

Technical Report No. 2

Air Emissions Inventory for the Greater Metropolitan Region in New South Wales

Anthropogenic Ozone Precursors and Particle Emissions in the Greater Metropolitan and Sydney Regions: Results

Department of **Environment & Climate Change** NSW



ACKNOWLEDGEMENTS

This study was carried out with the assistance of organisations and individuals who should be recognised for their efforts.

Many thanks to the NSW Environmental Trust and Commonwealth Department of the Environment and Water Resources for providing the Department of Environment and Climate Change NSW (DECC) with funding to complete the study.

DECC would also like to thank a number of individuals for their efforts in preparing this report, including: Mr. Nick Agapides (DECC); and Ms. Janelle Pickup (DECC).

Published by:

Department of Environment and Climate Change NSW
59–61 Goulburn Street
PO Box A290
Sydney South 1232
Phone: (02) 9995 5000 (switchboard)
Phone: 131 555 (environment information and publications requests)
Phone: 1300 361 967 (national parks information and publications requests)
Fax: (02) 9995 5999
TTY: (02) 9211 4723

Email: info@environment.nsw.gov.au
Website: www.environment.nsw.gov.au

In April 2007 the Department of Environment and Conservation NSW became known as the Department of Environment and Climate Change NSW.

This material may be reproduced in whole or in part, provided the meaning is unchanged and the source is acknowledged.

ISBN 978 1 74122 490 0
DECC 2007/317
August 2007

EXECUTIVE SUMMARY

The Department of Environment and Climate Change NSW (DECC) has completed a three year air emissions inventory project. The base year of the 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 and shown in Figure ES1.

Table ES1 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 air emissions inventory includes emissions from biogenic (i.e. natural) and anthropogenic (i.e. human derived) sources.

The anthropogenic source groups included in the air emissions inventory are as follows:

- Commercial businesses (i.e. non-EPA-licensed);
- Domestic-commercial activities;
- Industrial premises (i.e. EPA-licensed);
- Off-road mobile (i.e. non-registered off-road vehicles and equipment); and
- On-road mobile (i.e. registered on-road vehicles).

The pollutants inventoried include criteria pollutants specified in the *Ambient Air Quality NEPM* (NEPC, 2003), air toxics associated with the *National Pollutant Inventory (NPI) NEPM* (NEPC, 2000) and the *Air Toxics NEPM* (NEPC, 2004) and any other pollutants associated with state specific programs, including: *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).

This report focuses on emissions of ozone precursors and particles from anthropogenic sources only, including:

- Oxides of nitrogen (NO_x);
- Particulate matter < 10 μm (PM₁₀);
- Particulate matter < 2.5 μm (PM_{2.5}); and
- Total volatile organic compounds (VOCs).

More detailed information about sources and emissions of other air pollutants from the biogenic, commercial businesses, domestic-commercial activities, industrial premises, off-road mobile and on-road mobile source groups can be found in the individual air emissions inventory reports (DECC, 2007a; DECC, 2007b; DECC, 2007c; DECC, 2007d; DECC, 2007e; DECC, 2007f; and DECC, 2007g), respectively.



Figure ES1 Definition of Greater Metropolitan, Sydney, Newcastle and Wollongong regions

Table ES2 shows total estimated annual anthropogenic emissions of ozone precursors and particles from each anthropogenic source group in the GMR and Sydney region in 1992 and 2003. Increased and decreased changes in emissions are shown as **red bold** and **green bold** text, respectively.

Table ES3 shows the proportion of total estimated annual anthropogenic emissions of ozone precursors and particles from each anthropogenic source group in the GMR and Sydney region in 1992 and 2003.

Table ES2 Total estimated annual anthropogenic emissions by source group in the GMR and Sydney region in 1992 and 2003

Substance	Anthropogenic Source Group					Anthropogenic Total
	Commercial	Domestic-Commercial	Industrial	Off-Road Mobile	On-Road Mobile	
2003 Annual Emissions (tonnes/year) – GMR						
OXIDES OF NITROGEN	2,648	1,791	175,537	23,470	88,609	292,054
PARTICULATE MATTER < 10 µm	4,032	6,651	46,530	14,566	3,349	75,128
PARTICULATE MATTER < 2.5 µm	1,270	6,428	13,127	6,486	3,188	30,499
TOTAL VOCS	13,844	67,303	17,786	7,640	64,493	171,067
1992¹ Annual Emissions (tonnes/year) – GMR						
OXIDES OF NITROGEN		6,580	123,300	9,810	98,990	238,680
PARTICULATE MATTER < 10 µm ²		16,170	67,510	9,230	7,120	100,030
TOTAL VOCS		85,670	20,550	9,510	93,380	209,110
Change in Annual Emissions (%) – GMR						
OXIDES OF NITROGEN		-32.5	+42.4	+139.2	-10.5	+22.4
PARTICULATE MATTER < 10 µm		-33.9	-31.1	+57.8	-53.0	-24.9
TOTAL VOCS		-5.3	-13.4	-19.7	-30.9	-18.2
2003 Annual Emissions (tonnes/year) – Sydney						
OXIDES OF NITROGEN	1,870	1,356	14,032	9,514	65,996	92,768
PARTICULATE MATTER < 10 µm	2,143	4,993	7,911	3,707	2,552	21,305
PARTICULATE MATTER < 2.5 µm	723	4,826	3,390	1,761	2,426	13,126
TOTAL VOCS	9,973	51,929	13,989	4,772	50,171	130,834
1992¹ Annual Emissions (tonnes/year) – Sydney						
OXIDES OF NITROGEN		4,810	13,440	3,080	80,400	101,730
PARTICULATE MATTER < 10 µm ²		9,210	8,320	1,830	6,100	25,460
TOTAL VOCS		70,020	16,820	6,300	77,520	170,660
Change in Annual Emissions (%) - Sydney						
OXIDES OF NITROGEN		-32.9	+4.4	+208.9	-17.9	-8.8
PARTICULATE MATTER < 10 µm		-22.5	-4.9	+102.5	-58.2	-16.3
TOTAL VOCS		-11.6	-16.8	-24.3	-35.3	-23.3

¹ Carnovale et. al. (1996).

² The 1992 and 2003 emission inventory estimates for particles are for total suspended particulate (TSP) matter and particulate matter < 10 µm (PM₁₀), respectively. While TSP and PM₁₀ emissions are not directly comparable, they have been presented for illustrative purposes.

Table ES3 Proportion of total estimated annual anthropogenic emissions by source group in the GMR and Sydney region in 1992 and 2003

Substance	Anthropogenic Source Group					Anthropogenic Total
	Commercial	Domestic-Commercial	Industrial	Off-Road Mobile	On-Road Mobile	
Proportion of 2003 Annual Anthropogenic Emissions (%) – GMR						
OXIDES OF NITROGEN	0.9	0.6	60.1	8.0	30.3	100
PARTICULATE MATTER < 10 µm	5.4	8.9	61.9	19.4	4.5	100
PARTICULATE MATTER < 2.5 µm	4.2	21.1	43.0	21.3	10.5	100
TOTAL VOCS	8.1	39.3	10.4	4.5	37.7	100
		Domestic-Commercial	Industrial	Off-Road Mobile	On-Road Mobile	
Proportion of 1992³ Annual Anthropogenic Emissions (%) - GMR						
OXIDES OF NITROGEN		2.8	51.7	4.1	41.5	100
PARTICULATE MATTER < 10 µm ⁴		16.2	67.5	9.2	7.1	100
TOTAL VOCS		41.0	9.8	4.5	44.7	100
	Commercial	Domestic-Commercial	Industrial	Off-Road Mobile	On-Road Mobile	
Proportion of 2003 Annual Anthropogenic Emissions (%) - Sydney						
OXIDES OF NITROGEN	2.0	1.5	15.1	10.3	71.1	100
PARTICULATE MATTER < 10 µm	10.1	23.4	37.1	17.4	12.0	100
PARTICULATE MATTER < 2.5 µm	5.5	36.8	25.8	13.4	18.5	100
TOTAL VOCS	7.6	39.7	10.7	3.6	38.3	100
		Domestic-Commercial	Industrial	Off-Road Mobile	On-Road Mobile	
Proportion of 1992³ Annual Anthropogenic Emissions (%) - Sydney						
OXIDES OF NITROGEN		4.7	13.2	3.0	79.0	100
PARTICULATE MATTER < 10 µm ⁴		36.2	32.7	7.2	24.0	100
TOTAL VOCS		41.0	9.9	3.7	45.4	100

³ Carnovale et. al. (1996).

⁴ The 1992 and 2003 emission inventory estimates for particles are for total suspended particulate (TSP) matter and particulate matter < 10 µm (PM₁₀), respectively. While TSP and PM₁₀ emissions are not directly comparable, they have been presented for illustrative purposes.

Figure A1 to Figure A8 in Appendix A (pages 33 to 36) show the proportion of total estimated annual anthropogenic emissions of oxides of nitrogen, particulate matter < 10 µm, particulate matter < 2.5 µm and total VOCs from each anthropogenic source group in the GMR and Sydney region respectively in 2003.

While it is difficult to draw comparisons between the 1992 and 2003 estimates due to differences in activity data, emission estimation techniques and source coverage, the following simple observations can be made:

- Annual oxides of nitrogen emissions in the GMR and Sydney region during 2003 are ~1.22 and ~0.91 times respectively more than 1992 estimates. Changes in GMR emissions are largely due to an increase in industrial (i.e. Generation of electrical power from coal) and off-road mobile (i.e. inclusion of commercial boats, commercial off-road vehicles and equipment, construction off-road vehicles and equipment and industrial off-road vehicles and equipment) emissions, while changes in Sydney region emissions are largely due to a decrease in on-road mobile emissions;
- Annual total VOCs emissions in the GMR and Sydney region during 2003 are ~0.82 and ~0.77 times respectively more than 1992 estimates. Changes in GMR and Sydney region emissions are largely due to a decrease in on-road mobile emissions; and
- Comparisons between TSP and PM₁₀/PM_{2.5} emission estimates cannot readily be made. Overall, annual PM₁₀/PM_{2.5} emission estimates would be higher in 2003 compared with 1992 due to a larger coverage of source types within the commercial, domestic-commercial, industrial and off-road mobile source groups.

Table ES4 and Table ES5 present the changes in priority ranking of source groups in the GMR and Sydney region based on 1992 and 2003 emission inventory estimates. Priority ranking 1 indicates the source group has the highest emissions, while priority ranking 4 indicates the source group has the lowest emissions. Changes in priority ranking are shown in **red bold** text.

Table ES4 Changes in annual priority ranking of source groups in the GMR – 1992 to 2003

Source Group	NO _x		Total VOCs		PM ₁₀		PM _{2.5}	
	1992	2003	1992	2003	1992 ⁵	2003	1992	2003
Domestic-Commercial	4	4	2	1	2	3	-	2
Industrial	1	1	3	3	1	1	-	1
Off-Road Mobile	3	3	4	4	3	2	-	3
On-Road Mobile	2	2	1	2	4	4	-	4

Table ES5 Changes in annual priority ranking of source groups in the Sydney region – 1992 to 2003

Source Group	NO _x		Total VOCs		PM ₁₀		PM _{2.5}	
	1992	2003	1992	2003	1992 ⁵	2003	1992	2003
Domestic-Commercial	3	4	2	1	1	2	-	1
Industrial	2	2	3	3	2	1	-	2
Off-Road Mobile	4	3	4	4	4	3	-	4
On-Road Mobile	1	1	1	2	3	4	-	3

While there are some changes in priority rankings of source groups when comparing 1992 and 2003 emission inventory estimates, the data presented in Table ES2 and Table ES3 shows that in broad terms, there has been little change in the source groups that should be the focus for reducing ozone precursor and particle emissions.

⁵ The 1992 and 2003 emission inventory estimates for particles are for total suspended particulate (TSP) matter and particulate matter < 10 µm (PM₁₀), respectively. While TSP and PM₁₀ emissions are not directly comparable, they have been presented for illustrative purposes.

Table ES6, Figure A9 and Figure A10 in Appendix A (pages 37 to 38) show anthropogenic sources of oxides of nitrogen emissions ranked in descending order according to total estimated annual emissions in the GMR and Sydney region. The individual and cumulative proportions of anthropogenic emissions are also shown for each source type.

Table ES6 Ranking of anthropogenic sources of oxides of nitrogen on an annual basis

Source Group	Source Type	Oxides of Nitrogen		
		Annual Emissions (tonnes/year)	Proportion of Annual Anthropogenic Emissions (%)	Cumulative Proportion (%)
GMR				
Industrial	Generation of electrical power from coal	145,440	49.8	49.8
On-Road Mobile	Exhaust Emissions Passenger Cars - Petrol	49,011	16.8	66.6
On-Road Mobile	Exhaust Emissions Heavy Duty Commercial - Diesel	25,289	8.7	75.2
Industrial	Primary iron and steel production	7,827	2.7	77.9
Off-Road Mobile	Industrial Off-Road Vehicles and Equipment	6,800	2.3	80.2
Off-Road Mobile	Commercial Ships	6,176	2.1	82.4
Industrial	Cement or lime production	6,115	2.1	84.5
On-Road Mobile	Exhaust Emissions Light Duty Commercial - Petrol	5,851	2.0	86.5
On-Road Mobile	Exhaust Emissions Light Duty - Diesel	5,287	1.8	88.3
Off-Road Mobile	Railways	3,350	1.1	89.4
Off-Road Mobile	Aircraft	3,267	1.1	90.5
On-Road Mobile	Exhaust Emissions - Other	3,171	1.1	91.6
Industrial	Petroleum refining	2,789	1.0	92.6
Industrial	Generation of electrical power from gas	2,681	0.9	93.5
Off-Road Mobile	Commercial Boats	2,478	0.8	94.3
Industrial	Production of container glass	1,609	0.6	94.9
Industrial	Coal mining	1,400	0.5	95.4
Commercial	Hospitals (Except Psychiatric Hospitals)	1,323	0.5	95.8
Industrial	Petrochemical production	1,199	0.4	96.2
Industrial	Production of ammonium nitrate	1,056	0.4	96.6
Industrial	Generation of electrical power from biogas	1,026	0.4	97.0
Off-Road Mobile	Commercial Off-Road Vehicles and Equipment	1,008	0.3	97.3
Commercial	Unaccounted Gaseous Fuel Combustion	1,006	0.3	97.6
Industrial	Storage of Petroleum and/or Petroleum Products	864	0.3	97.9
Industrial	Production of float glass	839	0.3	98.2
Domestic-Commercial	Gaseous Fuel Combustion	762	0.3	98.5
Industrial	Sewage Treatment - processing by large plants	604	0.2	98.7
Domestic-Commercial	Solid Fuel Combustion	480	0.2	98.9
Industrial	Primary aluminium production	343	0.1	99.0
Domestic-Commercial	Lawn Mowing & Garden Equipment (POS)	269	0.1	99.1
Industrial	Crushing, grinding or separating works	248	0.1	99.1
Industrial	Ceramics production (excluding glass)	237	0.1	99.2
Off-Road Mobile	Construction Off-Road Vehicles and Equipment	218	0.1	99.3
Domestic-Commercial	Lawn Mowing & Garden Equipment (Domestic)	177	0.1	99.4
All	Other	1,853	0.6	100

Source Group	Source Type	Oxides of Nitrogen		
		Annual Emissions (tonnes/year)	Proportion of Annual Anthropogenic Emissions (%)	Cumulative Proportion (%)
Sydney				
On-Road Mobile	Exhaust Emissions Passenger Cars - Petrol	38,175	41.2	41.2
On-Road Mobile	Exhaust Emissions Heavy Duty Commercial - Diesel	16,908	18.2	59.4
On-Road Mobile	Exhaust Emissions Light Duty Commercial - Petrol	4,534	4.9	64.3
On-Road Mobile	Exhaust Emissions Light Duty - Diesel	4,245	4.6	68.8
Off-Road Mobile	Aircraft	3,218	3.5	72.3
Industrial	Petroleum refining	2,789	3.0	75.3
Industrial	Generation of electrical power from gas	2,681	2.9	78.2
On-Road Mobile	Exhaust Emissions - Other	2,135	2.3	80.5
Industrial	Production of container glass	1,609	1.7	82.2
Off-Road Mobile	Railways	1,608	1.7	84.0
Off-Road Mobile	Commercial Ships	1,606	1.7	85.7
Off-Road Mobile	Industrial Off-Road Vehicles and Equipment	1,510	1.6	87.3
Industrial	Cement or lime production	1,337	1.4	88.8
Industrial	Petrochemical production	1,199	1.3	90.1
Industrial	Generation of electrical power from biogas	1,026	1.1	91.2
Industrial	Storage of Petroleum and/or Petroleum Products	864	0.9	92.1
Off-Road Mobile	Commercial Boats	853	0.9	93.0
Industrial	Production of float glass	839	0.9	93.9
Commercial	Hospitals (Except Psychiatric Hospitals)	827	0.9	94.8
Commercial	Unaccounted Gaseous Fuel Combustion	791	0.9	95.7
Industrial	Sewage Treatment - processing by large plants	601	0.6	96.3
Domestic-Commercial	Gaseous Fuel Combustion	599	0.6	97.0
Off-Road Mobile	Commercial Off-Road Vehicles and Equipment	440	0.5	97.4
Domestic-Commercial	Solid Fuel Combustion	361	0.4	97.8
Industrial	Crushing, grinding or separating works	239	0.3	98.1
Domestic-Commercial	Lawn Mowing & Garden Equipment (POS)	181	0.2	98.3
Off-Road Mobile	Construction Off-Road Vehicles and Equipment	171	0.2	98.5
Industrial	Ceramics production (excluding glass)	161	0.2	98.6
Domestic-Commercial	Lawn Mowing & Garden Equipment (Domestic)	133	0.1	98.8
Industrial	Paper production using recycled materials	121	0.1	98.9
Off-Road Mobile	Recreational Boats	109	0.1	99.0
Commercial	Port Operators	102	0.1	99.1
Industrial	Secondary aluminium production	58.4	0.1	99.2
Domestic-Commercial	Barbecues	54.6	0.1	99.3
All	Other	680	0.7	100.0

Table ES7, Figure A11 and Figure A12 in Appendix A (pages 39 to 40) show anthropogenic sources of total VOCs emissions ranked in descending order according to total estimated annual emissions in the GMR and Sydney region. The individual and cumulative proportions of anthropogenic emissions are also shown for each source type.

Table ES7 Ranking of anthropogenic sources of total VOCs on an annual basis

Source Group	Source Type	Total VOCs		
		Annual Emissions (tonnes/year)	Proportion of Annual Anthropogenic Emissions (%)	Cumulative Proportion (%)
GMR				
On-Road Mobile	Exhaust Emissions Passenger Cars - Petrol	33,062	19.3	19.3
Domestic-Commercial	Aerosols and Solvents	26,220	15.3	34.7
Domestic-Commercial	Surface Coating	16,898	9.9	44.5
On-Road Mobile	Evaporative Emissions – Petrol	14,956	8.7	53.3
Domestic-Commercial	Solid Fuel Combustion	12,663	7.4	60.7
On-Road Mobile	Exhaust Emissions Light Duty Commercial - Petrol	5,916	3.5	64.1
On-Road Mobile	Exhaust Emissions – Other	5,829	3.4	67.5
Commercial	Automotive Fuel Retailing	5,625	3.3	70.8
Commercial	Smash Repairing	5,445	3.2	74.0
Domestic-Commercial	Lawn Mowing & Garden Equipment (Domestic)	5,419	3.2	77.2
Off-Road Mobile	Recreational Boats	3,626	2.1	79.3
On-Road Mobile	Exhaust Emissions Heavy Duty Commercial - Diesel	3,583	2.1	81.4
Industrial	Petroleum refining	3,165	1.8	83.2
Industrial	Metal plating or coating works	2,484	1.5	84.7
Industrial	Printing	2,474	1.4	86.1
Domestic-Commercial	Cutback Bitumen	2,374	1.4	87.5
Domestic-Commercial	Natural Gas Leakage	1,988	1.2	88.7
Domestic-Commercial	Lawn Mowing & Garden Equipment (POS)	1,643	1.0	89.7
Commercial	Printing	1,296	0.8	90.4
Industrial	Other metal processing	1,228	0.7	91.1
On-Road Mobile	Exhaust Emissions Light Duty - Diesel	1,147	0.7	91.8
Off-Road Mobile	Loading and Unloading Fuels	1,129	0.7	92.5
Off-Road Mobile	Commercial Boats	1,044	0.6	93.1
Industrial	Generation of electrical power from coal	698	0.4	93.5
Industrial	Other chemical processing	673	0.4	93.9
Off-Road Mobile	Aircraft	666	0.4	94.3
Industrial	Primary iron and steel production	580	0.3	94.6
Industrial	Hazardous waste generation or storage	580	0.3	94.9
Off-Road Mobile	Industrial Off-Road Vehicles and Equipment	579	0.3	95.3
Industrial	Plastics production	552	0.3	95.6
Industrial	Generation of electrical power from gas	502	0.3	95.9
Industrial	Other Chemical Storage	469	0.3	96.2
Industrial	Solid waste landfilling	462	0.3	96.4
Industrial	Petrochemical production	457	0.3	96.7
All	Other	5,632	3.3	100

Source Group	Source Type	Total VOCs		
		Annual Emissions (tonnes/year)	Proportion of Annual Anthropogenic Emissions (%)	Cumulative Proportion (%)
Sydney				
On-Road Mobile	Exhaust Emissions Passenger Cars - Petrol	26,066	19.9	19.9
Domestic-Commercial	Aerosols and Solvents	20,637	15.8	35.7
Domestic-Commercial	Surface Coating	13,112	10.0	45.7
On-Road Mobile	Evaporative Emissions - Petrol	11,783	9.0	54.7
Domestic-Commercial	Solid Fuel Combustion	9,524	7.3	62.0
On-Road Mobile	Exhaust Emissions Light Duty Commercial - Petrol	4,627	3.5	65.5
Commercial	Smash Repairing	4,271	3.3	68.8
On-Road Mobile	Exhaust Emissions - Other	4,143	3.2	72.0
Domestic-Commercial	Lawn Mowing & Garden Equipment (Domestic)	4,076	3.1	75.1
Commercial	Automotive Fuel Retailing	3,445	2.6	77.7
Industrial	Petroleum refining	3,165	2.4	80.1
On-Road Mobile	Exhaust Emissions Heavy Duty Commercial - Diesel	2,597	2.0	82.1
Industrial	Printing	2,418	1.8	84.0
Industrial	Metal plating or coating works	2,327	1.8	85.8
Off-Road Mobile	Recreational Boats	2,292	1.8	87.5
Domestic-Commercial	Cutback Bitumen	1,826	1.4	88.9
Domestic-Commercial	Natural Gas Leakage	1,569	1.2	90.1
Commercial	Printing	1,170	0.9	91.0
Off-Road Mobile	Loading and Unloading Fuels	1,121	0.9	91.8
Industrial	Other metal processing	1,118	0.9	92.7
Domestic-Commercial	Lawn Mowing & Garden Equipment (POS)	1,108	0.8	93.6
On-Road Mobile	Exhaust Emissions Light Duty - Diesel	955	0.7	94.3
Industrial	Other chemical processing	625	0.5	94.8
Off-Road Mobile	Aircraft	621	0.5	95.2
Industrial	Plastics production	551	0.4	95.7
Industrial	Generation of electrical power from gas	502	0.4	96.0
Industrial	Petrochemical production	457	0.3	96.4
Off-Road Mobile	Commercial Boats	359	0.3	96.7
Industrial	Hazardous waste generation or storage	326	0.2	96.9
Industrial	Storage of Petroleum and/or Petroleum Products	265	0.2	97.1
Industrial	Solid waste landfilling	252	0.2	97.3
Commercial	Laundries and Dry-Cleaners	217	0.2	97.5
Industrial	Other Chemical Storage	177	0.1	97.6
Industrial	Composting and related reprocessing or treatment	176	0.1	97.7
All	Other	2,956	2.3	100

Table ES8, Figure A13 and Figure A14 in Appendix A (pages 41 to 42) show anthropogenic sources of particulate matter < 10 µm emissions ranked in descending order according to total estimated annual emissions in the GMR and Sydney region. The individual and cumulative proportions of anthropogenic emissions are also shown for each source type.

Table ES8 Ranking of anthropogenic sources of particulate matter < 10 µm on an annual basis

Source Group	Source Type	Particulate Matter < 10 µm		
		Annual Emissions (tonnes/year)	Proportion of Annual Anthropogenic Emissions (%)	Cumulative Proportion (%)
GMR				
Industrial	Coal mining	25,256	33.6	33.6
Off-Road Mobile	Industrial Off-Road Vehicles and Equipment	12,584	16.8	50.4
Domestic-Commercial	Solid Fuel Combustion	6,172	8.2	58.6
Industrial	Generation of electrical power from coal	4,816	6.4	65.0
Industrial	Other land-based extraction	3,472	4.6	69.6
Industrial	Crushing, grinding or separating works	2,513	3.3	73.0
Commercial	Poultry Farming (Meat)	1,841	2.5	75.4
Industrial	Hard-rock gravel quarrying	1,687	2.2	77.7
Industrial	Primary iron and steel production	1,620	2.2	79.8
Commercial	Gravel and Sand Quarrying	1,252	1.7	81.5
Off-Road Mobile	Commercial Off-Road Vehicles and Equipment	1,159	1.5	83.0
On-Road Mobile	Exhaust Emissions Light Duty – Diesel	1,106	1.5	84.5
Industrial	Ceramics production (excluding glass)	1,099	1.5	86.0
On-Road Mobile	Exhaust Emissions Passenger Cars - Petrol	1,056	1.4	87.4
On-Road Mobile	Exhaust Emissions Heavy Duty Commercial - Diesel	1,033	1.4	88.7
Industrial	Solid waste landfilling	928	1.2	90.0
Industrial	Concrete batching	606	0.8	90.8
Commercial	Poultry Farming (Eggs)	594	0.8	91.6
Industrial	Poultry production	444	0.6	92.2
Industrial	Primary aluminium production	433	0.6	92.7
Industrial	Mining (other than coal)	371	0.5	93.2
Industrial	Coal loading	310	0.4	93.6
Industrial	Cement or lime production	282	0.4	94.0
Industrial	Petroleum refining	265	0.4	94.4
Domestic-Commercial	Lawn Mowing & Garden Equipment (Domestic)	251	0.3	94.7
Off-Road Mobile	Recreational Boats	233	0.3	95.0
Off-Road Mobile	Commercial Ships	213	0.3	95.3
Industrial	Production of ammonium nitrate	210	0.3	95.6
Industrial	Cement or lime handling	199	0.3	95.8
Industrial	Bitumen pre-mix or hotmix production	198	0.3	96.1
Industrial	Plastics production	194	0.3	96.4
Off-Road Mobile	Commercial Boats	167	0.2	96.6
Industrial	Inert waste landfilling	164	0.2	96.8
Domestic-Commercial	Lawn Mowing & Garden Equipment (POS)	154	0.2	97.0
All	Other	2,244	3.0	100.0

Source Group	Source Type	Particulate Matter < 10 µm		
		Annual Emissions (tonnes/year)	Proportion of Annual Anthropogenic Emissions (%)	Cumulative Proportion (%)
Sydney				
Domestic-Commercial	Solid Fuel Combustion	4,642	21.8	21.8
Off-Road Mobile	Industrial Off-Road Vehicles and Equipment	2,794	13.1	34.9
Industrial	Crushing, grinding or separating works	2,051	9.6	44.5
Industrial	Other land-based extraction	1,768	8.3	52.8
On-Road Mobile	Exhaust Emissions Passenger Cars - Petrol	867	4.1	56.9
On-Road Mobile	Exhaust Emissions Light Duty - Diesel	866	4.1	61.0
Industrial	Ceramics production (excluding glass)	841	3.9	64.9
Commercial	Poultry Farming (Meat)	831	3.9	68.8
On-Road Mobile	Exhaust Emissions Heavy Duty Commercial - Diesel	702	3.3	72.1
Commercial	Gravel and Sand Quarrying	560	2.6	74.7
Commercial	Poultry Farming (Eggs)	534	2.5	77.2
Off-Road Mobile	Commercial Off-Road Vehicles and Equipment	505	2.4	79.6
Industrial	Concrete batching	487	2.3	81.9
Industrial	Solid waste landfilling	484	2.3	84.2
Industrial	Poultry production	383	1.8	86.0
Industrial	Petroleum refining	265	1.2	87.2
Industrial	Plastics production	194	0.9	88.1
Domestic-Commercial	Lawn Mowing & Garden Equipment (Domestic)	189	0.9	89.0
Off-Road Mobile	Recreational Boats	147	0.7	89.7
Industrial	Hard-rock gravel quarrying	125	0.6	90.3
Industrial	Production of float glass	113	0.5	90.8
Industrial	Coal mining	109	0.5	91.3
Domestic-Commercial	Lawn Mowing & Garden Equipment (POS)	104	0.5	91.8
Industrial	Production of container glass	86.3	0.4	92.2
Off-Road Mobile	Aircraft	86.2	0.4	92.6
Industrial	Cement or lime production	71.5	0.3	93.0
Industrial	Storage of Petroleum and/or Petroleum Products	67.9	0.3	93.3
On-Road Mobile	Exhaust Emissions - Other	67.7	0.3	93.6
Industrial	Sewage Treatment - processing by small plants	66.9	0.3	93.9
Industrial	Composting and related reprocessing or treatment	63.8	0.3	94.2
Commercial	Unaccounted Gaseous Fuel Combustion	63.3	0.3	94.5
Commercial	Hospitals (Except Psychiatric Hospitals)	62.9	0.3	94.8
Industrial	Inert waste landfilling	61.8	0.3	95.1
Industrial	Bitumen pre-mix or hotmix production	60.8	0.3	95.4
All	Other	984	4.6	100.0

Table ES9, Figure A15 and Figure A16 in Appendix A (pages 43 to 44) show anthropogenic sources of particulate matter < 2.5 µm emissions ranked in descending order according to total estimated annual emissions in the GMR and Sydney region. The individual and cumulative proportions of anthropogenic emissions are also shown for each source type.

