

Executive Summary

The Department of Environment and Climate Change NSW (DECC), in collaboration with Optimised Operations (Tseng et. al., 2006), has completed a three year air emissions inventory project for off-road mobile sources. The base year of the off-road mobile inventory represents activities that took place during the 2003 calendar year and is accompanied by emission projections in yearly increments up to the 2031 calendar year. The area included in the study covers greater Sydney, Newcastle and Wollongong regions, known collectively as the Greater Metropolitan Region (GMR).

The study region defined as the GMR measures 210 km (east-west) by 273 km (north-south). The study region is defined in Table ES1.1 and shown in Figure ES1.1.

Table ES1.1: Definition of Greater Metropolitan, Sydney, Newcastle and Wollongong Regions

Region	South-west corner MGA ¹ co-ordinates		North-east corner MGA ¹ co-ordinates	
	Easting (km)	Northing (km)	Easting (km)	Northing (km)
Greater Metropolitan	210	6159	420	6432
Sydney	261	6201	360	6300
Newcastle	360	6348	408	6372
Wollongong	279	6174	318	6201

¹ MGA = Map Grid of Australia based on the Geocentric Datum of Australia 1994 (GDA94) (ICSM, 2002).

The off-road mobile air emissions inventory includes emissions from the following sources:

- Aircraft;
- Commercial boats;
- Commercial off-road vehicles and equipment;
- Commercial ships;
- Construction off-road vehicles and equipment;
- Industrial off-road vehicles and equipment;
- Loading and unloading petroleum products;
- Railways; and
- Recreational boats.

The pollutants inventoried include criteria pollutants specified in the Air NEPM (NEPC, 2003), air toxics associated with the National Pollutant Inventory (NEPC, 2000) and the Air Toxics NEPM (NEPC, 2004) and any other pollutants associated with state specific programs, i.e. Load Based Licensing (Protection of the Environment Operations (General) Regulation 1998 (PCO, 1998)) and Protection of the Environment Operations (Clean Air) Regulation 2002 (PCO, 2005).



Figure ES1.1: Definition of Greater Metropolitan, Sydney, Newcastle and Wollongong Regions

Table ES1.2 shows total estimated annual emissions (for selected substances) from all off-road mobile sources in the study region (i.e. GMR), Sydney, Newcastle and Wollongong regions. Total estimated annual emissions are also presented for the region defined as Non-Urban. This region is the area of the GMR minus the combined areas of the Sydney, Newcastle and Wollongong regions. These substances have been selected since they are:

- ❑ The most common air pollutants found in airsheds according to the National Pollutant Inventory (NEPC, 2000);
- ❑ Referred to in National Environment Protection Measures (NEPMs) for criteria pollutants (NEPC, 2003) and air toxics (NEPC, 2004); and
- ❑ They have been classified as priority air pollutants (NEPC, 2005).

Table ES1.2: Total estimated annual emissions from off-road mobile sources in each region

Substance	Emissions (tonnes/year)				
	Sydney	Newcastle	Wollongong	Non-Urban	GMR
1,3 BUTADIENE	$1.60 \times 10^{+01}$	3.15	8.77×10^{-01}	6.78	$2.68 \times 10^{+01}$
ACETALDEHYDE	$1.14 \times 10^{+02}$	$2.29 \times 10^{+01}$	7.83	$1.12 \times 10^{+02}$	$2.57 \times 10^{+02}$
BENZENE	$6.57 \times 10^{+01}$	5.52	3.56	$3.85 \times 10^{+01}$	$1.13 \times 10^{+02}$
CARBON MONOXIDE	$2.03 \times 10^{+04}$	$1.45 \times 10^{+03}$	$7.93 \times 10^{+02}$	$9.65 \times 10^{+03}$	$3.21 \times 10^{+04}$
FORMALDEHYDE	$1.17 \times 10^{+02}$	$2.00 \times 10^{+01}$	5.49	$6.97 \times 10^{+01}$	$2.12 \times 10^{+02}$
ISOMERS OF XYLENE	$2.45 \times 10^{+02}$	$1.56 \times 10^{+01}$	$1.56 \times 10^{+01}$	$1.56 \times 10^{+02}$	$4.32 \times 10^{+02}$
LEAD AND COMPOUNDS	$1.33 \times 10^{+01}$	1.44	1.89	$3.83 \times 10^{+01}$	$5.49 \times 10^{+01}$
OXIDES OF NITROGEN	$9.51 \times 10^{+03}$	$2.95 \times 10^{+03}$	$9.14 \times 10^{+02}$	$1.01 \times 10^{+04}$	$2.35 \times 10^{+04}$
PARTICULATE MATTER < 10 µm	$3.71 \times 10^{+03}$	$4.69 \times 10^{+02}$	$5.08 \times 10^{+02}$	$9.88 \times 10^{+03}$	$1.46 \times 10^{+04}$
PARTICULATE MATTER < 2.5 µm	$1.76 \times 10^{+03}$	$2.53 \times 10^{+02}$	$2.28 \times 10^{+02}$	$4.24 \times 10^{+03}$	$6.49 \times 10^{+03}$
POLYCYCLIC AROMATIC HYDROCARBONS	$2.76 \times 10^{+01}$	1.97	8.65×10^{-01}	9.50	$4.00 \times 10^{+01}$
SULFUR DIOXIDE	$1.37 \times 10^{+03}$	$1.26 \times 10^{+03}$	$2.50 \times 10^{+02}$	$1.28 \times 10^{+03}$	$4.17 \times 10^{+03}$
TETRACHLOROETHYLENE	2.50	1.39×10^{-01}	1.62×10^{-01}	1.47	4.27
TOLUENE	$2.18 \times 10^{+02}$	$1.43 \times 10^{+01}$	$1.34 \times 10^{+01}$	$1.38 \times 10^{+02}$	$3.83 \times 10^{+02}$
TOTAL SUSPENDED PARTICULATES	$1.55 \times 10^{+04}$	$1.77 \times 10^{+03}$	$2.22 \times 10^{+03}$	$4.46 \times 10^{+04}$	$6.41 \times 10^{+04}$
TOTAL VOCs	$4.77 \times 10^{+03}$	$3.12 \times 10^{+02}$	$2.32 \times 10^{+02}$	$2.32 \times 10^{+03}$	$7.64 \times 10^{+03}$
TRICHLOROETHYLENE	1.54	8.51×10^{-02}	9.97×10^{-02}	9.03×10^{-01}	2.62

Figure ES1.2 shows the proportion of total estimated annual emissions (for selected substances) from all off-road mobile sources in the GMR, Sydney, Newcastle, Wollongong and Non-Urban regions.

