6.12 DISCUSSION OF RESULTS

This section presents the key findings of the emissions analysis. Discussion is presented on the following topics:

- Criteria pollutant and benzene emission trends under the scenarios modelled, for the aggregate emissions from the Australian State and Territory capital cities;
- relative changes in VKT, fuel type and emission profiles using aggregated national emissions data. For the purposes of this analysis, data for Scenario 1 in year 2000 and data for Scenario 4 in year 2010 are compared.
- Emission sensitivity to benzene content in petrol;
- Emission sensitivity to other fuel properties;
- Greenhouse gas emissions.

6.12.1 Combined State and Territory Pollutant Emissions

A summary of modelled emissions of HC, NO_x, CO, PM_{10} and benzene for the combined Australian State and Territory capital cities is presented in Figures 6-1 to 6-5. Note that emissions of all the pollutants considered for each capital city are presented in Appendix 6-F.

Figure 6-1 shows the projected variation in hydrocarbon emissions for each of the modelled scenarios for the combined Australian State and Territory capital cities. A 15% reduction between 2000 and 2010 is estimated for business as usual (Scenario 1) conditions, due to the effects of the phase out of pre-catalyst vehicles and uptake of the recent Australian Design Rules for petrol (ADR37/01) and diesel (ADR70/00) vehicles. Scenarios 2 to 6 are estimated to result in emissions reductions of between 20% and 25% between 2000 and 2010.

In the longer term, improvements to hydrocarbon emissions may be limited by evaporative losses, which are not directly affected by improvements to engine or exhaust emission control technology.

