

**Technical Report No. 1**

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

**2008 Calendar Year**

**Consolidated Natural and Human-Made Emissions:  
Results**



## ACKNOWLEDGMENTS

This study was performed with the help of organisations and individuals who should be recognised for their efforts.

The 801 residential households and 1108 EPA-licensed premises that participated in the domestic and industrial surveys conducted by Taverner Research and the Office of Environment and Heritage, respectively, are gratefully acknowledged. Their input has enabled a thorough evaluation of domestic and industrial sources of air emissions. Data provided by other government departments and service providers, including Airservices Australia, Allpower Industries Australia Pty Ltd, Australian Asphalt Pavement Association, Australian Bureau of Agricultural and Resource Economics and Sciences, Australian Bureau of Statistics, Australian Paint Manufacturers Federation Inc., Australian Rail Track Corporation, Bureau of Infrastructure, Transport and Regional Economics, Bureau of Transport Statistics, Commonwealth Scientific and Industrial Research Organisation, Department of Resources, Energy and Tourism, Informark, International Fertilizer Industry Association, Jemena Gas Networks (NSW) Ltd, Lloyds Register, NSW Department of Health, NSW Maritime, NSW Registry of Births, Deaths and Marriages, NSW Rural Fire Service, Newcastle Buses and Ferries, Newcastle Port Corporation, Office of Environment and Heritage, Outboard Engine Distributors Association, Primary Industries Division of the Department of Trade and Investment, Regional Infrastructure and Services, Pacific National, Port Kembla Port Corporation, RailCorp, Sydney Ports Corporation, Taverner Research, Transport for NSW, United States Department of Agriculture and Winetitles Pty Ltd, were essential for the completion of this study.

The work of a number of individuals is acknowledged, including Mr Nick Agapides, Manager Major Air Projects, Mr Kelsey Bawden, Senior Technical Policy Advisor and Mr Gareth Jones, Senior Atmospheric Scientist for their efforts in project scoping and management, developing emission estimation methodologies, collecting activity data, developing databases, estimating emissions and preparing this report.

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Published by:

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ISBN 978-1-74293-556-0

EPA 2012/0255

August 2012

## **EXECUTIVE SUMMARY**

An air emissions inventory project for natural and human-made sources has taken over 2 years to complete. The base year of the inventory represents activities that took place during the 2008 calendar year and is accompanied by emission projections in yearly increments up to the 2036 calendar year. The area included in the inventory covers the greater Sydney, Newcastle and Wollongong regions, known collectively as the Greater Metropolitan Region (GMR).

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

**Table ES-1: Definition of Greater Metropolitan, Sydney, Newcastle and Wollongong regions**

Region	South-west corner MGA <sup>1</sup> coordinates		North-east corner MGA coordinates	
	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

The air emissions inventory includes emissions from biogenic (i.e. natural living organisms), geogenic (i.e. natural non-living) and anthropogenic (i.e. human-made) sources, as follows:

- Natural (e.g. bushfires, marine aerosol and vegetation);
- Commercial businesses (e.g. non-EPA licensed<sup>2</sup> printers, quarries and service stations);
- Domestic activities (e.g. residential lawn mowing, portable fuel containers and wood heaters);
- Industrial premises (e.g. EPA licensed<sup>3</sup> coal mines, oil refineries and power stations);
- Off-road vehicles and equipment (e.g. dump trucks, bulldozers, and marine vessels); and
- On-road transport (e.g. registered buses, cars and trucks).

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<sup>1</sup> Map Grid of Australia based on the Geocentric Datum of Australia 1994 (GDA94) (ICSM, 2006).

<sup>2</sup> Not a scheduled activity or scheduled development work as defined in the *Protection of the Environment (Operations) Act 1997* (PCO, 2010a).

<sup>3</sup> An activity listed in Schedule 1 of the *Protection of the Environment (Operations) Act 1997* (PCO, 2010a).



**Figure ES-1: Definition of Greater Metropolitan, Sydney, Newcastle and Wollongong regions**

The pollutants inventoried include criteria pollutants specified in the Ambient Air Quality NEPM (NEPC, 2003), air toxics associated with the National Pollutant Inventory NEPM (NEPC, 2008) and the Air Toxics NEPM (NEPC, 2004), and any other pollutants associated with state-specific programs, i.e. Load Based Licensing (Protection of the Environment Operations (General) Regulation 2009 (PCO, 2010b)) and the Protection of the Environment Operations (Clean Air) Regulation 2010 (PCO, 2011).

This report presents emissions of criteria pollutants referred to in the Ambient Air Quality NEPM (NEPC, 2003), including:

- Carbon monoxide (CO);
- Oxides of nitrogen (NO<sub>x</sub>);
- Particulate matter ≤ 10 μm (PM<sub>10</sub>);
- Particulate matter ≤ 2.5 μm (PM<sub>2.5</sub>);
- Sulfur dioxide (SO<sub>2</sub>); and
- Total volatile organic compounds (VOC).

More detailed information about source types and emissions of other air pollutants from natural, commercial businesses, domestic activities, industrial premises, off-road vehicles and equipment and on-road transport sources can be found in the individual air emissions inventory reports (EPA, 2012a; EPA, 2012b; EPA, 2012c; EPA, 2012d; EPA, 2012e; and EPA, 2012f), respectively.

Table ES-2 presents total estimated annual emissions of criteria pollutants from natural and human-made sources in the whole GMR and the Sydney, Newcastle and Wollongong regions. Total estimated annual emissions are also presented for the region defined as Non Urban. This region is the area of the GMR minus the combined areas of the Sydney, Newcastle and Wollongong regions.

**Table ES-2: Total estimated annual emissions from natural and human-made sources in each region**

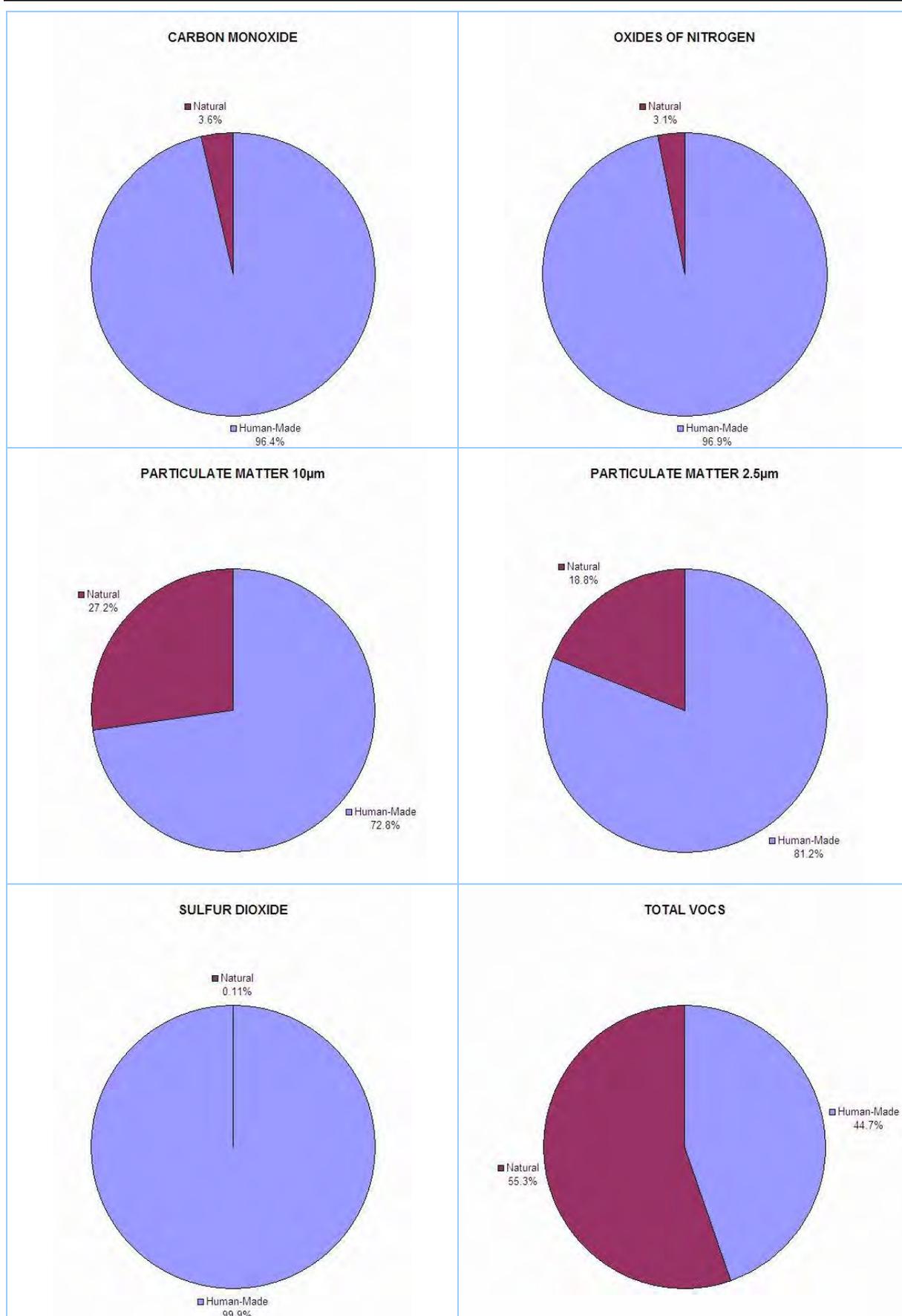
Substance	Region	Emissions (tonne/year)		
		Human-Made	Natural	Grand Total
CARBON MONOXIDE	Sydney	241,208	5,484	246,692
	Newcastle	60,225	301	60,526
	Wollongong	540,390	603	540,993
	Non Urban	88,937	28,545	117,482
	GMR	930,759	34,934	965,693
OXIDES OF NITROGEN	Sydney	73,427	1,296	74,722
	Newcastle	9,506	126	9,632
	Wollongong	11,708	71	11,779
	Non Urban	214,704	8,319	223,023
	GMR	309,344	9,811	319,156
PARTICULATE MATTER $\leq 10 \mu\text{m}$	Sydney	16,543	3,901	20,443
	Newcastle	4,838	689	5,526
	Wollongong	2,690	327	3,017
	Non Urban	65,752	28,719	94,471
	GMR	89,823	33,635	123,458
PARTICULATE MATTER $\leq 2.5 \mu\text{m}$	Sydney	10,777	951	11,728
	Newcastle	2,023	121	2,144
	Wollongong	1,869	90	1,959
	Non Urban	17,076	6,176	23,253
	GMR	31,744	7,338	39,083
SULFUR DIOXIDE	Sydney	10,749	50	10,798
	Newcastle	11,593	2.72	11,596
	Wollongong	9,063	5.49	9,068
	Non Urban	257,516	259	257,774
	GMR	288,920	317	289,237
TOTAL VOLATILE ORGANIC COMPOUNDS	Sydney	98,889	32,468	131,356
	Newcastle	7,985	3,404	11,389
	Wollongong	5,205	3,482	8,687
	Non Urban	24,879	130,284	155,163
	GMR	136,957	169,637	306,595

Table ES-3 presents the proportions of total estimated annual emissions of criteria pollutants from natural and human-made sources in the whole GMR and the Sydney, Newcastle, Wollongong and Non Urban regions.

**Table ES-3: Proportions of total estimated annual emissions from natural and human-made sources in each region**

Substance	Region	Proportions (%)	
		Human-Made	Natural
CARBON MONOXIDE	Sydney	97.78	2.22
	Newcastle	99.50	0.50
	Wollongong	99.89	0.11
	Non Urban	75.70	24.30
	GMR	96.38	3.62
OXIDES OF NITROGEN	Sydney	98.27	1.73
	Newcastle	98.69	1.31
	Wollongong	99.40	0.60
	Non Urban	96.27	3.73
	GMR	96.93	3.07
PARTICULATE MATTER ≤ 10 µm	Sydney	80.92	19.08
	Newcastle	87.54	12.46
	Wollongong	89.17	10.83
	Non Urban	69.60	30.40
	GMR	72.76	27.24
PARTICULATE MATTER ≤ 2.5 µm	Sydney	91.89	8.11
	Newcastle	94.37	5.63
	Wollongong	95.40	4.60
	Non Urban	73.44	26.56
	GMR	81.22	18.78
SULFUR DIOXIDE	Sydney	99.54	0.46
	Newcastle	99.98	$2.35 \times 10^{-2}$
	Wollongong	99.94	$6.05 \times 10^{-2}$
	Non Urban	99.90	0.10
	GMR	99.89	0.11
TOTAL VOLATILE ORGANIC COMPOUNDS	Sydney	75.28	24.72
	Newcastle	70.11	29.89
	Wollongong	59.92	40.08
	Non Urban	16.03	83.97
	GMR	44.67	55.33

Figure ES-2, Figure ES-3, Figure ES-4, Figure ES-5 and Figure ES-6 show the proportions of total estimated annual emissions of criteria pollutants from natural and human-made sources in the whole GMR and the Sydney, Newcastle, Wollongong and Non Urban regions, respectively.



**Figure ES-2: Proportions of total estimated annual emissions from natural and human-made sources in the GMR**

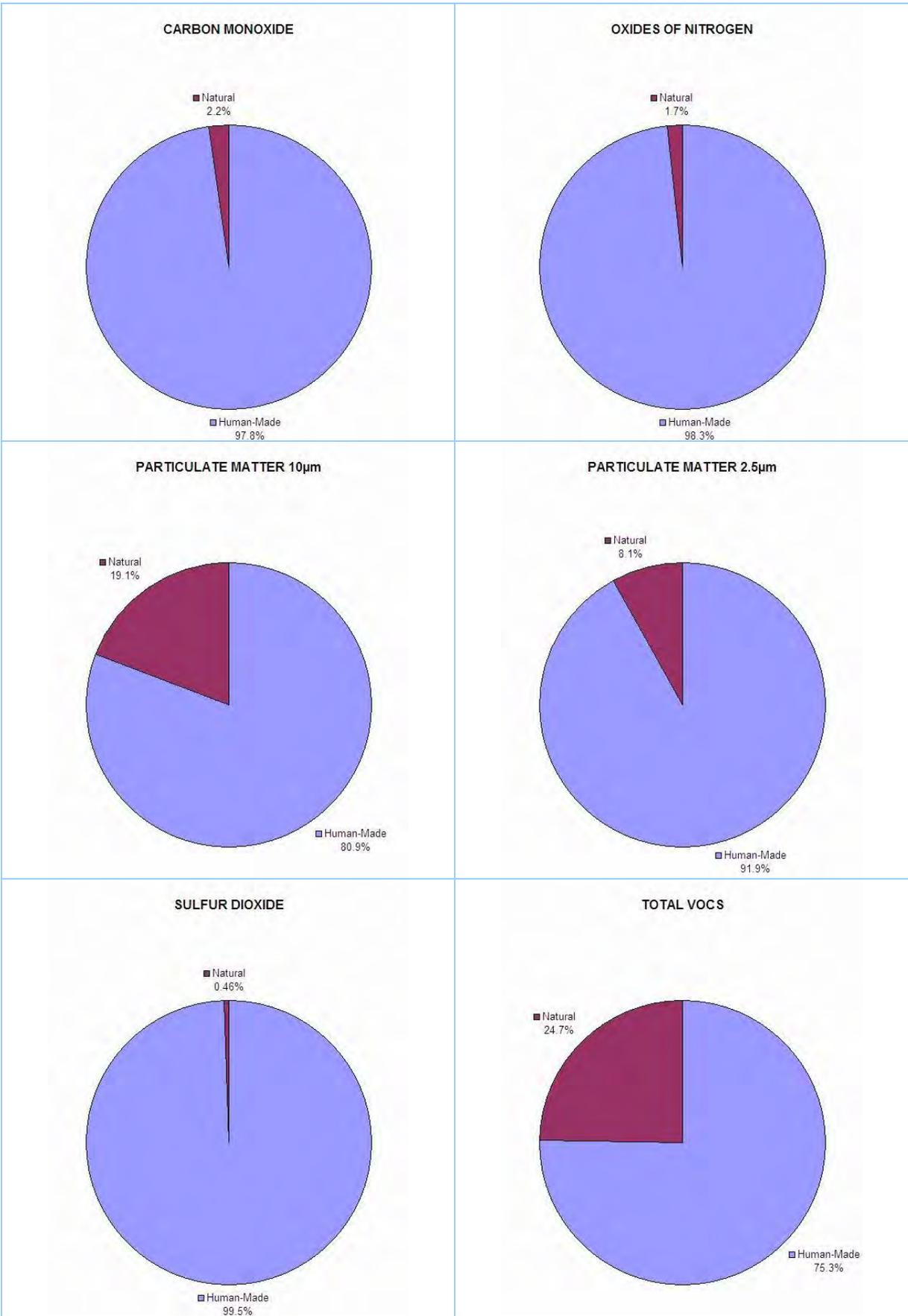


Figure ES-3: Proportions of total estimated annual emissions from natural and human-made sources in the Sydney region

