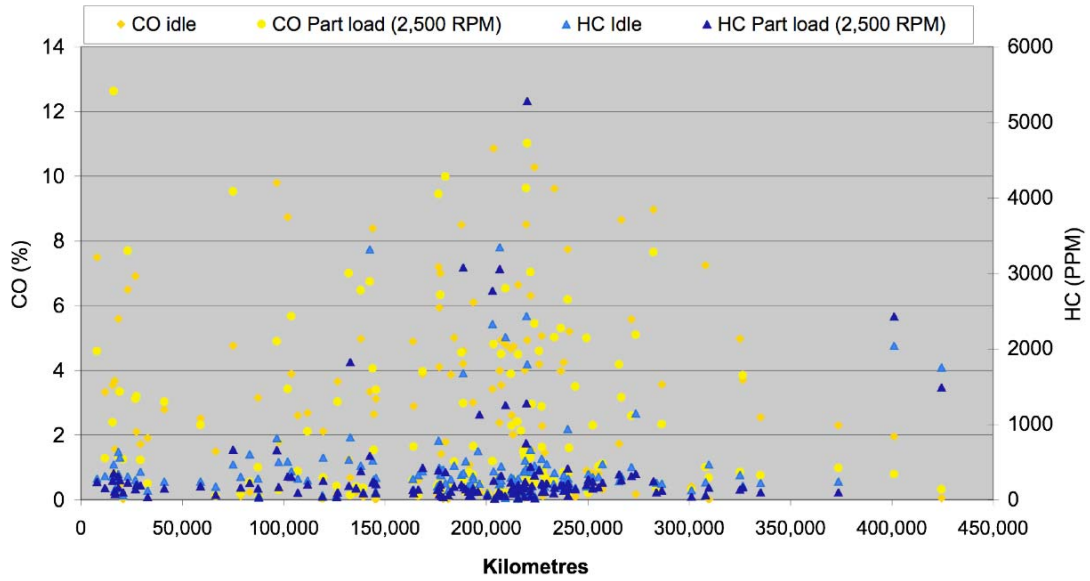
Although age and mileage are considered by the general public to be indicators of a vehicle’s likely emissions, this is not generally found to be true when vehicles are tested. Studies such as the New Zealand Pilot Project⁹ have concluded that technology (such as the presence or absence of an exhaust catalytic converter or of a carburettor) is the best predictor of a vehicle’s likely emissions.

Vehicles recorded as having travelled more than 300,000km were found to be as likely to have low emissions of carbon monoxide (CO) and hydrocarbons (HC) as those recorded as having travelled 100,000km¹⁰. Similarly, some of the lowest emissions were recorded from vehicles manufactured in 1984 and 1985.

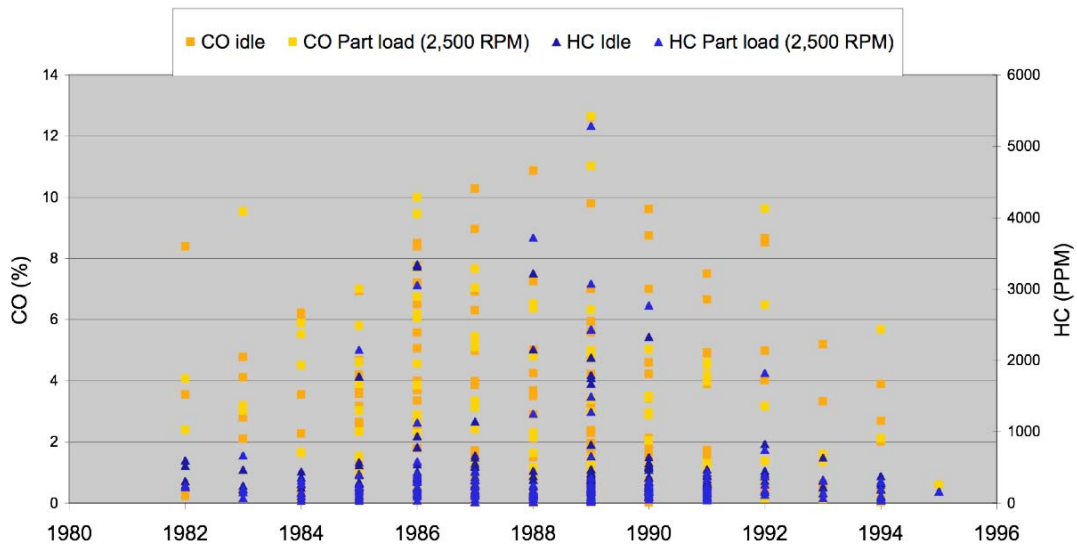
⁹ Vehicle Emissions Pilot Project 2006 <http://www.transport.govt.nz/vehicle-emissions-pilot-project-reports-1/>

¹⁰ Note that we have no way of knowing if vehicles’ odometers had previously been tampered with or if they had been “round the clock” more than once.

CO and HC results for vehicle odometer reading

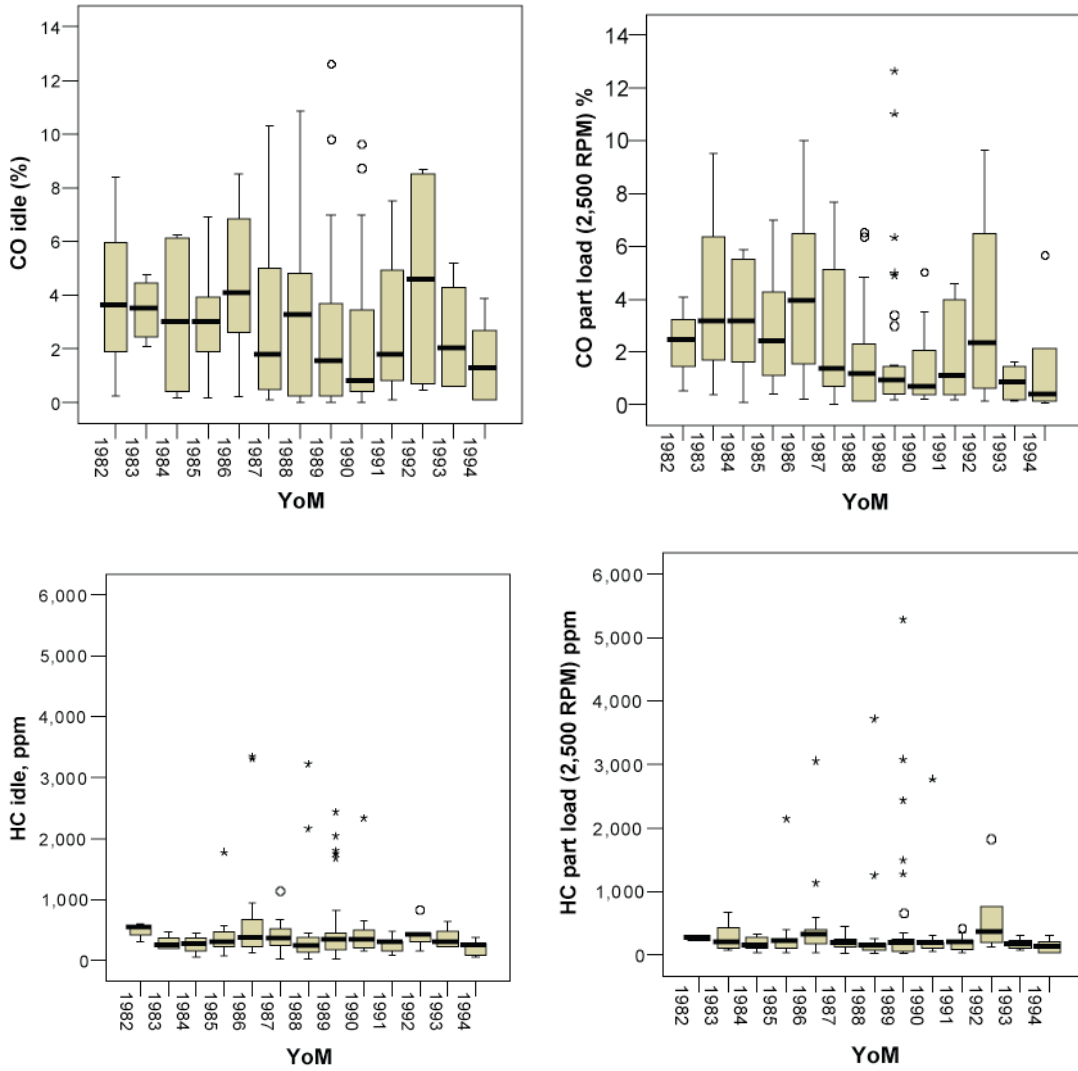


CO and HC results for Vehicle Year (YoM)



If the average emissions for vehicles of a given vehicle year (year of manufacture) were considered, rather than the results for individual vehicles, there was still no clear overall indication that CO emissions from younger vehicles were lower than from those vehicles that had been in the fleet for longer.

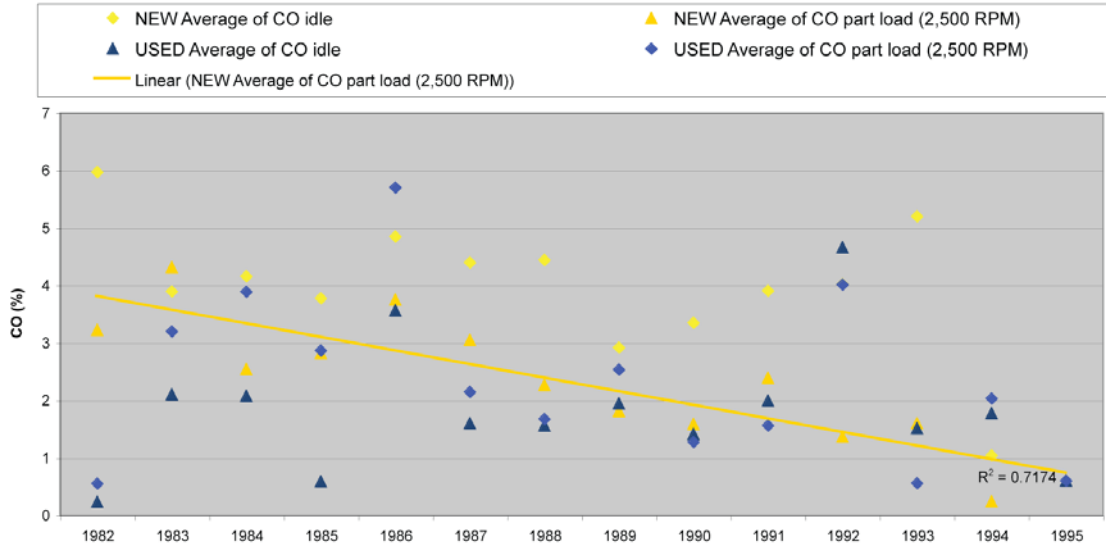
Box and whisker plots comparing range of emissions for vehicles by year of manufacture (YoM)



The median values shown by the solid horizontal bars in the box and whisker plots does suggest that vehicles made before 1987 emit more CO (except for those made in 1992), especially under the part-load condition. However, no clear relationship can be seen between HC and YoM.

The lack of a clear link can be seen in the chart below. This analysis has split Japanese-used vehicles from New Zealand-new as the Japanese-used vehicles were built to different standards and would not be expected to have the same results as New Zealand-new ones. The only trend that was significant was for emissions of CO at part load for New Zealand-new vehicles to decrease with age (see trend line on graph). However none of the other measurements or test results for CO or HC (not shown here) showed any significant trends.

Average CO emissions for New Zealand-new and Japanese-used vehicles



WOULD THE SCRAPPED VEHICLES PASS AN EMISSIONS TEST?

Because New Zealand does not have any in-service test limits for emissions we need to look at those in place in other jurisdictions to consider if vehicles are ‘clean’ or ‘dirty’. Also, because New Zealand did not have a legal requirement for vehicles to be built to a specific standard until 2004, age is not necessarily a relevant guide. However, in the absence of any other standards, the results have been compared against the different limits in place in the UK for vehicles of known ages.

The emissions test limits that apply for petrol vehicles in the UK are:

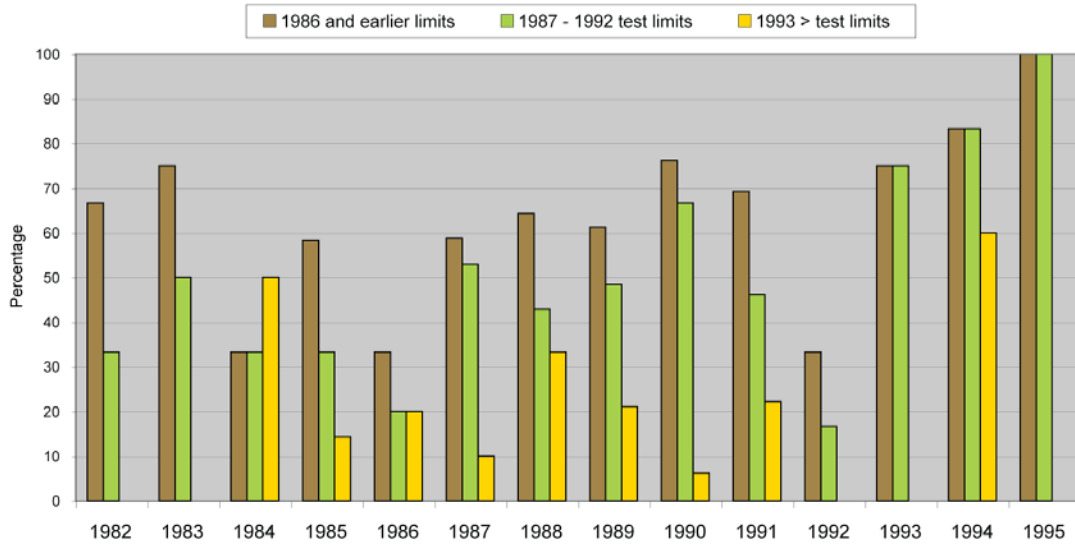
- First used before 1 August 1975 (visible smoke test only)
- First used between 1 August 1975 and 31 July 1986 (4.5% CO, 1,200ppm HC)
- First used between 1 August 1987 and 31 July 1992 (3.5% CO, 1,200ppm HC)
- After 1 August 1992 (0.5% CO and 200 ppm HC)¹¹

Of those tested, 47% of vehicles would have passed the UK emissions test for pre-1992 vehicles (3.5% CO, 1,200ppm HC).