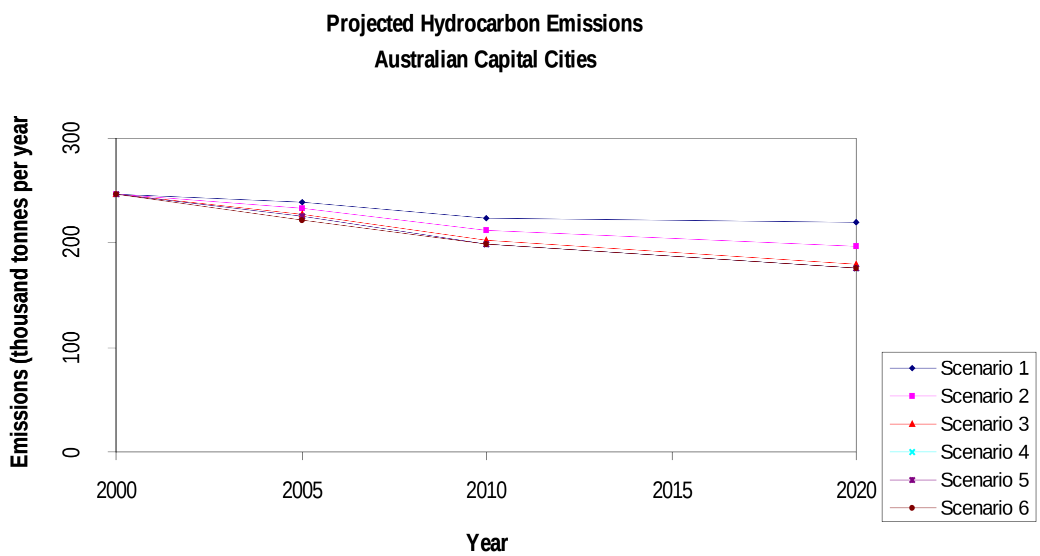


FIGURE 6-1: HYDROCARBON EMISSIONS - COMBINED STATE AND TERRITORY CAPITALS

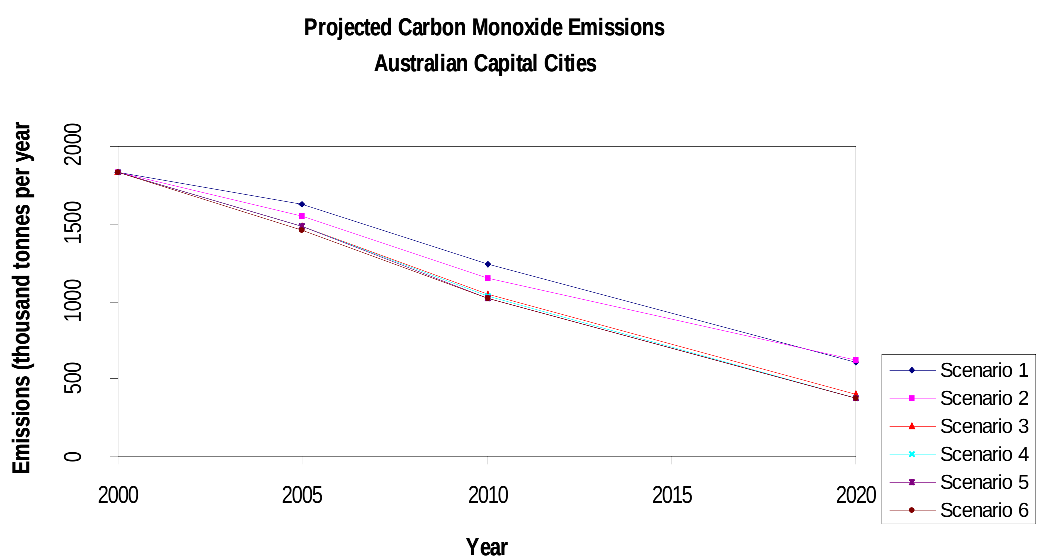


FIGURE 6-2: CARBON MONOXIDE EMISSIONS - COMBINED STATE AND TERRITORY CAPITALS

Figure 6-2 shows the projected improvement in emissions of carbon monoxide. For the base case, a reduction of 40% is estimated between 2000 and 2010 as the current Australian Design Rules take effect. Scenarios 2 to 6 are estimated to result in emissions reductions of between 45% and 51% between 2000 and 2010.

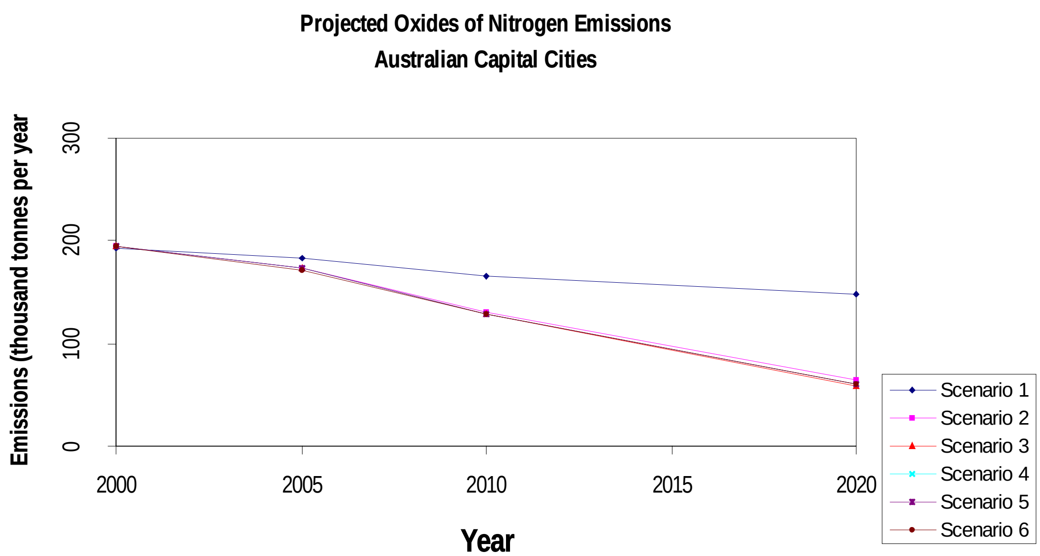


FIGURE 6-3: OXIDES OF NITROGEN EMISSIONS

Figure 6-3 shows the projected improvement in emissions of oxides of nitrogen. For the base case, a reduction of 17% is estimated between 2000 and 2010 as the current Australian Design Rules take effect. Scenarios 2 to 6 are estimated to result in emissions reductions of approximately 34% between 2000 and 2010.