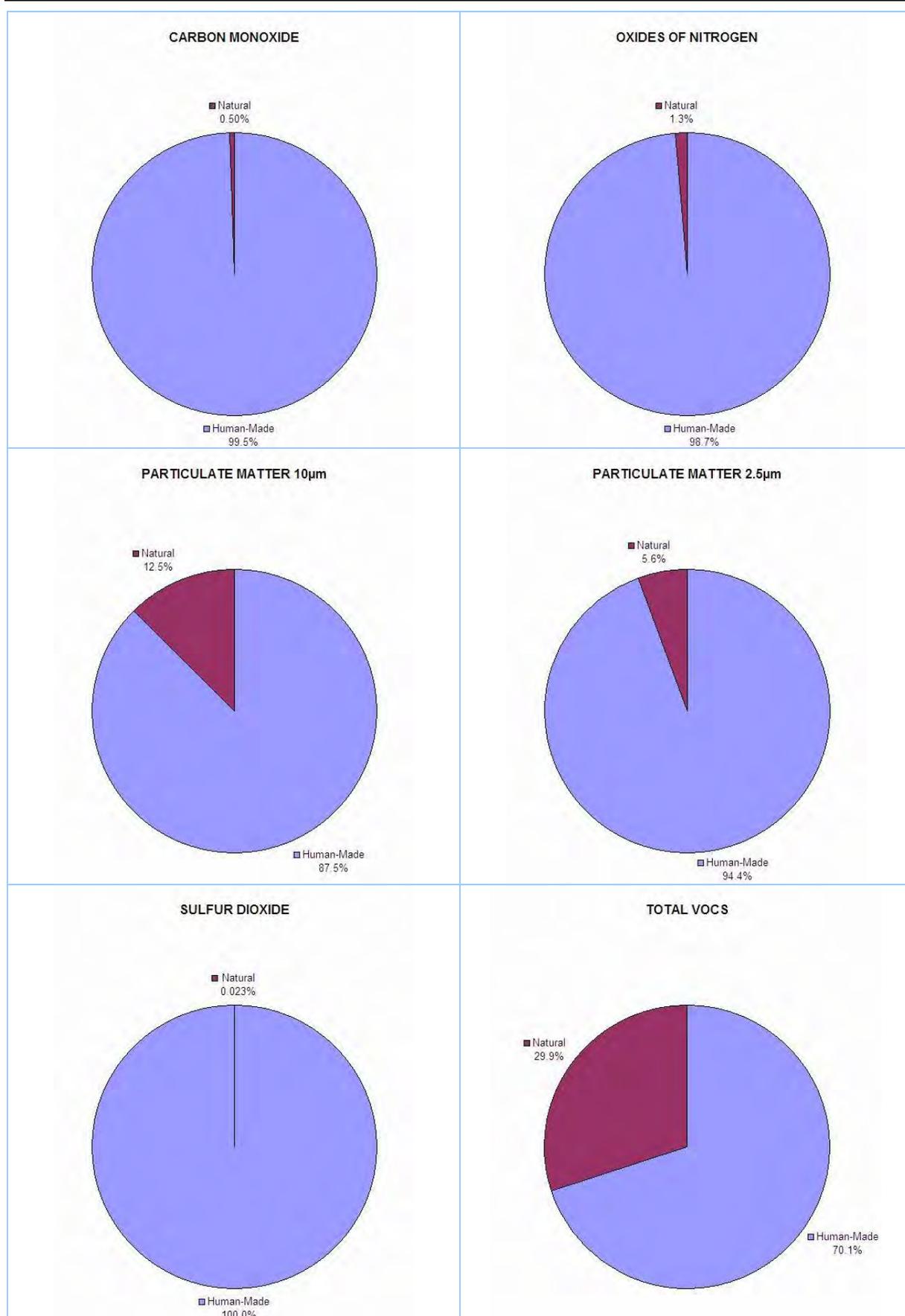


Figure ES-4: Proportions of total estimated annual emissions from natural and human-made sources in the Newcastle region

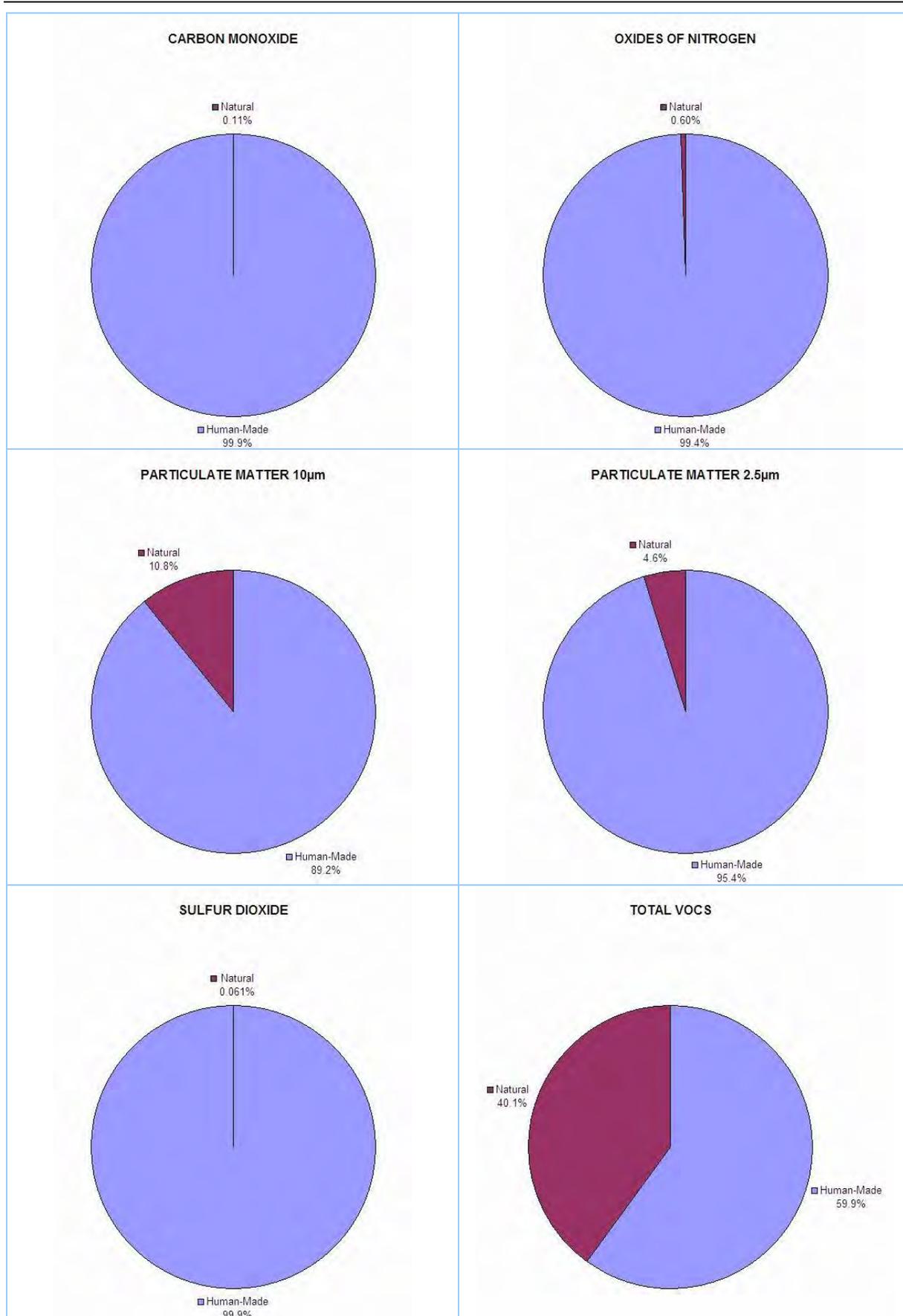
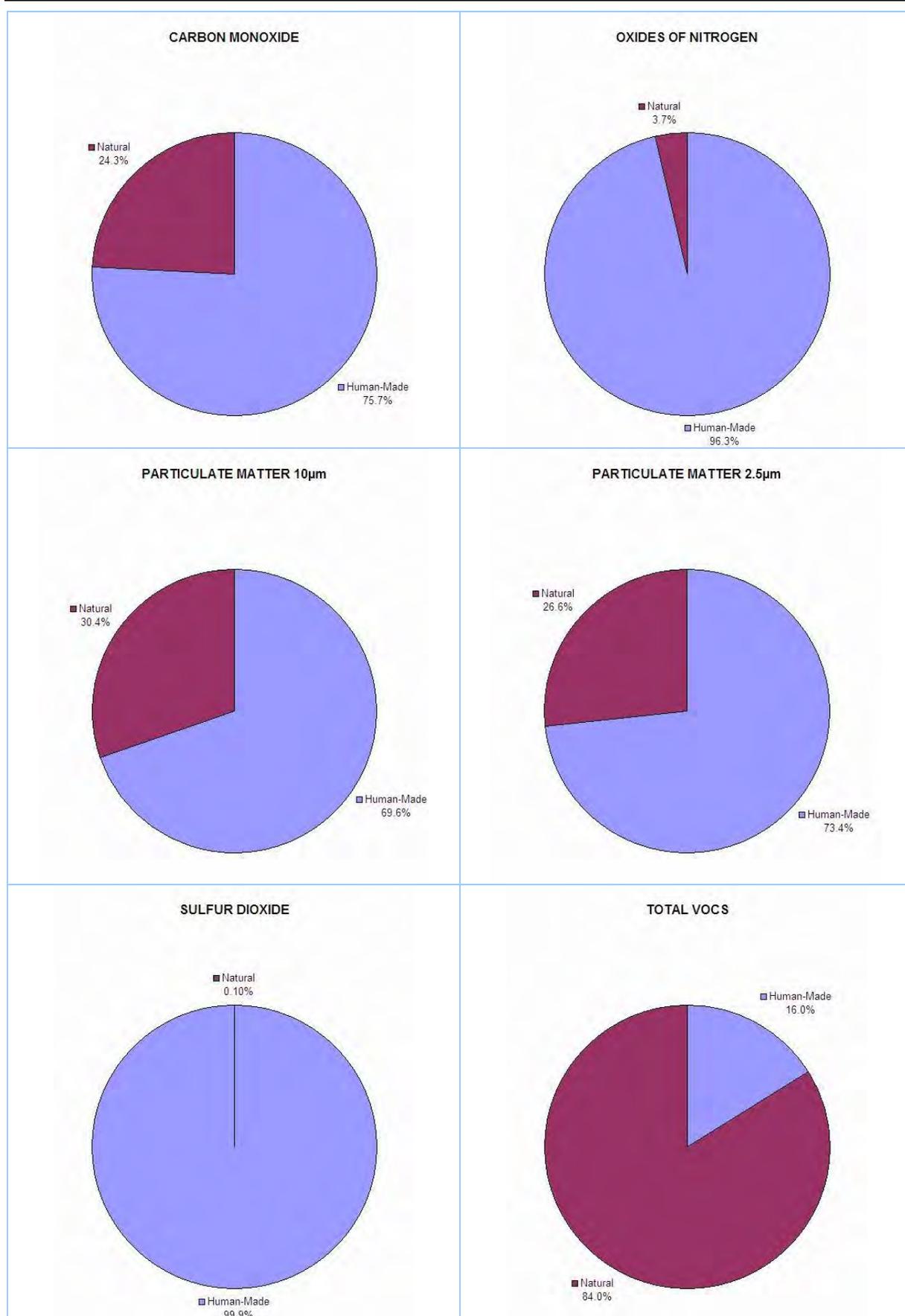


Figure ES-5: Proportions of total estimated annual emissions from natural and human-made sources in the Wollongong region



**Figure ES-6: Proportions of total estimated annual emissions from natural and human-made sources in the Non Urban region**

Table ES-4 presents total estimated annual emissions of criteria pollutants by human-made source type in the whole GMR and the Sydney, Newcastle, Wollongong and Non Urban regions.

**Table ES-4: Total estimated annual emissions by human-made source type in each region**

Substance	Region	Emissions (tonne/year)					
		Commercial	Domestic-Commercial	Industrial	Off-Road Mobile	On-Road Mobile	Grand Total
CARBON MONOXIDE	Sydney	335	82,186	14,173	20,801	123,712	241,208
	Newcastle	9.20	6,554	41,950	3,343	8,369	60,225
	Wollongong	20	4,412	529,474	1,698	4,786	540,390
	Non Urban	24	16,226	27,768	27,975	16,944	88,937
	GMR	389	109,377	613,365	53,817	153,812	930,759
OXIDES OF NITROGEN	Sydney	344	2,531	8,921	16,238	45,392	73,427
	Newcastle	39	184	1,833	3,548	3,902	9,506
	Wollongong	12	130	7,784	1,598	2,184	11,708
	Non Urban	106	445	172,873	31,826	9,453	214,704
	GMR	501	3,290	191,411	53,210	60,932	309,344
PARTICULATE MATTER $\leq 10 \mu\text{m}$	Sydney	1,111	6,088	6,215	1,019	2,110	16,543
	Newcastle	129	504	3,744	284	176	4,838
	Wollongong	48	334	2,099	119	90	2,690
	Non Urban	732	1,262	61,155	2,185	417	65,752
	GMR	2,020	8,189	73,213	3,607	2,793	89,823
PARTICULATE MATTER $\leq 2.5 \mu\text{m}$	Sydney	485	5,853	1,935	952	1,553	10,777
	Newcastle	30	485	1,110	266	131	2,023
	Wollongong	14	321	1,354	112	68	1,869
	Non Urban	167	1,214	13,273	2,104	319	17,076
	GMR	695	7,873	17,672	3,433	2,071	31,744
SULFUR DIOXIDE	Sydney	108	131	5,574	4,725	210	10,749
	Newcastle	1.62	11	10,266	1,300	15	11,593
	Wollongong	0.73	7.07	8,494	553	8.13	9,063
	Non Urban	70	26	256,139	1,246	35	257,516
	GMR	180	175	280,472	7,824	269	288,920
TOTAL VOLATILE ORGANIC COMPOUNDS	Sydney	6,652	53,178	8,205	7,341	23,512	98,889
	Newcastle	476	3,757	771	1,303	1,678	7,985
	Wollongong	358	2,660	716	591	879	5,205
	Non Urban	1,689	9,213	1,826	8,715	3,435	24,879
	GMR	9,176	68,809	11,519	17,950	29,504	136,957

Table ES-5 presents the proportions of total estimated annual emissions of criteria pollutants by human-made source type in the whole GMR and the Sydney, Newcastle, Wollongong and Non Urban regions.

**Table ES-5: Proportions of total estimated annual emissions by human-made source type in each region**

Substance	Region	Proportions (%)				
		Commercial	Domestic-Commercial	Industrial	Off-Road Mobile	On-Road Mobile
CARBON MONOXIDE	Sydney	0.14	34.07	5.88	8.62	51.29
	Newcastle	$1.53 \times 10^{-2}$	10.88	69.66	5.55	13.90
	Wollongong	$3.64 \times 10^{-3}$	0.82	97.98	0.31	0.89
	Non Urban	$2.73 \times 10^{-2}$	18.24	31.22	31.45	19.05
	GMR	$4.17 \times 10^{-2}$	11.75	65.90	5.78	16.53
OXIDES OF NITROGEN	Sydney	0.47	3.45	12.15	22.11	61.82
	Newcastle	0.41	1.94	19.28	37.32	41.05
	Wollongong	0.10	1.11	66.48	13.65	18.65
	Non Urban	$4.93 \times 10^{-2}$	0.21	80.52	14.82	4.40
	GMR	0.16	1.06	61.88	17.20	19.70
PARTICULATE MATTER $\leq 10 \mu\text{m}$	Sydney	6.72	36.80	37.57	6.16	12.76
	Newcastle	2.67	10.42	77.40	5.87	3.64
	Wollongong	1.77	12.42	78.03	4.42	3.35
	Non Urban	1.11	1.92	93.01	3.32	0.63
	GMR	2.25	9.12	81.51	4.02	3.11
PARTICULATE MATTER $\leq 2.5 \mu\text{m}$	Sydney	4.50	54.31	17.95	8.83	14.41
	Newcastle	1.48	23.97	54.89	13.17	6.49
	Wollongong	0.74	17.20	72.44	5.97	3.65
	Non Urban	0.98	7.11	77.73	12.32	1.87
	GMR	2.19	24.80	55.67	10.82	6.52
SULFUR DIOXIDE	Sydney	1.01	1.22	51.86	43.96	1.96
	Newcastle	$1.40 \times 10^{-2}$	$9.06 \times 10^{-2}$	88.55	11.21	0.13
	Wollongong	$8.01 \times 10^{-3}$	$7.80 \times 10^{-2}$	93.72	6.10	$8.97 \times 10^{-2}$
	Non Urban	$2.71 \times 10^{-2}$	$1.01 \times 10^{-2}$	99.47	0.48	$1.36 \times 10^{-2}$
	GMR	$6.25 \times 10^{-2}$	$6.05 \times 10^{-2}$	97.08	2.71	$9.30 \times 10^{-2}$
TOTAL VOLATILE ORGANIC COMPOUNDS	Sydney	6.73	53.78	8.30	7.42	23.78
	Newcastle	5.96	47.05	9.66	16.31	21.02
	Wollongong	6.89	51.11	13.76	11.36	16.88
	Non Urban	6.79	37.03	7.34	35.03	13.81
	GMR	6.70	50.24	8.41	13.11	21.54

Figure ES-7, Figure ES-8, Figure ES-9, Figure ES-10 and Figure ES-11 show the proportions of total estimated annual emissions of criteria pollutants by human-made source type in the whole GMR and the Sydney, Newcastle, Wollongong and Non Urban regions, respectively.