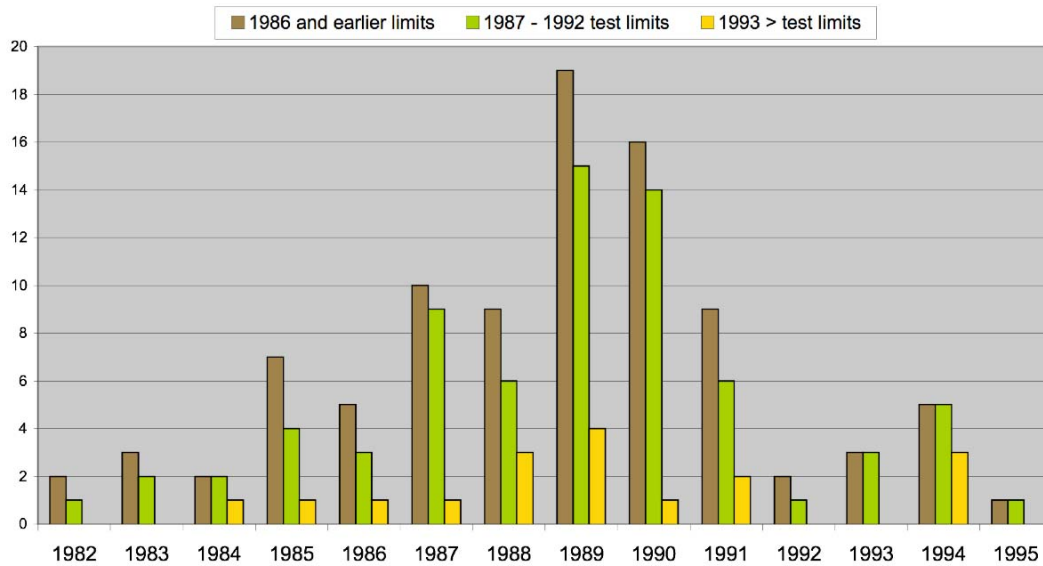
Only 11% of the vehicles tested would have passed the UK’s test limits for post-1992 vehicles (0.5% CO and 200ppm HC) shown in yellow in the graph below, but there was no clear trend for newer vehicles to be more likely to pass. Also, as most vehicles tested were pre-1992 this is not unexpected. The finding of older vehicles passing the modern test is a little surprising as few New Zealand-new vehicles would have been fitted with the technology assumed to be required to pass this quite strict test. The yellow columns in the graph below show the percentage of mid-1980s vehicles that would pass the post-1992 test limits. There are, of course, very few vehicles in these earlier model years (as shown in the second graph), but it remains a useful indicator that age alone is not a good guide to emissions.

¹¹ NB: Lambda values are also tested in the UK for vehicles after 1992, but have not been considered here.

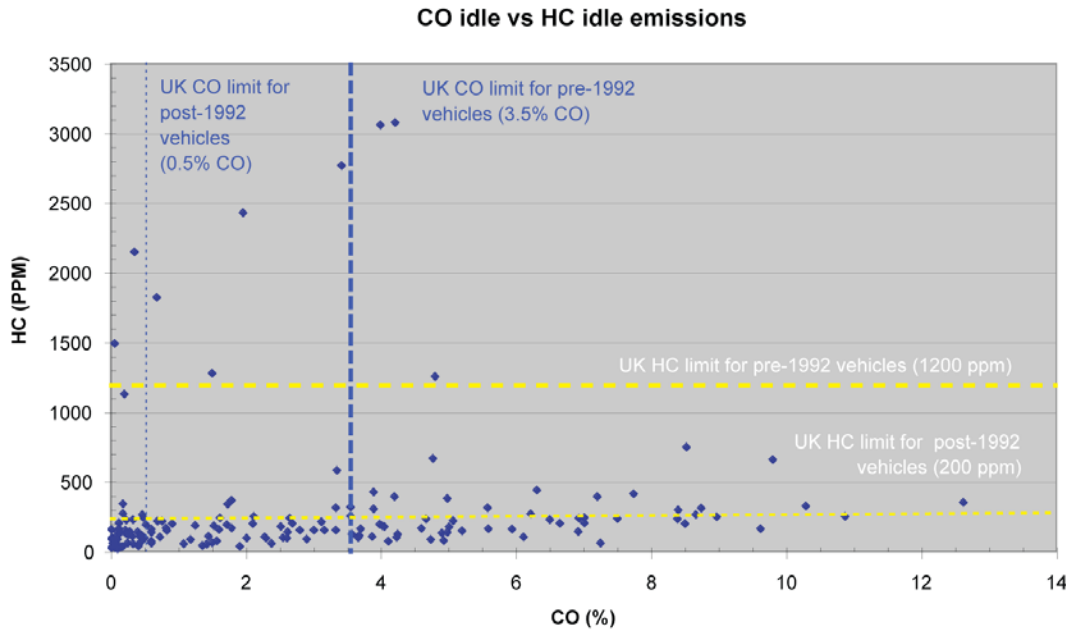
Percentage of vehicles tested in vehicle year that would pass different UK emissions test limits



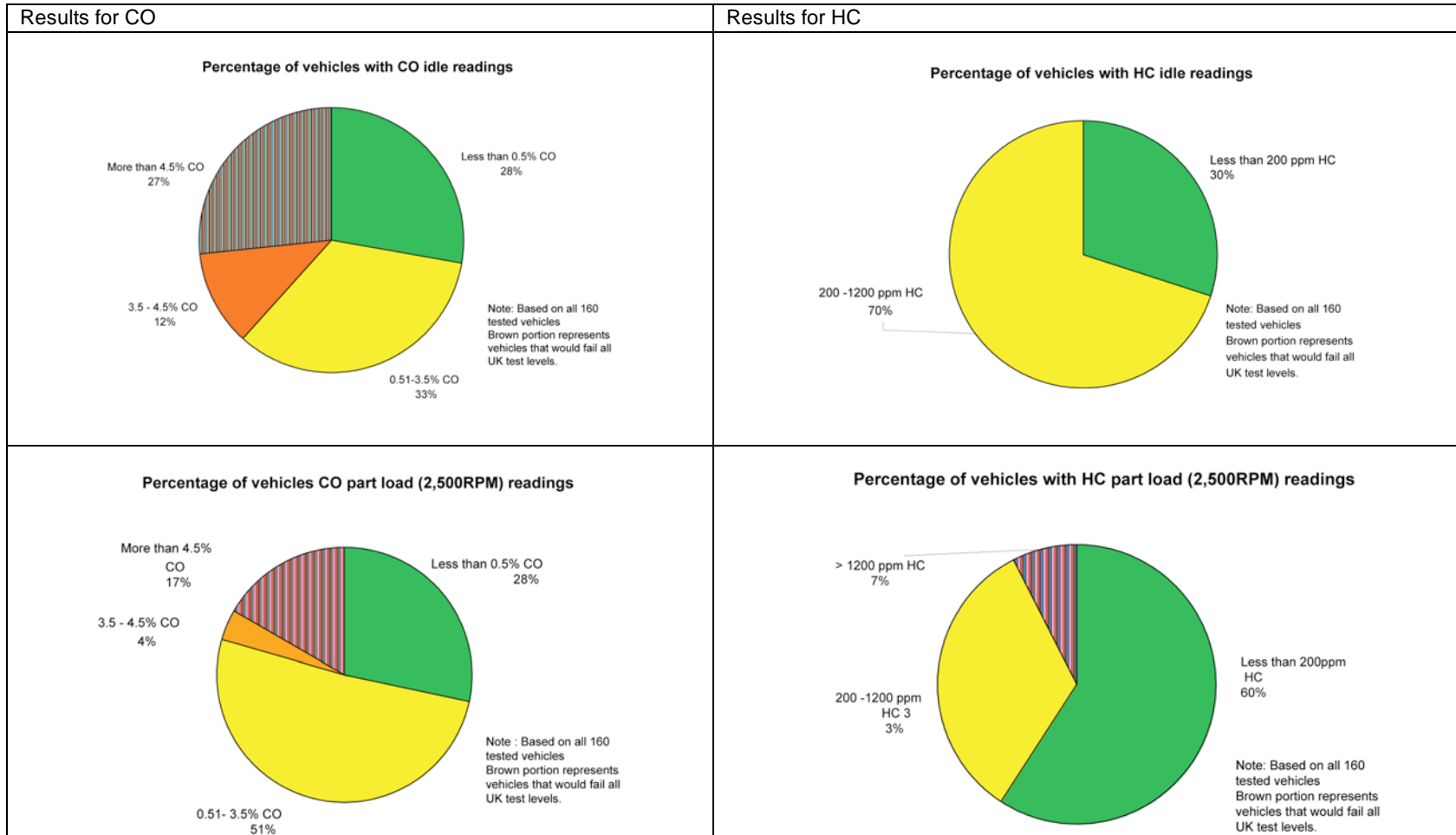
Number of vehicles tested in vehicle year that would pass different UK emissions test limits



As with earlier studies, such as the Pilot Project, there was a much wider range of results for CO emissions than for HC emissions. It is useful to show the results on one graph to show the spread. Note: one data point (4.93% CO vs 5287 HC) is not shown as it caused significant distortion to the graph. The data has been included in relevant analysis.



The following pie charts show the percentage of vehicles that would pass the different in-service test limits that are in place in the UK for vehicles 'first used' in different years. The green segments show those that would have passed the most recent (post-1992) standards. The yellow segments represent the vehicles that would have passed the 1987-1992 limits. Those in the orange segment would pass the test limits for vehicles built from 1978-1987 and those in the brown segments would not pass any UK test and would be classified by most people as 'high emitters'.

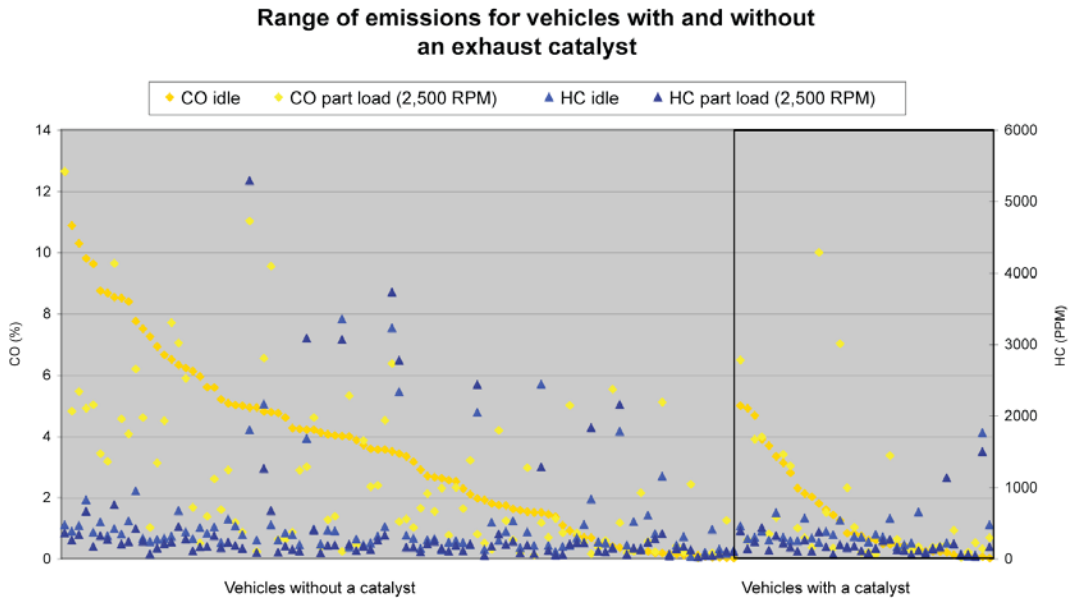


PRESENCE OF A CATALYTIC CONVERTER AS A GUIDE TO EMISSIONS

When the vehicles were accepted by the BCCC the operator recorded a range of details, including whether a catalytic converter could be seen. If there was one, the BCCC did not attempt to determine if it was still working. In some cases it is also possible that the operator did not see the 'cat' even if there was one (perhaps because of its location), so the figures discussed are not 'absolute'.

The range of emissions-reduction equipment on a vehicle is far wider than just the presence or absence of a catalytic converter (or carburettor) discussed below. However, because these items are easily seen they were the only two considered during the survey of the vehicle at the time of scrappage. The survey did not attempt to identify any other types of emissions control technologies on the vehicles.

As expected, the presence (or absence) of a 'cat' was the variable that proved to be the most useful as a guide to the likely emissions of a vehicle.



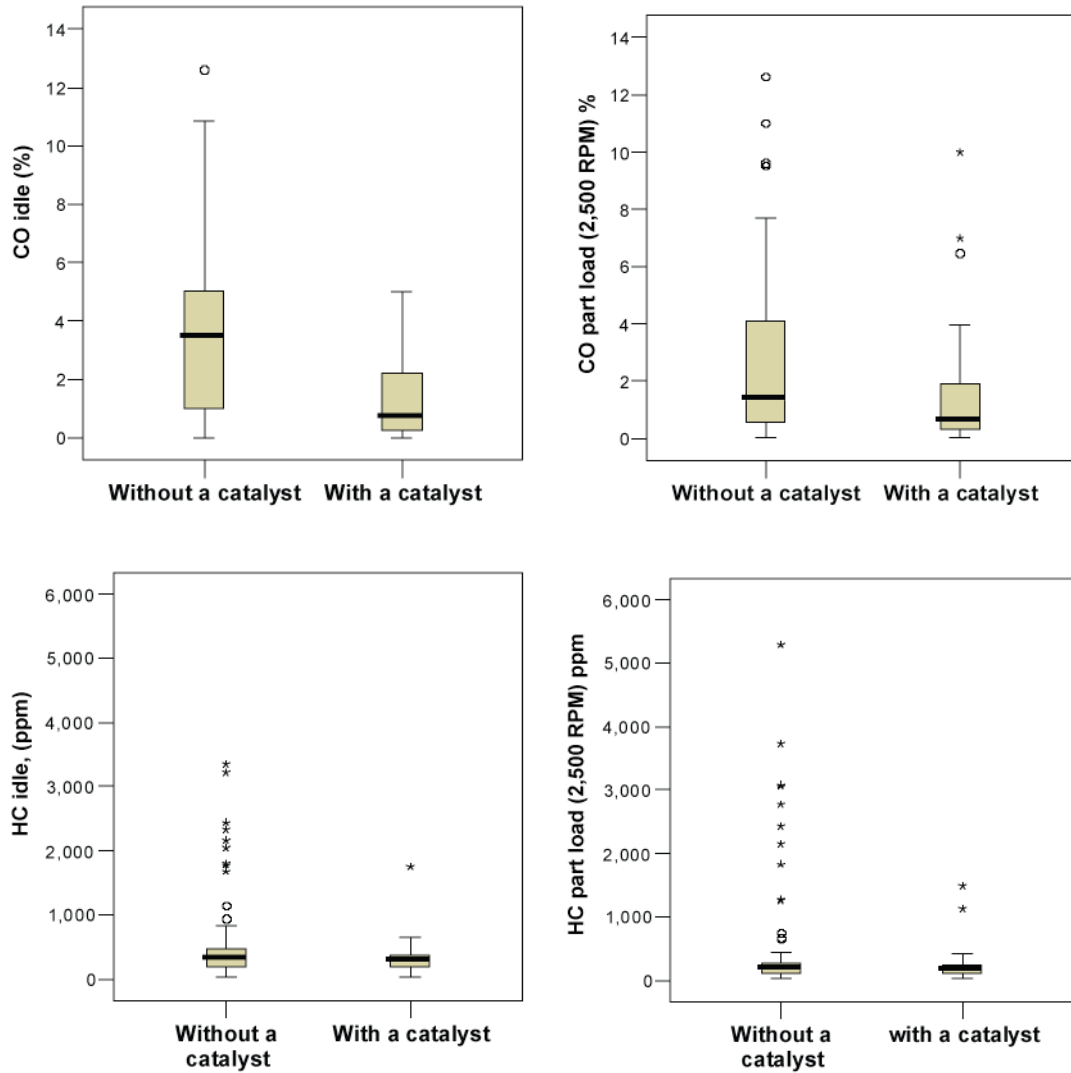
Vehicles without a catalytic converter emitted significantly (Sig. < 0.05¹²) more CO than a vehicle with a catalytic converter under both idle and part-load conditions (2500 RPM). However, the difference in HC concentrations emitted from the two categories of vehicles is not significant, although it was noted that about 10 vehicles without a 'cat' emitted very high concentrations of HC. Given the very small number of New Zealand-new vehicles reported as having 'cats' (18), care must be taken when interpreting this finding for New Zealand-new vehicles.