Table ES9 Ranking of anthropogenic sources of particulate matter < 2.5 µm on an annual basis

Source Group	Source Type	Particulate Matter < 2.5 µm		
		Annual Emissions (tonnes/year)	Proportion of Annual Anthropogenic Emissions (%)	Cumulative Proportion (%)
GMR				
Domestic-Commercial	Solid Fuel Combustion	5,986	19.6	19.6
Off-Road Mobile	Industrial Off-Road Vehicles and Equipment	5,191	17.0	36.6
Industrial	Coal mining	4,154	13.6	50.3
Industrial	Generation of electrical power from coal	1,708	5.6	55.9
Industrial	Primary iron and steel production	1,444	4.7	60.6
On-Road Mobile	Exhaust Emissions Light Duty – Diesel	1,073	3.5	64.1
On-Road Mobile	Exhaust Emissions Heavy Duty Commercial – Diesel	1,002	3.3	67.4
On-Road Mobile	Exhaust Emissions Passenger Cars - Petrol	972	3.2	70.6
Industrial	Crushing, grinding or separating works	918	3.0	73.6
Industrial	Other land-based extraction	799	2.6	76.2
Industrial	Ceramics production (excluding glass)	798	2.6	78.8
Off-Road Mobile	Commercial Off-Road Vehicles and Equipment	528	1.7	80.6
Commercial	Poultry Farming (Meat)	526	1.7	82.3
Industrial	Hard-rock gravel quarrying	435	1.4	83.7
Industrial	Primary aluminium production	312	1.0	84.7
Commercial	Gravel and Sand Quarrying	296	1.0	85.7
Industrial	Petroleum refining	237	0.8	86.5
Domestic-Commercial	Lawn Mowing & Garden Equipment (Domestic)	231	0.8	87.2
Off-Road Mobile	Recreational Boats	214	0.7	87.9
Industrial	Production of ammonium nitrate	207	0.7	88.6
Off-Road Mobile	Commercial Ships	204	0.7	89.3
Industrial	Plastics production	192	0.6	89.9
Industrial	Solid waste landfilling	189	0.6	90.5
Industrial	Cement or lime production	175	0.6	91.1
Commercial	Poultry Farming (Eggs)	170	0.6	91.7
Off-Road Mobile	Commercial Boats	155	0.5	92.2
Industrial	Bitumen pre-mix or hotmix production	145	0.5	92.7
Domestic-Commercial	Lawn Mowing & Garden Equipment (POS)	143	0.5	93.1
Industrial	Concrete batching	134	0.4	93.6
Industrial	Poultry production	120	0.4	94.0
Industrial	Production of float glass	111	0.4	94.3
Commercial	Hospitals (Except Psychiatric Hospitals)	101	0.3	94.7
Off-Road Mobile	Railways	90.1	0.3	94.9
Industrial	Production of container glass	86.3	0.3	95.2
All	Other	1,454	4.8	100

Source Group	Source Type	Particulate Matter < 2.5 µm		
		Annual Emissions (tonnes/year)	Proportion of Annual Anthropogenic Emissions (%)	Cumulative Proportion (%)
Sydney				
Domestic-Commercial	Solid Fuel Combustion	4,503	34.3	34.3
Off-Road Mobile	Industrial Off-Road Vehicles and Equipment	1,152	8.8	43.1
On-Road Mobile	Exhaust Emissions Light Duty - Diesel	840	6.4	49.5
Industrial	Crushing, grinding or separating works	807	6.2	55.6
On-Road Mobile	Exhaust Emissions Passenger Cars - Petrol	797	6.1	61.7
On-Road Mobile	Exhaust Emissions Heavy Duty Commercial - Diesel	681	5.2	66.9
Industrial	Ceramics production (excluding glass)	606	4.6	71.5
Industrial	Other land-based extraction	418	3.2	74.7
Commercial	Poultry Farming (Meat)	237	1.8	76.5
Industrial	Petroleum refining	237	1.8	78.3
Off-Road Mobile	Commercial Off-Road Vehicles and Equipment	230	1.8	80.1
Industrial	Plastics production	192	1.5	81.5
Domestic-Commercial	Lawn Mowing & Garden Equipment (Domestic)	173	1.3	82.8
Commercial	Poultry Farming (Eggs)	153	1.2	84.0
Commercial	Gravel and Sand Quarrying	136	1.0	85.0
Off-Road Mobile	Recreational Boats	135	1.0	86.1
Industrial	Concrete batching	114	0.9	86.9
Industrial	Production of float glass	111	0.8	87.8
Industrial	Poultry production	106	0.8	88.6
Industrial	Solid waste landfilling	98.5	0.8	89.3
Domestic-Commercial	Lawn Mowing & Garden Equipment (POS)	96.3	0.7	90.1
Industrial	Production of container glass	86.3	0.7	90.7
Off-Road Mobile	Aircraft	80.0	0.6	91.3
Industrial	Storage of Petroleum and/or Petroleum Products	67.7	0.5	91.9
Commercial	Unaccounted Gaseous Fuel Combustion	63.3	0.5	92.3
Commercial	Hospitals (Except Psychiatric Hospitals)	62.9	0.5	92.8
On-Road Mobile	Exhaust Emissions - Other	62.3	0.5	93.3
Off-Road Mobile	Commercial Boats	53.4	0.4	93.7
Off-Road Mobile	Commercial Ships	53.1	0.4	94.1
Domestic-Commercial	Gaseous Fuel Combustion	47.8	0.4	94.5
Industrial	Cement or lime production	47.3	0.4	94.8
Industrial	Generation of electrical power from gas	46.4	0.4	95.2
On-Road Mobile	Exhaust Emissions Light Duty Commercial - Petrol	46.1	0.4	95.5
Industrial	Petrochemical production	45.3	0.3	95.9
All	Other	541	4.1	100

CONTENTS

EXECUTIVE SUMMARY	i
1 INTRODUCTION	1
2 OZONE PRECURSORS	2
2.1 January Weekday	2
2.1.1 Emission Estimates	2
2.1.2 Ranked Emission Estimates	4
2.1.2.1 Oxides of Nitrogen	4
2.1.2.2 Total VOCs	6
2.2 January Weekend Day	8
2.2.1 Emission Estimates	8
2.2.2 Ranked Emission Estimates	9
2.2.2.1 Oxides of Nitrogen	9
2.2.2.2 Total VOCs	11
3 PARTICLES.....	13
3.1 July Weekday.....	13
3.1.1 Emission Estimates	13
3.1.2 Ranked Emission Estimates	15
3.1.2.1 Particulate Matter < 10 µm	15
3.1.2.2 Particulate Matter < 2.5 µm	17
3.2 July Weekend Day	19
3.2.1 Emission Estimates	19
3.2.2 Ranked Emission Estimates	20
3.2.2.1 Particulate Matter < 10 µm	20
3.2.2.2 Particulate Matter < 2.5 µm	22
4 SUMMARY OF PRIORITY SOURCES OF OZONE PRECURSORS AND PARTICLES.....	24
5 REFERENCES	32
APPENDIX A: ANNUAL EMISSIONS.....	33
APPENDIX B: DAILY JANUARY EMISSIONS	45
APPENDIX C: DAILY JULY EMISSIONS.....	57

LIST OF TABLES

Table ES1	Definition of Greater Metropolitan, Sydney, Newcastle and Wollongong regions	i
Table ES2	Total estimated annual anthropogenic emissions by source group in the GMR and Sydney region in 1992 and 2003	iv
Table ES3	Proportion of total estimated annual anthropogenic emissions by source group in the GMR and Sydney region in 1992 and 2003	v
Table ES4	Changes in annual priority ranking of source groups in the GMR – 1992 to 2003	vi
Table ES5	Changes in annual priority ranking of source groups in the Sydney region – 1992 to 2003.....	vi
Table ES6	Ranking of anthropogenic sources of oxides of nitrogen on an annual basis.....	vii
Table ES7	Ranking of anthropogenic sources of total VOCs on an annual basis	ix
Table ES8	Ranking of anthropogenic sources of particulate matter < 10 µm on an annual basis	xi
Table ES9	Ranking of anthropogenic sources of particulate matter < 2.5 µm on an annual basis	xiii
Table 2.1	Total estimated daily emissions of ozone precursors by anthropogenic source group in the GMR and Sydney region for a typical January weekday	2
Table 2.2	January weekday priority ranking of source groups in the GMR and Sydney region for ozone precursors – 2003	3
Table 2.3	Ranking of anthropogenic sources of oxides of nitrogen for a typical January weekday	4
Table 2.4	Ranking of anthropogenic sources of total VOCs for a typical January weekday	6
Table 2.5	Total estimated daily emissions of ozone precursors by anthropogenic source group in the GMR and Sydney region for a typical January weekend day	8
Table 2.6	January weekend day priority ranking of source groups in the GMR and Sydney region for ozone precursors – 2003	8
Table 2.7	Ranking of anthropogenic sources of oxides of nitrogen for a typical January weekend day	9
Table 2.8	Ranking of anthropogenic sources of total VOCs for a typical January weekend day	11

Table 3.1	Total estimated daily emissions of particles by anthropogenic source group in the GMR and Sydney region for a typical July weekday	13
Table 3.2	July weekday priority ranking of source groups in the GMR and Sydney region for particles – 2003	14
Table 3.3	Ranking of anthropogenic sources of particulate matter < 10 µm for a typical July weekday.....	15
Table 3.4	Ranking of anthropogenic sources of particulate matter < 2.5 µm for a typical July weekday.....	17
Table 3.5	Total estimated daily emissions by anthropogenic source group in each region for a typical July weekend day	19
Table 3.6	July weekend day priority ranking of source groups in the GMR and Sydney region for particles – 2003	19
Table 3.7	Ranking of anthropogenic sources of particulate matter < 10 µm for a typical July weekend day.....	20
Table 3.8	Ranking of anthropogenic sources of particulate matter < 2.5 µm for a typical July weekend day.....	22
Table 4.1	Priority sources of ozone precursors and particles in the GMR and Sydney region.....	25

LIST OF FIGURES

Figure ES1	Definition of Greater Metropolitan, Sydney, Newcastle and Wollongong regionsii
Figure 4.1	Priority sectors of NO _x emissions in the GMR 28
Figure 4.2	Priority sectors of VOCs emissions in the GMR 28
Figure 4.3	Priority sectors of PM ₁₀ emissions in the GMR 29
Figure 4.4	Priority sectors of PM _{2.5} emissions in the GMR..... 29
Figure 4.5	Priority sectors of NO _x emissions in the Sydney region..... 30
Figure 4.6	Priority sectors of VOCs emissions in the Sydney region..... 30
Figure 4.7	Priority sectors of PM ₁₀ emissions in the Sydney region..... 31
Figure 4.8	Priority sectors of PM _{2.5} emissions in the Sydney region 31
Figure A1	Proportion of total estimated annual emissions of oxides of nitrogen from each anthropogenic source group in the GMR..... 33
Figure A2	Proportion of total estimated annual emissions of particulate matter < 10 µm from each anthropogenic source group in the GMR..... 33
Figure A3	Proportion of total estimated annual emissions of particulate matter < 2.5 µm from each anthropogenic source group in the GMR..... 34
Figure A4	Proportion of total estimated annual emissions of total VOCs from each anthropogenic source group in the GMR..... 34
Figure A5	Proportion of total estimated annual emissions of oxides of nitrogen from each anthropogenic source group in the Sydney region 35
Figure A6	Proportion of total estimated annual emissions of particulate matter < 10 µm from each anthropogenic source group in the Sydney region 35
Figure A7	Proportion of total estimated annual emissions of particulate matter < 2.5 µm from each anthropogenic source group in the Sydney region 36
Figure A8	Proportion of total estimated annual emissions of total VOCs from each anthropogenic source group in the Sydney region 36
Figure A9	Ranking of anthropogenic sources of oxides of nitrogen in the GMR on an annual basis..... 37

Figure A10	Ranking of anthropogenic sources of oxides of nitrogen in the Sydney region on an annual basis	38
Figure A11	Ranking of anthropogenic sources of total VOCs in the GMR on an annual basis ..	39
Figure A12	Ranking of anthropogenic sources of total VOCs in the Sydney region on an annual basis	40
Figure A13	Ranking of anthropogenic sources of particulate matter < 10 µm in the GMR on an annual basis	41
Figure A14	Ranking of anthropogenic sources of particulate matter < 10 µm in the Sydney region on an annual basis	42
Figure A15	Ranking of anthropogenic sources of particulate matter < 2.5 µm in the GMR on an annual basis	43
Figure A16	Ranking of anthropogenic sources of particulate matter < 2.5 µm in the Sydney region on an annual basis	44
Figure B1	Proportion of total estimated daily emissions of oxides of nitrogen from each anthropogenic source group in the GMR for a typical January weekday	45
Figure B2	Proportion of total estimated daily emissions of total VOCs from each anthropogenic source group in the GMR for a typical January weekday	45
Figure B3	Proportion of total estimated daily emissions of oxides of nitrogen from each anthropogenic source group in the Sydney region for a typical January weekday	46
Figure B4	Proportion of total estimated daily emissions of total VOCs from each anthropogenic source group in the Sydney region for a typical January weekday	46
Figure B5	Ranking of anthropogenic sources of oxides of nitrogen in the GMR for a typical January weekday	47
Figure B6	Ranking of anthropogenic sources of oxides of nitrogen in the Sydney region for a typical January weekday	48
Figure B7	Ranking of anthropogenic sources of total VOCs in the GMR for a typical January weekday	49
Figure B8	Ranking of anthropogenic sources of total VOCs in the Sydney region for a typical January weekday	50
Figure B9	Proportion of total estimated daily emissions of oxides of nitrogen from each anthropogenic source group in the GMR for a typical January weekend day	51
Figure B10	Proportion of total estimated daily emissions of total VOCs from each anthropogenic source group in the GMR for a typical January weekend day	51

Figure B11	Proportion of total estimated daily emissions of oxides of nitrogen from each anthropogenic source group in the Sydney region for a typical January weekend day	52
Figure B12	Proportion of total estimated daily emissions of total VOCs from each anthropogenic source group in the Sydney region for a typical January weekend day	52
Figure B13	Ranking of anthropogenic sources of oxides of nitrogen in the GMR for a typical January weekend day	53
Figure B14	Ranking of anthropogenic sources of oxides of nitrogen in the Sydney region for a typical January weekend day.....	54
Figure B15	Ranking of anthropogenic sources of total VOCs in the GMR for a typical January weekend day	55
Figure B16	Ranking of anthropogenic sources of total VOCs in the Sydney region for a typical January weekend day	56
Figure C1	Proportion of total estimated daily emissions of particulate matter < 10 µm from each anthropogenic source group in the GMR for a typical July weekday.....	57
Figure C2	Proportion of total estimated daily emissions of particulate matter < 2.5 µm from each anthropogenic source group in the GMR for a typical July weekday.....	57
Figure C3	Proportion of total estimated daily emissions of particulate matter < 10 µm from each anthropogenic source group in the Sydney region for a typical July weekday	58
Figure C4	Proportion of total estimated daily emissions of particulate matter < 2.5 µm from each anthropogenic source group in the Sydney region for a typical July weekday	58
Figure C5	Ranking of anthropogenic sources of particulate matter < 10 µm in the GMR for a typical July weekday	59
Figure C6	Ranking of anthropogenic sources of particulate matter < 10 µm in the Sydney region for a typical July weekday	60
Figure C7	Ranking of anthropogenic sources of particulate matter < 2.5 µm in the GMR for a typical July weekday	61
Figure C8	Ranking of anthropogenic sources of particulate matter < 2.5 µm in the Sydney region for a typical July weekday	62
Figure C9	Proportion of total estimated daily emissions of particulate matter < 10 µm from each anthropogenic source group in the GMR for a typical July weekend day	63
Figure C10	Proportion of total estimated daily emissions of particulate matter < 2.5 µm from each anthropogenic source group in the GMR for a typical July weekend day	63

Figure C11	Proportion of total estimated daily emissions of particulate matter < 10 µm from each anthropogenic source group in the Sydney region for a typical July weekend day	64
Figure C12	Proportion of total estimated daily emissions of particulate matter < 2.5 µm from each anthropogenic source group in the Sydney region for a typical July weekend day	64
Figure C13	Ranking of anthropogenic sources of particulate matter < 10 µm in the GMR for a typical July weekend day	65
Figure C14	Ranking of anthropogenic sources of particulate matter < 10 µm in the Sydney region for a typical July weekend day	66
Figure C15	Ranking of anthropogenic sources of particulate matter < 2.5 µm in the GMR for a typical July weekend day	67
Figure C16	Ranking of anthropogenic sources of particulate matter < 2.5 µm in the Sydney region for a typical July weekend day	68

1 INTRODUCTION

The Department of Environment and Climate Change NSW (DECC) has completed a three year air emissions inventory project. The base year of the 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 air emissions inventory includes emissions from biogenic (i.e. natural) and anthropogenic (i.e. human derived) sources.

The anthropogenic source groups included in the air emissions inventory include:

- Commercial businesses (i.e. non-EPA-licensed);
- Domestic-commercial activities;
- Industrial premises (i.e. EPA-licensed);
- Off-road mobile (i.e. non-registered off-road vehicles and equipment); and
- On-road mobile (i.e. registered on-road vehicles).

The purpose of this report is to focus on emissions of ozone precursors and particles, including:

- Oxides of nitrogen (NO_x);
- Particulate matter < 10 µm (PM₁₀);
- Particulate matter < 2.5 µm (PM_{2.5}); and
- Total volatile organic compounds (VOCs).

More detailed information about sources and emissions of other air pollutants from the biogenic, commercial businesses, domestic-commercial activities, industrial premises, off-road mobile and on-road mobile source groups can be found in the individual air emissions inventory reports (DECC, 2007a; DECC, 2007b; DECC, 2007c; DECC, 2007d; DECC, 2007e; DECC, 2007f; and DECC, 2007g), respectively.

The information in this report is structured as follows:

- An emissions summary for ozone precursors presented by source group and source type for the GMR and Sydney region (Section 2).
- An emissions summary for particles presented by source group and source type for the GMR and Sydney region (Section 3).
- A summary of priority sources of ozone precursors and particles presented by anthropogenic source type for the GMR and Sydney region (Section 4).
- A list of references (Section 5).
- Annual emissions charts showing the proportion of total estimated annual anthropogenic emissions of oxides of nitrogen, particulate matter < 10 µm, particulate matter < 2.5 µm and total VOCs from each anthropogenic source group and source type in the GMR and Sydney region (Appendix A).
- Daily January emissions charts showing the proportion of total estimated annual anthropogenic emissions of oxides of nitrogen and total VOCs from each anthropogenic source group and source type in the GMR and Sydney region (Appendix B).
- Daily July emissions charts showing the proportion of total estimated annual anthropogenic emissions of particulate matter < 10 µm and particulate matter < 2.5 µm from each anthropogenic source group and source type in the GMR and Sydney region (Appendix C).

2 OZONE PRECURSORS

This section presents estimated daily emissions of ozone precursors (i.e. oxides of nitrogen and total VOCs) from commercial, domestic-commercial, industrial, off-road mobile and on-road mobile sources in the GMR and Sydney region for the 2003 calendar year.

Emission estimates for a typical January weekday and weekend day are presented for each source group and source type together with the proportion of total estimated anthropogenic emissions. The anthropogenic sources of oxides of nitrogen and total VOCs are also ranked according to total estimated January weekday and January weekend day emissions in the GMR and Sydney region.

Ozone precursor emissions have been presented for a typical January weekday and January weekend day, since these represent the highest anthropogenic emissions that would likely occur during times conducive to photochemical smog formation.

2.1 January Weekday

2.1.1 Emission Estimates

Table 2.1 and Figure B1 to Figure B4 in Appendix B (pages 45 to 46) show total estimated emissions and proportion of ozone precursors from each anthropogenic source group in the GMR and Sydney region for a typical January weekday.

Table 2.1 Total estimated daily emissions of ozone precursors by anthropogenic source group in the GMR and Sydney region for a typical January weekday

Substance	Anthropogenic Source Group					Anthropogenic Total
	Commercial	Domestic-Commercial	Industrial	Off-Road Mobile	On-Road Mobile	
2003 January Weekday Emissions (tonnes/day) - GMR						
OXIDES OF NITROGEN	6.7	3.7	475	58.2	225	769
TOTAL VOCS	44.2	151	48.7	15.1	143	402
Proportion of 2003 January Weekday Anthropogenic Emissions (%) - GMR						
OXIDES OF NITROGEN	0.9	0.5	61.8	7.6	29.2	100
TOTAL VOCS	11.0	37.5	12.1	3.8	35.6	100
2003 January Weekday Emissions (tonnes/day) - Sydney						
OXIDES OF NITROGEN	4.7	2.7	37.8	24.2	167	237
TOTAL VOCS	31.7	117	38.2	9.4	112	308
Proportion of 2003 January Weekday Anthropogenic Emissions (%) - Sydney						
OXIDES OF NITROGEN	2.0	1.1	15.9	10.2	70.7	100
TOTAL VOCS	10.3	37.9	12.4	3.1	36.3	100

Table 2.2 presents the priority ranking of source groups in the GMR and Sydney region based on 2003 January weekday emission inventory estimates for ozone precursors. Priority ranking 1 indicates the source group has the highest emissions, while priority ranking 5 indicates the source group has the lowest emissions.

Table 2.2 January weekday priority ranking of source groups in the GMR and Sydney region for ozone precursors – 2003

Source Group	NO _x		VOCs	
	GMR	Sydney	GMR	Sydney
Commercial	4	4	4	4
Domestic-Commercial	5	5	1	1
Industrial	1	2	3	3
Off-Road Mobile	3	3	5	5
On-Road Mobile	2	1	2	2

2.1.2 Ranked Emission Estimates

2.1.2.1 Oxides of Nitrogen

Table 2.3 and Figure B5 to Figure B6 in Appendix B (pages 47 to 48) show anthropogenic sources of oxides of nitrogen emissions ranked in descending order according to total estimated January weekday emissions in the GMR and Sydney region. The individual and cumulative proportions of anthropogenic emissions are also shown for each source type.

Table 2.3 Ranking of anthropogenic sources of oxides of nitrogen for a typical January weekday

Source Group	Source Type	Oxides of Nitrogen		
		January Weekday Emissions (tonnes/day)	Proportion of January Weekday Anthropogenic Emissions (%)	Cumulative Proportion (%)
GMR				
Industrial	Generation of electrical power from coal	394	51.3	51.3
On-Road Mobile	Exhaust Emissions Passenger Cars - Petrol	124	16.2	67.4
On-Road Mobile	Exhaust Emissions Heavy Duty Commercial - Diesel	64.1	8.3	75.8
Industrial	Primary iron and steel production	21.0	2.7	78.5
Industrial	Cement or lime production	16.5	2.1	80.7
Off-Road Mobile	Commercial Ships	15.8	2.1	82.7
On-Road Mobile	Exhaust Emissions Light Duty Commercial - Petrol	14.8	1.9	84.6
Off-Road Mobile	Industrial Off-Road Vehicles and Equipment	14.8	1.9	86.6
On-Road Mobile	Exhaust Emissions Light Duty - Diesel	13.4	1.7	88.3
Off-Road Mobile	Aircraft	8.7	1.1	89.4
Off-Road Mobile	Railways	8.5	1.1	90.6
On-Road Mobile	Exhaust Emissions - Other	8.0	1.0	91.6
Industrial	Petroleum refining	7.5	1.0	92.6
Industrial	Generation of electrical power from gas	7.2	0.9	93.5
Off-Road Mobile	Commercial Boats	6.9	0.9	94.4
Industrial	Production of container glass	4.3	0.6	95.0
Industrial	Coal mining	4.0	0.5	95.5
Commercial	Hospitals (Except Psychiatric Hospitals)	3.6	0.5	96.0
Industrial	Petrochemical production	3.2	0.4	96.4
Industrial	Production of ammonium nitrate	2.8	0.4	96.7
Industrial	Generation of electrical power from biogas	2.8	0.4	97.1
Off-Road Mobile	Commercial Off-Road Vehicles and Equipment	2.5	0.3	97.4
Industrial	Storage of Petroleum and/or Petroleum Products	2.3	0.3	97.7
Commercial	Unaccounted Gaseous Fuel Combustion	2.3	0.3	98.0
Industrial	Production of float glass	2.3	0.3	98.3
Domestic-Commercial	Gaseous Fuel Combustion	1.7	0.2	98.6
Industrial	Sewage Treatment - processing by large plants	1.6	0.2	98.8
Domestic-Commercial	Lawn Mowing & Garden Equipment (POS)	1.3	0.2	98.9
Industrial	Primary aluminium production	0.9	0.1	99.1
Off-Road Mobile	Construction Off-Road Vehicles and Equipment	0.7	0.1	99.1
Industrial	Ceramics production (excluding glass)	0.6	0.1	99.2
Industrial	Crushing, grinding or separating works	0.6	0.1	99.3
Industrial	Other chemical processing	0.4	0.05	99.4
Industrial	Other metal processing	0.3	0.04	99.4
All	Other	4.6	0.6	100.0

Air Emissions Inventory for the Greater Metropolitan Region in New South Wales
 2. Ozone Precursors

Source Group	Source Type	Oxides of Nitrogen		
		January Weekday Emissions (tonnes/day)	Proportion of January Weekday Anthropogenic Emissions (%)	Cumulative Proportion (%)
Sydney				
On-Road Mobile	Exhaust Emissions Passenger Cars - Petrol	96.8	40.9	40.9
On-Road Mobile	Exhaust Emissions Heavy Duty Commercial - Diesel	42.9	18.1	59.0
On-Road Mobile	Exhaust Emissions Light Duty Commercial - Petrol	11.5	4.9	63.9
On-Road Mobile	Exhaust Emissions Light Duty - Diesel	10.8	4.5	68.4
Off-Road Mobile	Aircraft	8.6	3.6	72.0
Industrial	Petroleum refining	7.5	3.2	75.2
Industrial	Generation of electrical power from gas	7.2	3.0	78.2
On-Road Mobile	Exhaust Emissions - Other	5.4	2.3	80.5
Industrial	Production of container glass	4.3	1.8	82.3
Off-Road Mobile	Commercial Ships	4.1	1.7	84.1
Off-Road Mobile	Railways	4.1	1.7	85.8
Industrial	Cement or lime production	3.6	1.5	87.3
Off-Road Mobile	Industrial Off-Road Vehicles and Equipment	3.3	1.4	88.7
Industrial	Petrochemical production	3.2	1.4	90.1
Industrial	Generation of electrical power from biogas	2.8	1.2	91.2
Off-Road Mobile	Commercial Boats	2.4	1.0	92.2
Industrial	Storage of Petroleum and/or Petroleum Products	2.3	1.0	93.2
Industrial	Production of float glass	2.3	1.0	94.2
Commercial	Hospitals (Except Psychiatric Hospitals)	2.2	0.9	95.1
Commercial	Unaccounted Gaseous Fuel Combustion	1.8	0.8	95.9
Industrial	Sewage Treatment - processing by large plants	1.6	0.7	96.6
Domestic-Commercial	Gaseous Fuel Combustion	1.4	0.6	97.1
Off-Road Mobile	Commercial Off-Road Vehicles and Equipment	1.1	0.5	97.6
Domestic-Commercial	Lawn Mowing & Garden Equipment (POS)	0.9	0.4	98.0
Industrial	Crushing, grinding or separating works	0.6	0.3	98.2
Off-Road Mobile	Construction Off-Road Vehicles and Equipment	0.5	0.2	98.5
Industrial	Ceramics production (excluding glass)	0.4	0.2	98.6
Industrial	Paper production using recycled materials	0.3	0.1	98.8
Commercial	Port Operators	0.3	0.1	98.9
Domestic-Commercial	Lawn Mowing & Garden Equipment (Domestic)	0.2	0.1	99.0
Industrial	Secondary aluminium production	0.2	0.1	99.1
Off-Road Mobile	Recreational Boats	0.1	0.1	99.1
Commercial	Glass and Glass Product Manufacturing	0.1	0.1	99.2
Domestic-Commercial	Barbecues	0.1	0.1	99.2
All	Other	1.8	0.8	100

2.1.2.2 Total VOCs

Table 2.4 and Figure B7 to Figure B8 in Appendix B (pages 49 to 50) show anthropogenic sources of total VOCs emissions ranked in descending order according to total estimated January weekday emissions in the GMR and Sydney region. The individual and cumulative proportions of anthropogenic emissions are also shown for each source type.

Table 2.4 Ranking of anthropogenic sources of total VOCs for a typical January weekday

Source Group	Source Type	Total VOCs		
		January Weekday Emissions (tonnes/day)	Proportion of January Weekday Anthropogenic Emissions (%)	Cumulative Proportion (%)
GMR				
Domestic-Commercial	Aerosols and Solvents	71.8	17.9	17.9
On-Road Mobile	Exhaust Emissions Passenger Cars - Petrol	70.3	17.5	35.3
Domestic-Commercial	Surface Coating	46.3	11.5	46.9
On-Road Mobile	Evaporative Emissions - Petrol	37.9	9.4	56.3
Commercial	Automotive Fuel Retailing	19.2	4.8	61.1
Commercial	Smash Repairing	17.1	4.2	65.3
On-Road Mobile	Exhaust Emissions Light Duty Commercial - Petrol	12.6	3.1	68.4
On-Road Mobile	Exhaust Emissions - Other	12.4	3.1	71.5
Domestic-Commercial	Lawn Mowing & Garden Equipment (Domestic)	10.1	2.5	74.0
Industrial	Petroleum refining	8.8	2.2	76.2
Domestic-Commercial	Lawn Mowing & Garden Equipment (POS)	7.9	2.0	78.2
On-Road Mobile	Exhaust Emissions Heavy Duty Commercial - Diesel	7.6	1.9	80.1
Industrial	Printing	6.7	1.7	81.8
Industrial	Metal plating or coating works	6.7	1.7	83.5
Domestic-Commercial	Cutback Bitumen	6.5	1.6	85.1
Off-Road Mobile	Recreational Boats	4.9	1.2	86.3
Domestic-Commercial	Natural Gas Leakage	4.5	1.1	87.4
Commercial	Printing	4.1	1.0	88.4
Domestic-Commercial	Solid Fuel Combustion	3.4	0.8	89.3
Industrial	Other metal processing	3.2	0.8	90.1
Off-Road Mobile	Commercial Boats	2.9	0.7	90.8
Off-Road Mobile	Loading and Unloading Fuels	2.7	0.7	91.5
On-Road Mobile	Exhaust Emissions Light Duty - Diesel	2.4	0.6	92.1
Industrial	Other chemical processing	2.2	0.5	92.6
Industrial	Generation of electrical power from coal	1.9	0.5	93.1
Off-Road Mobile	Aircraft	1.8	0.4	93.5
Industrial	Hazardous waste generation or storage	1.6	0.4	93.9
Industrial	Primary iron and steel production	1.6	0.4	94.3
Industrial	Plastics production	1.6	0.4	94.7
Industrial	Generation of electrical power from gas	1.3	0.3	95.1
Industrial	Other Chemical Storage	1.3	0.3	95.4
Off-Road Mobile	Industrial Off-Road Vehicles and Equipment	1.3	0.3	95.7
Industrial	Solid waste landfilling	1.3	0.3	96.0
Industrial	Petrochemical production	1.2	0.3	96.3
All	Other	14.9	3.7	100.0

Air Emissions Inventory for the Greater Metropolitan Region in New South Wales
 2. Ozone Precursors

Source Group	Source Type	Total VOCs		
		January Weekday Emissions (tonnes/day)	Proportion of January Weekday Anthropogenic Emissions (%)	Cumulative Proportion (%)
Sydney				
Domestic-Commercial	Aerosols and Solvents	56.5	18.4	18.4
On-Road Mobile	Exhaust Emissions Passenger Cars - Petrol	55.5	18.0	36.4
Domestic-Commercial	Surface Coating	35.9	11.7	48.1
On-Road Mobile	Evaporative Emissions - Petrol	29.9	9.7	57.8
Commercial	Smash Repairing	13.4	4.4	62.2
Commercial	Automotive Fuel Retailing	11.6	3.8	66.0
On-Road Mobile	Exhaust Emissions Light Duty Commercial - Petrol	9.8	3.2	69.2
Industrial	Petroleum refining	8.8	2.9	72.0
On-Road Mobile	Exhaust Emissions - Other	8.8	2.9	74.9
Domestic-Commercial	Lawn Mowing & Garden Equipment (Domestic)	7.6	2.5	77.4
Industrial	Printing	6.6	2.1	79.5
Industrial	Metal plating or coating works	6.3	2.0	81.6
On-Road Mobile	Exhaust Emissions Heavy Duty Commercial - Diesel	5.5	1.8	83.3
Domestic-Commercial	Lawn Mowing & Garden Equipment (POS)	5.4	1.7	85.1
Domestic-Commercial	Cutback Bitumen	5.0	1.6	86.7
Commercial	Printing	3.7	1.2	87.9
Domestic-Commercial	Natural Gas Leakage	3.6	1.2	89.1
Off-Road Mobile	Recreational Boats	3.1	1.0	90.1
Industrial	Other metal processing	3.0	1.0	91.1
Off-Road Mobile	Loading and Unloading Fuels	2.7	0.9	91.9
Domestic-Commercial	Solid Fuel Combustion	2.5	0.8	92.8
Industrial	Other chemical processing	2.1	0.7	93.4
On-Road Mobile	Exhaust Emissions Light Duty - Diesel	2.0	0.7	94.1
Off-Road Mobile	Aircraft	1.7	0.5	94.6
Industrial	Plastics production	1.6	0.5	95.1
Industrial	Generation of electrical power from gas	1.3	0.4	95.6
Industrial	Petrochemical production	1.2	0.4	96.0
Off-Road Mobile	Commercial Boats	1.0	0.3	96.3
Industrial	Storage of Petroleum and/or Petroleum Products	0.7	0.2	96.5
Industrial	Solid waste landfilling	0.7	0.2	96.7
Commercial	Laundries and Dry-Cleaners	0.7	0.2	97.0
Industrial	Hazardous waste generation or storage	0.7	0.2	97.2
Industrial	Other Chemical Storage	0.5	0.2	97.4
Industrial	Composting and related reprocessing or treatment	0.5	0.2	97.5
All	Other	7.7	2.5	100.0

2.2 January Weekend Day

2.2.1 Emission Estimates

Table 2.5 and Figure B9 to Figure B12 in Appendix B (pages 51 to 52) show total estimated emissions and proportion of ozone precursors from each anthropogenic source group in the GMR and Sydney region for a typical January weekend day.

Table 2.5 Total estimated daily emissions of ozone precursors by anthropogenic source group in the GMR and Sydney region for a typical January weekend day

Substance	Anthropogenic Source Group					Anthropogenic Total
	Commercial	Domestic-Commercial	Industrial	Off-Road Mobile	On-Road Mobile	
2003 January Weekend Day Emissions (tonnes/day) - GMR						
OXIDES OF NITROGEN	6.6	3.8	473	59.6	197	740
TOTAL VOCS	22.7	181	40.6	47.7	125	418
Proportion of 2003 January Weekend Day Anthropogenic Emissions (%) - GMR						
OXIDES OF NITROGEN	0.9	0.5	64.0	8.1	26.6	100
TOTAL VOCS	5.4	43.4	9.7	11.4	30.0	100
2003 January Weekend Day Emissions (tonnes/day) - Sydney						
OXIDES OF NITROGEN	4.7	2.9	37.3	25.7	146	217
TOTAL VOCS	16.5	140	32.1	29.5	97.6	316
Proportion of 2003 January Weekend Day Anthropogenic Emissions (%) - Sydney						
OXIDES OF NITROGEN	2.2	1.3	17.2	11.8	67.5	100
TOTAL VOCS	5.2	44.4	10.1	9.4	30.9	100

Table 2.6 presents the priority ranking of source groups in the GMR and Sydney region based on 2003 January weekend day emission inventory estimates for ozone precursors. Priority ranking 1 indicates the source group has the highest emissions, while priority ranking 5 indicates the source group has the lowest emissions.

Table 2.6 January weekend day priority ranking of source groups in the GMR and Sydney region for ozone precursors – 2003

Source Group	NO _x		VOCs	
	GMR	Sydney	GMR	Sydney
Commercial	4	4	5	5
Domestic-Commercial	5	5	1	1
Industrial	1	2	4	3
Off-Road Mobile	3	3	3	4
On-Road Mobile	2	1	2	2

2.2.2 Ranked Emission Estimates

2.2.2.1 Oxides of Nitrogen

Table 2.7 and Figure B13 to Figure B14 in Appendix B (pages 53 to 54) show anthropogenic sources of oxides of nitrogen emissions ranked in descending order according to total estimated January weekend day emissions in the GMR and Sydney region. The individual and cumulative proportions of anthropogenic emissions are also shown for each source type.