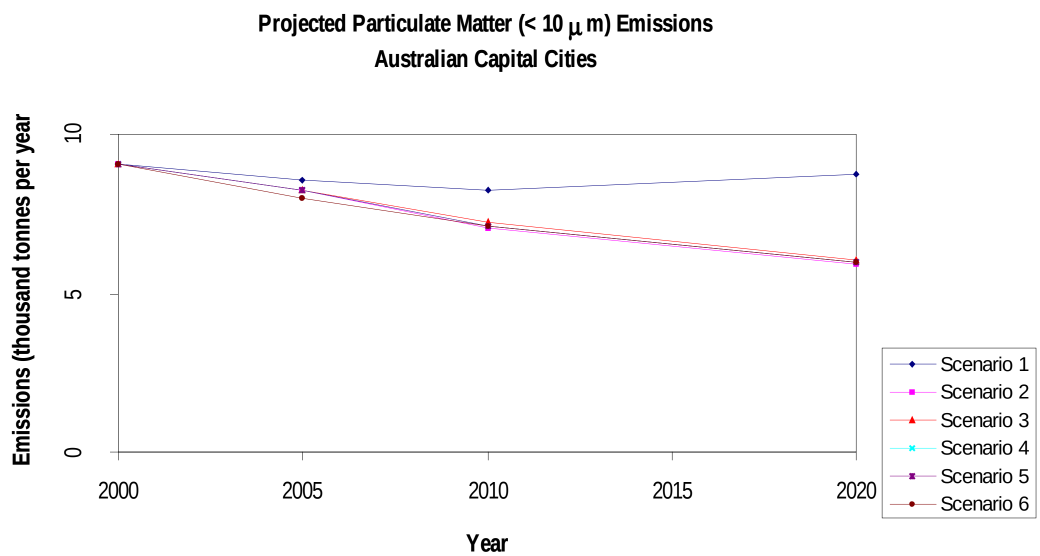


FIGURE 6-4: PARTICULAR MATTER (< 10 μm) EMISSIONS

Figure 6-4 shows the projected emissions of fine particulate matter. For the base case, a reduction of 10% is estimated between 2000 and 2010 as the current Australian Design Rules take effect. Scenarios 2 to 6 are estimated to result in emissions reductions of approximately 25% between 2000 and 2010.

The results indicate that under business as usual conditions, particulate emissions from vehicles would be expected to increase from 2010. This is due to the expected increased in the use of diesel vehicles. Under the scenarios modelling adoption of Euro 3 and 4 exhaust emission standards, particulate emissions are predicted to reduce substantially over the next ten years.

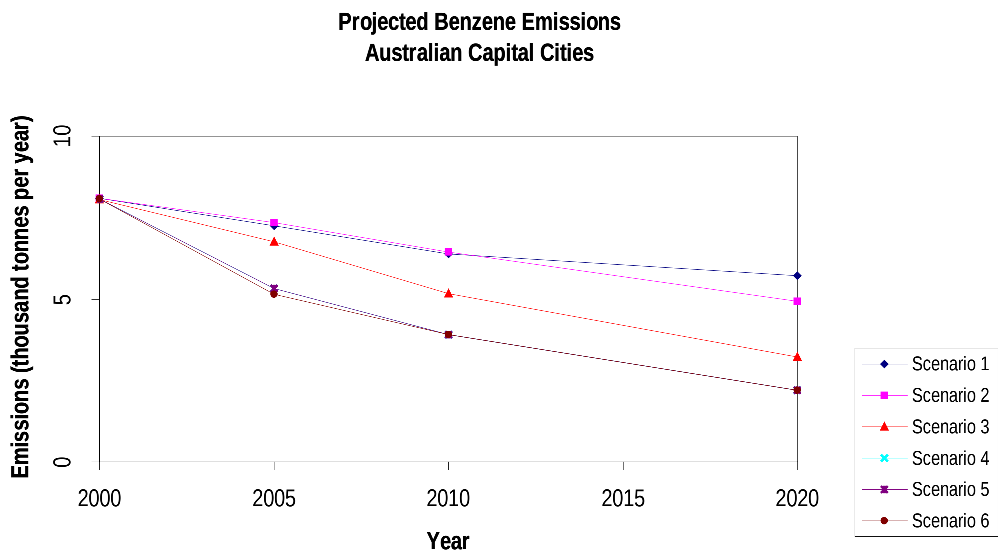


FIGURE 6-5: BENZENE EMISSIONS

Figure 6-5 shows the projected improvement in emissions of benzene. For the base case, a reduction of 26% is estimated between 2000 and 2010 as the current Australian Design Rules take effect. Scenarios 2 to 6 are estimated to result in emissions reductions of 28% to 53% between 2000 and 2010.

The benzene results show a gradual reduction in the predicted benzene emissions under all scenarios. Vehicle control measures are an important for reduction in exhaust emissions of benzene and fuel formulation is an important influence on evaporative benzene emissions.

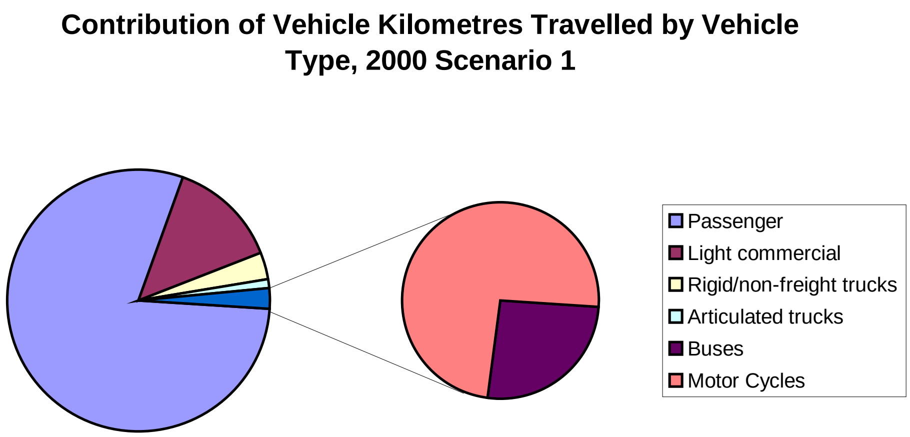
The major influence on emissions flows from the implementation of improvements to vehicle engine and control technology. These vehicle improvements impose constraints upon the quality of fuel required for the technologies to operate correctly. Principally the fuel quality improvements required to support improved vehicle controls are low sulfur concentrations and availability of high octane (95 RON). As well as enabling control technology fuel quality has a direct influence on air emissions.