The low CO readings from vehicles with 'cats' as they are being scrapped is of interest as it shows that the technology is robust and that the emissions-control technology was still functioning well on vehicles that were manufactured in the 1980s and had travelled over 200,000km.

Of the 36 vehicles recorded as having 'cats' and which were emissions-tested, about half would pass the present day emissions test required in Europe for modern 'cat'-equipped vehicles and virtually all (94%) would pass the European test appropriate for their age.

The average emissions from non-'cat' vehicles were higher than for those with 'cats', but more than 70% of the non-'cat' vehicles tested would still have passed the UK test limits appropriate for their age and technology (ie, pre-1992 test). This is an unexpected finding as it was assumed that more of the vehicles being scrapped would be at the end of their mechanical life and so would have higher emissions.

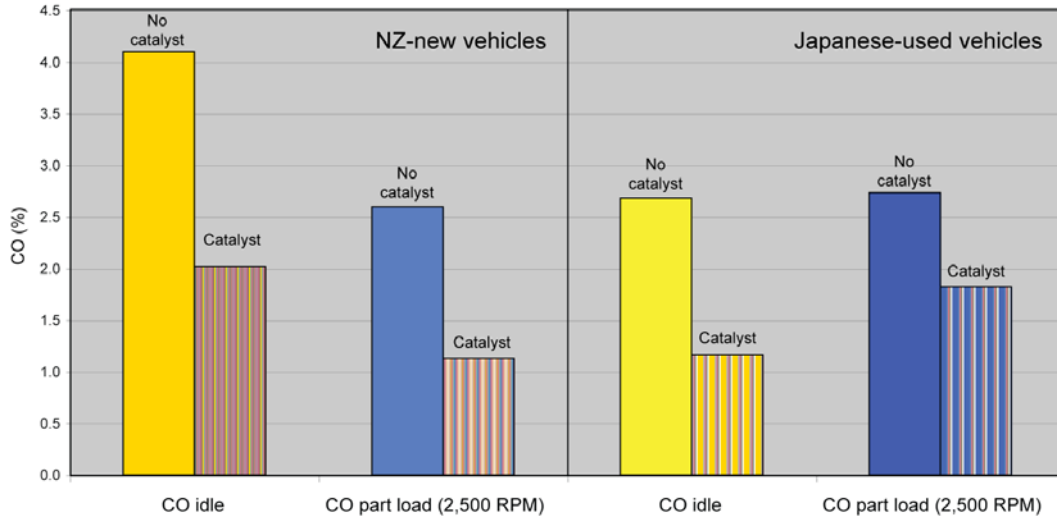
¹² ie the finding is statistically significant at the 95% confidence level, or we have at least a 95% probability to say that this finding is true.



Also of note is that the emissions of CO at high-idle (2,500RPM) from vehicles identified as being Japanese-used, were higher than for the same vehicles at idle. The difference was statistically significant (Sig. < 0.05).

The difference between idle and high-idle is present when considering the median values. This finding is the opposite of that found for CO emissions values for New Zealand-new vehicles. The latter show consistently higher emissions for CO at idle than for high-idle (part load).

Average CO emissions for NZ-new and Japanese-used vehicles with and without exhaust catalysts

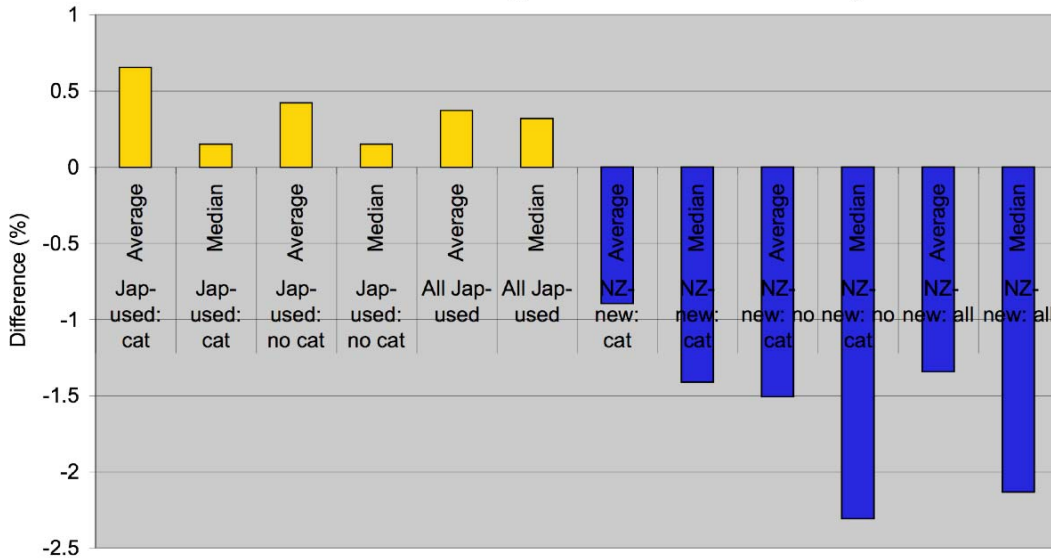


It is possible that this result for Japanese-used vehicles is because Japanese in-service emission tests do not test vehicles at high-idle. There may therefore be some aspect of these vehicles that is not designed or maintained to pass a high-idle test. The relatively small sample and the fact that the vehicles were at the end of their mechanical life, rather than being a sample of the overall fleet, means caution must be taken in interpreting this finding.

This effect has not been noticed in previous research, such as the Pilot Project. A re-analysis of some of the data from the Pilot Project shows the same effect of higher emissions at high-idle for Japanese-used vehicles in a much larger sample of vehicles (770 vehicles). However, the authors used a different way of categorising the vehicles in their study and the results may not be directly comparable.

If the finding is correct, it may indicate that Japanese-used vehicles might not be able to pass the UK two-part CO test, with a 0.5% CO limit, even though it might appear to be a reasonable test for a vehicle with a catalytic converter. In this case, vehicle owners might face the expense of trying to repair a vehicle to reduce its high-idle CO amount, when it is in fact operating as the manufacturer intended it to and there is no fault to be remedied.

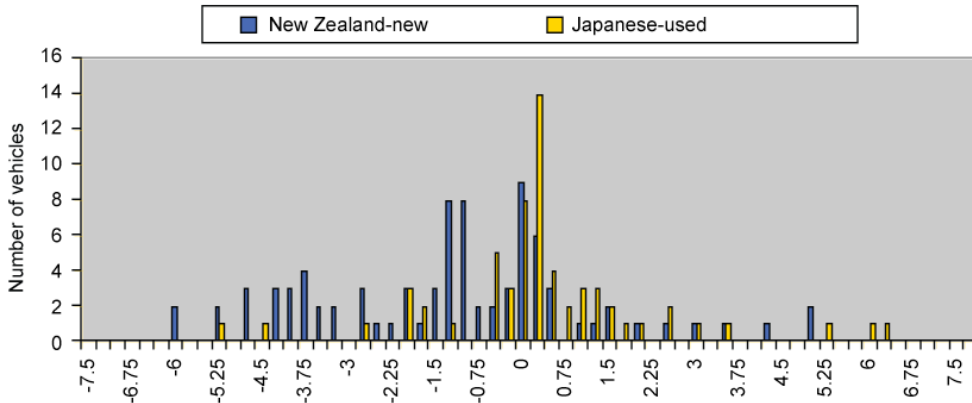
Difference between high idle and idle for CO readings



NB: A negative value means high-idle result was lower than natural idle result

The difference between idle and high-idle (part load) CO emissions for individual vehicles is still clear, but examples can be found of vehicles with large positive or negative differences between idle and high-idle.

Range of differences for individual vehicles that were tested



JAPANESE IN-SERVICE TESTS

There is a popular perception that Japanese-used vehicles are disproportionate contributors to poor air quality. Previous research has shown this not to be the case, and this study confirmed that finding. Of the vehicles which could be identified as being Japanese-used or New Zealand-new, and for which there was emission-test data, the Japanese-used vehicles were found to have much lower CO emissions at idle and high-idle, and therefore are assumed to have lower on-road CO emissions. This finding of the Japanese used-vehicles being cleaner was expected because of the greater percentage of Japanese-used vehicles with catalytic converters present. However, comparing just those vehicles with ‘cats’, the measured emissions from the Japanese-used vehicles were still lower on average.¹³

Average emissions for vehicles identified as having catalytic converters

	CO idle	CO part load (2,500 RPM)	HC idle	HC part load (2,500 RPM)
New Zealand-new vehicles	1.7	1.1	4.8	3.1
Japanese-used vehicles	1.0	2.2	2.8	2.4

Because Japan has its own in-service emission tests it is appropriate to look at the Japanese test limits, rather than UK limits, to see if the Japanese-used vehicles are performing as expected. Testing in Japan is simpler than in the UK. The limits that apply are at (natural) idle: 1% CO and 300ppm hydrocarbons. Of those vehicles tested where the import status could be identified, 41% would have failed the Japanese in-service tests. Most, although not all, of those that would have failed were identified as not having a catalytic converter.

Percentage of vehicles identified as being Japanese-used that would pass Japanese in-service emission tests

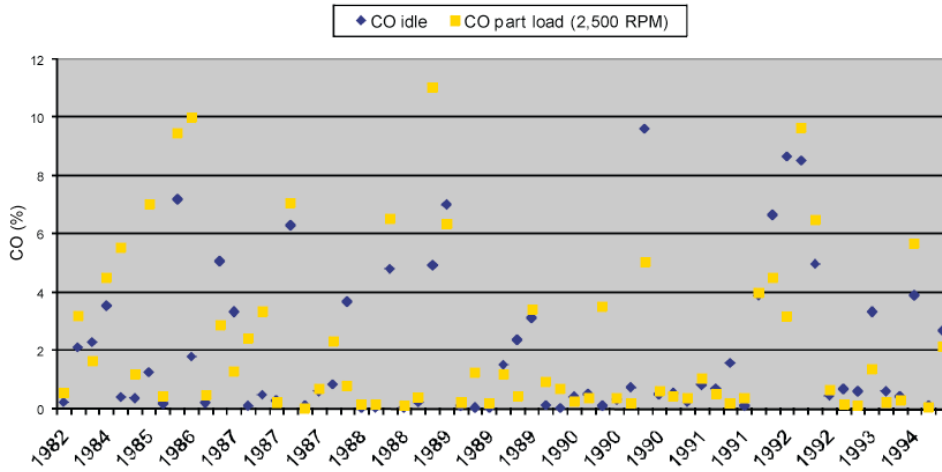
Japanese in-service emission test limits	Japanese-used vehicles identified as not having a catalytic converter	Japanese-used vehicles identified as having a catalytic converter	All Japanese-used vehicles
Fail	54%	28%	42%
Pass	46%	72%	58%

There was no trend for older Japanese-used vehicles to be more likely to have higher CO emissions. More interestingly, there was no trend for vehicles that arrived in New Zealand more recently to have

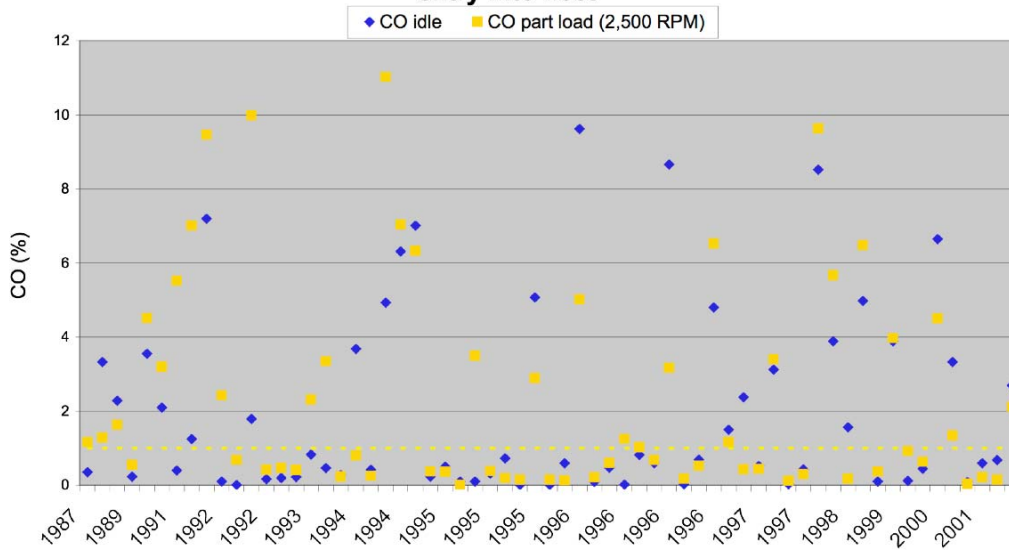
¹³ Note that, because on-road emissions are strongly influenced by driving conditions (eg, speed and rate of acceleration and braking) and engine temperature, it is not possible to use these results to state that on-road emissions would be lower.

lower emissions. It was expected that more recently imported vehicles would have lower emissions because they would have been required to comply with Japanese in-service tests and would not have been exposed to lead in New Zealand's fuel until 1996.

CO emissions from Japanese-used vehicles sorted by vehicle year



CO emissions from Japanese-used vehicles sorted by date of entry into fleet



REMOVAL OF CATALYTIC CONVERTERS

About a quarter of the vehicles that the BCCC recorded information for were identified as having been fitted with a catalytic converter (60/219). In theory, all of the Japanese-used vehicles should have been fitted with a catalytic converter. However, according to the BCCC only 45% (41/92) of the Japanese-used vehicles (whose import status could be identified) had a catalytic converter fitted.