Table 2.7 Ranking of anthropogenic sources of oxides of nitrogen for a typical January weekend day

Source Group	Source Type	Oxides of Nitrogen		
		January Weekend Day Emissions (tonnes/day)	Proportion of January Weekend Day Anthropogenic Emissions (%)	Cumulative Proportion (%)
GMR				
Industrial	Generation of electrical power from coal	394	53.2	53.2
On-Road Mobile	Exhaust Emissions Passenger Cars - Petrol	109	14.7	67.9
On-Road Mobile	Exhaust Emissions Heavy Duty Commercial - Diesel	56.1	7.6	75.5
Industrial	Primary iron and steel production	21.0	2.8	78.4
Off-Road Mobile	Commercial Ships	16.9	2.3	80.7
Industrial	Cement or lime production	16.5	2.2	82.9
On-Road Mobile	Exhaust Emissions Light Duty Commercial - Petrol	13.0	1.8	84.6
On-Road Mobile	Exhaust Emissions Light Duty - Diesel	11.7	1.6	86.2
Off-Road Mobile	Industrial Off-Road Vehicles and Equipment	11.3	1.5	87.8
Off-Road Mobile	Railways	11.3	1.5	89.3
Off-Road Mobile	Aircraft	8.5	1.2	90.4
Industrial	Petroleum refining	7.5	1.0	91.4
Industrial	Generation of electrical power from gas	7.2	1.0	92.4
On-Road Mobile	Exhaust Emissions - Other	7.0	1.0	93.4
Off-Road Mobile	Commercial Boats	6.5	0.9	94.2
Industrial	Production of container glass	4.3	0.6	94.8
Commercial	Hospitals (Except Psychiatric Hospitals)	3.6	0.5	95.3
Industrial	Coal mining	3.3	0.4	95.8
Industrial	Petrochemical production	3.2	0.4	96.2
Off-Road Mobile	Commercial Off-Road Vehicles and Equipment	2.9	0.4	96.6
Industrial	Production of ammonium nitrate	2.8	0.4	97.0
Industrial	Generation of electrical power from biogas	2.8	0.4	97.3
Industrial	Storage of Petroleum and/or Petroleum Products	2.3	0.3	97.7
Commercial	Unaccounted Gaseous Fuel Combustion	2.3	0.3	98.0
Industrial	Production of float glass	2.3	0.3	98.3
Off-Road Mobile	Recreational Boats	1.9	0.3	98.5
Domestic-Commercial	Gaseous Fuel Combustion	1.7	0.2	98.8
Industrial	Sewage Treatment - processing by large plants	1.6	0.2	99.0
Domestic-Commercial	Lawn Mowing & Garden Equipment (Domestic)	1.5	0.2	99.2
Industrial	Primary aluminium production	0.9	0.1	99.3
Industrial	Ceramics production (excluding glass)	0.6	0.1	99.4
Industrial	Crushing, grinding or separating works	0.6	0.1	99.5
Off-Road Mobile	Construction Off-Road Vehicles and Equipment	0.4	0.1	99.5
Industrial	Paper production using recycled materials	0.3	0.04	99.6
All	Other	3.2	0.4	100.0

Anthropogenic Ozone Precursors and Particle Emissions in the Greater Metropolitan and Sydney Regions
2. Ozone Precursors

Source Group	Source Type	Oxides of Nitrogen		
		January Weekend Day Emissions (tonnes/day)	Proportion of January Weekend Day Anthropogenic Emissions (%)	Cumulative Proportion (%)
Sydney				
On-Road Mobile	Exhaust Emissions Passenger Cars - Petrol	84.7	39.0	39.0
On-Road Mobile	Exhaust Emissions Heavy Duty Commercial - Diesel	37.5	17.3	56.3
On-Road Mobile	Exhaust Emissions Light Duty Commercial - Petrol	10.1	4.6	61.0
On-Road Mobile	Exhaust Emissions Light Duty - Diesel	9.4	4.3	65.3
Off-Road Mobile	Aircraft	8.4	3.9	69.2
Industrial	Petroleum refining	7.5	3.5	72.6
Industrial	Generation of electrical power from gas	7.2	3.3	75.9
Off-Road Mobile	Railways	5.4	2.5	78.4
On-Road Mobile	Exhaust Emissions - Other	4.7	2.2	80.6
Off-Road Mobile	Commercial Ships	4.4	2.0	82.6
Industrial	Production of container glass	4.3	2.0	84.6
Industrial	Cement or lime production	3.6	1.7	86.3
Industrial	Petrochemical production	3.2	1.5	87.8
Industrial	Generation of electrical power from biogas	2.8	1.3	89.1
Off-Road Mobile	Industrial Off-Road Vehicles and Equipment	2.5	1.2	90.2
Industrial	Storage of Petroleum and/or Petroleum Products	2.3	1.1	91.3
Industrial	Production of float glass	2.3	1.0	92.3
Off-Road Mobile	Commercial Boats	2.2	1.0	93.3
Commercial	Hospitals (Except Psychiatric Hospitals)	2.2	1.0	94.4
Commercial	Unaccounted Gaseous Fuel Combustion	1.8	0.8	95.2
Industrial	Sewage Treatment - processing by large plants	1.6	0.7	96.0
Domestic-Commercial	Gaseous Fuel Combustion	1.4	0.6	96.6
Off-Road Mobile	Commercial Off-Road Vehicles and Equipment	1.2	0.6	97.2
Off-Road Mobile	Recreational Boats	1.2	0.5	97.7
Domestic-Commercial	Lawn Mowing & Garden Equipment (Domestic)	1.1	0.5	98.2
Industrial	Crushing, grinding or separating works	0.6	0.3	98.5
Industrial	Ceramics production (excluding glass)	0.4	0.2	98.7
Industrial	Paper production using recycled materials	0.3	0.1	98.8
Off-Road Mobile	Construction Off-Road Vehicles and Equipment	0.3	0.1	99.0
Commercial	Port Operators	0.3	0.1	99.1
Domestic-Commercial	Barbecues	0.2	0.1	99.2
Domestic-Commercial	Solid Fuel Combustion	0.2	0.1	99.3
Industrial	Secondary aluminium production	0.2	0.1	99.4
Commercial	Glass and Glass Product Manufacturing	0.1	0.1	99.4
All	Other	1.2	0.6	100.0

2.2.2.2 Total VOCs

Table 2.8 and Figure B15 to Figure B16 in Appendix B (pages 55 to 56) show anthropogenic sources of total VOCs emissions ranked in descending order according to total estimated January weekend day emissions in the GMR and Sydney region. The individual and cumulative proportions of anthropogenic emissions are also shown for each source type.

Table 2.8 Ranking of anthropogenic sources of total VOCs for a typical January weekend day

Source Group	Source Type	Total VOCs		
		January Weekend Day Emissions (tonnes/day)	Proportion of January Weekend Day Anthropogenic Emissions (%)	Cumulative Proportion (%)
GMR				
Domestic-Commercial	Aerosols and Solvents	71.8	17.2	17.2
On-Road Mobile	Exhaust Emissions Passenger Cars - Petrol	61.5	14.7	31.9
Domestic-Commercial	Surface Coating	46.3	11.1	43.0
Domestic-Commercial	Lawn Mowing & Garden Equipment (Domestic)	46.2	11.1	54.1
Off-Road Mobile	Recreational Boats	39.3	9.4	63.5
On-Road Mobile	Evaporative Emissions - Petrol	33.2	8.0	71.5
On-Road Mobile	Exhaust Emissions Light Duty Commercial - Petrol	11.0	2.6	74.1
On-Road Mobile	Exhaust Emissions - Other	10.9	2.6	76.7
Commercial	Automotive Fuel Retailing	9.5	2.3	79.0
Industrial	Petroleum refining	8.8	2.1	81.1
Commercial	Smash Repairing	8.5	2.0	83.1
On-Road Mobile	Exhaust Emissions Heavy Duty Commercial - Diesel	6.7	1.6	84.7
Domestic-Commercial	Cutback Bitumen	6.5	1.6	86.3
Industrial	Metal plating or coating works	6.5	1.6	87.8
Domestic-Commercial	Solid Fuel Combustion	5.5	1.3	89.2
Domestic-Commercial	Natural Gas Leakage	4.5	1.1	90.2
Industrial	Printing	4.4	1.1	91.3
Off-Road Mobile	Commercial Boats	2.7	0.7	92.0
Industrial	Other metal processing	2.5	0.6	92.6
On-Road Mobile	Exhaust Emissions Light Duty - Diesel	2.1	0.5	93.1
Industrial	Generation of electrical power from coal	1.9	0.5	93.5
Commercial	Printing	1.8	0.4	94.0
Off-Road Mobile	Aircraft	1.7	0.4	94.4
Industrial	Primary iron and steel production	1.6	0.4	94.7
Industrial	Other Chemical Storage	1.4	0.3	95.1
Industrial	Generation of electrical power from gas	1.3	0.3	95.4
Off-Road Mobile	Loading and Unloading Fuels	1.3	0.3	95.7
Industrial	Solid waste landfilling	1.3	0.3	96.0
Industrial	Petrochemical production	1.2	0.3	96.3
Industrial	Storage of Petroleum and/or Petroleum Products	1.2	0.3	96.6
Off-Road Mobile	Industrial Off-Road Vehicles and Equipment	1.0	0.2	96.8
Industrial	Other chemical processing	0.9	0.2	97.0
Industrial	Plastics production	0.9	0.2	97.2
Industrial	Production of ammonium nitrate	0.7	0.2	97.4
All	Other	10.9	2.6	100

Anthropogenic Ozone Precursors and Particle Emissions in the Greater Metropolitan and Sydney Regions
 2. Ozone Precursors

Source Group	Source Type	Total VOCs		
		January Weekend Day Emissions (tonnes/day)	Proportion of January Weekend Day Anthropogenic Emissions (%)	Cumulative Proportion (%)
Sydney				
Domestic-Commercial	Aerosols and Solvents	56.5	17.9	17.9
On-Road Mobile	Exhaust Emissions Passenger Cars - Petrol	48.5	15.4	33.3
Domestic-Commercial	Surface Coating	35.9	11.4	44.6
Domestic-Commercial	Lawn Mowing & Garden Equipment (Domestic)	34.7	11.0	55.6
On-Road Mobile	Evaporative Emissions - Petrol	26.2	8.3	63.9
Off-Road Mobile	Recreational Boats	24.8	7.9	71.8
Industrial	Petroleum refining	8.8	2.8	74.6
On-Road Mobile	Exhaust Emissions Light Duty Commercial - Petrol	8.6	2.7	77.3
On-Road Mobile	Exhaust Emissions - Other	7.7	2.4	79.7
Commercial	Smash Repairing	6.7	2.1	81.8
Industrial	Metal plating or coating works	6.1	1.9	83.8
Commercial	Automotive Fuel Retailing	6.1	1.9	85.7
Domestic-Commercial	Cutback Bitumen	5.0	1.6	87.3
On-Road Mobile	Exhaust Emissions Heavy Duty Commercial - Diesel	4.8	1.5	88.8
Industrial	Printing	4.3	1.4	90.2
Domestic-Commercial	Solid Fuel Combustion	4.2	1.3	91.5
Domestic-Commercial	Natural Gas Leakage	3.6	1.1	92.6
Industrial	Other metal processing	2.5	0.8	93.4
On-Road Mobile	Exhaust Emissions Light Duty - Diesel	1.8	0.6	94.0
Off-Road Mobile	Aircraft	1.6	0.5	94.5
Commercial	Printing	1.6	0.5	95.0
Industrial	Generation of electrical power from gas	1.3	0.4	95.4
Off-Road Mobile	Loading and Unloading Fuels	1.3	0.4	95.8
Industrial	Petrochemical production	1.2	0.4	96.2
Off-Road Mobile	Commercial Boats	0.9	0.3	96.5
Industrial	Plastics production	0.9	0.3	96.8
Industrial	Other chemical processing	0.8	0.2	97.0
Industrial	Storage of Petroleum and/or Petroleum Products	0.7	0.2	97.2
Industrial	Solid waste landfilling	0.7	0.2	97.5
Industrial	Other Chemical Storage	0.5	0.2	97.6
Industrial	Composting and related reprocessing or treatment	0.5	0.1	97.8
Industrial	Concrete batching	0.4	0.1	97.9
Industrial	Hazardous waste generation or storage	0.4	0.1	98.0
Commercial	Chemical Product Manufacturing n.e.c.	0.4	0.1	98.1
All	Other	6.0	1.9	100.0

3 PARTICLES

This section presents estimated daily emissions of particles (i.e. particulate matter < 10 µm and particulate matter < 2.5 µm) from commercial, domestic-commercial, industrial, off-road mobile and on-road mobile sources in the GMR and Sydney region for the 2003 calendar year.

Emission estimates for a typical July weekday and weekend day are presented for each source group and source type together with the proportion of total estimated anthropogenic emissions. The anthropogenic sources of particulate matter < 10 µm and particulate matter < 2.5 µm are also ranked according to total estimated July weekday and July weekend day emissions in the GMR and Sydney region.

Particle emissions have been presented for a typical July weekday and July weekend day, since these represent the highest anthropogenic emissions that would likely occur during times conducive to elevated ambient concentrations of particles.

3.1 July Weekday

3.1.1 Emission Estimates

Table 3.1 and Figure C1 to Figure C4 in Appendix C (pages 57 to 58) show total estimated emissions and proportion of particles from each anthropogenic source group in the GMR and Sydney region for a typical July weekday.

Table 3.1 Total estimated daily emissions of particles by anthropogenic source group in the GMR and Sydney region for a typical July weekday

Substance	Anthropogenic Source Group					Anthropogenic Total
	Commercial	Domestic-Commercial	Industrial	Off-Road Mobile	On-Road Mobile	
2003 July Weekday Emissions (tonnes/day) - GMR						
PARTICULATE MATTER < 10 µm	11.3	46.7	129	41.8	9.9	238
PARTICULATE MATTER < 2.5 µm	3.6	45.3	36.1	18.2	9.5	113
Proportion of 2003 July Weekday Anthropogenic Emissions (%) - GMR						
PARTICULATE MATTER < 10 µm	4.7	19.6	54.0	17.5	4.2	100
PARTICULATE MATTER < 2.5 µm	3.2	40.2	32.0	16.2	8.4	100
2003 July Weekday Emissions (tonnes/day) - Sydney						
PARTICULATE MATTER < 10 µm	6.0	35.1	22.0	10.3	7.6	81.0
PARTICULATE MATTER < 2.5 µm	2.1	34.0	9.4	4.7	7.2	57.4
Proportion of 2003 July Weekday Anthropogenic Emissions (%) - Sydney						
PARTICULATE MATTER < 10 µm	7.4	43.4	27.1	12.7	9.4	100
PARTICULATE MATTER < 2.5 µm	3.6	59.3	16.3	8.2	12.5	100

Table 3.2 presents the priority ranking of source groups in the GMR and Sydney region based on 2003 July weekday emission inventory estimates for particles. Priority ranking 1 indicates the source group has the highest emissions, while priority ranking 5 indicates the source group has the lowest emissions.

Table 3.2 July weekday priority ranking of source groups in the GMR and Sydney region for particles – 2003

Source Group	PM ₁₀		PM _{2.5}	
	GMR	Sydney	GMR	Sydney
Commercial	4	5	5	5
Domestic-Commercial	2	1	1	1
Industrial	1	2	2	2
Off-Road Mobile	3	3	3	4
On-Road Mobile	5	4	4	3

3.1.2 Ranked Emission Estimates

3.1.2.1 Particulate Matter < 10 µm

Table 3.3 and Figure C5 to Figure C6 in Appendix C (pages 59 to 60) show anthropogenic sources of particulate matter < 10 µm emissions ranked in descending order according to total estimated July weekday emissions in the GMR and Sydney region. The individual and cumulative proportions of anthropogenic emissions are also shown for each source type.

Table 3.3 Ranking of anthropogenic sources of particulate matter < 10 µm for a typical July weekday

Source Group	Source Type	Particulate Matter < 10 µm		
		July Weekday Emissions (tonnes/day)	Proportion of July Weekday Anthropogenic Emissions (%)	Cumulative Proportion (%)
GMR				
Industrial	Coal mining	69.9	29.3	29.3
Domestic-Commercial	Solid Fuel Combustion	45.9	19.2	48.6
Off-Road Mobile	Industrial Off-Road Vehicles and Equipment	37.1	15.6	64.1
Industrial	Generation of electrical power from coal	13.1	5.5	69.6
Industrial	Other land-based extraction	9.6	4.0	73.6
Industrial	Crushing, grinding or separating works	6.9	2.9	76.5
Commercial	Poultry Farming (Meat)	4.9	2.1	78.6
Industrial	Hard-rock gravel quarrying	4.8	2.0	80.6
Industrial	Primary iron and steel production	4.4	1.8	82.5
Commercial	Gravel and Sand Quarrying	3.7	1.5	84.0
On-Road Mobile	Exhaust Emissions Light Duty - Diesel	3.3	1.4	85.4
On-Road Mobile	Exhaust Emissions Passenger Cars - Petrol	3.1	1.3	86.7
On-Road Mobile	Exhaust Emissions Heavy Duty Commercial - Diesel	3.1	1.3	88.0
Off-Road Mobile	Commercial Off-Road Vehicles and Equipment	3.0	1.3	89.3
Industrial	Ceramics production (excluding glass)	3.0	1.3	90.5
Industrial	Solid waste landfilling	2.5	1.0	91.6
Industrial	Concrete batching	2.0	0.8	92.4
Commercial	Poultry Farming (Eggs)	1.6	0.7	93.1
Industrial	Poultry production	1.2	0.5	93.6
Industrial	Primary aluminium production	1.2	0.5	94.1
Industrial	Mining (other than coal)	1.0	0.4	94.5
Industrial	Coal loading	0.8	0.3	94.8
Industrial	Cement or lime production	0.7	0.3	95.1
Industrial	Petroleum refining	0.7	0.3	95.4
Industrial	Cement or lime handling	0.6	0.2	95.7
Industrial	Bitumen pre-mix or hotmix production	0.6	0.2	95.9
Industrial	Production of ammonium nitrate	0.6	0.2	96.2
Industrial	Plastics production	0.6	0.2	96.4
Off-Road Mobile	Commercial Ships	0.5	0.2	96.6
Off-Road Mobile	Commercial Boats	0.5	0.2	96.8
Industrial	Inert waste landfilling	0.4	0.2	97.0
Domestic-Commercial	Lawn Mowing & Garden Equipment (POS)	0.4	0.2	97.2
Industrial	Production of float glass	0.3	0.1	97.3
Commercial	Unaccounted Gaseous Fuel Combustion	0.3	0.1	97.4
All	Other	6.2	2.6	100

Source Group	Source Type	Particulate Matter < 10 µm		
		July Weekday Emissions (tonnes/day)	Proportion of July Weekday Anthropogenic Emissions (%)	Cumulative Proportion (%)
Sydney				
Domestic-Commercial	Solid Fuel Combustion	34.5	42.6	42.6
Off-Road Mobile	Industrial Off-Road Vehicles and Equipment	8.2	10.2	52.8
Industrial	Crushing, grinding or separating works	5.7	7.0	59.8
Industrial	Other land-based extraction	4.9	6.0	65.8
On-Road Mobile	Exhaust Emissions Passenger Cars - Petrol	2.6	3.2	69.0
On-Road Mobile	Exhaust Emissions Light Duty - Diesel	2.6	3.2	72.1
Industrial	Ceramics production (excluding glass)	2.3	2.8	75.0
Commercial	Poultry Farming (Meat)	2.2	2.8	77.7
On-Road Mobile	Exhaust Emissions Heavy Duty Commercial - Diesel	2.1	2.6	80.3
Commercial	Gravel and Sand Quarrying	1.7	2.0	82.3
Industrial	Concrete batching	1.6	2.0	84.3
Commercial	Poultry Farming (Eggs)	1.4	1.8	86.1
Off-Road Mobile	Commercial Off-Road Vehicles and Equipment	1.3	1.6	87.7
Industrial	Solid waste landfilling	1.3	1.6	89.3
Industrial	Poultry production	1.0	1.3	90.6
Industrial	Petroleum refining	0.7	0.9	91.5
Industrial	Plastics production	0.6	0.7	92.2
Industrial	Hard-rock gravel quarrying	0.4	0.5	92.6
Industrial	Production of float glass	0.3	0.4	93.0
Domestic-Commercial	Lawn Mowing & Garden Equipment (POS)	0.3	0.3	93.3
Off-Road Mobile	Aircraft	0.2	0.3	93.6
Industrial	Production of container glass	0.2	0.3	93.9
Commercial	Unaccounted Gaseous Fuel Combustion	0.2	0.3	94.2
On-Road Mobile	Exhaust Emissions - Other	0.2	0.2	94.4
Industrial	Cement or lime production	0.2	0.2	94.6
Industrial	Bitumen pre-mix or hotmix production	0.2	0.2	94.9
Industrial	Storage of Petroleum and/or Petroleum Products	0.2	0.2	95.1
Industrial	Sewage Treatment - processing by small plants	0.2	0.2	95.3
Domestic-Commercial	Lawn Mowing & Garden Equipment (Domestic)	0.2	0.2	95.5
Industrial	Composting and related reprocessing or treatment	0.2	0.2	95.8
Industrial	Inert waste landfilling	0.2	0.2	96.0
Commercial	Hospitals (Except Psychiatric Hospitals)	0.2	0.2	96.2
Domestic-Commercial	Gaseous Fuel Combustion	0.2	0.2	96.4
Industrial	Scrap metal recovery	0.2	0.2	96.6
All	Other	2.8	3.4	100.0

3.1.2.2 Particulate Matter < 2.5 µm

Table 3.4 and Figure C7 to Figure C8 in Appendix C (pages 61 to 62) show anthropogenic sources of particulate matter < 2.5 µm emissions ranked in descending order according to total estimated July weekday emissions in the GMR and Sydney region. The individual and cumulative proportions of anthropogenic emissions are also shown for each source type.

Table 3.4 Ranking of anthropogenic sources of particulate matter < 2.5 µm for a typical July weekday

Source Group	Source Type	Particulate Matter < 2.5 µm		
		July Weekday Emissions (tonnes/day)	Proportion of July Weekday Anthropogenic Emissions (%)	Cumulative Proportion (%)
GMR				
Domestic-Commercial	Solid Fuel Combustion	44.5	39.5	39.5
Off-Road Mobile	Industrial Off-Road Vehicles and Equipment	15.3	13.6	53.1
Industrial	Coal mining	11.4	10.2	63.2
Industrial	Generation of electrical power from coal	4.6	4.1	67.3
Industrial	Primary iron and steel production	3.9	3.4	70.8
On-Road Mobile	Exhaust Emissions Light Duty - Diesel	3.2	2.8	73.6
On-Road Mobile	Exhaust Emissions Heavy Duty Commercial - Diesel	3.0	2.6	76.2
On-Road Mobile	Exhaust Emissions Passenger Cars - Petrol	2.9	2.6	78.8
Industrial	Crushing, grinding or separating works	2.4	2.2	81.0
Industrial	Other land-based extraction	2.2	2.0	82.9
Industrial	Ceramics production (excluding glass)	2.2	1.9	84.9
Commercial	Poultry Farming (Meat)	1.4	1.3	86.1
Off-Road Mobile	Commercial Off-Road Vehicles and Equipment	1.4	1.2	87.4
Industrial	Hard-rock gravel quarrying	1.3	1.1	88.5
Commercial	Gravel and Sand Quarrying	0.9	0.8	89.3
Industrial	Primary aluminium production	0.8	0.7	90.0
Industrial	Petroleum refining	0.6	0.6	90.6
Industrial	Production of ammonium nitrate	0.6	0.5	91.1
Industrial	Plastics production	0.5	0.5	91.6
Off-Road Mobile	Commercial Ships	0.5	0.5	92.0
Industrial	Solid waste landfilling	0.5	0.5	92.5
Industrial	Cement or lime production	0.5	0.4	92.9
Commercial	Poultry Farming (Eggs)	0.5	0.4	93.3
Industrial	Concrete batching	0.5	0.4	93.7
Off-Road Mobile	Commercial Boats	0.4	0.4	94.1
Industrial	Bitumen pre-mix or hotmix production	0.4	0.4	94.4
Domestic-Commercial	Lawn Mowing & Garden Equipment (POS)	0.3	0.3	94.7
Industrial	Poultry production	0.3	0.3	95.0
Industrial	Production of float glass	0.3	0.3	95.3
Commercial	Unaccounted Gaseous Fuel Combustion	0.3	0.2	95.5
Commercial	Hospitals (Except Psychiatric Hospitals)	0.3	0.2	95.8
On-Road Mobile	Exhaust Emissions - Other	0.3	0.2	96.0
Off-Road Mobile	Aircraft	0.2	0.2	96.2
Industrial	Production of container glass	0.2	0.2	96.4
All	Other	4.0	3.6	100

Source Group	Source Type	Particulate Matter < 2.5 µm		
		July Weekday Emissions (tonnes/day)	Proportion of July Weekday Anthropogenic Emissions (%)	Cumulative Proportion (%)
Sydney				
Domestic-Commercial	Solid Fuel Combustion	33.5	58.3	58.3
Off-Road Mobile	Industrial Off-Road Vehicles and Equipment	3.4	5.9	64.2
On-Road Mobile	Exhaust Emissions Light Duty - Diesel	2.5	4.3	68.6
On-Road Mobile	Exhaust Emissions Passenger Cars - Petrol	2.4	4.1	72.7
Industrial	Crushing, grinding or separating works	2.1	3.7	76.4
On-Road Mobile	Exhaust Emissions Heavy Duty Commercial - Diesel	2.0	3.5	79.9
Industrial	Ceramics production (excluding glass)	1.7	2.9	82.8
Industrial	Other land-based extraction	1.2	2.0	84.9
Commercial	Poultry Farming (Meat)	0.6	1.1	86.0
Industrial	Petroleum refining	0.6	1.1	87.1
Off-Road Mobile	Commercial Off-Road Vehicles and Equipment	0.6	1.0	88.1
Industrial	Plastics production	0.5	0.9	89.1
Commercial	Gravel and Sand Quarrying	0.4	0.7	89.8
Commercial	Poultry Farming (Eggs)	0.4	0.7	90.5
Industrial	Concrete batching	0.4	0.7	91.2
Industrial	Production of float glass	0.3	0.5	91.7
Industrial	Poultry production	0.3	0.5	92.2
Industrial	Solid waste landfilling	0.3	0.5	92.7
Domestic-Commercial	Lawn Mowing & Garden Equipment (POS)	0.2	0.4	93.1
Industrial	Production of container glass	0.2	0.4	93.5
Commercial	Unaccounted Gaseous Fuel Combustion	0.2	0.4	93.9
Off-Road Mobile	Aircraft	0.2	0.4	94.2
On-Road Mobile	Exhaust Emissions - Other	0.2	0.3	94.6
Industrial	Storage of Petroleum and/or Petroleum Products	0.2	0.3	94.9
Commercial	Hospitals (Except Psychiatric Hospitals)	0.2	0.3	95.2
Domestic-Commercial	Gaseous Fuel Combustion	0.2	0.3	95.5
Domestic-Commercial	Lawn Mowing & Garden Equipment (Domestic)	0.2	0.3	95.7
Off-Road Mobile	Commercial Boats	0.1	0.3	96.0
On-Road Mobile	Exhaust Emissions Light Duty Commercial - Petrol	0.1	0.2	96.2
Off-Road Mobile	Commercial Ships	0.1	0.2	96.5
Industrial	Cement or lime production	0.1	0.2	96.7
Industrial	Generation of electrical power from gas	0.1	0.2	96.9
Industrial	Scrap metal recovery	0.1	0.2	97.1
Industrial	Petrochemical production	0.1	0.2	97.3
All	Other	1.5	2.7	100

3.2 July Weekend Day

3.2.1 Emission Estimates

Table 3.5 and Figure C9 to Figure C12 in Appendix C (pages 63 to 64) show total estimated emissions and proportion of particles from each anthropogenic source group in the GMR and Sydney region for a typical July weekend day.

Table 3.5 Total estimated daily emissions by anthropogenic source group in each region for a typical July weekend day

Substance	Anthropogenic Source Group					Anthropogenic Total
	Commercial	Domestic-Commercial	Industrial	Off-Road Mobile	On-Road Mobile	
2003 July Weekend Day Emissions (tonnes/day) - GMR						
PARTICULATE MATTER < 10 µm	10.0	77.1	118	34.2	8.7	248
PARTICULATE MATTER < 2.5 µm	3.1	74.7	33.5	15.5	8.3	135
Proportion of 2003 July Weekend Day Anthropogenic Emissions (%) - GMR						
PARTICULATE MATTER < 10 µm	4.0	31.1	47.6	13.8	3.5	100
PARTICULATE MATTER < 2.5 µm	2.3	55.3	24.8	11.5	6.1	100
2003 July Weekend Day Emissions (tonnes/day) - Sydney						
PARTICULATE MATTER < 10 µm	5.3	58.0	19.3	9.0	6.6	98.3
PARTICULATE MATTER < 2.5 µm	1.8	56.2	8.4	4.4	6.3	77.1
Proportion of 2003 July Weekend Day Anthropogenic Emissions (%) - Sydney						
PARTICULATE MATTER < 10 µm	5.4	59.0	19.6	9.2	6.7	100
PARTICULATE MATTER < 2.5 µm	2.3	72.9	10.9	5.7	8.2	100

Table 3.6 presents the priority ranking of source groups in the GMR and Sydney region based on 2003 July weekend day emission inventory estimates for particles. Priority ranking 1 indicates the source group has the highest emissions, while priority ranking 5 indicates the source group has the lowest emissions.

Table 3.6 July weekend day priority ranking of source groups in the GMR and Sydney region for particles – 2003

Source Group	PM ₁₀		PM _{2.5}	
	GMR	Sydney	GMR	Sydney
Commercial	4	5	5	5
Domestic-Commercial	2	1	1	1
Industrial	1	2	2	2
Off-Road Mobile	3	3	3	4
On-Road Mobile	5	4	4	3

3.2.2 Ranked Emission Estimates

3.2.2.1 Particulate Matter < 10 µm

Table 3.7 and Figure C13 to Figure C14 in Appendix C (pages 65 to 66) show anthropogenic sources of particulate matter < 10 µm emissions ranked in descending order according to total estimated July weekend day emissions in the GMR and Sydney region. The individual and cumulative proportions of anthropogenic emissions are also shown for each source type.

Table 3.7 Ranking of anthropogenic sources of particulate matter < 10 µm for a typical July weekend day

Source Group	Source Type	Particulate Matter < 10 µm		
		July Weekend Day Emissions (tonnes/day)	Proportion of July Weekend Day Anthropogenic Emissions (%)	Cumulative Proportion (%)
GMR				
Domestic-Commercial	Solid Fuel Combustion	75.8	30.6	30.6
Industrial	Coal mining	64.1	25.8	56.4
Off-Road Mobile	Industrial Off-Road Vehicles and Equipment	28.3	11.4	67.8
Industrial	Generation of electrical power from coal	13.1	5.3	73.0
Industrial	Other land-based extraction	8.6	3.5	76.5
Industrial	Crushing, grinding or separating works	5.8	2.4	78.9
Commercial	Poultry Farming (Meat)	4.9	2.0	80.9
Industrial	Primary iron and steel production	4.3	1.8	82.6
Industrial	Hard-rock gravel quarrying	4.1	1.6	84.3
Off-Road Mobile	Commercial Off-Road Vehicles and Equipment	3.4	1.4	85.6
Industrial	Ceramics production (excluding glass)	3.0	1.2	86.9
On-Road Mobile	Exhaust Emissions Light Duty - Diesel	2.9	1.2	88.0
On-Road Mobile	Exhaust Emissions Passenger Cars - Petrol	2.7	1.1	89.1
On-Road Mobile	Exhaust Emissions Heavy Duty Commercial - Diesel	2.7	1.1	90.2
Commercial	Gravel and Sand Quarrying	2.6	1.1	91.3
Industrial	Solid waste landfilling	2.5	1.0	92.3
Commercial	Poultry Farming (Eggs)	1.6	0.6	92.9
Industrial	Poultry production	1.2	0.5	93.4
Industrial	Primary aluminium production	1.2	0.5	93.8
Industrial	Concrete batching	1.1	0.5	94.3
Domestic-Commercial	Lawn Mowing & Garden Equipment (Domestic)	1.1	0.4	94.7
Industrial	Mining (other than coal)	1.0	0.4	95.1
Off-Road Mobile	Recreational Boats	0.8	0.3	95.5
Industrial	Coal loading	0.8	0.3	95.8
Industrial	Cement or lime production	0.7	0.3	96.1
Industrial	Petroleum refining	0.7	0.3	96.4
Off-Road Mobile	Commercial Ships	0.6	0.2	96.6
Industrial	Production of ammonium nitrate	0.6	0.2	96.9
Industrial	Plastics production	0.5	0.2	97.1
Industrial	Cement or lime handling	0.4	0.2	97.3
Industrial	Bitumen pre-mix or hotmix production	0.4	0.2	97.4
Off-Road Mobile	Commercial Boats	0.4	0.2	97.6
Industrial	Inert waste landfilling	0.4	0.2	97.8
Off-Road Mobile	Railways	0.3	0.1	97.9
All	Other	5.2	2.1	100.0

Source Group	Source Type	Particulate Matter < 10 µm		
		July Weekend Day Emissions (tonnes/day)	Proportion of July Weekend Day Anthropogenic Emissions (%)	Cumulative Proportion (%)
Sydney				
Domestic-Commercial	Solid Fuel Combustion	57.0	58.0	58.0
Off-Road Mobile	Industrial Off-Road Vehicles and Equipment	6.3	6.4	64.4
Industrial	Crushing, grinding or separating works	4.8	4.9	69.3
Industrial	Other land-based extraction	4.4	4.5	73.8
Industrial	Ceramics production (excluding glass)	2.3	2.3	76.1
On-Road Mobile	Exhaust Emissions Passenger Cars - Petrol	2.3	2.3	78.4
On-Road Mobile	Exhaust Emissions Light Duty - Diesel	2.2	2.3	80.7
Commercial	Poultry Farming (Meat)	2.2	2.3	83.0
On-Road Mobile	Exhaust Emissions Heavy Duty Commercial - Diesel	1.8	1.9	84.8
Off-Road Mobile	Commercial Off-Road Vehicles and Equipment	1.5	1.5	86.3
Commercial	Poultry Farming (Eggs)	1.4	1.5	87.8
Industrial	Solid waste landfilling	1.3	1.3	89.1
Commercial	Gravel and Sand Quarrying	1.1	1.1	90.3
Industrial	Poultry production	1.0	1.0	91.3
Industrial	Concrete batching	0.9	0.9	92.2
Domestic-Commercial	Lawn Mowing & Garden Equipment (Domestic)	0.8	0.8	93.1
Industrial	Petroleum refining	0.7	0.7	93.8
Industrial	Plastics production	0.5	0.6	94.3
Off-Road Mobile	Recreational Boats	0.5	0.5	94.9
Industrial	Production of float glass	0.3	0.3	95.2
Industrial	Hard-rock gravel quarrying	0.3	0.3	95.5
Industrial	Production of container glass	0.2	0.2	95.7
Off-Road Mobile	Aircraft	0.2	0.2	95.9
Commercial	Unaccounted Fuel Combustion	0.2	0.2	96.2
Industrial	Cement or lime production	0.2	0.2	96.3
Industrial	Storage of Petroleum and/or Petroleum Products	0.2	0.2	96.5
Industrial	Sewage Treatment - processing by small plants	0.2	0.2	96.7
On-Road Mobile	Exhaust Emissions - Other	0.2	0.2	96.9
Industrial	Composting and related reprocessing or treatment	0.2	0.2	97.1
Commercial	Hospitals (Except Psychiatric Hospitals)	0.2	0.2	97.2
Domestic-Commercial	Gaseous Fuel Combustion	0.2	0.2	97.4
Off-Road Mobile	Railways	0.2	0.2	97.6
Industrial	Coal mining	0.2	0.2	97.7
Industrial	Inert waste landfilling	0.2	0.2	97.9
All	Other	2.1	2.1	100.0

3.2.2.2 Particulate Matter < 2.5 µm

Table 3.8 and Figure C15 to Figure C16 in Appendix C (pages 67 to 68) show anthropogenic sources of particulate matter < 2.5 µm emissions ranked in descending order according to total estimated July weekend day emissions in the GMR and Sydney region. The individual and cumulative proportions of anthropogenic emissions are also shown for each source type.