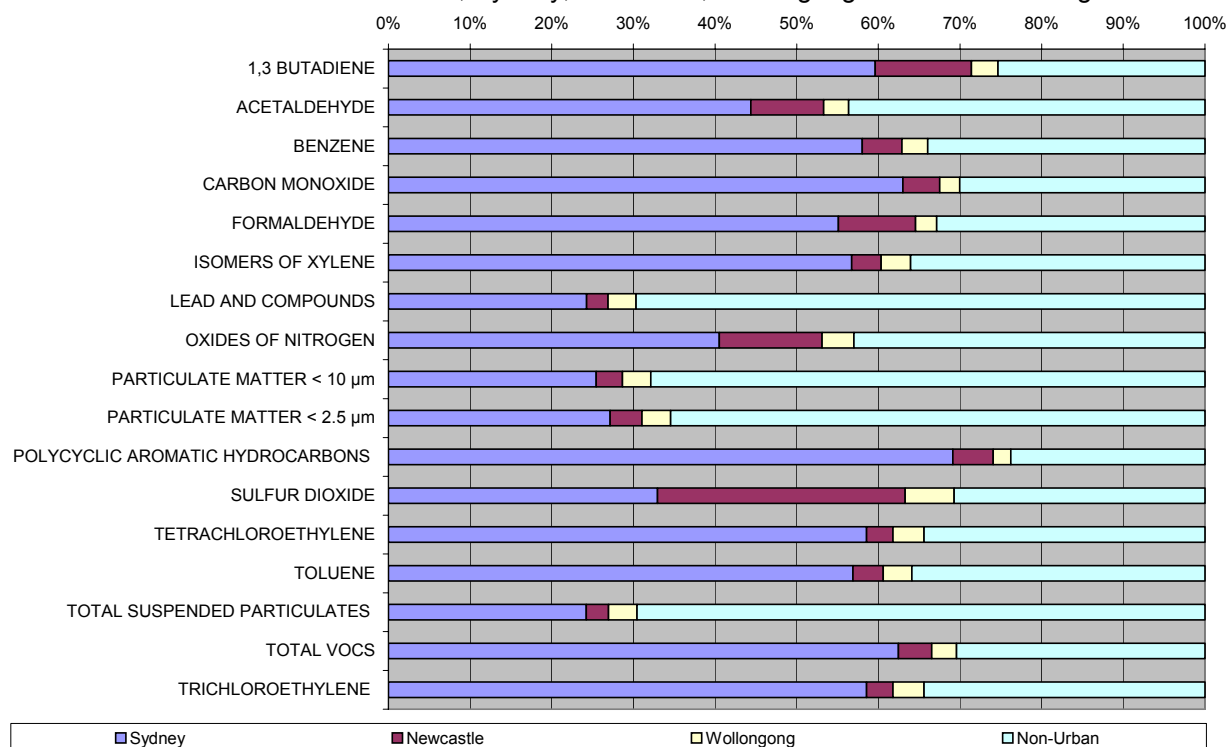


Figure ES1.2: Proportion of total estimated annual emissions from off-road mobile sources in each region

Tables ES1.3, ES1.4, ES1.5, ES1.6 and ES1.7 show total estimated annual emissions (for selected substances) from each off-road mobile source type in the GMR, Sydney, Newcastle, Wollongong and Non-Urban regions respectively.

Figures ES1.3, ES1.4, ES1.5, ES1.6 and ES1.7 show the proportion of total estimated annual emissions (for selected substances) from each off-road mobile source type in the GMR, Sydney, Newcastle, Wollongong and Non-Urban regions respectively.

Table ES1.3: Total estimated annual emissions by off-road mobile source type in the GMR

Substance	Emissions (tonnes/year)									
	Aircraft	Commercial Boats	Commercial Off-Road Vehicles and Equipment	Commercial Ships	Construction Off-Road Vehicles and Equipment	Industrial Off-Road Vehicles and Equipment	Loading and Unloading Fuels	Railways	Recreational Boats	Off-Road Mobile Total
1,3 BUTADIENE	8.29	2.23	2.86×10^{-01}	5.44	1.79×10^{-01}	7.57×10^{-01}	-	2.27	7.31	$2.68 \times 10^{+01}$
ACETALDEHYDE	$6.08 \times 10^{+01}$	$2.92 \times 10^{+01}$	$1.76 \times 10^{+01}$	$3.95 \times 10^{+01}$	3.81	$9.96 \times 10^{+01}$	-	4.28	1.99	$2.57 \times 10^{+02}$
BENZENE	$1.65 \times 10^{+01}$	$2.52 \times 10^{+01}$	1.99×10	3.86	1.72	6.59	3.12	2.49	$5.19 \times 10^{+01}$	$1.13 \times 10^{+02}$
CARBON MONOXIDE	$1.05 \times 10^{+04}$	$5.59 \times 10^{+03}$	$1.21 \times 10^{+03}$	$1.05 \times 10^{+03}$	$7.55 \times 10^{+02}$	$3.00 \times 10^{+03}$	-	$4.25 \times 10^{+02}$	$9.63 \times 10^{+03}$	$3.21 \times 10^{+04}$
FORMALDEHYDE	$8.21 \times 10^{+01}$	$1.72 \times 10^{+01}$	9.71	$3.01 \times 10^{+01}$	2.19	$5.34 \times 10^{+01}$	-	$1.26 \times 10^{+01}$	4.91	$2.12 \times 10^{+02}$
ISOMERS OF XYLENE	$1.37 \times 10^{+01}$	$1.01 \times 10^{+02}$	2.52	2.92	5.77	7.73	2.49	4.03×10^{-01}	$2.96 \times 10^{+02}$	$4.32 \times 10^{+02}$
LEAD AND COMPOUNDS	3.24×10^{-01}	3.26×10^{-03}	4.22	3.97×10^{-03}	2.37×10^{-03}	$5.04 \times 10^{+01}$	-	2.36×10^{-03}	1.70×10^{-04}	$5.49 \times 10^{+01}$
OXIDES OF NITROGEN	$3.27 \times 10^{+03}$	$2.48 \times 10^{+03}$	$1.01 \times 10^{+03}$	$6.18 \times 10^{+03}$	$2.18 \times 10^{+02}$	$6.80 \times 10^{+03}$	-	$3.35 \times 10^{+03}$	$1.72 \times 10^{+02}$	$2.35 \times 10^{+04}$
PARTICULATE MATTER < 10 µm	$9.25 \times 10^{+01}$	$1.67 \times 10^{+02}$	$1.16 \times 10^{+03}$	$2.13 \times 10^{+02}$	$1.71 \times 10^{+01}$	$1.26 \times 10^{+04}$	-	$9.98 \times 10^{+01}$	$2.33 \times 10^{+02}$	$1.46 \times 10^{+04}$
PARTICULATE MATTER < 2.5 µm	$8.58 \times 10^{+01}$	$1.55 \times 10^{+02}$	$5.28 \times 10^{+02}$	$2.04 \times 10^{+02}$	$1.65 \times 10^{+01}$	$5.19 \times 10^{+03}$	-	$9.01 \times 10^{+01}$	$2.14 \times 10^{+02}$	$6.49 \times 10^{+03}$
POLYCYCLIC AROMATIC HYDROCARBONS	$1.86 \times 10^{+01}$	3.28×10	7.17×10^{-01}	1.98×10	2.62×10^{-01}	3.64	-	1.47	$1.01 \times 10^{+01}$	$4.00 \times 10^{+01}$
SULFUR DIOXIDE	$2.40 \times 10^{+02}$	$5.98 \times 10^{+01}$	$3.16 \times 10^{+01}$	$3.15 \times 10^{+03}$	6.68	$1.95 \times 10^{+02}$	-	$4.68 \times 10^{+02}$	$2.14 \times 10^{+01}$	$4.17 \times 10^{+03}$
TETRACHLOROETHYLENE	3.12×10^{-02}	7.38×10^{-01}	1.20×10^{-02}	-	3.93×10^{-02}	9.11×10^{-04}	-	-	3.45	4.27
TOLUENE	$1.74 \times 10^{+01}$	$9.26 \times 10^{+01}$	2.92	3.44	5.40	9.80	7.60	2.52	$2.42 \times 10^{+02}$	$3.83 \times 10^{+02}$
TOTAL SUSPENDED PARTICULATES	$9.74 \times 10^{+01}$	$1.76 \times 10^{+02}$	$4.92 \times 10^{+03}$	$2.25 \times 10^{+02}$	$1.80 \times 10^{+01}$	$5.83 \times 10^{+04}$	-	$1.05 \times 10^{+02}$	$2.45 \times 10^{+02}$	$6.41 \times 10^{+04}$
TOTAL VOCs	$6.66 \times 10^{+02}$	$1.04 \times 10^{+03}$	$1.51 \times 10^{+02}$	$2.30 \times 10^{+02}$	$7.08 \times 10^{+01}$	$5.79 \times 10^{+02}$	$1.13 \times 10^{+03}$	$1.44 \times 10^{+02}$	$3.63 \times 10^{+03}$	$7.64 \times 10^{+03}$
TRICHLOROETHYLENE	1.92×10^{-02}	4.53×10^{-01}	7.37×10^{-03}	-	2.41×10^{-02}	5.59×10^{-04}	-	-	2.12	2.62