Number of vehicles identified as having a catalytic converter

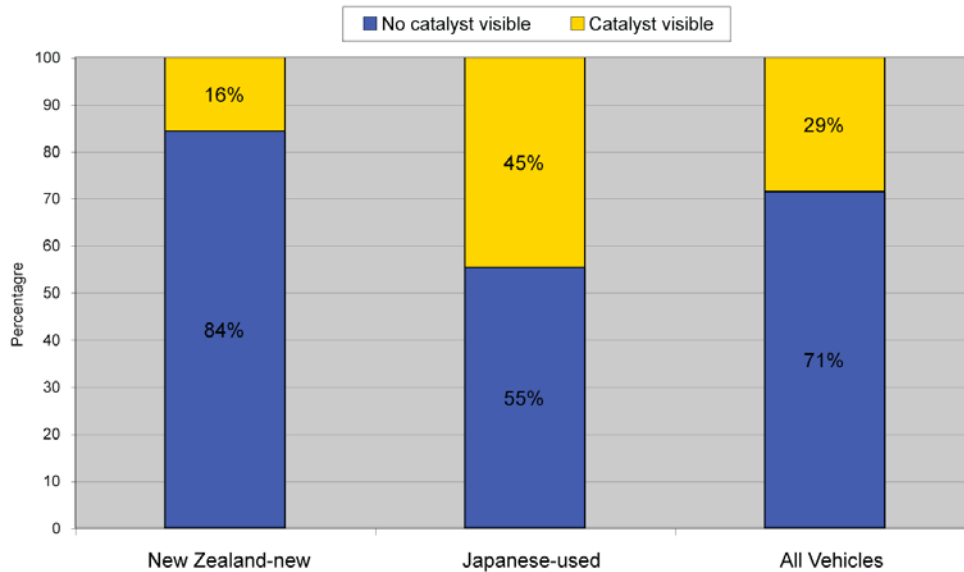
Catalytic converter present (Yes/No)	New Zealand-new vehicles		Japanese-used vehicles		All vehicles	
	No Cat	Cat	No Cat	Cat	No Cat	Cat
Number of vehicles	97	18	51	41	155	59
Percent	84%	16%	55%	45%	71%	29%

This finding suggests that the rate of removal of catalytic converters from Japanese-used vehicles being scrapped was very high, and considerably higher than the five percent removal figure given in the Pilot Project as a national average.

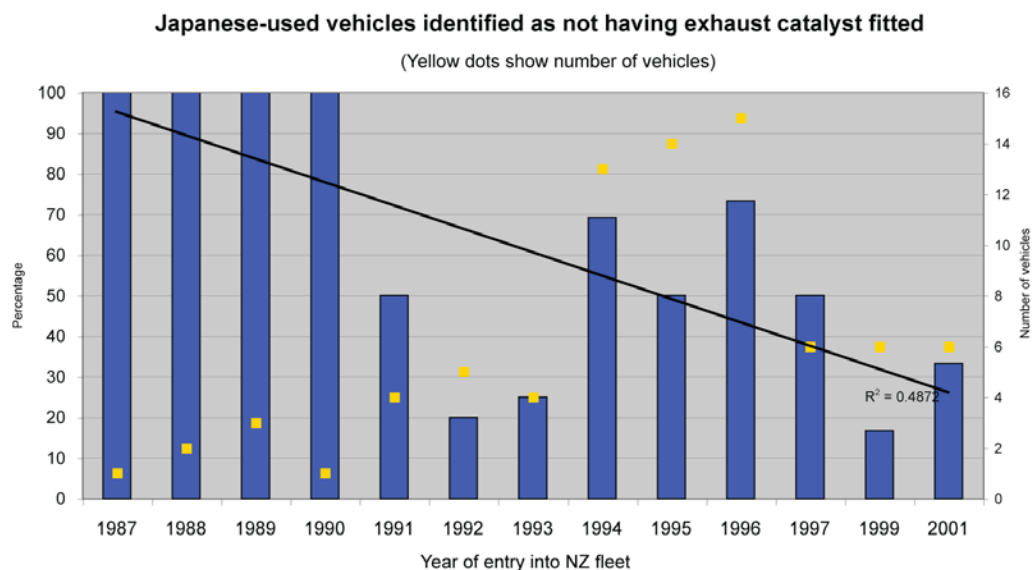
Although this finding is likely to reflect a high rate of 'cat' removal it may also reflect that it can be difficult to identify the presence of a 'cat'. At least 13 of the Japanese-used vehicles identified by BCCC as not having a 'cat' had CO emissions consistent with a vehicle fitted with a catalytic converter (ie, CO <1% and HC<300ppm). It is possible that this was achieved because, although the 'cat' had been removed, the remaining engine-management systems were still effective in minimising the emissions to a significant degree. However, even if those vehicles with low emissions were actually wrongly identified and did have 'cats' (and so are included in the total with 'cats'), this would still imply that about 40% (38/92) had had their catalytic converters removed before disposal.

It suggests that further work to identify the number of vehicles in the New Zealand fleet with and without 'cats' may be of value.

Presence of exhaust catalyts in scrapped vehicles



No indicators could be found to identify which Japanese-used vehicles had had their catalytic converters removed although there was a greater likelihood for vehicles imported more recently to still have their 'cats' present. It is not possible to estimate the rate of removal of 'cats' from New Zealand-new vehicles as none of those scrapped were legally required to be fitted with one when manufactured.



PRESENCE OF A CARBURETTOR AS A GUIDE TO EMISSIONS

Of the vehicles inspected by the BCCC, 130 had information on whether the vehicle had a carburettor or a catalytic converter present. As expected, given the age of the sample, the majority of this group of vehicles (57%) had a carburettor and no 'cat' and the smallest group was that with a 'cat' as well as a carburettor (7%).

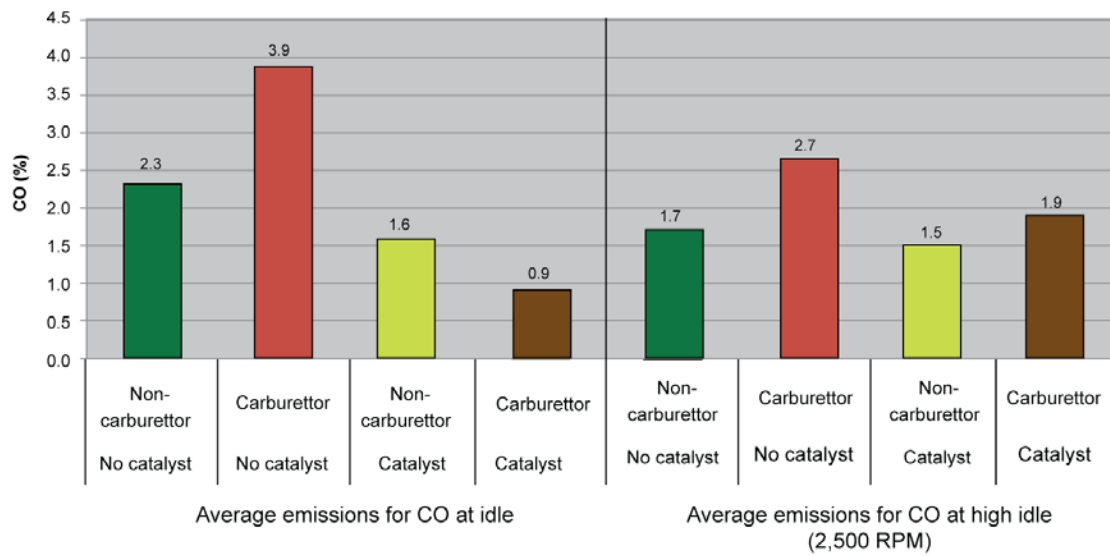
Presence or absence of a 'cat'	Presence or absence of a carburettor	Number of vehicles	Percent of sample
No 'cat'	Carburettor	75	57%
No 'cat'	Non-carburettor	19	15%
Cat	Non-carburettor	27	21%
Cat	Carburettor	9	7%
Total		130	100%

Consistent with earlier research, the presence (or absence) of a carburettor was found to be significant as a guide to the likely emissions of a vehicle. In general, carburettors are older technologies with components that wear and tend to drift 'out of tune' over time, providing less-precise amounts of fuel to be burned and potentially leading to higher emissions. The study did not identify what other forms of ignition or fuelling control vehicles had, although, vehicles without carburettors can be assumed to have some form of fuel-injection system. More recently, vehicles would also have an electronic engine-management system which uses electronic control units (small computer chips and sensors) to constantly monitor and adjust the engine and so are inherently better at keeping engines 'in tune'.

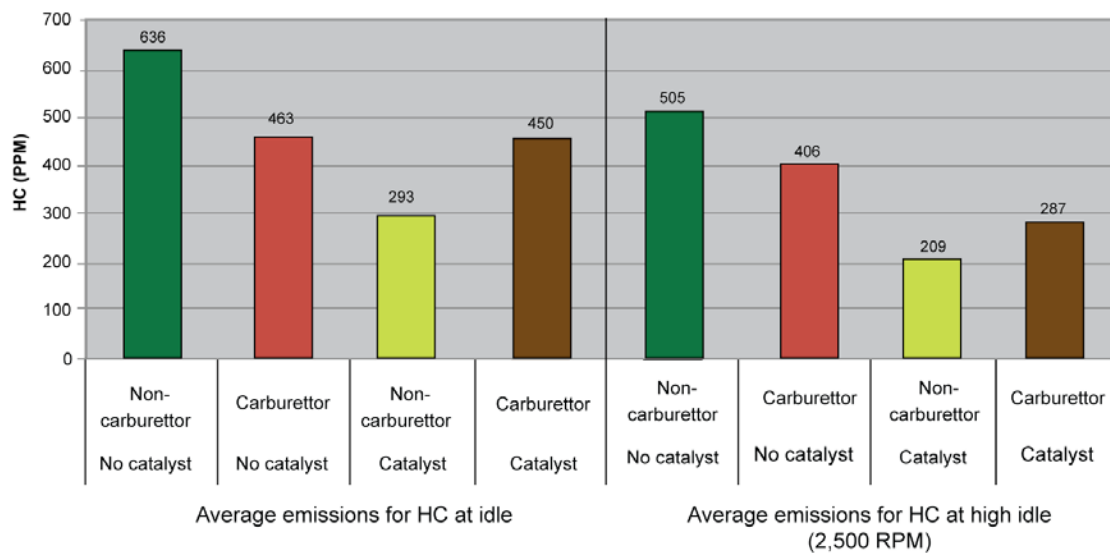
It would be reasonable to expect that vehicles with carburettors would have higher emissions than those fitted with more advanced technology. This was found to be true for this sample. In fact, the difference between the average emissions of both CO and HC for vehicles identified as having a carburettor and those without was almost identical to the difference for vehicles with and without a 'cat'. Although the effect of the two different technology types was the same, the actual number of vehicles fitted with each was quite different.

As expected, vehicles with a carburettor and without a catalytic converter were found to have significantly higher emissions than vehicles with more advanced technologies. Equally, vehicles with fuel injection (ie, identified as not having a carburettor) and with catalytic converters were generally the cleanest vehicles, but the differences between the other groups were not statistically significant.

CO emissions from vehicles with and without catalysts and carburettors



HC emissions from vehicles with and without catalysts and carburettors



If the intention of any future scrappage scheme is to improve air quality, then the provision of a larger incentive for vehicles with carburettors (and without catalytic converters) in order to actively encourage the scrappage of these vehicles would achieve the greatest benefits, as these are likely to have the highest on-road emissions. Focusing on vehicles without a 'cat' is likely to result in the perverse outcome of people removing them solely to take part in the trial.

VISIBLE SMOKE AS AN INDICATOR OF EMISSIONS

In 2006, the government introduced a requirement that vehicles must not show visible smoke at Warrant of Fitness (WoF) and Certificate of Fitness (CoF) testing. This was intended to target the very worst vehicles on the road and those likely to fail the on-road '10-second Rule' which makes it illegal for vehicles on the road to emit smoke for more than 10 seconds.

As part of this trial, vehicles were tested for visible smoke by both the BCCC at the time the vehicle was collected and then prior to being emissions-tested by ETNZ. The two groups identified quite different vehicles as showing smoke. Only five vehicles were identified by both groups as emitting smoke.

Presence of visible smoke

	Vehicles identified by Broken Car Collection Company as showing visible smoke	%	Vehicles identified by Emission Testing New Zealand as showing visible smoke	%
No smoke	53	39%	138	90%
Smoke	82	61%	15	10%
Total completed entries	135		153	
Blank	199		0	

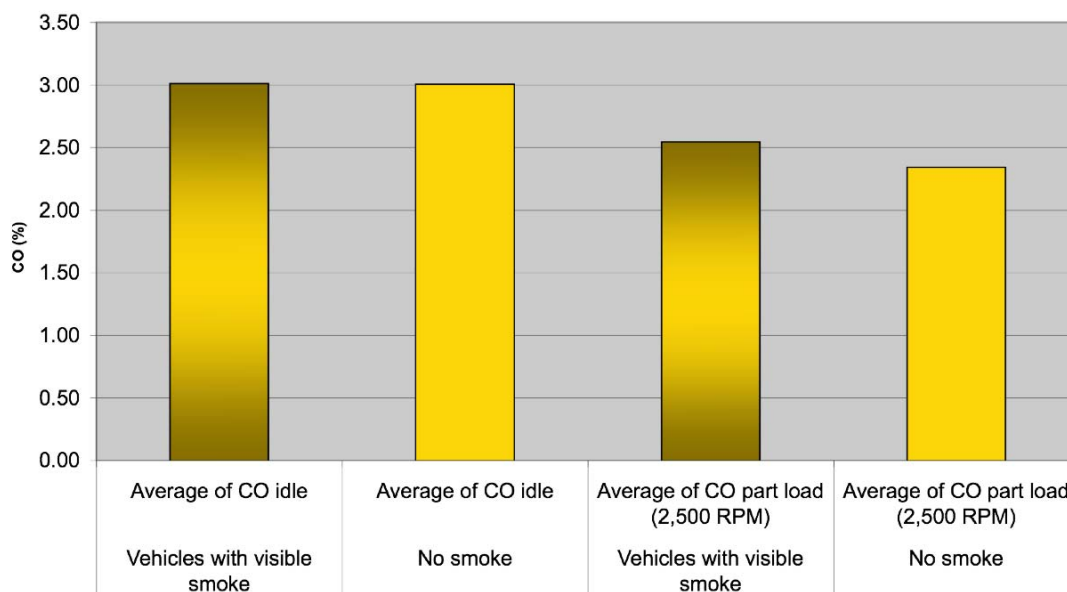
The divergent results for the two samples suggest that at least some of the problems that caused smoke in the vehicles may have been intermittent, or that external factors such as ambient lighting, whether the engine was properly warmed up, or the presence of water vapour (which is not smoke and occurs naturally as part of the combustion process) may have been important.

For the set of vehicles identified by BCCC as having smoke that were emissions-tested, no relationship could be found between the data from the emissions testing and the reported presence or absence of visible smoke. The vehicles had similar levels of emissions as vehicles without smoke. As those with smoke were about two-thirds of all the vehicles tested, this is not entirely surprising. However, the 15 vehicles identified by ETNZ as showing visual smoke emitted significantly (Sig. < 0.05) more HC (both idle and part-load) than those not showing smoke.