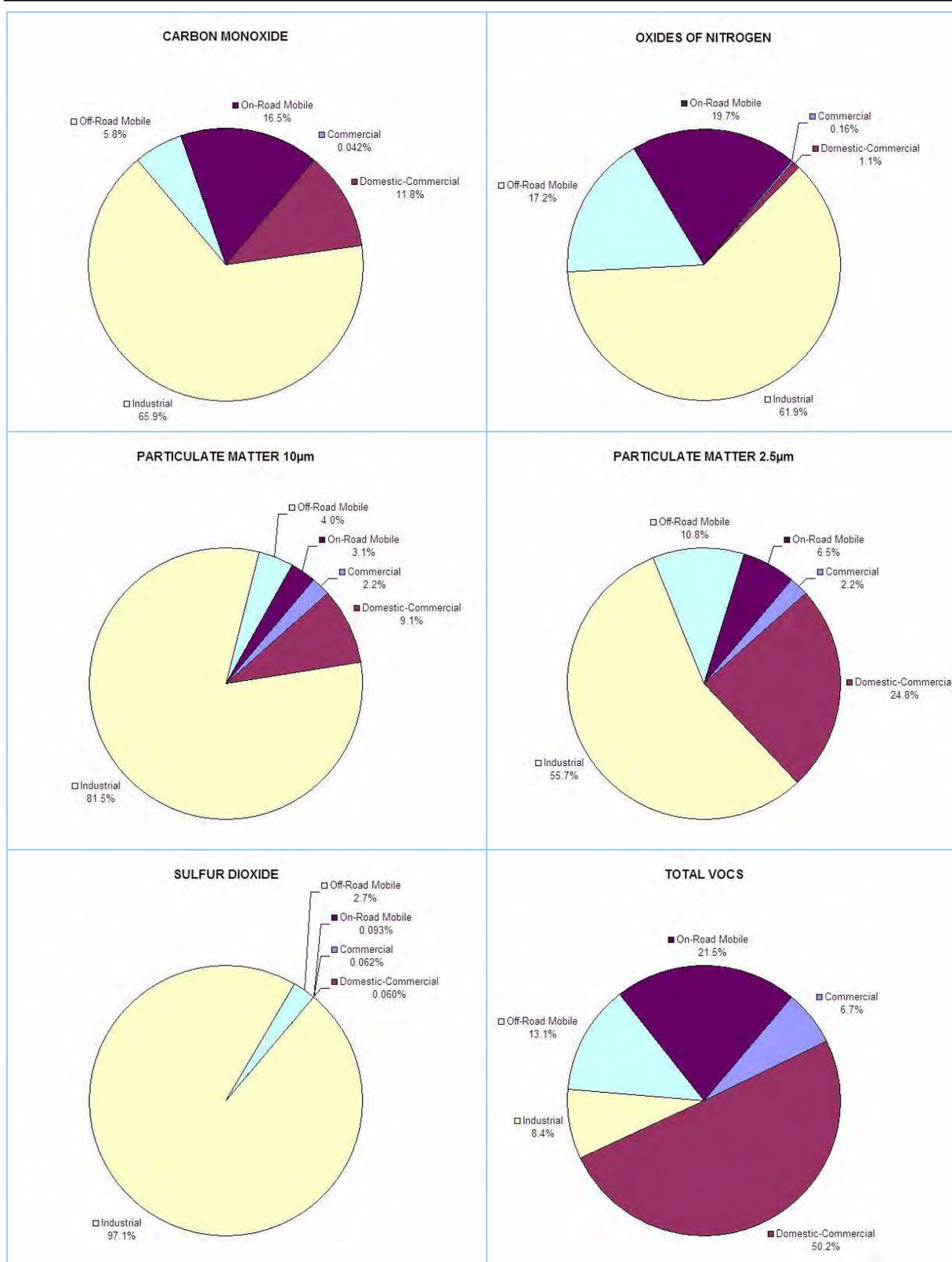


Figure ES-7: Proportions of total estimated annual emissions by human-made source type in the GMR

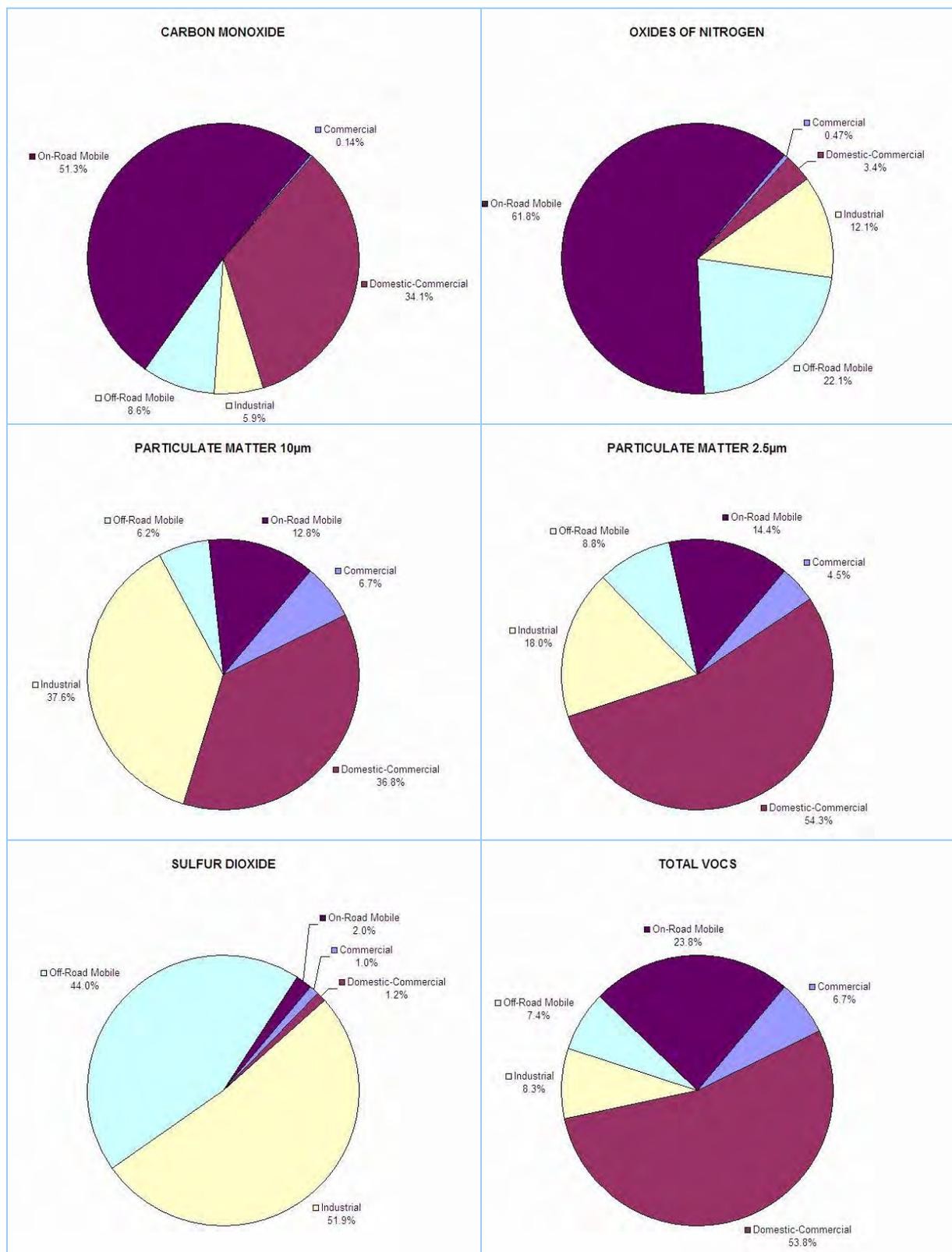


Figure ES-8: Proportions of total estimated annual emissions by human-made source type in the Sydney region



Figure ES-9: Proportions of total estimated annual emissions by human-made source type in the Newcastle region

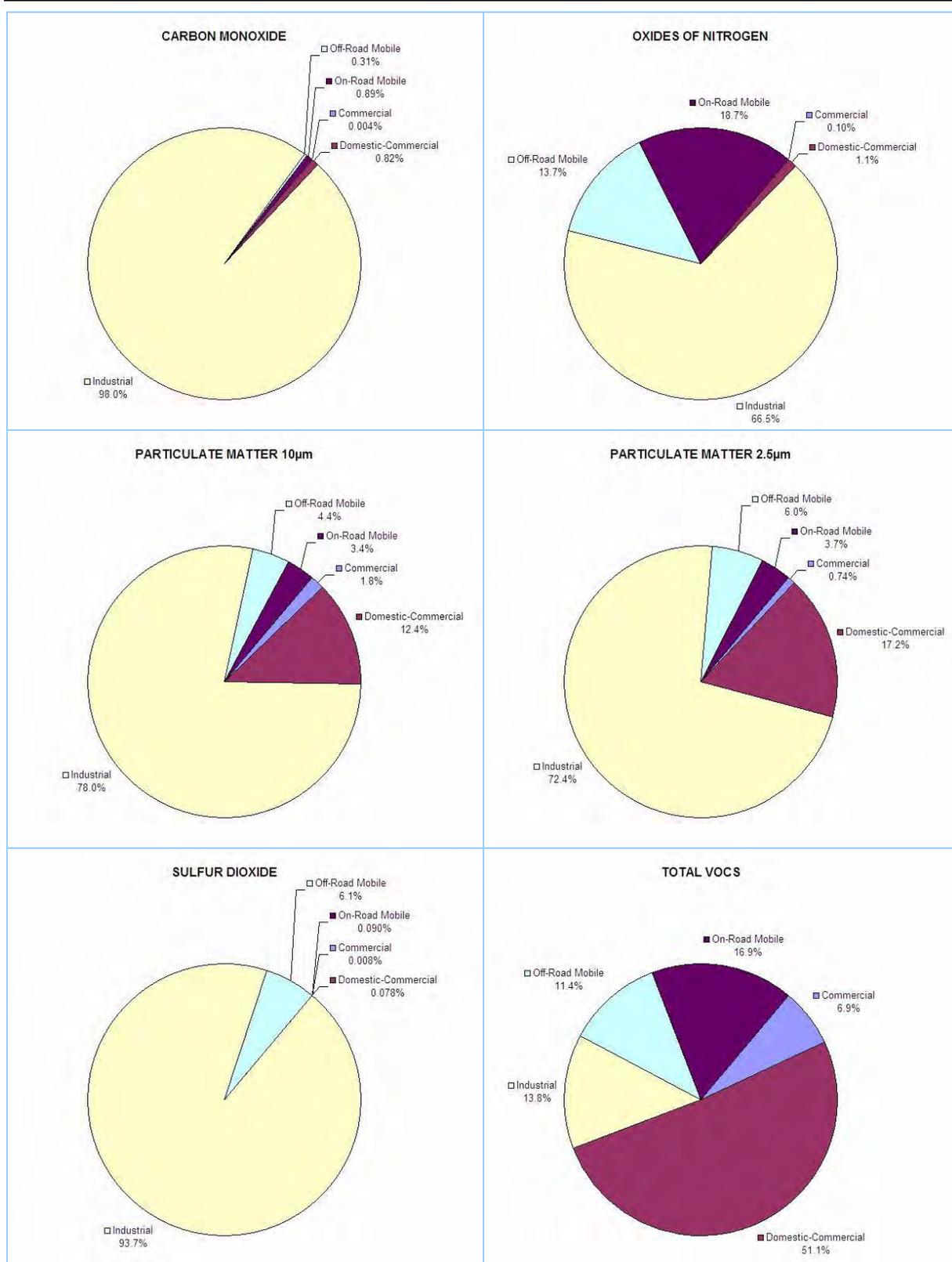


Figure ES-10: Proportions of total estimated annual emissions by human-made source type in the Wollongong region

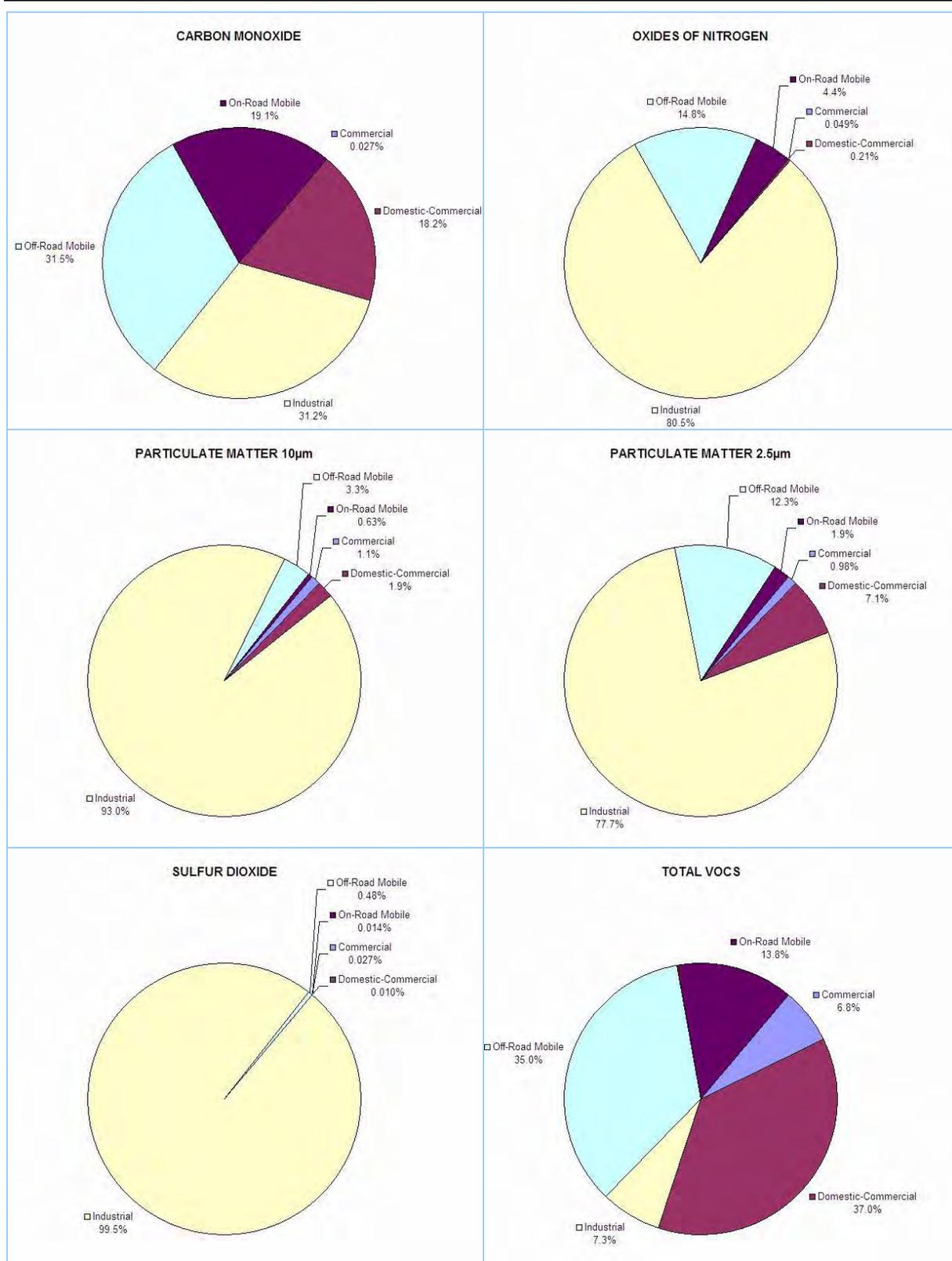


Figure ES-11: Proportions of total estimated annual emissions by human-made source type in the Non Urban region

Table ES-6 presents total estimated annual emissions, proportions and cumulative proportions for the top 10 human-made sources of carbon monoxide in the whole GMR and the Sydney, Newcastle, Wollongong and Non Urban regions.