Table 3.8 Ranking of anthropogenic sources of particulate matter < 2.5 µm for a typical July weekend day

Source Group	Source Type	Particulate Matter < 2.5 µm		
		July Weekend Day Emissions (tonnes/day)	Proportion of July Weekend Day Anthropogenic Emissions (%)	Cumulative Proportion (%)
GMR				
Domestic-Commercial	Solid Fuel Combustion	73.5	54.4	54.4
Off-Road Mobile	Industrial Off-Road Vehicles and Equipment	11.7	8.6	63.0
Industrial	Coal mining	10.6	7.9	70.9
Industrial	Generation of electrical power from coal	4.6	3.4	74.3
Industrial	Primary iron and steel production	3.9	2.9	77.2
On-Road Mobile	Exhaust Emissions Light Duty - Diesel	2.8	2.1	79.2
On-Road Mobile	Exhaust Emissions Heavy Duty Commercial - Diesel	2.6	1.9	81.1
On-Road Mobile	Exhaust Emissions Passenger Cars - Petrol	2.5	1.9	83.0
Industrial	Ceramics production (excluding glass)	2.2	1.6	84.6
Industrial	Crushing, grinding or separating works	2.1	1.6	86.2
Industrial	Other land-based extraction	1.9	1.4	87.6
Off-Road Mobile	Commercial Off-Road Vehicles and Equipment	1.6	1.1	88.8
Commercial	Poultry Farming (Meat)	1.4	1.0	89.8
Industrial	Hard-rock gravel quarrying	1.0	0.8	90.6
Domestic-Commercial	Lawn Mowing & Garden Equipment (Domestic)	1.0	0.7	91.3
Industrial	Primary aluminium production	0.8	0.6	91.9
Off-Road Mobile	Recreational Boats	0.8	0.6	92.5
Industrial	Petroleum refining	0.6	0.5	93.0
Industrial	Production of ammonium nitrate	0.6	0.4	93.4
Off-Road Mobile	Commercial Ships	0.6	0.4	93.8
Industrial	Plastics production	0.5	0.4	94.2
Commercial	Gravel and Sand Quarrying	0.5	0.4	94.6
Industrial	Solid waste landfilling	0.5	0.4	95.0
Industrial	Cement or lime production	0.5	0.3	95.3
Commercial	Poultry Farming (Eggs)	0.5	0.3	95.6
Off-Road Mobile	Commercial Boats	0.4	0.3	95.9
Industrial	Bitumen pre-mix or hotmix production	0.4	0.3	96.2
Industrial	Poultry production	0.3	0.2	96.4
Off-Road Mobile	Railways	0.3	0.2	96.7
Industrial	Production of float glass	0.3	0.2	96.9
Commercial	Unaccounted Fuel Combustion	0.3	0.2	97.1
Commercial	Hospitals (Except Psychiatric Hospitals)	0.3	0.2	97.3
Industrial	Concrete batching	0.2	0.2	97.5
Industrial	Production of container glass	0.2	0.2	97.6
All	Other	3.2	2.4	100

Source Group	Source Type	Particulate Matter < 2.5 µm		
		July Weekend Day Emissions (tonnes/day)	Proportion of July Weekend Day Anthropogenic Emissions (%)	Cumulative Proportion (%)
Sydney				
Domestic-Commercial	Solid Fuel Combustion	55.3	71.7	71.7
Off-Road Mobile	Industrial Off-Road Vehicles and Equipment	2.6	3.4	75.1
On-Road Mobile	Exhaust Emissions Light Duty - Diesel	2.2	2.8	77.9
On-Road Mobile	Exhaust Emissions Passenger Cars - Petrol	2.1	2.7	80.6
Industrial	Crushing, grinding or separating works	1.9	2.5	83.0
On-Road Mobile	Exhaust Emissions Heavy Duty Commercial - Diesel	1.8	2.3	85.3
Industrial	Ceramics production (excluding glass)	1.7	2.2	87.5
Industrial	Other land-based extraction	1.0	1.3	88.8
Domestic-Commercial	Lawn Mowing & Garden Equipment (Domestic)	0.7	1.0	89.8
Off-Road Mobile	Commercial Off-Road Vehicles and Equipment	0.7	0.9	90.6
Commercial	Poultry Farming (Meat)	0.6	0.8	91.5
Industrial	Petroleum refining	0.6	0.8	92.3
Industrial	Plastics production	0.5	0.7	93.0
Off-Road Mobile	Recreational Boats	0.5	0.6	93.6
Commercial	Poultry Farming (Eggs)	0.4	0.5	94.2
Industrial	Production of float glass	0.3	0.4	94.5
Industrial	Poultry production	0.3	0.4	94.9
Industrial	Solid waste landfilling	0.3	0.3	95.2
Commercial	Gravel and Sand Quarrying	0.2	0.3	95.6
Industrial	Production of container glass	0.2	0.3	95.9
Commercial	Unaccounted Fuel Combustion	0.2	0.3	96.1
Off-Road Mobile	Aircraft	0.2	0.3	96.4
Industrial	Concrete batching	0.2	0.3	96.7
Industrial	Storage of Petroleum and/or Petroleum Products	0.2	0.2	96.9
Commercial	Hospitals (Except Psychiatric Hospitals)	0.2	0.2	97.1
Domestic-Commercial	Gaseous Fuel Combustion	0.2	0.2	97.3
On-Road Mobile	Exhaust Emissions - Other	0.2	0.2	97.6
Off-Road Mobile	Railways	0.1	0.2	97.7
Off-Road Mobile	Commercial Ships	0.1	0.2	97.9
Off-Road Mobile	Commercial Boats	0.1	0.2	98.1
Industrial	Cement or lime production	0.1	0.2	98.3
Industrial	Generation of electrical power from gas	0.1	0.2	98.4
Industrial	Petrochemical production	0.1	0.2	98.6
On-Road Mobile	Exhaust Emissions Light Duty Commercial - Petrol	0.1	0.2	98.8
All	Other	1.0	1.2	100

4 SUMMARY OF PRIORITY SOURCES OF OZONE PRECURSORS AND PARTICLES

Table 4.1 shows the priority sources of ozone precursors and particles in the GMR and Sydney region. A red tick (i.e.) indicates the source type is a significant source of either ozone precursors or particles, while a green cross (i.e.) indicates the source type is not. For screening purposes, significant sources have been selected as follows:

- The annual (ozone precursors and particles), January week day/weekend day (ozone precursors) and July week day/weekend day (particles) proportion of each source type is greater than or equal to 0.5% of total anthropogenic emissions; and
- The annual (ozone precursors and particles), January week day/weekend day (ozone precursors) and July week day/weekend day (particles) cumulative proportion of each source type is within the 95th percentile of total anthropogenic emissions.

The numerical values in Table 4.1 are the highest of the annual (ozone precursors and particles), January week day/weekend day (ozone precursors) and July week day/weekend day (particles) proportion for each source type.

While the anthropogenic emission contributions in Table 4.1 are presented in the traditional manner (i.e. by Source Group and Source Type), there are alternative ways of grouping emission sources in order to fully represent the combined impact of dependant Source Groups and Source Types. Using the approach described above, Table 4.1 also classifies priority sources according to the Sector (i.e. Agriculture, Commercial and Services, Construction and Manufacturing, Energy, Mining, Residential and Transport) (ABARE, 2005).

Table 4.1 Priority sources of ozone precursors and particles in the GMR and Sydney region

Source Group	Source Type	Sector	GMR				Sydney					
			Ozone Precursors		Particles		Ozone Precursors		Particles			
			NO _x	VOCs	PM ₁₀	PM _{2.5}	NO _x	VOCs	PM ₁₀	PM _{2.5}		
Commercial	Automotive Fuel Retailing	Transport	☒	☑ 4.8	☒	☒	☒	☑ 3.8	☒	☒		
	Gravel and Sand Quarrying	Mining	☒	☒	☑ 1.7	☑ 1.0	☒	☒	☑ 2.6	☑ 1.0		
	Hospitals (Except Psychiatric Hospitals)	Commercial & Services	☒	☒	☒	☒	☑ 1.0	☒	☒	☑ 0.5		
	Poultry Farming (Eggs)	Agriculture	☒	☒	☑ 0.8	☑ 0.6	☒	☒	☑ 2.5	☑ 1.2		
	Poultry Farming (Meat)	Agriculture	☒	☒	☑ 2.5	☑ 1.7	☒	☒	☑ 3.9	☑ 1.8		
	Printing	Commercial & Services	☒	☑ 1.0	☒	☒	☒	☑ 1.2	☒	☒		
	Smash Repairing	Commercial & Services	☒	☑ 4.2	☒	☒	☒	☑ 4.4	☒	☒		
	Unaccounted Gaseous Fuel Combustion	Energy	☒	☒	☒	☒	☒	☒	☒	☑ 0.5		
Domestic-Commercial	Aerosols and Solvents	Residential	☒	☑ 17.9	☒	☒	☒	☑ 18.4	☒	☒		
	Cutback Bitumen	Transport	☒	☑ 1.6	☒	☒	☒	☑ 1.6	☒	☒		
	Lawn Mowing & Garden Equipment (Domestic)	Residential	☒	☑ 11.1	☒	☑ 0.8	☒	☑ 11.0	☑ 0.9	☑ 1.3		
	Lawn Mowing & Garden Equipment (POS)	Commercial & Services	☒	☑ 2.0	☒	☑ 0.5	☒	☑ 1.7	☑ 0.5	☑ 0.7		
	Natural Gas Leakage	Energy	☒	☑ 1.2	☒	☒	☒	☑ 1.2	☒	☒		
	Solid Fuel Combustion	Residential	☒	☑ 7.4	☑ 30.6	☑ 54.4	☒	☑ 7.3	☑ 58.0	☑ 71.7		
	Surface Coating	Commercial & Services Residential	☒	☑ 11.5	☒	☒	☒	☑ 11.7	☒	☒		

Anthropogenic Ozone Precursors and Particle Emissions in the Greater Metropolitan and Sydney Regions
 4. Summary of Priority Sources of Ozone Precursors and Particles

Source Group	Source Type	Sector	GMR						Sydney									
			Ozone Precursors			Particles			Ozone Precursors			Particles						
			NO _x	VOCs	PM ₁₀	PM _{2.5}	NO _x	VOCs	PM ₁₀	PM _{2.5}	NO _x	VOCs	PM ₁₀	PM _{2.5}				
Industrial	Bitumen pre-mix or hotmix production	Construction & Manufacturing	☒		☒		☒		☒	0.5	☒		☒		☒		☒	
	Cement or lime production	Construction & Manufacturing	☑	2.2	☒		☒		☒	0.6	☑	1.7	☒		☒		☒	
	Ceramics production (excluding glass)	Construction & Manufacturing	☒		☒		☑	1.5	☑	2.6	☒		☒		☑	3.9	☑	4.6
	Coal mining	Mining	☒		☒		☑	33.6	☑	13.6	☒		☒		☑	0.5	☒	
	Concrete batching	Construction & Manufacturing	☒		☒		☑	0.8	☒		☒		☒		☑	2.3	☑	0.9
	Crushing, grinding or separating works	Construction & Manufacturing	☒		☒		☑	3.3	☑	3.0	☒		☒		☑	9.6	☑	6.2
	Generation of electrical power from biogas	Energy	☒		☒		☒		☒		☑	1.3	☒		☒		☒	
	Generation of electrical power from coal	Energy	☑	53.2	☑	0.5	☑	6.4	☑	5.6	☒		☒		☒		☒	
	Generation of electrical power from gas	Energy	☑	1.0	☒		☒		☒		☑	3.3	☒		☒		☒	
	Hard-rock gravel quarrying	Mining	☒		☒		☑	2.2	☑	1.4	☒		☒		☑	0.6	☒	
	Metal plating or coating works	Construction & Manufacturing	☒		☑	1.7	☒		☒		☑	2.0	☒		☒		☒	
	Mining (other than coal)	Mining	☒		☒		☑	0.5	☒		☒		☒		☒		☒	
	Other chemical processing	Construction & Manufacturing	☒		☑	0.5	☒		☒		☑	0.7	☒		☒		☒	
	Other land-based extraction	Mining	☒		☒		☑	4.6	☑	2.6	☒		☒		☑	8.3	☑	3.2
	Other metal processing	Construction & Manufacturing	☒		☑	0.8	☒		☒		☑	1.0	☒		☒		☒	
	Petrochemical production	Construction & Manufacturing	☒		☒		☒		☒		☑	1.5	☒		☒		☒	
	Petroleum refining	Construction & Manufacturing	☑	1.0	☑	2.2	☒		☑	0.8	☑	3.5	☑	2.9	☑	1.2	☑	1.8
	Plastics production	Construction & Manufacturing	☒		☒		☒		☑	0.6	☒		☒		☑	0.9	☑	1.5
	Poultry production	Agriculture	☒		☒		☑	0.6	☒		☒		☒		☑	1.8	☑	0.8
	Primary aluminium production	Construction & Manufacturing	☒		☒		☑	0.6	☑	1.0	☒		☒		☒		☒	
	Primary iron and steel production	Construction & Manufacturing	☑	2.8	☒		☑	2.2	☑	4.7	☒		☒		☒		☒	
	Printing	Construction & Manufacturing	☒		☑	1.7	☒		☒		☑	2.1	☒		☒		☒	
	Production of ammonium nitrate	Construction & Manufacturing	☒		☒		☒		☑	0.7	☒		☒		☒		☒	
	Production of container glass	Construction & Manufacturing	☑	0.6	☒		☒		☒		☑	2.0	☒		☒		☑	0.7
Production of float glass	Construction & Manufacturing	☒		☒		☒		☒		☑	1.0	☒		☑	0.5	☑	0.8	
Solid waste landfilling	Commercial & Services	☒		☒		☑	1.2	☑	0.6	☒		☒		☑	2.3	☑	0.8	
Storage of Petroleum and/or Petroleum Products	Construction & Manufacturing	☒		☒		☒		☒		☑	1.1	☒		☒		☑	0.5	

Air Emissions Inventory for the Greater Metropolitan Region in New South Wales
 4. Summary of Priority Sources of Ozone Precursors and Particles

Source Group	Source Type	Sector	GMR								Sydney							
			Ozone Precursors				Particles				Ozone Precursors				Particles			
			NO _x	VOCs	PM ₁₀	PM _{2.5}	NO _x	VOCs	PM ₁₀	PM _{2.5}	NO _x	VOCs	PM ₁₀	PM _{2.5}				
Off-Road Mobile	Aircraft	Transport	☑	1.2	☒		☒		☒		☑	3.9	☑	0.5	☒		☑	0.6
	Commercial Boats	Transport	☑	0.9	☑	0.7	☒		☑	0.5	☑	1.0	☒		☒		☒	
	Commercial Off-Road Vehicles and Equipment	Transport	☒		☒		☑	1.5	☑	1.7	☒		☒		☑	2.4	☑	1.8
	Commercial Ships	Transport	☑	2.3	☒		☒		☑	0.7	☑	2.0	☒		☒		☒	
	Industrial Off-Road Vehicles and Equipment	Transport	☑	2.3	☒		☑	16.8	☑	17.0	☑	1.6	☒		☑	13.1	☑	8.8
	Loading and Unloading Fuels	Transport	☒		☑	0.7	☒		☒		☑	0.9	☒		☒		☒	
	Railways	Transport	☑	1.5	☒		☒		☒		☑	2.5	☒		☒		☒	
	Recreational Boats	Residential	☒		☑	9.4	☒		☑	0.7	☒		☑	7.9	☑	0.7	☑	1.0
On-Road Mobile	Evaporative Emissions - Petrol	Transport	☒		☑	9.4	☒		☒		☑	9.7	☒		☒		☒	
	Exhaust Emissions - Other	Transport	☑	1.1	☑	3.4	☒		☒		☑	2.3	☑	3.2	☒		☑	0.5
	Exhaust Emissions Heavy Duty Commercial - Diesel	Transport	☑	8.7	☑	2.1	☑	1.4	☑	3.3	☑	18.2	☑	2.0	☑	3.3	☑	5.2
	Exhaust Emissions Light Duty - Diesel	Transport	☑	1.8	☑	0.7	☑	1.5	☑	3.5	☑	4.6	☑	0.7	☑	4.1	☑	6.4
	Exhaust Emissions Light Duty Commercial - Petrol	Transport	☑	2.0	☑	3.5	☒		☒		☑	4.9	☑	3.5	☒		☒	
	Exhaust Emissions Passenger Cars - Petrol	Transport	☑	16.8	☑	19.3	☑	1.4	☑	3.2	☑	41.2	☑	19.9	☑	4.1	☑	6.1

Figure 4.1 presents the priority sectors of NO_x emissions in the GMR. The energy and transport sectors dominate in the GMR.

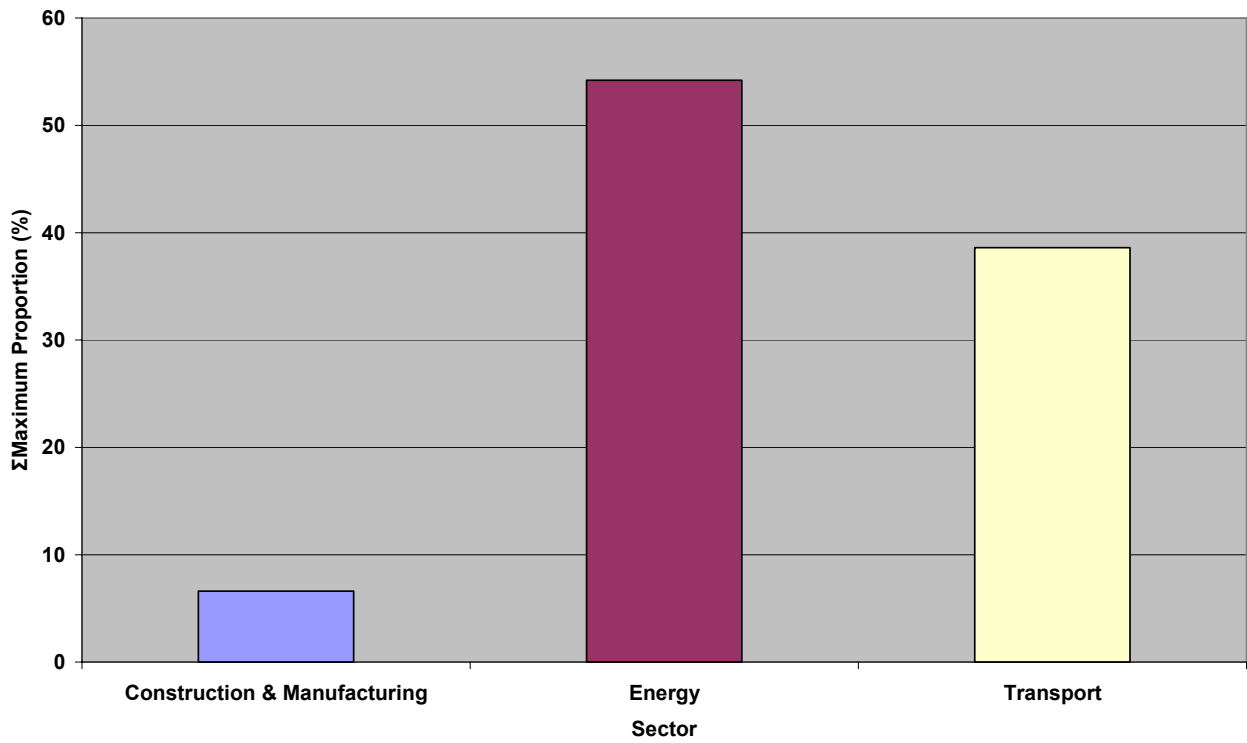


Figure 4.1 Priority sectors of NO_x emissions in the GMR

Figure 4.2 presents the priority sectors of VOCs emissions in the GMR. The residential, transport and commercial & services sectors dominate in the GMR.

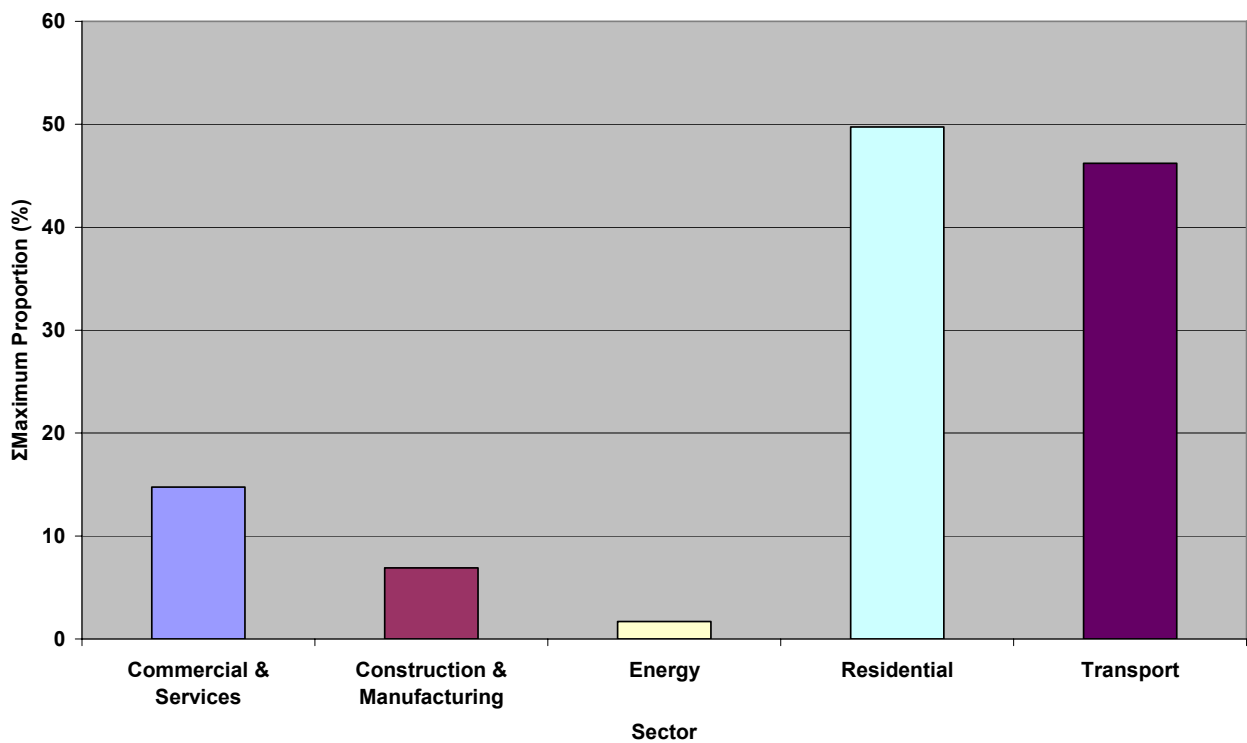


Figure 4.2 Priority sectors of VOCs emissions in the GMR

Figure 4.3 presents the priority sectors of PM₁₀ emissions in the GMR. The mining, residential and transport sectors dominate in the GMR.

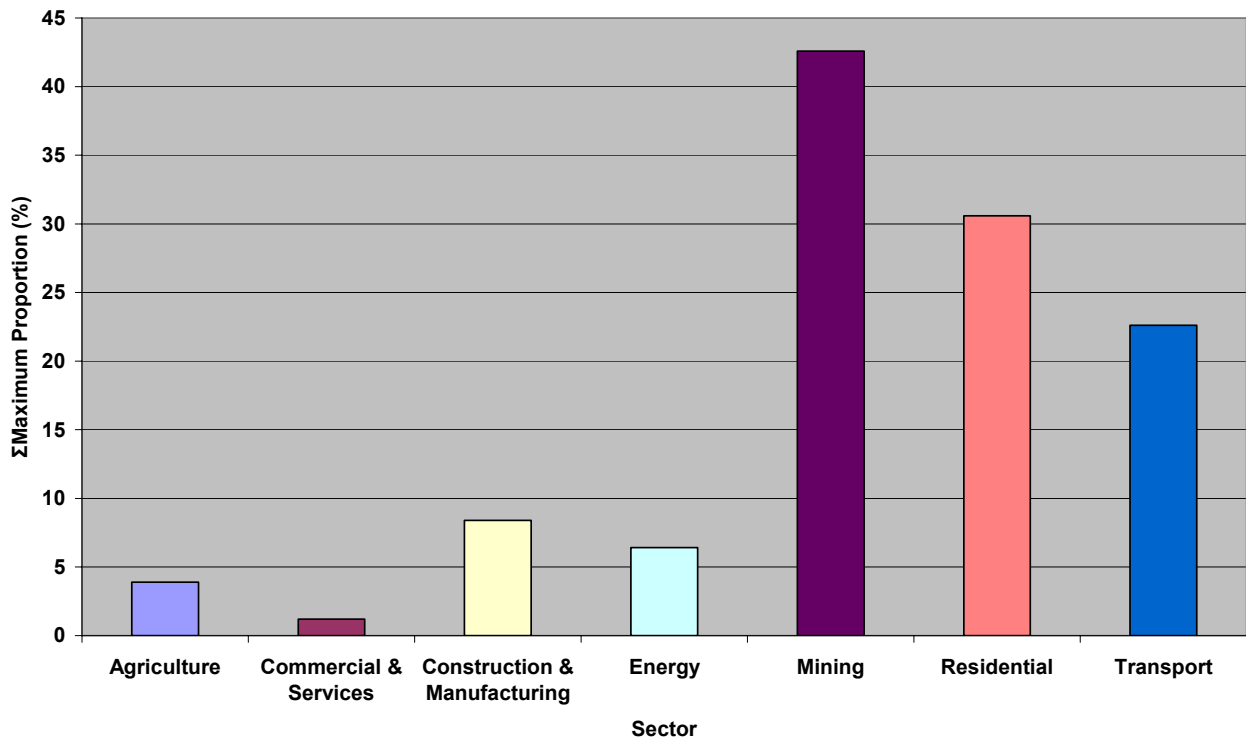


Figure 4.3 Priority sectors of PM₁₀ emissions in the GMR

Figure 4.4 presents the priority sectors of PM_{2.5} emissions in the GMR. The residential, transport, mining and construction & manufacturing sectors dominate in the GMR.

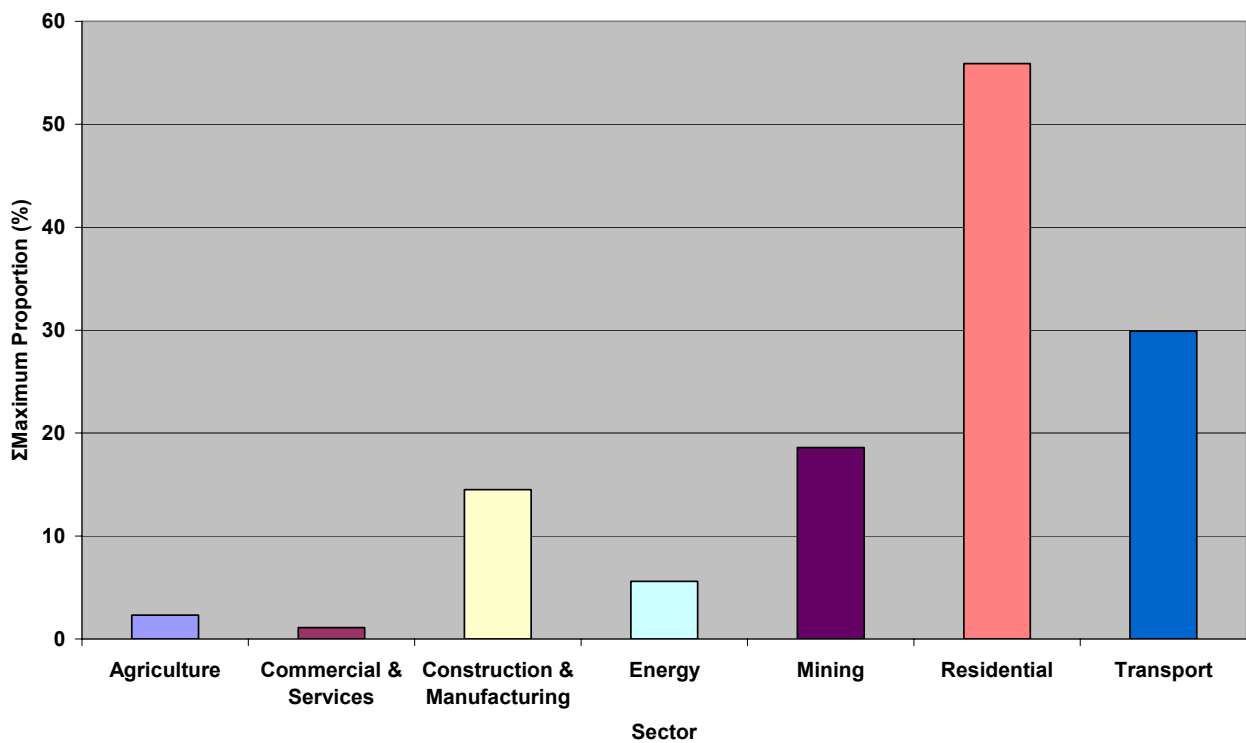


Figure 4.4 Priority sectors of PM_{2.5} emissions in the GMR

Figure 4.5 presents the priority sectors of NO_x emissions in the Sydney region. The transport and construction & manufacturing sectors dominate in the Sydney region.

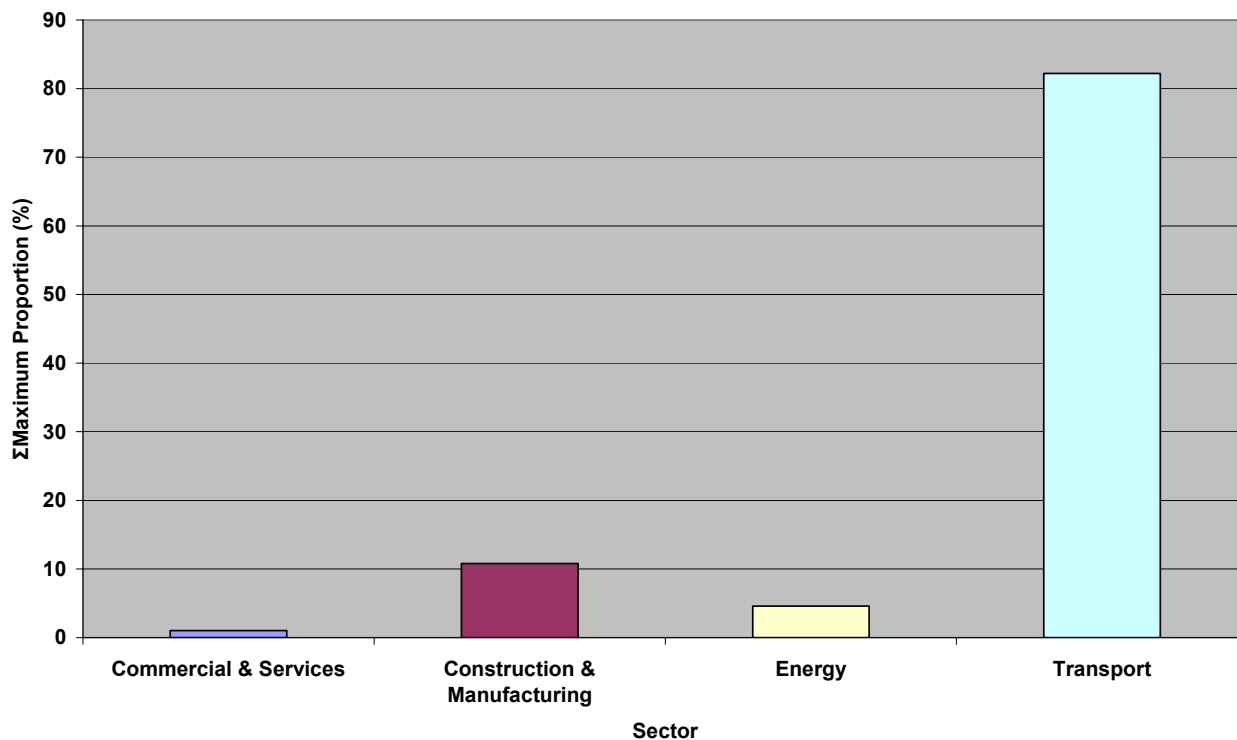


Figure 4.5 Priority sectors of NO_x emissions in the Sydney region

Figure 4.6 presents the priority sectors of VOCs emissions in the Sydney region. The residential, transport, commercial & services and construction & manufacturing sectors dominate in the Sydney region.

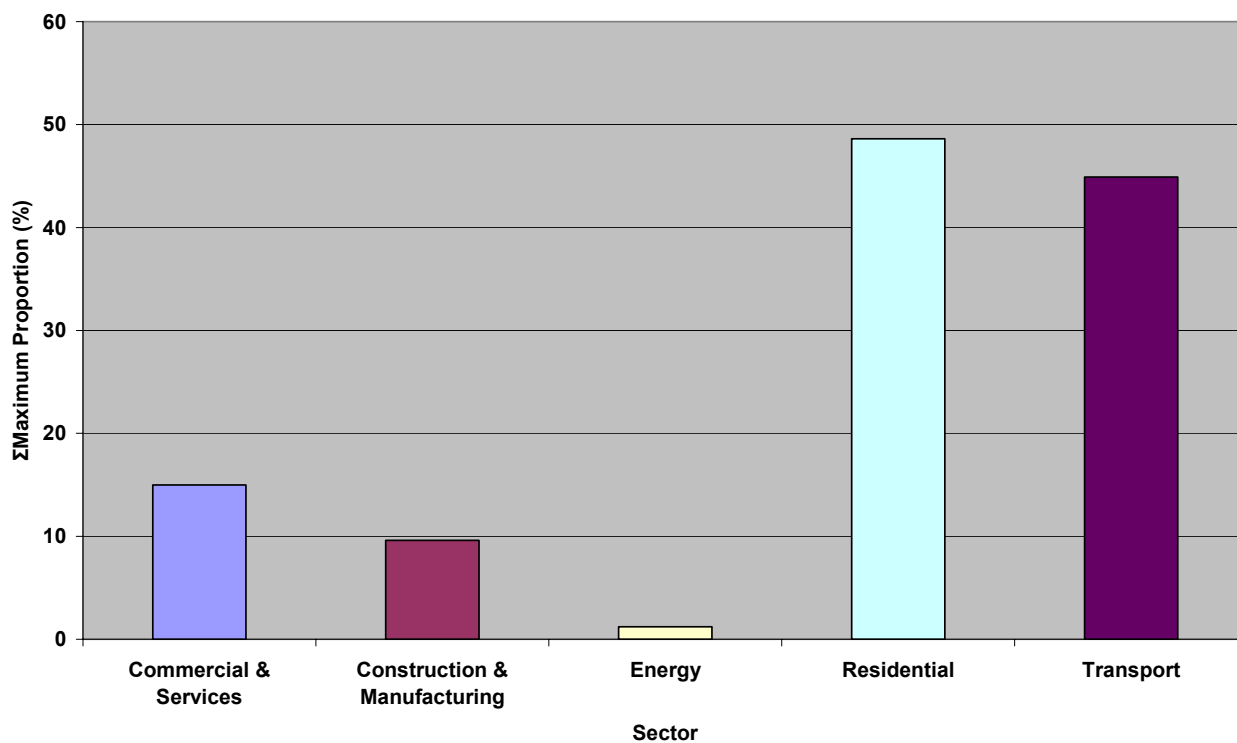


Figure 4.6 Priority sectors of VOCs emissions in the Sydney region

Figure 4.7 presents the priority sectors of PM₁₀ emissions in the Sydney region. The residential, transport, construction & manufacturing and mining sectors dominate in the Sydney region.