6.12.2 Relative Emission Trends – National Data

This section presents a discussion of relative changes in VKT composition, emissions per fuel type and emission profiles using aggregated national emissions data. For the purposes of this analysis, data for Scenario 1 in year 2000 and data for Scenario 4 in year 2010 are compared. The analysis of these data attempts to illustrate the overall effect of changes in vehicle usage patterns and the improving emissions performance for each vehicle type.

6.12.2.1 Contribution to total VKT by vehicle type

These results (Figure 12-6) show that passenger cars are expected to account for a smaller proportion of total VKT in future years. Strong growth in VKT is expected for light commercial vehicles (45% increase between 2000 and 2010) and articulated trucks (57% increase between 2000 and 2010). Growth in VKT for passenger vehicles and rigid/non-freight carrying trucks is estimated to be approximately 10% over this period. Note that the VKT projections are the same for each scenario.



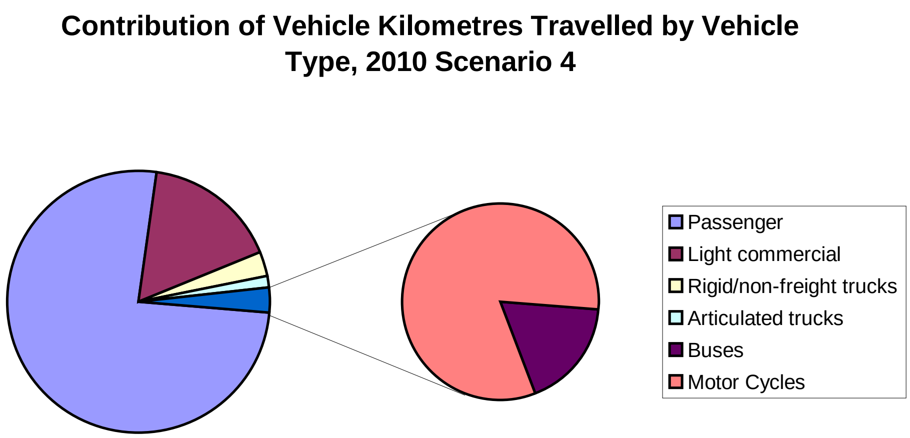
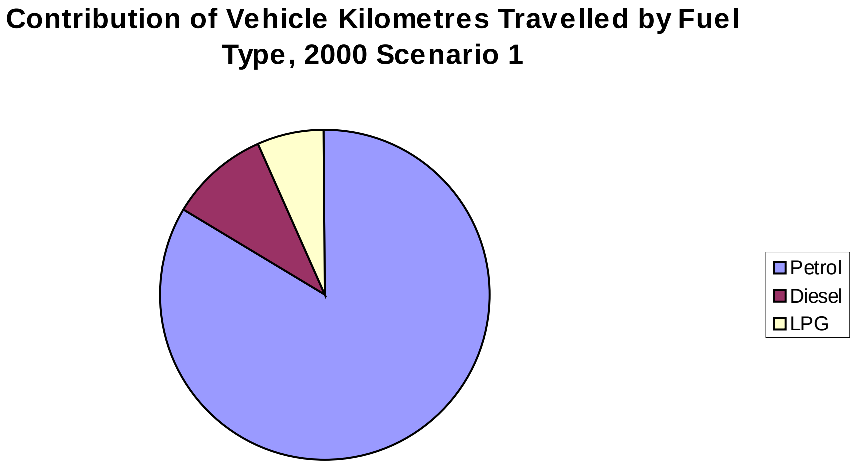


FIGURE 6-6: VEHICLE COMPONENTS OF VKT

6.12.2.2 Contribution to Total VKT by Fuel Type

Figure 6-7 indicates that the proportion of VKT accounted for by petrol fuelled vehicles is expected to decrease over the period studies. Petrol fuelled vehicle travel accounts for approximately 83% and 78% of total VKT in 2000 and 2010 respectively. Strong growth in the activity levels of diesel and LPG/CNG fuelled vehicles leads to an increase in the contribution made to total VKT.