**Table ES-6: Top 10 human-made sources of carbon monoxide in each region**

Source type	Activity	Emissions (tonne/year)	Proportions (%)	Cumulative Proportions (%)
<b>Top 10 human-made CARBON MONOXIDE sources in the GMR</b>				
Industrial	Iron or steel production (iron ore)	527,922	56.72	56.72
On-road mobile	Passenger vehicle petrol - exhaust	93,437	10.04	66.76
Domestic-commercial	Solid fuel burning (domestic)	53,985	5.80	72.56
Industrial	Aluminium production (alumina)	52,994	5.69	78.25
On-road mobile	Light duty commercial petrol - exhaust	48,731	5.24	83.49
Domestic-commercial	Lawn mowing exhaust (domestic)	34,994	3.76	87.25
Off-road mobile	Industrial vehicles and equipment	20,431	2.20	89.44
Domestic-commercial	Lawn mowing exhaust (public open spaces)	19,009	2.04	91.48
Off-road mobile	Recreational boats exhaust	14,585	1.57	93.05
Off-road mobile	Commercial boats exhaust	12,153	1.31	94.36
Human-made	Other	52,518	5.64	100.00
<b>Top 10 human-made CARBON MONOXIDE sources in the Sydney region</b>				
On-road mobile	Passenger vehicle petrol - exhaust	75,067	31.12	31.12
Domestic-commercial	Solid fuel burning (domestic)	40,034	16.60	47.72
On-road mobile	Light duty commercial petrol - exhaust	39,923	16.55	64.27
Domestic-commercial	Lawn mowing exhaust (domestic)	25,951	10.76	75.03
Domestic-commercial	Lawn mowing exhaust (public open spaces)	15,118	6.27	81.30
Off-road mobile	Recreational boats exhaust	6,912	2.87	84.16
Industrial	Iron or steel production (scrap metal)	6,882	2.85	87.01
Off-road mobile	Commercial boats exhaust	5,332	2.21	89.23
On-road mobile	Heavy duty commercial diesel - exhaust	4,081	1.69	90.92
On-road mobile	Others - exhaust	3,691	1.53	92.45
Human-made	Other	18,218	7.55	100.00
<b>Top 10 human-made CARBON MONOXIDE sources in the Newcastle region</b>				
Industrial	Aluminium production (alumina)	39,203	65.09	65.09
On-road mobile	Passenger vehicle petrol - exhaust	4,997	8.30	73.39
Domestic-commercial	Solid fuel burning (domestic)	3,345	5.55	78.95
On-road mobile	Light duty commercial petrol - exhaust	2,650	4.40	83.35
Industrial	Iron or steel production (scrap metal)	2,210	3.67	87.02
Domestic-commercial	Lawn mowing exhaust (domestic)	2,169	3.60	90.62
Off-road mobile	Commercial boats exhaust	1,566	2.60	93.22
Domestic-commercial	Lawn mowing exhaust (public open spaces)	965	1.60	94.82
Off-road mobile	Industrial vehicles and equipment	816	1.35	96.17
Off-road mobile	Recreational boats exhaust	717	1.19	97.37
Human-made	Other	1,586	2.63	100.00

Source type	Activity	Emissions (tonne/year)	Proportions (%)	Cumulative Proportions (%)
Top 10 human-made CARBON MONOXIDE sources in the Wollongong region				
Industrial	Iron or steel production (iron ore)	527,922	97.69	97.69
On-road mobile	Passenger vehicle petrol - exhaust	2,861	0.53	98.22
Domestic-commercial	Solid fuel burning (domestic)	2,209	0.41	98.63
On-road mobile	Light duty commercial petrol - exhaust	1,564	0.29	98.92
Domestic-commercial	Lawn mowing exhaust (domestic)	1,432	0.27	99.19
Industrial	Metal plating or coating	1,049	0.19	99.38
Off-road mobile	Industrial vehicles and equipment	770	0.14	99.52
Off-road mobile	Recreational boats exhaust	762	0.14	99.66
Domestic-commercial	Lawn mowing exhaust (public open spaces)	716	0.13	99.80
Industrial	Generation of electrical power from gas	445	$8.23 \times 10^{-2}$	99.88
Human-made	Other	660	0.12	100.00
Top 10 human-made CARBON MONOXIDE sources in the Non Urban region				
Off-road mobile	Industrial vehicles and equipment	15,361	17.27	17.27
Industrial	Aluminium production (alumina)	13,791	15.51	32.78
On-road mobile	Passenger vehicle petrol - exhaust	10,512	11.82	44.60
Domestic-commercial	Solid fuel burning (domestic)	8,396	9.44	54.04
Industrial	Generation of electrical power from coal	7,535	8.47	62.51
Off-road mobile	Recreational boats exhaust	6,194	6.96	69.48
Domestic-commercial	Lawn mowing exhaust (domestic)	5,443	6.12	75.60
Off-road mobile	Commercial boats exhaust	5,178	5.82	81.42
On-road mobile	Light duty commercial petrol - exhaust	4,595	5.17	86.58
Industrial	Mining for coal	4,497	5.06	91.64
Human-made	Other	7,435	8.36	100.00

Figure ES-12, Figure ES-13, Figure ES-14, Figure ES-15 and Figure ES-16 show the proportions of total estimated annual emissions for the top 10 human-made sources of carbon monoxide in the whole GMR and the Sydney, Newcastle, Wollongong and Non Urban regions, respectively.

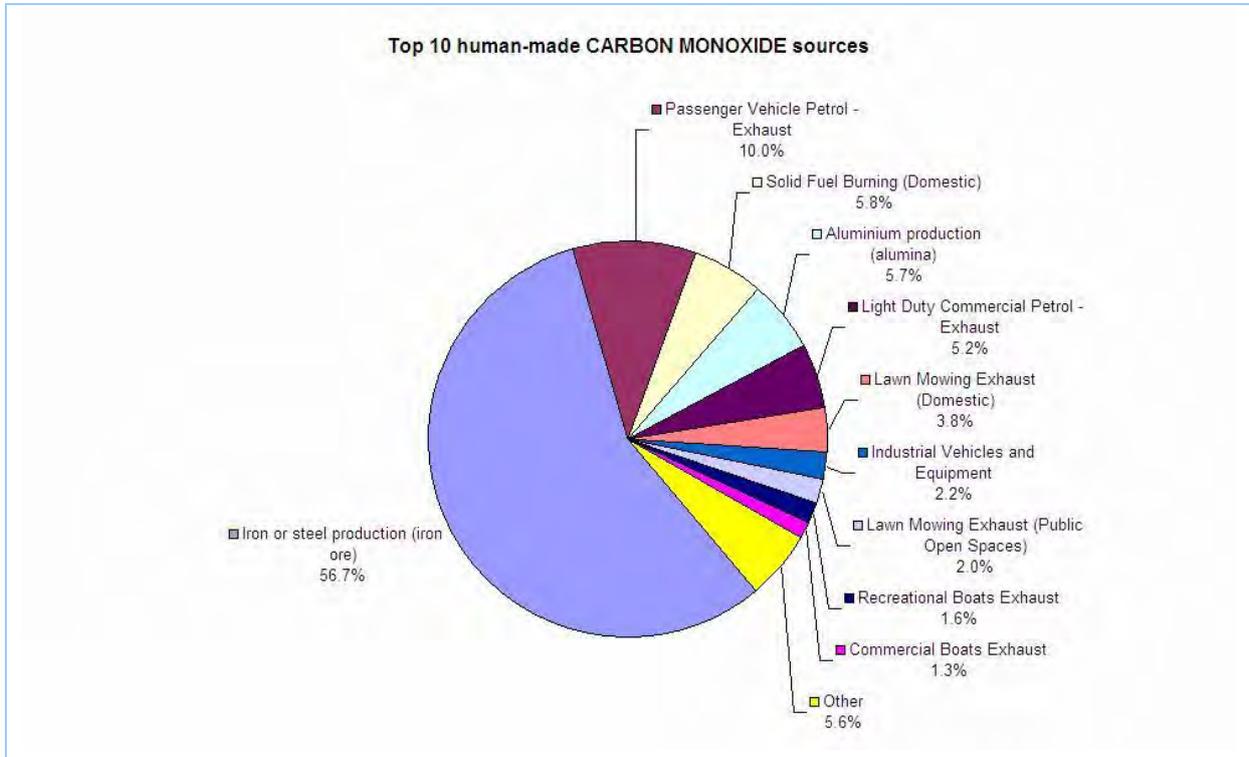


Figure ES-12: Top 10 human-made sources of carbon monoxide in the GMR

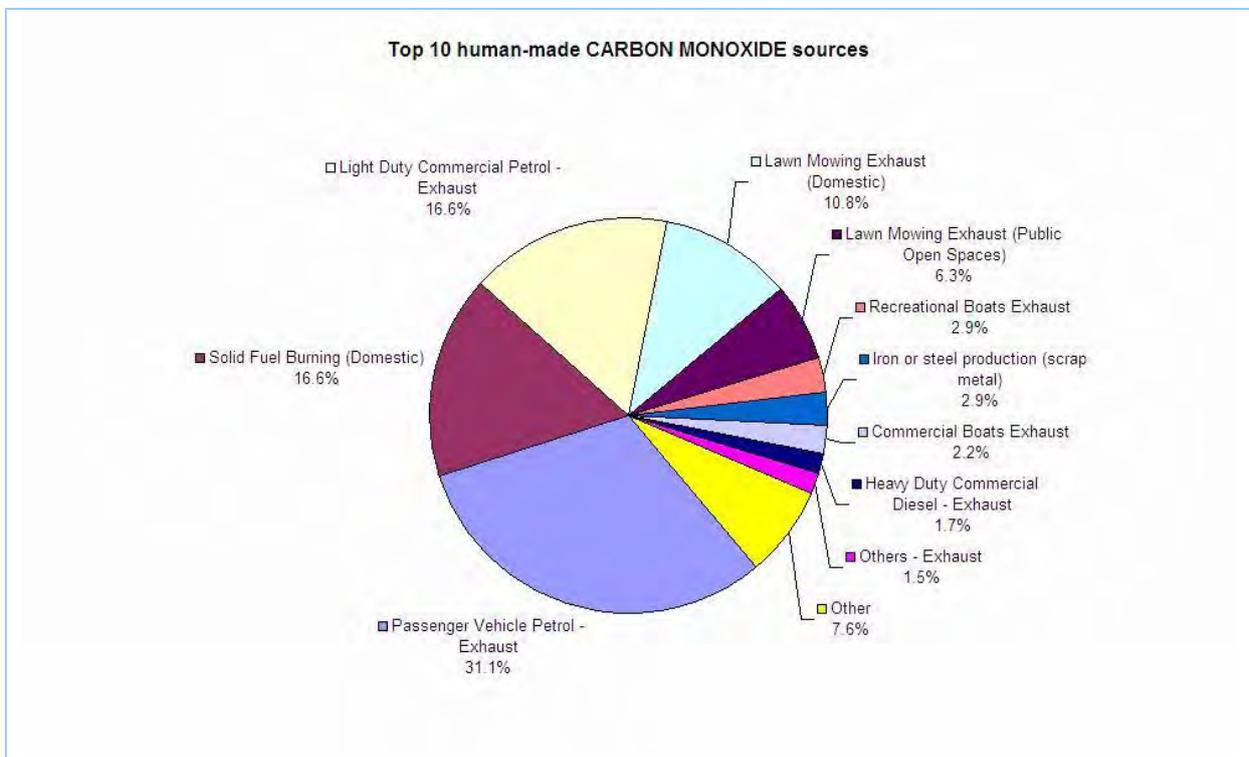


Figure ES-13: Top 10 human-made sources of carbon monoxide in the Sydney region

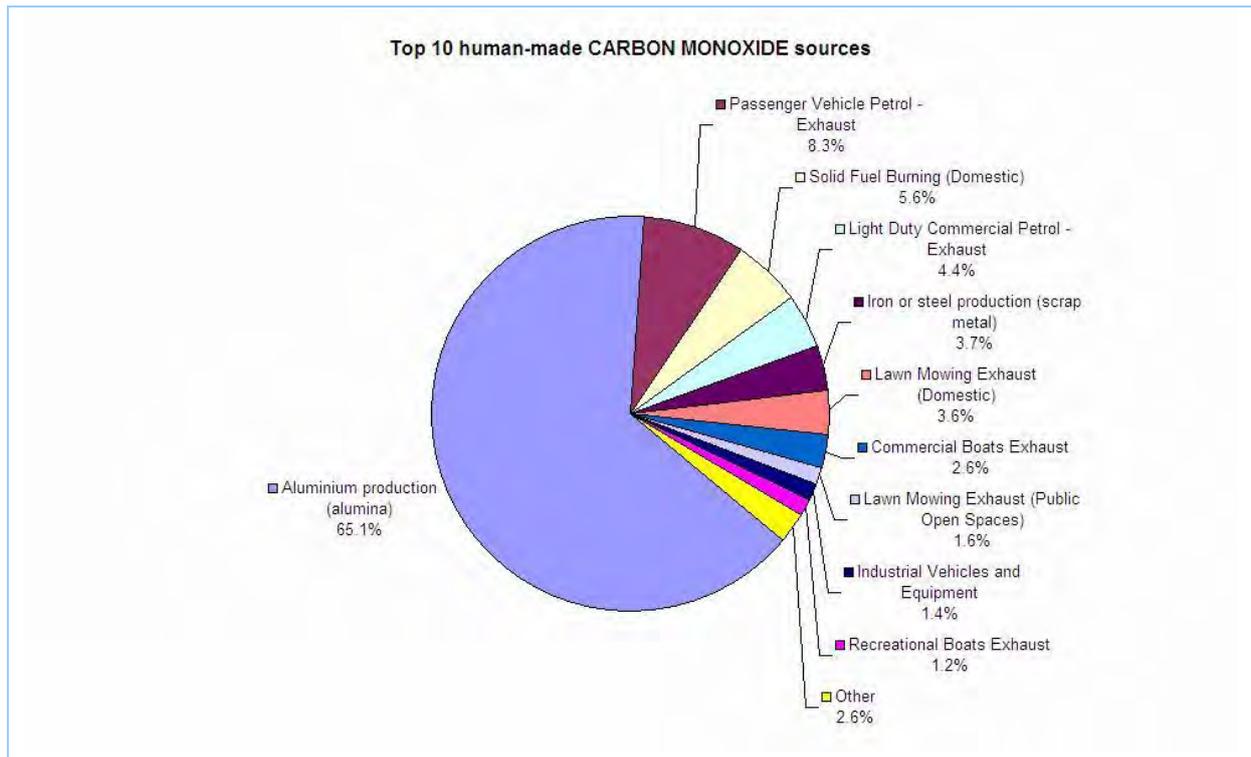


Figure ES-14: Top 10 human-made sources of carbon monoxide in the Newcastle region

