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REPORT

CleanRun On-Road Vehicle Emissions Monitoring

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Accessibility

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Contents

Introduction

The Department of Environment Regulation's (DER) CleanRun program operates an Accuscan 4600 Remote Sensing Device (RSD) that monitors the exhaust emissions of passing vehicles. The operation of this device forms part of DER's commitments to the National Environment Protection (Diesel Vehicle Emissions) Measure (Diesel NEPM) and the Perth Air Quality Management Plan (Perth AQMP).

DER deployed the RSD at six sites across the Perth metropolitan area in March and April 2016. Two days of monitoring was completed at each site.

Remote sensing of vehicle emissions provides DER with an efficient way to characterise the Perth vehicle fleet. The RSD is set up on a roadside and captures the emissions data of passing vehicles with no impact to traffic flow. Photographs capture the vehicle registration number, allowing vehicle registration information to be extracted from the Department of Transport (DoT) database.

Analysis of emissions data together with vehicle information allows DER to determine how vehicles are performing and how vehicle emission performance varies according to age, make, model and fuel type. This data can then be used to inform policy decisions on vehicle regulation.

Key Points – CleanRun On-Road Vehicle Emissions Monitoring
• Monitoring results extrapolated from the 2016 campaign showed petrol emissions continuing to decrease – a trend in line with previous campaigns. • An increased representation of diesel vehicles in the heavier ranges was noted in the latest results, compared to the 2009–10 campaign. • Carbon monoxide (CO) emissions levels recorded during the campaign showed all vehicle body types and most weight ranges had improved since the 2009–10 campaign. • Hydrocarbons (HC) emissions had also improved for all body vehicle types and most weight ranges since the 2009–10 campaign. • Overall, most vehicle weight ranges demonstrated gradual improvement since the 2009–10 campaign. • Results from the campaign showed emissions increased with speed – the faster a vehicle travelled, the more it emitted. • CO emissions were highest in petrol vehicles, while smoke emissions were highest in diesel vehicles. • For petrol vehicles, CO, HC and nitrogen oxide (NO) emissions were observed to increase as they aged, while smoke emissions decreased with age. • Most diesel vehicles had higher HC emissions than petrol vehicles. • Petrol vehicles manufactured in 2006 or later were the lowest emitters for the fuel type.

- Diesel vehicles manufactured in 2007 or later were the lowest emitters for the fuel type.
- LPG vehicles were higher polluters than other vehicles (and likely to get worse as the LPG fleet ages).
- Station sedans, sedans and hatchbacks recorded the best emissions performance.
- Utility vehicles had the highest NO and smoke emissions.
- Lighter vehicles were more likely to be petrol powered, while heavier vehicles were mostly diesel.
- The lightest vehicles monitored (anything less than 1,000 kg) recorded consistently poor emissions performance compared to heavier vehicles.
- Emissions from the heaviest vehicles monitored (anything over 1,600 kg) continued to get worse, which appeared to be linked to the increasing representation of diesel engines in the weight range.
- Newer vehicle emission standards were shown to have less of an impact on reducing emissions than older standards.

Figure 1: RSD monitoring locations

Equipment Used

Monitoring Equipment

The RSD measures the following exhaust pollutants:

- carbon monoxide (CO) as a percentage of exhaust volume;
- nitrogen oxide (NO) as parts per million (ppm);
- hydrocarbons (HC) as parts per million (ppm); and
- particulates (UV smoke) as a percentage of exhaust opacity.

The RSD measures exhaust gases by sampling gas conditions in the air in front of a vehicle (taken as the ambient condition or baseline) before sampling the gas conditions at the rear of a vehicle. The difference between the two conditions represents the emissions of the vehicle.

The RSD source/detector is set up on a roadside to project light (infrared and ultra violet) across the road to a reflector cube (Figure 2). The light reflected back to the RSD is partly absorbed by the vehicle exhaust and allows emissions to be calculated.

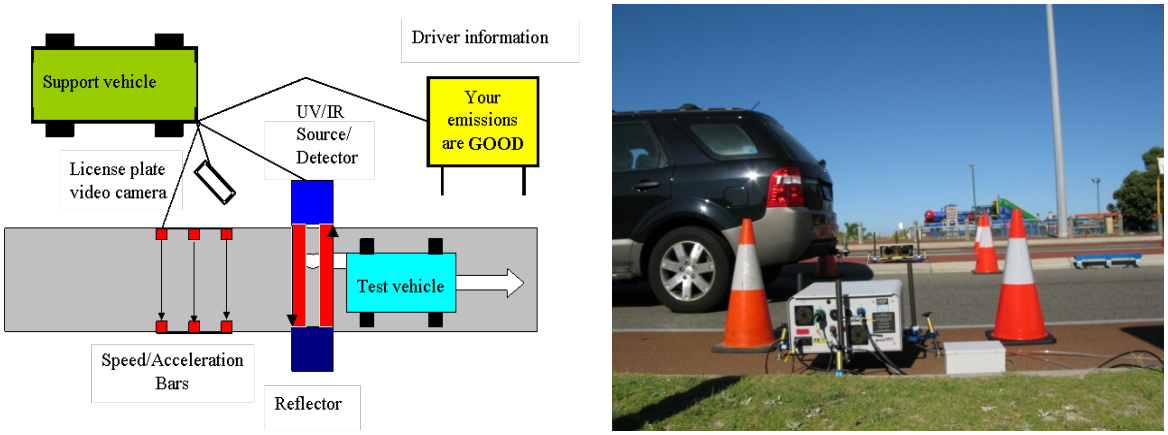


Figure 2: Schematic diagram of the RSD monitoring equipment[1] (left) and RSD source/detector and reflector in operation[2] (right)

A sample is captured by the RSD when a vehicle passes the speed/accelerator bars triggering the source/detector to take the initial sample. To trigger sampling, vehicles must be under load when passing through the RSD, which is determined by calculating the vehicle specific power (VSP). VSP is calculated by the RSD using the vehicle acceleration, velocity and road gradient.

As the vehicle is leaving the speed/accelerator bars, it will break the RSD light beam. The RSD will record the 'front of vehicle' gas concentrations just before the light beam is broken. Once the vehicle passes though the RSD, the light beam is re-established and the RSD records 50 'rear of vehicle' samples over half a second (one every 10

[1] Bluett, J., Dey, K., Fisher, G. (2008) *Assessing Vehicle Air Pollution Emissions*. Prepared for the Department of the Environment, Water, Heritage and the Arts by the National Institute of Water and Atmospheric Research Ltd (New Zealand).
[2] Department of Environment Conservation (2011).

milliseconds). If enough samples are valid, the average is taken of all valid samples and logged.

Following the triggering of the RSD sample, a camera records the rear registration plate of the vehicle. This allows the vehicle specific data from the DoT database to be entered into the data log after the sampling.

If the sample VSP is positive and the RSD successfully measures the front and rear of vehicle gas conditions, the test is assigned a valid sample flag in the data log.

Driver Feedback

The CleanRun smart sign provides immediate feedback to the driver about the emissions performance of the vehicle. The display presents one of the three options:

Your vehicle emissions are **GOOD** ☺ = saving $$$

Your vehicle emissions are **FAIR** 😐 = costing $$$

Your vehicle emissions are **POOR** ☹ = costing $$$

The score that appears on the smart sign is the lowest from all tested emissions. If any substance is rated as POOR, the vehicle receives a POOR. Similarly, if any substance is rated FAIR, the vehicle gets a FAIR. Only if all measured substances receive a GOOD rating will the vehicle be rated as GOOD.

Cut points entered into the RSD are used to determine the GOOD, FAIR or POOR results of the vehicle and are based on the emissions performance of the vehicle fleet from the previous deployment.

The cut points for the 2016 campaign were based on two days of testing at Oats Street, Carlisle during the 2014 deployment – presented in Table 1.

Table 1: Smart sign cut points

Emission category	Good	Fair	Poor
Carbon monoxide (CO) %	<0.554	0.554–1.873	>1.873
Hydrocarbons (HC) ppm	<195	195–556	>556
Nitrogen oxide (NO) ppm	<1370	1370–2050	>2050
UV smoke (PM) %	<0.05	0.05–0.15	>0.15

Site Selection

The RSD requires specific conditions to operate effectively. An ideal monitoring location has the following characteristics:

- a single lane road;
- a median strip for equipment placement;
- a road gradient greater than two degrees (that is the road is sloped upwards);
- north-south alignment to minimise glare in number plate photographs;
- adequate verge space for equipment trailer, camera, and the smart sign; and
- traffic flow of between 300 and 1,000 cars per hour.

Other important considerations include selecting sampling sites that:

- are representative of Perth's vehicle fleet;
- provide for operator safety;
- do not negatively impact on traffic flow and driver safety; and
- avoid sprinkler and bin collection days in residential areas.

The sites selected for the 2016 campaign were a mix of repeat and new sites.

Anstruther Road, Oats Street and Prindiville Drive were selected to collect data at the same location over multiple years. Coode Street, Weaponess Road and Winterfold Road were new sites selected to improve the coverage of RSD sampling over the Perth metropolitan area.

Selected site characteristics are summarised in Appendix A.

Data Collection

RSD Deployment

The RSD was deployed two days a week over six consecutive weeks. Deployments were made on consecutive days of the week, either Tuesday and Wednesday, or Wednesday and Thursday.

The field teams had the equipment calibrated and operational by 7am most mornings. The RSD was re-calibrated between 10am and 11am depending on traffic conditions. Monitoring was completed around 2pm most days. This time range was sufficient to capture morning peak traffic as well as midday traffic movements.

A 40 kilometres per hour (km/h) speed limit and a traffic cone 'funnel' was established before the equipment to encourage vehicles to accelerate past the RSD source/detector unit.

RSD Data Capture

Each monitoring location performed differently as a result of local traffic flow and features of the site. Vehicles passing through must have both a positive VSP value and a valid gas sample taken for a sample to be accepted.

In addition to having a valid sample, each vehicle required a readable number plate in the photograph taken. Number plates were verified by the DoT vehicle database. Additional samples were lost because of transcription and readability errors.

Vehicle samples that met these checks were included in the analysis. Table 2 details data capture and attrition rates resulting from data validation checks at all sites.

Table 2: Data capture and attrition rates

Site	Total Samples	Valid VSP	Valid Gas	Valid Samples (Gas and VSP)	Valid Plates	Verified Plates
Anstruther Road *1 and 2 March*	3699	3458	2960	2785	2675	2554
		93.48%	80.02%	75.29%	72.32%	69.05%
Oats Street *9 and 10 March*	5360	5256	4310	4232	3500	3328
		98.06%	80.41%	78.96%	65.30%	62.09%
Coode Street *15 and 16 March*	4629	4552	3374	3318	2976	2890
		98.34%	72.89%	71.68%	64.29%	62.43%
Weaponess Road *22 and 23 March*	7187	7075	5938	5846	5476	5252
		98.44%	82.62%	81.34%	76.19%	73.08%
Winterfold Road *30 and 31 March*	3797	3705	2929	2789	2730	2650
		97.58%	77.14%	73.45%	71.90%	69.79%
Prindiville Drive *5 and 6 April*	5053	4973	4108	4043	3779	3658
		98.42%	81.30%	80.01%	74.79%	72.39%
Total	29725	29019	23619	23078	21136	20431
		97.62%	79.46%	77.64%	71.11%	68.73%

The high VSP capture rates at all locations show sites selected had conditions that encouraged vehicles to accelerate through the RSD. The lower VSP capture rate at Anstruther Road was attributed to the equipment set-up.

The gas capture rate ranged between 83 and 72 per cent. The gas capture rate depended on a number of environmental factors such as wind, humidity and operating temperature. The Coode Street deployments were on significantly warmer and more humid days compared to other deployments. Deployments at Weaponess Road had mild weather and the site was more sheltered from winds. Equipment set up for the gas measurements is also a notable factor, with a large portion of the set-up time allocated to fine tuning the RSD alignment. Minor misalignments, unique to each site, likely influenced the gas capture rate.

The loss of samples from number plate readings varied across the sites. Anstruther Road and Winterfold Road lost 8.08 and 7.15 per cent, respectively, of valid samples as a result of unreadable plates. Oats Street suffered a 21.4 per cent loss of valid samples. The primary cause of number plate loss was glare. This issue was compounded at Oats Street due to the direction of the traffic relative to the morning sun and a tree canopy producing a sharp contrast of light over photographed number plates.

Vehicle Database Query

Valid number plate samples were compiled and queried using the DoT vehicle database. Samples with valid number plates had the following vehicle data fields from DoT added to the RSD measurements:

- Make;
- Model;
- Body type;
- Tare weight;
- Year of manufacture;
- Fuel type; and
- Suburb of registration.

These fields, in conjunction with the emission data collected by the RSD, were used to undertake a vehicle fleet health check and identify any vehicle groupings that were producing significant emissions relative to the rest of the fleet.

Results

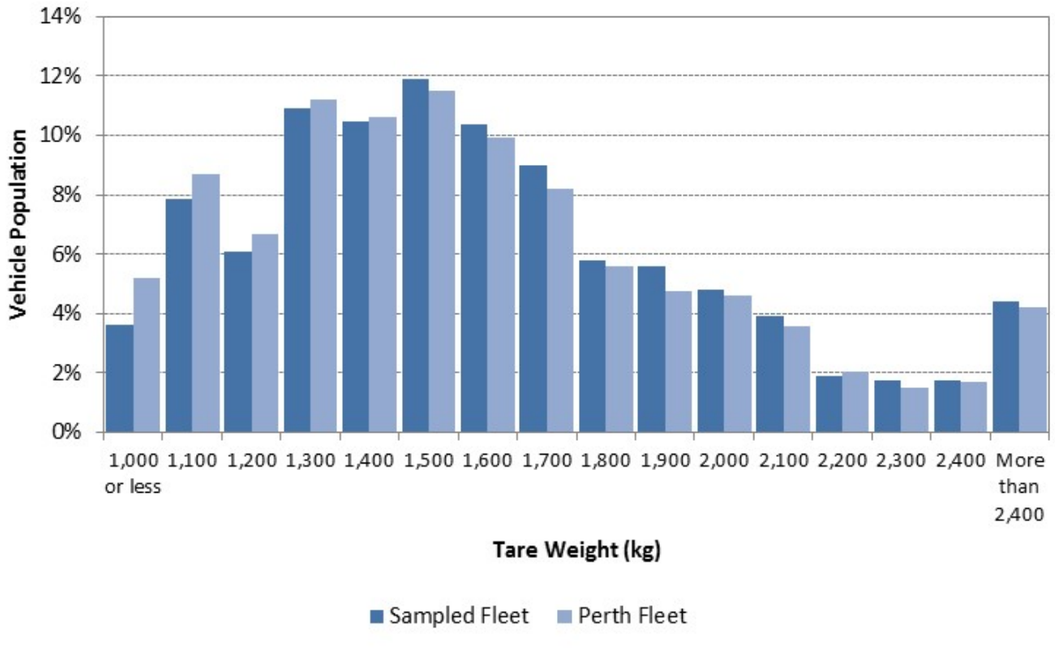
Fleet Representativeness Assessment

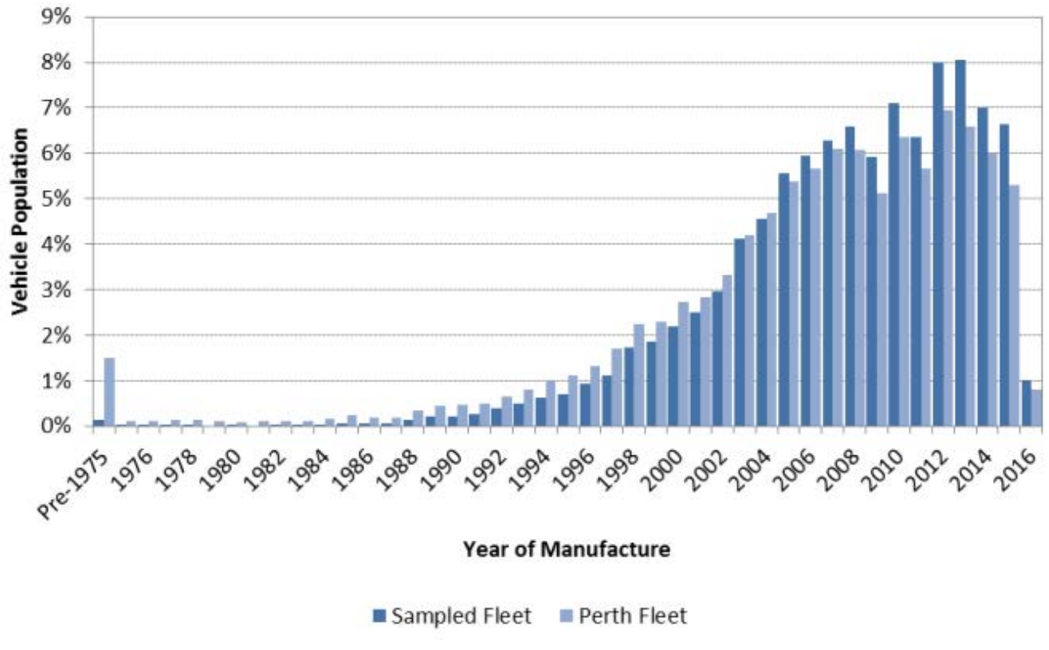
A comparison was made between the sampled fleet and the Perth metropolitan fleet to assess how representative the sampled vehicle fleet was of the wider Perth vehicle fleet.

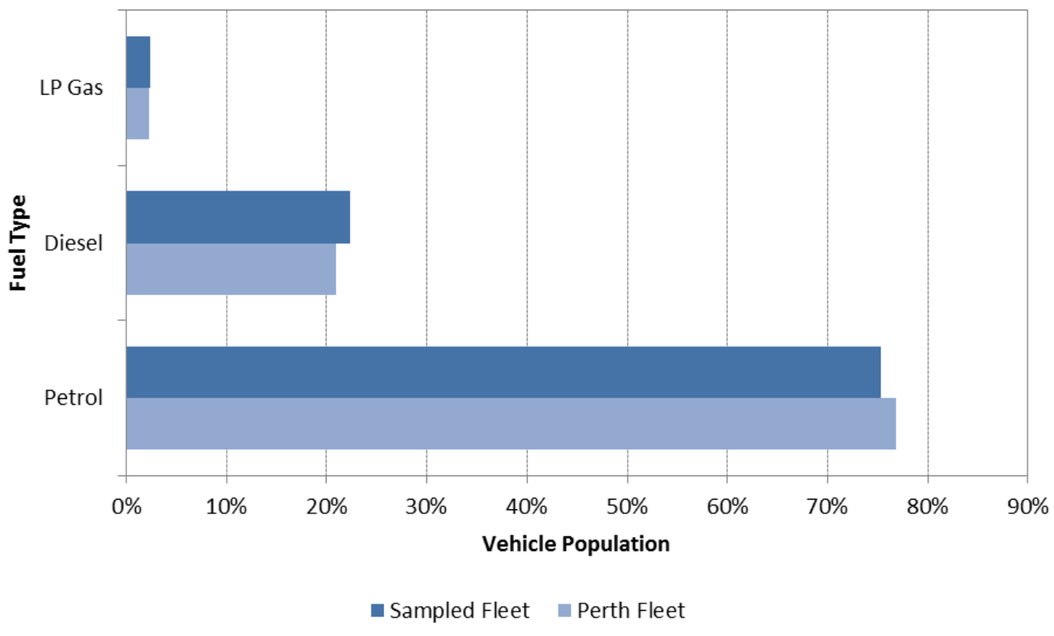
DoT provided and filtered vehicle data to meet the following criteria:

- vehicles registered to a postcode in the Perth metropolitan area;
- vehicles that combust fuel as their primary power source; and
- vehicles with a body type that can be sampled by the RSD.

The postcodes and body types used to filter the WA fleet data for comparison with the sample data are presented in Appendix B. Assessments of vehicle weight range, age, fuel type and body type are presented for all samples in Figure 3. Site specific comparisons of sampled vehicles to the Perth fleet are presented in Appendix A.







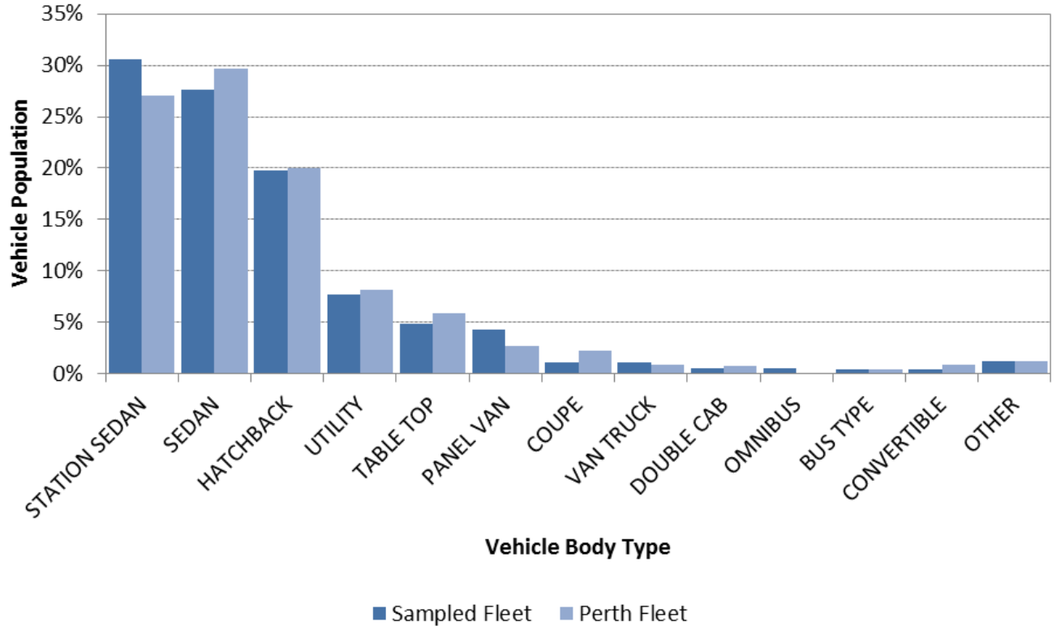


Figure 3: Sampled fleet vehicle data comparison to Perth fleet

Sampled vehicles had the same vehicle weight distribution as the Perth fleet. There were differences in the lower end of the scale, particularly around the 1,000 tonnes or less range. These differences were not considered significant.

Year of manufacture data shows the sampled fleet was slightly newer than the Perth fleet, with a notable discrepancy for pre-1975 vehicles. Several explanations exist for this but the most likely reasons are considered to be:

- Older vehicles registered by DoT but not active on the roads. Examples include recreational vehicles (that is, racing), vintage and classic cars.
- Older vehicles generally spend significantly less time on the road and travel far less compared to newer vehicles.[3]
- Sampling site selection:
    - Weaponess Road had substantially more vehicles represented in the mid-2000 or newer age groups. This was attributed to relative affluence of the area;
    - both 'commercial' sites (Anstruther Road and Prindiville Drive) were over-represented with 2010 and newer models. This was attributed to the proximity of several car sale yards in the vicinity of both sites; and
    - no sites demonstrated a significant over-representation of older vehicles.

Based on the above, the differences between the sampled fleet and Perth fleet ages were not considered significant.

Fuel data shows samples proportionally under-represented petrol vehicles and over-represented diesel vehicles. The differences were not considered significant.

Body type data show some proportional differences between 'station sedan' and 'sedan' body types. Overall, there were no significant differences in the sampled fleet body types compared to the Perth fleet body types.

The data show the sampled fleet had a similar weight and age range, as well as similar fuel and body types, to the wider Perth fleet. Sampling data were taken to be representative of the Perth fleet.

[3] UniQuest (2014) *Australian Motor Vehicle Emission Inventory for the National Pollutant Inventory (NPI)*. Prepared for Department of Environment 2 August 2014: www.npi.gov.au/system/files/resources/e8311456-8a41-4473-9fa1-d2f9994ff8da/files/australian-motor-vehicle-emissions-inventory-2014_0.pdf.

Smart Sign Cut Point Review

The GOOD/FAIR/POOR metrics from the 2016 campaign are presented in Table 3.

Table 3: Current smart sign cut points – results for 2016

Emission category	GOOD	FAIR	POOR
Carbon monoxide (CO) %	92.30%	5.85%	1.85%
Hydrocarbons (HC) ppm	94.45%	3.16%	2.38%
Nitrogen oxide (NO) ppm	92.72%	5.92%	1.36%
UV smoke (PM) %	77.69%	15.54%	6.77%
Totals	**71.04%**	**19.01%**	**9.95%**

The GOOD/FAIR/POOR results for CO, HC and NO show reasonable consistency. The poorer results for smoke were attributed to a more stringent criterion in comparison to the other pollutants and the calibration of equipment varying from site to site.

As vehicle technology improves, average fleet emissions reduce over time. The smart sign cut points need to be reviewed and adjusted regularly to ensure vehicles with comparatively poor emissions receive appropriate feedback.

In reviewing the smart sign cut points, the following principles were considered:

- the percentile ranges considered for GOOD, FAIR and POOR ratings should appear reasonable;
- the number of drivers that see GOOD, FAIR and POOR ratings should reflect a vehicle's overall performance relative to the whole of fleet; and
- vehicle fuel type should be considered in setting criteria where significant differences in emissions exist (for example, smoke emissions from diesel versus petrol).

Alternative cut points have been considered for adoption, taking the above points into consideration (as detailed in Appendix C). The recommended cut points to be applied for future sampling are presented in Table 4.

Table 4: New smart sign cut points

Emission category	Good	Fair	Poor
Carbon monoxide (CO) %	<0.292	0.292–1.048	>1.048
Hydrocarbons (HC) ppm	<63	63–316	>316
Nitrogen oxide (NO) ppm	<840	840–1435	>1435
UV smoke (PM) %	<0.160	0.160–0.401	>0.401

Vehicle Speed Performance

The RSD setup had a speed control of 50 km/h. However, vehicles passing through were travelling at a range of speeds. The distribution of speed, presented in Figure 4, shows most vehicles were travelling between 30 and 45 km/h through the RSD. It also shows that 2009–10 had a similar speed distribution, albeit slightly faster. The 2014 sample speed range was more skewed towards the 30–40 km/h range and could be considered a 'slower' sample than 2009–10 and 2016 data.