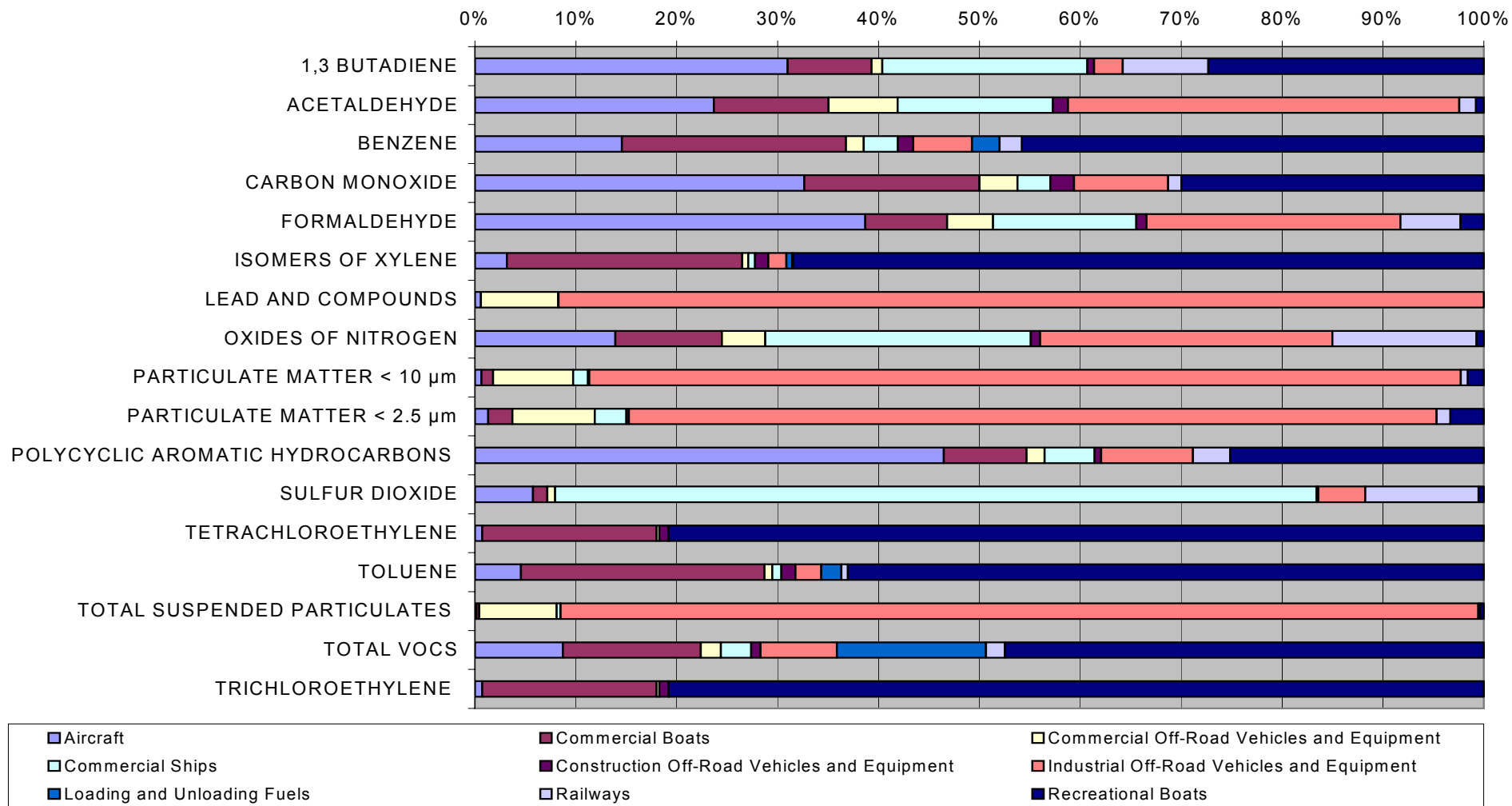


Figure ES1.3: Proportion of total estimated annual emissions by off-road mobile source type in the GMR

Table ES1.4: Total estimated annual emissions by off-road mobile source type in the Sydney region