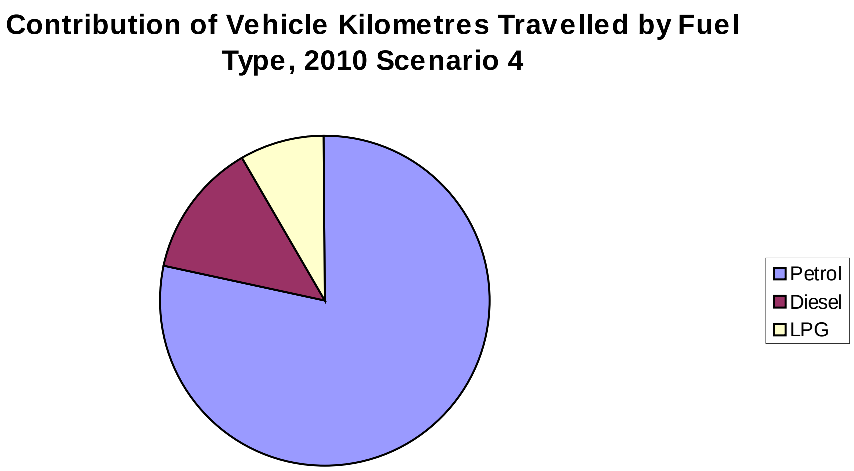


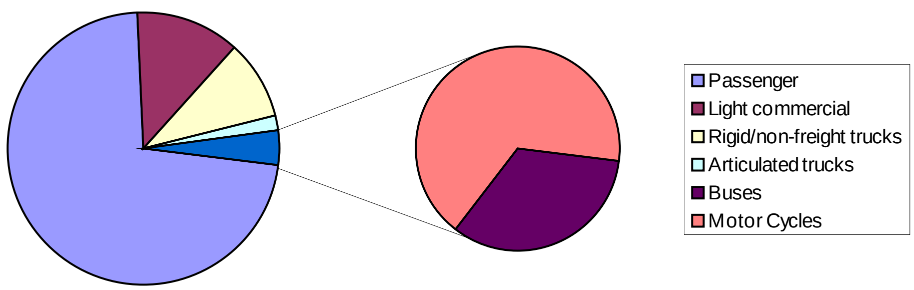
FIGURE 6-7: VKT BY FUEL TYPE

6.12.2.3 Contribution to Total Emissions by Vehicle Type

For volatile emissions the following discussion applies to summer time tailpipe emissions. Emissions in winter will differ but similar percentage contributions are expected. Evaporative emissions are relevant for volatile hydrocarbons present in fuel. The relative breakdown of tailpipe and evaporative emissions for total hydrocarbons and for benzene is discussed in Section 6.12.2.5.

Hydrocarbons (Figure 6-8) – Results for this pollutant follow essentially the same pattern as total VKT. The contribution made by passenger vehicles and buses is seen to decrease, with increases for other vehicle categories. Of interest is the increased contribution made by motorcycles, which rises from about 3% to 8% over this period. This indicates strong growth in VKT of this vehicle type and also the fact that stricter emission controls were not assumed for motorcycles in this study.

Contribution of Hydrocarbons by Vehicle Type, 2000
Scenario 1



Contribution of Hydrocarbons by Vehicle Type, 2010
Scenario 4

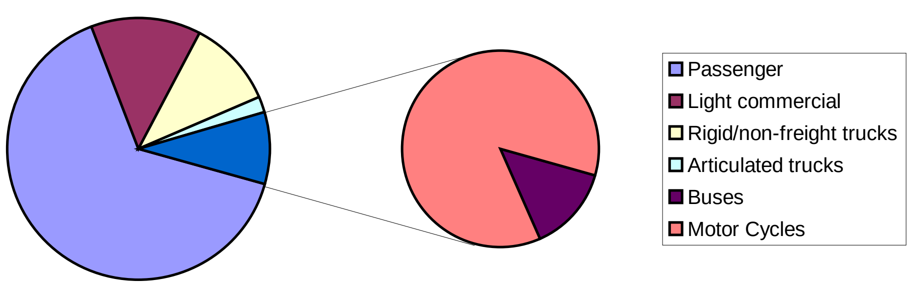
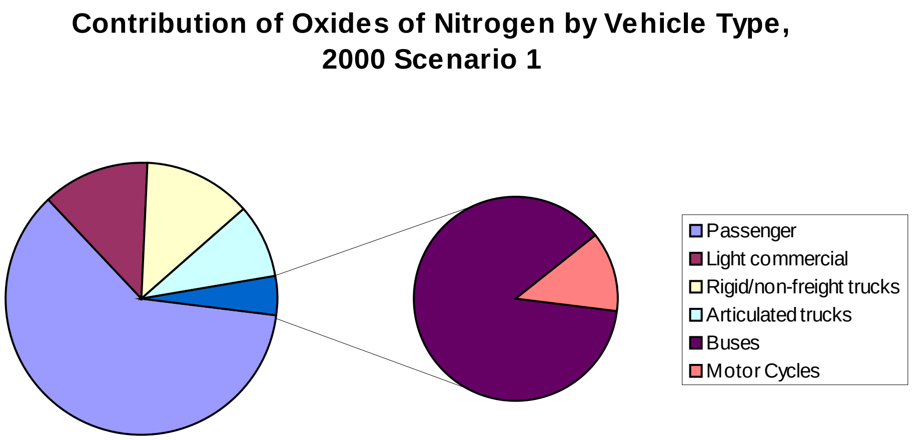