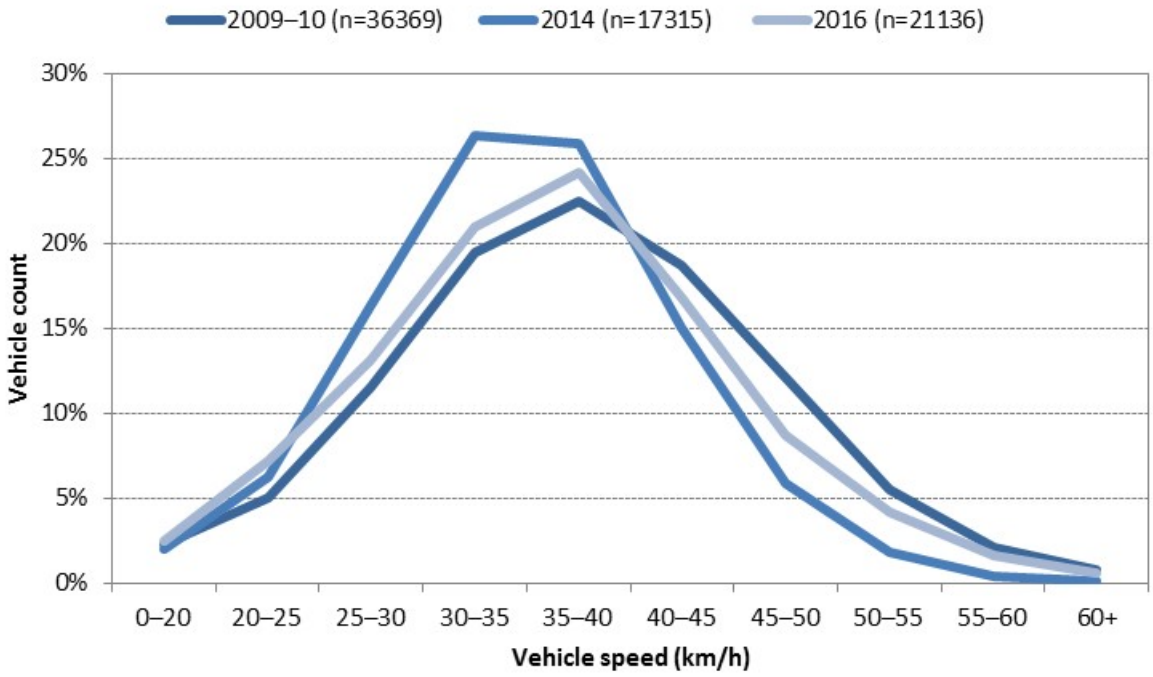


Figure 4: Vehicle counts by speed

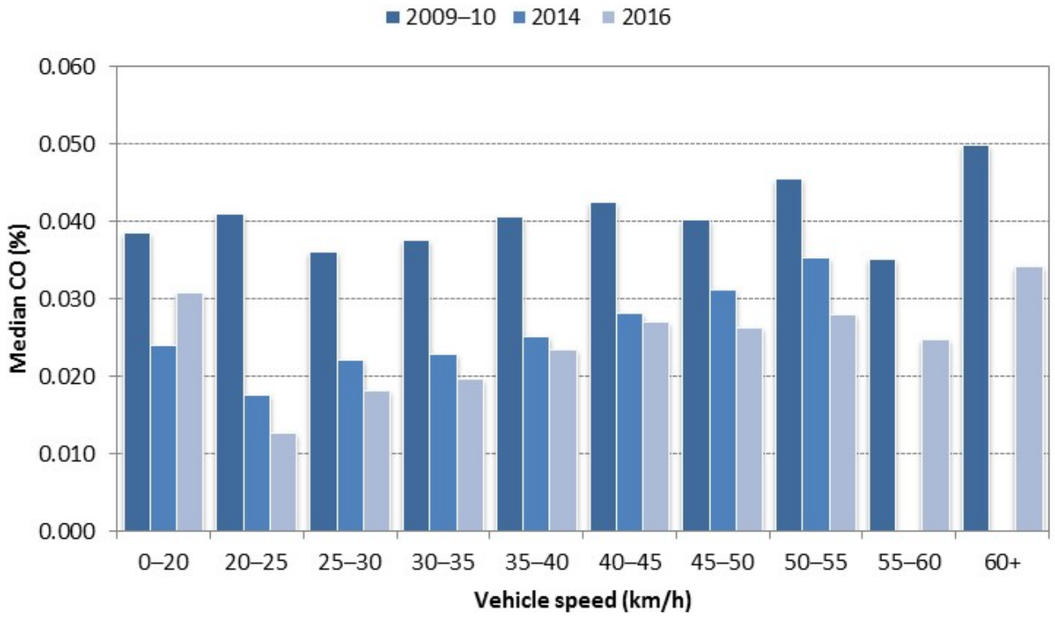
Emissions for CO, HC, NO and smoke are presented in Figure 5. Sampling data from the 2009–10 and 2014 RSD campaigns have been presented for comparative purposes. Statistical data are tabulated in Appendix D.

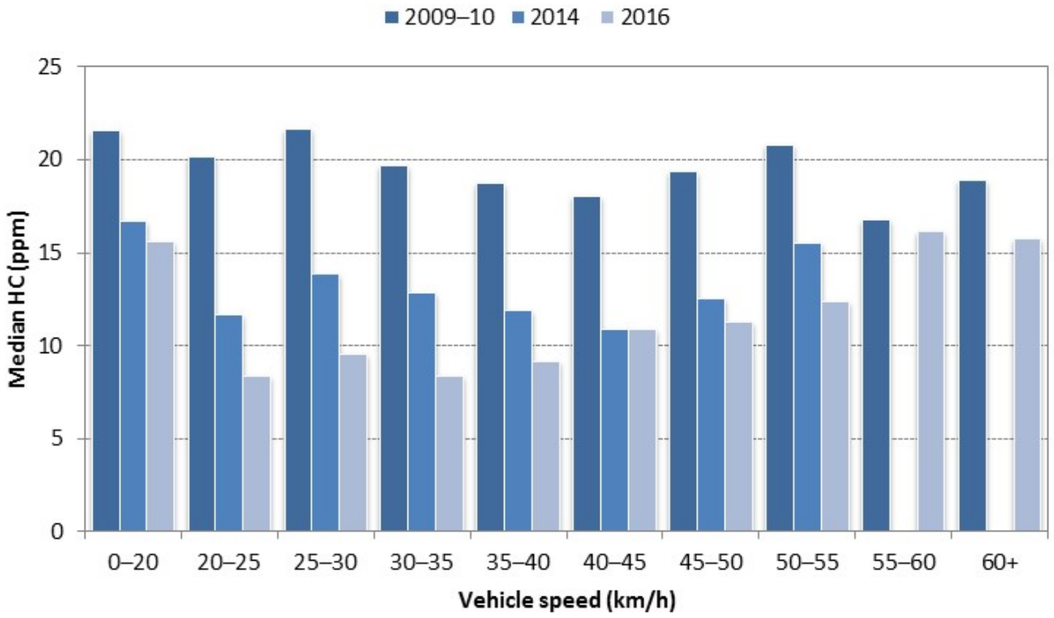
The overall trend observed was that emissions increased with speed. Significant differences in vehicle sample speeds between sampling campaigns limit comparisons in emissions data, for example if the sampling speed distribution is 'faster' than the norm then emissions will be skewed upwards.

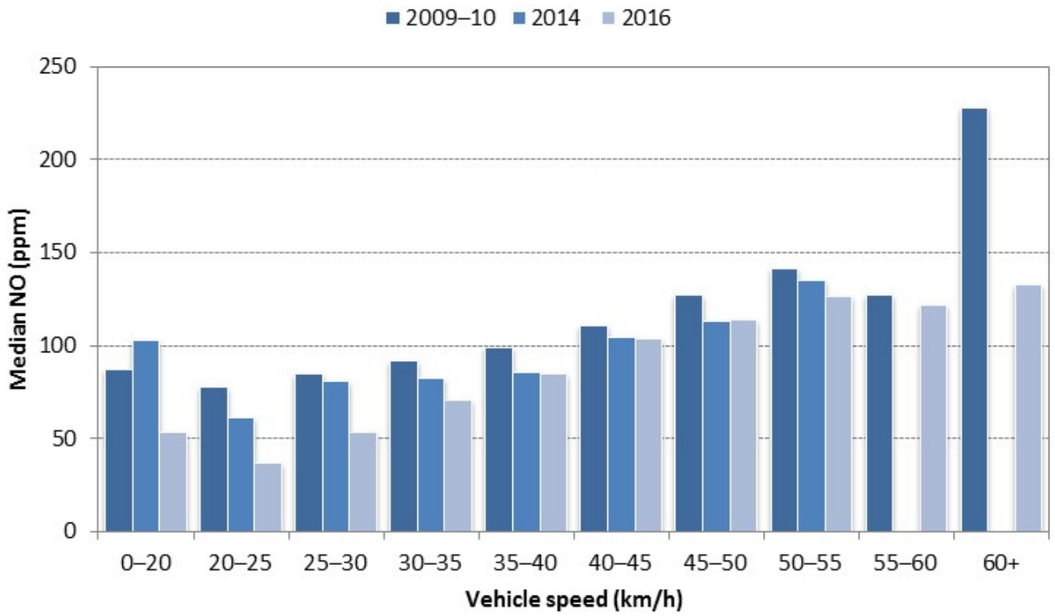
As demonstrated in Figure 4, the 2016 vehicle speed sample data were comparable to 2009–10 data. Care was taken when comparing against the 2014 dataset as it was marginally 'slower' than 2009–10 and 2016 datasets.

CO, NO, HC and smoke emissions demonstrate the trend of increasing emissions as vehicle speed increases. For HC the trend is weak and only apparent in the 2014 and 2016 data.

The only exception to the increasing trend observed is the 0–20 km/h range of sampling for CO, HC and NO, which has higher median emissions compared to 20–25 km/h range. The exception is most visible in the 2014 and 2016 datasets.







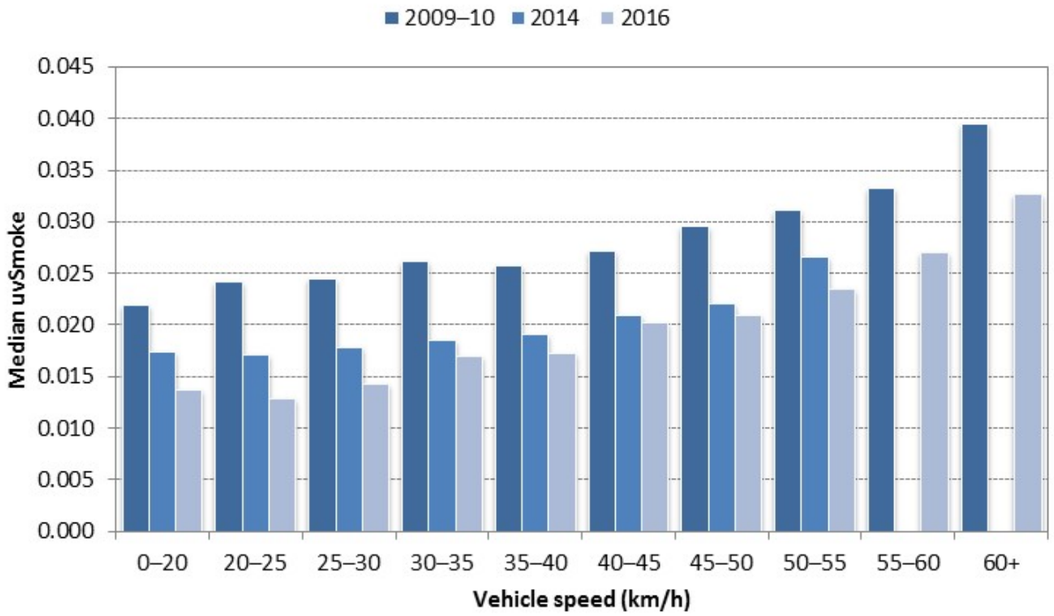


Figure 5: Median emissions over time per vehicle speed[4]

[4] Emissions data from 2014 for the 55–60 and 60+ km/h ranges were not included as there were insufficient samples available for each group (that is less than 100).

Fuel Performance

Emissions of all vehicles are statistically assessed in Figure 6. Sampling data from the 2009–10 and 2014 RSD campaigns are presented for comparison. The maximum values are not plotted due to extreme outlying data points disrupting the scale. The numerical data for the graphs are tabulated in Appendix D.

CO emissions are shown to be highest with petrol and liquid petroleum gas (LPG) vehicles. Sampling over the last three RSD campaigns show consistently decreasing emissions for petrol vehicles. LPG vehicles show decreasing emissions over time for the 95th, 90th and 70th percentile, but the median emissions data increased, suggesting that CO emissions from the bulk of LPG vehicles are getting worse over time.

HC emissions are shown to be highest for LPG vehicles. Petrol vehicles have higher emissions compared to diesel for the 99th, 95th and 90th percentile emitters, though the 70th percentile and median emissions data suggests that most diesel vehicles have higher hydrocarbon emissions. Petrol and diesel vehicles show decreasing emissions over time. LPG vehicles show a decreasing trend for higher emitters, but the 70th percentile and median data suggest the bulk of LPG vehicle HC emissions are getting worse over time.

NO emissions from petrol vehicles are more variable than those from diesel vehicles. While petrol vehicles show higher emissions in the 99th, 95th and 90th percentile ranges, the 70th percentile and median emission data show diesel vehicles are more significant producers of NO emissions than petrol vehicles. LPG vehicles show higher NO emissions than both diesel and petrol, with the median emissions data being comparable to diesel vehicles. The data also show NO emissions from LPG vehicles are getting worse over time.

Smoke emissions are dominated by diesel vehicles. The data show diesel vehicle emissions from the highest emitters are getting worse, while the lower percentiles are decreasing very slightly over time. Petrol and LPG smoke emissions are comparable and show a very small decreasing trend over time.

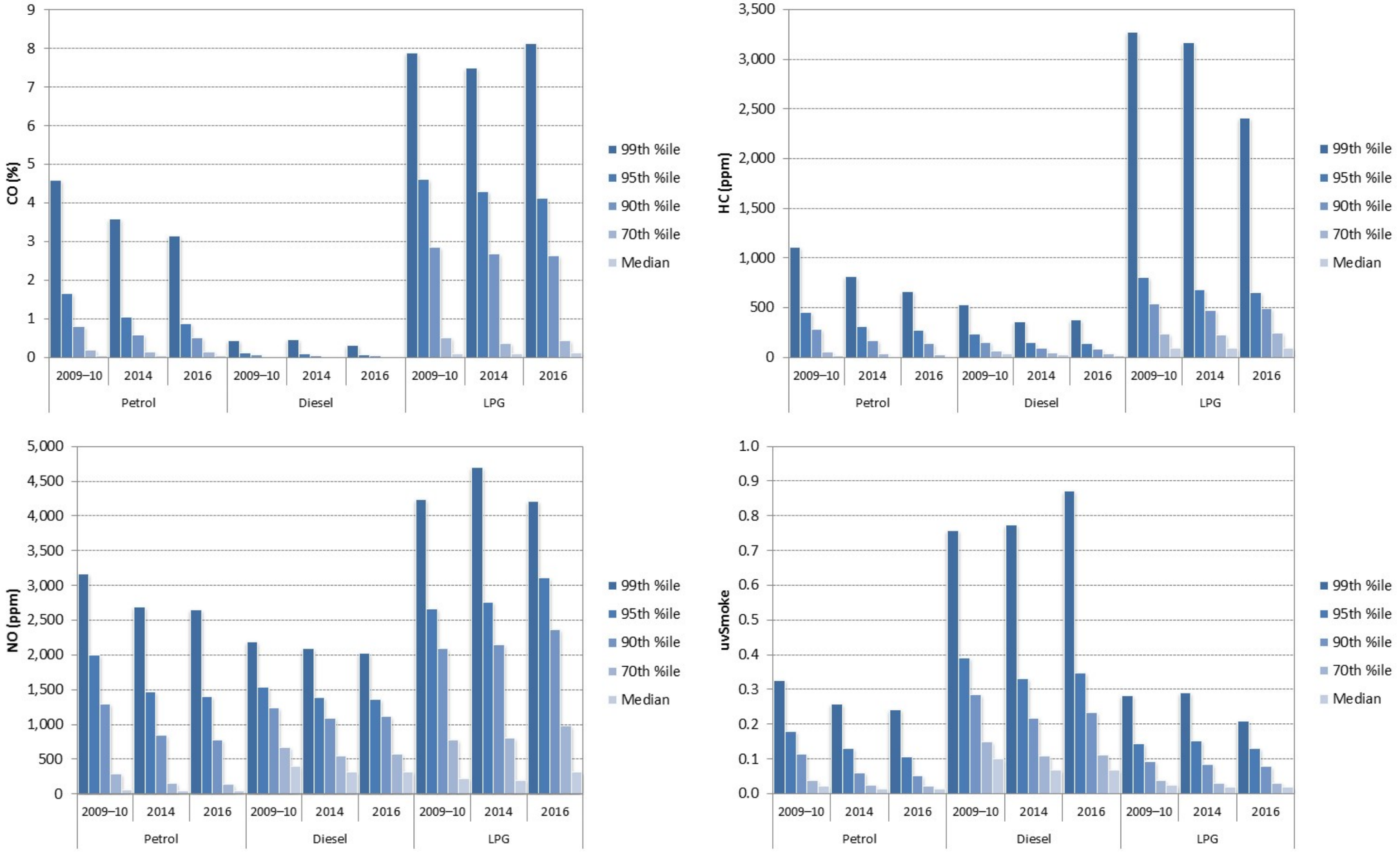


Figure 6: Emissions statistics over time per fuel type

Body Type Performance

The median emissions for the most common body types sampled (that is, greater than 100 valid samples during an RSD campaign) were compared over the three most recent monitoring campaigns.

For this assessment, the fuel type distribution of body types was considered as fuel type has a significant influence on emissions performance. The fuel type percentage breakdown for the most common body types sampled is presented in Figure 7.

Petrol is the dominant fuel type for several body types, particularly so for sedan, hatchback and coupe-style vehicles. Station sedans are petrol dominated, but with higher representation of diesel vehicles than the aforementioned body types. Diesel dominates the van truck and omnibus body types, and is similar to petrol for utility, table top, panel van and double cab body types.

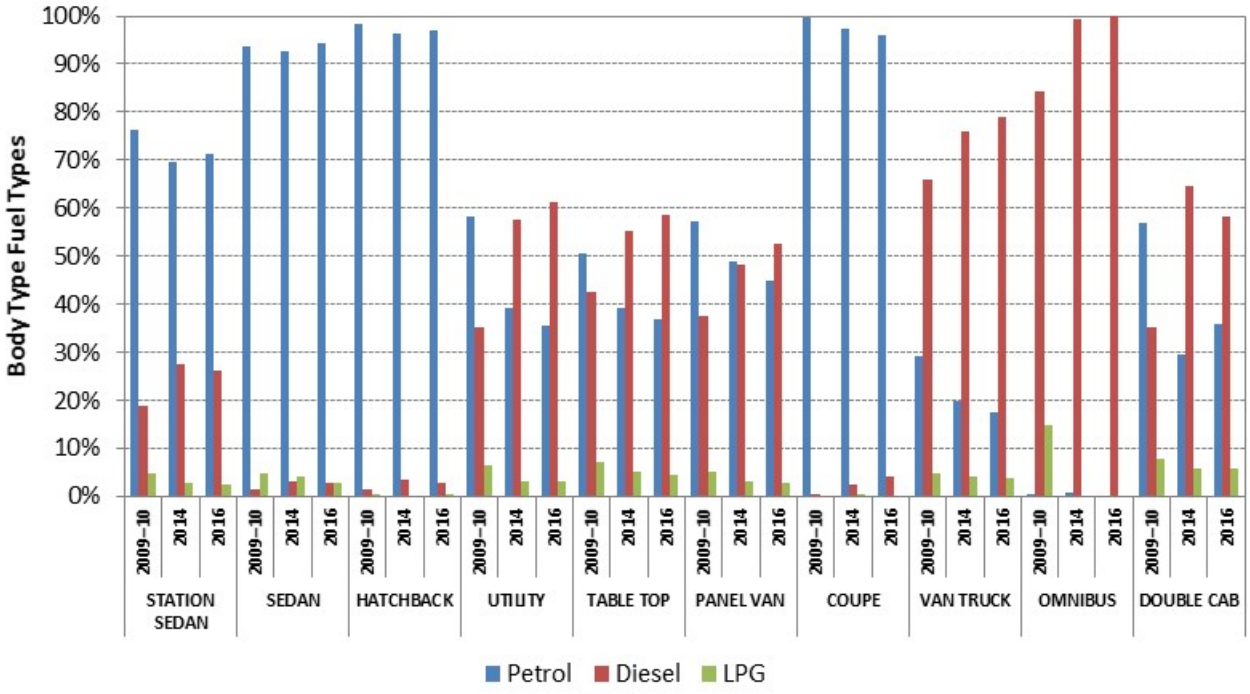
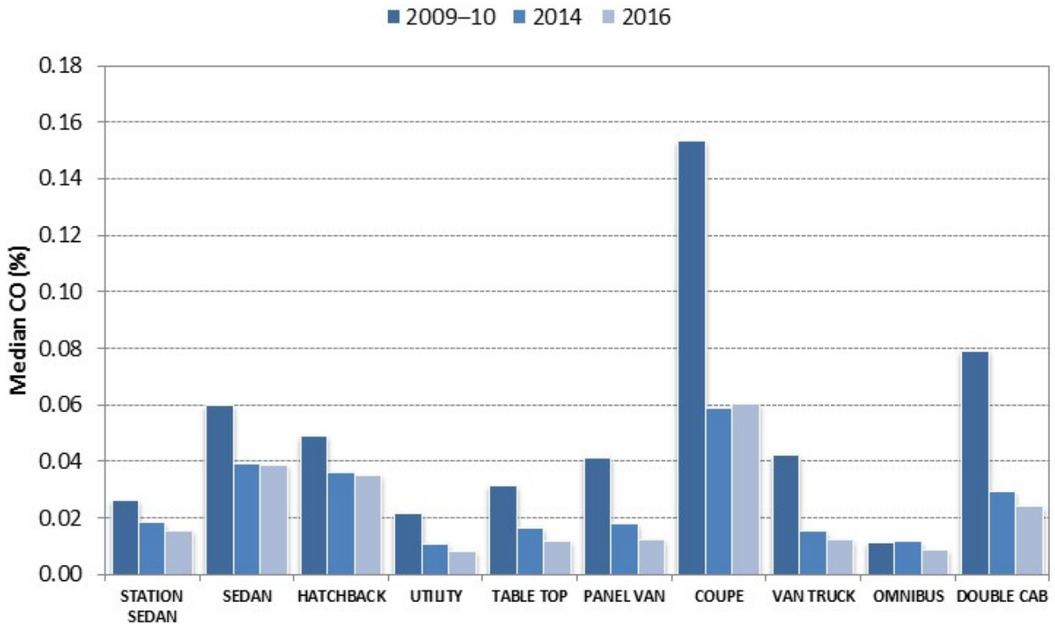
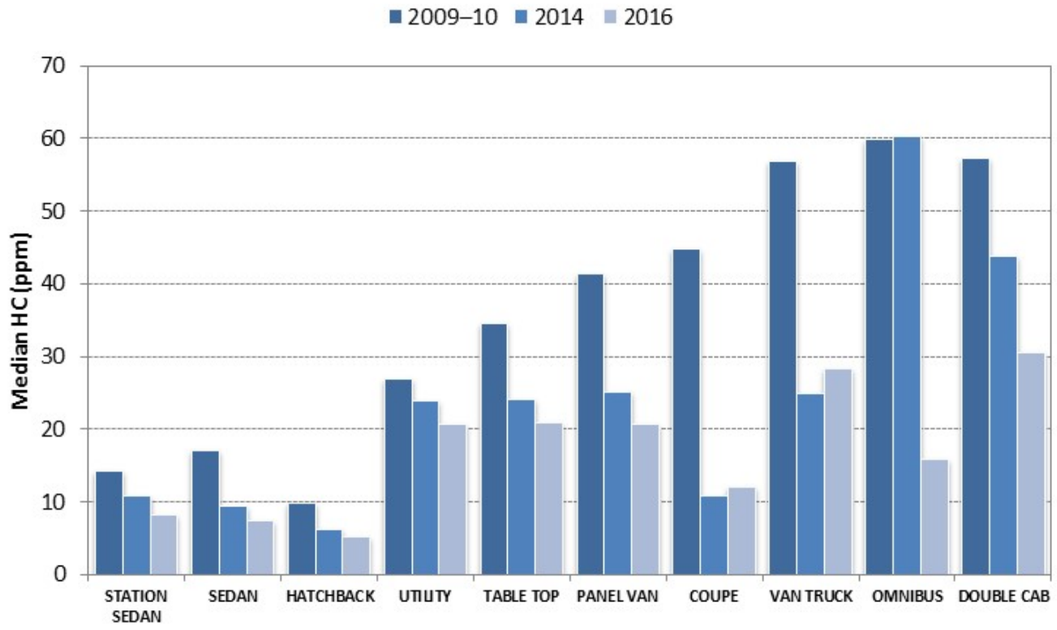
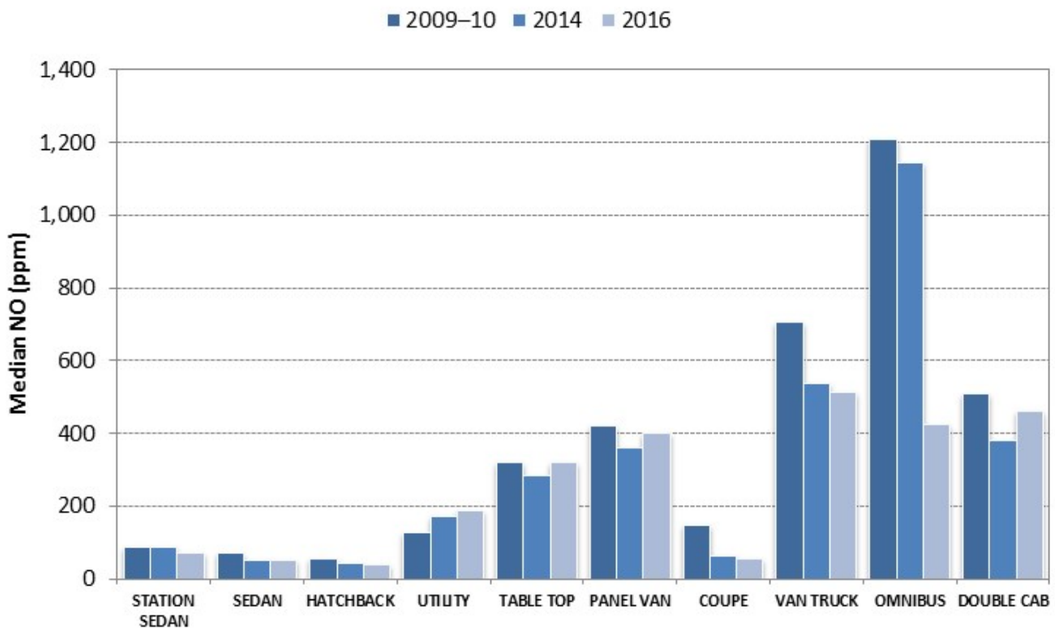


Figure 7: Body type fuel type percentages

Emissions for CO, HC, NO and smoke are presented in Figure 8. Sampling data from the 2009–10 and 2014 RSD campaigns are presented for comparative purposes. Statistical data are tabulated in Appendix D.