Substance	Emissions (tonnes/year)									
	Aircraft	Commercial Boats	Commercial Off-Road Vehicles and Equipment	Commercial Ships	Construction Off-Road Vehicles and Equipment	Industrial Off-Road Vehicles and Equipment	Loading and Unloading Fuels	Railways	Recreational Boats	Off-Road Mobile Total
1,3 BUTADIENE	7.63	7.67×10^{-01}	1.25×10^{-01}	1.41	1.40×10^{-01}	1.68×10^{-01}	-	1.09	4.62	$1.60 \times 10^{+01}$
ACETALDEHYDE	$5.76 \times 10^{+01}$	$1.01 \times 10^{+01}$	7.67	$1.03 \times 10^{+01}$	2.98	$2.21 \times 10^{+01}$	-	2.05	1.25	$1.14 \times 10^{+02}$
BENZENE	$1.53 \times 10^{+01}$	8.66	8.68×10^{-01}	1.00	1.34	1.46	3.07	1.20	$3.28 \times 10^{+01}$	$6.57 \times 10^{+01}$
CARBON MONOXIDE	$9.98 \times 10^{+03}$	$1.92 \times 10^{+03}$	$5.26 \times 10^{+02}$	$2.72 \times 10^{+02}$	$5.91 \times 10^{+02}$	$6.66 \times 10^{+02}$	-	$2.04 \times 10^{+02}$	$6.09 \times 10^{+03}$	$2.03 \times 10^{+04}$
FORMALDEHYDE	$7.62 \times 10^{+01}$	5.92	4.23	7.82	1.72	$1.18 \times 10^{+01}$	-	6.07	3.11	$1.17 \times 10^{+02}$
ISOMERS OF XYLENE	$1.28 \times 10^{+01}$	$3.47 \times 10^{+01}$	1.10	7.59×10^{-01}	4.52	1.72	2.45	1.93×10^{-01}	$1.87 \times 10^{+02}$	$2.45 \times 10^{+02}$
LEAD AND COMPOUNDS	3.01×10^{-01}	1.12×10^{-03}	1.84	1.03×10^{-03}	1.86×10^{-03}	$1.12 \times 10^{+01}$	-	1.13×10^{-03}	1.07×10^{-04}	$1.33 \times 10^{+01}$
OXIDES OF NITROGEN	$3.22 \times 10^{+03}$	$8.53 \times 10^{+02}$	$4.40 \times 10^{+02}$	$1.61 \times 10^{+03}$	$1.71 \times 10^{+02}$	$1.51 \times 10^{+03}$	-	$1.61 \times 10^{+03}$	$1.09 \times 10^{+02}$	$9.51 \times 10^{+03}$
PARTICULATE MATTER < 10 µm	$8.62 \times 10^{+01}$	$5.76 \times 10^{+01}$	$5.05 \times 10^{+02}$	$5.55 \times 10^{+01}$	$1.34 \times 10^{+01}$	$2.79 \times 10^{+03}$	-	$4.79 \times 10^{+01}$	$1.47 \times 10^{+02}$	$3.71 \times 10^{+03}$
PARTICULATE MATTER < 2.5 µm	$8.00 \times 10^{+01}$	$5.34 \times 10^{+01}$	$2.30 \times 10^{+02}$	$5.31 \times 10^{+01}$	$1.29 \times 10^{+01}$	$1.15 \times 10^{+03}$	-	$4.33 \times 10^{+01}$	$1.35 \times 10^{+02}$	$1.76 \times 10^{+03}$
POLYCYCLIC AROMATIC HYDROCARBONS	$1.76 \times 10^{+01}$	1.13	3.12×10^{-01}	5.15×10^{-01}	2.05×10^{-01}	8.08×10^{-01}	-	7.08×10^{-01}	6.35×10	$2.76 \times 10^{+01}$
SULFUR DIOXIDE	$2.35 \times 10^{+02}$	$2.06 \times 10^{+01}$	$1.38 \times 10^{+01}$	$8.18 \times 10^{+02}$	5.23	$4.32 \times 10^{+01}$	-	$2.25 \times 10^{+02}$	$1.35 \times 10^{+01}$	$1.37 \times 10^{+03}$
TETRACHLOROETHYLENE	2.99×10^{-02}	2.54×10^{-01}	5.23×10^{-03}	-	3.07×10^{-02}	2.02×10^{-04}	-	-	2.18	2.50
TOLUENE	$1.62 \times 10^{+01}$	$3.19 \times 10^{+01}$	1.28	8.95×10^{-01}	4.23	2.18	7.47	1.21	$1.53 \times 10^{+02}$	$2.18 \times 10^{+02}$
TOTAL SUSPENDED PARTICULATES	$9.08 \times 10^{+01}$	$6.06 \times 10^{+01}$	$2.14 \times 10^{+03}$	$5.84 \times 10^{+01}$	$1.41 \times 10^{+01}$	$1.29 \times 10^{+04}$	-	$5.04 \times 10^{+01}$	$1.55 \times 10^{+02}$	$1.55 \times 10^{+04}$
TOTAL VOCs	$6.21 \times 10^{+02}$	$3.59 \times 10^{+02}$	$6.59 \times 10^{+01}$	$5.98 \times 10^{+01}$	$5.54 \times 10^{+01}$	$1.28 \times 10^{+02}$	$1.12 \times 10^{+03}$	$6.91 \times 10^{+01}$	$2.29 \times 10^{+03}$	$4.77 \times 10^{+03}$
TRICHLOROETHYLENE	1.84×10^{-02}	1.56×10^{-01}	3.21×10^{-03}	-	1.89×10^{-02}	1.24×10^{-04}	-	-	1.34	1.54

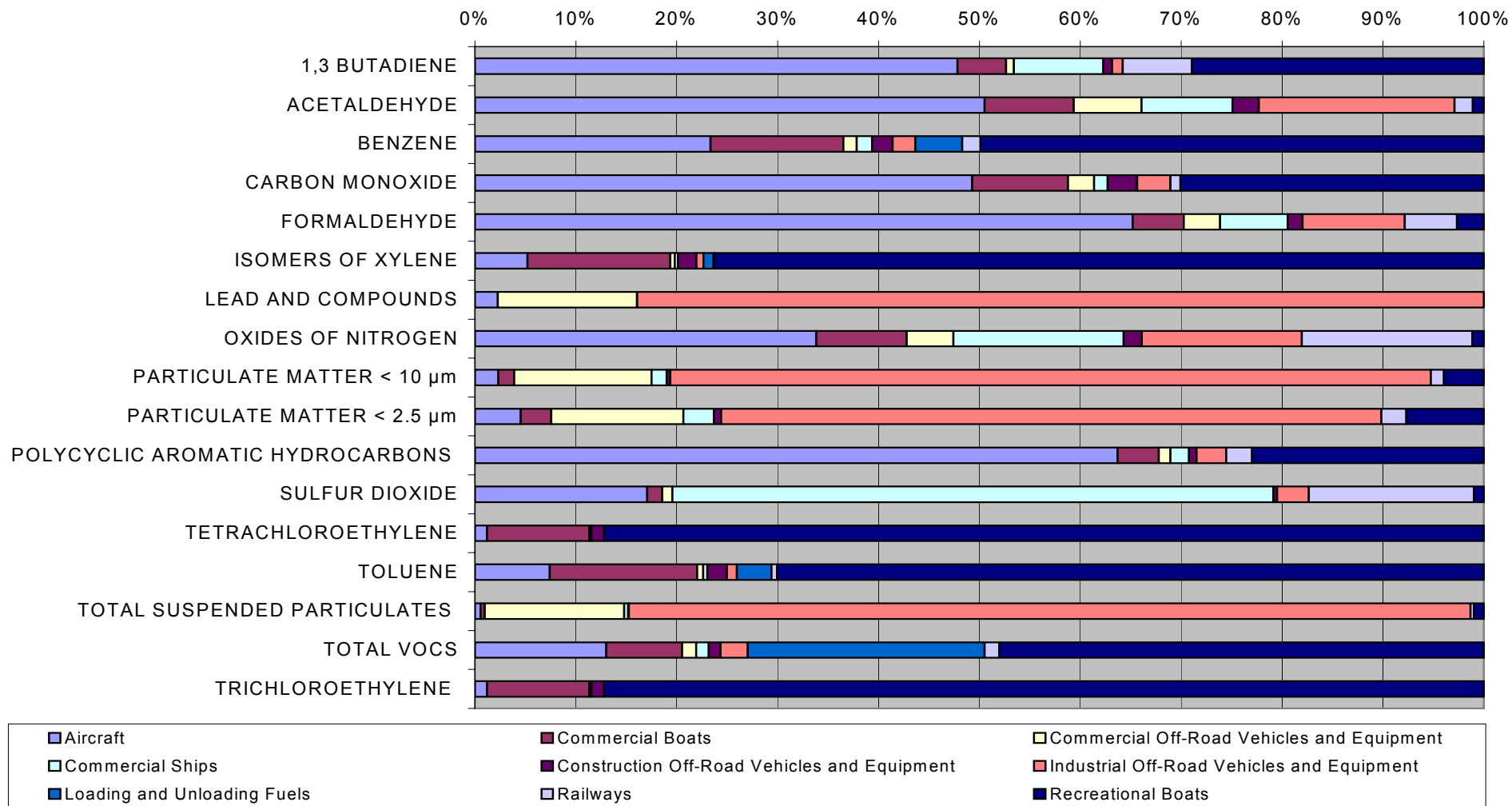


Figure ES1.4: Proportion of total estimated annual emissions by off-road mobile source type in the Sydney region