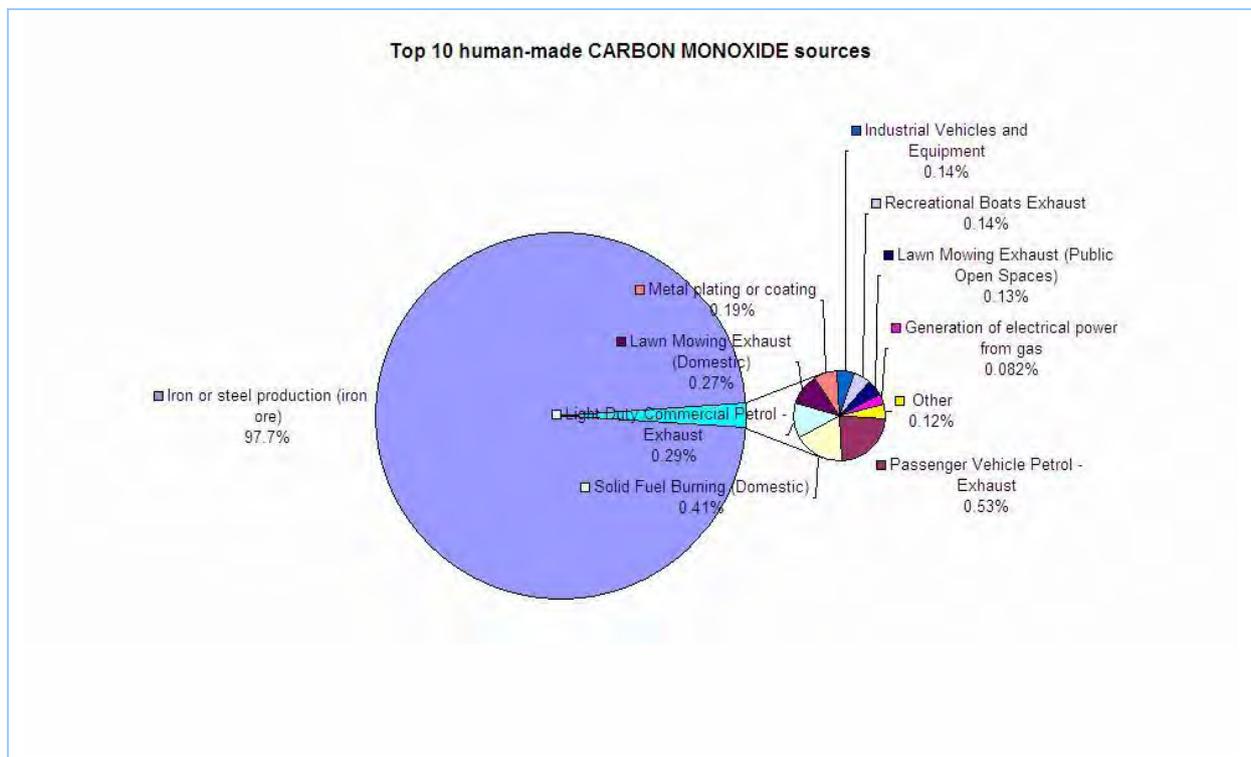
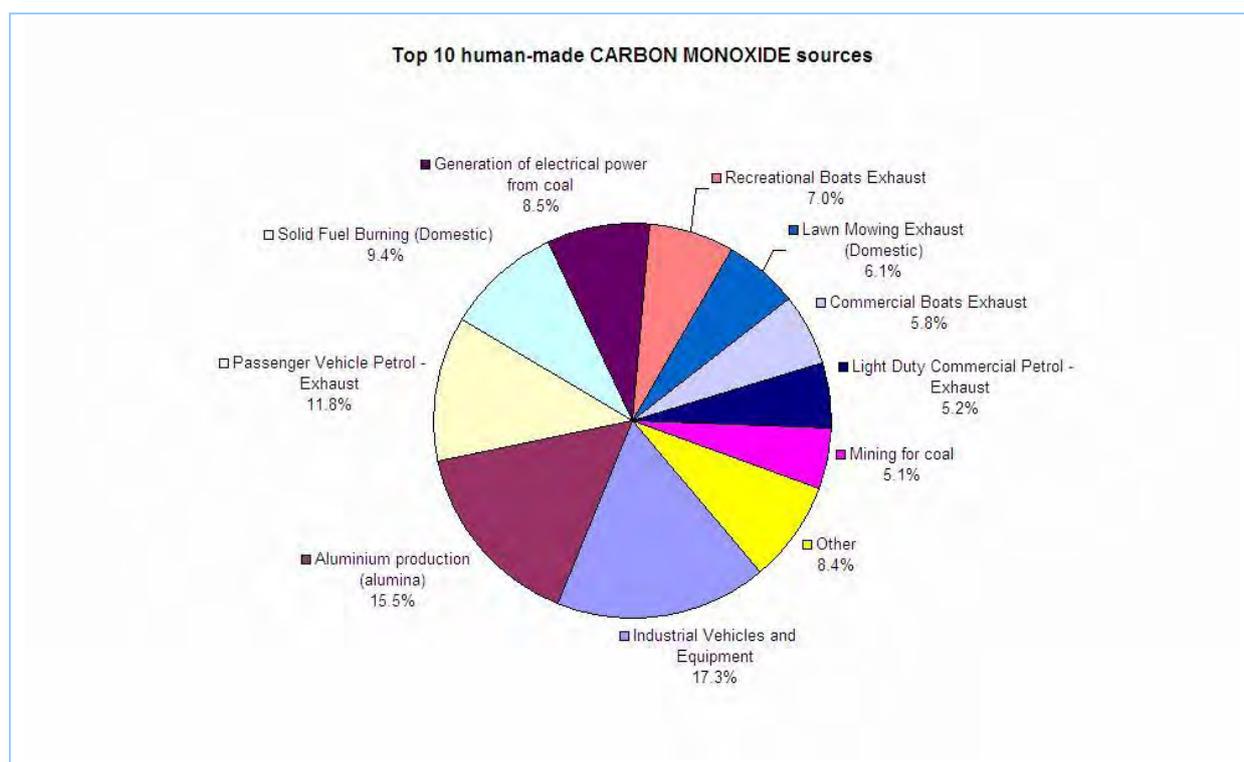


Figure ES-15: Top 10 human-made sources of carbon monoxide in the Wollongong region



**Figure ES-16: Top 10 human-made sources of carbon monoxide in the Non Urban region**

Table ES-7 presents total estimated annual emissions, proportions and cumulative proportions for the top 10 human-made sources of oxides of nitrogen in the whole GMR and the Sydney, Newcastle, Wollongong and Non Urban regions.

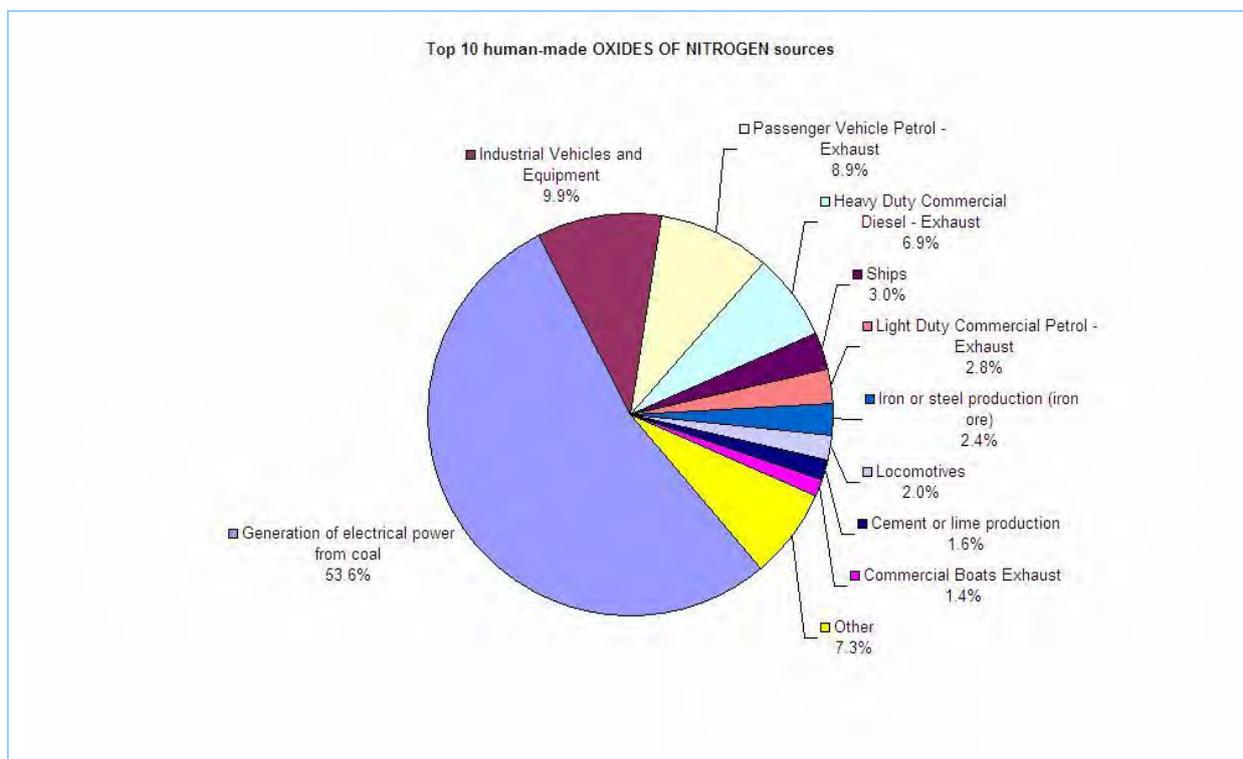
**Table ES-7: Top 10 human-made sources of oxides of nitrogen in each region**

Module	Activity	Emissions (tonne/year)	Proportions (%)	Cumulative Proportions (%)
<b>Top 10 human-made OXIDES OF NITROGEN sources in the GMR</b>				
Industrial	Generation of electrical power from coal	165,956	53.65	53.65
Off-road mobile	Industrial vehicles and equipment	30,716	9.93	63.58
On-road mobile	Passenger vehicle petrol – exhaust	27,515	8.89	72.47
On-road mobile	Heavy duty commercial diesel – exhaust	21,419	6.92	79.40
Off-road mobile	Ships	9,425	3.05	82.44
On-road mobile	Light duty commercial petrol – exhaust	8,679	2.81	85.25
Industrial	Iron or steel production (iron ore)	7,513	2.43	87.68
Off-road mobile	Locomotives	6,087	1.97	89.64
Industrial	Cement or lime production	5,020	1.62	91.27
Off-road mobile	Commercial boats exhaust	4,404	1.42	92.69
Human-made	Other	22,609	7.31	100.00
<b>Top 10 human-made OXIDES OF NITROGEN sources in the Sydney region</b>				
On-road mobile	Passenger vehicle petrol – exhaust	21,575	29.38	29.38
On-road mobile	Heavy duty commercial diesel – exhaust	14,423	19.64	49.03
On-road mobile	Light duty commercial petrol – exhaust	6,799	9.26	58.29
Off-road mobile	Ships	5,138	7.00	65.28
Off-road mobile	Commercial boats exhaust	3,319	4.52	69.80
Off-road mobile	Locomotives	2,927	3.99	73.79
Off-road mobile	Industrial vehicles and equipment	2,600	3.54	77.33
On-road mobile	Light duty diesel – exhaust	2,417	3.29	80.62
Industrial	Generation of electrical power from gas	2,077	2.83	83.45
Industrial	Petroleum products and fuel production	1,891	2.58	86.03
Human-made	Other	10,260	13.97	100.00
<b>Top 10 human-made OXIDES OF NITROGEN sources in the Newcastle region</b>				
On-road mobile	Passenger vehicle petrol – exhaust	1,666	17.52	17.52
Off-road mobile	Ships	1,643	17.28	34.81
On-road mobile	Heavy duty commercial diesel – exhaust	1,511	15.90	50.70
Off-road mobile	Industrial vehicles and equipment	1,305	13.73	64.43
Industrial	Ammonium nitrate production	844	8.88	73.31
On-road mobile	Light duty commercial petrol – exhaust	530	5.57	78.89
Industrial	Aluminium production (alumina)	347	3.65	82.54
Off-road mobile	Locomotives	306	3.22	85.75
Off-road mobile	Commercial boats exhaust	227	2.38	88.14
On-road mobile	Light duty diesel – exhaust	177	1.87	90.00
Human-made	Other	950	10.00	100.00

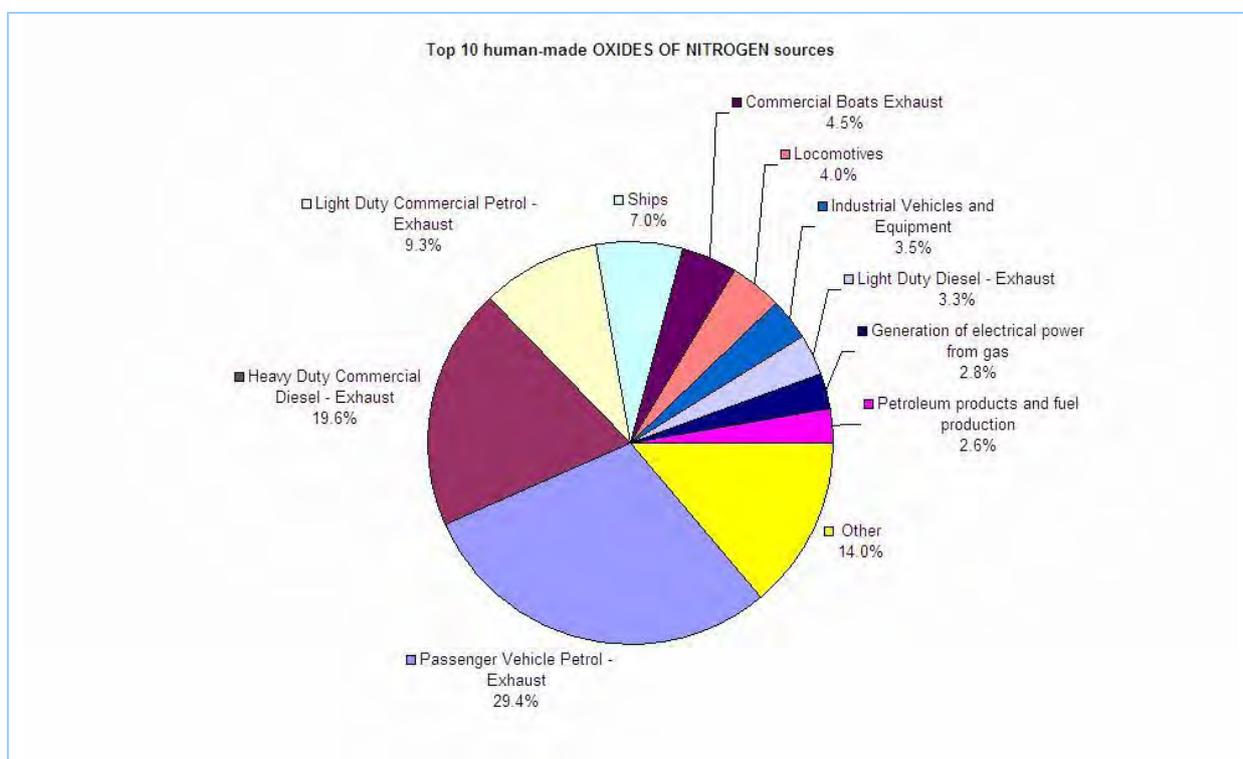
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Module	Activity	Emissions (tonne/year)	Proportions (%)	Cumulative Proportions (%)
Top 10 human-made OXIDES OF NITROGEN sources in the Wollongong region				
Industrial	Iron or steel production (iron ore)	7,513	64.17	64.17
On-road mobile	Passenger vehicle petrol - exhaust	938	8.02	72.19
On-road mobile	Heavy duty commercial diesel - exhaust	783	6.68	78.87
Off-road mobile	Ships	706	6.03	84.90
Off-road mobile	Industrial vehicles and equipment	607	5.18	90.08
On-road mobile	Light duty commercial petrol - exhaust	346	2.96	93.04
Off-road mobile	Locomotives	252	2.15	95.19
Industrial	Generation of electrical power from gas	178	1.52	96.71
On-road mobile	Light duty diesel - exhaust	107	0.91	97.62
Domestic-commercial	Gaseous fuel burning	78	0.66	98.28
Human-made	Other	201	1.72	100.00
Top 10 human-made OXIDES OF NITROGEN sources in the Non Urban region				
Industrial	Generation of electrical power from coal	165,956	77.30	77.30
Off-road mobile	Industrial vehicles and equipment	26,204	12.20	89.50
On-road mobile	Heavy duty commercial diesel - exhaust	4,702	2.19	91.69
Industrial	Cement or lime production	4,213	1.96	93.65
On-road mobile	Passenger vehicle petrol - exhaust	3,336	1.55	95.21
Off-road mobile	Locomotives	2,602	1.21	96.42
Industrial	Mining for coal	2,313	1.08	97.50
Off-road mobile	Ships	1,938	0.90	98.40
On-road mobile	Light duty commercial petrol - exhaust	1,004	0.47	98.87
Off-road mobile	Commercial boats exhaust	843	0.39	99.26
Human-made	Other	1,593	0.74	100.00

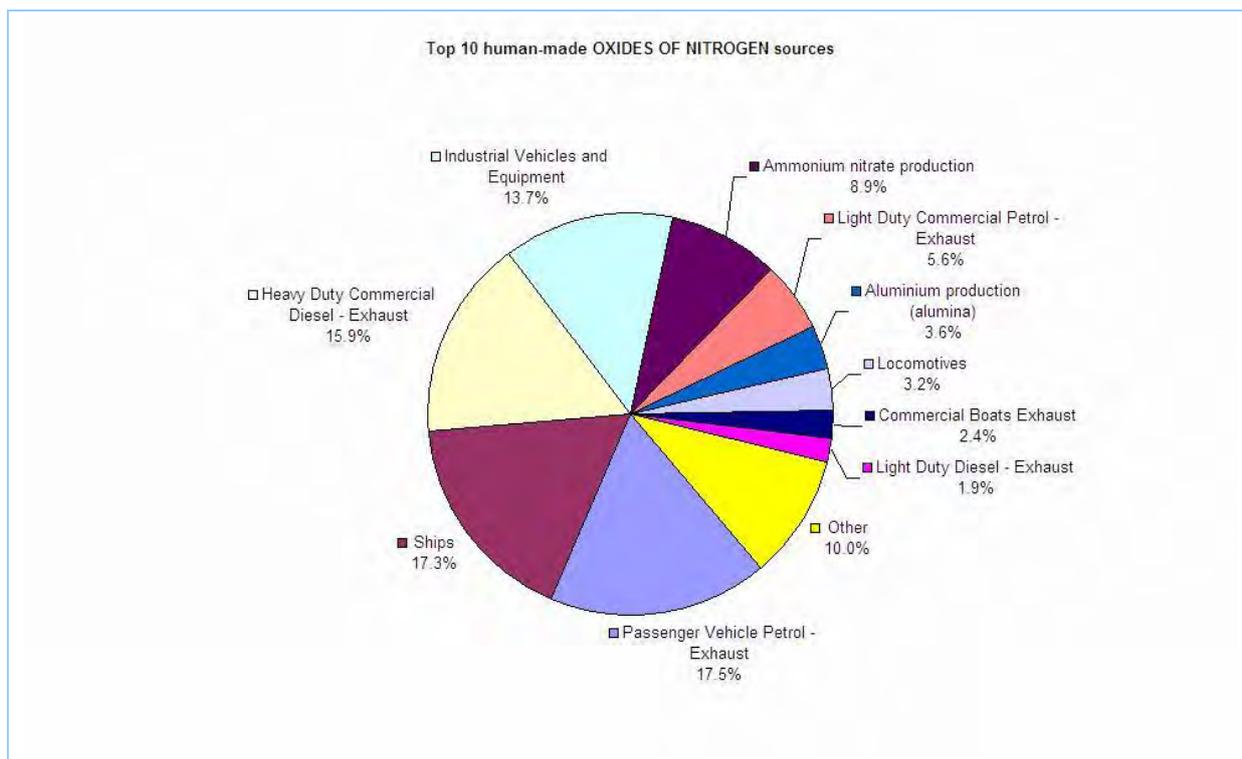
Figure ES-17, Figure ES-18, Figure ES-19, Figure ES-20 and Figure ES-21 show the proportions of total estimated annual emissions for the top 10 human-made sources of oxides of nitrogen in the whole GMR and the Sydney, Newcastle, Wollongong and Non Urban regions, respectively.