FIGURE 6-8: HYDROCARBON EMISSIONS BY VEHICLE TYPE

Oxides of Nitrogen (Figure 6-9) – diesel vehicles are substantial contributors to emissions of this pollutant, as shown by the results for rigid/non-freight trucks and articulated trucks, which are predominantly diesel fuelled. The relative contribution increases for light commercial vehicles and articulated trucks, which display strong VKT growth over this period. Passenger vehicles and rigid/non-freight trucks have a moderate rate of VKT growth over this period and their contribution made to total emissions is seen to decrease.



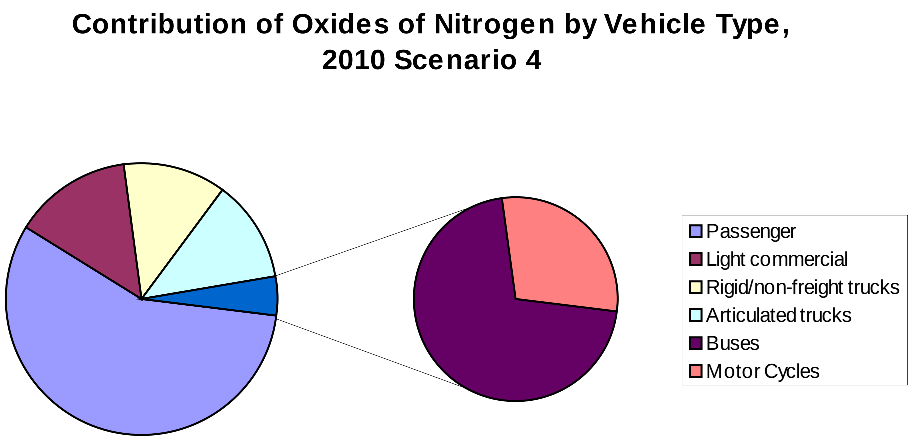
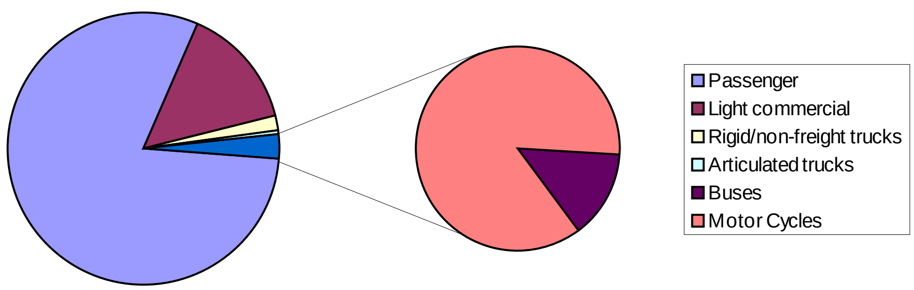


FIGURE 6-9: OXIDES OF NITROGEN EMISSIONS BY VEHICLE TYPE

Carbon monoxide (Figure 6-10) – petrol fuelled vehicles dominate emissions of this pollutant. Over the period 2000 to 2010, the contribution made by passenger vehicles and rigid/non-freight tucks decreases, while the contribution made by other vehicle types is increased. The contribution made by motorcycles increases by greater than a factor of 2.