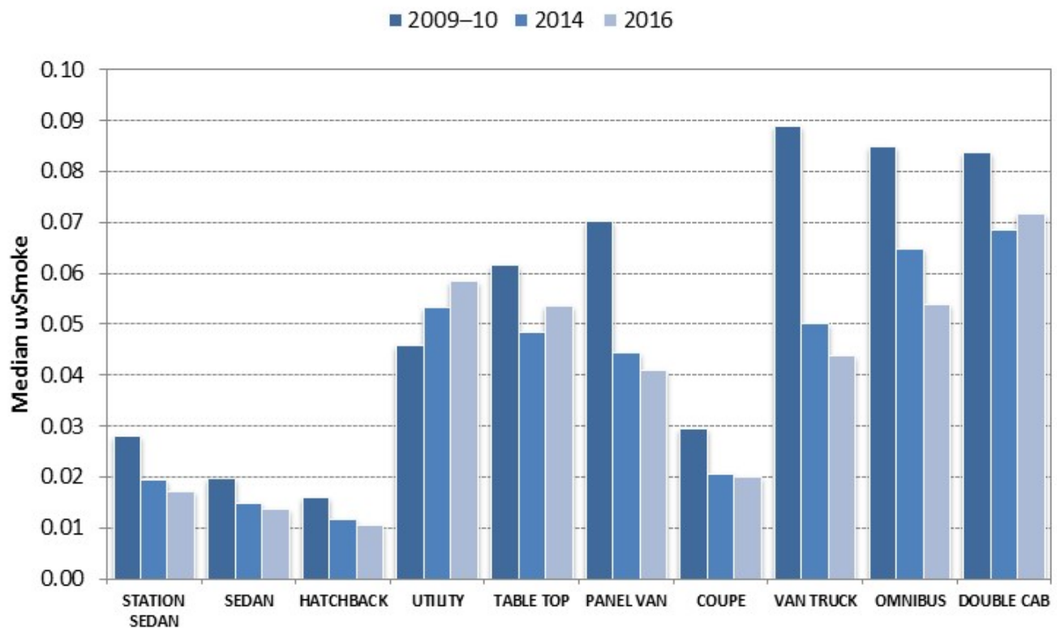


Figure 8: Median emissions over time per body type

CO emissions show all body types have improved since the 2009–10 sampling campaign. Coupe type vehicles show the worst performance for CO emissions. A review of the makes and models for 2016 sampled coupe body types found most were sports performance cars and likely to have larger engines. Engine size data were not included in the DoT dataset so the relationship between emissions and engine size could not be tested.

HC emissions have been improving for all body types since the 2009–10 sampling campaign. Body types with significant diesel populations have higher HC emissions compared to predominantly petrol body types. Double cabs have the highest HC emissions, with van trucks being comparable.

Body types with significant diesel populations have higher NO emissions compared to body types dominated by petrol. While some vehicle groups (coupes, vans and omnibuses) show improvement over time, emissions from most groups appear to only be marginally improving, or stable, over time. NO emissions from utility vehicles appear to be increasing over time. Van trucks, omnibuses and double cabs have the highest NO emissions, but have been improving since the 2009–10 campaign.

Body types with significant diesel populations have higher smoke emissions compared to body types dominated by petrol. Most vehicle groups show a decreasing trend over time, though utility vehicles show an increasing trend over time. Double cabs have the poorest performance for smoke emissions.

Vehicle Weight Performance

The heavier a vehicle, the more energy (fuel) is required to move it and keep it in motion, compared to a lighter vehicle.

The fuel type distribution of weight ranges were assessed as fuel type has a significant influence on emissions performance. The fuel type percentage breakdown for weight ranges considered in this assessment is presented in Figure 9.

Lighter vehicles are more likely to be petrol powered, while heavier vehicles are mostly diesel. There is also an increasing representation of diesel vehicles in the heavier weight ranges since the 2009–10 sampling campaign.

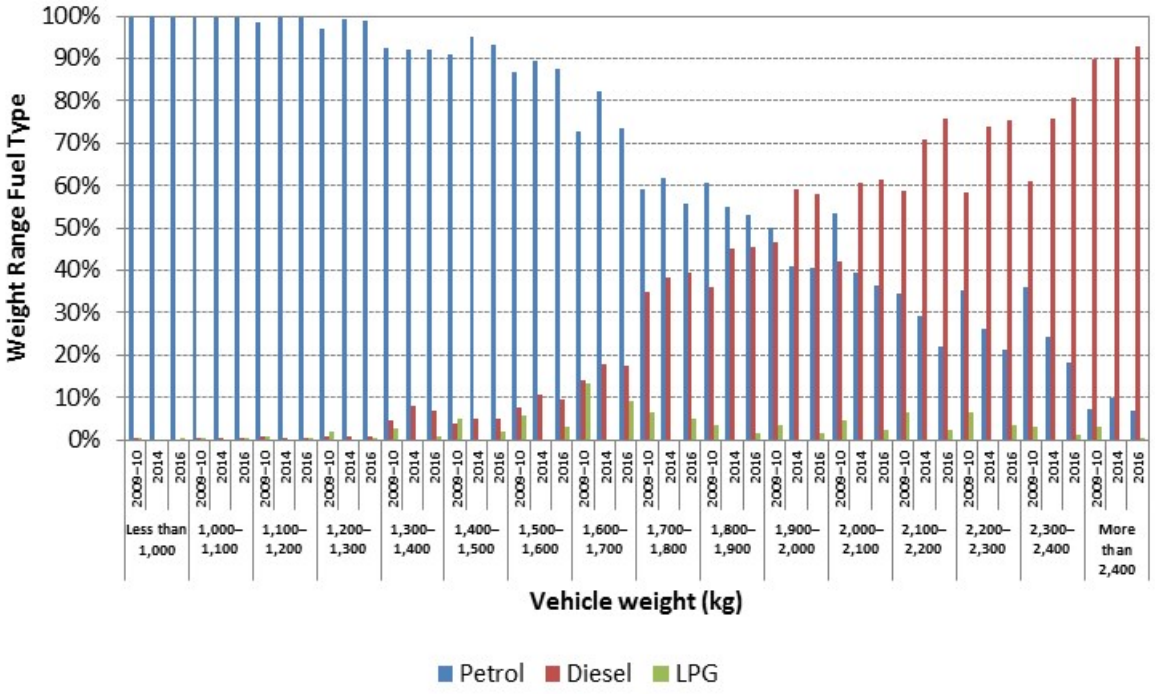
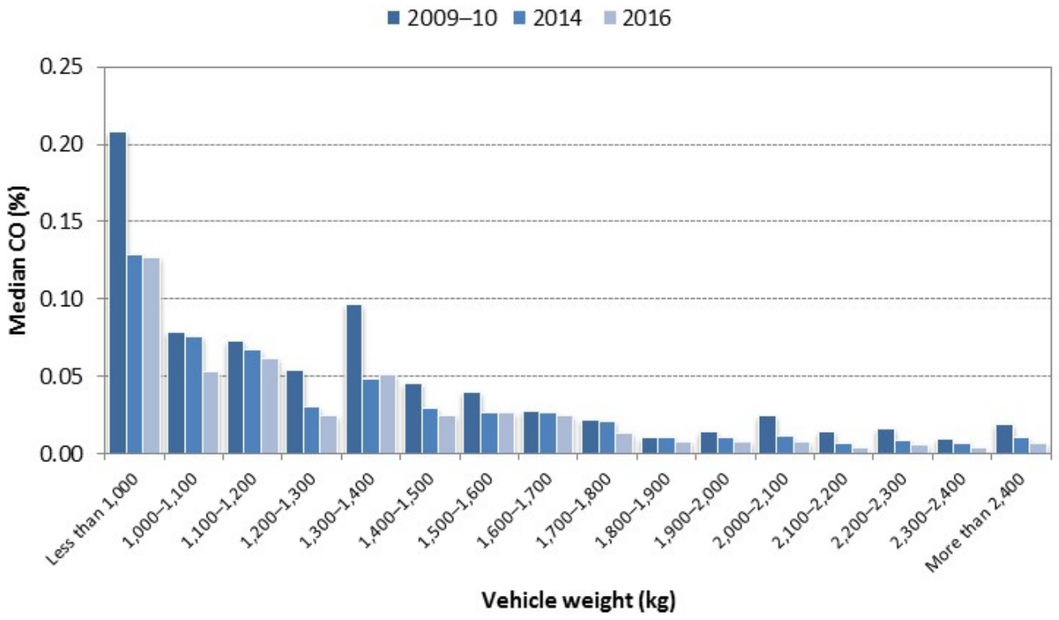
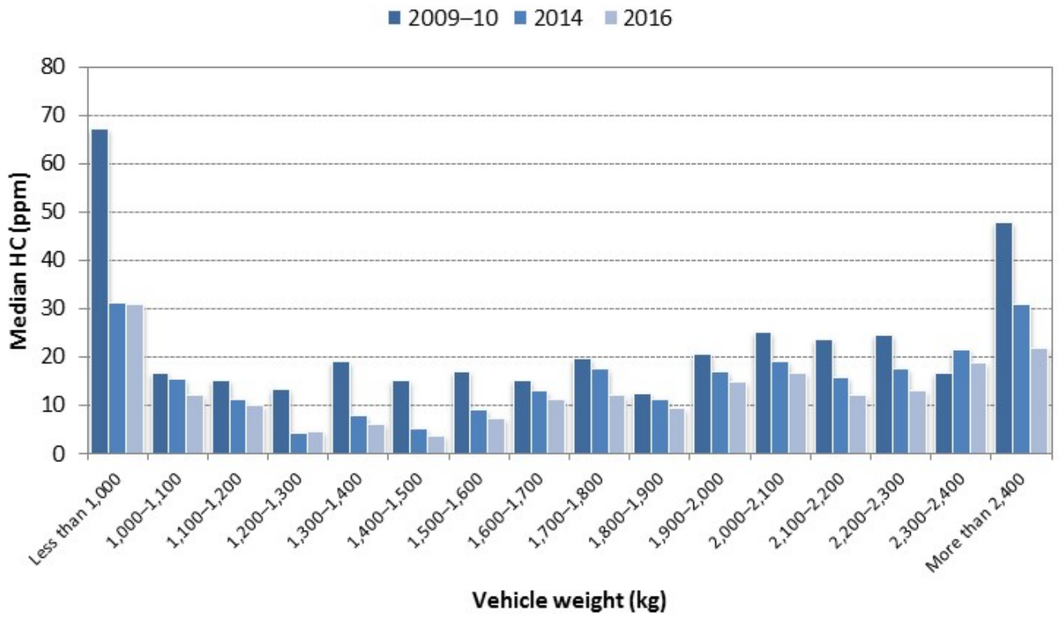
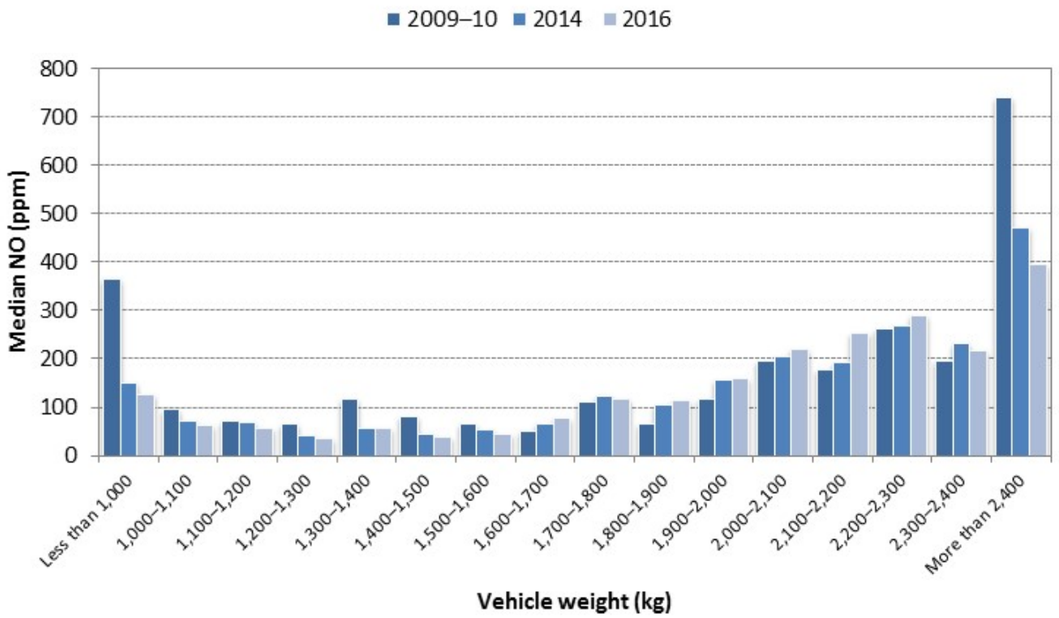


Figure 9: Vehicle weight range fuel type percentages

Emissions for CO, HC, NO and smoke are presented in Figure 10. Sampling data from the 2009–10 and 2014 RSD campaigns are presented for comparative purposes. Statistical data is tabulated in Appendix D.







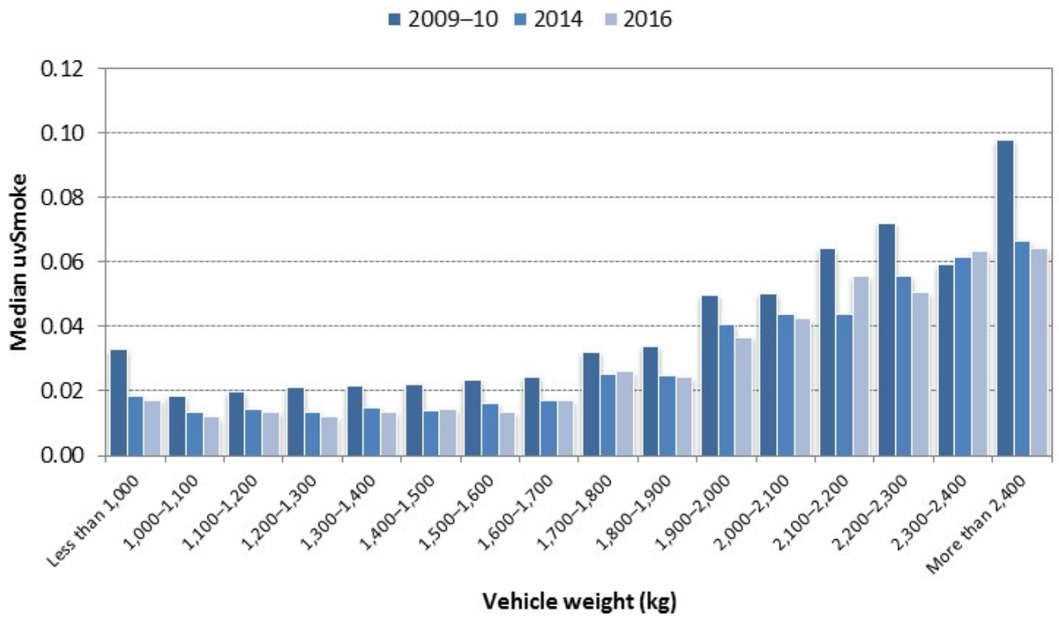


Figure 10: Median emissions over time per weight range

The analysis concluded that the ‘less than 1,000’ kg vehicle weight range shows higher emissions for CO, HC and NO, as well as smoke to some extent. For NO and smoke, higher emissions were only observed from vehicles 1,700 kg and heavier. For CO and HC, vehicles less than 1,000 kg are the largest emission sources.

CO emissions were higher in the lighter vehicles in the fleet, while emissions decreased as vehicle weight increased. This is likely to be a result of the increasing prevalence of diesel vehicles in the heavier fleet which have lower CO emissions than petrol. CO emissions have improved in most weight ranges since the 2009–10 sampling campaign.

HC emissions were lowest in the 1,200–1,500 kg range and gradually increased as weight increased. There has been an overall improvement in nearly all weight ranges for HC emissions since the 2009–10 sampling campaign.

NO emissions were seen to increase as vehicle weight increased, though emissions from the ‘greater than 2,400 kg range were significantly higher compared to lighter weight ranges. The 1,600–2,400 kg weight range shows emissions have been increasing since the 2009–10 sampling campaign.

Smoke emissions were higher in the heavier vehicles in the fleet. Similar to CO emissions, this was attributed to the increasing prevalence of diesel vehicles in the heavier fleet which had higher smoke emissions than petrol vehicles. Most vehicle weight ranges showed gradual improvement since the 2009–10 sampling campaign.

Year of Manufacture Performance

Year of manufacture is a proxy for vehicle technology. Vehicles in Australia are built in accordance with Australian Design Rules (ADRs), with a number of ADRs dedicated to emission standards for vehicles. Emission standards exist with respect to:

- vehicle weight (3.5 tonnes being the cut-off between 'light' and 'heavy' vehicles); and
- engine type (spark ignition or compression ignition).

Emission standards have been gradually tightened over the years with ADRs aligning with the European emission standards since the early 2000s.

RSD data can be used to assess the impact of changes to emission standards on vehicle emissions. The RSD equipment does not directly measure exhaust emissions, so direct comparison to ADR standards is not possible. Instead, step changes in the data should be apparent in years where improved emissions standards for a pollutant were introduced.

Emissions for light (equal to or less than 3.5 tonnes) petrol and diesel vehicles are presented in Figure 11 to Figure 14. The relevant ADR standard is overlain for reference.[5] Sampling data from the 2009–10 and 2014 RSD campaigns are presented for comparative purposes. Statistical data are tabulated in Appendix D.

For petrol vehicles, there are insufficient samples of vehicles manufactured before 1995 (that is, less than 100 valid samples) across all three sampling periods. Similarly for diesel, only vehicles manufactured in 2004 and later had sufficient sample sizes to be assessed. LPG vehicles and heavy vehicles were not assessed due to insufficient sample size for all years of manufacture.

[5] infrastructure.gov.au/roads/environment/files/Final_Emission_Limits_for_Light_Vehicles_Euro_2-Euro_6.pdf.