Table ES1.5: Total estimated annual emissions by off-road mobile source type in the Newcastle region

Substance	Emissions (tonnes/year)									
	Aircraft	Commercial Boats	Commercial Off-Road Vehicles and Equipment	Commercial Ships	Construction Off-Road Vehicles and Equipment	Industrial Off-Road Vehicles and Equipment	Loading and Unloading Fuels	Railways	Recreational Boats	Off-Road Mobile Total
1,3 BUTADIENE	5.55×10^{-01}	9.37×10^{-02}	1.49×10^{-02}	2.12	1.04×10^{-02}	1.82×10^{-02}	-	1.14×10^{-01}	2.20×10^{-01}	3.15
ACETALDEHYDE	2.46	1.23	9.15×10^{-01}	$1.54 \times 10^{+01}$	2.21×10^{-01}	2.39	-	2.14×10^{-01}	5.97×10^{-02}	$2.29 \times 10^{+01}$
BENZENE	9.13×10^{-01}	1.06	1.04×10^{-01}	1.50	9.95×10^{-02}	1.58×10^{-01}	-	1.25×10^{-01}	1.56	5.52
CARBON MONOXIDE	$3.18 \times 10^{+02}$	$2.35 \times 10^{+02}$	$6.27 \times 10^{+01}$	$4.08 \times 10^{+02}$	$4.38 \times 10^{+01}$	$7.20 \times 10^{+01}$	-	$2.13 \times 10^{+01}$	$2.90 \times 10^{+02}$	$1.45 \times 10^{+03}$
FORMALDEHYDE	4.86	7.24×10^{-01}	5.05×10^{-01}	$1.17 \times 10^{+01}$	1.27×10^{-01}	1.28	-	6.32×10^{-01}	1.48×10^{-01}	$2.00 \times 10^{+01}$
ISOMERS OF XYLENE	6.53×10^{-01}	4.25	1.31×10^{-01}	1.14	3.34×10^{-01}	1.85×10^{-01}	-	2.02×10^{-02}	8.91	$1.56 \times 10^{+01}$
LEAD AND COMPOUNDS	1.12×10^{-02}	1.37×10^{-04}	2.19×10^{-01}	1.55×10^{-03}	1.38×10^{-04}	1.21	-	1.18×10^{-04}	5.12×10^{-06}	1.44
OXIDES OF NITROGEN	$3.62 \times 10^{+01}$	$1.04 \times 10^{+02}$	$5.24 \times 10^{+01}$	$2.41 \times 10^{+03}$	$1.27 \times 10^{+01}$	$1.63 \times 10^{+02}$	-	$1.68 \times 10^{+02}$	5.17	$2.95 \times 10^{+03}$
PARTICULATE MATTER < 10 µm	2.98	7.04	$6.02 \times 10^{+01}$	$8.32 \times 10^{+01}$	9.91×10^{-01}	$3.02 \times 10^{+02}$	-	4.99	7.00	$4.69 \times 10^{+02}$
PARTICULATE MATTER < 2.5 µm	2.76	6.53	$2.75 \times 10^{+01}$	$7.96 \times 10^{+01}$	9.54×10^{-01}	$1.25 \times 10^{+02}$	-	4.51	6.45	$2.53 \times 10^{+02}$
POLYCYCLIC AROMATIC HYDROCARBONS	5.49×10^{-01}	1.38×10^{-01}	3.73×10^{-02}	7.72×10^{-01}	1.52×10^{-02}	8.74×10^{-02}	-	7.37×10^{-02}	3.03×10^{-01}	1.97
SULFUR DIOXIDE	3.64	2.51	1.64	$1.23 \times 10^{+03}$	3.87×10^{-01}	4.67	-	$2.34 \times 10^{+01}$	6.45×10^{-01}	$1.26 \times 10^{+03}$
TETRACHLOROETHYLENE	8.51×10^{-04}	3.10×10^{-02}	6.24×10^{-04}	-	2.28×10^{-03}	2.19×10^{-05}	-	-	1.04×10^{-01}	1.39×10^{-01}
TOLUENE	9.19×10^{-01}	3.90	1.52×10^{-01}	1.34	3.13×10^{-01}	2.35×10^{-01}	-	1.26×10^{-01}	7.27	$1.43 \times 10^{+01}$
TOTAL SUSPENDED PARTICULATES	3.14	7.41	$2.56 \times 10^{+02}$	$8.76 \times 10^{+01}$	1.04	$1.40 \times 10^{+03}$	-	5.25	7.37	$1.77 \times 10^{+03}$
TOTAL VOCs	$3.65 \times 10^{+01}$	$4.39 \times 10^{+01}$	7.86	$8.97 \times 10^{+01}$	4.10	$1.39 \times 10^{+01}$	-	7.20	$1.09 \times 10^{+02}$	$3.12 \times 10^{+02}$
TRICHLOROETHYLENE	5.23×10^{-04}	1.91×10^{-02}	3.83×10^{-04}	-	1.40×10^{-03}	1.34×10^{-05}	-	-	6.38×10^{-02}	8.51×10^{-02}