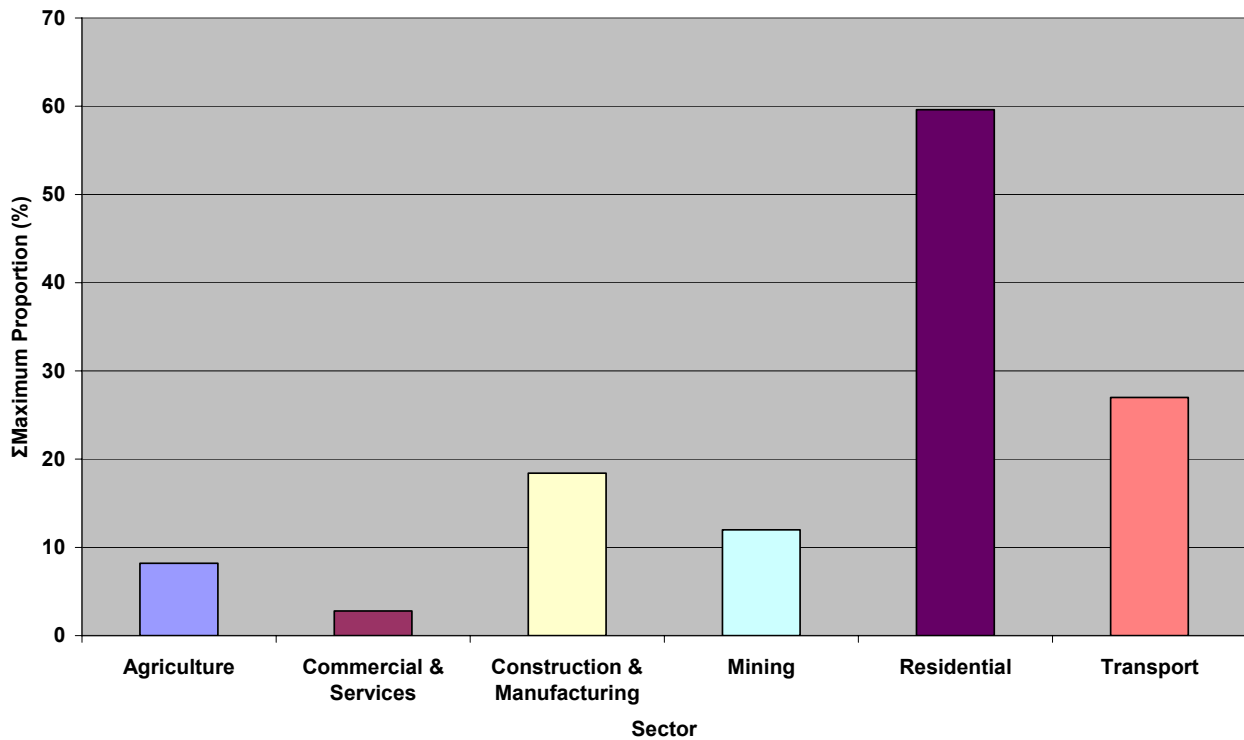


Figure 4.7 Priority sectors of PM₁₀ emissions in the Sydney region

Figure 4.8 presents the priority sectors of PM_{2.5} emissions in the GMR. The residential, transport and construction & manufacturing sectors dominate in the Sydney region.

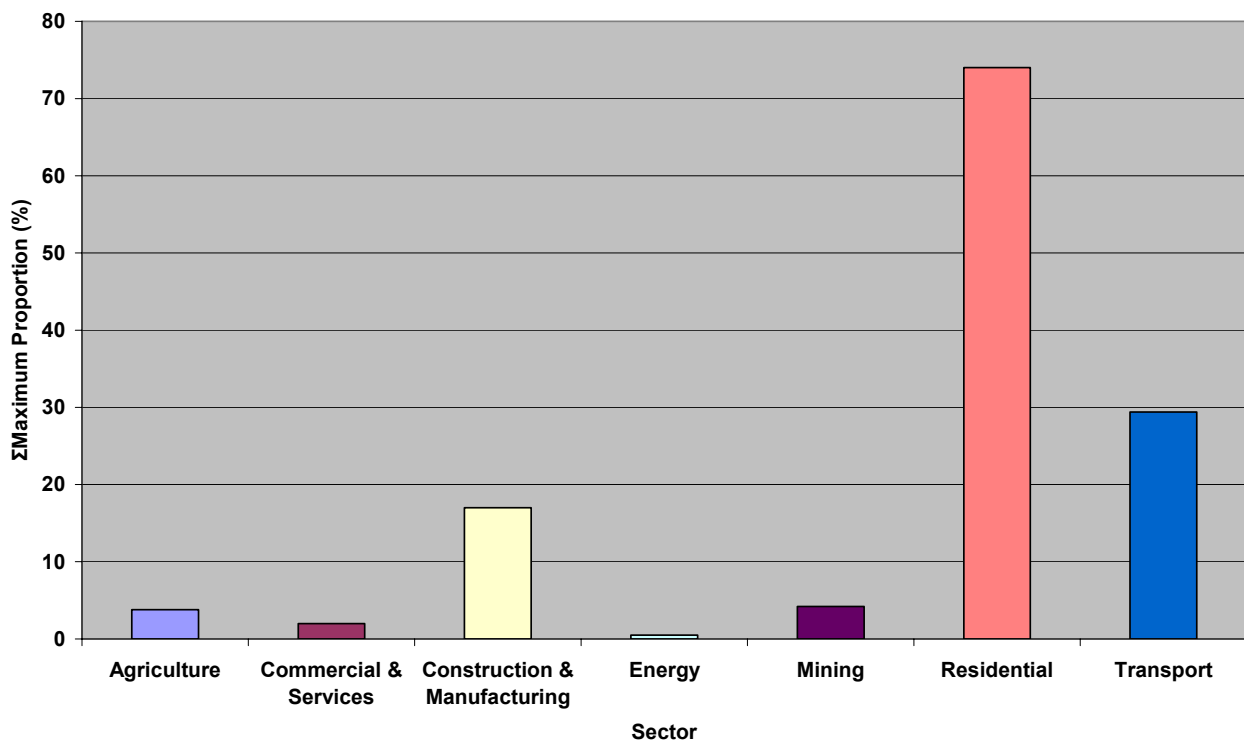


Figure 4.8 Priority sectors of PM_{2.5} emissions in the Sydney region

5 REFERENCES

ABARE (2005), *Australian Energy Statistics - Australian Energy Consumption by Industry & Fuel Type by State-Energy Units 1973-74 to 2003-04, Table F2*, Australian Bureau of Agriculture and Resource Economics, Canberra, Australia. <http://abareonlineshop.com/PdfFiles/PC13180.xls>

Carnovale, F., Tilly, K., Stuart, A., Carvalho, C., Summers, M. and Eriksen, P. (1996), *Metropolitan Air Quality Study – Air Emissions Inventory*, Environment Protection Authority of Victoria, Melbourne, Vic, 3001, Australia.

DECC (2007a), *Air Emissions Inventory for the Greater Metropolitan Region in NSW, Criteria Pollutant Emissions for all Sectors: Results*, Department of Environment and Climate Change NSW, Sydney, NSW 2000, Australia.

DECC (2007b), *Air Emissions Inventory for the Greater Metropolitan Region in NSW, Biogenic Emissions Module: Results*, Department of Environment and Climate Change NSW, Sydney, NSW 2000, Australia.

DECC (2007c), *Air Emissions Inventory for the Greater Metropolitan Region in NSW, Commercial Emissions Module: Results*, Department of Environment and Climate Change NSW, Sydney, NSW 2000, Australia.

DECC (2007d), *Air Emissions Inventory for the Greater Metropolitan Region in NSW, Domestic-Commercial Emissions Module: Results*, Department of Environment and Climate Change NSW, Sydney, NSW 2000, Australia.

DECC (2007e), *Air Emissions Inventory for the Greater Metropolitan Region in NSW, Industrial Emissions Module: Results*, Department of Environment and Climate Change NSW, Sydney, NSW 2000, Australia.

DECC (2007f), *Air Emissions Inventory for the Greater Metropolitan Region in NSW, Off-Road Mobile Emissions Module: Results*, Department of Environment and Climate Change NSW, Sydney, NSW 2000, Australia.

DECC (2007g), *Air Emissions Inventory for the Greater Metropolitan Region in NSW, On-Road Mobile Emissions Module: Results*, Department of Environment and Climate Change NSW, Sydney, NSW 2000, Australia.

ICSM (2002), *Geocentric Datum of Australia Technical Manual Version 2.2*, Intergovernmental Committee on Surveying and Mapping, GPO Box 378, Canberra, ACT 2601, Australia. <http://www.icsm.gov.au/icsm/gda/gdatm/gdav2.2.pdf>

NEPC (2000), *National Environment Protection (National Pollutant Inventory) Measure – As varied 20 June 2000*, Environment Protection & Heritage Council, Adelaide, Australia. http://www.ephc.gov.au/pdf/np/npivar_measure0600.pdf

NEPC (2003), *National Environment Protection (Ambient Air Quality) Measure – As varied May 2003*, Environment Protection & Heritage Council, Adelaide, Australia. http://www.ephc.gov.au/pdf/Air_Quality_NEPM/air_nepm_as_varied0503scaleplus.pdf

NEPC (2004), *National Environment Protection (Air Toxics) Measure*, Environment Protection & Heritage Council, Adelaide, Australia. http://www.ephc.gov.au/pdf/Air_Toxics/FinalAirToxicsNEPM.pdf

PCO (1998), *Protection of the Environment Operations (General) Regulation 1998*, New South Wales Parliamentary Counsel's Office, Sydney, Australia.

PCO (2005), *Protection of the Environment Operations (Clean Air) Regulation 2002*, New South Wales Parliamentary Counsel's Office, Sydney, Australia.

APPENDIX A: ANNUAL EMISSIONS

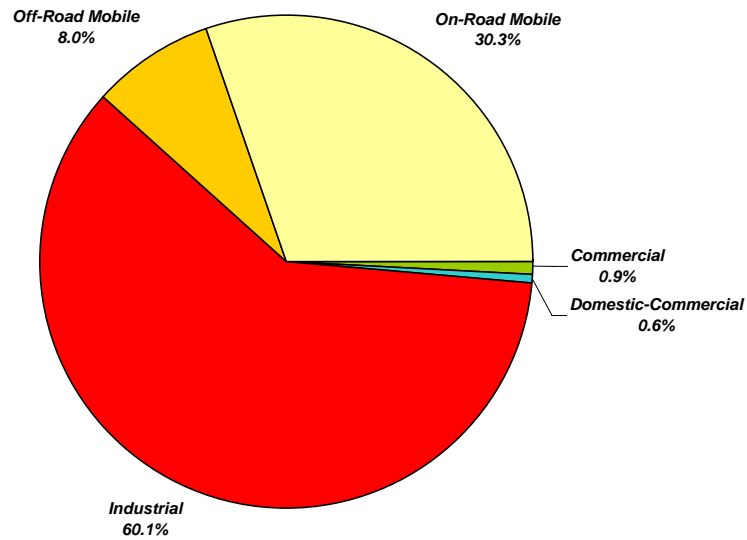


Figure A1 Proportion of total estimated annual emissions of oxides of nitrogen from each anthropogenic source group in the GMR

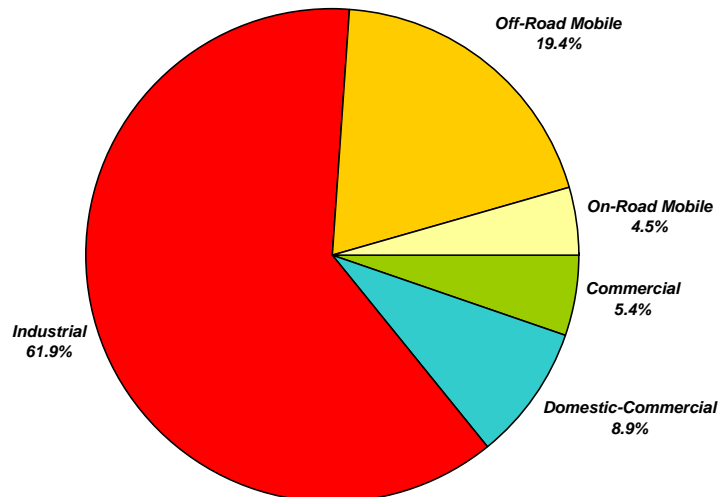


Figure A2 Proportion of total estimated annual emissions of particulate matter < 10 µm from each anthropogenic source group in the GMR

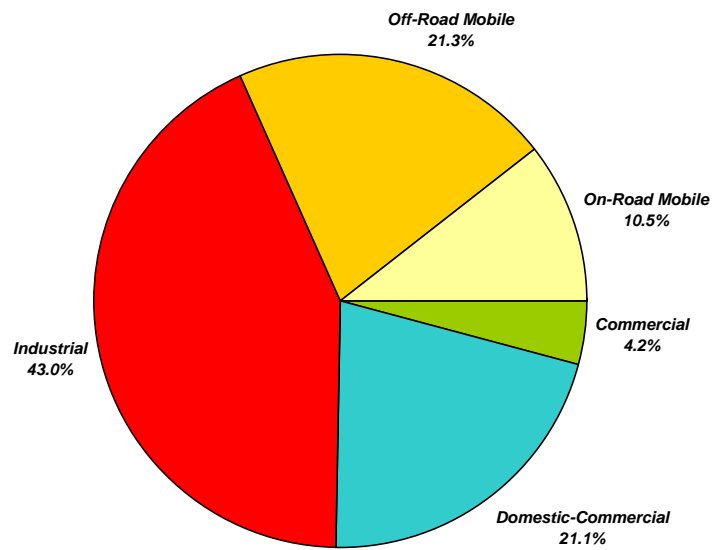


Figure A3 Proportion of total estimated annual emissions of particulate matter < 2.5 μm from each anthropogenic source group in the GMR

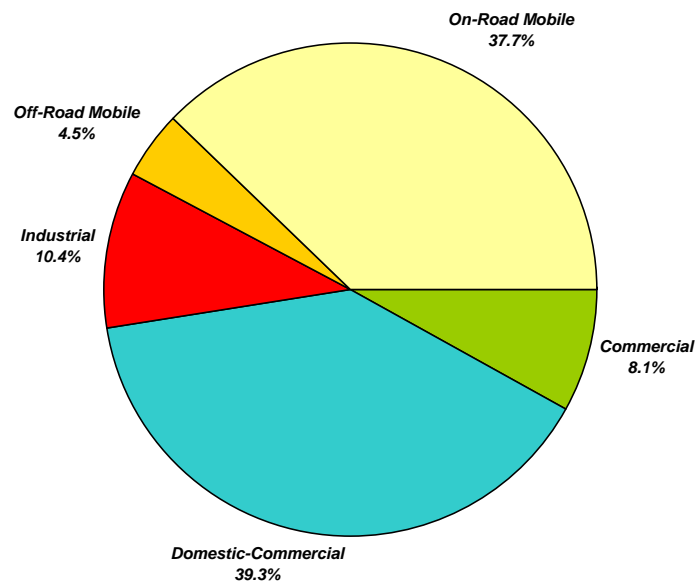


Figure A4 Proportion of total estimated annual emissions of total VOCs from each anthropogenic source group in the GMR

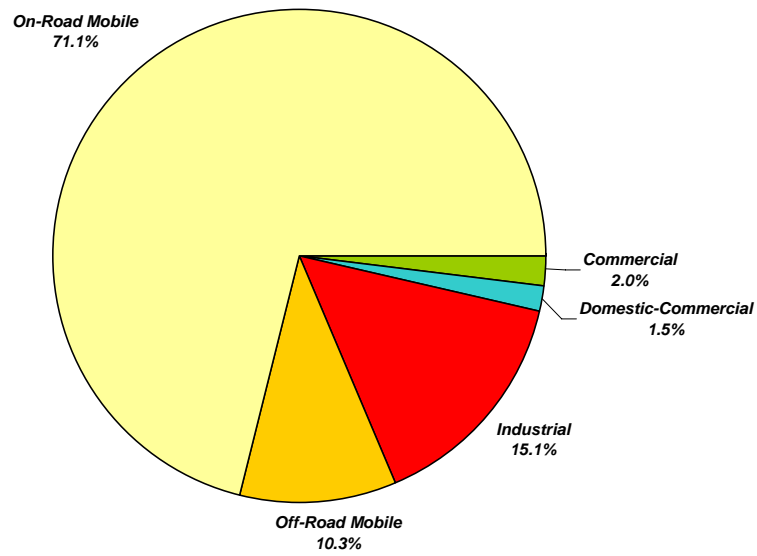


Figure A5 Proportion of total estimated annual emissions of oxides of nitrogen from each anthropogenic source group in the Sydney region

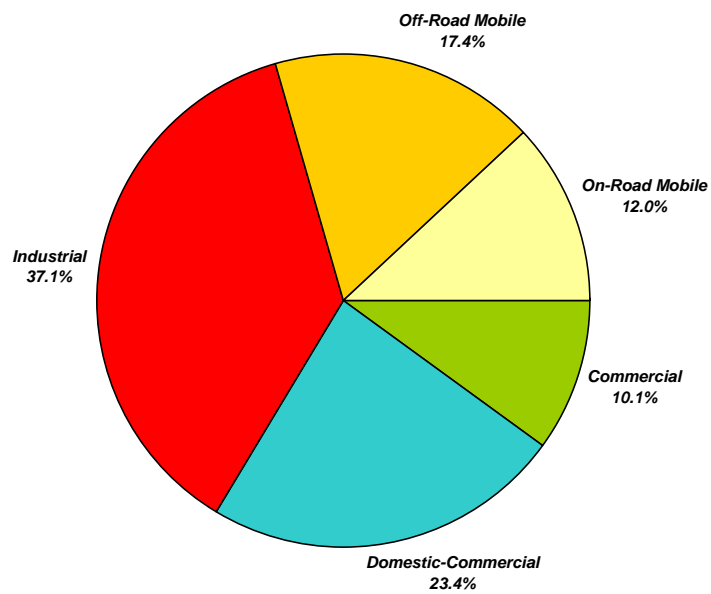


Figure A6 Proportion of total estimated annual emissions of particulate matter < 10 µm from each anthropogenic source group in the Sydney region

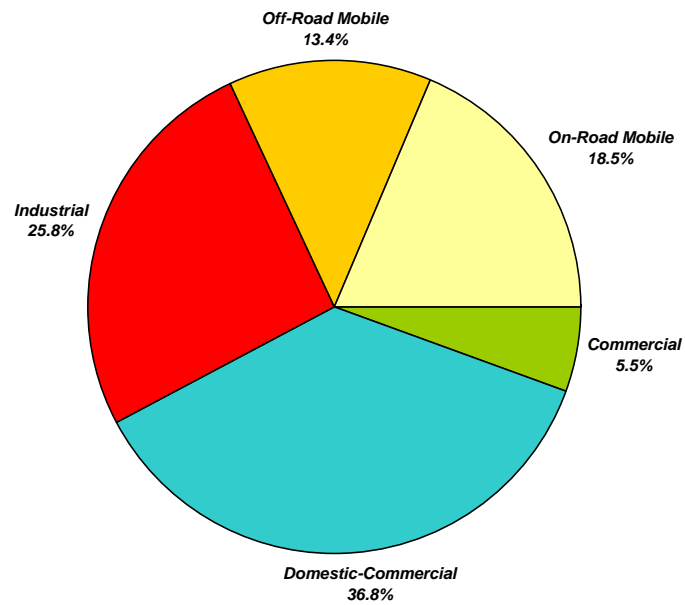


Figure A7 Proportion of total estimated annual emissions of particulate matter < 2.5 μm from each anthropogenic source group in the Sydney region

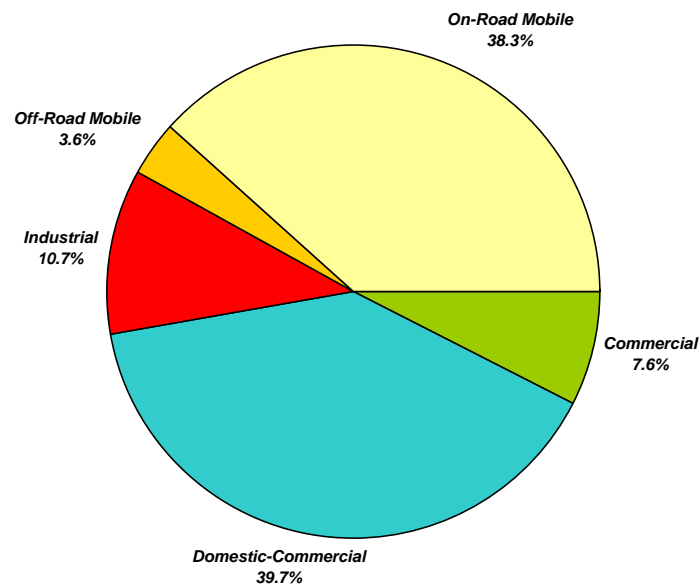


Figure A8 Proportion of total estimated annual emissions of total VOCs from each anthropogenic source group in the Sydney region

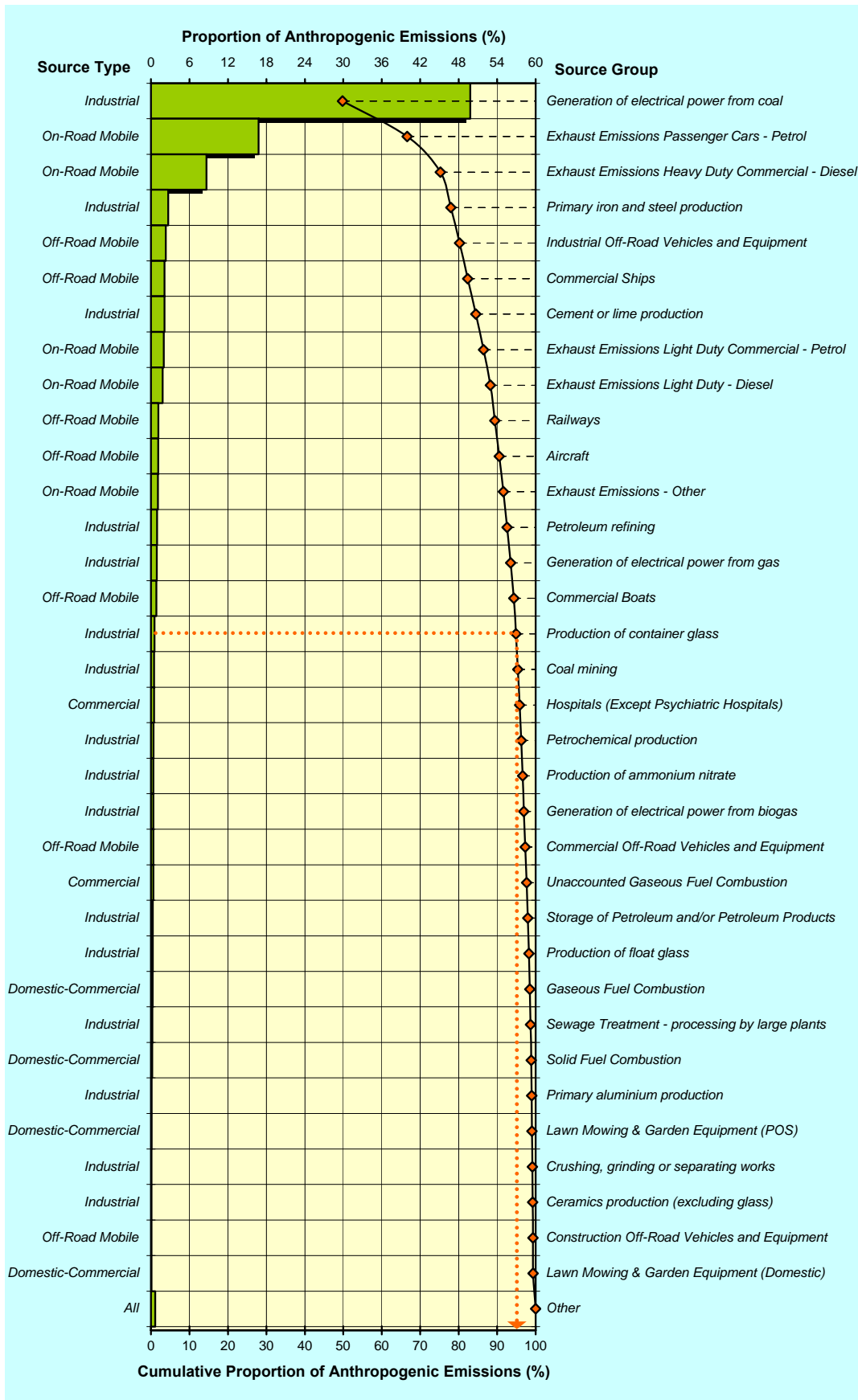


Figure A9 Ranking of anthropogenic sources of oxides of nitrogen in the GMR on an annual basis

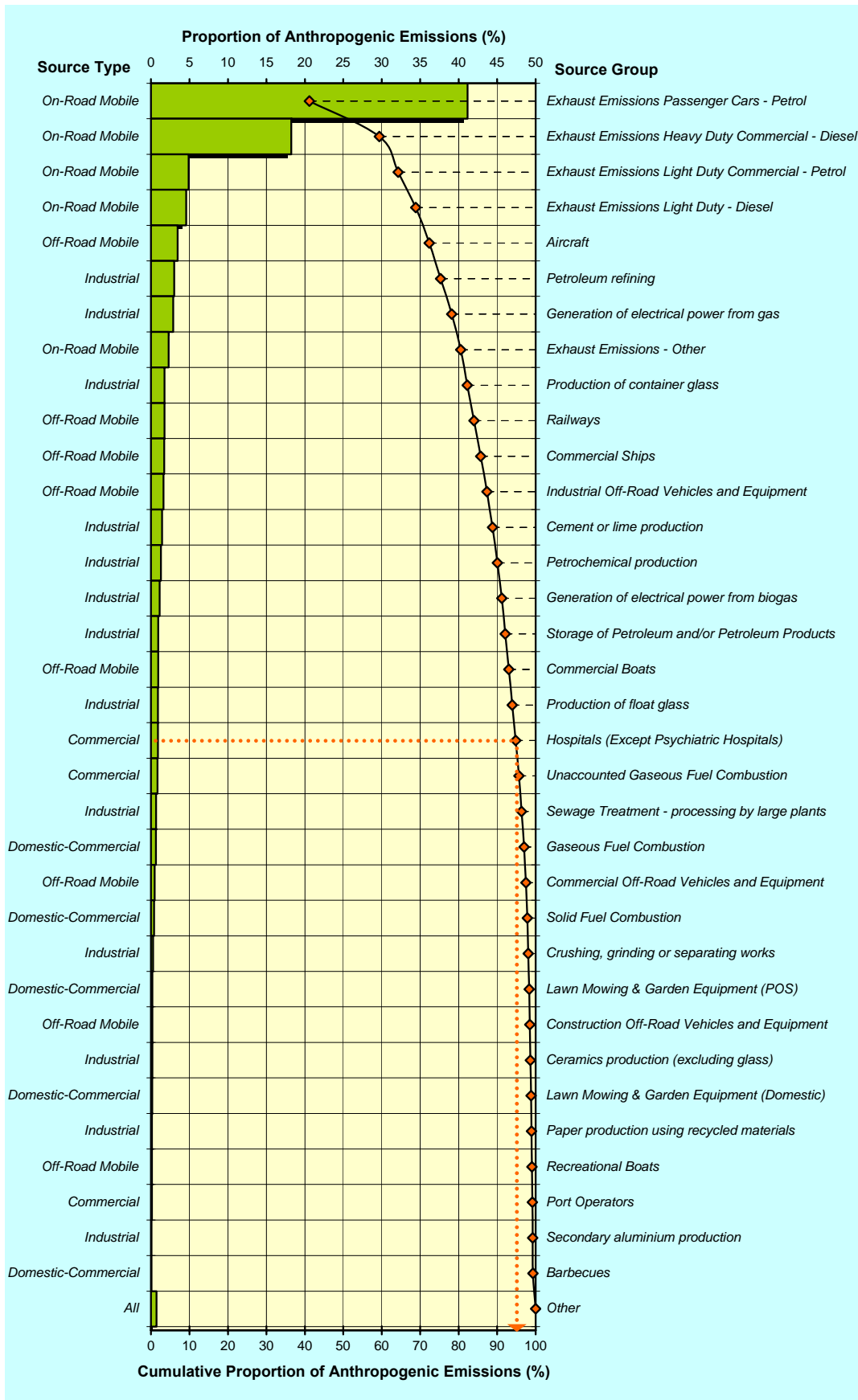


Figure A10 Ranking of anthropogenic sources of oxides of nitrogen in the Sydney region on an annual basis

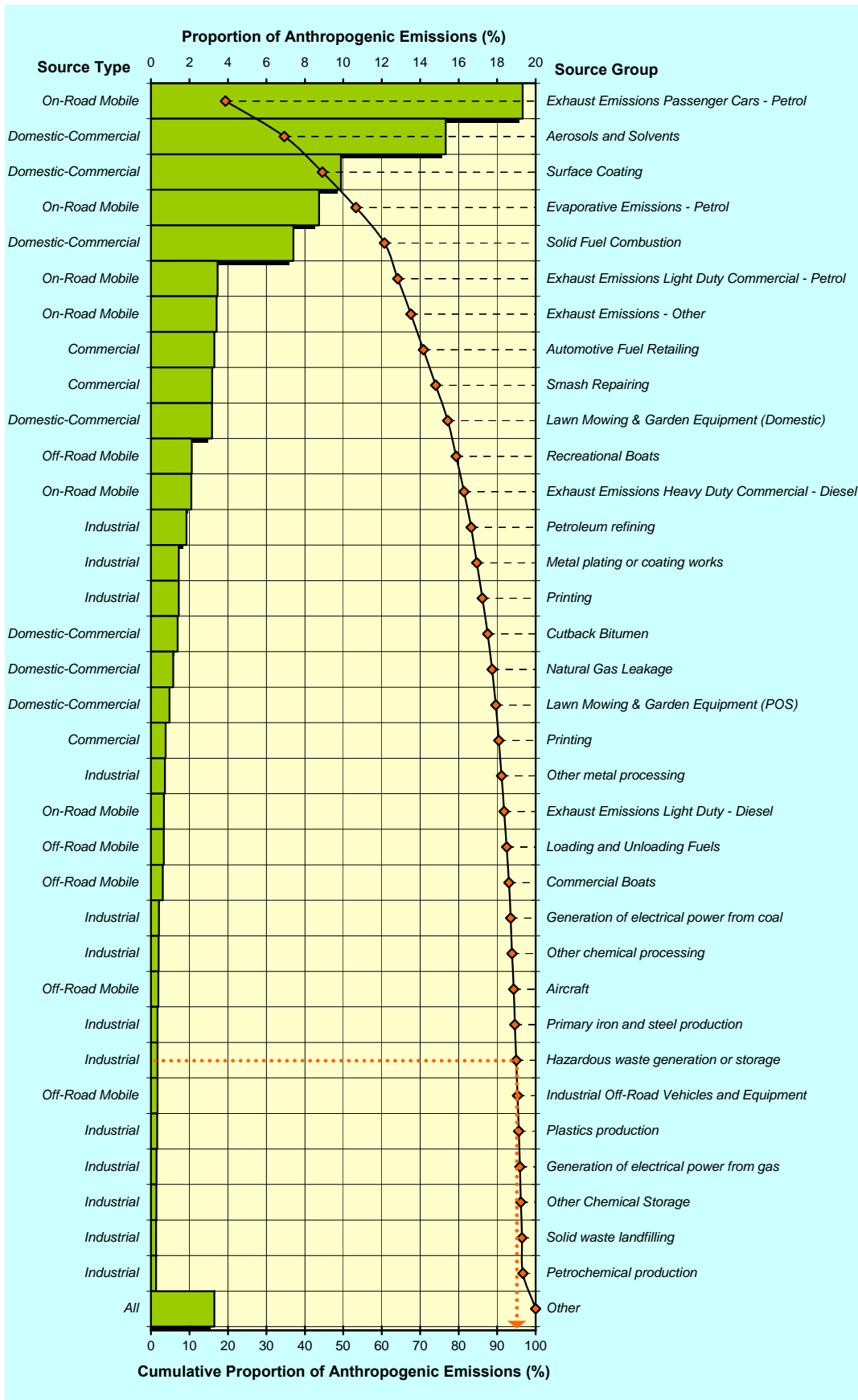


Figure A11 Ranking of anthropogenic sources of total VOCs in the GMR on an annual basis