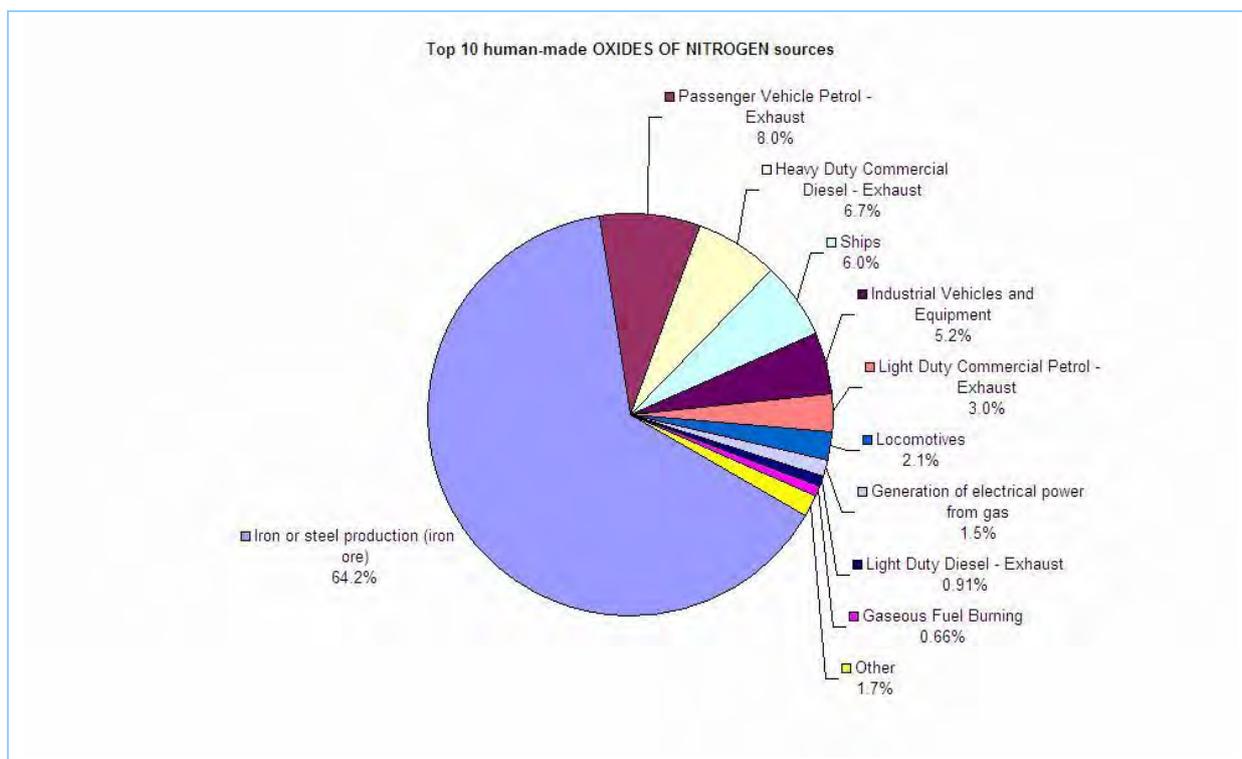
**Figure ES-17: Top 10 human-made sources of oxides of nitrogen in the GMR**



**Figure ES-18: Top 10 human-made sources of oxides of nitrogen in the Sydney region**



**Figure ES-19: Top 10 human-made sources of oxides of nitrogen in the Newcastle region**



**Figure ES-20: Top 10 human-made sources of oxides of nitrogen in the Wollongong region**

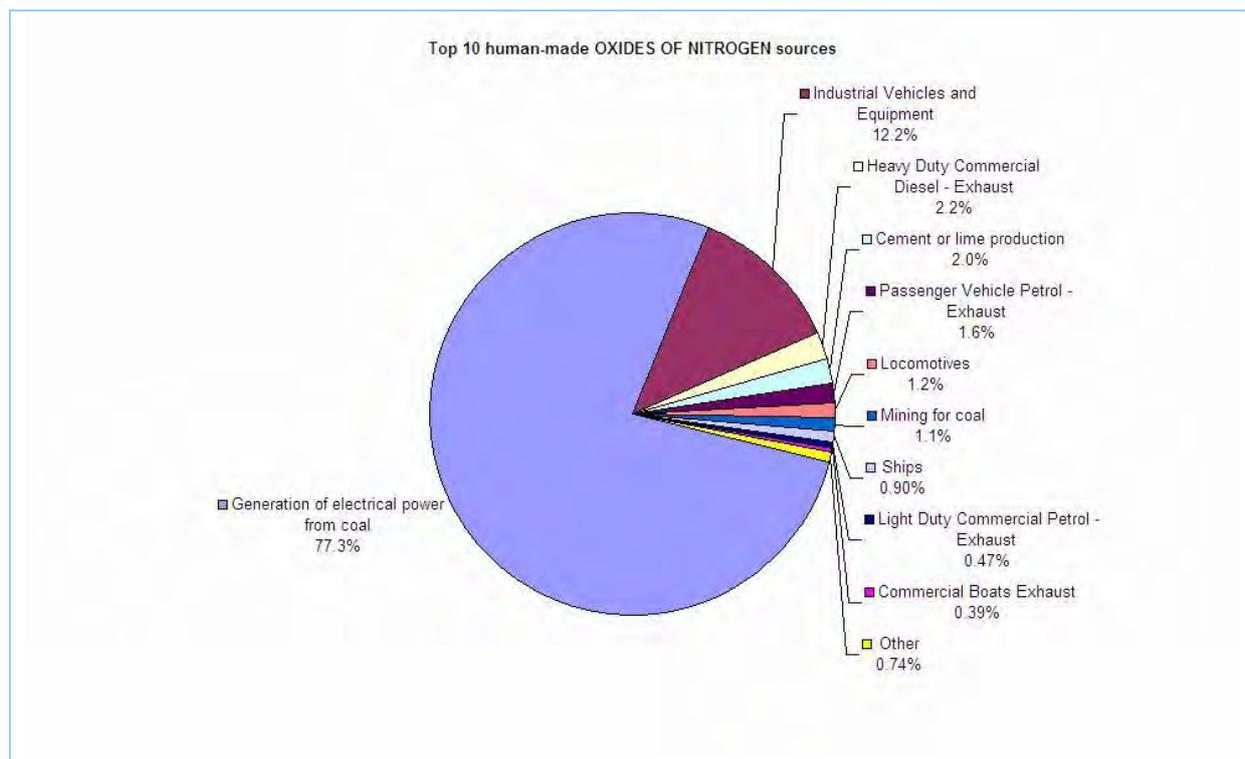


Figure ES-21: Top 10 human-made sources of oxides of nitrogen in the Non Urban region

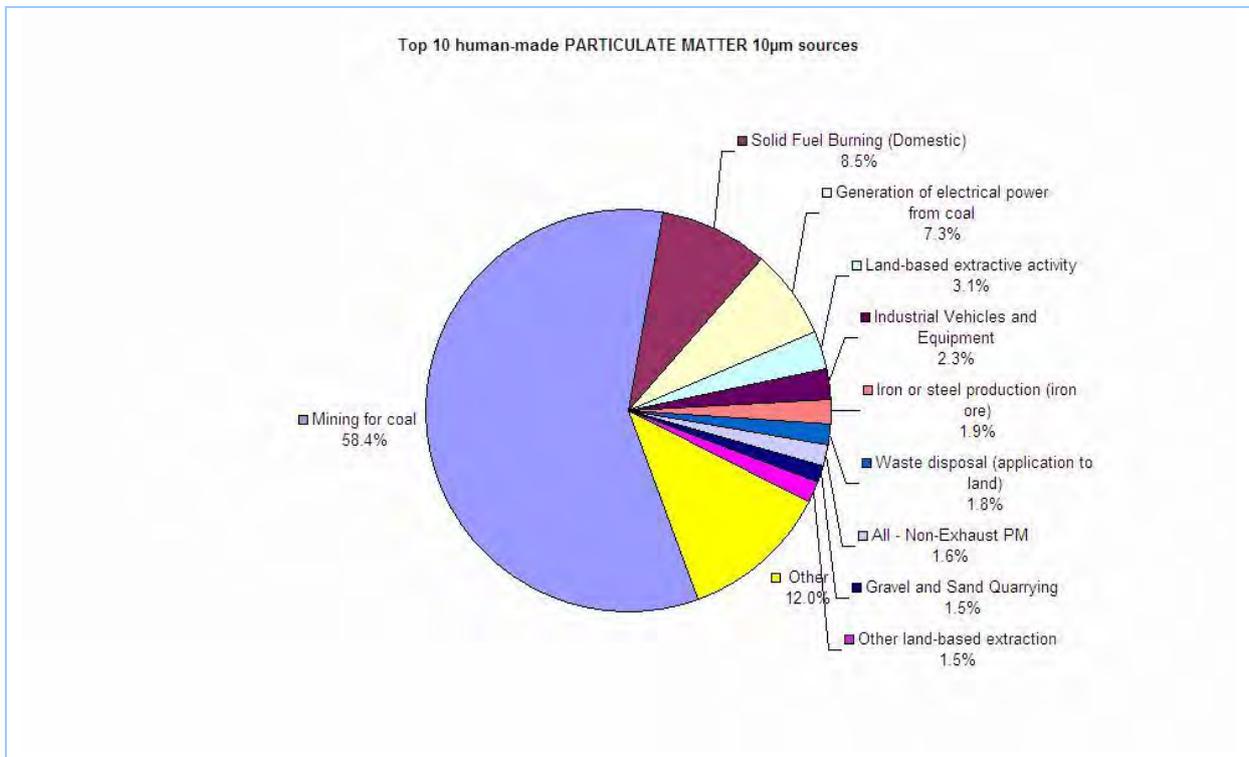
Table ES-8 presents total estimated annual emissions, proportions and cumulative proportions for the top 10 human-made sources of particulate matter  $\leq 10 \mu\text{m}$  in the whole GMR and the Sydney, Newcastle, Wollongong and Non Urban regions.

**Table ES-8: Top 10 human-made sources of particulate matter  $\leq 10 \mu\text{m}$  in each region**

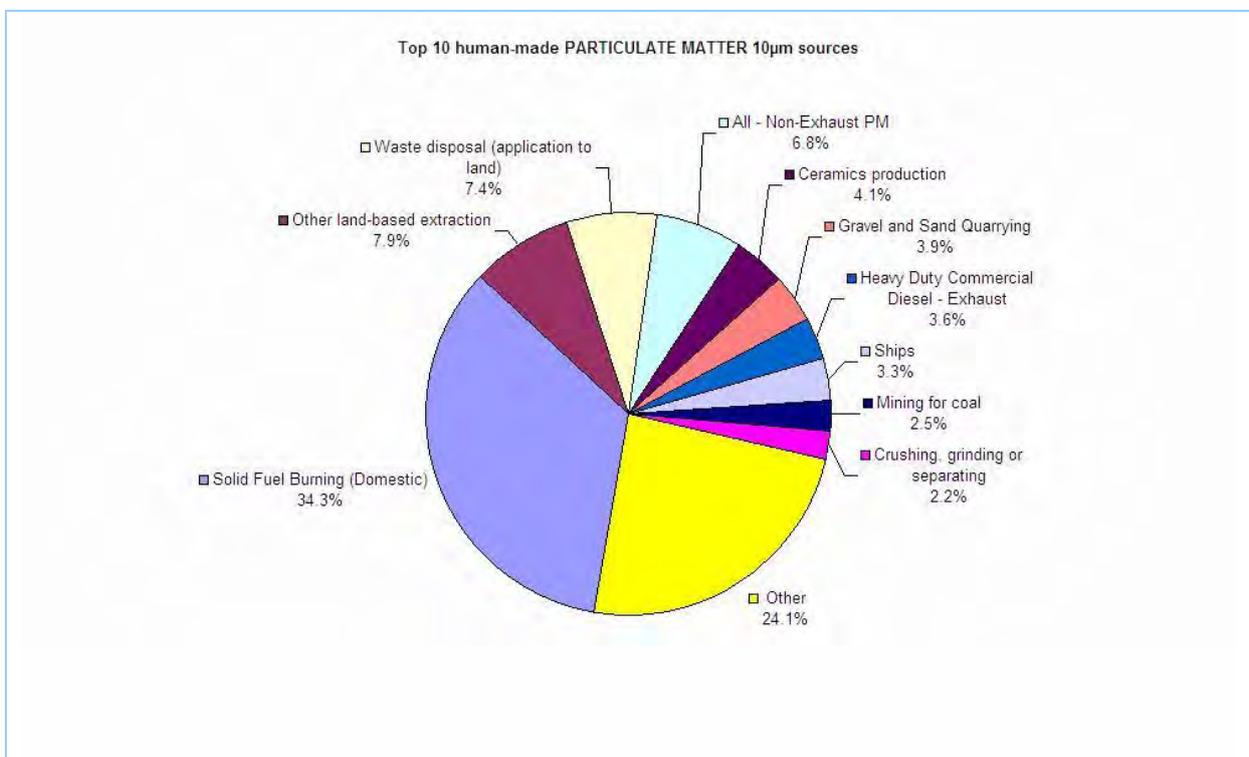
Module	Activity	Emissions (tonne/year)	Proportions (%)	Cumulative Proportions (%)
<b>Top 10 human-made PARTICULATE MATTER <math>\leq 10 \mu\text{m}</math> sources in the GMR</b>				
Industrial	Mining for coal	52,462	58.41	58.41
Domestic-commercial	Solid fuel burning (domestic)	7,645	8.51	66.92
Industrial	Generation of electrical power from coal	6,515	7.25	74.17
Industrial	Land-based extractive activity	2,802	3.12	77.29
Off-road mobile	Industrial vehicles and equipment	2,094	2.33	79.62
Industrial	Iron or steel production (iron ore)	1,749	1.95	81.57
Industrial	Waste disposal (application to land)	1,592	1.77	83.34
On-road mobile	All non-exhaust particulate matter	1,450	1.61	84.95
Commercial	Gravel and sand quarrying	1,388	1.54	86.50
Industrial	Other land-based extraction	1,363	1.52	88.02
Human-made	Other	10,763	11.98	100.00
<b>Top 10 human-made PARTICULATE MATTER <math>\leq 10 \mu\text{m}</math> sources in the Sydney region</b>				
Domestic-commercial	Solid fuel burning (domestic)	5,669	34.27	34.27
Industrial	Other land-based extraction	1,300	7.86	42.13
Industrial	Waste disposal (application to land)	1,224	7.40	49.53
On-road mobile	All non-exhaust particulate matter	1,123	6.79	56.32
Industrial	Ceramics production	681	4.12	60.43
Commercial	Gravel and sand quarrying	646	3.91	64.34
On-road mobile	Heavy duty commercial diesel - exhaust	592	3.58	67.91
Off-road mobile	Ships	539	3.26	71.17
Industrial	Mining for coal	410	2.48	73.65
Industrial	Crushing, grinding or separating	372	2.25	75.90
Human-made	Other	3,987	24.10	100.00
<b>Top 10 human-made PARTICULATE MATTER <math>\leq 10 \mu\text{m}</math> sources in the Newcastle region</b>				
Industrial	Mining for coal	1,747	36.11	36.11
Industrial	Coal works	753	15.57	51.68
Domestic-commercial	Solid fuel burning (domestic)	474	9.79	61.47
Industrial	Ammonium nitrate production	323	6.68	68.15
Industrial	Land-based extractive activity	207	4.27	72.43
Industrial	Aluminium production (alumina)	186	3.84	76.27
Off-road mobile	Ships	159	3.28	79.55
Industrial	Waste disposal (application to land)	158	3.27	82.81
Off-road mobile	Industrial vehicles and equipment	90	1.86	84.67
On-road mobile	All non-exhaust particulate matter	90	1.86	86.53
Human-made	Other	652	13.47	100.00