Contribution of Carbon Monoxide by Vehicle Type, 2000 Scenario 1



Contribution of Carbon Monoxide by Vehicle Type, 2010 Scenario 4

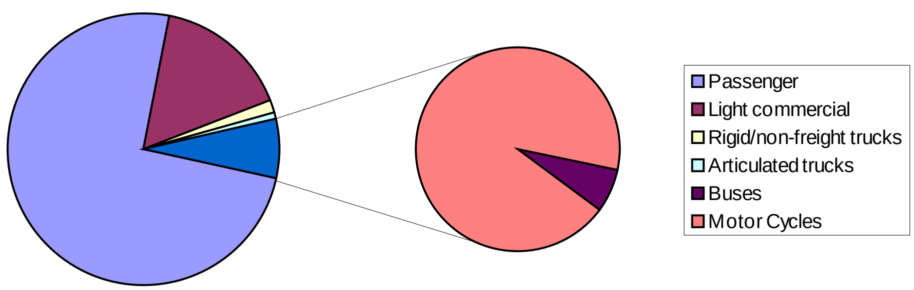
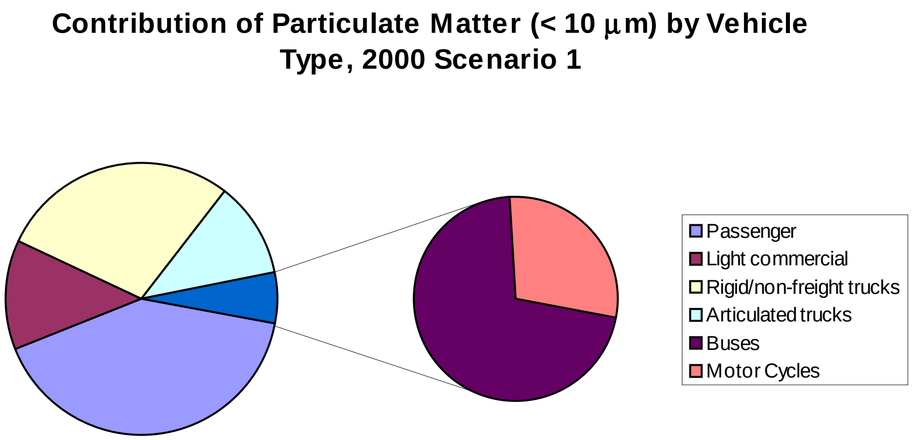


FIGURE 6-10: CARBON MONOXIDE EMISSIONS BY VEHICLE TYPE

Particulate Matter <10um (Figure 6-11) – results for 2000 indicate that diesel fuelled vehicles account for the majority of emissions. By 2010, stricter particulate emission controls for diesel vehicles indicate that petrol fuelled passenger vehicles and light commercial vehicles (which do not have stricter particulate standards) will account for the majority of particulate emissions.



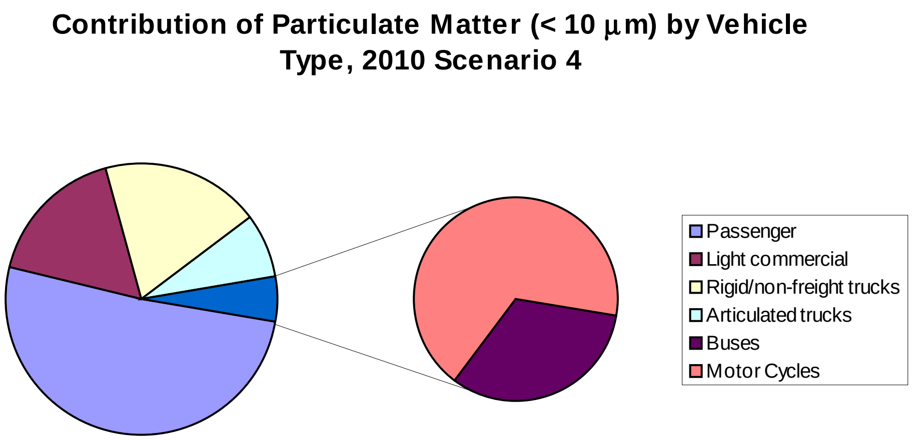
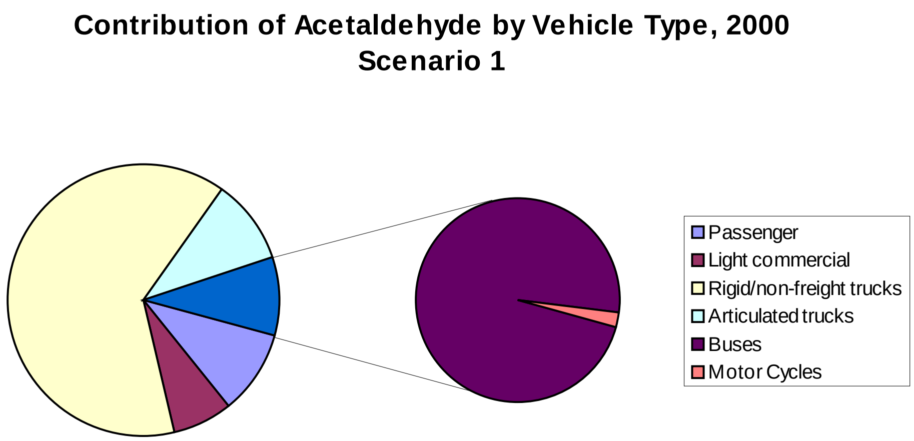


FIGURE 6-11: PARTICULATE MATTER EMISSIONS BY VEHICLE TYPE

Acetaldehyde (Figure 6-12) – diesel vehicles are the main source of acetaldehyde, accounting for approximately 80% of emissions in both 2000 and 2010. Rigid/non-freight trucks contribute more than 60% of total emissions in both years. Light commercial vehicles are the second largest source of acetaldehyde in 2010, which is an indication of the increasing usage of these vehicles and an increasing proportion of diesel fuelled vehicles within this category.