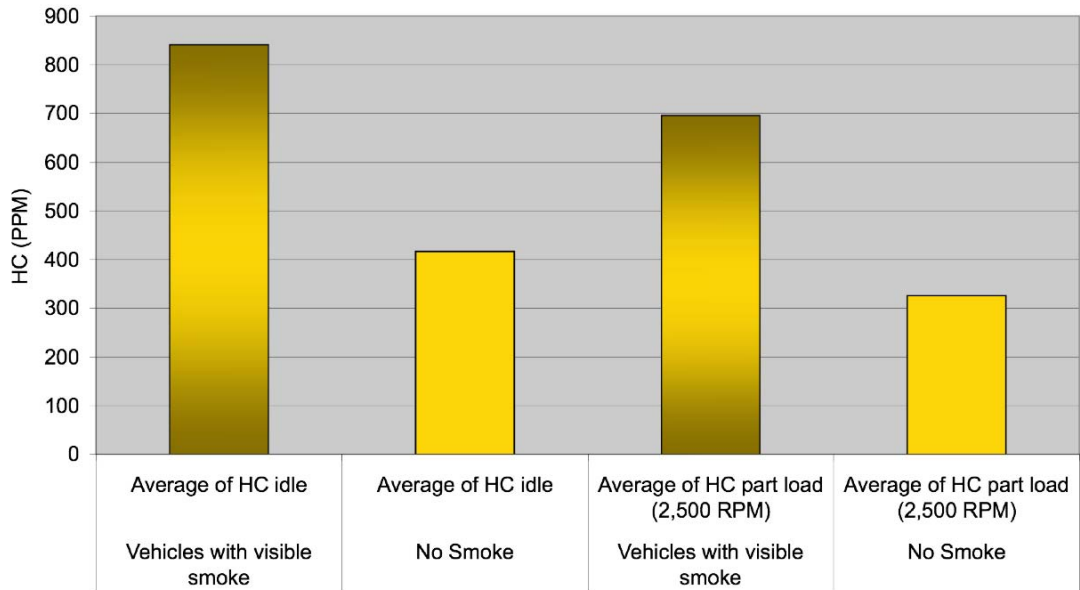
Unlike the HC emissions, the measured CO emissions emitted from those vehicles showing smoke were essentially the same as those without smoke. This is to be expected as the faults that generate high HC readings (such as poor fuelling or burning lubricating oil) generally lead to lower CO readings.

Although the tendency was for smoky vehicles to have high levels of HC emissions, several vehicles that were reported as showing smoke, and which were emissions-tested, had extremely low levels of harmful emissions. Some of the values of emissions recorded for vehicles reported by ETNZ to be showing smoke are so low it is more than likely that visible fumes were actually water vapour. As would be expected, other vehicles that showed high emissions in the testing (especially those with high CO but low HC emissions) had no visible smoke.

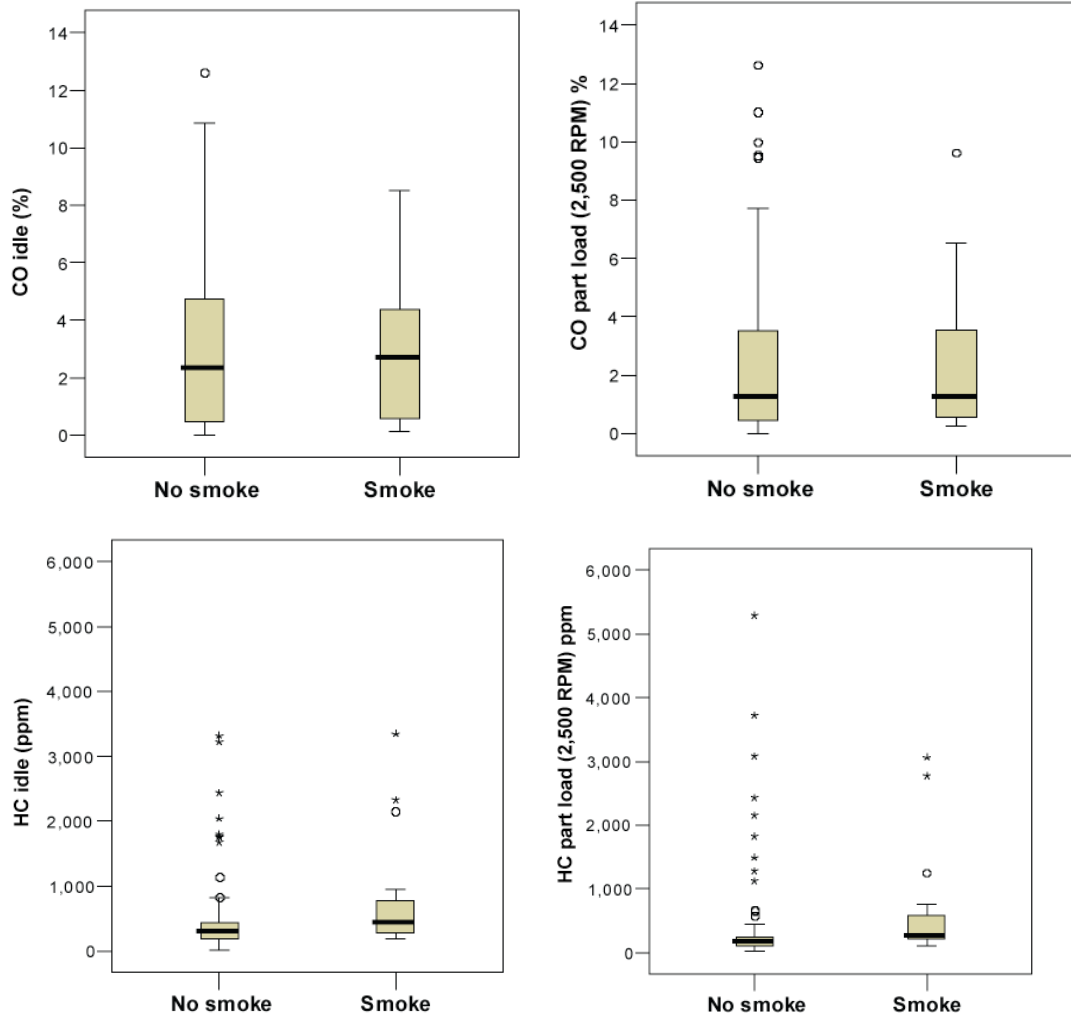
CO emissions for vehicles identified as showing visible smoke by ETNZ



HC emissions for vehicles identified as showing visible smoke by ETNZ

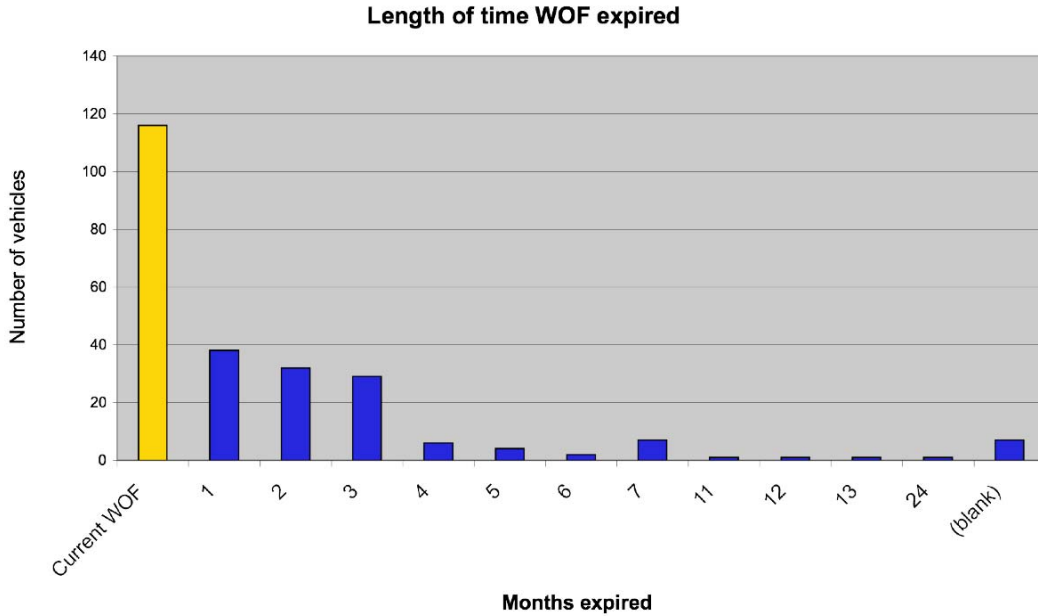


Box and whisker plots for emissions from vehicles showing smoke

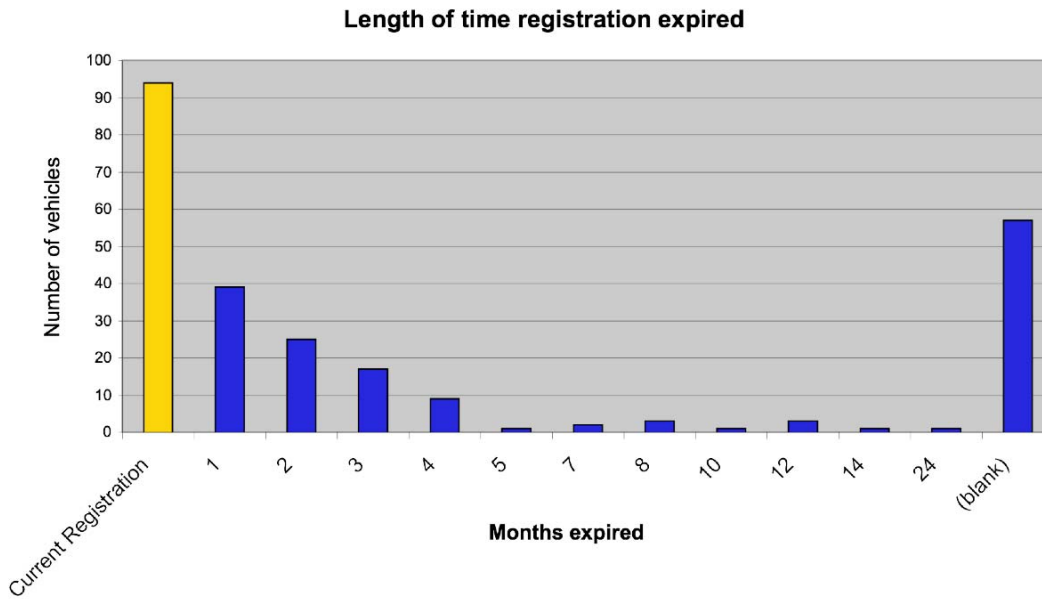


DID THE SCRAPPED VEHICLES HAVE A CURRENT WOF OR REGISTRATION?

One hundred and sixteen vehicles were recorded as having valid Warrants of Fitness (WoF) at the time of scrapping, 122 did not have a warrant and seven were not recorded. Of those without a WoF, 38 had expired WoFs of less than one month, and another 32 had expired two months previously. Fifty two vehicles were recorded as not having had a WoF for three or more months and should not have been eligible for the scheme. The BCCC advised that some owners misrepresented the length of expiry of their WoF in order to take part in the scheme and that this fact was not identified at the time of collection.



Seventy seven vehicles had current annual registration, 118 did not and 14 provided no information. Of those without registration, 27 had been unregistered for less than one month and 67 had been unregistered for three months or less.



PRESENCE OR ABSENCE OF WOF AS REASON TO SCRAP VEHICLE

As noted, vehicle owners were asked if their decision to scrap the vehicle was influenced by the offer of the PT pass. Approximately three-quarters (74%) said that it was. A question that arises from this result was whether the offer of a PT pass affected the decision-making of any specific group of people.

For example, it was possible that owners of a vehicle in reasonable mechanical order and with a current WoF might otherwise have sold it, rather than scrapped it if they wished to dispose of it. However, there was no evidence that having (or not having) a valid WoF affected the decision to take part.

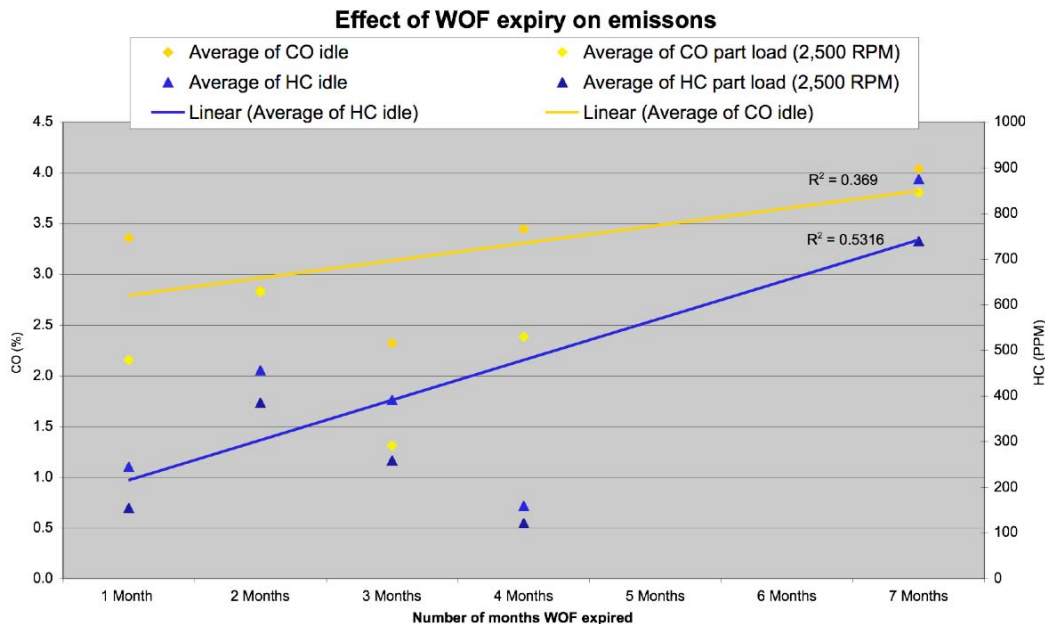
Current WoF as predictor of taking part in scheme

	No WoF	Current WoF	(blank)	All vehicles
Decision not made because of voucher	25%	26%	13%	25%
Decision made because of voucher	74%	73%	75%	74%
(blank)	2%	1%	13%	2%
Grand Total	129	116	8	253

WOF AS AN INDICATOR FOR EMISSIONS

According to anecdotal evidence, many vehicle owners use WoF testing as a substitute for regular maintenance, relying on the WoF tester to inform them that the vehicle has any other mechanical faults needing repair.

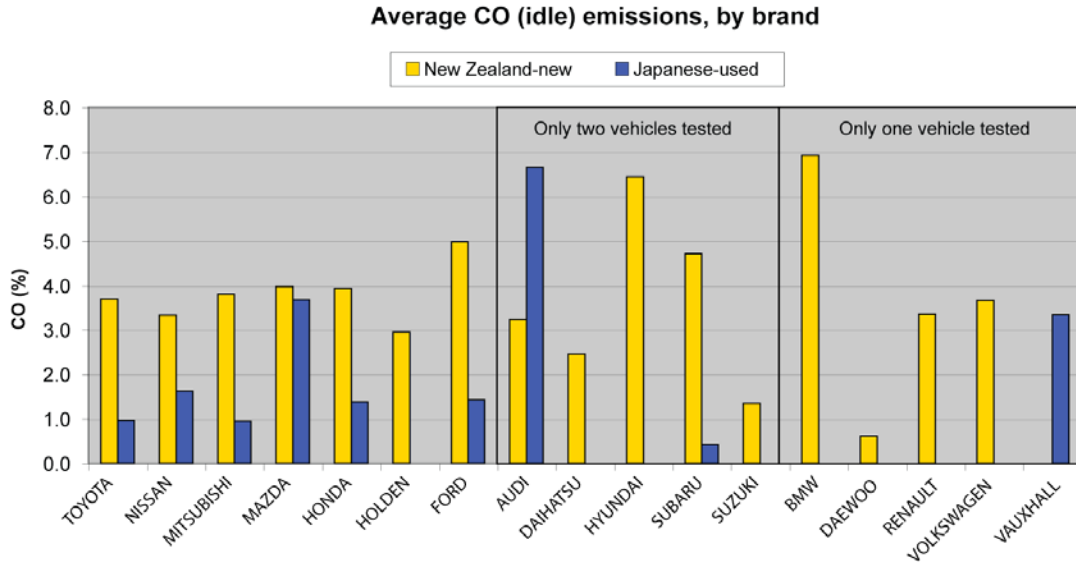
There was a trend for vehicles with WoFs that had expired for more than two or more months to have higher emissions, but the number of tested vehicles with expired WoFs was very small, so it is not clear if this is a valid finding. The finding may also reflect that vehicles with expired WoFs may have been unused for some months before being submitted for scrappage and subsequent emissions-testing. In these cases the fuel in the vehicle might have deteriorated.