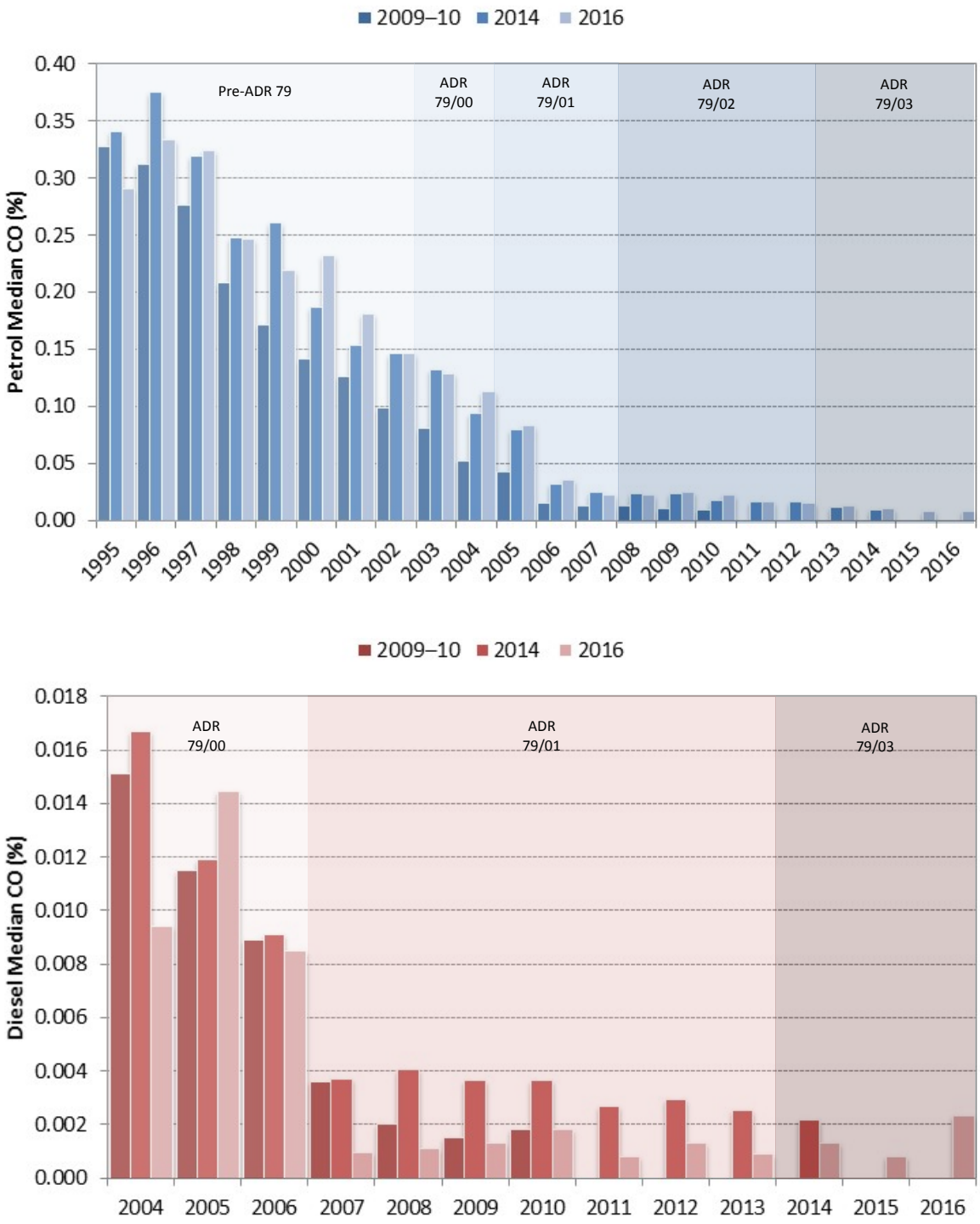


Figure 11: Median CO emissions over time per year of manufacture

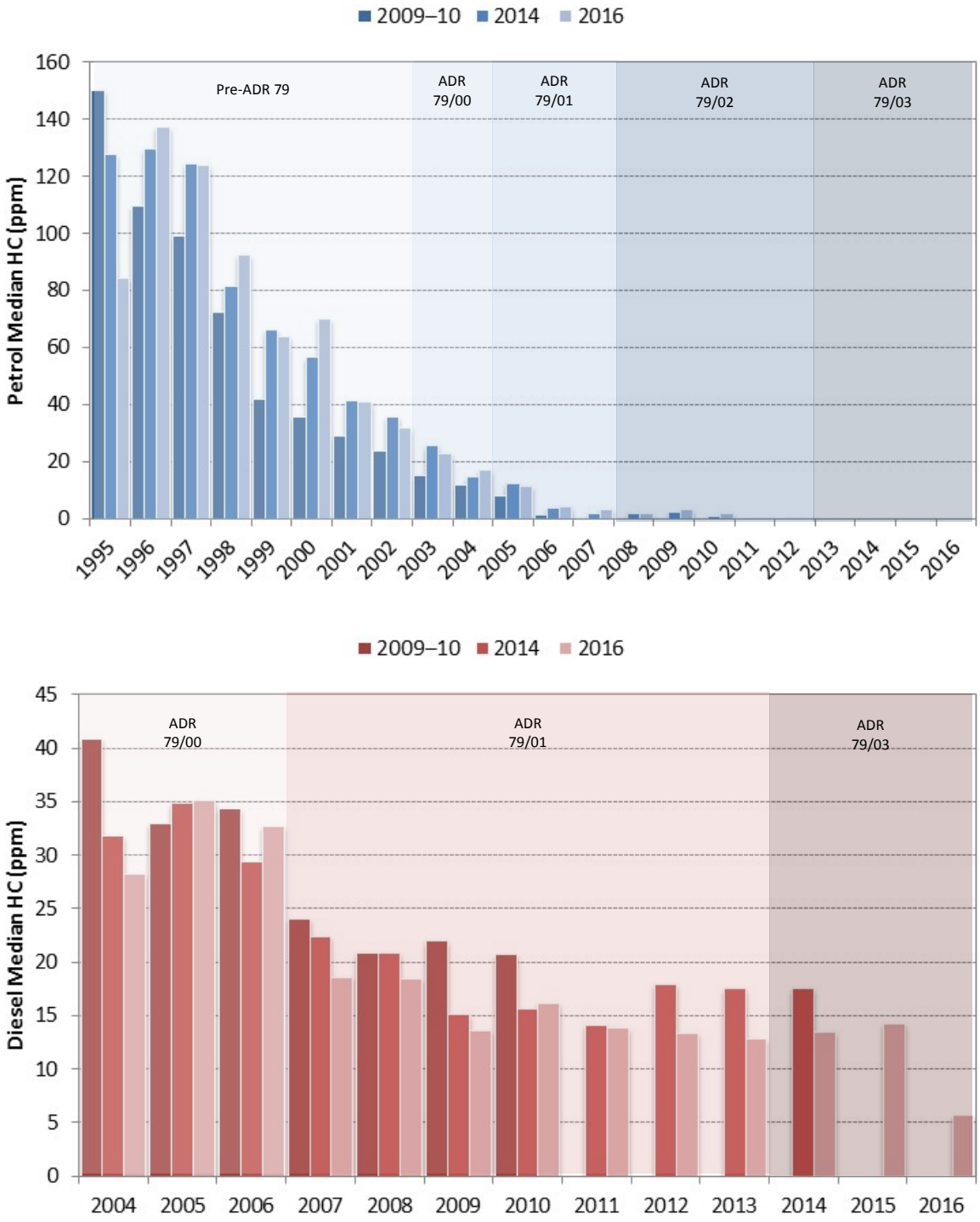


Figure 12: Median HC emissions over time per year of manufacture

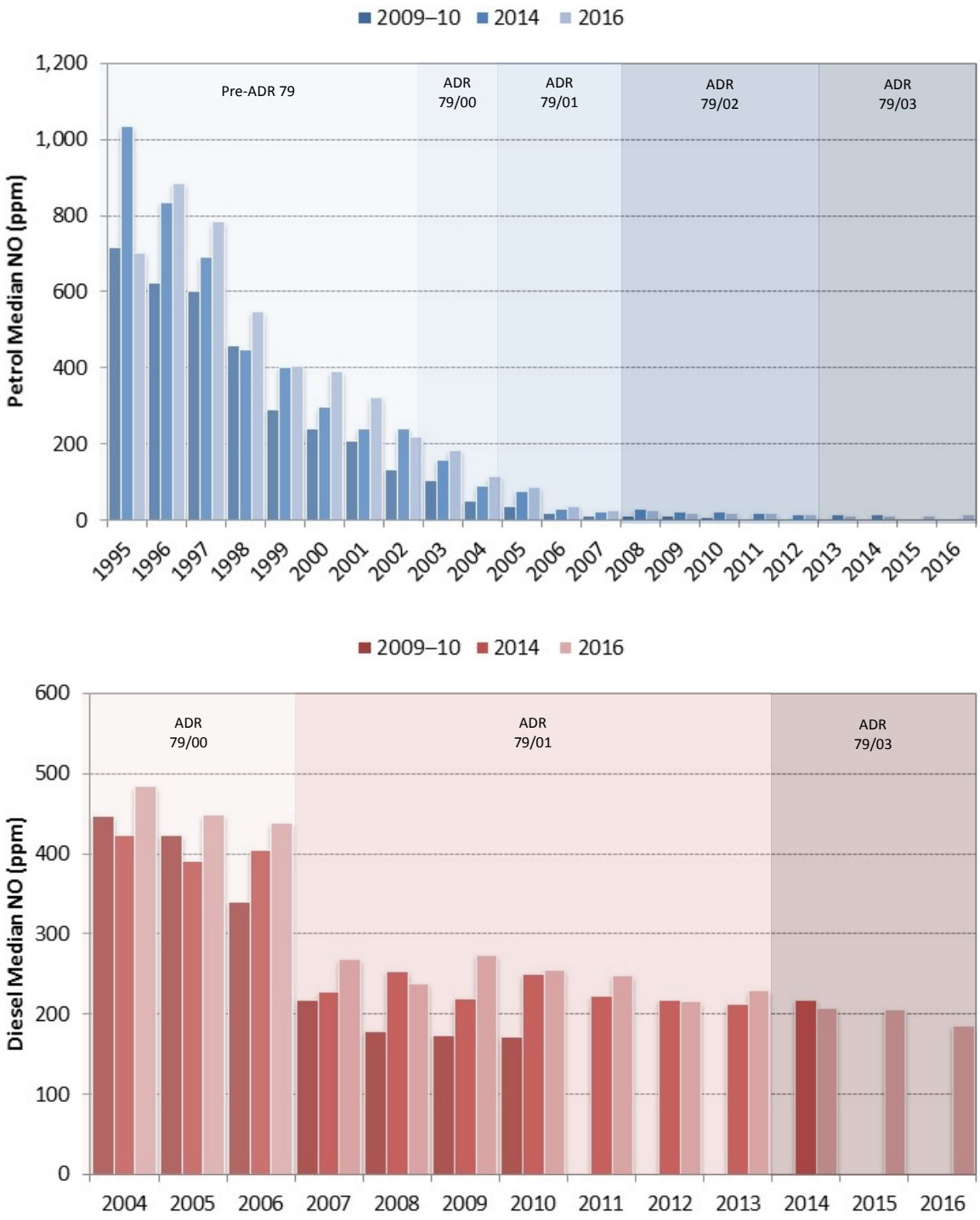


Figure 13: Median NO emissions over time per year of manufacture

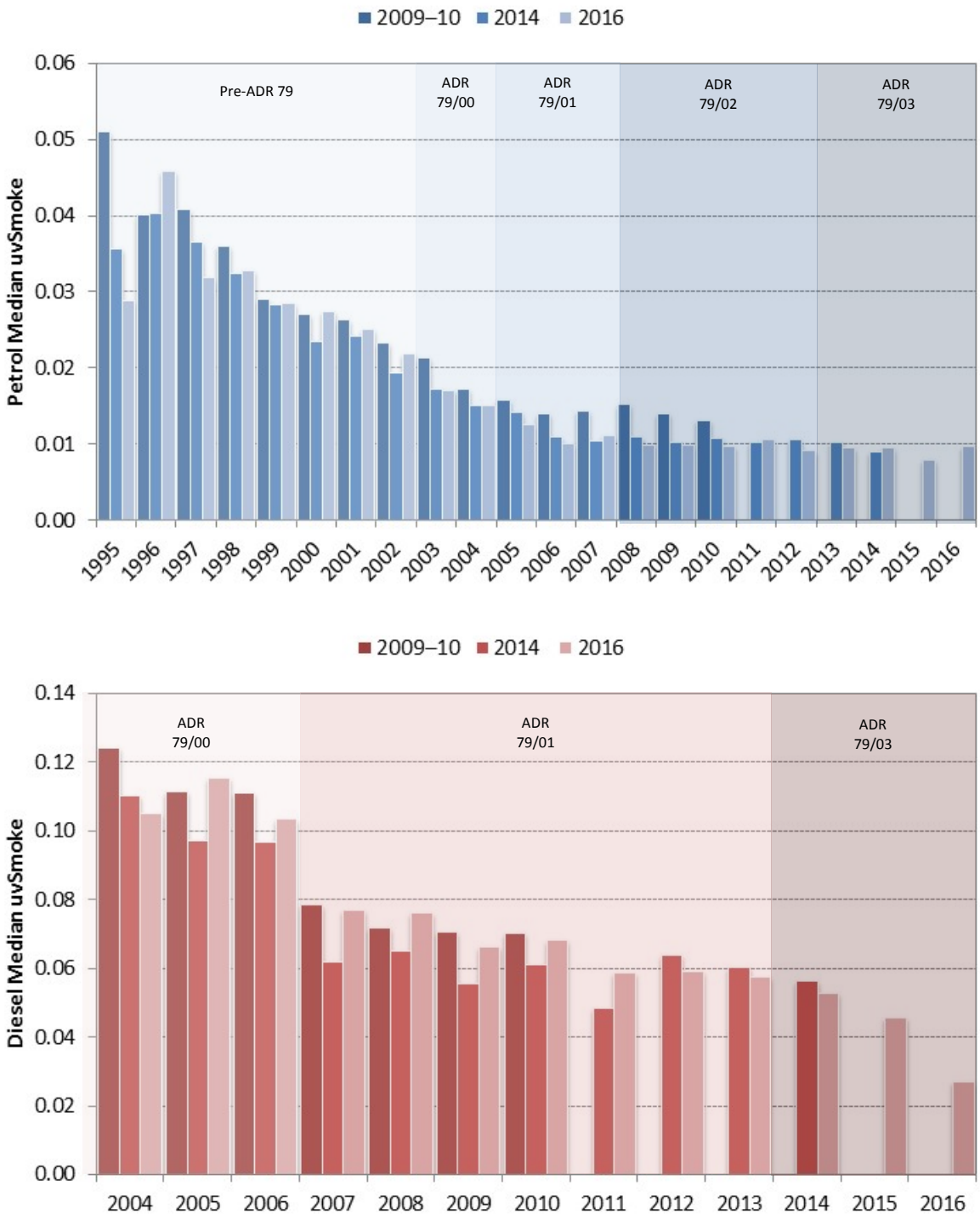


Figure 14: Median smoke emissions over time per year of manufacture

Vehicle Aging

For petrol vehicles, CO, HC and NO emissions are observed to increase as they age. This can be seen in the pattern of emissions increasing between each sampling campaign for most individual years of manufacture. Smoke emissions are observed to decrease as vehicles age.

Diesel vehicle data are more varied than petrol vehicle data. CO emissions from the 2016 sampling campaign are lower than 2009–10 and 2014 data for individual years of manufacture. HC data show improving emissions as vehicles age for most years of manufacture groups. Smoke data show minimal difference between 2009–10 data and 2016 data; however, the 2014 data shows each year group performing better compared to 2009–10 sampling. Only NO data show a trend of emissions increasing as a vehicle ages, albeit very weakly.

Emission Standards

All datasets show improvements in emissions between manufacturing years. This trend is less significant in recent years. While the trends can be easily seen for older years in Figure 11 to Figure 14, the data presented in Appendix D (Figure 15 and Figure 16) show the trends more clearly for newer models.

For petrol vehicles, the largest step change is noticeable in vehicles manufactured in 2006 or later. This coincides with the introduction of ‘Euro 3’ emission standards under ADR79/01. The data show a significant reduction of CO emissions despite CO emission standards not significantly changing under ‘Euro 3’.

‘Euro 4’ emission standards for light petrol vehicles were introduced between 2008 and 2010 and effectively halved the permissible emissions. Sampling data suggest emissions improvements were not significantly realised during this time. Further investigation is required to explain this observation.

Emissions of HC from 2011 and newer petrol vehicles are below detection for most vehicles. This time period does not align with the introduction of newer emission standards.

For diesel vehicles, the biggest step change appears in 2007 or later vehicles, and coincides with the tail-end introduction of ‘Euro 4’ emission standards under ADR79/02. Similar to petrol, ‘Euro 4’ diesel permissible levels are effectively half those of ‘Euro 3’. ‘Euro 5’ core emission standards for diesel vehicles were introduced in November 2013, though sampling data suggests these standards failed to make a discernible difference in diesel vehicle emissions.

Key Findings

Vehicle Speed

- Emissions were observed to be related to speed – the faster a vehicle travelled, the more it emitted.
- Vehicles travelling 20 km/h or slower were observed to have unexpectedly high emissions. A review of the vehicle fuel types, body types, weights and year of manufacture data found no group was more or less represented in this speed range. The result is attributed to the way the RSD samples vehicles travelling at low speeds. Vehicles travelling at lower speeds are more likely to be operating in lower gears (with engines working harder to produce the same output compared to higher gears).
- Analysis of key variables (fuel type, body type, vehicle weight and year of manufacture) suggests that the 2014 dataset is not significantly different to the 2009–10 and 2016 datasets, and that the slower speed of vehicles in the 2014 dataset does not appear to affect the assessment of emission trends.

Fuel type

- CO emissions are an issue for petrol vehicles, while smoke emissions are an issue for diesel vehicles. NO emissions were prevalent from diesel vehicles, though poorly performing petrol vehicles had NO emissions comparable to poorly performing diesel vehicles. HC emissions were higher from poorly performing petrol vehicles than diesel vehicles. Most diesel vehicles had higher HC emissions than petrol vehicles.
- LPG vehicles had notably higher emissions than petrol and diesel vehicles. This is attributed to LPG vehicle engines not being optimised to burn LPG as a result of historic conversion from petrol, or from being a ‘dual-fuel’ vehicle – which is a common feature in the taxi fleet.
- LPG vehicle emissions appear to be getting worse over time rather than improving, as would be expected when older vehicles leave the fleet and are replaced with newer vehicles. Sampling data show significantly fewer LPG vehicles with a year of manufacture after 2011.

Body Type

- Of the most common body types sampled, station sedans, sedans and hatchbacks had the best emissions performance. Coupes also had good emissions performance for most pollutants compared to other major body types, though they had the worst CO emissions.
- Utility vehicles have increasing NO and uvSmoke emissions since the 2009–10 sampling campaign. The reasons for this are unclear.

Vehicle Weight

- The ‘less than 1,000 kg’ vehicle weight range shows significantly higher emissions for CO, HC and NO compared to other lighter weight ranges. For CO

and HC, the ‘less than 1,000 kg’ vehicle weight range produced the most emissions. A review of sample counts and other vehicle variables available (for example make/model and age) does not suggest a possible reason for this result. One hypothesis to test could be vehicle build quality, based on the assumption that the less than 1000kg range represents ‘budget’ vehicles lacking robust fuel efficiency or emission control technology.

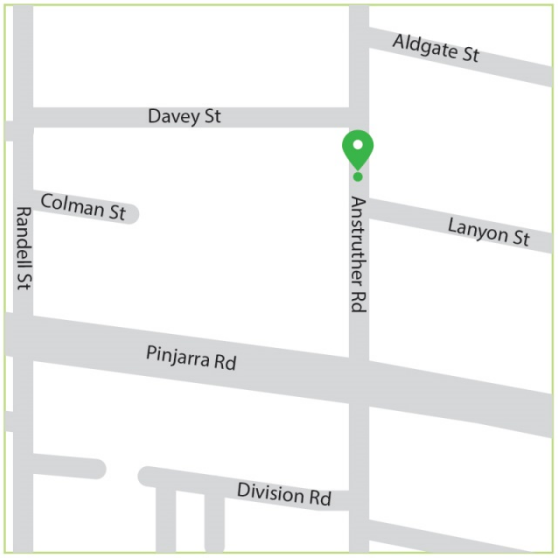
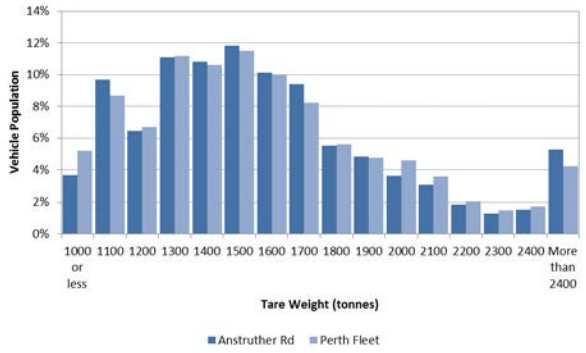
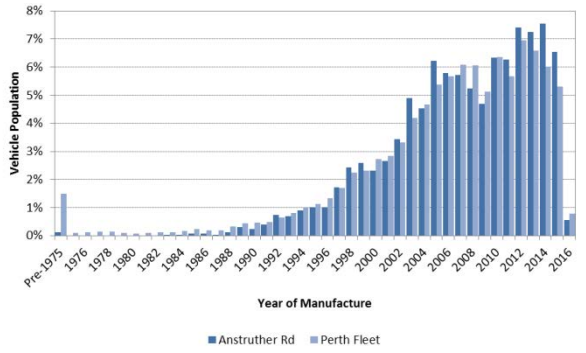
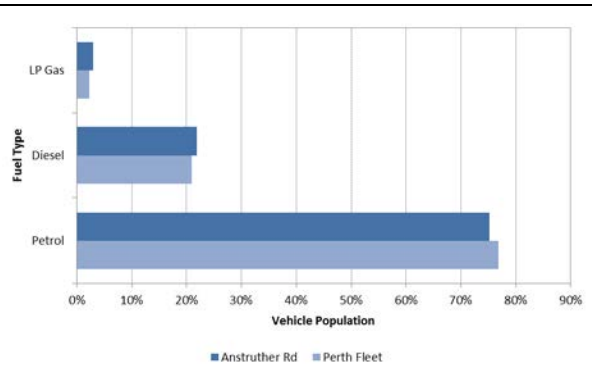
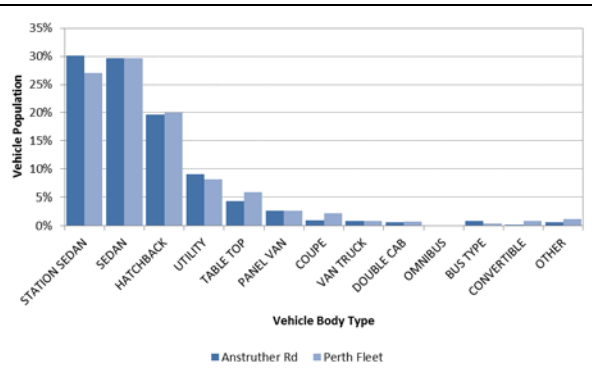
- CO emissions were lower for heavier vehicles, while HC, NO and smoke emissions increased as vehicle weight increased. It is considered that this effect is primarily from the influence of the dominant fuel type in each weight range.
- Most vehicle weight groups show an improvement in emissions since the 2009–10 sampling campaign. However, NO emissions in vehicles weighing between 1,600 kg and 2,400 kg have consistently increased over that time. This trend appears to be linked with the increasing diesel representation in these weight ranges since the 2009–10 sampling campaign.

Year of Manufacture

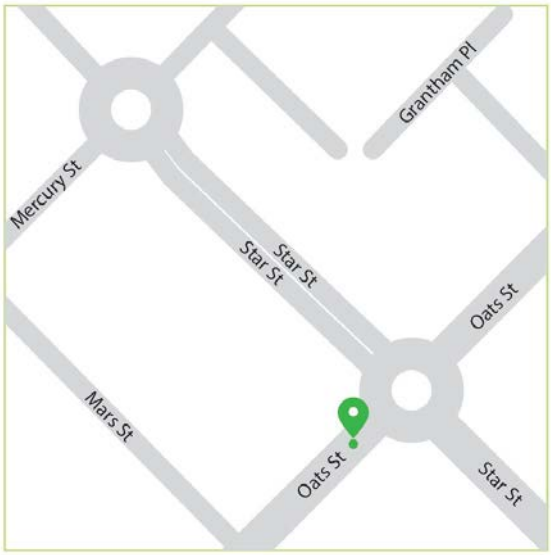
- It is expected that as a vehicle ages, its emissions will increase due to degradation of the engine and installed emission control technology. The data in some circumstances are not consistent with this expectation, most notably with smoke emissions from petrol vehicles. Factors like fuel quality improvements and road surface conditions may be influencing results.
- Newer vehicles had superior emission performance compared to older vehicles. However, the introduction of more stringent emission standards over time does not appear to consistently result in significant improvements in emissions when they come into effect. It is possible vehicles in the fleet are built to higher standards than required by law due to the vehicle also being sold in international markets with stricter emission standards. This may explain the gradual improvement from year to year rather than ‘step change’ improvements.

Appendix A

Site Characteristics

Anstruther Rd, Mandurah	
	**Site 1:** Anstruther Rd, Mandurah **Direction:** Northbound **Slope:** 3.5° **Average flow rate:** 264 cars/hour **Fleet:** Mix of local, commercial and residential traffic.
Fleet Representation (tare weight, year of manufacture, fuel type, body type)	
	
	

Oats St, Carlisle



Site 2: Oats St, Carlisle

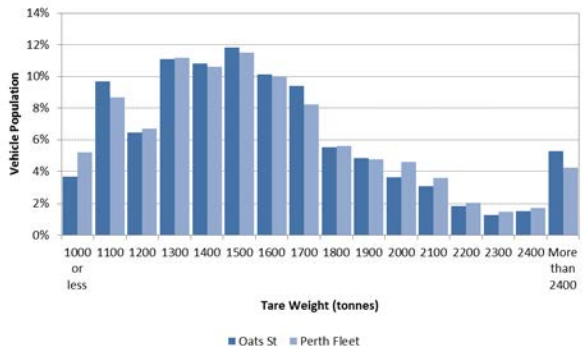
Direction: Southwest – site has glare issues

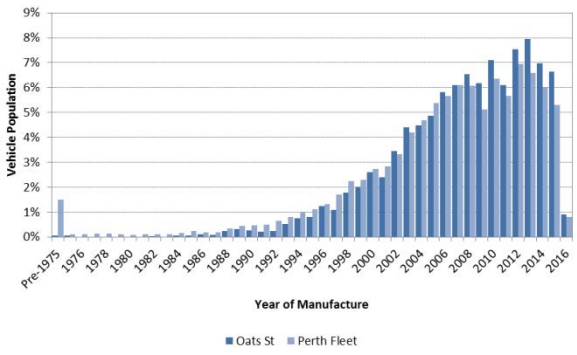
Slope: 2.3°

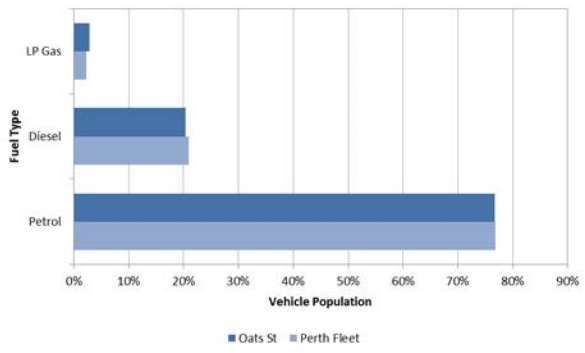
Average flow rate: 386 cars/hour

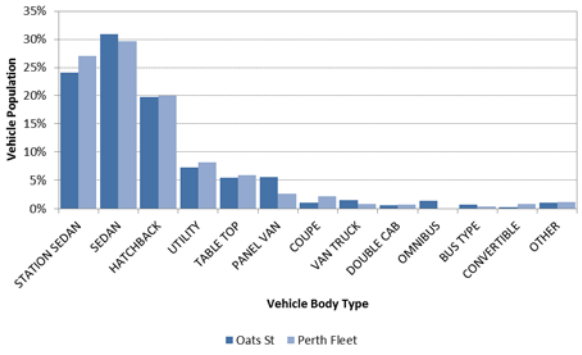
Fleet: Primarily residential traffic. Some commercial traffic.

Fleet Representation (tare weight, year of manufacture, fuel type, body type)





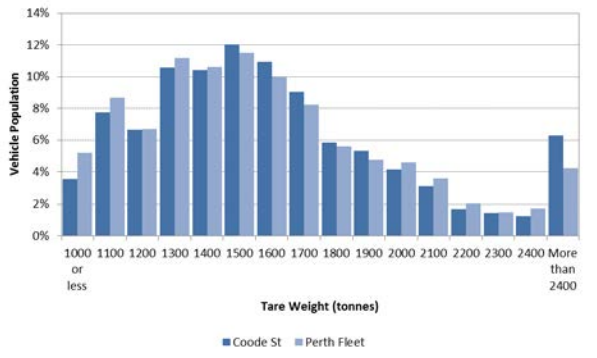


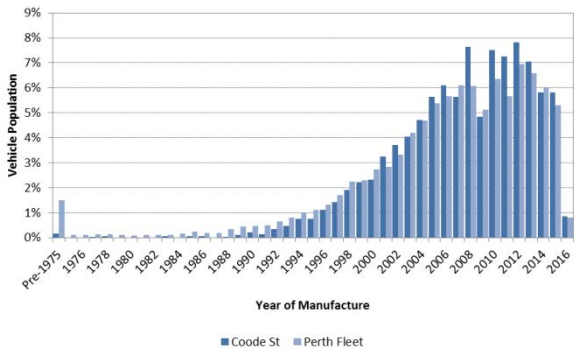


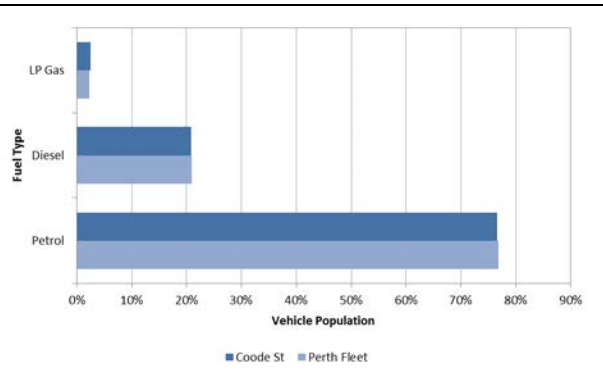
Coode St, Morley

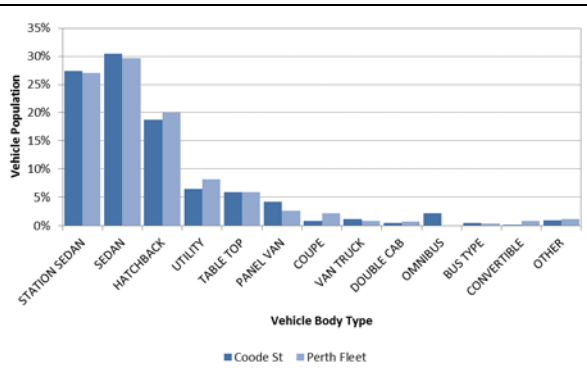
Site 3: Coode St, Morley
Direction: Southeast
Slope: 5.2°
Average flow rate: 329 cars/hour
Fleet: Almost entirely residential traffic.