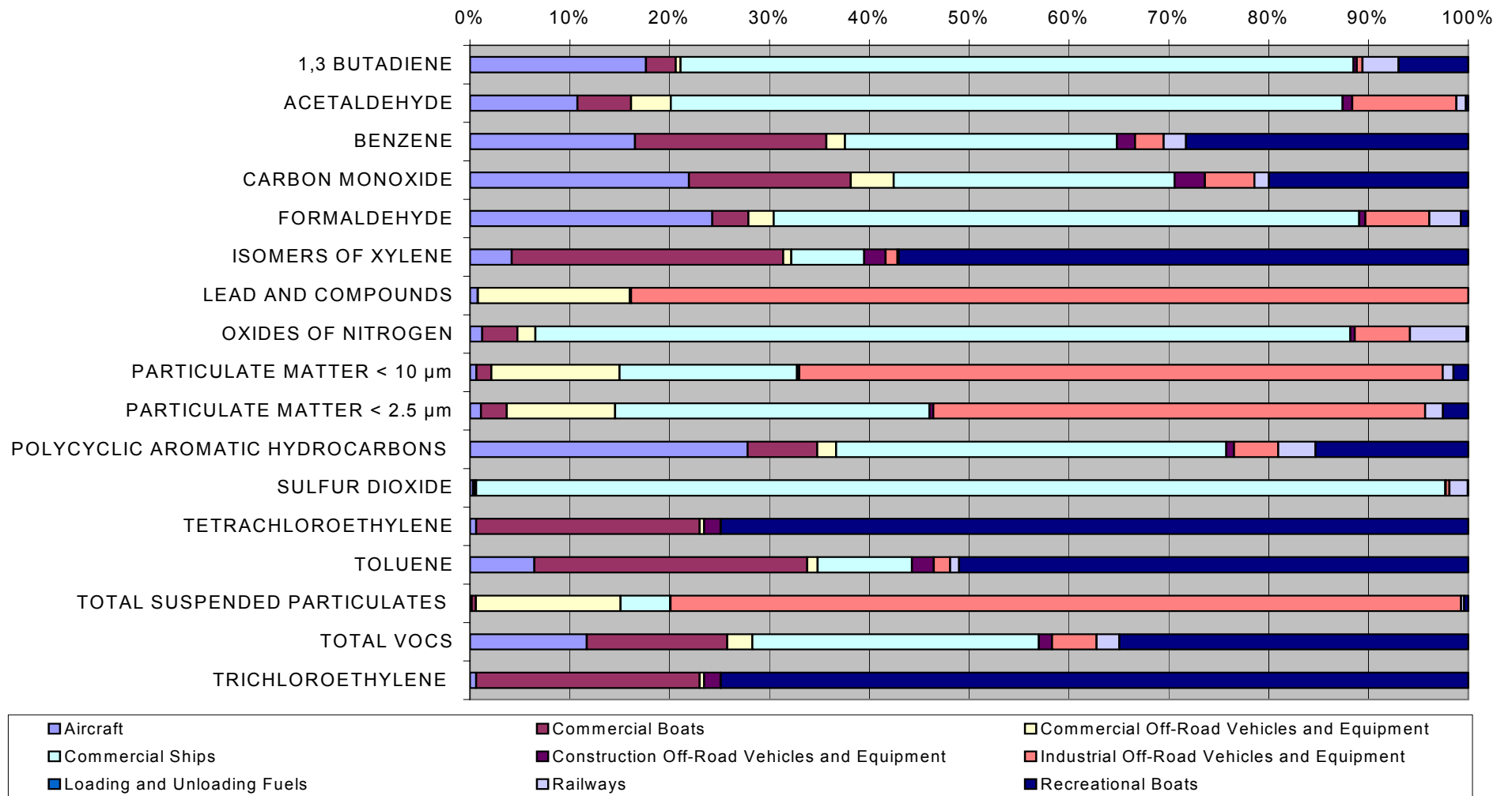


Figure ES1.5: Proportion of total estimated annual emissions by off-road mobile source type in the Newcastle region

Table ES1.6: Total estimated annual emissions by off-road mobile source type in the Wollongong region

Substance	Emissions (tonnes/year)									
	Aircraft	Commercial Boats	Commercial Off-Road Vehicles and Equipment	Commercial Ships	Construction Off-Road Vehicles and Equipment	Industrial Off-Road Vehicles and Equipment	Loading and Unloading Fuels	Railways	Recreational Boats	Off-Road Mobile Total
1,3 BUTADIENE	6.82×10^{-03}	6.20×10^{-02}	5.15×10^{-03}	3.80×10^{-01}	3.77×10^{-03}	2.72×10^{-02}	-	9.32×10^{-02}	2.98×10^{-01}	8.77×10^{-01}
ACETALDEHYDE	1.54×10^{-02}	8.14×10^{-01}	3.17×10^{-01}	2.77	8.00×10^{-02}	3.59	-	1.75×10^{-01}	8.09×10^{-02}	7.83
BENZENE	1.18×10^{-02}	7.01×10^{-01}	3.58×10^{-02}	2.70×10^{-01}	3.60×10^{-02}	2.37×10^{-01}	5.15×10^{-02}	1.02×10^{-01}	2.12	3.56
CARBON MONOXIDE	7.77	$1.56 \times 10^{+02}$	$2.17 \times 10^{+01}$	$7.33 \times 10^{+01}$	$1.59 \times 10^{+01}$	$1.08 \times 10^{+02}$	-	$1.74 \times 10^{+01}$	$3.93 \times 10^{+02}$	$7.93 \times 10^{+02}$
FORMALDEHYDE	4.91×10^{-02}	4.79×10^{-01}	1.75×10^{-01}	2.11	4.60×10^{-02}	1.92	-	5.18×10^{-01}	2.00×10^{-01}	5.49
ISOMERS OF XYLENE	1.01×10^{-02}	2.81	4.53×10^{-02}	2.04×10^{-01}	1.21×10^{-01}	2.78×10^{-01}	3.70×10^{-02}	1.65×10^{-02}	$1.21 \times 10^{+01}$	$1.56 \times 10^{+01}$
LEAD AND COMPOUNDS	3.63×10^{-04}	9.07×10^{-05}	7.59×10^{-02}	2.78×10^{-04}	4.98×10^{-05}	1.81	-	9.69×10^{-05}	6.94×10^{-06}	1.89
OXIDES OF NITROGEN	5.62×10^{-01}	$6.90 \times 10^{+01}$	$1.81 \times 10^{+01}$	$4.32 \times 10^{+02}$	4.59	$2.45 \times 10^{+02}$	-	$1.37 \times 10^{+02}$	7.00	$9.14 \times 10^{+02}$
PARTICULATE MATTER < 10 µm	1.51×10^{-01}	4.66	$2.09 \times 10^{+01}$	$1.49 \times 10^{+01}$	3.59×10^{-01}	$4.53 \times 10^{+02}$	-	4.09	9.49	$5.08 \times 10^{+02}$
PARTICULATE MATTER < 2.5 µm	1.39×10^{-01}	4.33	9.51	$1.43 \times 10^{+01}$	3.46×10^{-01}	$1.87 \times 10^{+02}$	-	3.70	8.73	$2.28 \times 10^{+02}$
POLYCYCLIC AROMATIC HYDROCARBONS	1.56×10^{-02}	9.13×10^{-02}	1.29×10^{-02}	1.39×10^{-01}	5.51×10^{-03}	1.31×10^{-01}	-	6.04×10^{-02}	4.10×10^{-01}	8.65×10^{-01}
SULFUR DIOXIDE	4.37×10^{-02}	1.66	5.69×10^{-01}	$2.20 \times 10^{+02}$	1.40×10^{-01}	7.01	-	$1.92 \times 10^{+01}$	8.73×10^{-01}	$2.50 \times 10^{+02}$
TETRACHLOROETHYLENE	4.14×10^{-07}	2.05×10^{-02}	2.16×10^{-04}	-	8.24×10^{-04}	3.28×10^{-05}	-	-	1.41×10^{-01}	1.62×10^{-01}
TOLUENE	1.69×10^{-02}	2.58	5.26×10^{-02}	2.41×10^{-01}	1.13×10^{-01}	3.53×10^{-01}	1.24×10^{-01}	1.03×10^{-01}	9.85	$1.34 \times 10^{+01}$
TOTAL SUSPENDED PARTICULATES	1.58×10^{-01}	4.91	$8.86 \times 10^{+01}$	$1.57 \times 10^{+01}$	3.78×10^{-01}	$2.10 \times 10^{+03}$	-	4.31	9.99	$2.22 \times 10^{+03}$
TOTAL VOCs	4.08×10^{-01}	$2.91 \times 10^{+01}$	2.72	$1.61 \times 10^{+01}$	1.49	$2.08 \times 10^{+01}$	7.71	5.90	$1.48 \times 10^{+02}$	$2.32 \times 10^{+02}$
TRICHLOROETHYLENE	2.54×10^{-07}	1.26×10^{-02}	1.33×10^{-04}	-	5.06×10^{-04}	2.01×10^{-05}	-	-	8.64×10^{-02}	9.97×10^{-02}