Cases in which the owners identified that they were scrapping the vehicle because of exhaust problems, showed no obvious pattern of higher emissions evident in the samples that were emissions-tested. There was also no relationship between the levels of emissions and any of the other fault types recorded in the survey as reasons for scrapping the vehicle.

VEHICLE BRAND AS AN INDICATOR OF EMISSIONS

Given the small number of vehicles of most brands, it is not possible to make meaningful statements about emissions of different brands of vehicles. The following graph is more useful to show the difference between emissions for New Zealand-new and Japanese-used vehicles compared with the differences between brands.



The difference between the emissions from the Japanese-used vehicles in the sample and the New Zealand-new ones is likely to be because Japanese-used vehicles were more likely to have a catalytic converter. There are no obvious explanations for the differences among the brands.

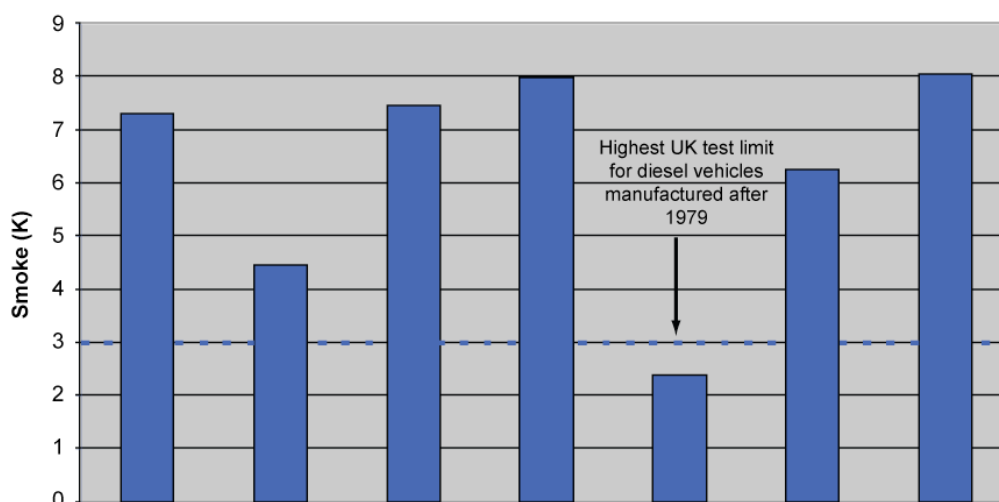
DIESEL VEHICLES

Only seven diesel vehicles were tested and this sample is too small to be useful in drawing wider conclusions about the New Zealand vehicle fleet.

It is a concern that, of those vehicles tested, only one vehicle would have passed the least stringent UK emissions-test limits for diesel vehicles built after 1979 (non-turbo vehicles are required to meet $K=2.5m^{-1}$ and turbo vehicles $K=3m^{-1}$). The average smoke measurement of $K=6.2m^{-1}$ is almost twice that reported as average for a set of 21 diesel vehicles tested in 2005 for the Pilot Project¹⁴. This high level of smoke confirms that it is appropriate to target older diesel vehicles as part of any scrappage scheme because of their excessive contribution to poor air quality. It noted, though, that at least some of the faults responsible for the excessive emissions could have been caused by lack of basic maintenance and could have been easily rectified.

Apart from their relatively high levels of smoke emissions, the characteristics of the diesel vehicles were not obviously different from those of petrol vehicles of the same age range (1989-1996), odometer reading (110,000-330,000 km) and usage patterns. All of those tested, which could be accurately identified, were Japanese-used vehicles.

Emissions test results for the seven diesel vehicles



Because diesel vehicles are responsible for most of the fine particulate emissions (which are generally considered the most harmful), the very low rate of participation in the scheme is of concern. Further research on why the disposal patterns of diesel vehicles appear to be different from those for petrol vehicles should be considered. Alternatively, any further scrappage scheme may need to consider the issues relating to diesel vehicles more carefully if the removal of the most environmentally damaging parts of the diesel fleet is to be achieved.

¹⁴ <http://www.transport.govt.nz/assets/NewPDFs/06-09-30-Final-diesel-report.pdf>

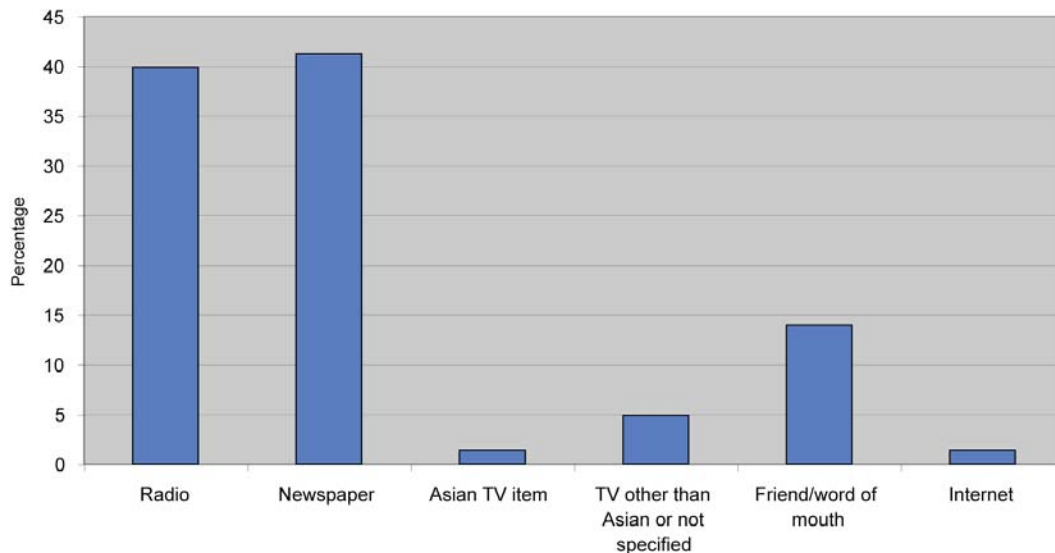
FINDINGS FROM FOLLOW-UP SURVEY ON OUTCOMES OF SCRAPPAGE SCHEME

About four months after the scrappage scheme ended, participants were contacted for a short telephone survey about their experiences with the scheme. One hundred and forty three people were able to be contacted and took part in the survey.

Most people reported that they found out about the scrappage scheme from the paid advertising in the print media and on the radio. This finding will be important as it implies that a relatively large budget for paid advertising will be necessary to raise awareness of any future scrappage scheme. When the trial was being developed it was hoped that the media coverage of the launch would be sufficient to raise awareness.

While ethnicity was not a question asked in the follow-up survey, a relatively large number of people who took part in the trial were Chinese-speaking and this necessitated the hiring of a translator to survey this group. Unfortunately, many of this group could not be reached when the phone survey was undertaken but for those who could be contacted, a TV news story on the local Chinese-language pay-TV channel and word-of-mouth communication were found to be particularly important as sources of information. The importance of the Chinese-language television to reach this community, which is relatively large in Auckland, may have relevance for contacting this community in the future.

How did you find out about the trial and offer?

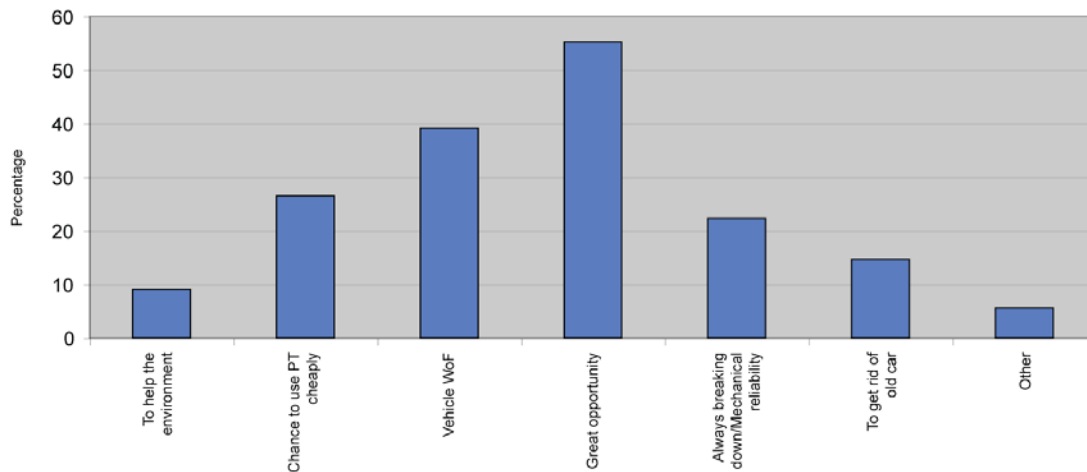


Of the reasons given by participants for taking part in the scheme, most (55%) cited that it was a “great opportunity” and many then added “to dispose of a vehicle”. A relatively large group (25%) said that they wanted to take up the opportunity to “use PT cheaply”. Few were motivated by environmental matters. When prompted, some people said that the environment was a good additional reason to participate, but the environment was not a primary motive, except for a couple of participants.

Most people (97%) reported that they were satisfied with taking part in the scheme and that the process had been easy. The few serious complaints received were related to the public-transport passes, in cases where people had not understood from the advertising about the limitations on the use of the passes (especially that they were valid for only two calendar months). These people felt that they had been misled and had not received sufficient value from their usage of the public transport.

What made you participate in the trial vehicle scrappage scheme?

Note totals do not add to 100 as participants could choose more than one option



EASE OF TAKING PART IN THE TRIAL

The survey asked people if they knew how to dispose of an old vehicle before they took part in the scheme. A surprisingly large number (55%) said that they did. However, it appears that this result may have been distorted by people not understanding the question. Some participants were reported to have replied, "Sell it". Once clarified what was intended, the surveyor said that people felt that information on how to dispose could be readily available if they needed to know, "They had just never thought of it before".

It does appear that providing more information to people (possibly through WoF-issuing garages, tyre shops, or on annual registration papers) about how to dispose of a vehicle, may increase voluntary scrappage.

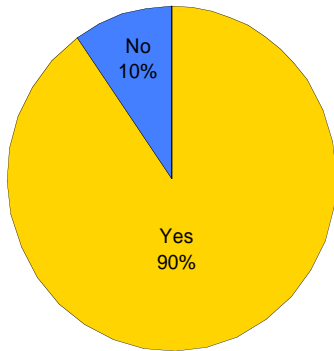
RESPONSE TO PUBLIC TRANSPORT PASSES AS AN INDUCEMENT

There was a high degree of support for the offer of public transport passes, with 90% of the participants saying that the offer represented value for money. Many commented that they considered their vehicles were "worthless".

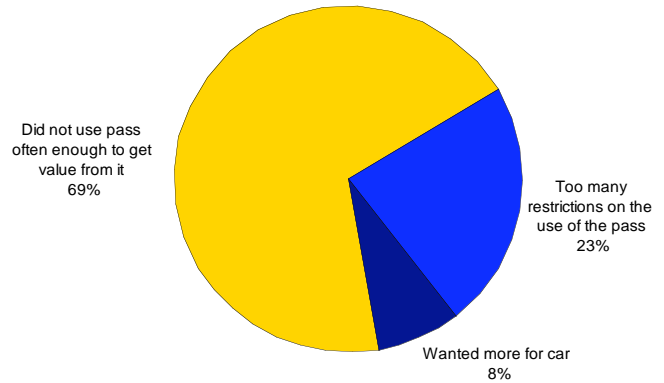
It is likely that the result is distorted because people were taking part in the scheme knowing that it offered a public transport pass. However, it is noteworthy that the scheme's proposal was treated so positively.

Of those who did not think it was value for money, the concerns were mainly over the terms and conditions of the pass. The most common concern was that respondents were not able to use the pass within the two-month time frame to get sufficient value from it. Only a few participants would have wanted more money for their vehicle but, as they took part knowing the reward, this finding is to be expected.

Did you think the offer was value for money?



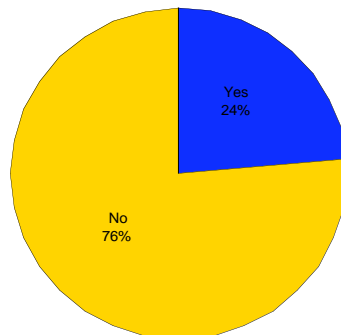
Why did you think offer was not value for money



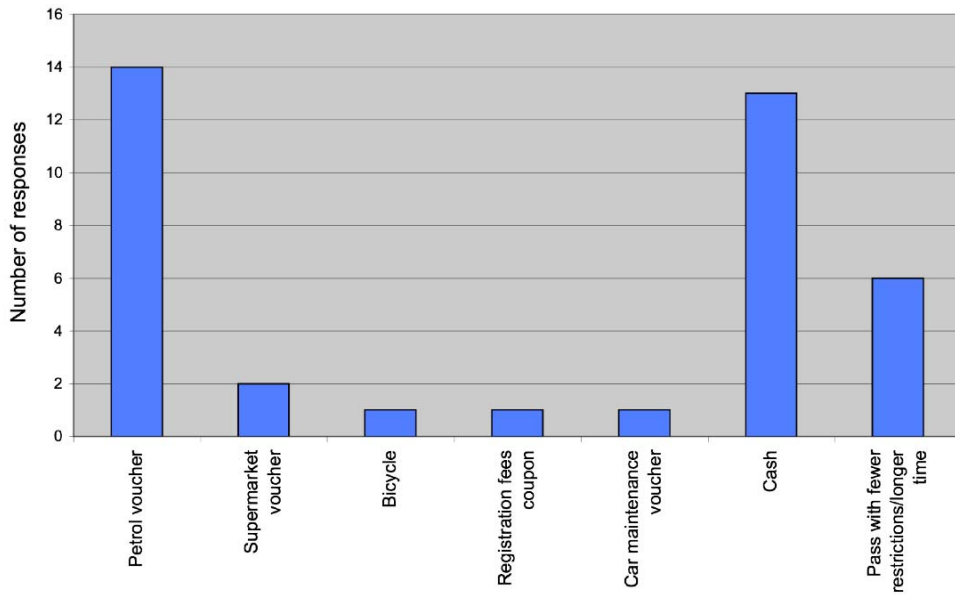
About three-quarters of respondents (76%) were happy with the offer of the transport pass and did not want an alternative. Of those who answered that they would have preferred an alternative reward, there was no clear preference for any other option. Petrol vouchers and cash were the most likely options mentioned. This suggests that a public transport pass would be a good offer if the scheme was to be repeated.