Module	Activity	Emissions (tonne/year)	Proportions (%)	Cumulative Proportions (%)
<b>Top 10 human-made PARTICULATE MATTER ≤ 10 µm sources in the Wollongong region</b>				
Industrial	Iron or steel production (iron ore)	1,749	65.02	65.02
Domestic-commercial	Solid fuel burning (domestic)	313	11.63	76.64
Industrial	Mining for coal	86	3.19	79.83
Industrial	Coal works	74	2.74	82.57
Off-road mobile	Ships	68	2.51	85.08
On-road mobile	All non-exhaust particulate matter	44	1.63	86.71
Industrial	Generation of electrical power from gas	36	1.32	88.04
Off-road mobile	Industrial vehicles and equipment	35	1.32	89.36
Commercial	Gravel and sand quarrying	35	1.31	90.66
Industrial	Waste disposal (application to land)	32	1.20	91.86
Human-made	Other	219	8.14	100.00
<b>Top 10 human-made PARTICULATE MATTER ≤ 10 µm sources in the Non Urban region</b>				
Industrial	Mining for coal	50,219	76.38	76.38
Industrial	Generation of electrical power from coal	6,515	9.91	86.29
Industrial	Land-based extractive activity	2,301	3.50	89.79
Off-road mobile	Industrial vehicles and equipment	1,818	2.77	92.55
Domestic-commercial	Solid fuel burning (domestic)	1,189	1.81	94.36
Industrial	Cement or lime production	637	0.97	95.33
Commercial	Gravel and sand quarrying	621	0.94	96.27
Industrial	Mining for minerals	441	0.67	96.94
Industrial	Aluminium production (alumina)	205	0.31	97.25
On-road mobile	All non-exhaust particulate matter	193	0.29	97.55
Human-made	Other	1,612	2.45	100.00

Figure ES-22, Figure ES-23, Figure ES-24, Figure ES-25 and Figure ES-26 show the proportions of total estimated annual emissions for the top 10 human-made sources of particulate matter  $\leq 10 \mu\text{m}$  in the whole GMR and the Sydney, Newcastle, Wollongong and Non Urban regions, respectively.



**Figure ES-22: Top 10 human-made sources of particulate matter  $\leq 10 \mu\text{m}$  in the GMR**



**Figure ES-23: Top 10 human-made sources of particulate matter  $\leq 10 \mu\text{m}$  in the Sydney region**

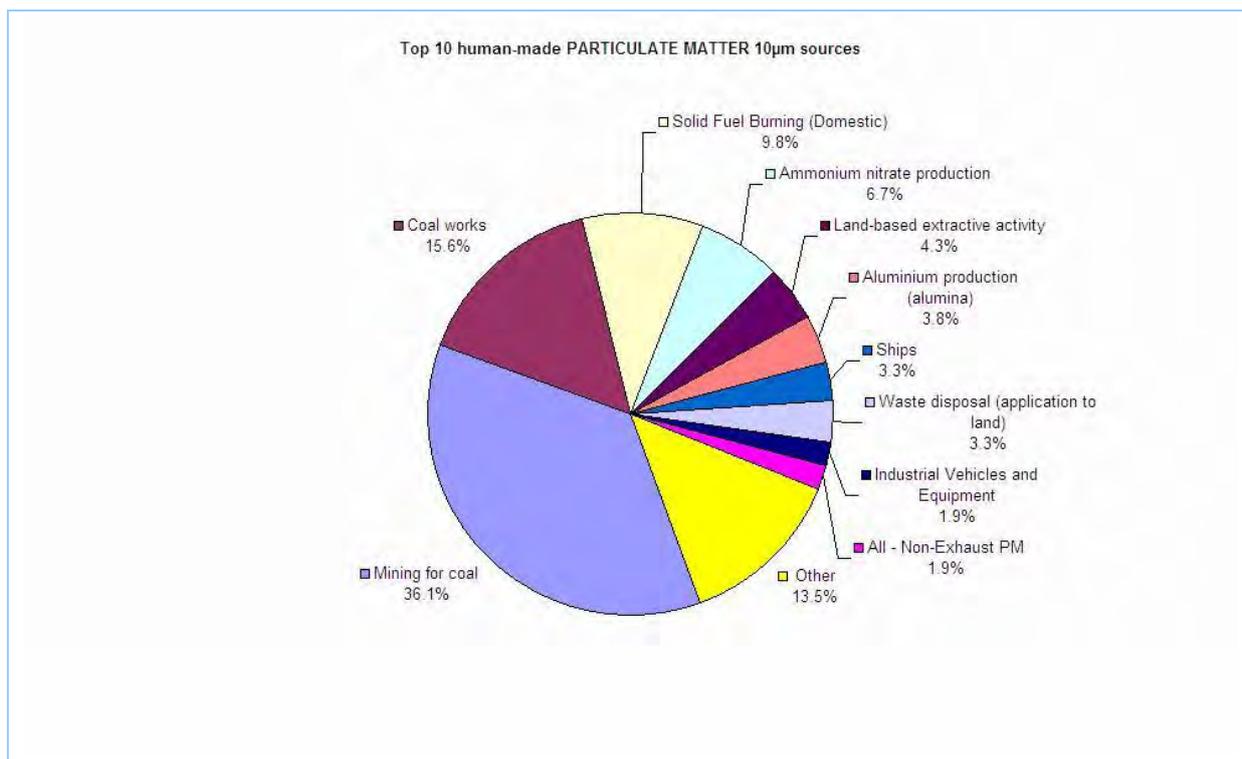


Figure ES-24: Top 10 human-made sources of particulate matter  $\leq 10 \mu\text{m}$  in the Newcastle region

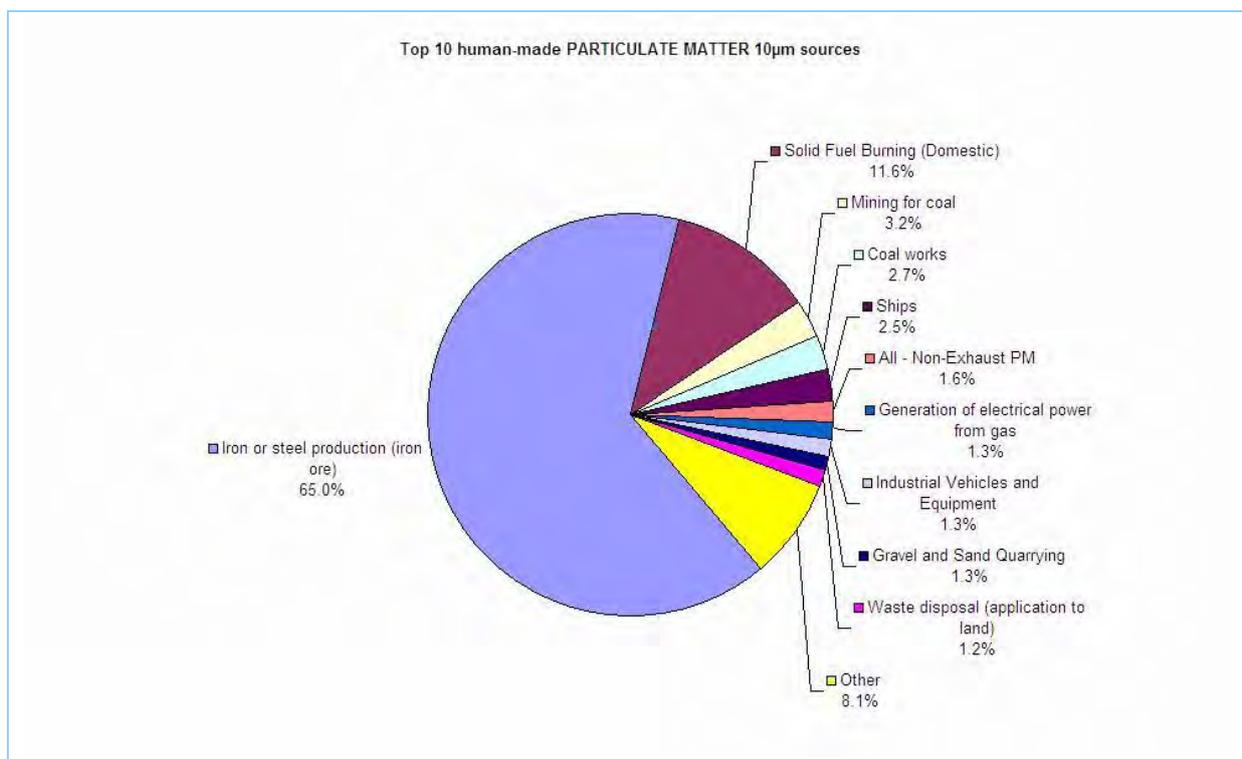


Figure ES-25: Top 10 human-made sources of particulate matter  $\leq 10 \mu\text{m}$  in the Wollongong region

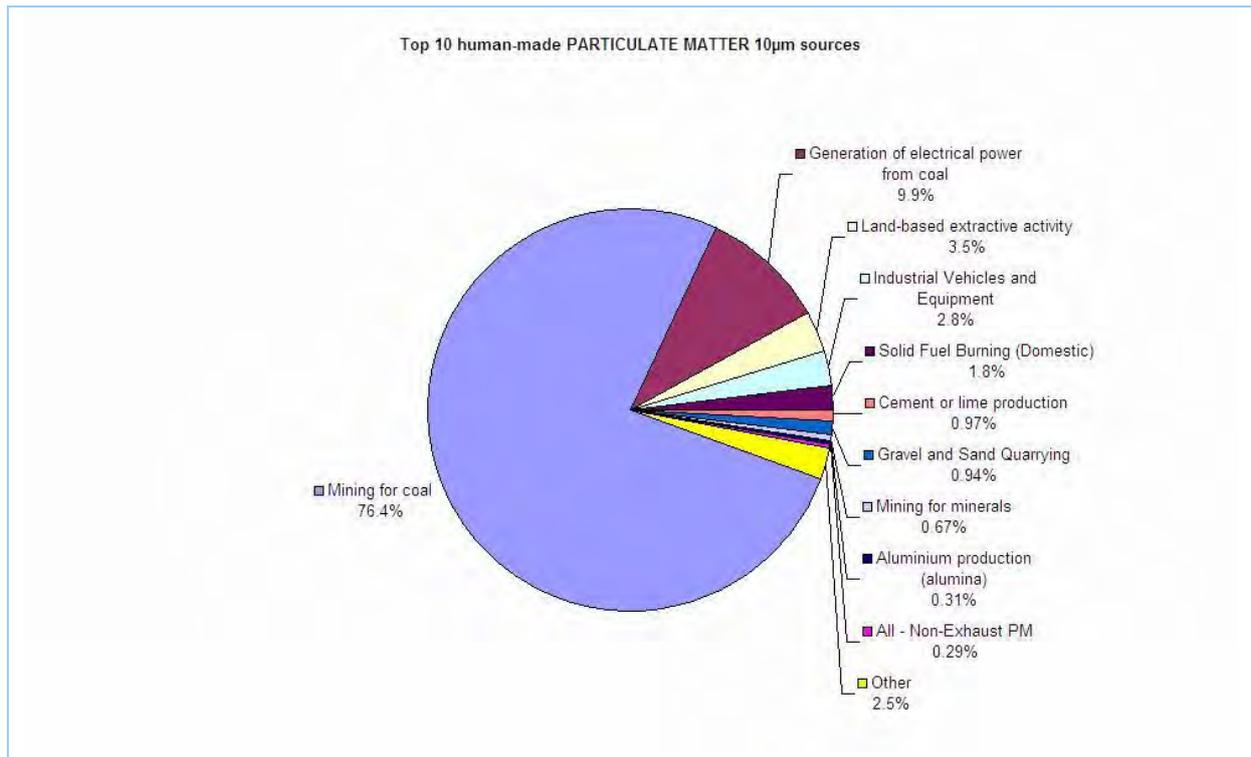


Figure ES-26: Top 10 human-made sources of particulate matter  $\leq 10 \mu\text{m}$  in the Non Urban region

Table ES-9 presents total estimated annual emissions, proportions and cumulative proportions for the top 10 human-made sources of particulate matter  $\leq 2.5 \mu\text{m}$  in the whole GMR and the Sydney, Newcastle, Wollongong and Non Urban regions.

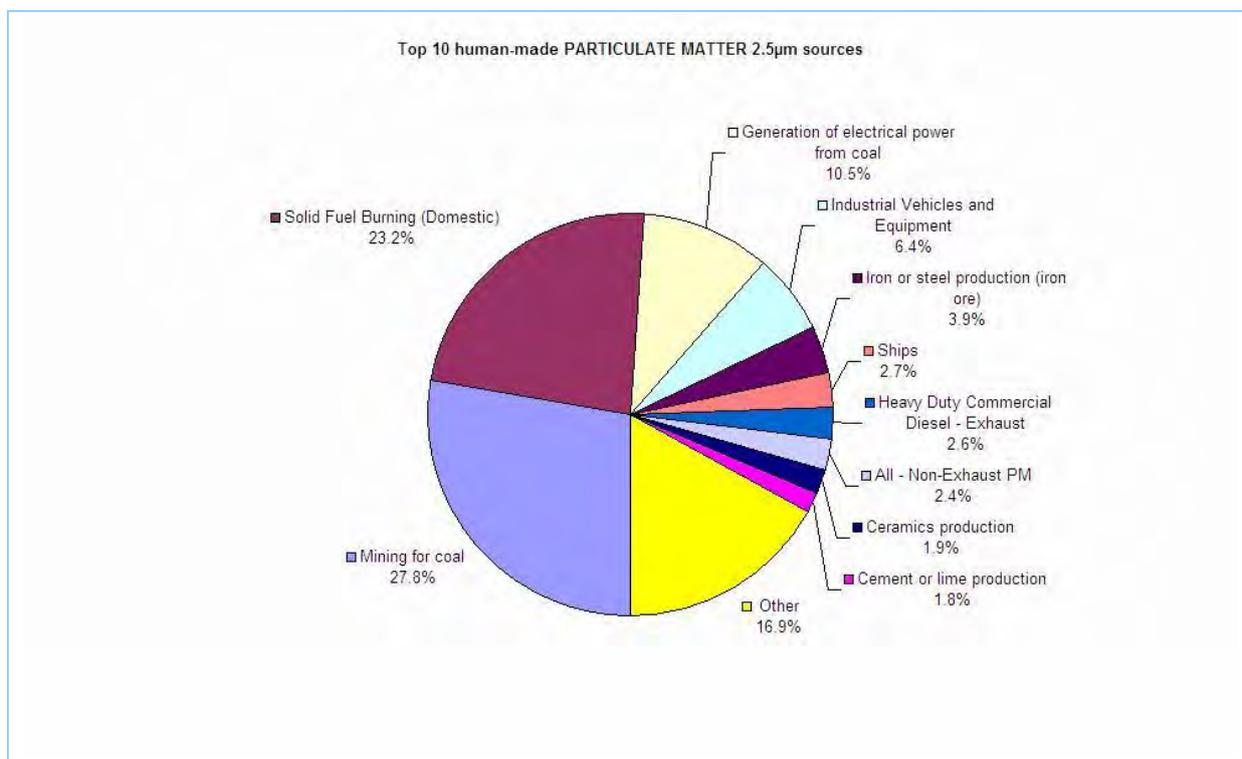
**Table ES-9: Top 10 human-made sources of particulate matter  $\leq 2.5 \mu\text{m}$  in each region**