Fleet Representation (tare weight, year of manufacture, fuel type, body type)

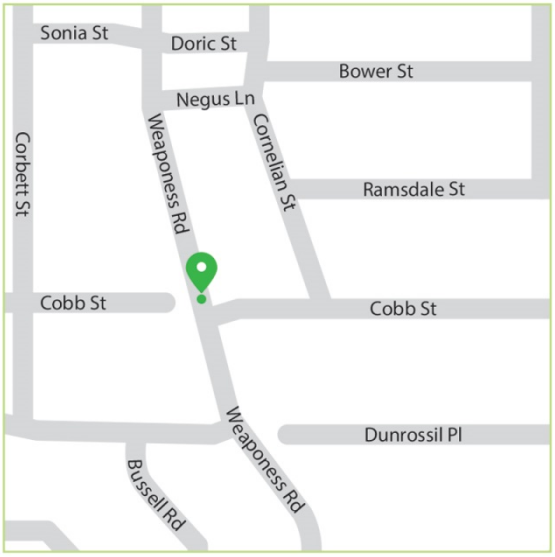






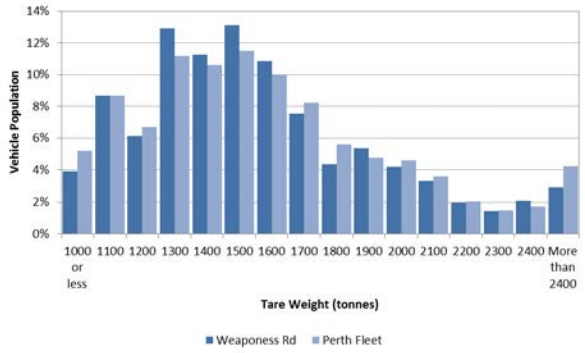


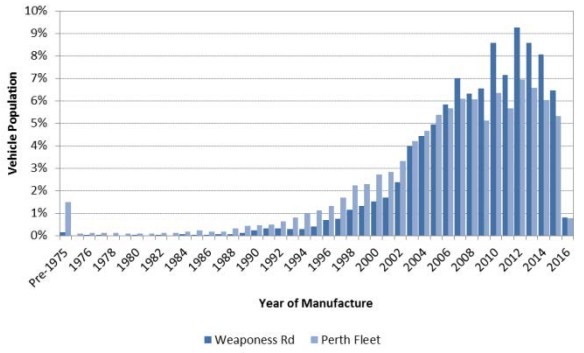
Weaponess Rd, Wembley Downs

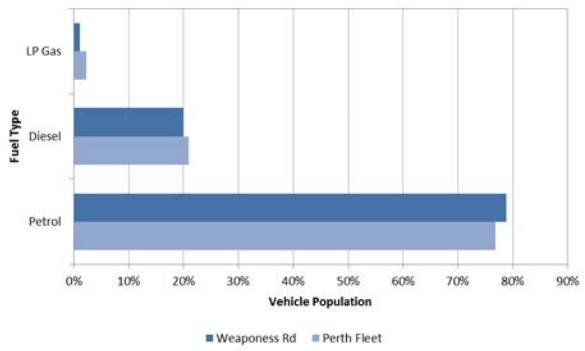


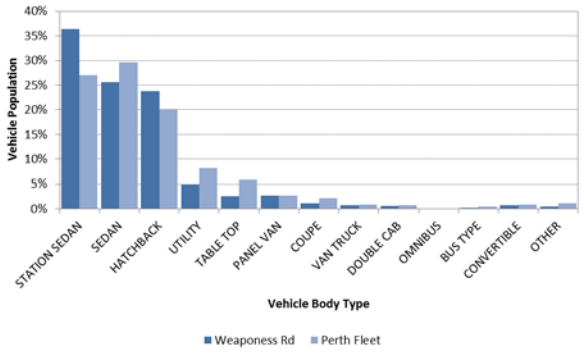
Site 4: Weaponess Rd, Wembley Downs
Direction: South
Slope: 5.0°
Average flow rate: 512 cars/hour
Fleet: Almost entirely residential traffic. Higher representation of newer and larger vehicles compared to most other sites.

Fleet Representation (tare weight, year of manufacture, fuel type, body type)

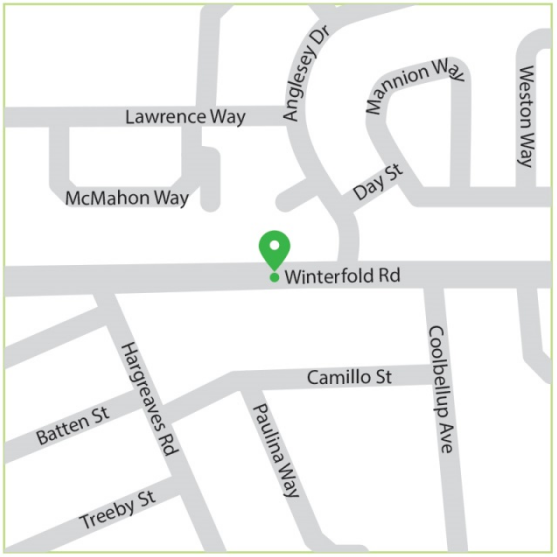






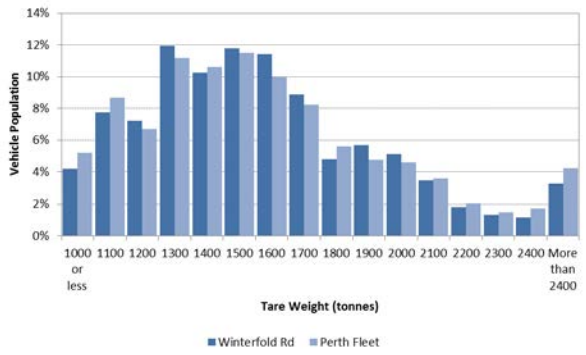


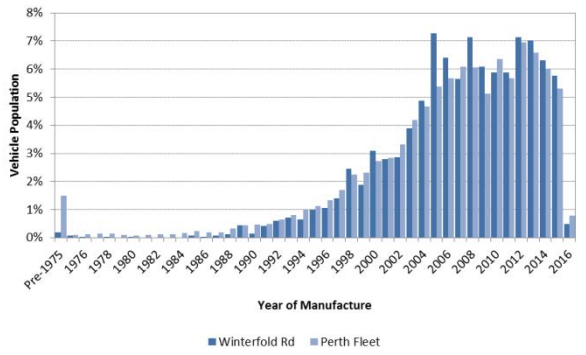
Winterfold Rd, Kardinya

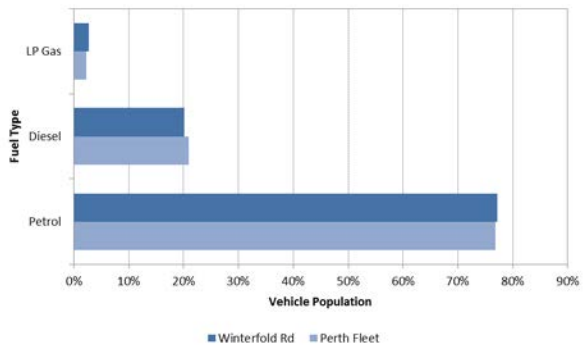


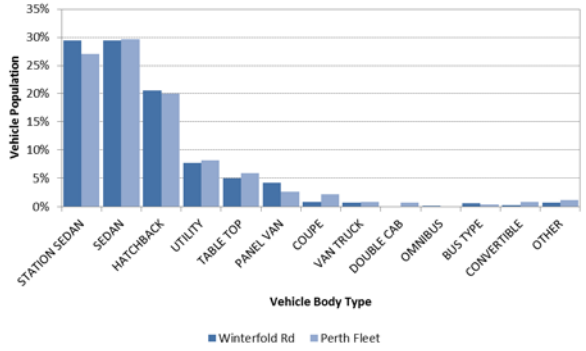
Site 5: Winterfold Rd, Kardinya
Direction: East
Slope: 5.9°
Average flow rate: 268 cars/hour
Fleet: Almost entirely residential traffic.

Fleet Representation (tare weight, year of manufacture, fuel type, body type)





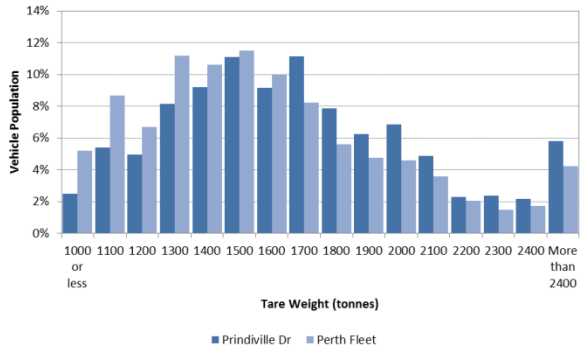


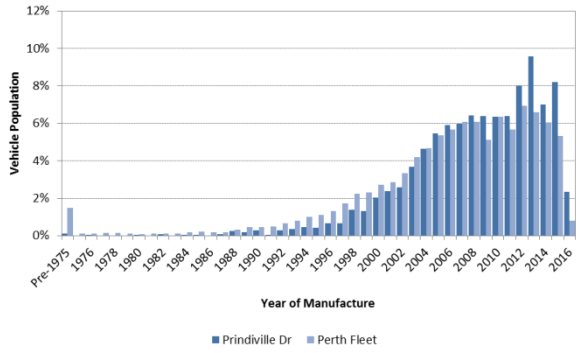


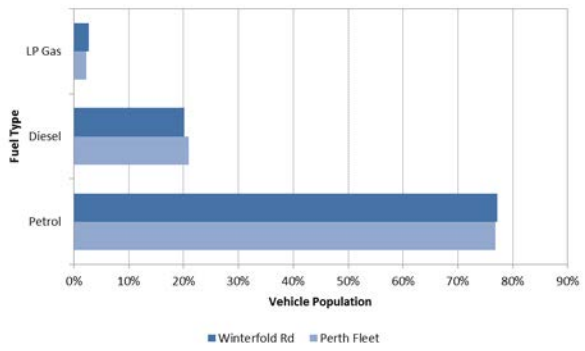
Prindiville Dr, Wangara

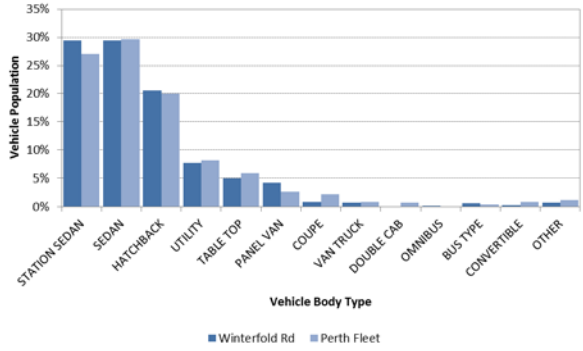
Site 6: Prindiville Dr, Wangara
Direction: North
Slope: 5.8°
Average flow rate: 384 cars/hour
Fleet: Mostly commercial traffic.

Fleet Representation (tare weight, year of manufacture, fuel type, body type)









Appendix B

Data Used for Fleet Representation Assessment

Table 5: Postcodes representing the Perth metro area

Postcodes									
6000	6018	6033	6058	6073	6104	6147	6162	6180	6503
6003	6019	6034	6059	6074	6105	6148	6163	6181	6556
6004	6020	6035	6060	6076	6106	6149	6164	6182	6558
6005	6021	6036	6061	6077	6107	6150	6165	6207	6560
6006	6022	6037	6062	6078	6108	6151	6166	6208	6562
6007	6023	6038	6063	6079	6109	6152	6167	6209	6566
6008	6024	6041	6064	6081	6110	6153	6168	6210	6567
6009	6025	6050	6065	6082	6111	6154	6169	6211	
6010	6026	6051	6066	6083	6112	6155	6170	6213	
6011	6027	6052	6067	6084	6121	6156	6171	6214	
6012	6028	6053	6068	6090	6122	6157	6172	6215	
6014	6029	6054	6069	6100	6123	6158	6173	6302	
6015	6030	6055	6070	6101	6124	6159	6174	6390	
6016	6031	6056	6071	6102	6125	6160	6175	6501	
6017	6032	6057	6072	6103	6126	6161	6176	6502	

Table 6: Vehicle body types measurable by RSD

Measurable

Measurable
AMBULANCE
ARMOURED TRUCK
BIN CARRIER
BOX TOP
BUS TYPE
CONVERTIBLE
COUPE
DOUBLE CAB
FIRE TENDER
FLAT TOP
FORK LIFT TRUCK
GARBAGE WAGON
HATCHBACK
HEARSE

Measurable
INVITATION VEHICLE
JEEP
KITCHEN TRUCK
MOBILE CARAVAN
MOTOR WAGON
MOURNING COACH
MULTI-BODY TYPE
OMNIBUS
PANEL VAN
POST VINTAGE VEHICLE
REFRIGERATED VAN
ROAD SWEEPER
ROADSTER
SCHOOL BUS
SEDAN
STATION SEDAN
STATION WAGON
STREET ROD
STRETCH LIMOUSINE
TABLE TOP
THREE-WHEEL CAR
TOW TRUCK CL 1
TOW TRUCK CL 2
UTILITY
VAN TRUCK
VETERAN VEHICLE
VINTAGE VEHICLE
WORK VAN

Not Measurable

Not Measurable
BACK HOE
BEACH BUGGY
BITUMEN SPRAYER
BOAT TRAILER
BULLDOZER
CAMPER TRAILER
CAR CARRIER
CARAVAN

Not Measurable
CARAVAN SEMI-TRAILER
CARRIER
CEMENT AGITATOR
CHASSIS MOUNTED BIN
CONVERTER DOLLY
DOG TRAILER
DRILLING RIG
DUMP TRUCK
ELEVATING PLATFORM
ENDURO MOTOR CYCLE
EXCAVATOR
FARM/ENDURO BIKE
FIRE ENGINE
FORK LIFT
FRONT END LOADER
HOIST
HORSE FLOAT
INVALID WHEEL CHAIR
INVITATION MOTOR CYCLE
INVITATION SEMI-TRAILER
INVITATION SIDE CAR
INVITATION TRAILER
JINKER
KITCHEN TRAILER
LOW LOADER
MOBILE BATHROOM
MOBILE CRANE
MOBILE WORKSHOP
MOPED
MOTOR CYCLE
MOTOR TRICYCLE
OFF-ROAD 3 WHEEL VEHICLE
OFF-ROAD 4 WHEEL VEHICLE
OFF-ROAD AIR CUSHION
OFF-ROAD BEACH BUGGY
OFF-ROAD MOTOR CYCLE
OFF-ROAD OTHER BODY
PIG TRAILER
POLE TYPE JINKER
POST VINTAGE MOTOR CYCLE

Not Measurable
POST VINTAGE SIDE CAR
PRIME MOVER
QUAD MOTORCYCLE
REFRIGERATED TRAILER
ROAD GRADER
ROAD RAIL AMBULANCE
ROAD RAIL BUS TYPE
ROAD RAIL PANEL VAN
ROAD RAIL STATION SEDAN
ROAD RAIL STATION WAGON
ROAD RAIL TABLE TOP
ROAD RAIL UTILITY
ROAD ROLLER
SCOOTER
SCRAPER
SELF PROP HEADER
SEMI-TRAILER
SIDE CAR
SKID STEER LOADER
SPECIAL RECREATION
SPECIAL UTILITY
STOCK TRAILER
STOCK TRUCK
SUPER SPREADER
TANKER TRAILER
TIP TRUCK
TOOL CARRIER
TOOL TRUCK
TOW MOTOR
TOW TRUCK CL 3
TRACTOR
TRACTOR PLANT
TRAILER
TRAILER MOUNTED BIN
TRAILER PLANT
TRENCH DIGGER
TRUCK TANKER
TURRET TRUCK
VAN TRAILER
VEHICLE CARRIER

Not Measurable
VETERAN MOTOR CYCLE
VIBRATOR
VINTAGE MOTOR CYCLE
VINTAGE SIDE CAR
WATER TANK TRAC

Appendix C

Smart Sign Cut Point Update

The scenarios tested to update the Smart sign cut points are presented in Table 7.

Scenario 1 and 2 reflect cut points set through strict statistical criteria. The worst one per cent of emitters for a pollutant were assigned POOR, the next nine per cent were considered FAIR, and the remaining 90 per cent were GOOD. When applied to the 2016 dataset, only a limited number of vehicles received a POOR rating for both scenarios.

Scenario 3 and 4 criteria show over 50 per cent of vehicles received a FAIR rating. The GOOD and POOR rating varied between the two scenarios, but either option represents a significant divergence from the historic distribution of feedback from the smart sign.

Scenario 5 and 6 cut points were based on a more arbitrary percentile range compared to the other scenarios. However, these scenarios were focused on producing a GOOD/FAIR/POOR percentage distribution of 70/20/10. Without accounting for fuel type (scenario 5), diesel vehicles saw a 50/38/12 GOOD/FAIR/POOR percentage distribution. Accounting for fuel type (scenario 6) significantly improved this ratio, removing an unreasonable bias that diesel vehicles would experience driving through the RSD.

With respect to the three criteria outlined in the report for selecting cut points, the cut points from scenario 6 appear the most reasonable to apply for future sampling. The specific cut points are presented in the report (Table 4). Compared to the current cut points presented in Table 1, the CO, HC and NO cut points have been tightened, while the smoke cut points have been relaxed.

Table 7: Alternate smart sign cut points – results for 2016

Emission category	GOOD	FAIR	POOR
Scenario 1: Current criteria (90% GOOD, 9% FAIR, 1% POOR)			
Carbon monoxide (CO) %	90.00%	9.00%	1.00%
Hydrocarbons (HC) ppm	90.00%	9.00%	1.00%
Nitrogen oxide (NO) ppm	90.00%	9.00%	1.00%
UV smoke (PM) %	90.00%	9.00%	1.00%
Scenario 1 Totals	**75.31%**	**21.21%**	**3.47%**
Scenario 2: Current criteria (90% GOOD, 9% FAIR, 1% POOR) using petrol vehicle data for CO and HC, and diesel vehicle data for NO and uvSmoke			
Carbon monoxide (CO) %	91.62%	7.41%	0.97%
Hydrocarbons (HC) ppm	90.37%	8.65%	0.98%
Nitrogen oxide (NO) ppm	92.07%	5.46%	2.47%
UV smoke (PM) %	96.91%	2.83%	0.26%
Scenario 2 Totals	**81.50%**	**14.33%**	**4.17%**
Scenario 3: 'Above average = GOOD' criteria (50% GOOD, 40% FAIR, 10% POOR)			
Carbon monoxide (CO) %	50.00%	40.00%	10.00%
Hydrocarbons (HC) ppm	50.00%	40.00%	10.00%
Nitrogen oxide (NO) ppm	50.00%	40.00%	10.00%
UV smoke (PM) %	50.00%	40.00%	10.00%
Scenario 3 Totals	**17.07%**	**58.25%**	**24.68%**
Scenario 4: 'Above average = GOOD' criteria (50% GOOD, 40% FAIR, 10% POOR) using petrol vehicle data for CO and HC, and diesel vehicle data for NO and uvSmoke			
Carbon monoxide (CO) %	58.35%	33.27%	8.38%
Hydrocarbons (HC) ppm	45.04%	45.33%	9.63%
Nitrogen oxide (NO) ppm	72.82%	19.24%	7.93%
UV smoke (PM) %	82.87%	14.04%	3.09%
Scenario 4 Totals	**29.70%**	**51.80%**	**18.50%**
Scenario 5: 'Nudged' criteria (88% GOOD, 9% FAIR, 3% POOR)			
Carbon monoxide (CO) %	88.00%	9.00%	3.00%
Hydrocarbons (HC) ppm	88.00%	9.00%	3.00%
Nitrogen oxide (NO) ppm	88.00%	9.00%	3.00%
UV smoke (PM) %	88.00%	9.00%	3.00%
Scenario 5 Totals	**70.98%**	**19.86%**	**9.15%**
Scenario 6: 'Nudged' criteria (82% GOOD, 14% FAIR, 4% POOR) using petrol vehicle data for CO and HC, and diesel vehicle data for NO and uvSmoke			
Carbon monoxide (CO) %	85.20%	11.27%	3.53%
Hydrocarbons (HC) ppm	81.84%	14.26%	3.90%
Nitrogen oxide (NO) ppm	88.19%	6.78%	5.03%
UV smoke (PM) %	93.97%	4.97%	1.06%
Scenario 6 Totals	**69.92%**	**19.94%**	**10.14%**

Appendix D

Statistical Data Tables

Table 8: CO emissions statistics by vehicle speed

CO (%)	0–20 km/h			20–25 km/h			25–30 km/h			30–35 km/h			35–40 km/h			40–45 km/h			45–50 km/h			50–55 km/h			55–60 km/h			60+ km/h		
	2009–10	2014	2016	2009–10	2014	2016	2009–10	2014	2016	2009–10	2014	2016	2009–10	2014	2016	2009–10	2014	2016	2009–10	2014	2016	2009–10	2014	2016	2009–10	2014	2016	2009–10	2014	2016
Max	9.75	9.48	3.95	9.87	8.47	6.86	8.76	8.63	11.0	12.6	11.5	13.5	12.9	9.95	11.9	11.3	13.0	10.8	10.5	13.0	10.5	9.17	7.64	9.87	10.5		9.27	5.99		6.02
99th %ile	5.89	2.80	2.10	3.94	2.86	2.39	4.14	3.41	2.44	4.64	3.73	3.03	4.62	3.41	2.78	4.61	3.18	3.47	4.70	4.45	3.85	5.12	2.00	3.06	4.17		4.14	3.24		4.74
95th %ile	1.72	0.94	0.89	1.64	0.94	0.65	1.53	0.93	0.77	1.45	0.84	0.79	1.52	0.85	0.74	1.53	0.90	0.80	1.58	1.22	0.86	2.03	0.88	0.87	1.44		1.02	1.42		1.35
90th %ile	0.78	0.58	0.58	0.83	0.47	0.33	0.73	0.50	0.41	0.72	0.44	0.44	0.70	0.45	0.43	0.74	0.49	0.47	0.69	0.54	0.48	0.79	0.50	0.45	0.60		0.48	0.71		0.53
70th %ile	0.16	0.10	0.13	0.17	0.07	0.05	0.15	0.09	0.07	0.15	0.08	0.08	0.15	0.09	0.09	0.15	0.10	0.11	0.14	0.11	0.10	0.17	0.14	0.10	0.12		0.10	0.21		0.10
Median	0.04	0.02	0.03	0.04	0.02	0.01	0.04	0.02	0.02	0.04	0.02	0.02	0.04	0.03	0.02	0.04	0.03	0.03	0.04	0.03	0.03	0.05	0.04	0.03	0.04		0.02	0.05		0.03
Linear trends																														
99th %ile	-1.89839			-0.77445			-0.85368			-0.80213			-0.91980			-0.57089			-0.42831			-1.02999								
95th %ile	-0.41316			-0.49617			-0.38149			-0.33383			-0.39156			-0.36480			-0.35953			-0.57846								
90th %ile	-0.09842			-0.24777			-0.15747			-0.14003			-0.13802			-0.13412			-0.10411			-0.16613								
70th %ile	-0.01909			-0.06016			-0.04068			-0.03295			-0.02787			-0.02128			-0.01791			-0.03224								
Median	-0.00390			-0.01420			-0.00900			-0.00900			-0.00865			-0.00770			-0.00693			-0.00878								

Table 9: HC emissions statistics by vehicle speed

HC (ppm)	0–20 km/h			20–25 km/h			25–30 km/h			30–35 km/h			35–40 km/h			40–45 km/h			45–50 km/h			50–55 km/h			55–60 km/h			60+ km/h		
	2009–10	2014	2016	2009–10	2014	2016	2009–10	2014	2016	2009–10	2014	2016	2009-10	2014	2016	2009-10	2014	2016	2009-10	2014	2016	2009-10	2014	2016	2009-10	2014	2016	2009-10	2014	2016
Max	15795	3170	10709	67987	3246	7306	5685	2698	10036	28617	40270	10544	19228	22962	3554	8897	3836	33977	7891	26116	8024	27982	893	4385	11732		2607	1092		758
99th %ile	1739	1071	707	1491	823	557	1031	818	750	1313	732	657	1158	673	630	1069	658	600	838	705	631	1045	421	602	828		668	667		371
95th %ile	620	412	408	517	322	251	497	350	262	470	303	269	439	268	259	413	259	277	377	248	254	393	176	230	314		324	399		216
90th %ile	351	218	212	342	182	114	300	192	126	289	147	136	266	143	130	258	140	139	234	143	148	246	108	138	190		176	220		123
70th %ile	70.2	52.9	43.1	71.6	40.0	26.5	66.9	39.9	30.2	61.5	36.9	30.1	57.1	35.4	31.4	55.0	35.3	33.3	52.7	34.0	35.2	53.7	43.5	35.4	50.8		36.0	60.9		32.6
Median	21.6	16.7	15.6	20.1	11.7	8.35	21.6	13.8	9.55	19.7	12.8	8.35	18.7	11.9	9.11	18.0	10.9	10.8	19.4	12.5	11.3	20.8	15.5	12.4	16.8		16.1	18.9		15.7
Linear trends																														
99th %ile	-515.97039			-467.07437			-140.88623			-327.69039			-264.24311			-234.66293			-103.46837			-221.31368								
95th %ile	-105.70825			-133.11358			-117.33119			-100.61341			-90.08061			-68.19795			-61.28762			-81.27729								
90th %ile	-69.46370			-113.81037			-87.12351			-76.27605			-68.04815			-59.71642			-42.89356			-54.05972								
70th %ile	-13.54976			-22.53037			-18.37363			-15.73459			-12.83699			-10.85807			-8.75116			-9.10799								
Median	-2.97395			-5.88910			-6.03440			-5.68313			-4.80630			-3.58678			-4.07513			-4.21638								

Table 10: NO emissions statistics by vehicle speed

NO (ppm)	0–20 km/h			20–25 km/h			25–30 km/h			30–35 km/h			35–40 km/h			40–45 km/h			45–50 km/h			50–55 km/h			55–60 km/h			60+ km/h		
	2009 -10	2014	2016	2009 –10	2014	2016	2009 –10	2014	2016	2009 –10	2014	2016	2009 –10	2014	2016	2009 –10	2014	2016	2009 –10	2014	2016	2009 –10	2014	2016	2009 –10	2014	2016	2009 –10	2014	2016
Max	4562	3349	3542	7682	5488	3452	5218	4642	5142	6987	5778	4748	9022	5232	4817	5086	6251	5037	6844	4929	4326	6844	3379	4711	4753		4247	3990		4313
99th %ile	2938	2702	1984	2842	2421	2215	3007	2398	2476	3006	2615	2405	3151	2741	2705	3200	2969	3053	3290	2713	2653	3221	2996	3012	3359		3067	3285		3892
95th %ile	1615	1755	1311	1781	1421	1014	1798	1499	1212	1897	1468	1359	1923	1456	1501	2046	1652	1648	2049	1562	1537	2163	1346	1615	2045		1848	2143		1613
90th %ile	1178	1235	792	1258	895	642	1202	1010	810	1276	945	930	1300	964	1027	1387	1038	1096	1420	1111	1060	1437	1080	999	1435		1080	1698		1040
70th %ile	349	394	193	365	234	145	348	268	191	398	271	245	392	265	287	420	323	324	468	326	320	495	437	356	432		352	592		348
Median	87.3	103	53.4	77.3	60.9	37.1	85.1	81.0	53.4	91.8	82.2	70.8	99.1	85.5	84.4	111	104	104	127	113	113	141	135	126	127		122	228		132
Linear trends																														
99th %ile	-477.09058			-313.70957			-265.25972			-300.37827			-222.94034			-73.59446			-318.62826			-104.36930								
95th %ile	-151.85630			-383.37645			-292.87440			-269.02948			-211.10782			-198.85010			-255.96168			-273.94790								
90th %ile	-193.25569			-308.00227			-196.05742			-172.89077			-136.61330			-145.32755			-180.10175			-218.75718								
70th %ile	-77.90942			-110.15047			-78.25632			-76.33956			-52.25005			-48.06770			-73.99114			-69.44309								
Median	-16.96760			-20.11360			-15.86120			-10.48940			-7.32335			-3.42928			-6.81520			-7.33460								