The mention of petrol vouchers is interesting as it indicates (perhaps not surprisingly) that people intended to purchase another vehicle or had access to another one.

Would you have preferred something else instead of a public transport pass?

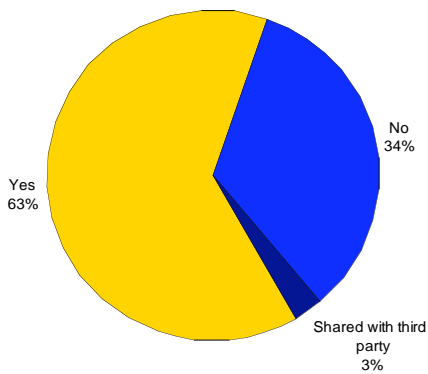


What other incentive would you have preferred?

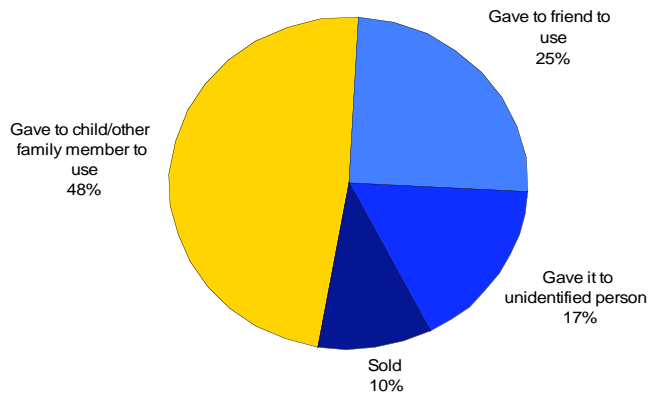


Two-thirds (63%) of the participants used the passes themselves. Of those that did not, most gave them to a family member or friend. Only 10% reported that they sold them.

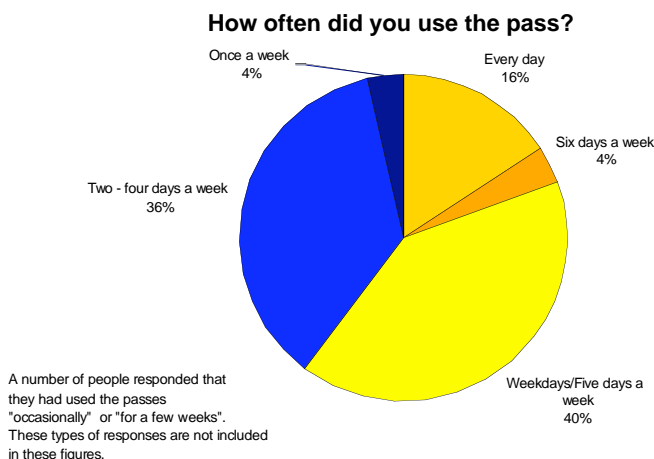
Did you personally use the pass?



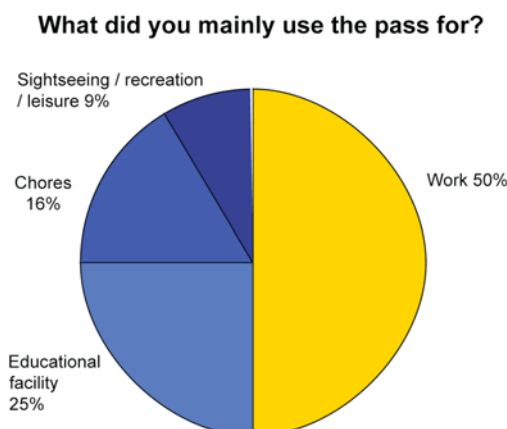
If you did not use the pass, what did you do with it?



Respondents were asked how often they (or the person they gave the pass to) used the pass. The results showed that the passes were generally well used, although there were a number of comments from participants that they could not use the pass often enough during the period to get sufficient value from it. Many of this group of people said they would have preferred non-expiring tickets, such as ten-trip tickets. Only two respondents said that they had not used the passes at all.



Most people used the passes to get to work (50%), or to educational facilities (25%). Almost none used them for leisure purposes or at least, solely for leisure. Some commented that they would have liked to be able to use the passes on the ferry services as these were more likely to be used for leisure.



ONGOING USE OF PUBLIC TRANSPORT BY PARTICIPANTS

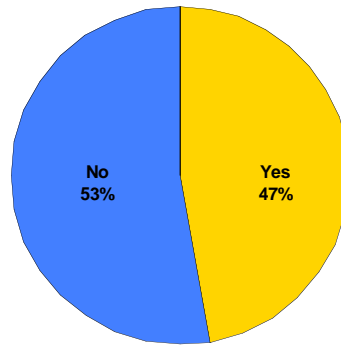
In what was perhaps a surprising finding, almost half of the respondents said that the trial had encouraged them to make more use of public transport. Of those who said it would not increase their usage, about half said that this was because they were already using public transport.

Of those who thought it would not increase their usage of public transport, the most common reason was that PT was inconvenient. Only a few (9%) provided responses that were actively negative; eg, that public transport was expensive, unsafe or overcrowded.

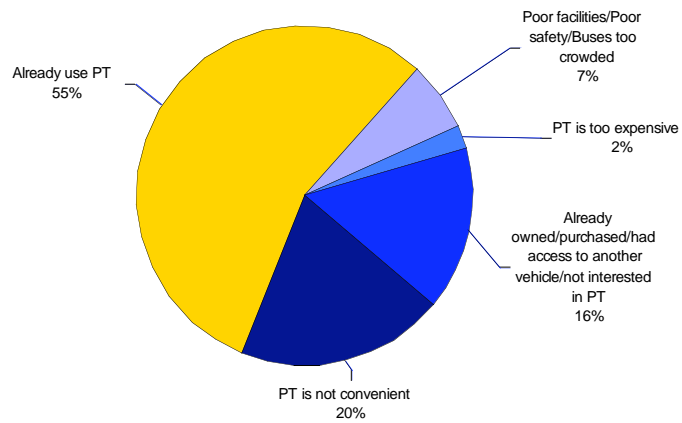
Twenty three percent of respondents said that their opinion of public transport had changed. Of those whose opinion had changed, 83% said that their opinion had improved.

The surveyor commented that the questions on Auckland’s public transport sparked a lot of conversation with participants. The surveyor reported that, “Comparisons were often made to the Melbourne transportation system and San Diego. There was also the feeling that the attitude of the bus drivers provided no incentive to travel on buses. Some people understood that the infrastructure of Auckland made it difficult to obtain a good transportation system, but that there was certainly a lot of room for improvement with the existing infrastructure.”

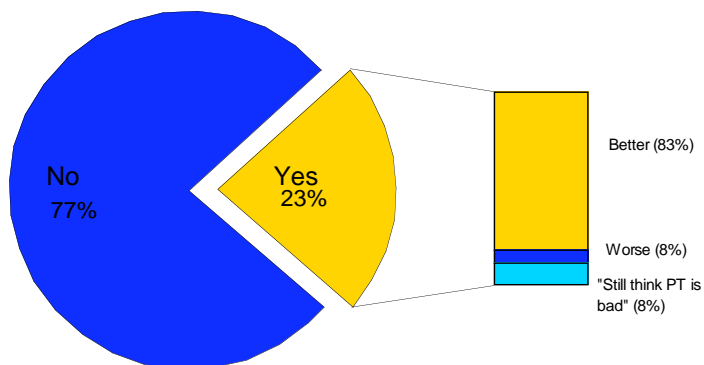
Do you think this trial has encouraged you to make more use of public transport?



Reason they did not increase use of PT



Has your impression of Auckland PT changed?

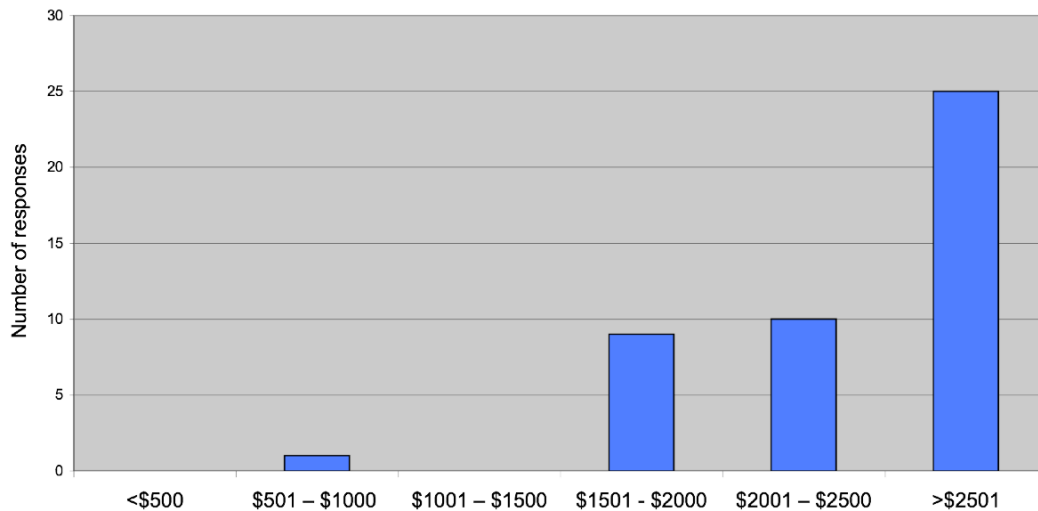


PURCHASE OF ANOTHER VEHICLE BY PARTICIPANTS

Only 36% of participants had purchased another vehicle at the time of the survey. In the survey question about whether they had increased their use of public transport, some respondents (16%) indicated that they had already purchased, or had access to, another vehicle before scrapping the one involved in the trial. This finding may, therefore, underestimate the actual number, but the number of those who had purchased another vehicle is lower than might have been expected in a city known for its use of the private motor car.

Of those who had purchased another vehicle, most had purchased one worth more than \$2,500. The average age of the replacement vehicles purchased was 11.3 years, which is roughly seven years younger than the average age of vehicles being scrapped.

Value of replacement vehicle purchased
 36% of those sampled had purchased another car.
 The average age was 11.3 years



GENERAL COMMENTS ON THE SCHEME

At the end of the survey, people were asked if they had any general comments. The following are the verbatim comments recorded by the surveyor. As can be seen, most people were satisfied with the general approach and were reasonably positive about the use of public transport as an incentive.

- Auckland has lots of old cars. Govt should have more efforts to improve public transport and encourage people to use.
- Very good.
- Too many limits on the pass. Ad was misleading.
- More effort will encourage public to use public transport.
- More activities similar to this should be undertaken. More efforts to promote public transport use.
- Should go on to have the similar types.
- Very good. More efforts to encourage public transport.
- Very good offer. Others asked me if the scheme was still running. Should go on to have same or similar again.
- Helped me get rid of my car easily.
- Should be better designed reward system; eg, use of public transport for longer period or long distance travel or petrol coupon
- Still use car because Auckland public transport is inconvenient and expensive
- Will not encourage people to use public transport as public transport is not convenient.
- People will only use public transport if it is convenient.
- Positive impact on environment. More should be encouraged but with more value-for-money reward.
- The scheme will result in less old cars on the road but will have little impact on encouraging people to use public transport unless public transport is really convenient.
- The scheme was very welcomed. The government shall make it known to more people. Should be improved to attract more people to participate.

- The scheme will result in less old cars on the road but doubt about the impact on usage of public transport. Overall it would be positive.
- Auckland public transport is too expensive. You have to pay for another ticket when you transfer. Waiting is too long. One ticket for each trip. The scheme is very good.
- The scheme should have encouraged usage of public transport and have a positive impact on the environment.
- Survey was too long!
- Believes Melbourne is a city NZ should be looking at in terms of transport. But understands Auckland's infrastructure makes public transport difficult
- Didn't deregister her car which she was told would happen for her, and as such she is still receiving paperwork etc.
- Was a very good scheme.
- Would do it again.
- The guy that helped him was very useful.
- The way it was advertised was misleading. The two months maximum caught them off guard. Thought they had \$450 (or the amount that was given in the ad) to use in public transport for as long as they want. They estimate they spent approximately \$150 over the two-month period. Advertising needs to be clearer.
- Advertising a bit confusing. A friend had to clarify
- It was good to get cars out of people's backyards and clean up the environment
- Good idea
- Would do the scheme again if they had another car that couldn't be fixed.

COST BENEFIT OF THE SCHEME

BUDGET

The project was jointly funded by the Ministry of Transport, ARC, ARTA and the BCCC. The ARC provided the largest amount of funding to the project. Not including staff time, the project costs were slightly over \$100,000.

Budget

Launch costs	\$ 1,100
Advertising	\$ 46,400
Emissions testing	\$ 3,600
Data analysis and translation	\$ 1,100
Public transport passes	\$ 50,600
Total	\$102,800

EFFECTIVENESS OF THE SCHEME

Two hundred and fifty three vehicles were scrapped, which implies that it cost approximately \$400 of direct costs per vehicle scrapped ($\$102,800/253 \text{ vehicles} = \406.32). Four hundred dollars per vehicle is a relatively large amount and it is not clear that the budget offers any opportunities to reduce costs if the scheme was to be offered again. For example, even if the scheme drew in twice as many vehicles (500) for the same advertising budget, the expenditure on the public transport passes would cost a further \$50,000. This would only reduce the costs to around \$300 per vehicle (500 vehicles/\$150,000.)

The BCCC reports that it normally processes 700-800 vehicles per week. An additional 253 vehicles collected over six weeks was not a significant increase in their normal operations.

The relatively high cost per vehicle does not mean the trial was not justified, or was a failure. The benefits exceeded \$400 per vehicle if the health and social benefits from the removal of these vehicles are taken into consideration. However, if a scheme was to be run again a higher rate of vehicle scrappage (or lower per-vehicle cost) would be sought.

HEALTH BENEFITS

If it is assumed that the vehicles that were scrapped would otherwise have continued to operate for one further year, a fairly rudimentary calculation can be made for the amount of carbon monoxide (CO), which is arguably the most significant pollutant from petrol vehicles, that the scheme saved. Estimating on-road emissions for vehicles is difficult without detailed and expensive loaded tests. Accordingly, average CO emissions for vehicles (derived from data provided by the ARC) have been used, rather than data from the simple emissions-testing carried out on the scrapped vehicles.

Using average CO emission figures suggests that the scheme directly prevented the release of about 40 tonnes of carbon monoxide (CO). By referring to the health costs provided in the Health and Air Pollution in New Zealand (HAPiNZ) report, released in 2007, on the costs associated with the release of CO, we can estimate that the health benefits from the project were approximately \$15,000¹⁵ or \$60 per vehicle from savings in premature death. In addition to the direct effects on mortality, the HAPiNZ study identified other health costs, including “restricted activity days” to which CO is a contributor. If these other non-premature mortality-related health costs are included, the health savings may amount to a further \$30,000 - \$50,000¹⁶.