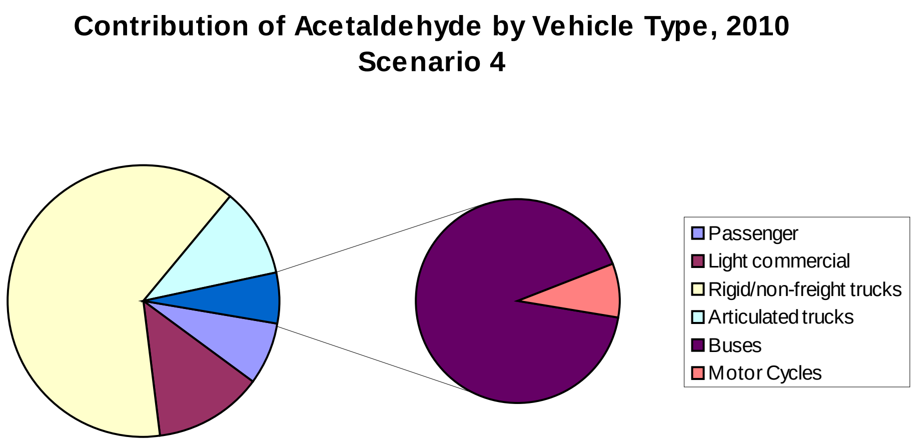
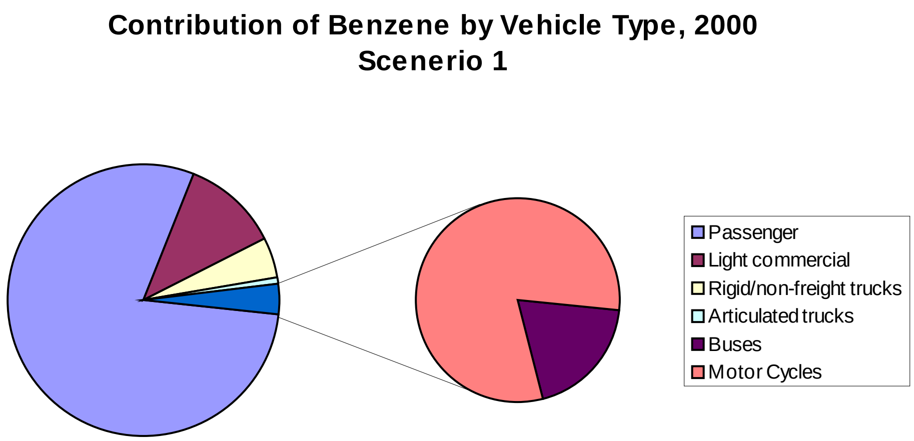


FIGURE 6-12: ACETALDEHYDE EMISSIONS BY VEHICLE TYPE

Benzene (Figure 6-13) – petrol fuelled vehicles are the main source of benzene. For Scenario 1 in 2000, passenger vehicles and light commercial vehicles account for over 90% of total emissions. This proportion is estimated to decrease to 80% in 2010 for Scenario 4 as tighter HC emission limits and lower fuel benzene levels are applied. In 2010, motorcycles make a contribution to total benzene emissions of about 10%, which is comparable to the contribution made by light commercial vehicles.



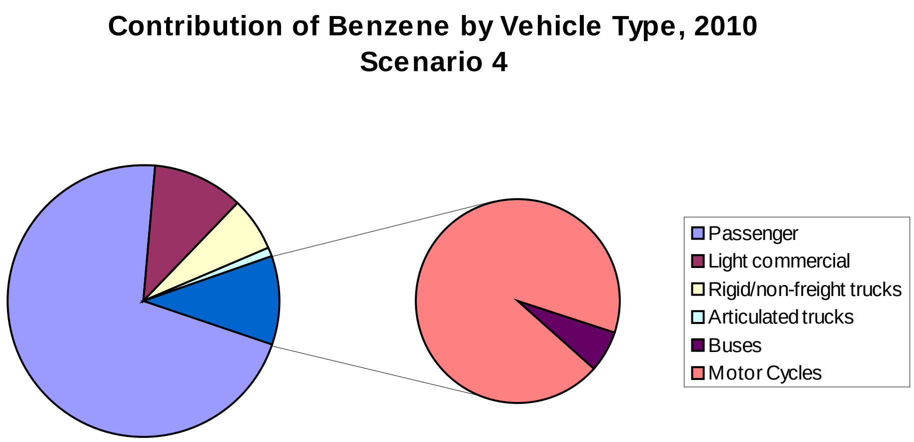


FIGURE 6-13: BENZENE EMISSIONS BY VEHICLE TYPE