Table 11: uvSmoke emissions statistics by vehicle speed

uvSmoke	0–20 km/h			20–25 km/h			25–30 km/h			30–35 km/h			35–40 km/h			40–45 km/h			45–50 km/h			50–55 km/h			55–60 km/h			60+ km/h		
	2009 –10	2014	2016	2009 –10	2014	2016	2009 –10	2014	2016	2009 –10	2014	2016	2009 –10	2014	2016	2009 –10	2014	2016	2009 –10	2014	2016	2009 –10	2014	2016	2009 –10	2014	2016	2009 –10	2014	2016
Max	1.12	3.56	0.91	1.66	0.98	2.26	3.57	1.48	3.16	2.32	2.11	2.00	3.85	2.43	2.37	2.01	1.26	4.11	2.43	1.21	1.59	4.24	2.11	5.26	1.11		1.79	5.99		0.56
99th %ile	0.44	0.47	0.27	0.48	0.39	0.36	0.47	0.38	0.33	0.44	0.49	0.36	0.43	0.36	0.43	0.45	0.38	0.43	0.43	0.46	0.49	0.44	0.37	0.51	0.45		0.55	3.24		0.36
95th %ile	0.21	0.18	0.16	0.21	0.17	0.16	0.22	0.18	0.16	0.22	0.20	0.16	0.22	0.18	0.19	0.21	0.20	0.19	0.23	0.18	0.18	0.23	0.19	0.22	0.22		0.25	1.42		0.21
90th %ile	0.16	0.12	0.11	0.15	0.11	0.10	0.15	0.12	0.10	0.15	0.13	0.11	0.16	0.12	0.12	0.15	0.12	0.12	0.16	0.12	0.12	0.17	0.16	0.14	0.16		0.19	0.71		0.12
70th %ile	0.05	0.04	0.03	0.05	0.04	0.02	0.05	0.04	0.03	0.05	0.04	0.03	0.05	0.04	0.03	0.05	0.04	0.04	0.06	0.04	0.04	0.06	0.05	0.05	0.06		0.05	0.21		0.06
Median	0.02	0.02	0.01	0.02	0.02	0.01	0.02	0.02	0.01	0.03	0.02	0.02	0.03	0.02	0.02	0.03	0.02	0.02	0.03	0.02	0.02	0.03	0.03	0.02	0.03		0.03	0.05		0.03
Linear trends																														
99th %ile	-0.08635			-0.05618			-0.06747			-0.03689			0.00363			-0.01216			0.02732			0.03337								
95th %ile	-0.02401			-0.02630			-0.03361			-0.03257			-0.01692			-0.00982			-0.02083			-0.00525								
90th %ile	-0.02272			-0.02703			-0.02353			-0.02176			-0.01994			-0.01693			-0.01717			-0.01555								
70th %ile	-0.01151			-0.01072			-0.01011			-0.00815			-0.00761			-0.00630			-0.00795			-0.00684								
Median	-0.00413			-0.00570			-0.00515			-0.00455			-0.00420			-0.00350			-0.00433			-0.00380								

Table 12: CO emissions statistics by fuel type

CO (%)	Petrol			Diesel			LPG		
	2009–10	2014	2016	2009–10	2014	2016	2009–10	2014	2016
Max	12.9	13.0	13.5	9.17	5.14	5.73	11.5	10.4	10.8
99th %ile	4.60	3.59	3.14	0.42	0.46	0.32	7.87	7.49	8.13
95th %ile	1.66	1.05	0.88	0.13	0.09	0.07	4.62	4.29	4.13
90th %ile	0.81	0.57	0.52	0.07	0.05	0.04	2.85	2.68	2.64
70th %ile	0.20	0.14	0.14	0.03	0.01	0.01	0.50	0.36	0.43
Median	0.06	0.04	0.04	0.01	0.01	<0.01	0.10	0.10	0.11
Linear trends									
99th %ile	-0.72684			-0.05186			0.12790		
95th %ile	-0.39037			-0.02635			-0.24214		
90th %ile	-0.14539			-0.01896			-0.10301		
70th %ile	-0.03180			-0.00755			-0.03348		
Median	-0.00845			-0.00290			0.00570		

Table 13: HC emissions statistics by fuel type

HC (ppm)	Petrol			Diesel			LPG		
	2009–10	2014	2016	2009–10	2014	2016	2009–10	2014	2016
Max	67987	40270	33977	5662	3285	10709	23305	5475	10544
99th %ile	1109	814	663	528	357	375	3271	3165	2408
95th %ile	453	314	273	235	147	133	800	680	653
90th %ile	279	164	143	147	93.0	84.1	536	475	487
70th %ile	51.7	31.5	28.2	59.1	41.6	34.7	231	224	245
Median	13.9	7.91	6.17	33.3	22.1	18.0	88.5	93.1	93.4
Linear trends									
99th %ile	-223.14173			-76.49871			-431.49493		
95th %ile	-90.34966			-50.86326			-73.78545		
90th %ile	-68.13375			-31.43696			-24.61502		
70th %ile	-11.79282			-12.20402			6.89392		
Median	-3.84580			-7.62135			2.48085		

Table 14: NO emissions statistics by fuel type

NO (ppm)	Petrol			Diesel			LPG		
	2009–10	2014	2016	2009–10	2014	2016	2009–10	2014	2016
Max	6987	5232	5142	6844	4138	3736	9022	6251	4605
99th %ile	3167	2697	2656	2184	2089	2027	4240	4702	4211
95th %ile	1998	1472	1396	1533	1383	1367	2668	2755	3114
90th %ile	1296	848	780	1245	1095	1116	2095	2144	2360
70th %ile	286	153	140	667	548	573	777	799	985
Median	62.3	44.4	40.6	396	310	317	224	195	310
Linear trends									
99th %ile	-255.60455			-78.50804			-14.52497		
95th %ile	-300.88205			-82.86073			223.22575		
90th %ile	-258.05594			-64.43100			132.73000		
70th %ile	-73.02724			-46.80450			103.91317		
Median	-10.85885			-39.93170			43.23425		

Table 15: uvSmoke emissions statistics by fuel type

uvSmoke	Petrol			Diesel			LPG		
	2009–10	2014	2016	2009–10	2014	2016	2009–10	2014	2016
Max	3.57	1.51	2.91	4.24	3.56	5.26	0.92	1.00	0.38
99th %ile	0.33	0.26	0.24	0.76	0.77	0.87	0.28	0.29	0.21
95th %ile	0.18	0.13	0.10	0.39	0.33	0.35	0.14	0.15	0.13
90th %ile	0.11	0.06	0.05	0.29	0.22	0.23	0.09	0.08	0.08
70th %ile	0.04	0.02	0.02	0.15	0.11	0.11	0.04	0.03	0.03
Median	0.02	0.01	0.01	0.10	0.07	0.07	0.02	0.02	0.02
Linear trends									
99th %ile	-0.04203			0.05755			-0.03681		
95th %ile	-0.03679			-0.02199			-0.00666		
90th %ile	-0.03029			-0.02631			-0.00659		
70th %ile	-0.00700			-0.01922			-0.00378		
Median	-0.00435			-0.01608			-0.00285		

Table 16: CO emissions statistics by body type

CO (%)	STATION SEDAN			SEDAN			HATCHBACK			UTILITY			TABLE TOP			PANEL VAN			COUPE			VAN TRUCK			OMNIBUS			DOUBLE CAB		
	2009–10	2014	2016	2009–10	2014	2016	2009–10	2014	2016	2009-10	2014	2016	2009–10	2014	2016	2009–10	2014	2016	2009–10	2014	2016	2009–10	2014	2016	2009–10	2014	2016	2009–10	2014	2016
Max	9.21	8.59	13.18	12.92	13.03	11.95	10.64	11.15	10.21	9.84	8.63	9.87	11.33	11.47	13.46	11.45	10.54	10.07	9.75	13.00	5.75	8.69	8.98	6.02	2.03	0.74	0.38	7.91	4.06	4.08
99th %ile	3.94	2.46	2.26	4.57	3.85	3.17	4.24	2.25	1.83	4.21	2.18	3.80	5.09	4.26	4.26	6.24	7.03	5.85	6.58	5.86	4.23	4.08	2.24	5.28	0.20	0.22	0.27	4.96	2.70	3.80
95th %ile	1.16	0.75	0.65	1.56	1.02	0.85	1.37	0.71	0.65	1.48	0.81	0.90	1.82	1.12	0.98	2.93	2.15	2.10	3.28	2.39	1.24	1.01	0.45	0.44	0.05	0.05	0.05	2.07	1.45	1.70
90th %ile	0.58	0.41	0.36	0.76	0.55	0.51	0.61	0.41	0.41	0.65	0.35	0.39	0.83	0.55	0.46	1.54	1.01	0.78	1.73	0.99	0.92	0.43	0.25	0.18	0.04	0.04	0.03	1.14	0.76	0.89
70th %ile	0.10	0.07	0.07	0.21	0.14	0.14	0.15	0.12	0.11	0.10	0.04	0.03	0.11	0.06	0.05	0.21	0.11	0.06	0.51	0.21	0.22	0.10	0.04	0.03	0.02	0.02	0.01	0.27	0.12	0.13
Median	0.03	0.02	0.02	0.06	0.04	0.04	0.05	0.04	0.03	0.02	0.01	0.01	0.03	0.02	0.01	0.04	0.02	0.01	0.15	0.06	0.06	0.04	0.02	0.01	0.01	0.01	0.01	0.08	0.03	0.02
Linear trends																														
99th %ile	-0.84122			-0.69835			-1.20472			-0.20802			-0.41108			-0.19737			-1.17617			0.59842			0.03266			-0.58002		
95th %ile	-0.25362			-0.35390			-0.36011			-0.28863			-0.42291			-0.41487			-1.01913			-0.28772			-0.00026			-0.18668		
90th %ile	-0.10797			-0.12273			-0.09893			-0.12912			-0.18638			-0.37874			-0.40308			-0.12363			-0.00429			-0.12679		
70th %ile	-0.01644			-0.03404			-0.02353			-0.03179			-0.02932			-0.07462			-0.14295			-0.03356			-0.00066			-0.06739		
Median	-0.00550			-0.01075			-0.00713			-0.00680			-0.00985			-0.01435			-0.04635			-0.01500			-0.00150			-0.02745		

Table 17: HC emissions statistics by body type

HC (ppm)	STATION SEDAN			SEDAN			HATCHBACK			UTILITY			TABLE TOP			PANEL VAN			COUPE			VAN TRUCK			OMNIBUS			DOUBLE CAB		
	2009–10	2014	2016	2009–10	2014	2016	2009–10	2014	2016	2009–10	2014	2016	2009–10	2014	2016	2009–10	2014	2016	2009–10	2014	2016	2009–10	2014	2016	2009–10	2014	2016	2009–10	2014	2016
Max	13232	9741	10544	67987	28822	3414	27982	40270	10036	23305	4423	7306	20715	7293	8024	19228	12576	10709	28617	3242	5086	2593	26116	33977	3106	479	456	3110	1028	8792
99th %ile	856	555	509	1108	823	628	967	612	533	932	663	774	1489	946	1048	1712	980	1105	3301	2097	3460	1567	791	719	618	365	270	1778	898	816
95th %ile	365	235	194	453	354	296	426	188	189	403	263	303	504	328	361	572	417	364	815	911	631	427	314	332	268	155	98	468	355	385
90th %ile	219	124	95.9	286	188	167	208	93.6	90.7	255	155	170	326	205	212	356	270	239	574	396	438	280	227	161	228	122	64.1	340	300	269
70th %ile	43.6	30.1	27.0	57.0	34.9	30.1	33.8	25.0	25.0	63.0	48.2	47.6	95.8	58.6	50.7	109	60.9	49.5	206	59.7	57.8	129	55.3	62.0	82.2	83.8	24.5	134	89.0	96.4
Median	14.2	10.8	8.17	17.1	9.51	7.46	9.74	6.16	5.09	26.8	23.8	20.7	34.5	24.1	20.8	41.3	25.1	20.7	44.7	10.8	11.9	56.9	24.8	28.2	59.9	60.3	15.9	57.3	43.7	30.6
Linear trends																														
99th %ile	-173.28674			-239.85303			-217.08960			-78.58532			-220.51373			-303.38831			79.25898			-423.79821			-173.57254			-481.07387		
95th %ile	-85.22381			-78.66909			-118.48982			-50.36752			-71.65476			-104.25462			-91.63598			-47.24961			-84.92516			-41.69063		
90th %ile	-61.78507			-59.41255			-58.44560			-42.30835			-56.83756			-58.62901			-68.18896			-59.79985			-81.82321			-35.11207		
70th %ile	-8.31023			-13.48434			-4.40897			-7.70005			-22.54348			-29.85671			-74.17146			-33.54887			-28.87231			-19.00574		
Median	-3.03745			-4.81580			-2.32198			-3.08395			-6.86268			-10.32935			-16.38535			-14.30645			-22.02855			-13.36153		

Table 18: NO emissions statistics by body type

NO (ppm)	STATION SEDAN			SEDAN			HATCHBACK			UTILITY			TABLE TOP			PANEL VAN			COUPE			VAN TRUCK			OMNIBUS			DOUBLE CAB		
	2009–10	2014	2016	2009–10	2014	2016	2009–10	2014	2016	2009–10	2014	2016	2009–10	2014	2016	2009–10	2014	2016	2009–10	2014	2016	2009–10	2014	2016	2009–10	2014	2016	2009–10	2014	2016
Max	6844	4929	4464	6044	5488	4711	4531	5035	4570	5983	6251	4326	6844	3752	4228	6987	5778	5142	4322	3349	2790	4573	3386	3854	9022	3672	3188	4562	3446	3604
99th %ile	3119	2542	2455	2955	2802	2651	2809	2101	2200	3167	2602	2808	3517	3209	3024	3899	3614	3804	3361	3042	2318	3403	3002	2315	5282	3016	2705	3313	2570	2973
95th %ile	1834	1359	1304	1814	1493	1377	1612	1005	1033	1826	1457	1458	2276	2052	1943	2633	2121	2229	2399	1754	1617	2086	2117	1612	2396	2473	1457	2500	1940	2537
90th %ile	1142	888	871	1187	857	808	974	570	583	1258	937	1011	1660	1362	1404	2030	1550	1649	1772	1137	1062	1704	1591	1455	1816	2113	1258	2094	1398	2027
70th %ile	328	258	232	296	188	174	195	126	119	380	353	382	668	601	655	818	710	794	633	250	249	1133	869	850	1393	1429	667	955	638	730
Median	84.9	86.4	70.5	70.2	52.5	50.7	54.1	41.4	39.6	129	170	186	319	285	318	419	359	399	146	63.0	55.9	707	536	511	1210	1144	424	508	379	462
Linear trends																														
99th %ile	-332.22302			-151.97735			-304.69997			-179.45503			-246.26588			-47.98502			-521.87716			-543.91268			-1288.58013			-169.95105		
95th %ile	-265.04788			-218.57343			-289.49603			-183.65850			-166.93888			-202.05790			-390.94075			-236.96200			-469.16993			18.55492		
90th %ile	-135.31450			-189.37736			-195.64516			-123.88780			-127.76265			-190.54720			-354.97530			-124.37855			-279.13535			-33.42830		
70th %ile	-48.22524			-61.16261			-38.02799			1.08449			-6.51440			-12.03389			-192.16065			-141.29980			-363.13214			-112.44502		
Median	-7.19930			-9.74693			-7.22225			28.74945			-0.58760			-10.08690			-44.87110			-97.74800			-392.58700			-22.91363		

Table 19: uvSmoke emissions statistics by body type

uvSmoke	STATION SEDAN			SEDAN			HATCHBACK			UTILITY			TABLE TOP			PANEL VAN			COUPE			VAN TRUCK			OMNIBUS			DOUBLE CAB		
	2009–10	2014	2016	2009–10	2014	2016	2009–10	2014	2016	2009–10	2014	2016	2009–10	2014	2016	2009–10	2014	2016	2009–10	2014	2016	2009–10	2014	2016	2009–10	2014	2016	2009–10	2014	2016
Max	3.57	3.56	2.90	3.85	2.11	1.13	1.42	1.23	1.01	1.78	1.34	2.37	4.24	1.39	2.06	2.32	1.51	5.26	1.37	0.69	0.81	1.45	1.20	2.91	0.60	0.28	1.81	2.48	1.54	4.11
99th %ile	0.39	0.39	0.41	0.32	0.26	0.23	0.29	0.25	0.21	0.46	0.62	0.81	0.66	0.67	0.66	0.64	0.53	0.62	0.59	0.47	0.52	0.71	0.65	0.64	0.42	0.22	0.29	0.70	0.58	1.16
95th %ile	0.21	0.18	0.17	0.16	0.11	0.10	0.13	0.08	0.07	0.25	0.31	0.32	0.33	0.24	0.30	0.33	0.27	0.30	0.29	0.26	0.22	0.44	0.37	0.41	0.28	0.13	0.18	0.33	0.36	0.42
90th %ile	0.15	0.12	0.11	0.09	0.06	0.06	0.07	0.04	0.04	0.18	0.20	0.22	0.23	0.18	0.19	0.24	0.21	0.20	0.22	0.20	0.16	0.31	0.22	0.24	0.20	0.12	0.14	0.24	0.27	0.23
70th %ile	0.05	0.04	0.03	0.03	0.03	0.02	0.03	0.02	0.02	0.09	0.09	0.10	0.12	0.09	0.10	0.14	0.09	0.08	0.06	0.04	0.04	0.16	0.08	0.09	0.11	0.09	0.08	0.14	0.13	0.12
Median	0.03	0.02	0.02	0.02	0.01	0.01	0.02	0.01	0.01	0.05	0.05	0.06	0.06	0.05	0.05	0.07	0.04	0.04	0.03	0.02	0.02	0.09	0.05	0.04	0.08	0.06	0.05	0.08	0.07	0.07
Linear trends																														
99th %ile	0.00909			-0.04355			-0.03745			0.17438			-0.00015			-0.00762			-0.03497			-0.03881			-0.06916			0.23379		
95th %ile	-0.01659			-0.02580			-0.02978			0.03174			-0.01511			-0.01692			-0.03543			-0.01665			-0.04952			0.04592		
90th %ile	-0.01675			-0.01825			-0.01190			0.01739			-0.02062			-0.01797			-0.03485			-0.03431			-0.03273			-0.00762		
70th %ile	-0.00908			-0.00445			-0.00360			0.00527			-0.01047			-0.02608			-0.01313			-0.03634			-0.01221			-0.00798		
Median	-0.00555			-0.00295			-0.00270			0.00635			-0.00400			-0.01465			-0.00475			-0.02258			-0.01553			-0.00603		

Table 20: CO emissions statistics by weight range

CO (%)	Less than 1,000 kg			1,000–1,100 kg			1,100–1,200 kg			1,200–1,300 kg			1,300–1,400 kg			1,400–1,500 kg			1,500–1,600 kg			1,600–1,700 kg		
	2009–10	2014	2016	2009–10	2014	2016	2009–10	2014	2016	2009–10	2014	2016	2009–10	2014	2016	2009–10	2014	2016	2009–10	2014	2016	2009–10	2014	2016
Max	12.92	13.00	10.21	10.64	8.42	11.95	12.62	11.15	9.05	11.45	11.47	9.45	11.05	13.03	13.18	10.46	9.18	11.04	9.99	9.01	13.46	8.56	10.20	7.79
99th %ile	6.72	5.23	5.41	4.81	3.64	1.72	4.23	3.12	2.28	5.03	4.45	3.05	5.09	4.77	3.92	5.65	3.94	4.08	4.14	3.73	2.62	3.57	3.26	2.95
95th %ile	3.59	2.61	2.25	1.52	1.07	0.71	1.82	1.07	0.79	2.00	0.94	0.75	2.08	1.14	0.87	1.88	1.07	1.04	1.15	0.86	0.77	0.96	0.93	0.96
90th %ile	2.31	1.23	1.16	0.72	0.56	0.47	0.85	0.58	0.47	1.00	0.51	0.43	1.02	0.62	0.55	0.88	0.51	0.49	0.61	0.45	0.45	0.50	0.54	0.51
70th %ile	0.51	0.35	0.34	0.22	0.20	0.17	0.22	0.18	0.16	0.21	0.11	0.09	0.28	0.17	0.18	0.19	0.10	0.10	0.12	0.09	0.10	0.09	0.10	0.09
Median	0.21	0.13	0.13	0.08	0.08	0.05	0.07	0.07	0.06	0.05	0.03	0.02	0.10	0.05	0.05	0.05	0.03	0.02	0.04	0.03	0.03	0.03	0.03	0.02
Linear trends																								
99th %ile	-0.65625			-1.54650			-0.97674			-0.98916			-0.58232			-0.78470			-0.75641			-0.31312		
95th %ile	-0.67070			-0.40844			-0.51261			-0.62386			-0.60126			-0.41877			-0.19224			-0.00104		
90th %ile	-0.57783			-0.12483			-0.18994			-0.28641			-0.23449			-0.19440			-0.08040			0.00295		
70th %ile	-0.08552			-0.02313			-0.03386			-0.06250			-0.04784			-0.04348			-0.01456			-0.00279		
Median	-0.04083			-0.01248			-0.00568			-0.01495			-0.02268			-0.01048			-0.00658			-0.00158		

CO (%)	1,700–1,800 kg			1,800–1,900 kg			1,900–2,000 kg			2,000–2,100 kg			2,100–2,200 kg			2,200–2,300 kg			2,300–2,400 kg			More than 2,400 kg		
	2009–10	2014	2016	2009–10	2014	2016	2009–10	2014	2016	2009–10	2014	2016	2009–10	2014	2016	2009–10	2014	2016	2009–10	2014	2016	2009–10	2014	2016
Max	7.23	5.31	9.87	5.93	8.49	4.79	8.40	10.38	5.18	8.96	7.49	7.21	8.77	5.37	2.36	6.63	5.18	4.47	11.33	2.32	2.67	6.35	5.14	2.87
99th %ile	2.84	2.53	2.67	2.63	1.28	1.59	3.60	1.84	1.08	2.95	1.79	3.42	4.96	1.31	0.69	4.47	2.97	2.14	2.89	1.11	1.25	0.95	1.50	0.47
95th %ile	0.98	0.83	0.75	0.54	0.39	0.51	0.76	0.55	0.34	0.86	0.58	0.67	0.88	0.47	0.17	2.36	0.87	0.13	0.47	0.22	0.17	0.19	0.13	0.12
90th %ile	0.46	0.41	0.41	0.22	0.19	0.25	0.29	0.20	0.15	0.39	0.31	0.36	0.26	0.12	0.07	1.16	0.22	0.04	0.14	0.08	0.07	0.11	0.06	0.06
70th %ile	0.07	0.07	0.05	0.03	0.03	0.03	0.04	0.03	0.02	0.07	0.05	0.03	0.04	0.02	0.01	0.04	0.02	0.01	0.03	0.02	0.01	0.04	0.02	0.02
Median	0.02	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.01	0.01	0.01	0.01	<0.01	0.02	0.01	0.01	0.01	0.01	<0.01	0.02	0.01	0.01
Linear trends																								
99th %ile	-0.08402			-0.52414			-1.25919			0.23847			-2.13736			-1.16898			-0.82127			-0.23933		
95th %ile	-0.11701			-0.01325			-0.21053			-0.09924			-0.35488			-1.11433			-0.14994			-0.03771		
90th %ile	-0.02075			0.01384			-0.07050			-0.01366			-0.09739			-0.55698			-0.03430			-0.02484		
70th %ile	-0.00845			-0.00063			-0.00810			-0.01762			-0.01464			-0.01470			-0.00746			-0.01199		
Median	-0.00450			-0.00140			-0.00370			-0.00820			-0.00483			-0.00538			-0.00290			-0.00600		

Table 21: HC emissions statistics by weight range

HC (ppm)	Less than 1,000 kg			1,000–1,100 kg			1,100–1,200 kg			1,200–1,300 kg			1,300–1,400 kg			1,400–1,500 kg			1,500–1,600 kg			1,600–1,700 kg		
	2009–10	2014	2016	2009–10	2014	2016	2009–10	2014	2016	2009–10	2014	2016	2009–10	2014	2016	2009–10	2014	2016	2009–10	2014	2016	2009–10	2014	2016
Max	67987	40270	10036	28617	2658	4124	9291	2698	4183	16660	28822	33977	8897	9741	8792	11732	12576	10709	23305	2455	1693	20715	22962	10544
99th %ile	2329	1509	1395	1070	882	556	1608	849	490	1578	815	565	1220	964	746	1003	740	675	834	666	571	741	673	670
95th %ile	859	658	638	445	350	260	482	293	216	547	269	231	511	370	301	439	328	325	363	285	265	299	298	265
90th %ile	603	476	454	278	179	145	317	138	111	339	128	89.7	338	176	140	287	173	180	239	163	147	169	165	151
70th %ile	205	93.3	105	55.5	48.6	42.6	54.5	39.3	32.9	49.1	25.4	20.2	74.7	28.2	26.5	59.6	26.0	22.5	54.8	32.2	26.6	41.0	37.1	35.8
Median	67.3	31.1	31.0	16.8	15.5	12.1	15.1	11.3	9.89	13.2	4.20	4.46	19.0	7.94	5.97	15.3	5.17	3.55	16.9	9.04	7.34	15.1	12.9	11.1
Linear trends																								
99th %ile	-467.15977			-256.95293			-558.82468			-506.69618			-236.96692			-163.94829			-131.62550			-35.67581		
95th %ile	-110.65416			-92.29804			-132.90653			-158.00098			-104.89496			-56.72223			-48.98633			-17.27376		
90th %ile	-74.14967			-66.39678			-102.84479			-124.67205			-99.22682			-53.66498			-46.28530			-9.00778		
70th %ile	-50.13456			-6.47222			-10.78517			-14.48398			-24.07732			-18.57835			-14.08628			-2.58551		
Median	-18.17880			-2.35463			-2.59625			-4.38698			-6.53213			-5.85288			-4.75925			-2.01265		