In a parallel analysis, the ARC used its draft Vehicle Emissions Prediction Model, a computer model of the vehicle fleet, to estimate the amount of harmful emissions that had been prevented by the trial. They also concluded that the scheme prevented emissions of about 40 tonnes of CO. This suggests that the costs outlined in this report are reasonable. The model estimated the likely levels of a range of other emissions that were prevented and these are presented below.

Exhaust emission	Amount of pollutant directly prevented from release (tonnes per annum)
Carbon monoxide (CO)	43.4
Carbon dioxide (CO ₂)	421.4
Hydrocarbons (HC)	3.7
Oxides of Nitrogen (NO _x)	3.2
Fine Particulate matter (PM ₁₀) Exhaust	0.05
Fine Particulate matter (PM ₁₀) (brake and tyre)	0.03

The figures are based on the following assumptions:

- 55% of the fleet have catalytic converter removed
- Annual VKT for vehicle = 52* average weekly VKT reported in study
- Average speed = 40km/hr
- There is no allowance for these vehicles having a disproportionately large number of 'gross emitters'.

Fine particulate matter (particles smaller than 10 microns known as PM₁₀) are usually considered the most damaging to human health. They are generally associated with diesel vehicles, but some PM₁₀ are emitted from petrol vehicles. The ARC model suggests that emissions of 0.08 tonnes of PM₁₀ were avoided by the trial. In turn, this has an estimated health benefit of \$18,000 or \$71 per vehicle¹⁷. These health savings are in addition to those from the avoided CO emissions.

It appears from these calculations that the savings in health costs from the scheme are measurable and were in the range of \$61,000 - \$78,000, (\$251-\$321 per vehicle).

SOCIAL COSTS

Older cars are usually less safe than newer vehicles, so the removal of older vehicles from the road will give measurable safety benefits, as well as providing direct health benefits. The social benefits from reduced accident costs can be measured in dollar terms. In estimating these benefits, the key question is how many people who took part in the scheme would switch to using public transport and, if they changed, for how long after scrapping their car they would continue to use public transport. The length of time of the use of public transport is important because public transport is significantly safer as a means of transport than private cars. The longer people use public transport, the greater are the public benefits from a reduction in the number of road accidents.

There are also safety benefits from replacing vehicles with newer ones (for those who reported that they had done so). However, the safety benefits from upgrading vehicles were found, in the Ministry's analysis, to be 'second-order effects'.

The Ministry considered two scenarios¹⁸ in which the benefits from the adoption of public transport were assumed to last only two months (the validity of the passes). It then considered a second optimistic scenario in which it was assumed that the switch to public transport lasted for a year.

¹⁵ This calculation is based on data on total CO emissions in the Auckland region, divided by the vehicle population. This amount is approximately 160kg of CO per vehicle per year * 253 vehicles = 40 T.

¹⁶ See Appendix 1 for the assumptions used in these scenarios.

¹⁷ Figures derived from the ARC's unpublished report on the costs of Air Pollution in the Auckland Region. This estimated the cost to human health to be \$228,000 per tonne of PM₁₀.

¹⁸ See Appendix 2 for the assumptions used in these scenarios.

ESTIMATED REDUCTION IN SOCIAL COST OF ROAD INJURIES

Reductions social costs	Scenario 1	Scenario 2 (optimistic scenario)
From switching to PT uses	\$19,100	\$114,300
From upgrading vehicles earlier ¹⁹	\$4,100	\$24,800
Total	\$23,200	\$139,100
Average per vehicle	\$90	\$550

The actual social benefits are likely to be at the conservative end of these scenarios (possibly \$100-\$200 per vehicle), but are nevertheless significant within the context of this study.

If the savings from reduced social cost (\$90-\$550) are combined with the estimated health savings (\$251-\$321) then it may be argued that, although the direct costs were relatively high, the health and safety benefits outweighed the direct costs (\$400).

CO-BENEFITS

As well as providing direct health and safety benefits, the scheme provided other benefits that are more difficult to quantify. The trial seems to have been very popular with those who took part and had a high degree of public and media support. Almost a year later, the Ministry and others involved are still receiving enquiries from the public about the scheme and requests to repeat it.

The BCCC considered the scheme to be successful as it brought in more recent vehicles than they normally process and, as these are more profitable for them to dismantle, the trial was worthwhile. In the words of the BCCC, “The trial scrappage scheme sped up the time from ‘road-to-grave’ and probably prevented parts from being removed to support another ‘old smoker’”. These are useful, but largely, un-measurable benefits.

The trial also yielded new data on the state of the New Zealand vehicle fleet that previous surveys had not found. For these reasons the scheme can be regarded as very successful.

The only obvious reason to question the success of the scheme was the relatively small acceptance of the offer, in the context of the size of the greater Auckland vehicle fleet (~800,000 passenger vehicles). In this context, the BCCC normally processes 700-800 vehicles per week, so an additional 253 vehicles collected over six weeks was not a significant increase in their normal operations. The trial, therefore, did not bring in as many vehicles overall as they might have expected, given the high public interest.

¹⁹See Appendix 2.

DID THE TRIAL ACHIEVE ITS STATED OBJECTIVES?

As noted in the introduction, the trial had four stated objectives. To discover:

- how effective the incentive is as an inducement for people to trade in their end-of-life vehicles?
- what type of vehicles would this trial remove from the vehicle fleet?
- what impact it would have on air quality?
- what impact would this trial have on fleet turnover?

It is worth considering these individually:

HOW EFFECTIVE WAS THE INCENTIVE AS AN INDUCEMENT FOR PEOPLE TO TRADE IN THEIR END-OF-LIFE VEHICLES?

It is clear from the feedback that people taking part in the trial were happy with the inducement and did not specifically want any other alternative option, except possibly a pass with fewer restrictions on its use (eg. ten-trip tickets) or one that also included Auckland's ferry services. The ferry was seen to have recreational rather than simple 'utility' value and its absence was noted by some participants.

However, only those who thought the offer of a public transport pass was a good inducement opted to take part in the scheme, and therefore we cannot know the number of vehicles that might have been scrapped if a different inducement had been offered.

If the scheme was to be reintroduced, it is recommended that a wider range of inducements be offered.

WHAT TYPE OF VEHICLES WOULD THIS TRIAL REMOVE FROM THE VEHICLE FLEET?

In general, the scheme was successful in collecting the types of vehicles it intended to. These were defined at the start of the project as vehicles that were about to fail, or had just failed, a Warrant of Fitness inspection. Most of the vehicles presented had a history of safety or mechanical faults and their removal was timely. However, some of the scrapped vehicles were clearly functioning very well, if their emissions-test results are used as an indication.

If the scheme was to be run again, and its key objectives were to improve air quality, then it might be appropriate to offer different incentives for high-emitting vehicles. This trial has clearly shown that, in the absence of an emissions test, New Zealand-new vehicles (especially pre-1996 vehicles, as most of those are known not to have modern emissions controls) should be targeted. It may also be appropriate to provide extra incentives for diesel vehicles as the scheme attracted very few.

WHAT IMPACT WOULD IT HAVE ON AIR QUALITY?

The relatively small number of vehicles collected in the trial means that the overall effects on air quality were negligible, but it did indicate that the benefits were in proportion to the scale of the project. A larger scheme could reasonably be assumed to generate wider and longer-term benefits.

Because the emission tests that were performed on the scrapped vehicles did not measure on-road emissions, we cannot accurately estimate the true benefits. This report shows that there were measurable health benefits from the scheme, but individually these were not enough to justify the total cost of the trial.

Although not part of the specific objectives agreed at the start of the trial, it is clear that the region also benefited from improved road safety from the removal of these scrapped vehicles. There were also measurable safety benefits from the increased use of public transport, even if that increased use did not extend past the end of the trial. If these two factors (improved road safety and increased use of public transport) are considered, then the combined benefits outweighed the costs.

WHAT IMPACT WOULD THIS TRIAL HAVE ON FLEET TURNOVER?

The trial showed that the inducement caused people to scrap their vehicles earlier than they might otherwise have chosen to do, although the relatively small number of vehicles collected in the trial meant that the overall effects on fleet turnover were negligible.

APPENDIX 1

HEALTH EFFECTS OF REDUCING CO EMISSIONS IN AUCKLAND

Carbon monoxide (CO) in the air is associated with adverse health effects. The most severe effect is the stress on the cardiovascular system, causing premature mortality. Any reduction in the concentration of CO will lead to a reduction in these severe health problems, as well as improvements in other less-severe effects caused by CO; eg, headaches, tiredness, and learning difficulties in children. The mortality effects have recently been assessed for Auckland in a major new study²⁰. This has shown that the 2001 annual premature mortality for Auckland (the urban areas comprising Auckland City, Waitakere City, North Shore City and Manukau City) was 184 associated mostly with fine particulates (PM₁₀) but including 71 cases associated with CO.

The recently updated Auckland Air Emissions Inventory prepared by the Auckland Regional Council²¹ shows that the total annual emission of CO amounted to 171,000 tonnes for the 2004 year – the latest year calculated. If the reasonable assumption is made that CO is spread evenly across the urban area (vehicle emissions are well spread), then these 171,000 tonnes can be directly correlated with the 71 annual cases of premature mortality.

Therefore, a reduction of one tonne of annual CO emissions can be derived from a reduction in the mortality number of 71/171,000 or 0.00042 cases. This can be scaled linearly; ie, a reduction of 2,500 tonnes of CO emissions is needed to reduce the annual CO mortality by one person.

The figures for health costs can also be calculated by using information prepared for the Health and Air Pollution in New Zealand (HAPiNZ) study. The HAPiNZ report used a 'cost' of a premature mortality of \$750,000 per premature death. So one tonne of CO reduced saves \$750,000 * 0.00042 = \$315. Forty tonnes represents roughly \$15,000 in avoided health costs.

Gavin Fisher
15 April 2008

²⁰ Fisher, G.W; Kjellstrom, T.; Kingham, S.; Hales, S.; O'Fallon, C.; Shrestha, R.; Sherman M. (2007). Health and air pollution in New Zealand. Final Report to the Health Research Council, Ministry for the Environment and Ministry of Transport. June. 156 p. Available at www.hapinz.org.nz.

²¹ Auckland Air Emissions Inventory: 2004. (2007). Auckland Regional Council Technical Publication 292. 56 p. Available at www.arc.govt.nz.

APPENDIX 2

SCENARIOS USED TO ASSESS SOCIAL COSTS OF THE SCHEME

Scenario 1 (estimated benefits for the trial period only)

- Assume 35% upgrade their vehicles (based on survey and scaled to full sample size)
- Assume these car owners would have upgraded vehicles at some stage so benefit is for the trial period (two months) only
- Assume 36% switch to PT (based on 39% who said the trial encouraged them to use PT and scaled to full sample size)
- Assume PT switch lasted for the trial period (2 months) only and social cost associated with PT use is zero
- Assume remaining 29% no change (vehicle not in use anyway)
- Assume the follow-up survey results apply to full sample size if those individuals are included in the sample
- Assume no change in VKT.

Scenario 2 (extending to 1 year) – caution: this scenario may be too optimistic

- Assume those 35% who upgraded their vehicles would not have done so otherwise
- Assume PT switch lasted for entire year
- All other assumptions same as Scenario 1.

The estimates of benefits from upgrading vehicles takes into account the reduction in risk from switching to newer vehicles, based on an average reduction in risk of 3.5% per year – source.

This is based on the report: Keall, M, Newstead, S and Scully, J (2006). *Projecting Effects of Improvements in Passive Safety of the New Zealand Light Vehicle Fleet to 2010*. Monash University Accident Research Centre, Report No. 258.

<http://www.monash.edu.au/muarc/reports/muarc258.pdf>

APPENDIX 3

QUESTIONNAIRE USED WHEN VEHICLES WERE SURRENDERED



SCRAPPED VEHICLE SURVEY

Section 1: Vehicle owner information

1. Is the person presenting the vehicle the owner? Yes No

 Contact Name

 Contact Number

2. Street address of owner

3. Was the vehicle usually used for:
 - a. getting to an educational facility?
 - b. getting to work ?
 - c. household chores?

4. Did the vehicle regularly carry more than just the driver?
 Yes No
(eg, Family car)

5. Was the decision to scrap the vehicle made Yes No
because of the voucher offer?

 If not, why?

6. On average, how many kms would you travel in this vehicle a week?

Please clearly indicate if your comments are commercially sensitive or if, for some other reason, you consider they should not be disclosed.

I confirm that I am the owner of this vehicle or have the authority to dispose of it. I also agree to use the public transport pass as intended. I also agree to be contacted at the end of the trial to undertake a short interview regarding my experience of the trial and public transport pass.

Signature: _____ Date: _____

Section 2: Vehicle Information

6. Make
7. Model
8. Chassis number
9. Year of Manufacture
10. Registration Number
11. Petrol Diesel CNG LPG
12. Carburetted? Yes No
13. Is an exhaust catalyst visible? Yes No
14. Engine CC
15. Odometer reading (km/m)
16. WoF/CoF Current? Yes No If no, how long expired?
17. Registration Current? Yes No If no, how long expired?
18. Would the vehicle pass a visible smoke check? Yes No
19. Were there any other obvious reasons, apart from smoke, why the vehicle might have failed a WoF?
 - Lights Yes No
 - Structure (especially corrosion) Yes No
 - Tyres/Wheels Yes No
 - Exhaust Yes No
 - Others if obvious.....



APPENDIX 4

QUESTIONNAIRE USED IN FOLLOW-UP PHONE SURVEY

Introduction

Good evening, my name is _____ calling from the Ministry of Transport.
Is _____ there please?

I am ringing about your involvement in the trial Vehicle Scrappage Scheme in Auckland. Do you have five minutes to participate in a post-trial evaluation survey?

Close

Thank you for being part of the pilot and your time and feedback during this survey. Have a nice evening.

EVALUATION FORM

Name:

Code number:

1. How did you find out about the trial and offer? (prompts could include radio, newspaper, Asian TV item)
2. What made you participate in the trial vehicle-scrappage scheme? (tick multiple answers if necessary)

To help the environment	Chance to use PT cheaply
Great opportunity	Vehicle WoF
Always breaking down	

Other
3. Did you think the offer was value for money?
Yes No
4. If not, why not?
5. Would you have preferred something else instead of a public transport pass?
Yes No
6. If yes, what?
7. Did you know how to dispose of a vehicle before this trial?
Yes No
8. Was this an easy process for you to follow?
Yes No
9. If not, why not?
10. Did you personally use the pass?
Yes No
If no, what did you do with it?
11. How often did you use the pass?

12. What did you mainly use the pass for?
Work Educational facility Chores Other
13. Do you think this trial has encouraged you to make more use of public transport?
Yes No
If not, why not?
14. Has your perception of public transport in Auckland changed since the trial?
Yes No
15. If yes, how have your perceptions changed?
Better Worse Other
16. Have you bought another vehicle?
Yes No
17. If yes, how much did it cost?
Cost <\$500 \$501 – \$1000
 \$1001 – \$1500 \$1501 - \$2000
 \$2001 – \$2500 >\$2501
18. What make and age is the vehicle?
Make
Age
24. Do you have any other comments, positive or negative?