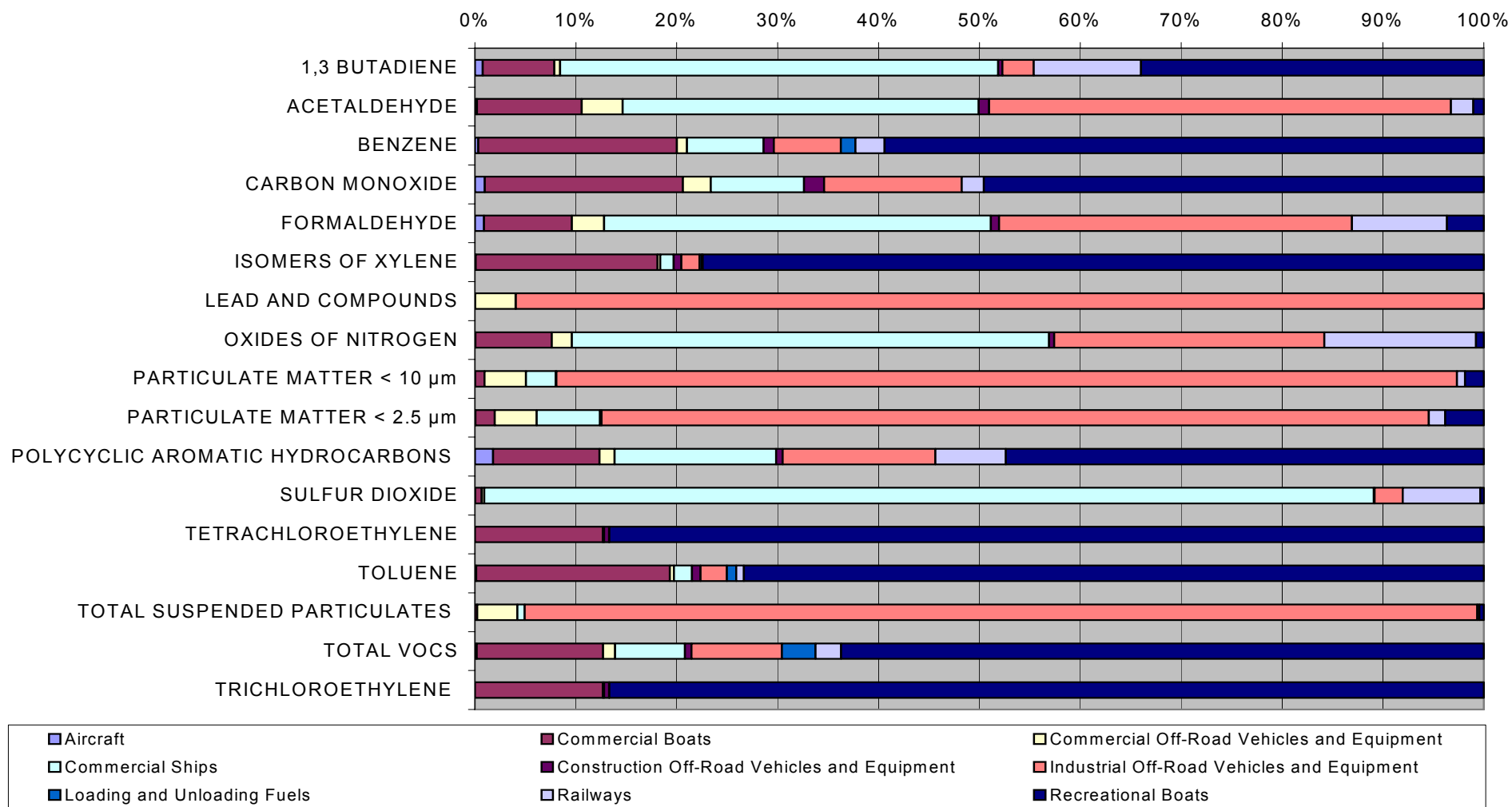


Figure ES1.6: Proportion of total estimated annual emissions by off-road mobile source type in the Wollongong region

Table ES1.7: Total estimated annual emissions by off-road mobile source type in the Non-Urban region