HC (ppm)	1,700–1,800 kg			1,800–1,900 kg			1,900–2,000 kg			2,000–2,100 kg			2,100–2,200 kg			2,200–2,300 kg			2,300–2,400 kg			More than 2,400 kg		
	2009–10	2014	2016	2009–10	2014	2016	2009–10	2014	2016	2009–10	2014	2016	2009–10	2014	2016	2009–10	2014	2016	2009–10	2014	2016	2009–10	2014	2016
Max	6589	3242	8024	5662	5475	7306	13343	4888	1462	13232	3131	1454	3259	936	1905	3643	814	4385	1527	493	330	3637	3285	1505
99th %ile	652	547	676	566	428	473	880	571	350	788	451	526	670	415	470	612	433	356	590	316	256	773	450	436
95th %ile	280	242	239	241	172	177	319	221	136	343	234	225	317	182	140	355	259	147	205	149	127	330	202	200
90th %ile	175	159	140	124	87.0	88.7	167	123	90.6	232	132	125	159	87.5	77.5	239	157	76.0	108	81.0	70.9	237	139	93.8
70th %ile	48.3	43.9	36.0	37.0	31.3	28.2	48.8	37.6	34.9	57.1	41.5	38.5	55.8	30.8	26.8	61.3	40.6	30.1	33.8	39.3	32.0	87.1	58.0	36.7
Median	19.6	17.7	12.0	12.5	11.3	9.29	20.6	16.8	14.9	25.1	19.0	16.7	23.6	15.6	12.1	24.4	17.5	13.0	16.5	21.6	18.8	47.8	31.0	21.7
Linear trends																								
99th %ile	12.35861			-46.66297			-265.09259			-131.06524			-99.98470			-128.24171			-166.68481			-168.34726		
95th %ile	-20.42720			-31.86492			-91.61737			-59.00624			-88.62858			-104.26454			-39.16346			-64.64585		
90th %ile	-17.65627			-17.72609			-38.39837			-53.72957			-40.55304			-81.65121			-18.52267			-71.65770		
70th %ile	-6.15101			-4.43380			-6.91138			-9.30775			-14.49910			-15.58894			-0.89612			-25.21857		
Median	-3.79963			-1.61228			-2.85725			-4.18673			-5.72733			-5.72745			1.10530			-13.06438		

Table 22: NO emissions statistics by weight range

NO (ppm)	Less than 1,000 kg			1,000–1,100 kg			1,100–1,200 kg			1,200–1,300 kg			1,300–1,400 kg			1,400–1,500 kg			1,500–1,600 kg			1,600–1,700 kg		
	2009–10	2014	2016	2009–10	2014	2016	2009–10	2014	2016	2009–10	2014	2016	2009–10	2014	2016	2009–10	2014	2016	2009–10	2014	2016	2009–10	2014	2016
Max	6044	4591	3763	4088	5035	4605	5322	4407	4817	6987	5232	4711	5983	5778	5142	5428	6251	4748	6844	5488	5037	6844	4710	4464
99th %ile	3444	3407	2816	2962	2892	2749	3140	2394	2742	3356	3006	2912	3396	2396	2640	3212	2777	2965	3084	2731	2507	2392	2652	3003
95th %ile	2577	2134	2045	1965	1671	1626	2028	1415	1281	2126	1492	1336	2191	1376	1397	2167	1602	1653	1788	1351	1273	1333	1383	1393
90th %ile	1932	1537	1309	1351	1070	1022	1332	859	678	1434	857	665	1558	850	838	1424	902	996	1129	773	746	798	887	920
70th %ile	826	511	454	363	259	239	319	197	154	331	148	105	459	164	172	375	168	163	292	191	164	193	232	261
Median	365	149	125	94.6	71.9	63.1	70.5	68.3	56.3	65.0	42.5	34.4	116	57.5	55.1	81.3	43.0	39.3	66.2	52.6	45.5	50.7	65.8	76.8
Linear trends																								
99th %ile	-314.02407			-106.58664			-198.97209			-221.64004			-378.43708			-123.45395			-288.50903			305.21227		
95th %ile	-265.95378			-169.85063			-373.56170			-395.14023			-396.98343			-256.63063			-257.23983			29.83067		
90th %ile	-311.34515			-164.25175			-327.16832			-384.48351			-360.00013			-214.09445			-191.55960			60.62420		
70th %ile	-186.36288			-62.36609			-82.78801			-112.57810			-143.11844			-105.90698			-63.92460			33.70951		
Median	-120.11535			-15.76488			-7.06743			-15.32888			-30.48830			-20.99250			-10.37600			13.08098		

NO (ppm)	1,700–1,800 kg			1,800–1,900 kg			1,900–2,000 kg			2,000–2,100 kg			2,100–2,200 kg			2,200–2,300 kg			2,300–2,400 kg			More than 2,400 kg		
	2009–10	2014	2016	2009–10	2014	2016	2009–10	2014	2016	2009–10	2014	2016	2009–10	2014	2016	2009–10	2014	2016	2009–10	2014	2016	2009–10	2014	2016
Max	4338	3632	3438	4721	4138	4197	4683	5080	3213	4835	4062	4070	5086	3495	4429	2937	3646	3891	2800	3090	2460	9022	3672	3188
99th %ile	2981	2589	2368	2654	2273	1952	2517	3133	2059	3562	2711	2634	2428	2254	2050	2549	2293	2481	1924	1695	1717	2868	2839	2207
95th %ile	1855	1557	1480	1353	1254	1243	1222	1310	1249	2202	1463	1407	1399	1255	1315	1807	1383	1555	1463	1090	1243	1941	1847	1530
90th %ile	1059	1088	1013	925	736	724	863	774	819	1317	1061	1094	998	998	997	1293	1017	1115	928	888	1092	1596	1468	1292
70th %ile	387	349	329	239	237	245	286	323	339	513	496	546	506	410	523	593	576	560	448	509	579	1152	871	769
Median	112	123	117	66.6	104	114	115	156	158	195	205	221	177	191	251	263	268	290	194	231	218	741	471	396
Linear trends																								
99th %ile	-306.31291			-350.87430			-229.10664			-464.10473			-189.23206			-34.06766			-103.44674			-330.75767		
95th %ile	-187.34882			-55.10590			13.50945			-397.62218			-42.00595			-125.79695			-110.07080			-205.74415		
90th %ile	-22.99940			-100.77027			-22.31083			-111.58875			-0.52645			-88.88090			82.10902			-151.92590		
70th %ile	-29.08470			3.19311			26.30505			16.77224			8.44204			-16.37911			65.83044			-191.58942		
Median	2.73850			23.80998			21.50630			13.02335			37.21840			13.58608			11.78985			-172.57955		

Table 23: uvSmoke emissions statistics by weight range

uvSmoke	Less than 1,000 kg			1,000–1,100 kg			1,100–1,200 kg			1,200–1,300 kg			1,300–1,400 kg			1,400–1,500 kg			1,500–1,600 kg			1,600–1,700 kg		
	2009–10	2014	2016	2009–10	2014	2016	2009–10	2014	2016	2009–10	2014	2016	2009–10	2014	2016	2009–10	2014	2016	2009–10	2014	2016	2009–10	2014	2016
Max	2.52	1.23	0.55	1.32	0.69	0.81	3.85	0.58	0.55	1.47	1.26	2.91	1.46	2.11	1.22	1.20	0.86	1.80	1.65	1.00	1.85	2.48	1.54	2.90
99th %ile	0.52	0.42	0.40	0.30	0.25	0.20	0.37	0.29	0.24	0.38	0.24	0.27	0.40	0.27	0.26	0.32	0.31	0.27	0.31	0.25	0.22	0.36	0.32	0.35
95th %ile	0.29	0.26	0.23	0.15	0.12	0.08	0.21	0.13	0.07	0.20	0.12	0.09	0.20	0.15	0.13	0.19	0.15	0.14	0.16	0.14	0.12	0.17	0.15	0.14
90th %ile	0.21	0.17	0.13	0.09	0.06	0.05	0.13	0.05	0.05	0.13	0.06	0.05	0.14	0.08	0.06	0.14	0.08	0.08	0.11	0.07	0.06	0.11	0.08	0.09
70th %ile	0.07	0.04	0.04	0.03	0.03	0.02	0.03	0.03	0.02	0.04	0.02	0.02	0.04	0.03	0.02	0.04	0.03	0.03	0.04	0.03	0.02	0.04	0.03	0.03
Median	0.03	0.02	0.02	0.02	0.01	0.01	0.02	0.01	0.01	0.02	0.01	0.01	0.02	0.01	0.01	0.02	0.01	0.01	0.02	0.02	0.01	0.02	0.02	0.02
Linear trends																								
99th %ile	-0.05820			-0.04939			-0.06306			-0.05457			-0.06985			-0.02381			-0.04370			-0.00368		
95th %ile	-0.03045			-0.03591			-0.06589			-0.05120			-0.03913			-0.02228			-0.02000			-0.01301		
90th %ile	-0.03543			-0.02039			-0.04218			-0.04335			-0.03906			-0.02807			-0.02407			-0.01024		
70th %ile	-0.01595			-0.00474			-0.00520			-0.00860			-0.00893			-0.00615			-0.00756			-0.00560		
Median	-0.00798			-0.00330			-0.00320			-0.00455			-0.00418			-0.00378			-0.00480			-0.00375		

uvSmoke	1,700–1,800 kg			1,800–1,900 kg			1,900–2,000 kg			2,000–2,100 kg			2,100–2,200 kg			2,200–2,300 kg			2,300–2,400 kg			More than 2,400 kg		
	2009–10	2014	2016	2009–10	2014	2016	2009–10	2014	2016	2009–10	2014	2016	2009–10	2014	2016	2009–10	2014	2016	2009–10	2014	2016	2009–10	2014	2016
Max	3.47	1.34	4.11	1.78	0.71	5.26	1.74	3.56	1.59	3.57	1.39	2.26	2.32	1.02	2.47	1.28	1.21	0.54	0.92	1.17	1.82	4.24	1.76	3.16
99th %ile	0.52	0.61	0.78	0.52	0.42	0.62	0.56	0.71	0.69	0.56	0.53	0.89	0.63	0.64	0.74	0.40	0.65	0.37	0.64	0.36	0.53	0.85	0.61	0.62
95th %ile	0.23	0.22	0.26	0.26	0.21	0.23	0.27	0.27	0.30	0.30	0.27	0.31	0.36	0.26	0.29	0.24	0.22	0.19	0.35	0.21	0.21	0.41	0.28	0.31
90th %ile	0.17	0.15	0.16	0.17	0.15	0.16	0.20	0.20	0.19	0.22	0.21	0.20	0.25	0.18	0.21	0.20	0.18	0.16	0.20	0.17	0.16	0.30	0.19	0.23
70th %ile	0.08	0.06	0.06	0.07	0.06	0.06	0.09	0.09	0.09	0.11	0.08	0.08	0.12	0.08	0.09	0.13	0.09	0.09	0.09	0.09	0.08	0.15	0.10	0.11
Median	0.03	0.03	0.03	0.03	0.02	0.02	0.05	0.04	0.04	0.05	0.04	0.04	0.06	0.04	0.06	0.07	0.06	0.05	0.06	0.06	0.06	0.10	0.07	0.06
Linear trends																								
99th %ile	0.13324			0.04929			0.06298			0.16580			0.05424			-0.01361			-0.05405			-0.11522		
95th %ile	0.01170			-0.01773			0.01242			0.00533			-0.03093			-0.02644			-0.06968			-0.05274		
90th %ile	-0.00654			-0.00644			-0.00593			-0.01229			-0.01740			-0.02153			-0.01962			-0.03646		
70th %ile	-0.00678			-0.00454			-0.00057			-0.01161			-0.01403			-0.02406			-0.00557			-0.02343		
Median	-0.00290			-0.00473			-0.00665			-0.00385			-0.00423			-0.01060			0.00205			-0.01675		

Table 24: CO emissions statistics by year of manufacture – petrol vehicles

CO (%)	1995			1996			1997			1998			1999			2000			2001			2002			2003			2004			2005		
	2009 –10	2014	2016	2009 –10	2014	2016	2009 –10	2014	2016	2009 –10	2014	2016	2009 –10	2014	2016	2009 –10	2014	2016	2009 –10	2014	2016	2009 –10	2014	2016	2009 –10	2014	2016	2009 –10	2014	2016	2009 –10	2014	2016
Max	11.0	4.96	10.5	10.5	8.24	6.86	8.06	5.82	8.76	8.60	11.5	10.8	9.21	8.80	9.27	7.50	9.01	11.9	6.23	13.0	13.5	8.00	9.95	6.97	6.82	8.98	11.0	7.91	8.13	6.44	7.37	10.2	7.45
99th %ile	7.09	3.74	4.95	5.73	6.11	5.76	5.74	3.74	5.12	4.64	6.70	7.86	3.54	4.12	5.15	4.68	4.64	5.91	4.33	5.33	5.60	2.94	5.49	4.33	2.81	2.83	3.38	2.63	2.11	2.98	2.53	1.98	2.16
95th %ile	3.65	2.12	2.82	2.65	3.00	3.60	2.34	2.21	1.84	2.12	2.18	2.80	2.09	2.28	1.93	1.86	1.85	1.65	1.50	2.21	1.55	1.30	1.73	1.28	1.00	1.11	1.05	0.95	1.04	1.07	0.76	0.91	0.88
90th %ile	1.98	1.29	0.94	1.85	1.48	1.63	1.43	1.33	1.24	1.26	1.42	1.66	1.23	1.39	1.38	1.01	1.23	0.98	0.83	1.09	0.84	0.79	1.04	0.83	0.61	0.75	0.60	0.55	0.67	0.65	0.43	0.60	0.55
70th %ile	0.65	0.52	0.50	0.60	0.67	0.54	0.55	0.53	0.52	0.45	0.55	0.53	0.39	0.49	0.48	0.32	0.38	0.43	0.29	0.39	0.33	0.25	0.31	0.28	0.21	0.30	0.28	0.17	0.24	0.26	0.12	0.20	0.21
Median	0.33	0.34	0.29	0.31	0.38	0.33	0.28	0.32	0.32	0.21	0.25	0.25	0.17	0.26	0.22	0.14	0.19	0.23	0.13	0.15	0.18	0.10	0.15	0.15	0.08	0.13	0.13	0.05	0.09	0.11	0.04	0.08	0.08
Linear trends																																	
99th %ile	-1.06758			0.01691			-0.30797			1.61044			0.80195			0.61367			0.63486			0.69171			0.28756			0.17815			-0.18343		
95th %ile	-0.41227			0.47289			-0.24655			0.34117			-0.08187			-0.10843			0.02819			-0.01083			0.02258			0.05753			0.06282		
90th %ile	-0.51961			-0.11218			-0.09687			0.20365			0.07696			-0.01492			0.00622			0.01723			-0.00584			0.04751			0.05832		
70th %ile	-0.07528			-0.02978			-0.01464			0.04152			0.04472			0.05720			0.02153			0.01465			0.03442			0.04590			0.04763		
Median	-0.01848			0.01098			0.02383			0.01930			0.02375			0.04545			0.02768			0.02413			0.02425			0.03043			0.02010		

CO (%)	2006			2007			2008			2009			2010			2011			2012			2013			2014			2015			2016		
	2009 –10	2014	2016	2009 –10	2014	2016	2009 –10	2014	2016	2009 –10	2014	2016	2009 –10	2014	2016	2009 –10	2014	2016	2009 –10	2014	2016	2009 –10	2014	2016	2009 –10	2014	2016	2009 –10	2014	2016	2009 –10	2014	2016
Max	8.64	4.79	6.11	6.63	5.71	5.44	4.39	4.87	9.87	3.86	5.95	3.77	4.71	4.20	6.93		9.48	4.70		3.29	4.03		4.96	3.22		4.36	2.24			1.71			3.82
99th %ile	1.17	1.31	1.44	1.29	1.41	1.07	0.93	1.37	1.30	0.78	1.35	1.58	0.57	1.87	1.57		0.90	0.93		0.81	1.01		0.95	0.94		0.60	0.77			0.66			0.74
95th %ile	0.43	0.60	0.54	0.35	0.50	0.58	0.25	0.44	0.47	0.24	0.44	0.63	0.19	0.48	0.55		0.40	0.39		0.32	0.42		0.25	0.43		0.18	0.24			0.21			0.27
90th %ile	0.22	0.34	0.35	0.16	0.29	0.33	0.13	0.30	0.28	0.10	0.25	0.37	0.09	0.27	0.29		0.22	0.22		0.18	0.23		0.15	0.23		0.09	0.13			0.10			0.14
70th %ile	0.04	0.09	0.11	0.04	0.07	0.06	0.03	0.06	0.06	0.03	0.06	0.08	0.02	0.05	0.07		0.04	0.05		0.04	0.05		0.03	0.04		0.02	0.03			0.02			0.02
Median	0.02	0.03	0.04	0.01	0.03	0.02	0.01	0.02	0.02	0.01	0.02	0.02	0.01	0.02	0.02		0.02	0.02		0.02	0.02		0.01	0.01		0.01	0.01			0.01			0.01
Linear trends																																	
99th %ile	0.13286			-0.10804			0.18462			0.39978			0.49907			0.03396			0.20008			-0.01342			0.16906								
95th %ile	0.05781			0.11610			0.10981			0.19318			0.18039			-0.00821			0.09793			0.17964			0.06199								
90th %ile	0.06096			0.08209			0.07657			0.13077			0.09797			-0.00083			0.05190			0.08280			0.03824								
70th %ile	0.03468			0.01384			0.01545			0.02831			0.02171			0.00933			0.00292			0.00866			0.00850								
Median	0.01030			0.00488			0.00508			0.00740			0.00620			0.00040			-0.00080			0.00055			0.00125								

Table 25: HC emissions statistics by year of manufacture – petrol vehicles

HC (ppm)	1995			1996			1997			1998			1999			2000			2001			2002			2003			2004			2005		
	2009–10	2014	2016	2009–10	2014	2016	2009–10	2014	2016	2009–10	2014	2016	2009–10	2014	2016	2009–10	2014	2016	2009–10	2014	2016	2009–10	2014	2016	2009–10	2014	2016	2009–10	2014	2016	2009–10	2014	2016
Max	8550	966	1855	11732	2241	33977	4413	9741	3554	4530	40270	3223	5429	1352	8792	3123	2455	1579	6589	1554	1294	19228	12576	3812	5084	2834	3414	6246	1180	980	3792	7293	1517
99th %ile	1580	849	1126	1959	1816	2662	1648	1263	879	1504	2666	871	977	1042	657	1218	898	1014	748	1157	1009	820	1671	594	694	662	684	613	528	520	419	491	479
95th %ile	777	623	678	623	906	766	668	703	472	550	712	559	461	480	460	462	513	452	384	518	413	349	448	359	290	300	333	221	250	260	164	201	213
90th %ile	564	538	472	479	503	537	461	417	379	385	464	408	321	351	354	318	379	298	263	310	296	242	280	270	189	208	217	122	160	144	93.1	111	121
70th %ile	272	250	210	209	240	245	230	212	217	161	189	201	109	168	165	115	140	145	84.2	103	96.5	63.2	84.6	88.9	44.8	67.3	65.6	33.1	39.6	46.4	25.6	36.3	35.0
Median	150	128	84.3	110	129	137	99.2	124	124	72.5	81.3	92.3	41.6	66.2	63.9	35.6	56.6	70.1	29.1	41.5	40.6	23.7	35.7	31.7	15.1	25.6	22.6	11.7	14.6	16.9	7.83	12.0	11.0
Linear trends																																	
99th %ile	-227.16754			351.33713			-384.40098			-316.69593			-159.89415			-101.77535			130.56674			-112.80010			-5.23519			-46.59861			30.33986		
95th %ile	-49.89089			71.38813			-98.08998			4.11711			-0.38483			-4.70167			14.43022			4.73026			21.95068			19.83928			24.13456		
90th %ile	-46.19794			28.96445			-41.04112			11.30435			16.50079			-9.55020			16.39603			13.74293			14.40759			11.02857			14.17342		
70th %ile	-30.62484			18.25222			-6.28141			19.83090			27.76917			14.63928			6.16584			12.82230			10.37982			6.66252			4.70565		
Median	-32.88185			13.78280			12.31715			9.88758			11.12955			17.22820			5.74343			3.98483			3.76535			2.61140			1.59690		

HC (ppm)	2006			2007			2008			2009			2010			2011			2012			2013			2014			2015			2016		
	2009–10	2014	2016	2009–10	2014	2016	2009–10	2014	2016	2009–10	2014	2016	2009–10	2014	2016	2009–10	2014	2016	2009–10	2014	2016	2009–10	2014	2016	2009–10	2014	2016	2009–10	2014	2016	2009–10	2014	2016
Max	5779	1787	489	4722	496	1731	1082	22962	4672	950	2641	744	909	958	1300		3170	2607		1584	907		1478	965		373	488			900			237
99th %ile	355	388	226	295	239	360	209	345	239	255	250	308	139	342	322		268	262		204	164		260	188		183	153			224			198
95th %ile	81.2	115	105	71.0	103	110	59.8	93.7	77.5	53.1	95.3	106	48.6	88.9	77.1		75.6	74.7		75.0	67.0		58.8	55.8		43.3	41.3			39.1			105
90th %ile	43.3	69.4	67.4	37.3	58.2	54.4	33.6	52.3	46.4	30.7	49.6	56.5	25.3	51.9	49.1		43.7	44.7		44.5	41.9		34.9	36.1		27.7	23.7			18.9			27.1
70th %ile	12.3	18.6	20.4	9.38	14.5	17.1	9.67	15.1	16.6	7.24	16.4	18.4	5.48	15.2	13.9		10.3	11.2		12.1	10.8		7.70	7.7		2.55	3.32			1.34			3.61
Median	1.07	3.62	4.07	-0.89	1.53	3.26	-0.93	1.75	1.86	-2.38	2.26	3.37	-2.89	0.89	1.76		-1.61	0.22		0.12	-0.27		-3.04	-3.01		-7.80	-5.36			-6.81			-6.77
Linear trends																																	
99th %ile	-64.44618			32.53875			15.08052			26.30667			91.48196			-5.74895			-40.28097			-72.19586			-29.10171								
95th %ile	11.69548			19.51464			8.87316			26.34681			14.25801			-0.95199			-7.95611			-3.00222			-2.06304								
90th %ile	12.05348			8.54674			6.39063			12.87284			11.85767			1.03559			-2.53496			1.13059			-4.00425								
70th %ile	4.07632			3.86801			3.48388			5.56632			4.23300			0.89571			-1.29644			-0.02700			0.76315								
Median	1.50460			2.07360			1.39645			2.87515			2.32640			1.83425			-0.38780			0.02960			2.44055								

Table 26: NO emissions statistics by year of manufacture – petrol vehicles

NO (ppm)	1995			1996			1997			1998			1999			2000			2001			2002			2003			2004			2005		
	2009 –10	2014	2016	2009 –10	2014	2016	2009 –10	2014	2016	2009 –10	2014	2016	2009 –10	2014	2016	2009 –10	2014	2016	2009 –10	2014	2016	2009 –10	2014	2016	2009 –10	2014	2016	2009 –10	2014	2016	2009 –10	2014	2016
Max	4965	4359	3047	6987	4193	3854	5428	3245	4570	4573	5035	3604	5256	3869	3625	4584	4445	4748	5003	5080	5142	4174	3486	4527	3960	3430	5037	3037	5232	3697	4336	2797	4817
99th %ile	3569	3405	2687	3704	3880	3402	3506	3084	3708	3579	3482	3052	3428	3628	3108	3527	3176	3719	3586	3533	3612	3117	2610	3137	2831	2751	2967	2126	2309	2466	2011	1850	2524
95th %ile	2858	2690	2125	2805	2445	2702	2769	2513	3014	2777	2759	2546	2236	2591	2380	2479	2408	2675	2372	2284	2413	1944	2147	2143	1590	1678	1836	1159	1427	1331	860	1046	1265
90th %ile	2304	2548	1772	2306	1998	2471	2248	2168	2323	2189	2110	1943	1771	2117	1929	1928	1764	1968	1716	1756	1859	1222	1707	1482	989	1083	1171	648	820	928	479	658	833
70th %ile	1254	1508	1162	1117	1265	1504	1139	1283	1298	944	1002	1036	636	1009	808	636	640	875	549	589	772	387	569	581	302	398	413	146	246	294	102	217	246
Median	717	1034	701	624	834	883	603	692	785	458	447	548	292	402	406	238	298	392	209	241	321	133	239	217	103	158	183	49.8	90.1	114	35.8	76.5	87.2
Linear trends																																	
99th %ile	-440.92960			-150.89741			101.17124			-263.68235			-159.84739			96.38521			12.92217			9.64970			67.85087			170.17951			256.82046		
95th %ile	-366.36027			-51.30993			122.41065			-115.40495			72.01668			97.94570			20.93477			99.23738			122.78415			86.11572			202.64792		
90th %ile	-266.28645			82.60215			37.69695			-123.07340			79.02015			19.69980			71.60805			129.72325			91.09587			139.88279			176.61903		
70th %ile	-46.25025			193.69220			79.70115			45.97201			86.32944			119.54977			111.33550			96.56185			55.62185			73.92666			72.03598		
Median	-8.05125			129.49470			90.91600			45.01475			56.83195			76.78290			55.82868			41.77863			39.71390			31.95420			25.68265		