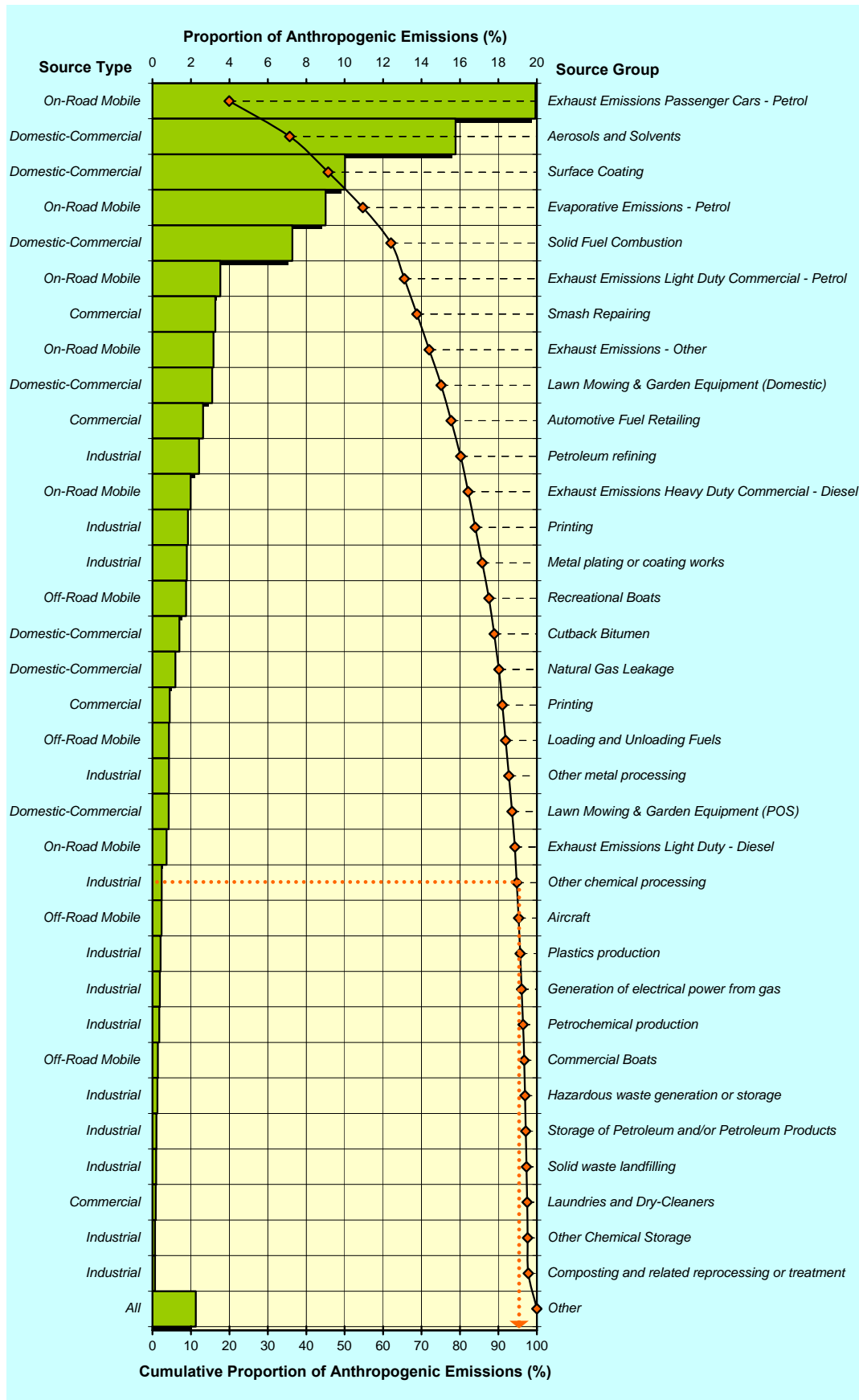


Figure A12 Ranking of anthropogenic sources of total VOCs in the Sydney region on an annual basis

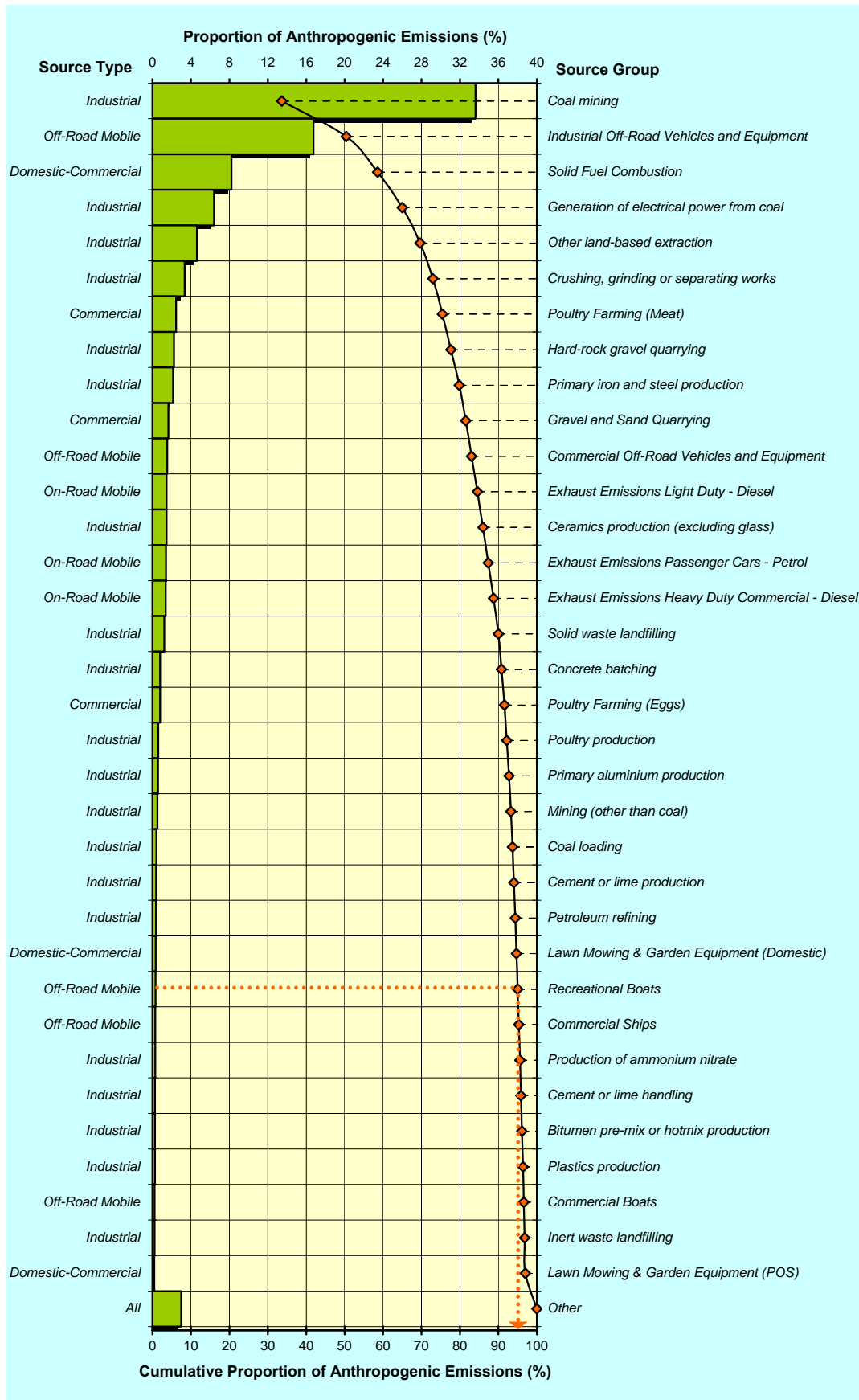


Figure A13 Ranking of anthropogenic sources of particulate matter < 10 μm in the GMR on an annual basis

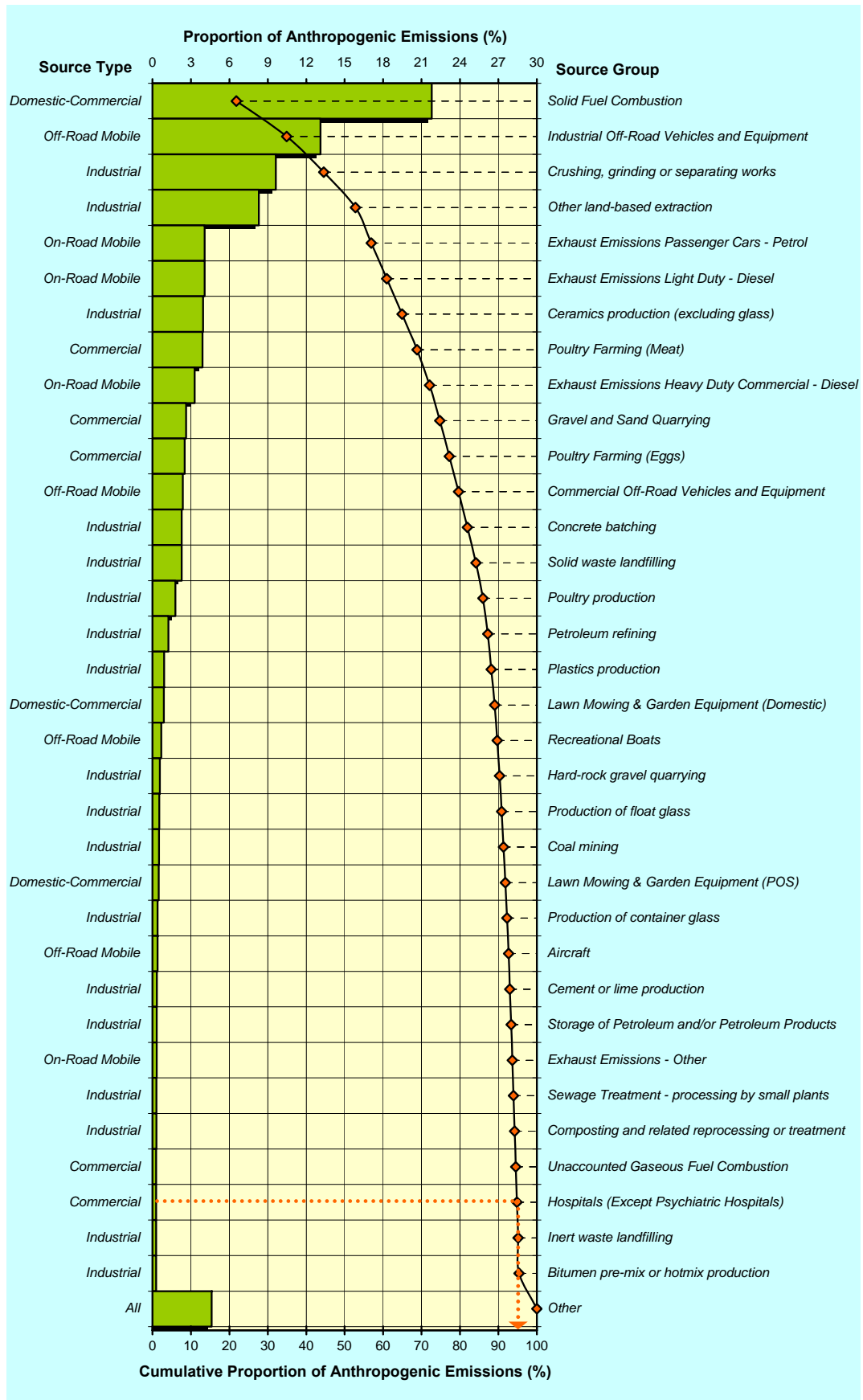


Figure A14 Ranking of anthropogenic sources of particulate matter < 10 μm in the Sydney region on an annual basis

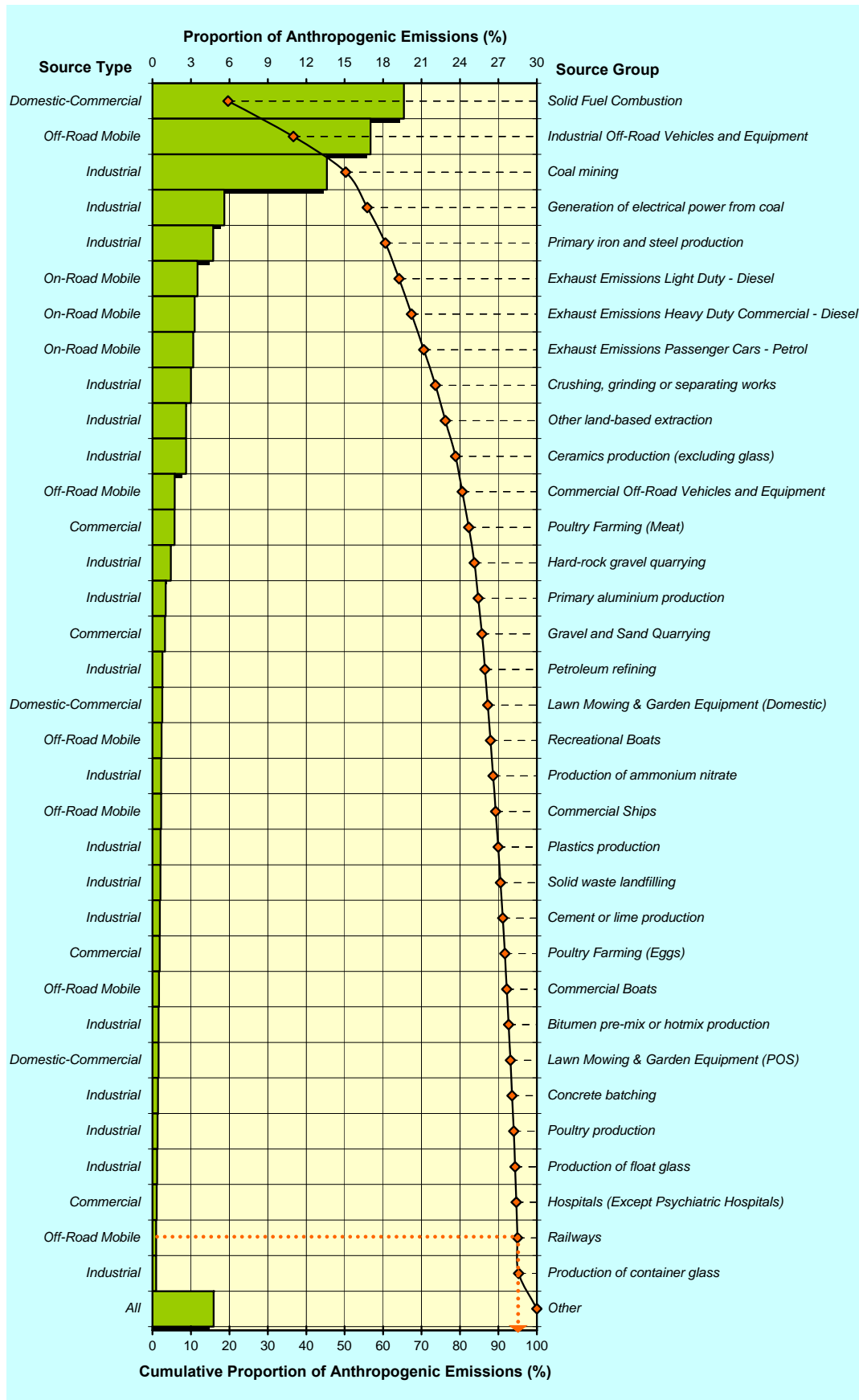


Figure A15 Ranking of anthropogenic sources of particulate matter $PM_{2.5}$ in the GMR on an annual basis

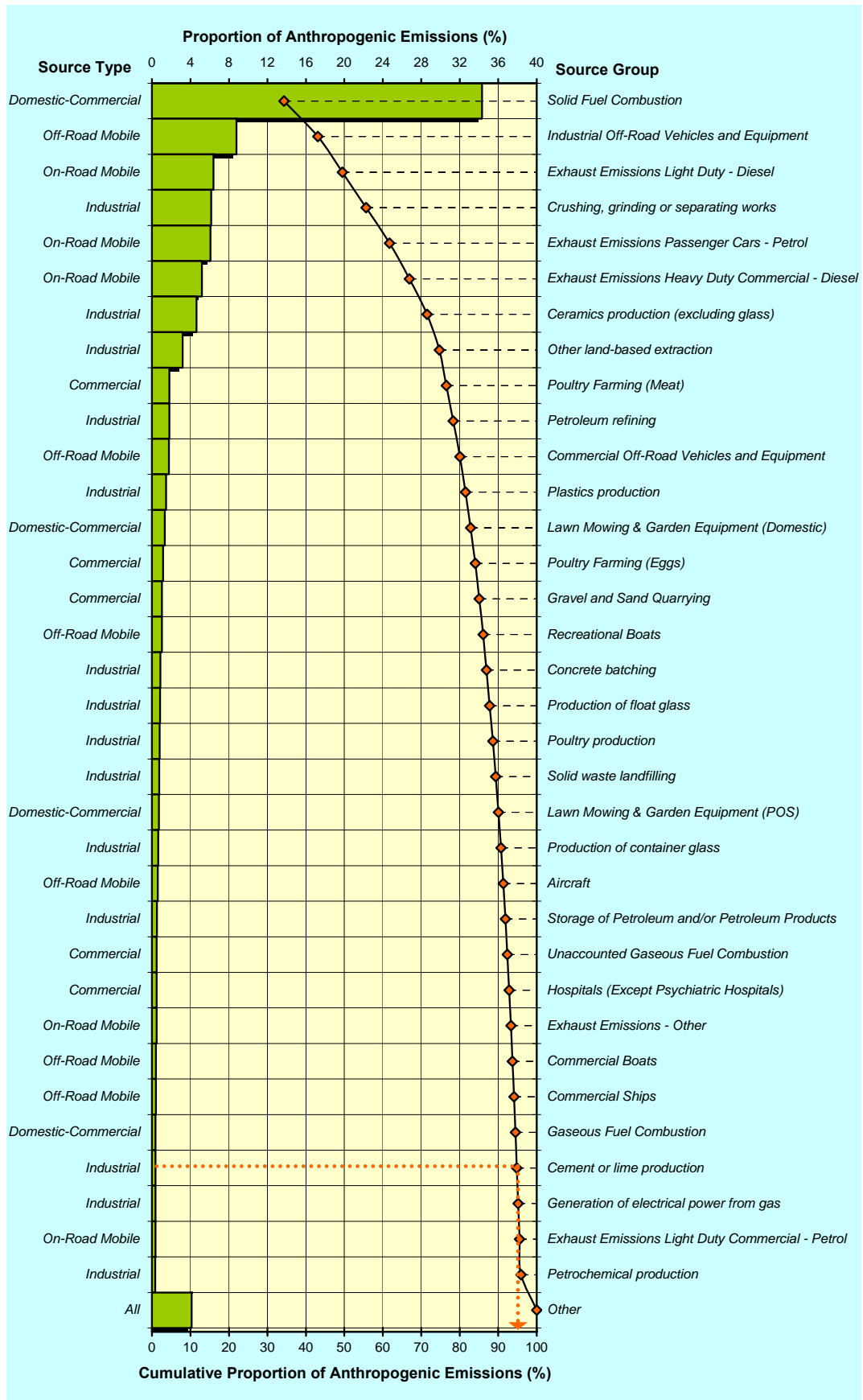


Figure A16 Ranking of anthropogenic sources of particulate matter < 2.5 μm in the Sydney region on an annual basis

APPENDIX B: DAILY JANUARY EMISSIONS

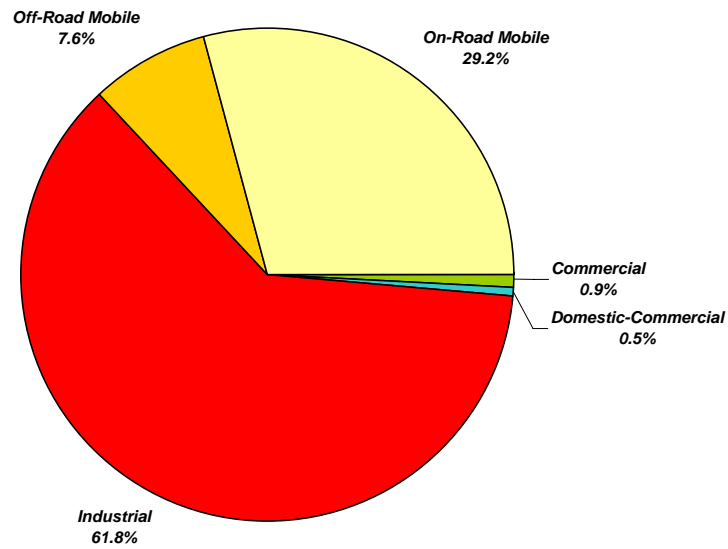


Figure B1 Proportion of total estimated daily emissions of oxides of nitrogen from each anthropogenic source group in the GMR for a typical January weekday

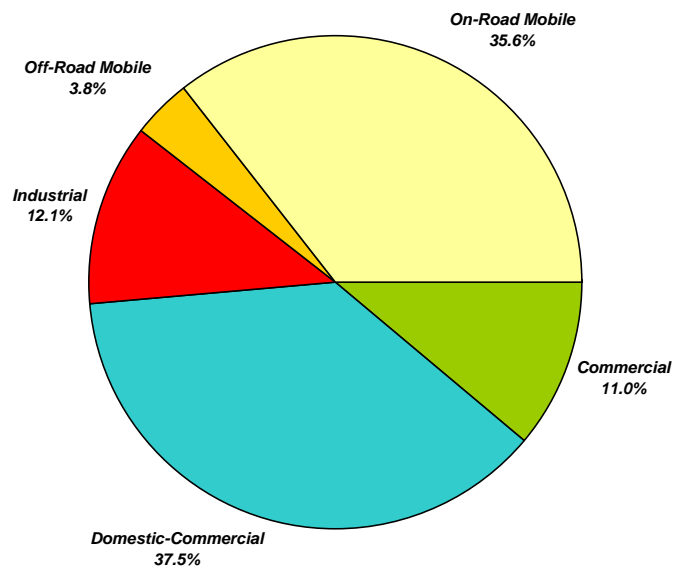


Figure B2 Proportion of total estimated daily emissions of total VOCs from each anthropogenic source group in the GMR for a typical January weekday

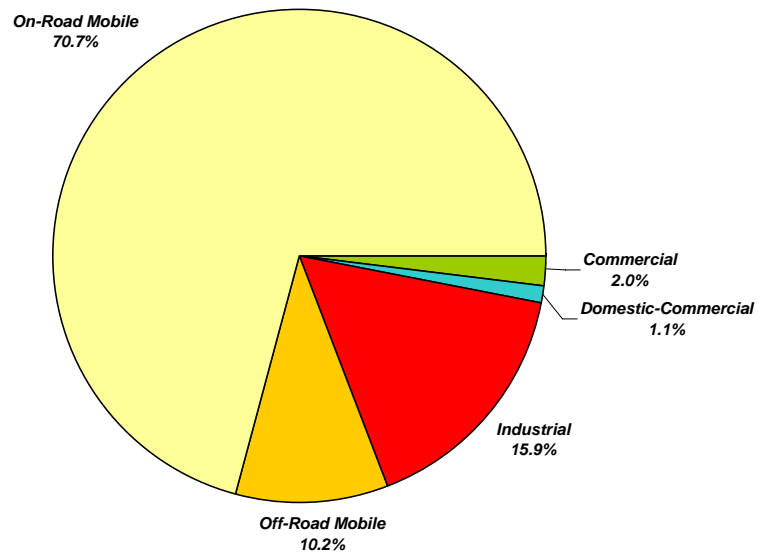


Figure B3 Proportion of total estimated daily emissions of oxides of nitrogen from each anthropogenic source group in the Sydney region for a typical January weekday

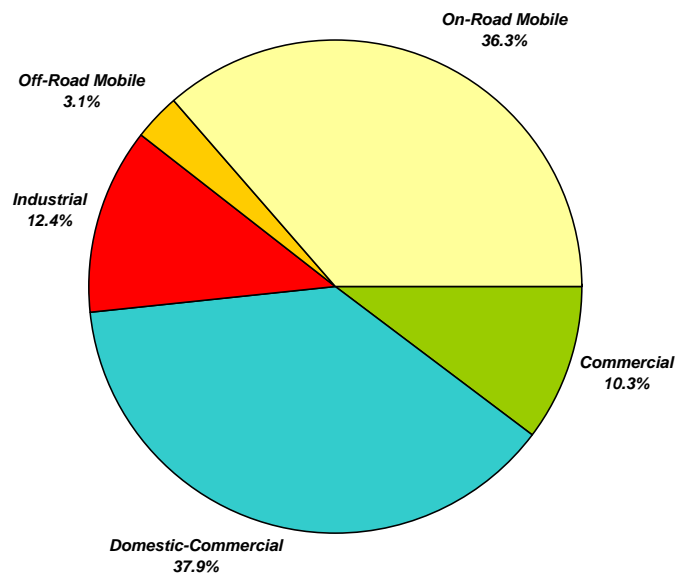


Figure B4 Proportion of total estimated daily emissions of total VOCs from each anthropogenic source group in the Sydney region for a typical January weekday

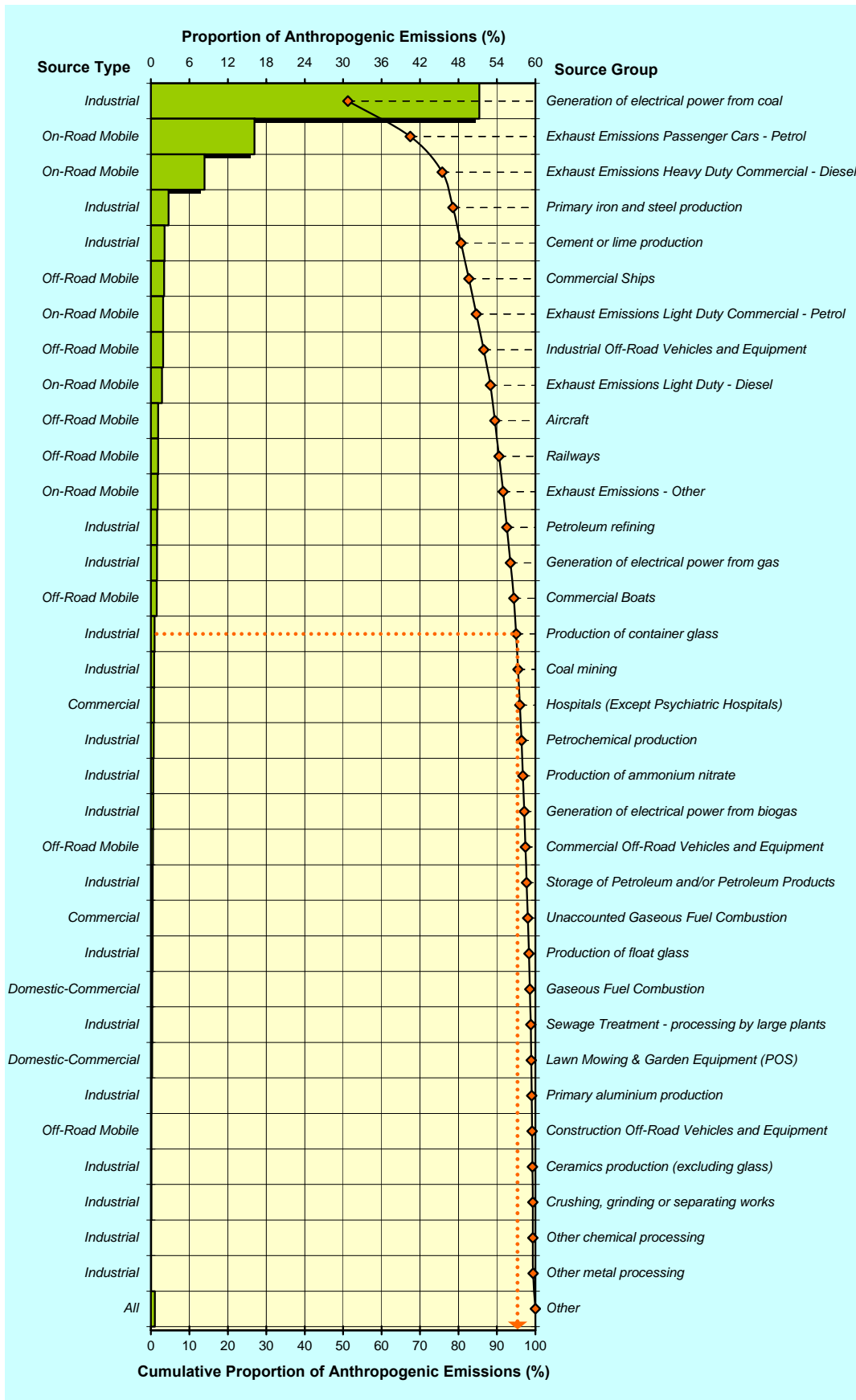


Figure B5 Ranking of anthropogenic sources of oxides of nitrogen in the GMR for a typical January weekday

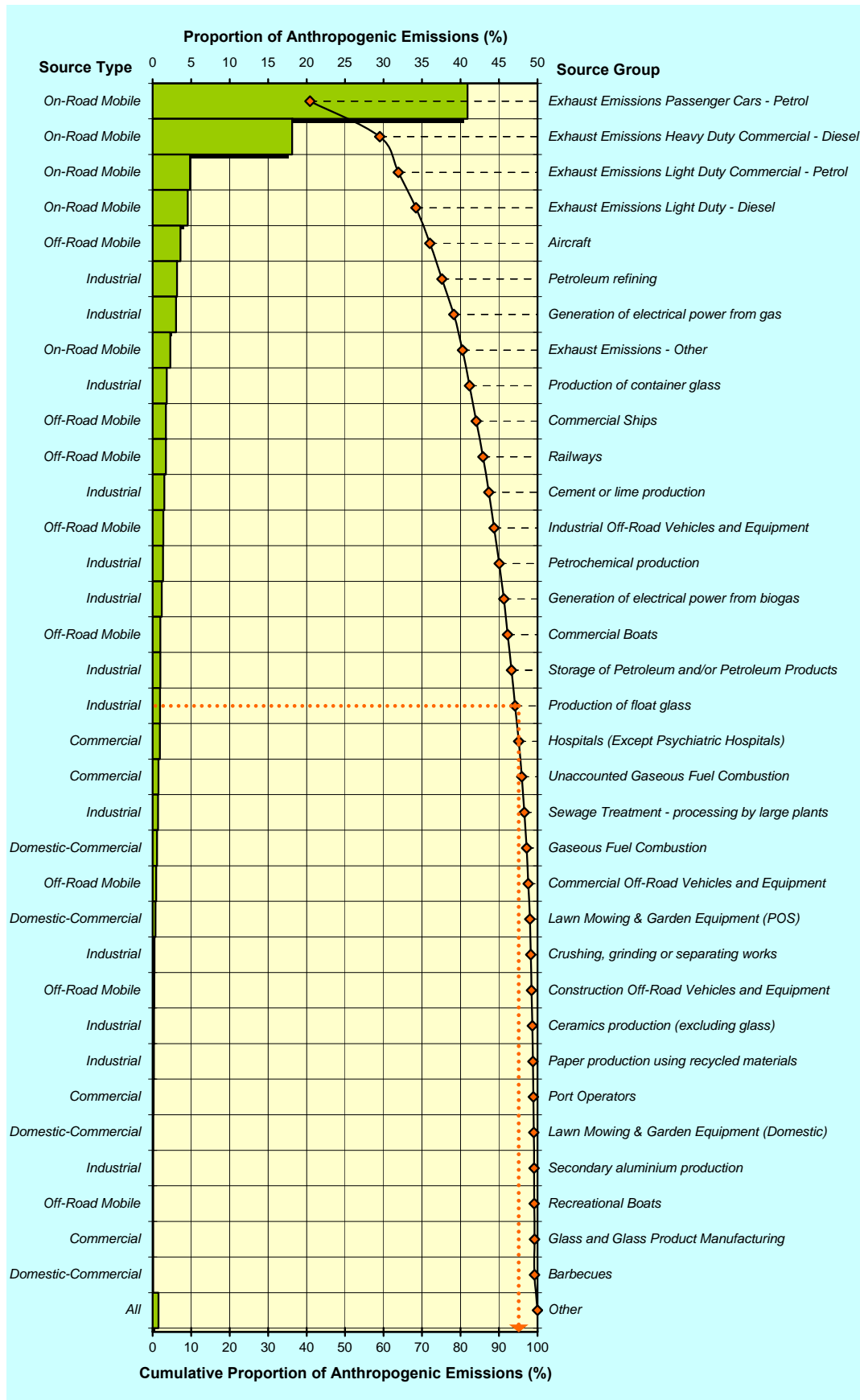


Figure B6 Ranking of anthropogenic sources of oxides of nitrogen in the Sydney region for a typical January weekday

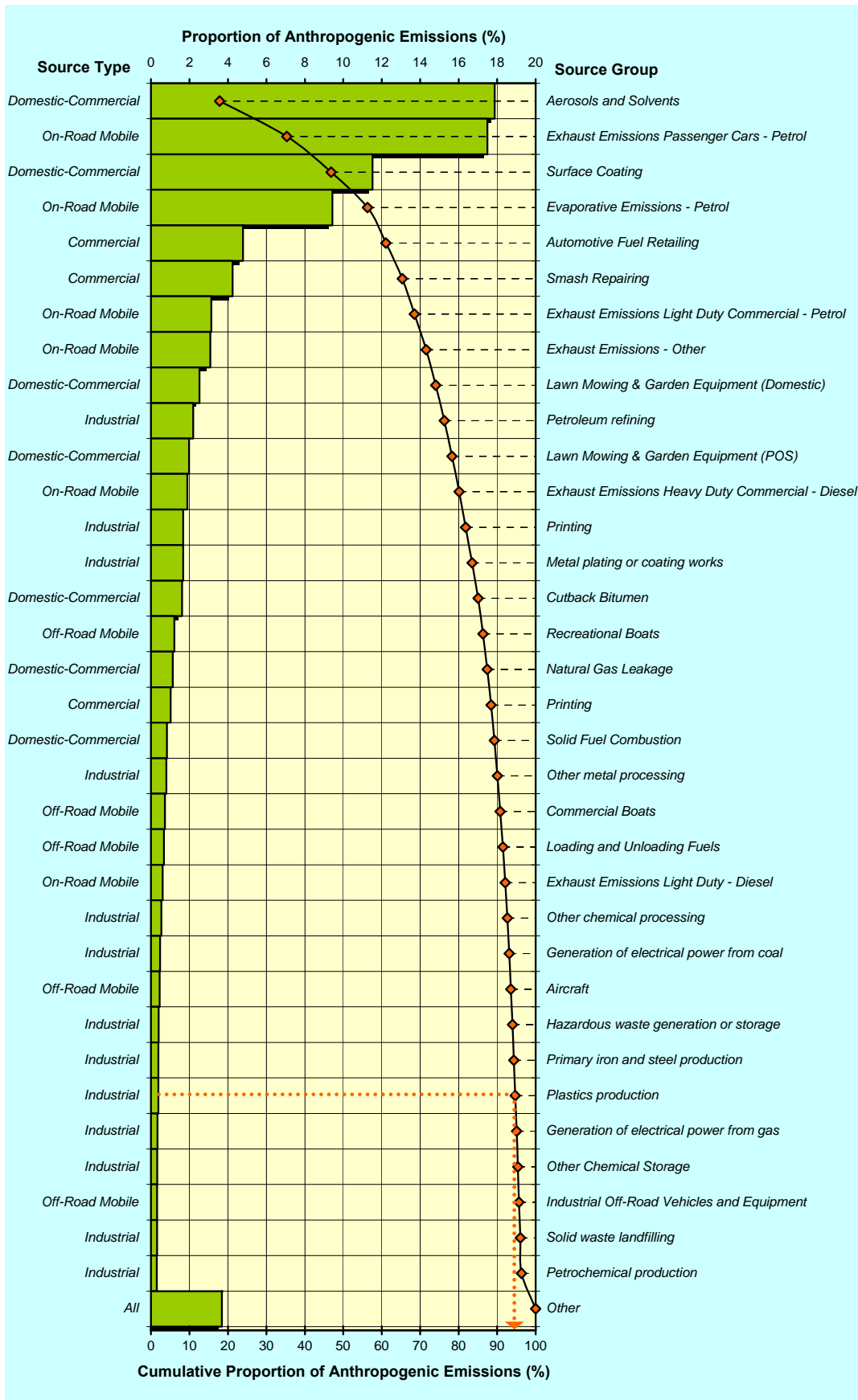


Figure B7 Ranking of anthropogenic sources of total VOCs in the GMR for a typical January weekday