Substance	Emissions (tonnes/year)									
	Aircraft	Commercial Boats	Commercial Off-Road Vehicles and Equipment	Commercial Ships	Construction Off-Road Vehicles and Equipment	Industrial Off-Road Vehicles and Equipment	Loading and Unloading Fuels	Railways	Recreational Boats	Off-Road Mobile Total
1,3 BUTADIENE	9.72×10^{-02}	1.30	1.41×10^{-01}	1.52	2.47×10^{-02}	5.43×10^{-01}	-	9.75×10^{-01}	2.17	6.78
ACETALDEHYDE	7.52×10^{-01}	$1.71 \times 10^{+01}$	8.69	$1.11 \times 10^{+01}$	5.26×10^{-01}	$7.15 \times 10^{+01}$	-	1.84	5.90×10^{-01}	$1.12 \times 10^{+02}$
BENZENE	2.30×10^{-01}	$1.47 \times 10^{+01}$	9.84×10^{-01}	1.08	2.37×10^{-01}	4.73	-	1.07	$1.54 \times 10^{+01}$	$3.85 \times 10^{+01}$
CARBON MONOXIDE	$1.84 \times 10^{+02}$	$3.27 \times 10^{+03}$	$5.96 \times 10^{+02}$	$2.93 \times 10^{+02}$	$1.04 \times 10^{+02}$	$2.15 \times 10^{+03}$	-	$1.82 \times 10^{+02}$	$2.86 \times 10^{+03}$	$9.65 \times 10^{+03}$
FORMALDEHYDE	9.31×10^{-01}	$1.01 \times 10^{+01}$	4.80	8.42	3.02×10^{-01}	$3.83 \times 10^{+01}$	-	5.42	1.46	$6.97 \times 10^{+01}$
ISOMERS OF XYLENE	2.25×10^{-01}	$5.91 \times 10^{+01}$	1.24	8.17×10^{-01}	7.96×10^{-01}	5.55	-	1.73×10^{-01}	$8.80 \times 10^{+01}$	$1.56 \times 10^{+02}$
LEAD AND COMPOUNDS	1.20×10^{-02}	1.91×10^{-03}	2.08	1.11×10^{-03}	3.27×10^{-04}	$3.62 \times 10^{+01}$	-	1.01×10^{-03}	5.05×10^{-05}	$3.83 \times 10^{+01}$
OXIDES OF NITROGEN	$1.23 \times 10^{+01}$	$1.45 \times 10^{+03}$	$4.98 \times 10^{+02}$	$1.73 \times 10^{+03}$	$3.01 \times 10^{+01}$	$4.88 \times 10^{+03}$	-	$1.44 \times 10^{+03}$	$5.10 \times 10^{+01}$	$1.01 \times 10^{+04}$
PARTICULATE MATTER < 10 µm	3.13	$9.80 \times 10^{+01}$	$5.72 \times 10^{+02}$	$5.98 \times 10^{+01}$	2.36	$9.04 \times 10^{+03}$	-	$4.28 \times 10^{+01}$	$6.91 \times 10^{+01}$	$9.88 \times 10^{+03}$
PARTICULATE MATTER < 2.5 µm	2.89	$9.10 \times 10^{+01}$	$2.61 \times 10^{+02}$	$5.72 \times 10^{+01}$	2.27	$3.73 \times 10^{+03}$	-	$3.87 \times 10^{+01}$	$6.36 \times 10^{+01}$	$4.24 \times 10^{+03}$
POLYCYCLIC AROMATIC HYDROCARBONS	4.06×10^{-01}	1.92	3.54×10^{-01}	5.54×10^{-01}	3.62×10^{-02}	2.61	-	6.32×10^{-01}	2.99	9.50
SULFUR DIOXIDE	1.22	$3.50 \times 10^{+01}$	$1.56 \times 10^{+01}$	$8.81 \times 10^{+02}$	9.22×10^{-01}	$1.40 \times 10^{+02}$	-	$2.01 \times 10^{+02}$	6.36	$1.28 \times 10^{+03}$
TETRACHLOROETHYLENE	4.10×10^{-04}	4.32×10^{-01}	5.93×10^{-03}	-	5.42×10^{-03}	6.54×10^{-04}	-	-	1.02	1.47
TOLUENE	3.13×10^{-01}	$5.43 \times 10^{+01}$	1.44	9.64×10^{-01}	7.45×10^{-01}	7.04	-	1.08	$7.18 \times 10^{+01}$	$1.38 \times 10^{+02}$
TOTAL SUSPENDED PARTICULATES	3.29	$1.03 \times 10^{+02}$	$2.43 \times 10^{+03}$	$6.29 \times 10^{+01}$	2.48	$4.19 \times 10^{+04}$	-	$4.51 \times 10^{+01}$	$7.28 \times 10^{+01}$	$4.46 \times 10^{+04}$
TOTAL VOCs	8.52	$6.12 \times 10^{+02}$	$7.46 \times 10^{+01}$	$6.44 \times 10^{+01}$	9.77	$4.15 \times 10^{+02}$	-	$6.18 \times 10^{+01}$	$1.08 \times 10^{+03}$	$2.32 \times 10^{+03}$
TRICHLOROETHYLENE	2.52×10^{-04}	2.65×10^{-01}	3.64×10^{-03}	-	3.33×10^{-03}	4.02×10^{-04}	-	-	6.29×10^{-01}	9.03×10^{-01}

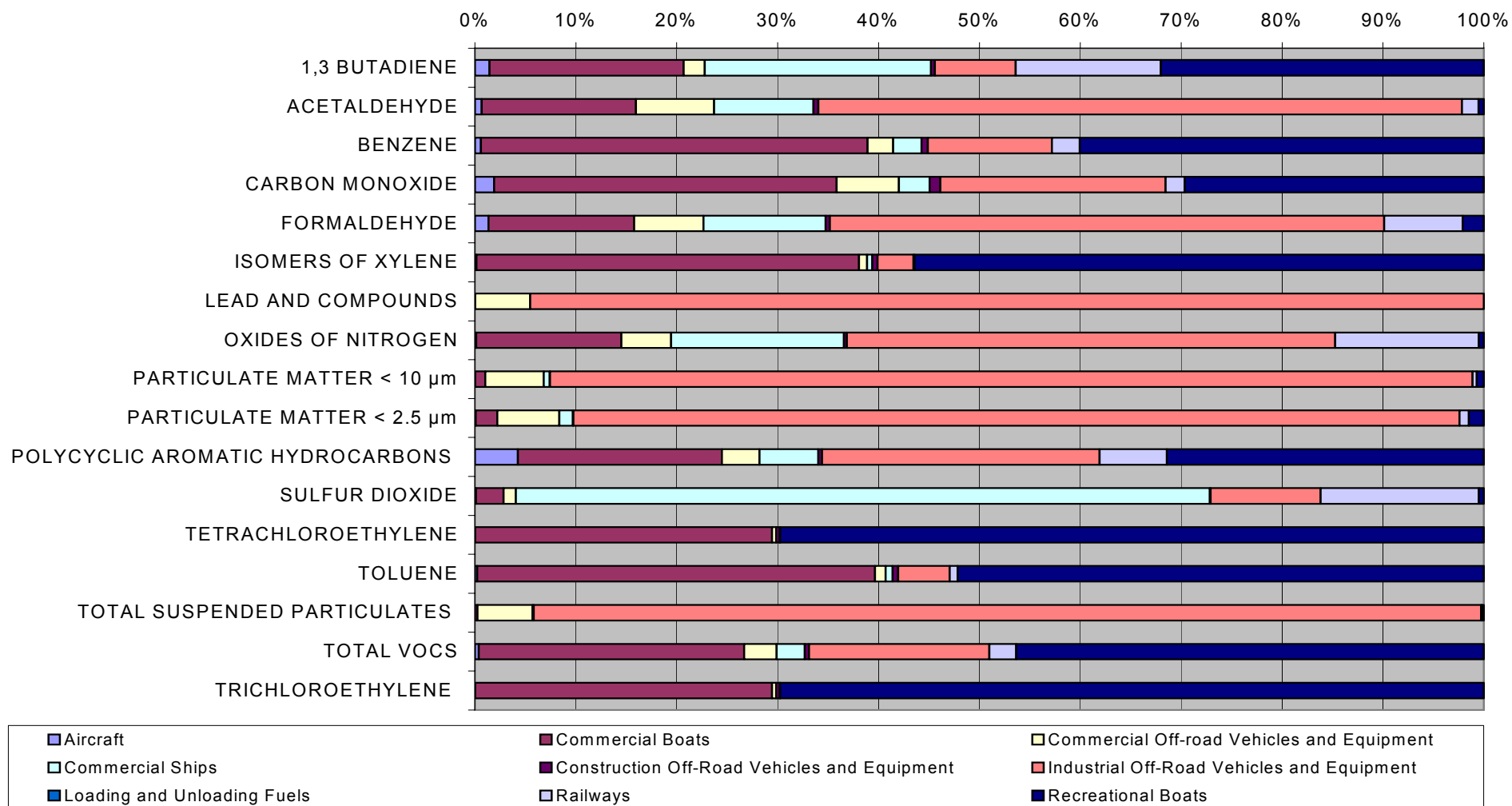


Figure ES1.7: Proportion of total estimated annual emissions by off-road mobile source type in the Non-Urban region