NO (ppm)	2006			2007			2008			2009			2010			2011			2012			2013			2014			2015			2016		
	2009 –10	2014	2016	2009 –10	2014	2016	2009 –10	2014	2016	2009 –10	2014	2016	2009 –10	2014	2016	2009 –10	2014	2016	2009 –10	2014	2016	2009 –10	2014	2016	2009 –10	2014	2016	2009 –10	2014	2016	2009 –10	2014	2016
Max	3386	3243	2263	4420	3047	2460	2985	3253	2728	3175	2509	2148	2988	4556	3866		2602	4055		1555	2688		1343	1460		3884	2765			2421			3128
99th %ile	1477	1563	1591	1223	1646	1704	1118	1435	1146	930	1179	1020	871	1225	938		1098	1059		796	873		889	671		737	1158			1010			584
95th %ile	460	683	624	348	498	481	255	480	425	200	458	395	210	397	440		392	370		259	270		278	210		200	178			187			112
90th %ile	192	341	310	166	255	282	120	262	230	97.6	245	239	93.5	222	231		177	181		148	156		144	122		112	90.3			92.3			83.7
70th %ile	51.1	84.7	91.5	40.1	67.8	72.1	33.8	69.0	63.8	31.3	64.3	63.3	27.0	58.0	58.5		46.7	53.3		41.5	43.8		37.9	38.6		37.4	31.2			31.3			33.9
Median	17.3	30.7	37.1	11.7	23.2	25.5	11.0	27.3	24.5	10.8	22.1	19.9	8.25	21.4	20.0		19.9	19.7		13.6	13.3		13.1	10.7		13.5	9.53			9.90			15.1
Linear trends																																	
99th %ile	57.04801			240.54580			13.98034			44.85380			33.35216			-38.88489			76.99024			-217.45312			421.03941								
95th %ile	82.35527			66.22044			84.75544			97.51031			115.15833			-21.94951			10.79759			-67.30132			-21.77386								
90th %ile	58.74185			58.03392			55.21206			70.64111			68.92386			3.96925			7.92422			-22.19436			-21.54018								
70th %ile	20.23769			16.00728			15.00780			16.01825			15.72671			6.62756			2.28476			0.66403			-6.25375								
Median	9.88958			6.88038			6.76608			4.54060			5.86455			-0.17470			-0.28550			-2.38055			-3.92570								

Table 27: Smoke emissions statistics by year of manufacture – petrol vehicles

uvSmoke	1995			1996			1997			1998			1999			2000			2001			2002			2003			2004			2005		
	2009–10	2014	2016	2009–10	2014	2016	2009–10	2014	2016	2009–10	2014	2016	2009–10	2014	2016	2009–10	2014	2016	2009–10	2014	2016	2009–10	2014	2016	2009–10	2014	2016	2009–10	2014	2016	2009–10	2014	2016
Max	0.98	0.36	0.55	3.57	0.60	2.91	1.29	1.09	1.22	0.65	1.23	0.37	2.41	0.83	0.60	1.02	0.51	0.50	0.79	0.51	0.36	1.13	0.71	1.30	1.46	0.32	0.48	1.23	0.41	1.11	0.79	0.34	1.01
99th %ile	0.33	0.25	0.37	0.53	0.58	0.58	0.51	0.28	0.49	0.38	0.33	0.28	0.29	0.29	0.34	0.30	0.38	0.27	0.24	0.32	0.30	0.24	0.26	0.23	0.19	0.21	0.26	0.16	0.20	0.23	0.14	0.17	0.19
95th %ile	0.23	0.20	0.23	0.24	0.24	0.31	0.24	0.20	0.23	0.22	0.22	0.16	0.18	0.22	0.18	0.19	0.18	0.18	0.16	0.18	0.16	0.15	0.17	0.15	0.12	0.14	0.13	0.07	0.08	0.09	0.07	0.07	0.07
90th %ile	0.19	0.15	0.16	0.18	0.18	0.22	0.18	0.15	0.15	0.17	0.18	0.14	0.14	0.16	0.14	0.14	0.13	0.15	0.11	0.14	0.12	0.11	0.13	0.10	0.07	0.08	0.08	0.05	0.05	0.06	0.05	0.04	0.05
70th %ile	0.10	0.07	0.07	0.08	0.08	0.11	0.09	0.07	0.06	0.07	0.06	0.06	0.05	0.06	0.05	0.05	0.04	0.05	0.04	0.04	0.04	0.04	0.04	0.04	0.03	0.03	0.03	0.03	0.02	0.03	0.03	0.02	0.02
Median	0.05	0.04	0.03	0.04	0.04	0.05	0.04	0.04	0.03	0.04	0.03	0.03	0.03	0.03	0.03	0.03	0.02	0.03	0.03	0.02	0.03	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.01	0.01
Linear trends																																	
99th %ile	0.02315			0.02494			-0.01174			-0.04945			0.02575			-0.01357			0.03009			-0.00504			0.03270			0.03418			0.02192		
95th %ile	-0.00277			0.03548			-0.00307			-0.02887			0.00117			-0.00381			-0.00002			-0.00201			0.00411			0.01073			0.00024		
90th %ile	-0.01796			0.01616			-0.01350			-0.01658			-0.00255			0.00103			0.00251			-0.00448			0.00497			0.00340			-0.00198		
70th %ile	-0.01746			0.01638			-0.01118			-0.00313			0.00115			-0.00125			-0.00270			-0.00168			-0.00167			-0.00095			-0.00220		
Median	-0.01110			0.00293			-0.00450			-0.00168			-0.00032			0.00020			-0.00068			-0.00075			-0.00215			-0.00113			-0.00165		

uvSmoke	2006			2007			2008			2009			2010			2011			2012			2013			2014			2015			2016		
	2009–10	2014	2016	2009–10	2014	2016	2009–10	2014	2016	2009–10	2014	2016	2009–10	2014	2016	2009–10	2014	2016	2009–10	2014	2016	2009–10	2014	2016	2009–10	2014	2016	2009–10	2014	2016	2009–10	2014	2016
Max	0.59	0.57	0.39	1.47	0.88	1.13	0.22	1.32	0.79	0.29	0.28	0.27	0.27	0.36	0.52		0.39	0.66		0.29	0.21		0.42	0.37		0.25	0.31			0.39			0.10
99th %ile	0.11	0.13	0.12	0.11	0.13	0.14	0.09	0.13	0.08	0.10	0.12	0.09	0.10	0.13	0.09		0.11	0.08		0.10	0.07		0.14	0.07		0.08	0.10			0.08			0.07
95th %ile	0.06	0.05	0.05	0.06	0.05	0.05	0.05	0.05	0.05	0.06	0.05	0.04	0.05	0.05	0.05		0.05	0.04		0.05	0.04		0.05	0.04		0.05	0.04			0.04			0.04
90th %ile	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.03	0.04	0.04	0.03		0.03	0.03		0.04	0.03		0.04	0.03		0.03	0.03			0.03			0.03
70th %ile	0.02	0.02	0.02	0.02	0.02	0.02	0.03	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02		0.02	0.02		0.02	0.02		0.02	0.02		0.02	0.02			0.02			0.02
Median	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01		0.01	0.01		0.01	0.01		0.01	0.01		0.01	0.01			0.01			0.01
Linear trends																																	
99th %ile	0.00124			0.01375			-0.00611			-0.00623			-0.00204			-0.03119			-0.02329			-0.06368			0.02294								
95th %ile	-0.00240			-0.00455			-0.00415			-0.00643			-0.00247			-0.00168			-0.00779			-0.00271			-0.00503								
90th %ile	-0.00308			-0.00286			-0.00263			-0.00444			-0.00217			-0.00078			-0.00356			-0.00410			-0.00249								
70th %ile	-0.00309			-0.00189			-0.00340			-0.00260			-0.00224			-0.00017			-0.00088			-0.00030			-0.00046								
Median	-0.00200			-0.00163			-0.00270			-0.00205			-0.00170			0.00050			-0.00150			-0.00080			0.00055								

Table 28: CO emissions statistics by year of manufacture – diesel vehicles

CO (%)	2004			2005			2006			2007			2008			2009			2010		
	2009–10	2014	2016	2009–10	2014	2016	2009–10	2014	2016	2009–10	2014	2016	2009–10	2014	2016	2009–10	2014	2016	2009–10	2014	2016
Max	1.363	0.624	0.233	0.845	1.451	0.471	1.456	0.470	0.722	0.540	1.234	0.704	1.430	1.122	0.857	0.875	1.592	0.756	0.595	1.782	0.439
99th %ile	0.398	0.193	0.115	0.263	0.343	0.374	0.471	0.217	0.276	0.261	0.577	0.233	0.272	0.303	0.147	0.373	0.348	0.184	0.228	0.585	0.154
95th %ile	0.118	0.151	0.064	0.133	0.133	0.136	0.116	0.116	0.111	0.110	0.073	0.088	0.095	0.068	0.054	0.084	0.072	0.088	0.052	0.067	0.057
90th %ile	0.075	0.095	0.045	0.070	0.072	0.070	0.072	0.050	0.057	0.061	0.042	0.041	0.045	0.042	0.028	0.033	0.039	0.050	0.026	0.029	0.026
70th %ile	0.032	0.028	0.016	0.030	0.033	0.028	0.028	0.024	0.017	0.014	0.012	0.009	0.008	0.012	0.007	0.008	0.011	0.008	0.007	0.012	0.007
Median	0.016	0.017	0.010	0.014	0.013	0.015	0.011	0.010	0.009	0.004	0.004	0.002	0.003	0.004	0.002	0.002	0.005	0.002	0.002	0.004	0.002
Linear trends																					
99th %ile	-0.14161			0.05537			-0.09744			-0.01438			-0.06269			-0.09442			-0.03708		
95th %ile	-0.02680			0.00120			-0.00259			-0.01135			-0.02070			0.00202			0.00256		
90th %ile	-0.01504			0.00002			-0.00756			-0.01000			-0.00830			0.00839			-0.00006		
70th %ile	-0.00801			-0.00111			-0.00544			-0.00262			-0.00050			-0.00026			0.00008		
Median	-0.00343			0.00045			-0.00113			-0.00103			-0.00060			-0.00015			0.00015		

CO (%)	2011			2012			2013			2014			2015			2016		
	2009–10	2014	2016	2009–10	2014	2016	2009–10	2014	2016	2009–10	2014	2016	2009–10	2014	2016	2009–10	2014	2016
Max		5.139	0.974		0.792	1.410		2.324	1.430		1.782	0.743			0.717			0.337
99th %ile		0.160	0.327		0.224	0.410		0.358	0.208		0.144	0.199			0.082			0.186
95th %ile		0.053	0.039		0.060	0.047		0.069	0.036		0.041	0.032			0.032			0.065
90th %ile		0.024	0.019		0.025	0.021		0.028	0.022		0.019	0.016			0.017			0.011
70th %ile		0.010	0.007		0.009	0.007		0.008	0.008		0.007	0.006			0.007			0.006
Median		0.003	0.001		0.004	0.002		0.003	0.002		0.002	0.001			0.002			0.003
Linear trends																		
99th %ile	0.16675			0.18672			-0.14997			0.05441								
95th %ile	-0.01406			-0.01274			-0.03256			-0.00832								
90th %ile	-0.00524			-0.00380			-0.00599			-0.00371								
70th %ile	-0.00318			-0.00250			-0.00020			-0.00132								
Median	-0.00190			-0.00190			-0.00110			-0.00090								

Table 29: HC emissions statistics by year of manufacture – diesel vehicles

HC (ppm)	2004			2005			2006			2007			2008			2009			2010		
	2009–10	2014	2016	2009–10	2014	2016	2009–10	2014	2016	2009–10	2014	2016	2009–10	2014	2016	2009–10	2014	2016	2009–10	2014	2016
Max	2552	566	1542	929	561	352	1031	350	1064	1011	406	5099	3643	344	1128	2891	443	845	1846	533	369
99th %ile	394	290	258	338	450	298	438	287	188	288	341	480	325	220	209	233	164	420	335	250	132
95th %ile	213	170	143	157	194	168	189	144	121	153	117	97.1	110	100	106	109	118	130	109	103	81.4
90th %ile	162	114	90.1	125	127	124	121	94.5	93.7	92.9	86.5	75.4	71.4	64.8	73.9	76.5	75.6	74.5	73.7	75.0	53.9
70th %ile	69.2	51.0	48.7	62.1	57.4	57.7	59.5	53.2	50.7	42.9	45.1	39.0	36.3	37.2	37.2	39.8	34.5	33.7	38.7	33.9	30.7
Median	42.7	32.3	28.4	34.8	35.9	36.1	37.8	29.9	32.7	24.9	23.0	20.8	21.0	21.0	19.0	22.0	15.7	14.5	20.9	16.0	16.8
Linear trends																					
99th %ile	-67.99786			-19.70252			-124.65963			95.85071			-58.05789			93.47916			-101.50622		
95th %ile	-34.97376			5.33058			-33.93960			-28.11849			-1.80225			10.40901			-13.55636		
90th %ile	-36.03888			-0.58483			-13.40634			-8.76942			1.23287			-0.98499			-9.90310		
70th %ile	-10.27288			-2.20139			-4.37843			-1.95659			0.46416			-3.03018			-3.99526		
Median	-7.11638			0.65375			-2.52220			-2.04853			-1.02953			-3.75250			-2.01290		

HC (ppm)	2011			2012			2013			2014			2015			2016		
	2009–10	2014	2016	2009–10	2014	2016	2009–10	2014	2016	2009–10	2014	2016	2009–10	2014	2016	2009–10	2014	2016
Max		3285	302		566	692		580	342		641	502			7306			121
99th %ile		268	181		264	193		198	197		275	192			162			101
95th %ile		97.2	84.0		110	93.1		96.8	90.0		100	100			78.9			59.0
90th %ile		70.0	57.2		67.5	58.5		65.5	66.0		70.8	54.9			54.4			46.7
70th %ile		26.5	25.3		33.3	28.8		32.2	26.9		33.0	25.9			25.2			18.8
Median		14.3	13.9		17.6	13.4		17.2	12.8		17.4	13.7			13.0			7.67
Linear trends																		
99th %ile	-86.67581			-71.05981			-0.26663			-82.98693								
95th %ile	-13.15893			-16.61057			-6.78000			0.15553								
90th %ile	-12.77762			-8.96402			0.46779			-15.81530								
70th %ile	-1.21304			-4.58370			-5.28686			-7.07591								
Median	-0.47440			-4.17840			-4.41040			-3.75885								

Table 30: NO emissions statistics by year of manufacture – diesel vehicles

NO (ppm)	2004			2005			2006			2007			2008			2009			2010		
	2009–10	2014	2016	2009–10	2014	2016	2009–10	2014	2016	2009–10	2014	2016	2009–10	2014	2016	2009–10	2014	2016	2009–10	2014	2016
Max	2979	3646	2910	2482	3009	2387	3715	3632	2997	3085	2943	3172	2514	3117	2942	3871	2755	2259	2912	3076	2505
99th %ile	2378	2126	2683	2068	2481	1988	2419	2479	2200	2516	2408	2454	1826	1633	2211	1586	2058	1673	1758	1767	1981
95th %ile	1611	1777	1851	1426	1681	1590	1748	1464	1612	1448	1338	1379	1178	1128	1450	1048	1181	1299	971	1416	1465
90th %ile	1334	1462	1309	1239	1298	1297	1357	1236	1226	1105	979	1036	933	945	1232	802	963	1001	767	1012	1254
70th %ile	699	789	851	695	707	882	680	704	709	467	514	550	414	492	555	344	443	538	334	502	601
Median	458	431	513	437	425	502	400	437	462	231	276	298	195	305	256	183	260	292	177	264	275
Linear trends																					
99th %ile	152.36106			-39.91085			-109.66847			-30.97972			192.71341			43.30684			111.44387		
95th %ile	120.28203			82.04152			-67.85920			-34.11605			135.85920			125.78840			247.04967		
90th %ile	-12.73915			28.67465			-65.44275			-34.58410			149.27739			99.23451			243.54420		
70th %ile	75.81913			93.63754			14.08527			41.19963			70.50906			97.05995			133.58280		
Median	27.36080			32.35460			30.79043			33.35085			30.18015			54.24340			49.11988		

NO (ppm)	2011			2012			2013			2014			2015			2016		
	2009–10	2014	2016	2009–10	2014	2016	2009–10	2014	2016	2009–10	2014	2016	2009–10	2014	2016	2009–10	2014	2016
Max		4138	3213		2461	2374		1693	2179		2174	2415			3736			2653
99th %ile		1694	1563		1711	1543		1466	1669		1584	1593			1604			2179
95th %ile		1157	1286		1159	1273		1096	1236		1115	1181			1119			1213
90th %ile		859	1061		829	962		875	987		868	916			894			1054
70th %ile		431	486		412	468		425	465		439	459			384			504
Median		234	256		235	228		219	241		221	223			217			234
Linear trends																		
99th %ile	-130.70798			-167.19778			203.70302			8.76612								
95th %ile	128.88170			114.27000			140.45640			66.39875								
90th %ile	202.13016			133.46092			112.49903			48.79291								
70th %ile	54.85326			56.42872			40.56007			19.80604								
Median	21.64940			-7.34050			22.73785			2.37165								

Table 31: Smoke emissions statistics by year of manufacture – diesel vehicles

uvSmoke	2004			2005			2006			2007			2008			2009			2010		
	2009–10	2014	2016	2009–10	2014	2016	2009–10	2014	2016	2009–10	2014	2016	2009–10	2014	2016	2009–10	2014	2016	2009–10	2014	2016
Max	2.32	1.03	5.26	0.96	2.11	1.22	1.78	1.76	0.82	2.43	1.17	0.82	0.78	0.81	0.90	1.48	0.92	4.11	0.96	1.34	2.32
99th %ile	0.93	0.98	1.31	0.57	0.89	0.79	0.61	0.67	0.64	0.48	0.79	0.47	0.45	0.48	0.66	0.51	0.65	0.88	0.51	0.53	0.93
95th %ile	0.37	0.34	0.39	0.32	0.46	0.47	0.38	0.36	0.36	0.28	0.27	0.30	0.22	0.26	0.33	0.25	0.28	0.31	0.24	0.23	0.37
90th %ile	0.29	0.23	0.25	0.26	0.27	0.30	0.28	0.23	0.28	0.21	0.21	0.25	0.18	0.16	0.25	0.18	0.17	0.22	0.18	0.16	0.29
70th %ile	0.17	0.14	0.15	0.16	0.15	0.16	0.15	0.13	0.16	0.11	0.11	0.12	0.10	0.09	0.12	0.10	0.09	0.10	0.11	0.09	0.17
Median	0.12	0.10	0.11	0.11	0.10	0.11	0.11	0.10	0.10	0.08	0.06	0.07	0.07	0.06	0.07	0.07	0.05	0.07	0.07	0.06	0.12
Linear trends																					
99th %ile	0.19078			0.11207			0.01481			-0.00654			0.10646			0.18465			-0.08451		
95th %ile	0.00931			0.07223			-0.01108			0.00902			0.05444			0.02851			0.00489		
90th %ile	-0.01808			0.02009			0.00067			0.01823			0.03455			0.01664			-0.00022		
70th %ile	-0.01161			-0.00153			0.00091			0.00404			0.00727			-0.00063			-0.00406		
Median	-0.00873			-0.00007			-0.00160			-0.00213			0.00228			-0.00255			-0.00210		

uvSmoke	2011			2012			2013			2014			2015			2016		
	2009–10	2014	2016	2009–10	2014	2016	2009–10	2014	2016	2009–10	2014	2016	2009–10	2014	2016	2009–10	2014	2016
Max		0.86	1.59		1.39	1.82		1.15	0.82		1.21	1.81			0.56			0.57
99th %ile		0.34	0.64		0.60	0.93		0.63	0.55		0.58	0.88			0.38			0.53
95th %ile		0.21	0.27		0.29	0.28		0.31	0.29		0.32	0.29			0.19			0.23
90th %ile		0.16	0.17		0.20	0.18		0.19	0.19		0.19	0.18			0.13			0.15
70th %ile		0.08	0.09		0.10	0.09		0.09	0.09		0.09	0.09			0.07			0.06
Median		0.05	0.06		0.06	0.06		0.06	0.05		0.06	0.05			0.04			0.03
Linear trends																		
99th %ile	0.29706			0.32804			-0.08126			0.29942								
95th %ile	0.06784			-0.01615			-0.01397			-0.03378								
90th %ile	0.00654			-0.01262			0.00352			-0.00893								
70th %ile	0.00620			-0.00958			-0.00084			-0.00177								
Median	0.01160			-0.00410			-0.00680			-0.00885								

Emission Standard	Year	Median CO Change			Median HC Change			Median NO Change			Median Smoke Change		
		2009–10	2014	2016	2009–10	2014	2016	2009–10	2014	2016	2009–10	2014	2016
ADR37/00	1994–1995	0.67%	27.51%	9.64%	0.44%	36.00%	47.98%	9.37%	5.88%	23.00%	7.93%	55.98%	29.51%
	1995–1996	4.57%	-10.29%	-15.15%	26.98%	-1.20%	-62.71%	12.96%	19.28%	-26.00%	21.62%	-12.89%	-58.82%
ADR37/01	1996–1997	11.44%	15.04%	2.99%	9.41%	3.92%	9.66%	3.35%	17.10%	11.11%	-2.12%	9.55%	30.50%
	1997–1998	24.69%	22.33%	23.85%	26.90%	34.65%	25.48%	23.99%	35.41%	30.13%	11.86%	11.11%	-2.51%
	1998–1999	17.77%	-5.33%	11.39%	42.60%	18.62%	30.79%	36.30%	10.14%	26.03%	19.28%	12.50%	13.00%
	1999–2000	17.46%	28.51%	-6.17%	14.40%	14.49%	-9.70%	18.33%	25.70%	3.36%	7.22%	16.93%	3.69%
	2000–2001	10.90%	17.74%	21.94%	18.24%	26.61%	42.04%	12.26%	19.14%	18.15%	2.22%	-2.34%	8.58%
	2001–2002	21.92%	4.89%	19.14%	18.59%	13.91%	21.99%	36.22%	0.74%	32.38%	11.74%	19.50%	12.97%
	2002–2003	18.51%	9.73%	12.25%	36.43%	28.51%	28.66%	22.72%	34.13%	15.87%	8.15%	11.34%	21.56%
Euro 2	2003–2004	34.52%	28.91%	11.90%	22.44%	42.82%	25.17%	51.75%	42.87%	37.74%	19.39%	12.79%	12.28%
ADR79/00	2004–2005	18.78%	15.42%	26.92%	33.04%	18.00%	34.83%	27.95%	15.13%	23.27%	8.41%	5.33%	16.67%
Euro 3	2005–2006	64.67%	59.75%	56.94%	86.40%	69.83%	63.05%	51.70%	59.78%	57.47%	11.39%	22.89%	20.00%
ADR79/01	2006–2007	16.94%	21.16%	37.59%	B/D	57.70%	20.01%	32.23%	24.50%	31.27%	-2.86%	5.02%	-11.50%
	2007–2008	3.20%	8.55%	0.00%	B/D	-14.64%	42.99%	6.67%	-17.60%	3.97%	-6.25%	-4.81%	11.21%
Euro 4	2008–2009	16.53%	-3.04%	-11.91%	B/D	-28.91%	-81.49%	1.37%	18.97%	18.79%	9.15%	5.50%	1.01%
ADR79/02	2009–2010	8.91%	24.47%	13.25%	B/D	60.74%	47.70%	23.59%	3.39%	-0.50%	5.76%	-3.88%	1.02%
	2010–2011		10.06%	23.61%		B/D	87.54%		7.06%	1.45%		5.14%	-9.79%
	2011–2012		0.00%	7.27%		B/D	B/D		31.42%	32.26%		-4.43%	14.55%
	2012–2013		27.33%	19.93%		B/D	B/D		4.09%	19.89%		2.83%	-4.40%
Euro 5	2013–2014		26.50%	19.59%		B/D	B/D		-2.97%	10.83%		12.62%	-0.53%
ADR79/03	2014–2015			16.24%			B/D			-3.93%			17.28%
	2015–2016			1.21%			B/D			-52.76%			-21.52%

Scale	Increase	Stable	Decrease
	-100.00%	0.00%	100.00%

B/D = Median sample below detection limit (less than zero)

Figure 15: Median year-to-year emission reduction per year of manufacture – petrol

Emission Standard	Year	Median CO Change			Median HC Change			Median NO Change			Median Smoke Change		
		2009–10	2014	2016	2009–10	2014	2016	2009–10	2014	2016	2009–10	2014	2016
Euro 2	2003–2004	1.95%	-1.83%	21.67%	-1.59%	8.10%	28.04%	0.79%	12.04%	-8.92%	0.40%	-1.56%	27.20%
ADR79/00	2004–2005	23.84%	28.74%	-53.72%	19.41%	-9.81%	-24.55%	5.21%	7.82%	7.43%	10.31%	11.96%	-10.01%
Euro 4	2005–2006	22.61%	23.53%	41.18%	-4.31%	15.68%	6.83%	19.90%	-3.35%	2.00%	0.18%	0.31%	10.23%
ADR79/02	2006–2007	59.55%	59.34%	88.82%	29.81%	24.17%	43.52%	35.84%	43.81%	39.03%	29.50%	36.12%	25.63%
	2007–2008	44.44%	-9.46%	-15.79%	13.48%	6.85%	0.38%	18.23%	-11.36%	11.15%	8.42%	-4.77%	1.17%
	2008–2009	25.00%	9.88%	-18.18%	-5.39%	27.37%	26.22%	2.61%	13.01%	-14.70%	1.95%	14.65%	12.80%
	2009–2010	-20.00%	0.00%	-38.46%	5.71%	-3.18%	-19.01%	0.54%	-14.00%	6.54%	0.57%	-10.03%	-2.56%
	2010–2011		26.03%	55.56%		9.78%	14.28%		11.49%	2.55%		20.85%	13.58%
	2011–2012		-9.26%	-62.50%		-27.56%	4.12%		2.09%	12.86%		-32.78%	-0.59%
	2012–2013		15.25%	30.77%		2.42%	3.69%		2.23%	-5.55%		5.63%	3.04%
Euro 5	2013–2014		14.00%	-44.44%		-0.29%	-5.20%		-2.16%	9.17%		6.79%	8.01%
(Core)	2014–2015			38.46%			-5.36%			1.18%			13.83%
ADR79/03	2015–2016			-187.50%			60.28%			9.89%			40.66%

Scale	Increase	Stable	Decrease
	-100.00%	0.00%	100.00%

B/D = Median sample below detection limit (less than zero)

Figure 16: Median year-to-year emission reduction per year of manufacture – diesel