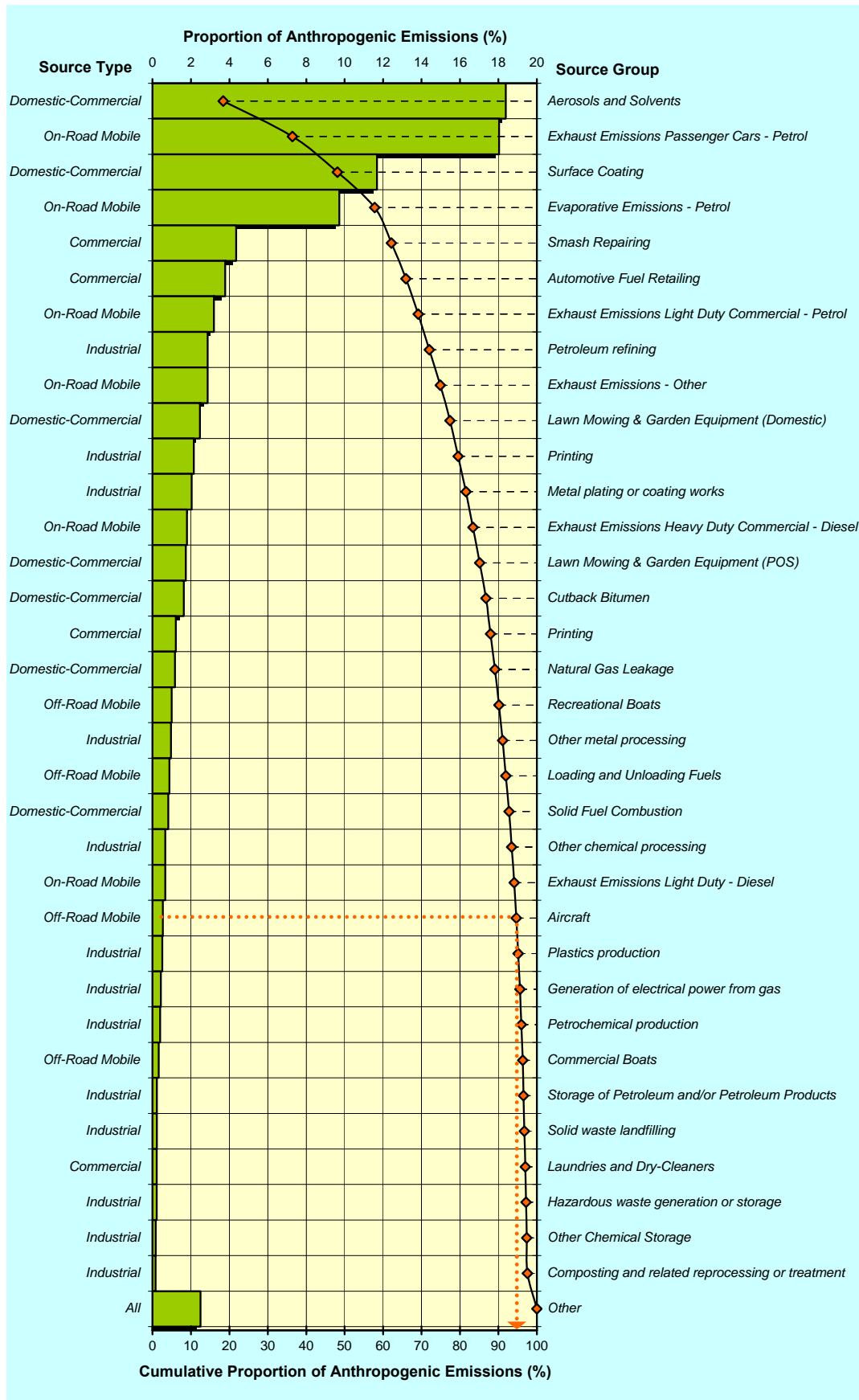


Figure B8 Ranking of anthropogenic sources of total VOCs in the Sydney region for a typical January weekday

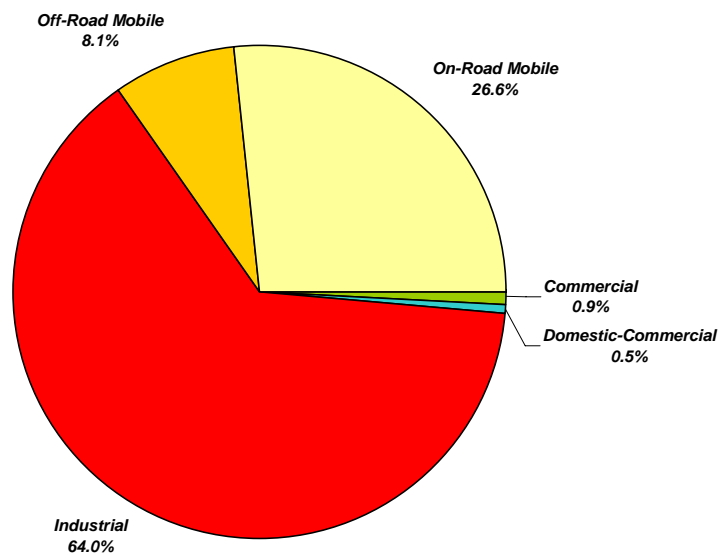


Figure B9 Proportion of total estimated daily emissions of oxides of nitrogen from each anthropogenic source group in the GMR for a typical January weekend day

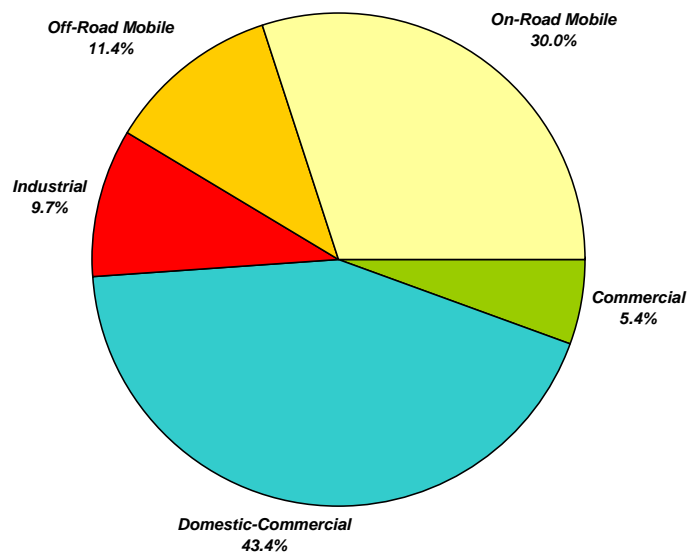


Figure B10 Proportion of total estimated daily emissions of total VOCs from each anthropogenic source group in the GMR for a typical January weekend day

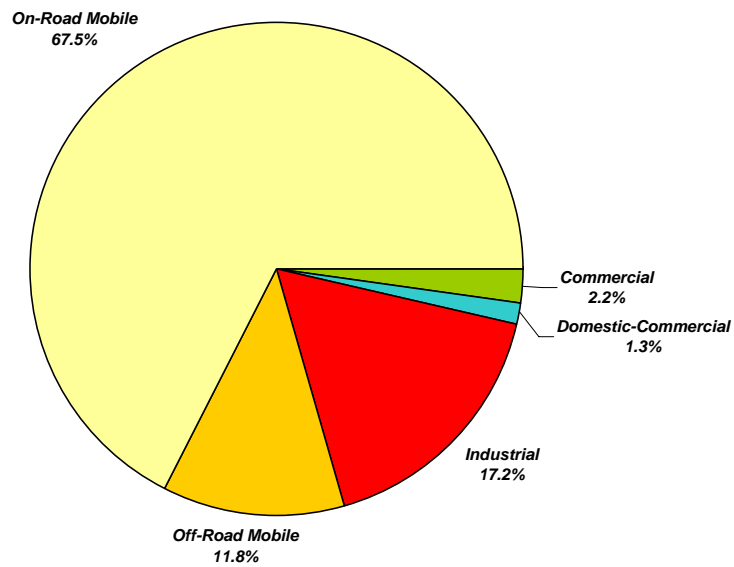


Figure B11 Proportion of total estimated daily emissions of oxides of nitrogen from each anthropogenic source group in the Sydney region for a typical January weekend day

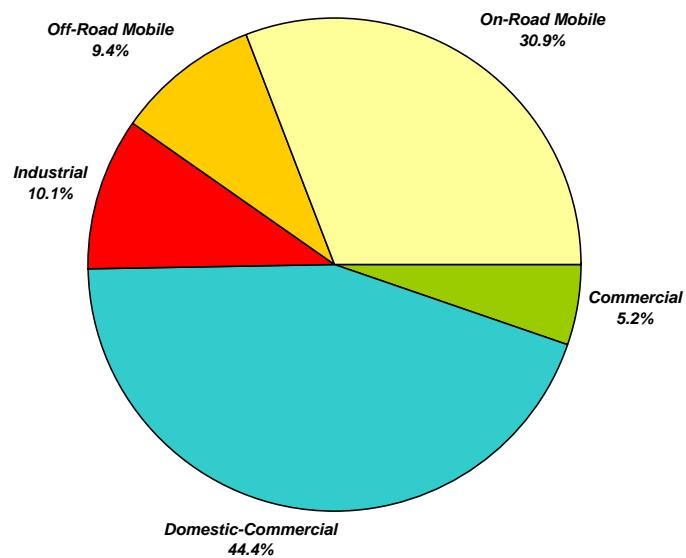


Figure B12 Proportion of total estimated daily emissions of total VOCs from each anthropogenic source group in the Sydney region for a typical January weekend day

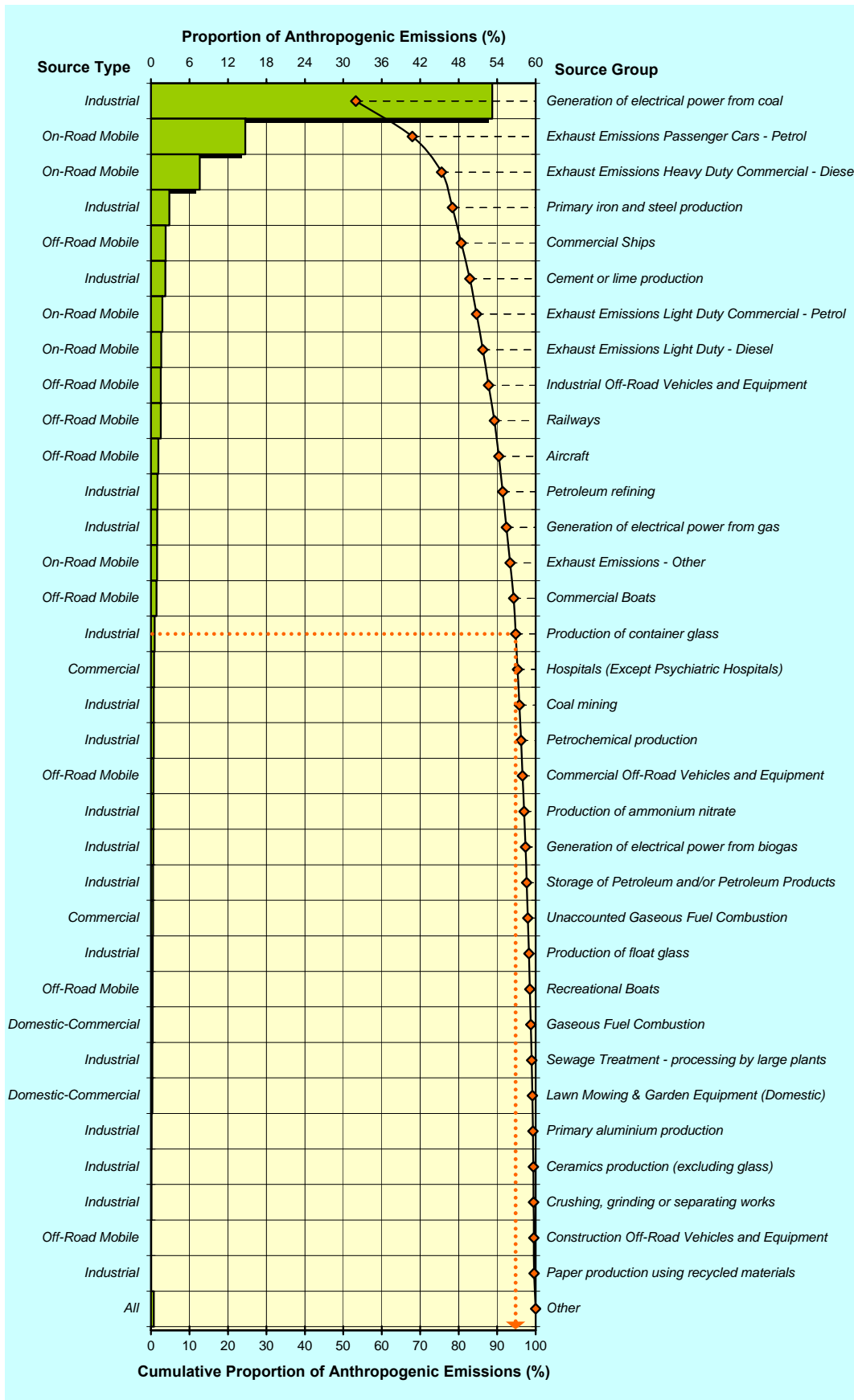


Figure B13 Ranking of anthropogenic sources of oxides of nitrogen in the GMR for a typical January weekend day

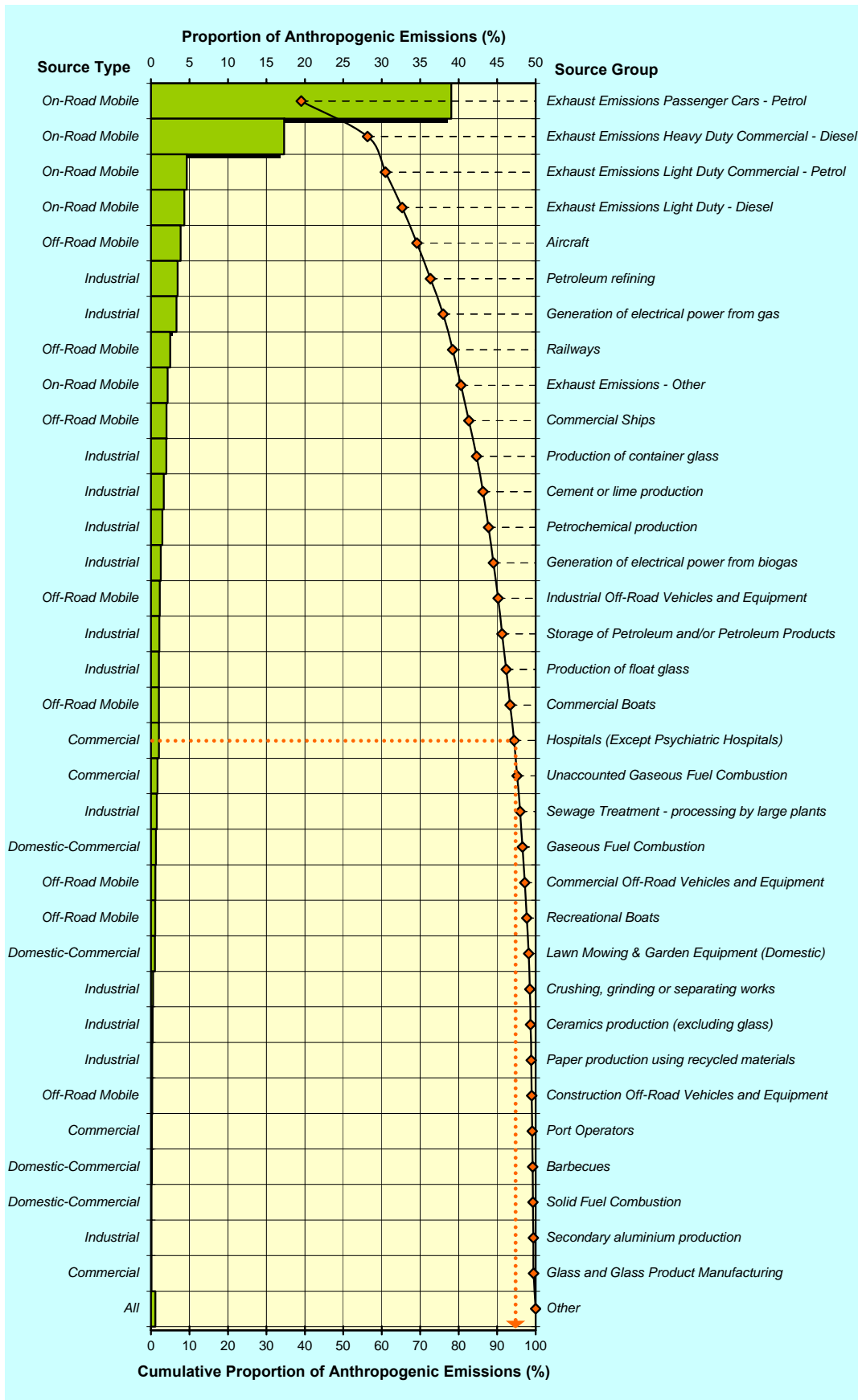


Figure B14 Ranking of anthropogenic sources of oxides of nitrogen in the Sydney region for a typical January weekend day

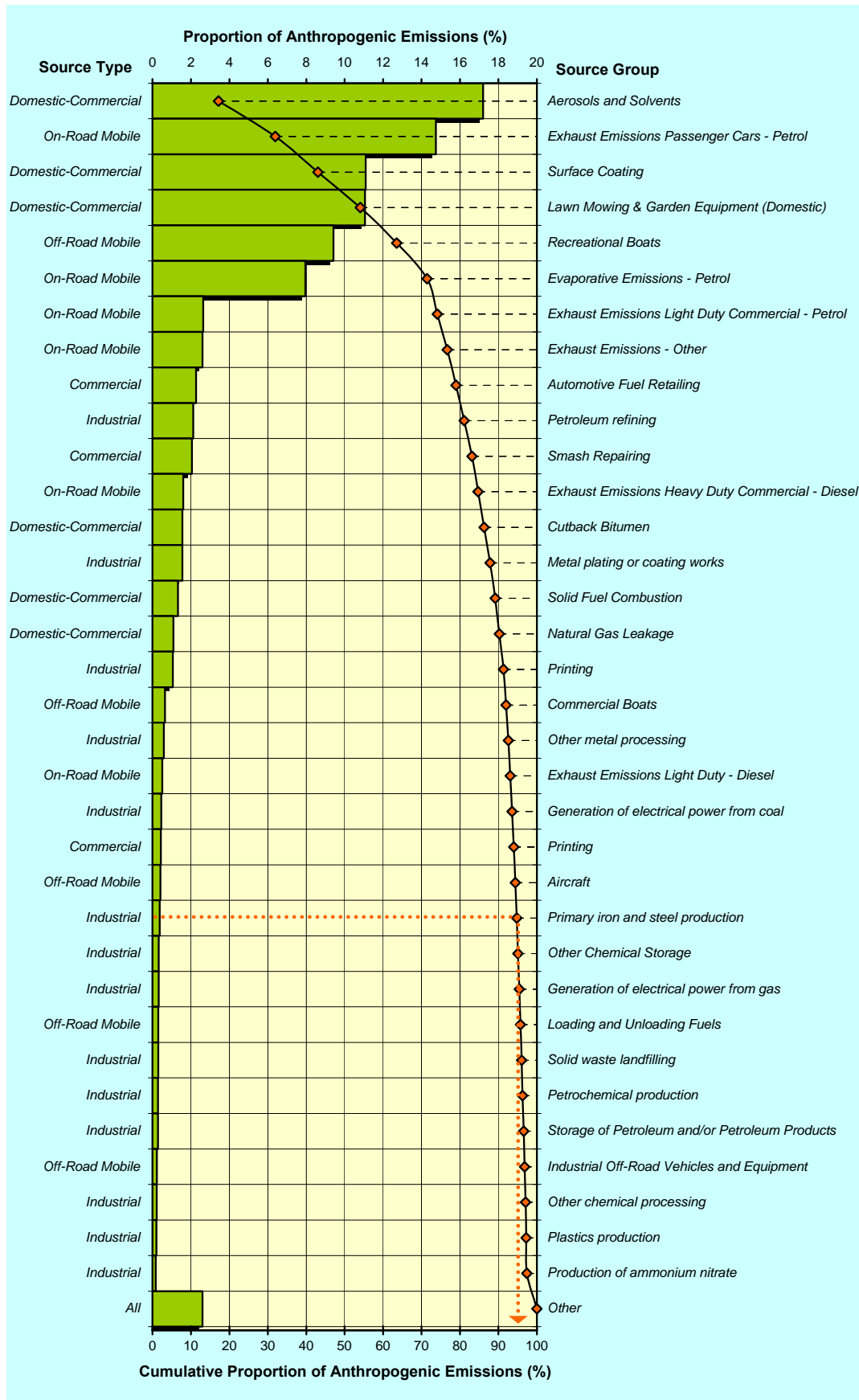


Figure B15 Ranking of anthropogenic sources of total VOCs in the GMR for a typical January weekend day

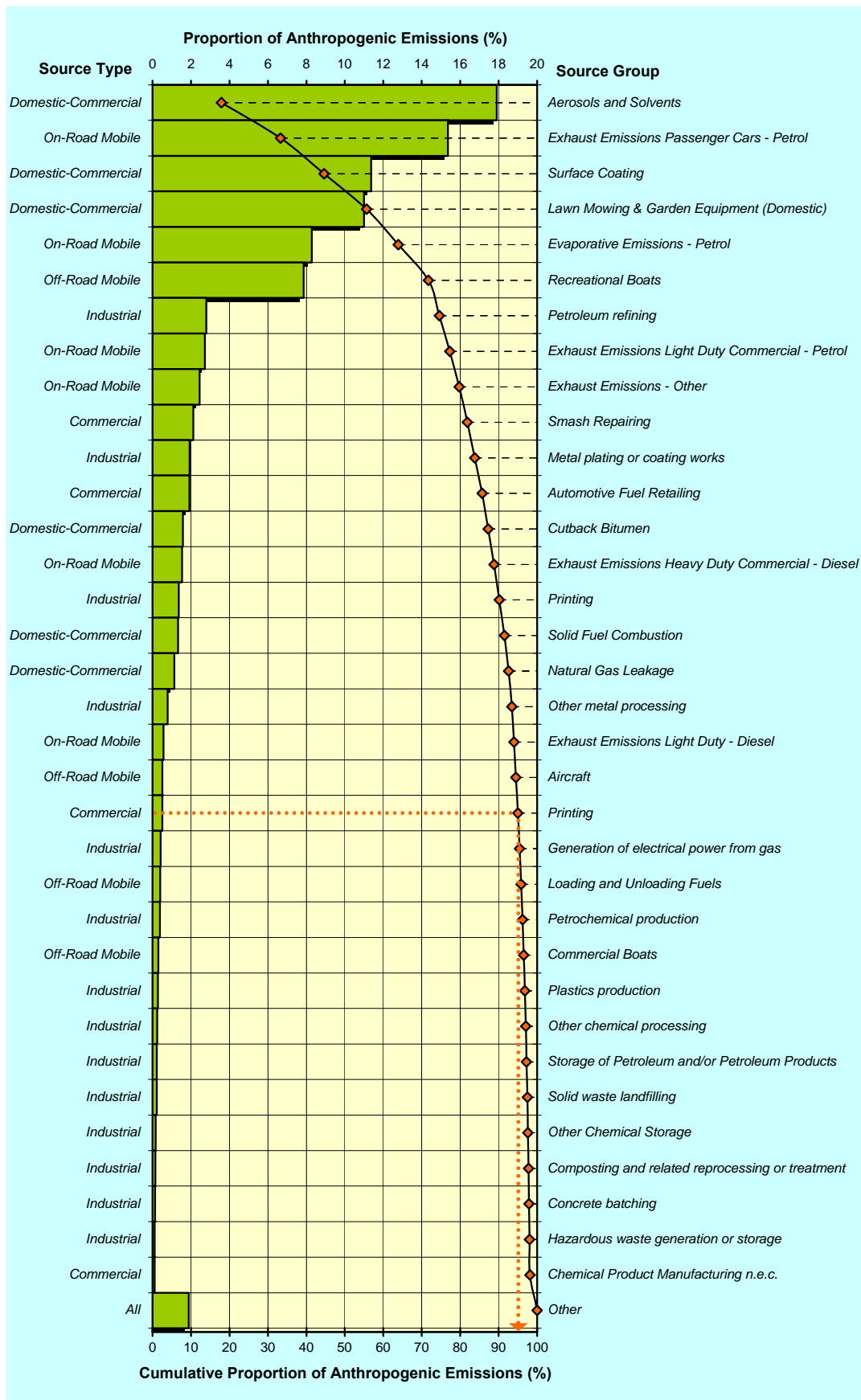


Figure B16 Ranking of anthropogenic sources of total VOCs in the Sydney region for a typical January weekend day

APPENDIX C: DAILY JULY EMISSIONS

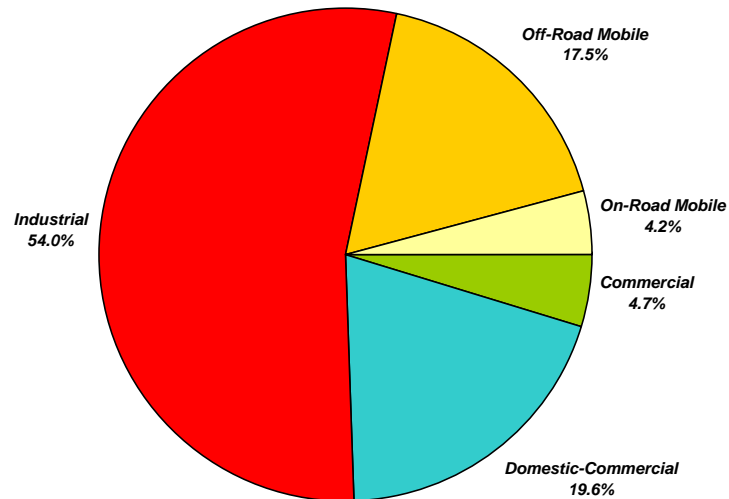


Figure C1 Proportion of total estimated daily emissions of particulate matter < 10 μm from each anthropogenic source group in the GMR for a typical July weekday

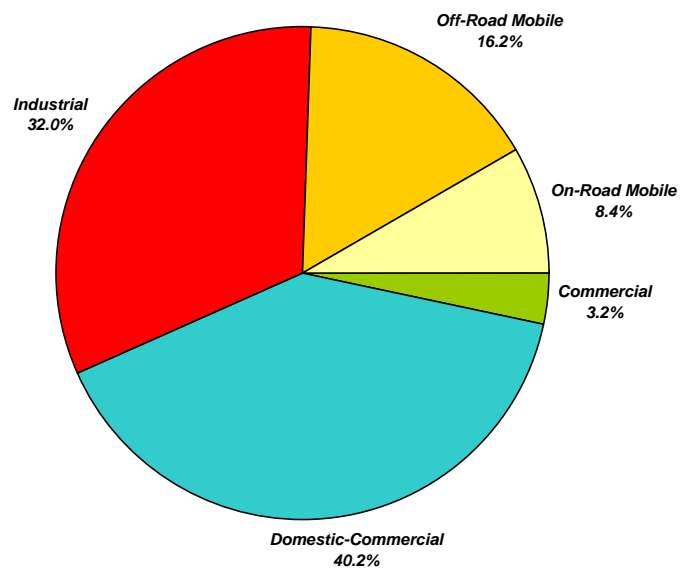


Figure C2 Proportion of total estimated daily emissions of particulate matter < 2.5 μm from each anthropogenic source group in the GMR for a typical July weekday

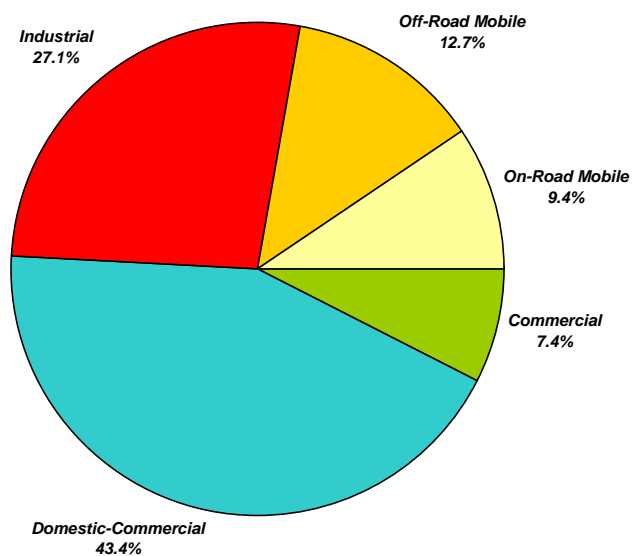


Figure C3 Proportion of total estimated daily emissions of particulate matter < 10 μm from each anthropogenic source group in the Sydney region for a typical July weekday

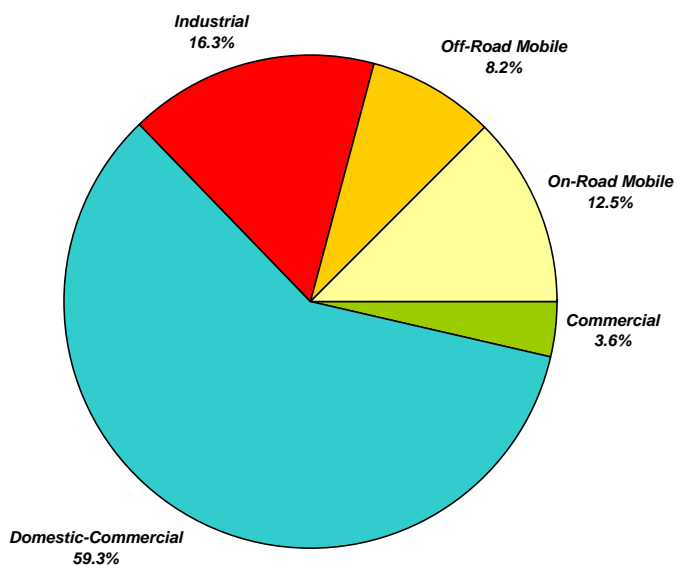


Figure C4 Proportion of total estimated daily emissions of particulate matter < 2.5 μm from each anthropogenic source group in the Sydney region for a typical July weekday

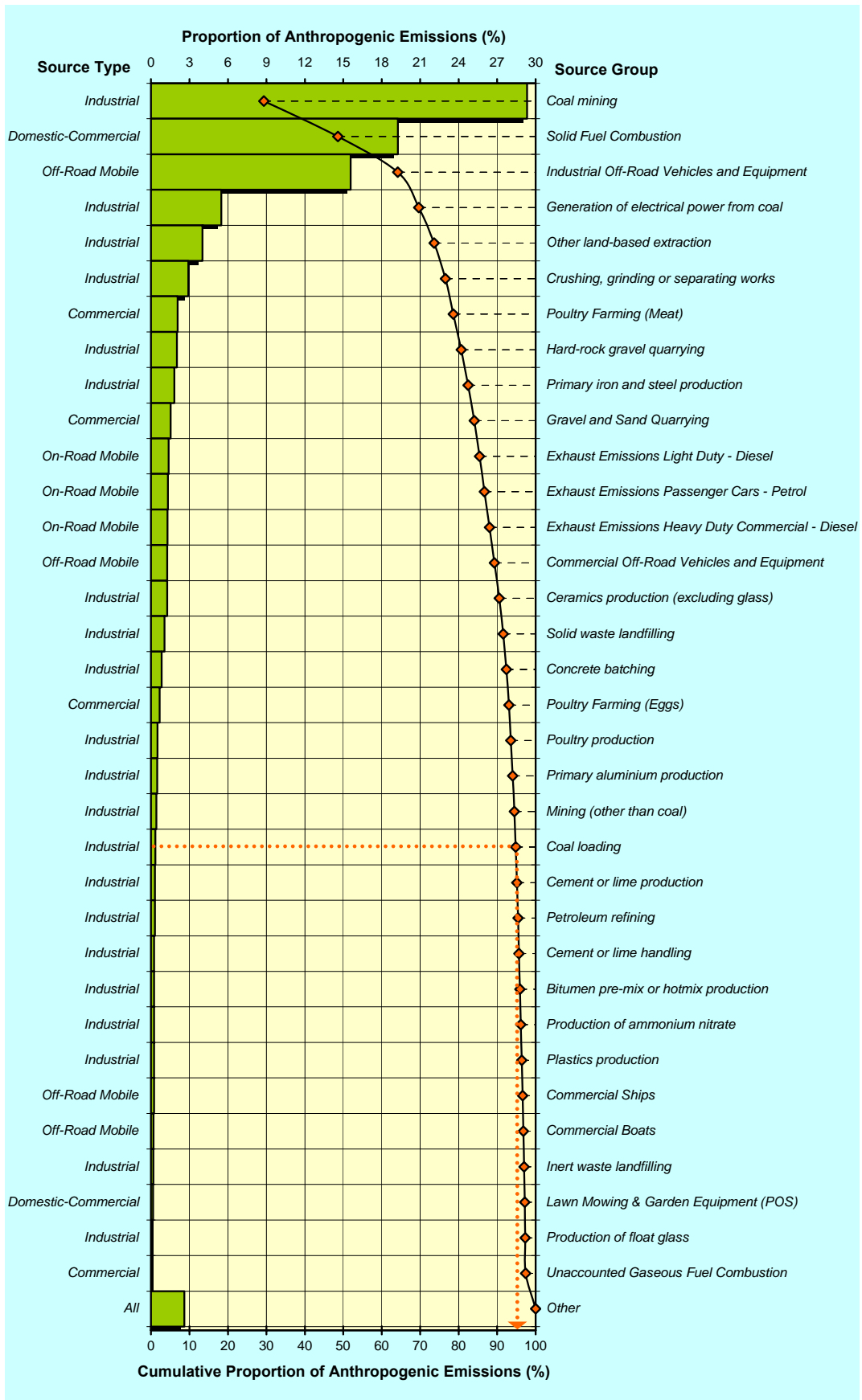


Figure C5 Ranking of anthropogenic sources of particulate matter < 10 µm in the GMR for a typical July weekday

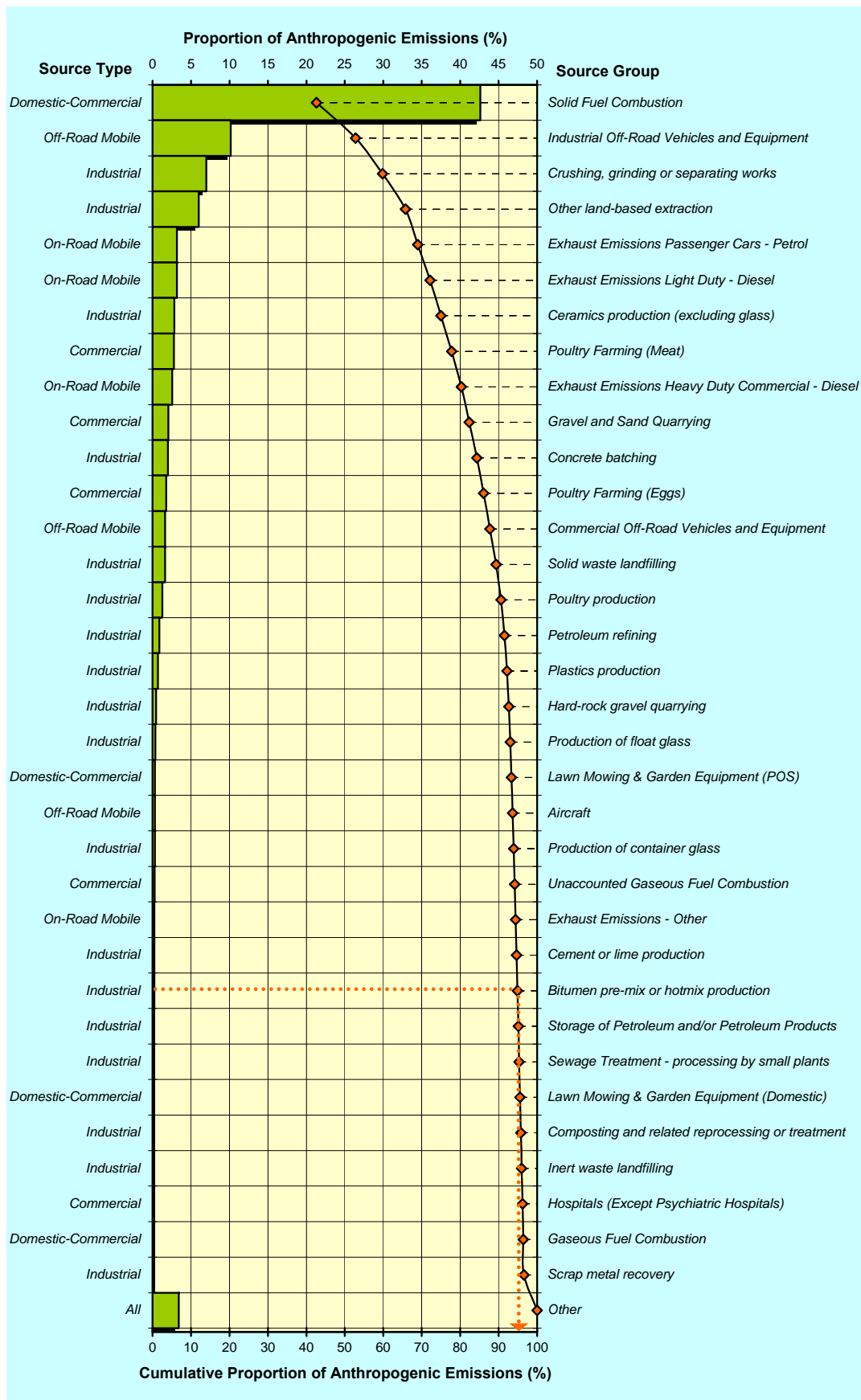


Figure C6 Ranking of anthropogenic sources of particulate matter < 10 μm in the Sydney region for a typical July weekday

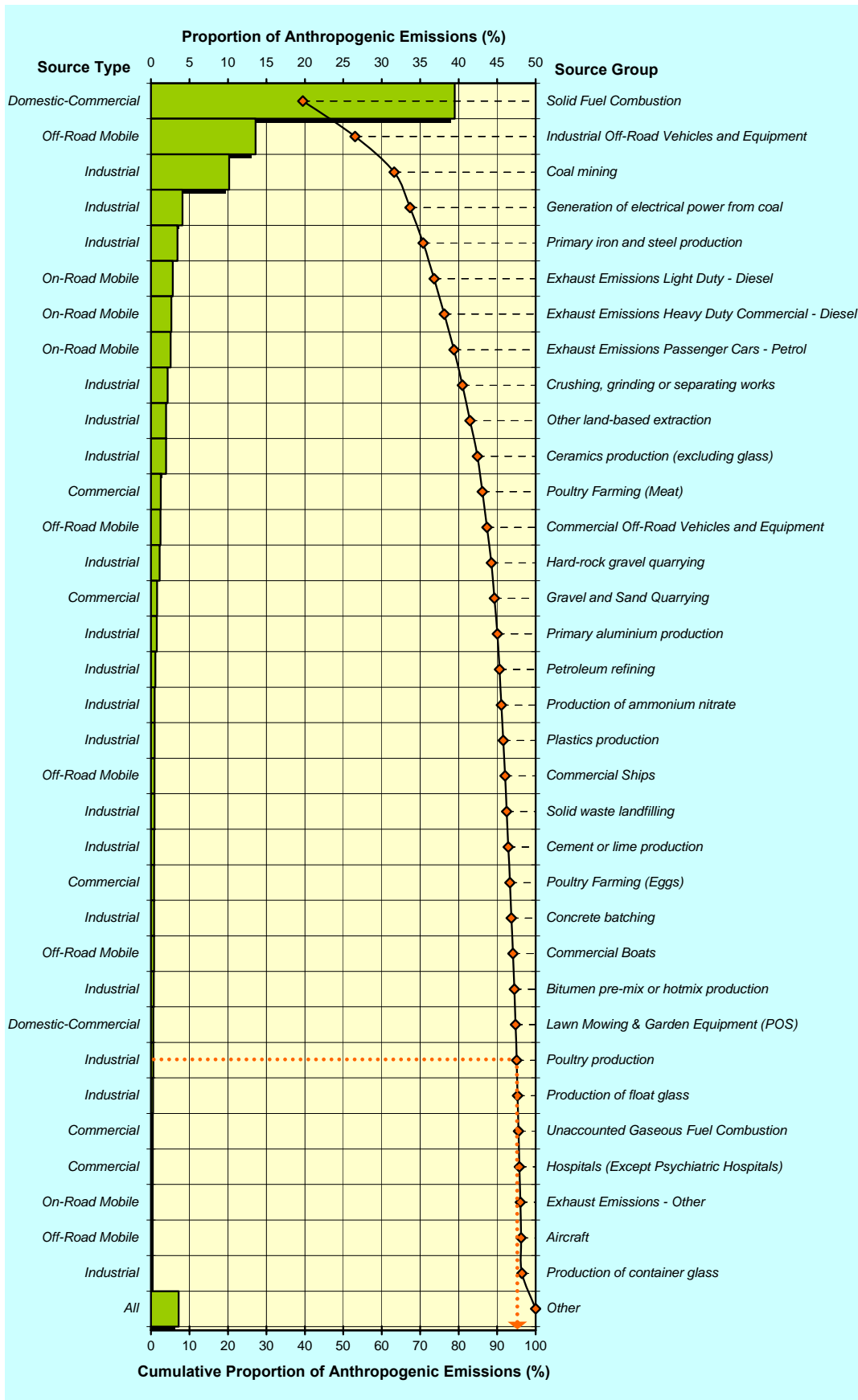


Figure C7 Ranking of anthropogenic sources of particulate matter < 2.5 μm in the GMR for a typical July weekday

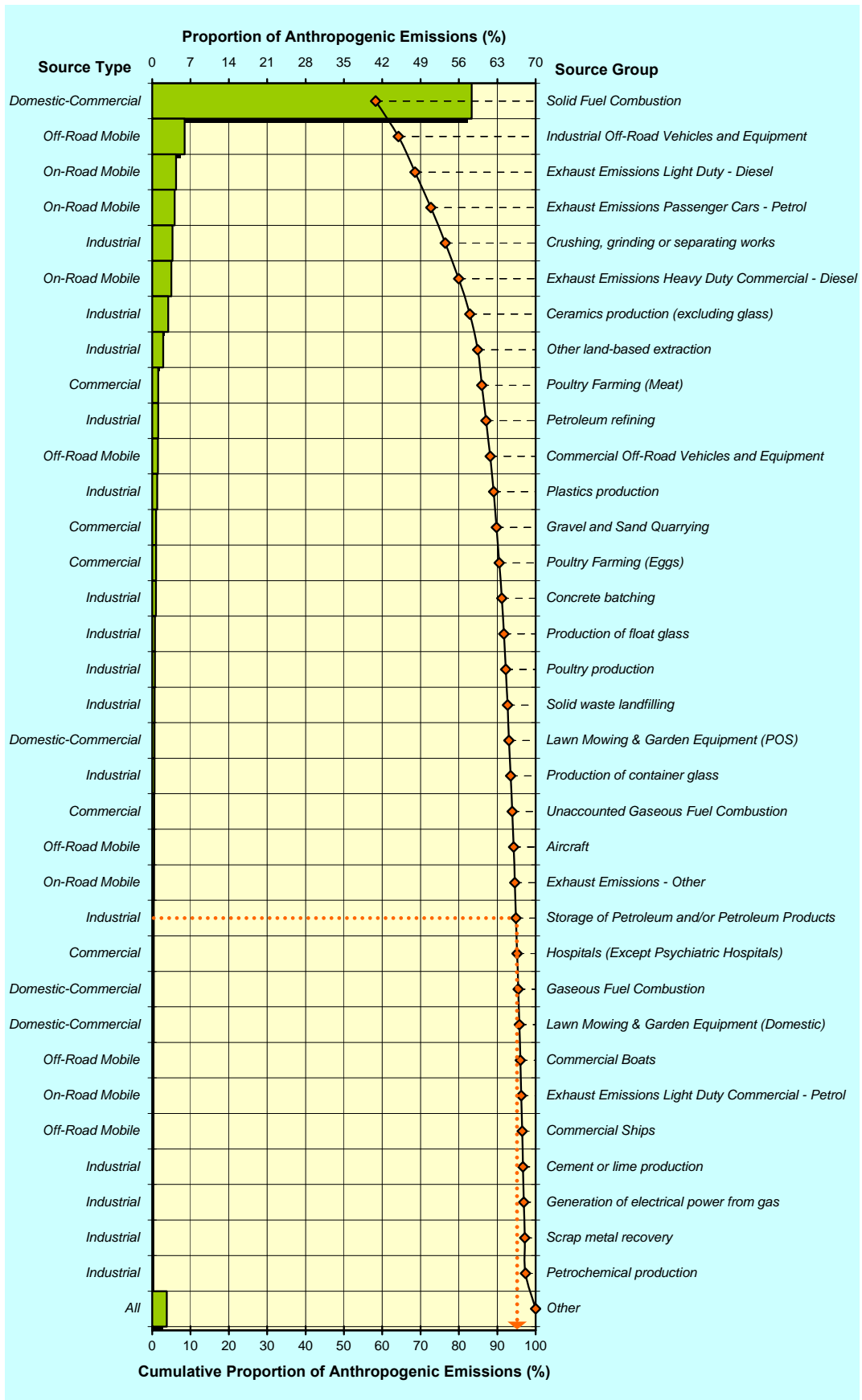


Figure C8 Ranking of anthropogenic sources of particulate matter < 2.5 μm in the Sydney region for a typical July weekday

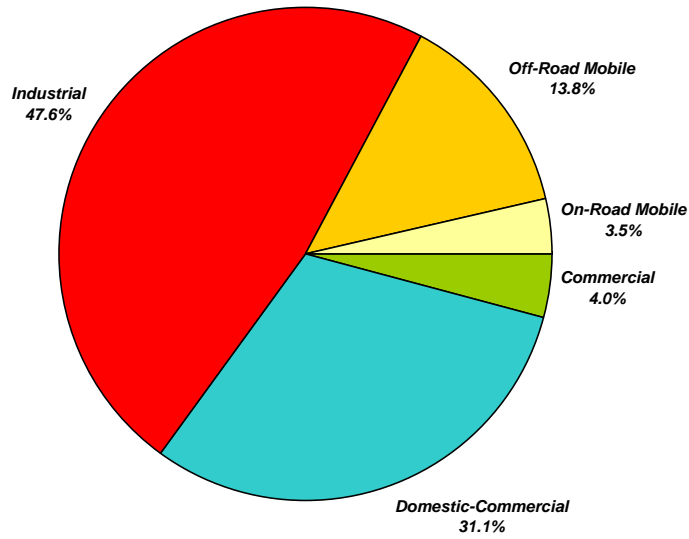


Figure C9 Proportion of total estimated daily emissions of particulate matter < 10 μm from each anthropogenic source group in the GMR for a typical July weekend day

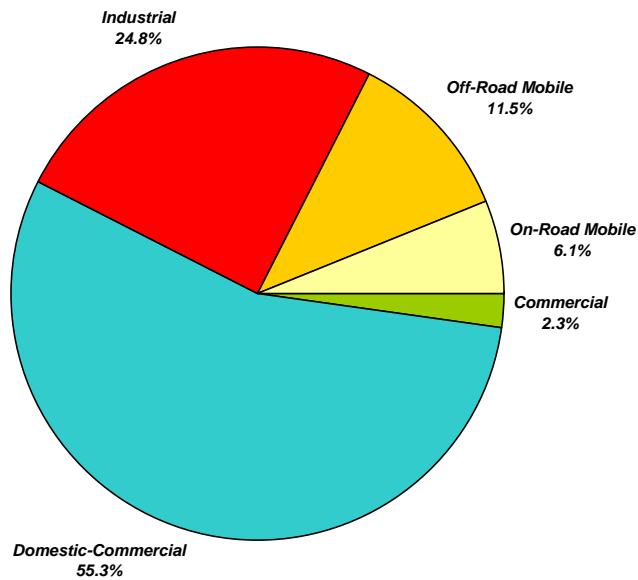


Figure C10 Proportion of total estimated daily emissions of particulate matter < 2.5 μm from each anthropogenic source group in the GMR for a typical July weekend day

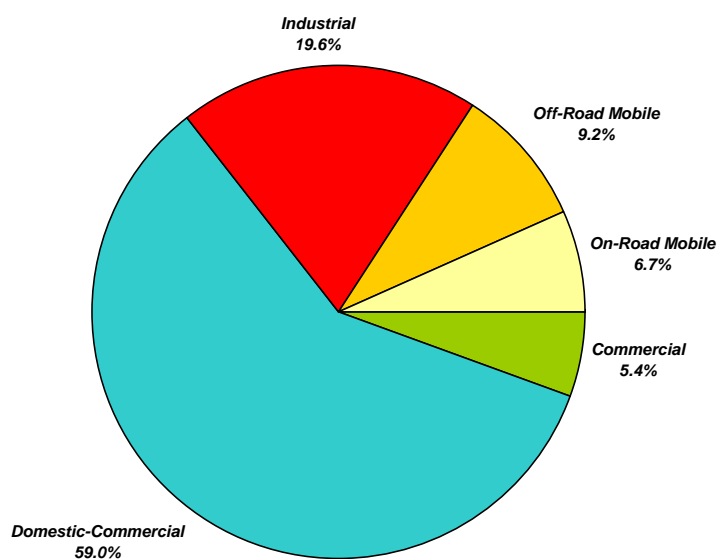


Figure C11 Proportion of total estimated daily emissions of particulate matter < 10 μm from each anthropogenic source group in the Sydney region for a typical July weekend day

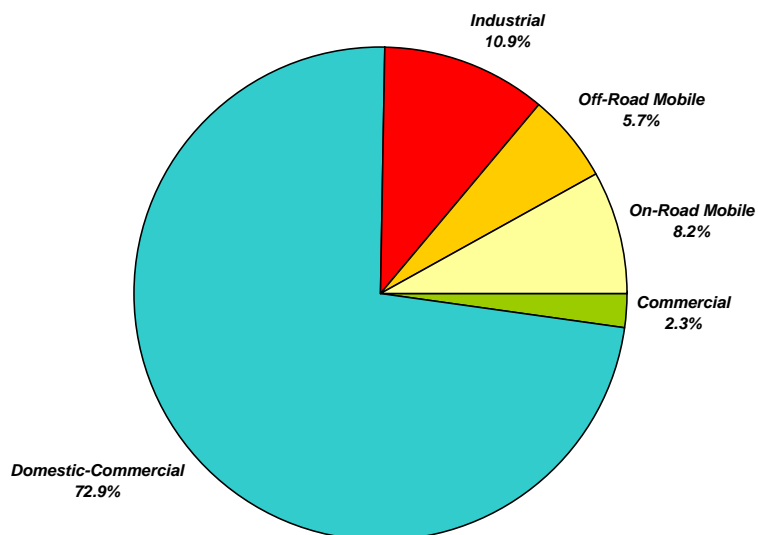


Figure C12 Proportion of total estimated daily emissions of particulate matter < 2.5 μm from each anthropogenic source group in the Sydney region for a typical July weekend day

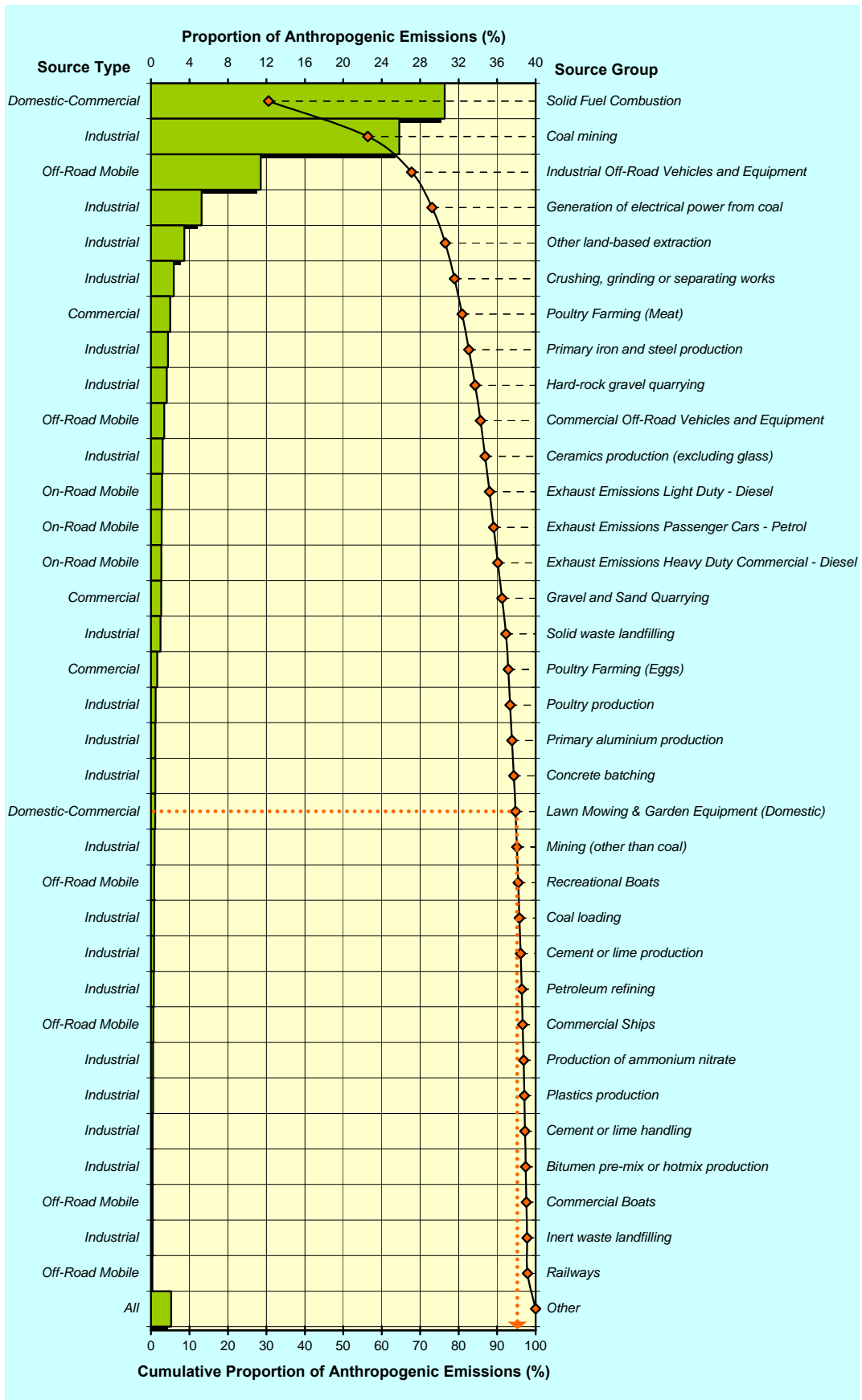


Figure C13 Ranking of anthropogenic sources of particulate matter < 10 μm in the GMR for a typical July weekend day

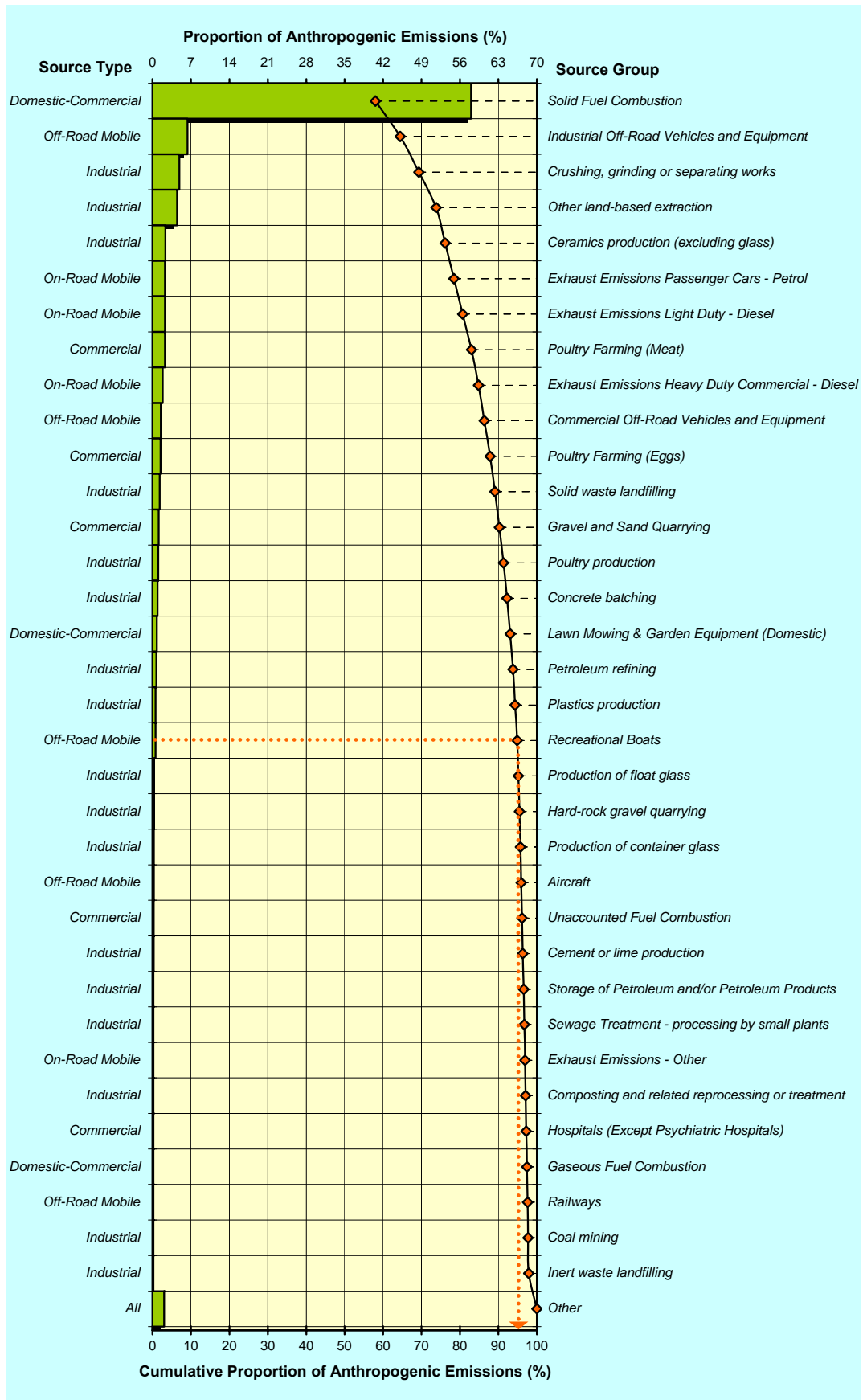


Figure C14 Ranking of anthropogenic sources of particulate matter < 10 µm in the Sydney region for a typical July weekend day

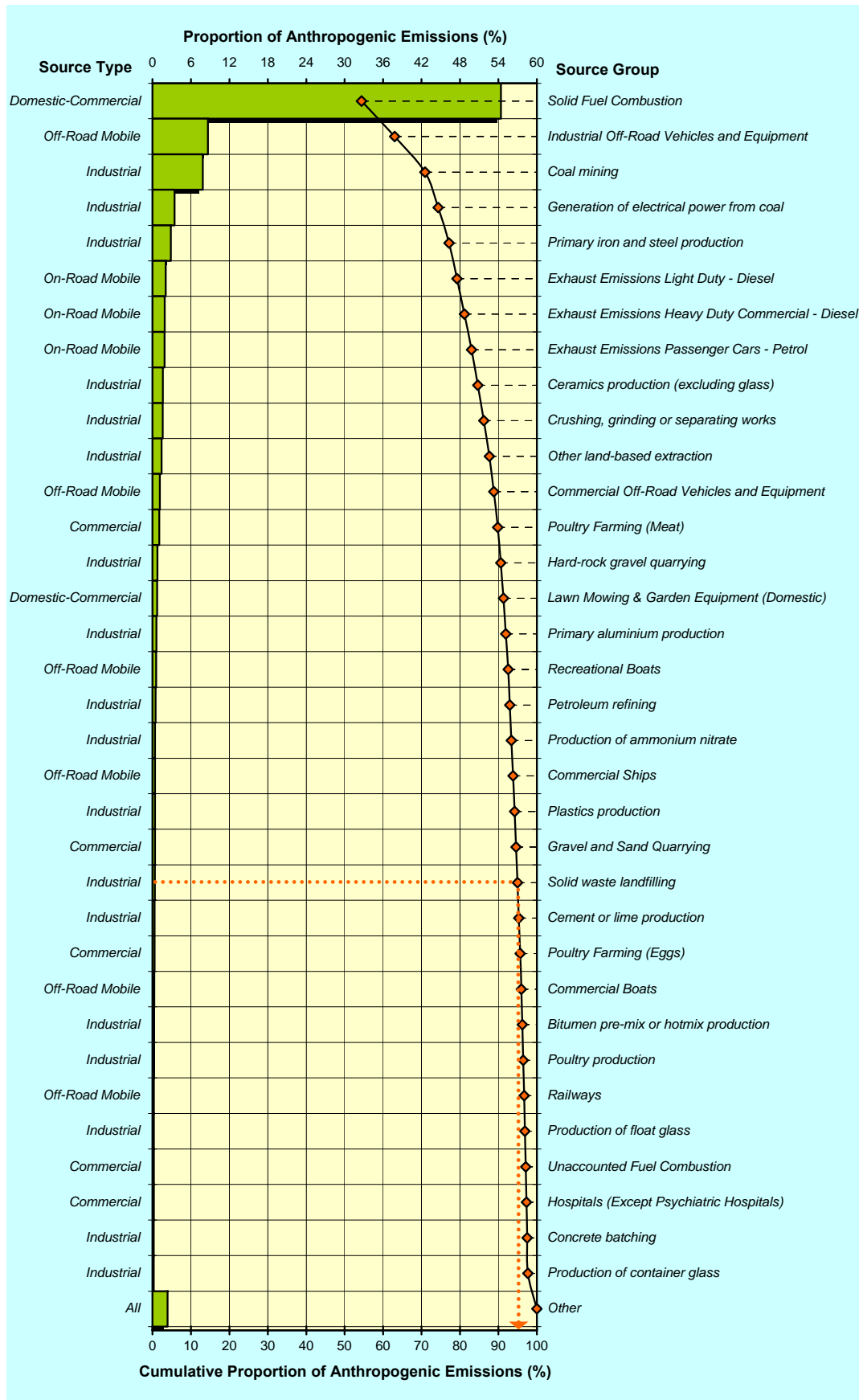


Figure C15 Ranking of anthropogenic sources of particulate matter < 2.5 μm in the GMR for a typical July weekend day

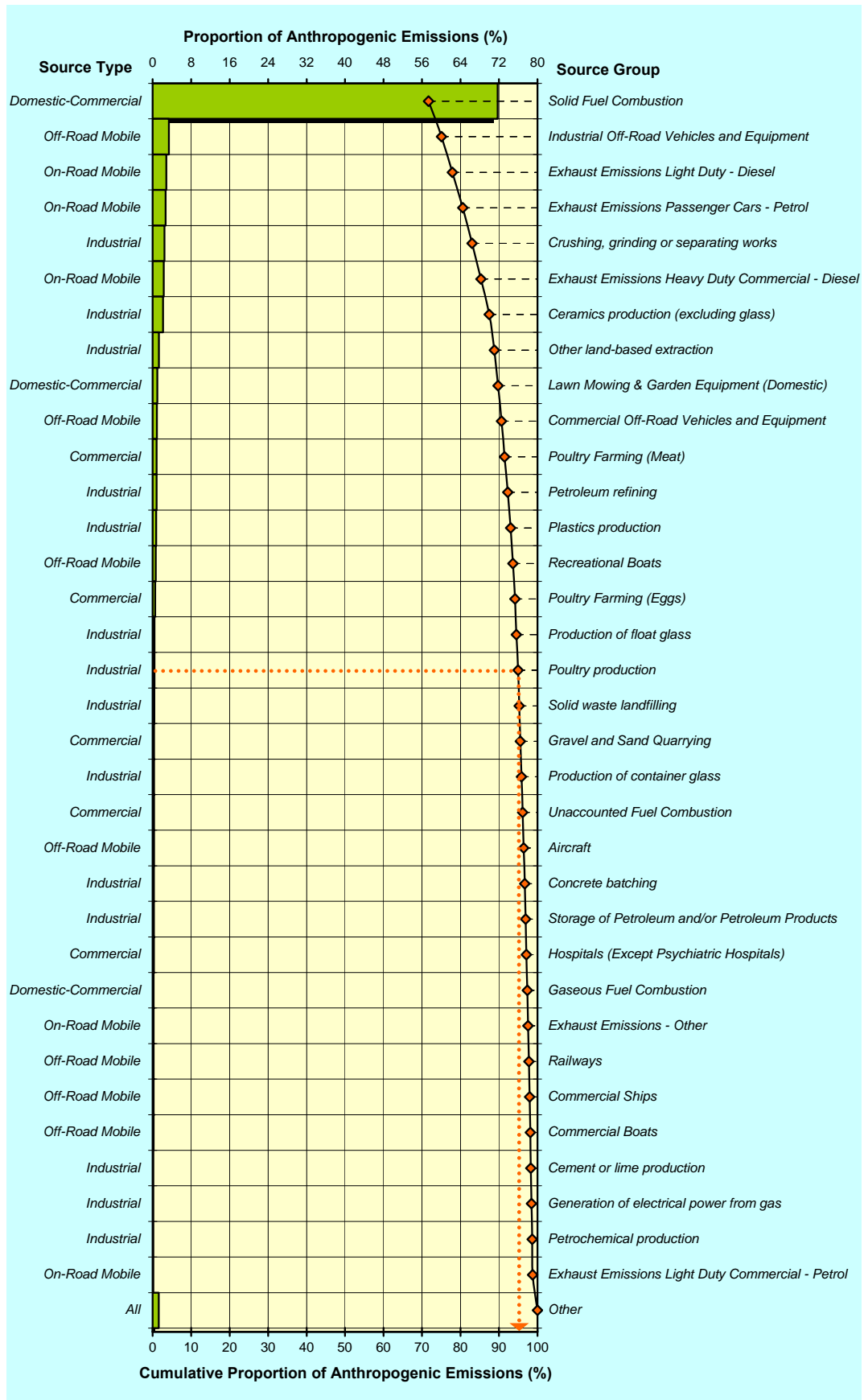


Figure C16 Ranking of anthropogenic sources of particulate matter < 2.5 μm in the Sydney region for a typical July weekend day