Module	Activity	Emissions (tonne/year)	Proportions (%)	Cumulative Proportions (%)
<b>Top 10 human-made PARTICULATE MATTER <math>\leq 2.5 \mu\text{m}</math> sources in the GMR</b>				
Industrial	Mining for coal	8,832	27.82	27.82
Domestic-commercial	Solid fuel burning (domestic)	7,359	23.18	51.01
Industrial	Generation of electrical power from coal	3,335	10.51	61.51
Off-road mobile	Industrial vehicles and equipment	2,031	6.40	67.91
Industrial	Iron or steel production (iron ore)	1,223	3.85	71.76
Off-road mobile	Ships	849	2.67	74.44
On-road mobile	Heavy duty commercial diesel - exhaust	816	2.57	77.01
On-road mobile	All non-exhaust particulate matter	771	2.43	79.44
Industrial	Ceramics production	593	1.87	81.30
Industrial	Cement or lime production	582	1.83	83.14
Human-made	Other	5,352	16.86	100.00
<b>Top 10 human-made PARTICULATE MATTER <math>\leq 2.5 \mu\text{m}</math> sources in the Sydney region</b>				
Domestic-commercial	Solid fuel burning (domestic)	5,457	50.64	50.64
On-road mobile	All non-exhaust particulate matter	597	5.54	56.19
On-road mobile	Heavy duty commercial diesel - exhaust	574	5.33	61.51
Off-road mobile	Ships	496	4.60	66.11
Industrial	Ceramics production	478	4.43	70.55
On-road mobile	Light duty diesel - exhaust	239	2.22	72.77
Industrial	Waste disposal (application to land)	226	2.10	74.87
Commercial	Synthetic resin manufacturing	189	1.75	76.62
Off-road mobile	Industrial vehicles and equipment	146	1.35	77.98
Industrial	Other land-based extraction	145	1.35	79.32
Human-made	Other	2,228	20.68	100.00
<b>Top 10 human-made PARTICULATE MATTER <math>\leq 2.5 \mu\text{m}</math> sources in the Newcastle region</b>				
Domestic-commercial	Solid fuel burning (domestic)	456	22.54	22.54
Industrial	Ammonium nitrate production	316	15.63	38.17
Industrial	Mining for coal	302	14.91	53.08
Off-road mobile	Ships	146	7.21	60.29
Industrial	Aluminium production (alumina)	119	5.90	66.19
Industrial	Coal works	93	4.61	70.81
Off-road mobile	Industrial vehicles and equipment	87	4.31	75.12
On-road mobile	Heavy duty commercial diesel - exhaust	56	2.74	77.86
Industrial	Iron or steel production (scrap metal)	53	2.60	80.46
Industrial	Boat construction/maintenance (dry/float)	49	2.41	82.88
Human-made	Other	346	17.12	100.00

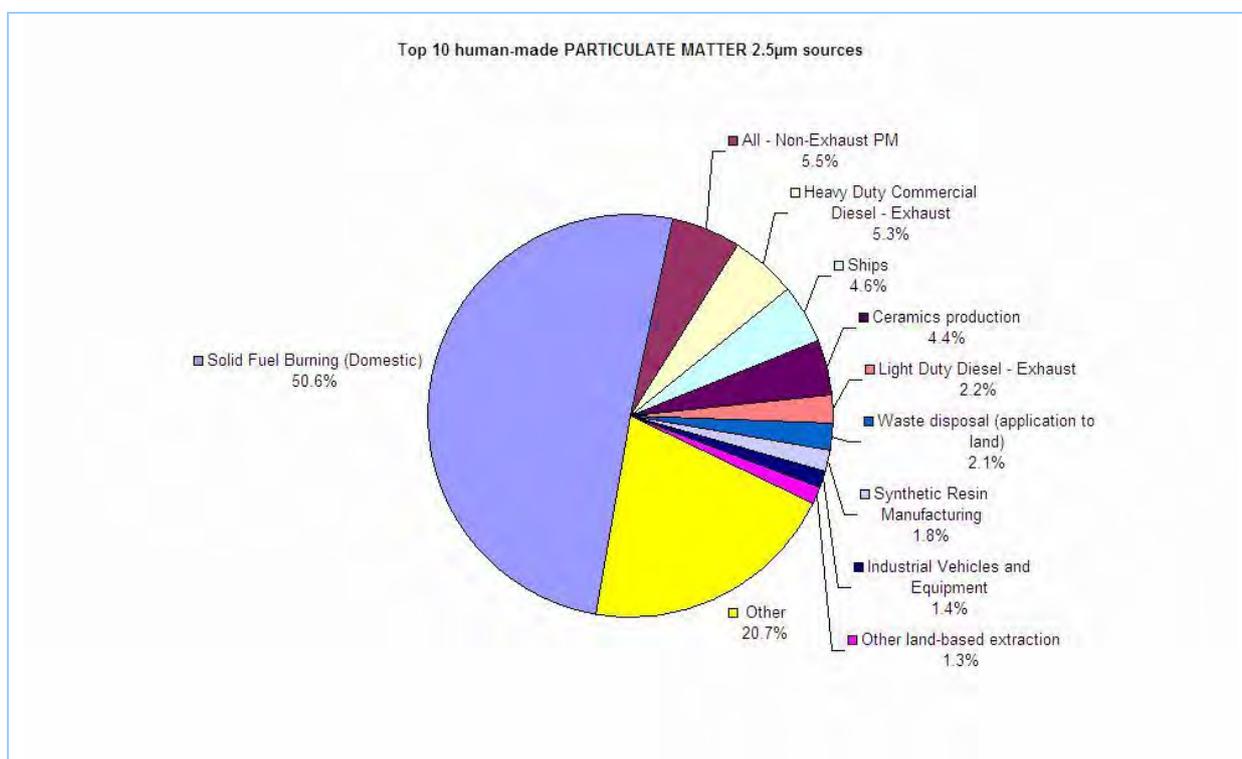
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Module	Activity	Emissions (tonne/year)	Proportions (%)	Cumulative Proportions (%)
Top 10 human-made PARTICULATE MATTER $\leq 2.5 \mu\text{m}$ sources in the Wollongong region				
Industrial	Iron or steel production (iron ore)	1,223	65.46	65.46
Domestic-commercial	Solid fuel burning (domestic)	301	16.12	81.57
Off-road mobile	Ships	62	3.33	84.90
Industrial	Generation of electrical power from gas	36	1.90	86.81
Off-road mobile	Industrial vehicles and equipment	34	1.84	88.65
On-road mobile	Heavy duty commercial diesel - exhaust	28	1.50	90.15
Industrial	Coke production	28	1.48	91.63
On-road mobile	All non-exhaust particulate matter	23	1.25	92.88
Industrial	Mining for coal	12	0.63	93.50
Industrial	Coal works	11	0.61	94.11
Human-made	Other	110	5.89	100.00
Top 10 human-made PARTICULATE MATTER $\leq 2.5 \mu\text{m}$ sources in the Non Urban region				
Industrial	Mining for coal	8,467	49.58	49.58
Industrial	Generation of electrical power from coal	3,335	19.53	69.11
Off-road mobile	Industrial vehicles and equipment	1,764	10.33	79.44
Domestic-commercial	Solid fuel burning (domestic)	1,145	6.70	86.15
Industrial	Cement or lime production	544	3.19	89.33
Industrial	Land-based extractive activity	463	2.71	92.05
On-road mobile	Heavy duty commercial diesel - exhaust	159	0.93	92.98
Off-road mobile	Ships	145	0.85	93.82
Commercial	Gravel and sand quarrying	136	0.80	94.62
Industrial	Aluminium production (alumina)	135	0.79	95.41
Human-made	Other	784	4.59	100.00

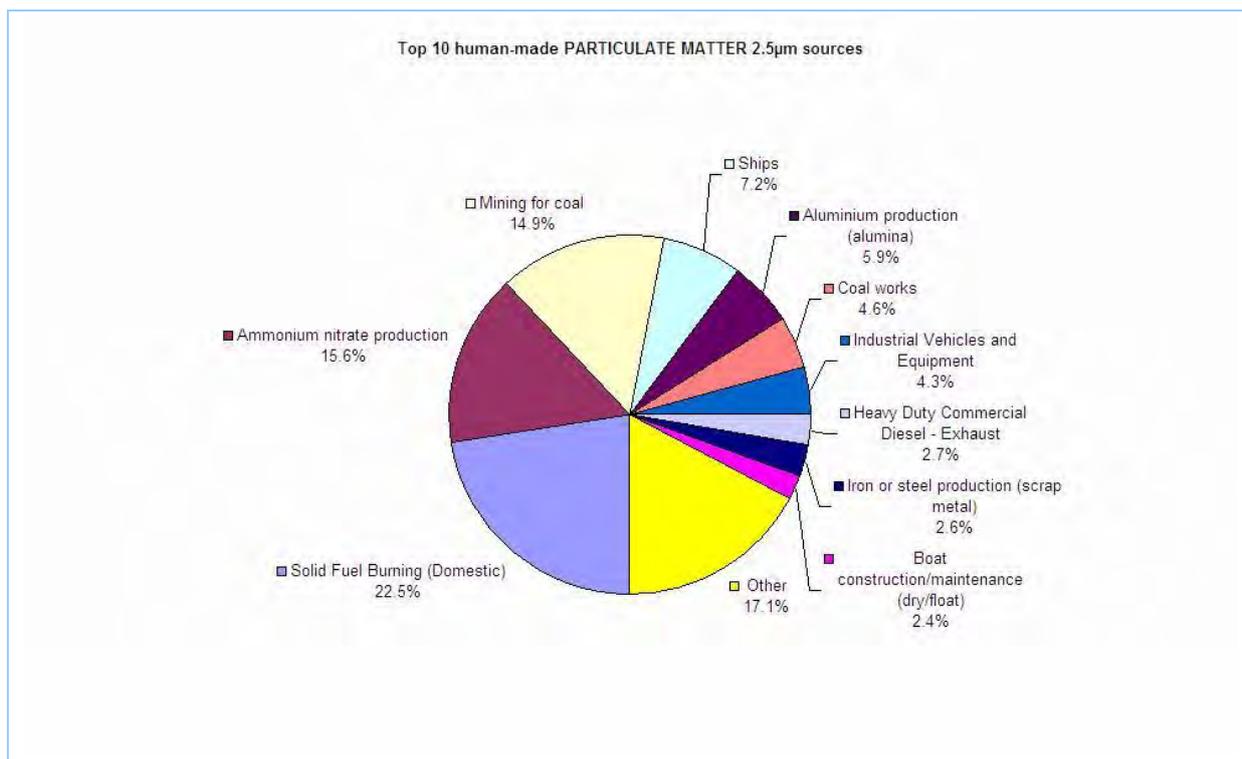
Figure ES-27, Figure ES-28, Figure ES-29, Figure ES-30 and Figure ES-31 show the proportions of total estimated annual emissions for the top 10 human-made sources of particulate matter  $\leq 2.5 \mu\text{m}$  in the whole GMR and the Sydney, Newcastle, Wollongong and Non Urban regions, respectively.



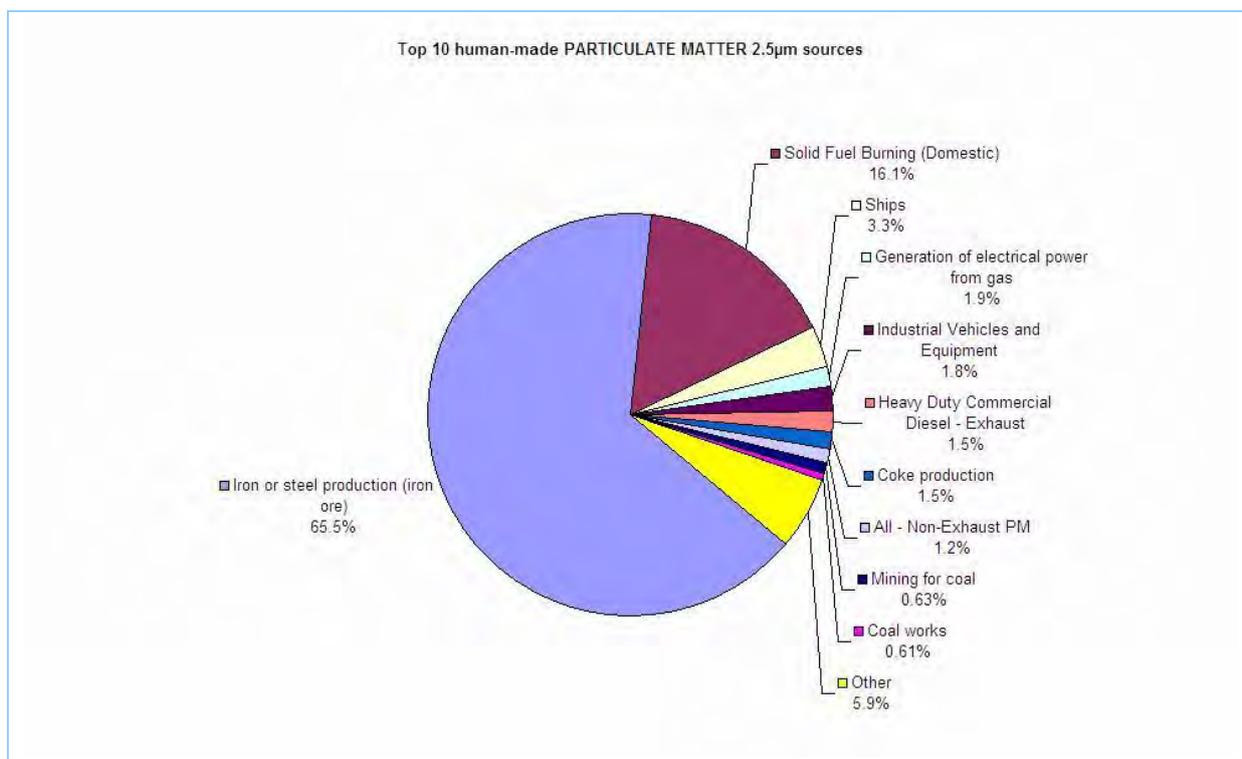
**Figure ES-27: Top 10 human-made sources of particulate matter  $\leq 2.5 \mu\text{m}$  in the GMR**



**Figure ES-28: Top 10 human-made sources of particulate matter  $\leq 2.5 \mu\text{m}$  in the Sydney region**



**Figure ES-29: Top 10 human-made sources of particulate matter  $\leq 2.5 \mu\text{m}$  in the Newcastle region**



**Figure ES-30: Top 10 human-made sources of particulate matter  $\leq 2.5 \mu\text{m}$  in the Wollongong region**

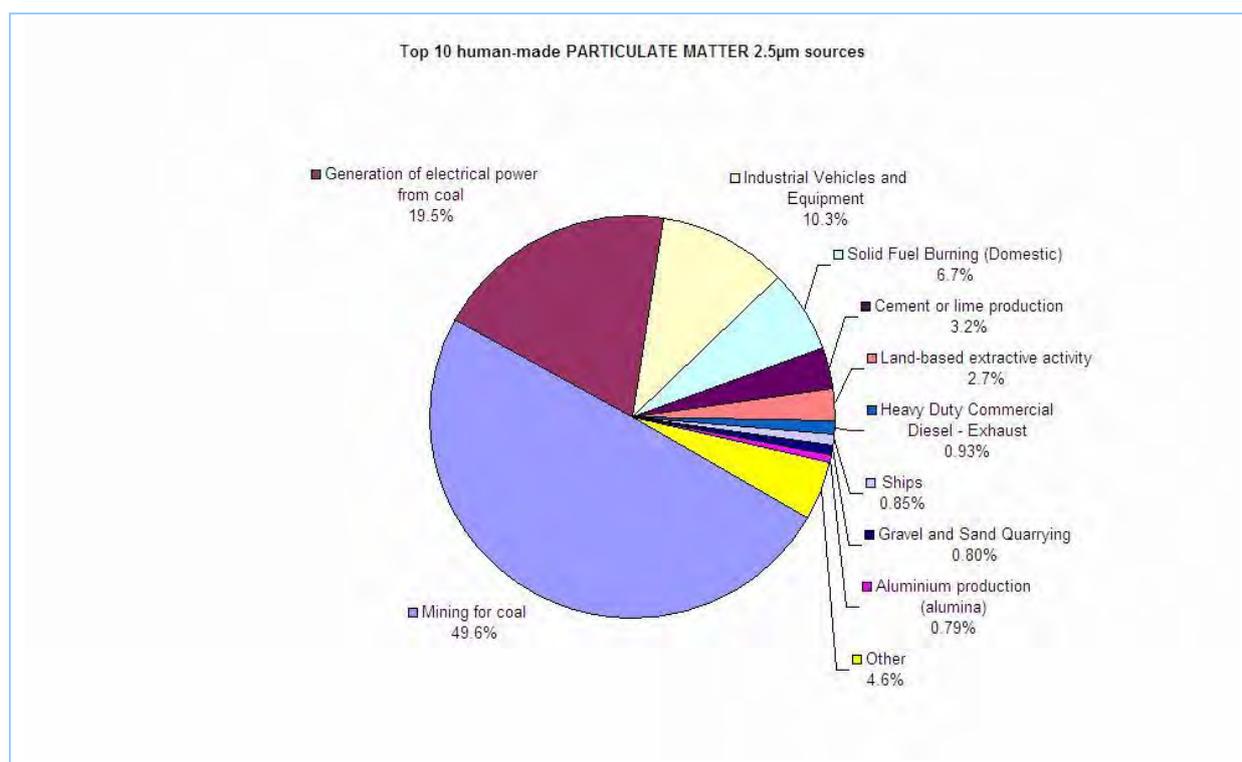


Figure ES-31: Top 10 human-made sources of particulate matter  $\leq 2.5 \mu\text{m}$  in the Non Urban region

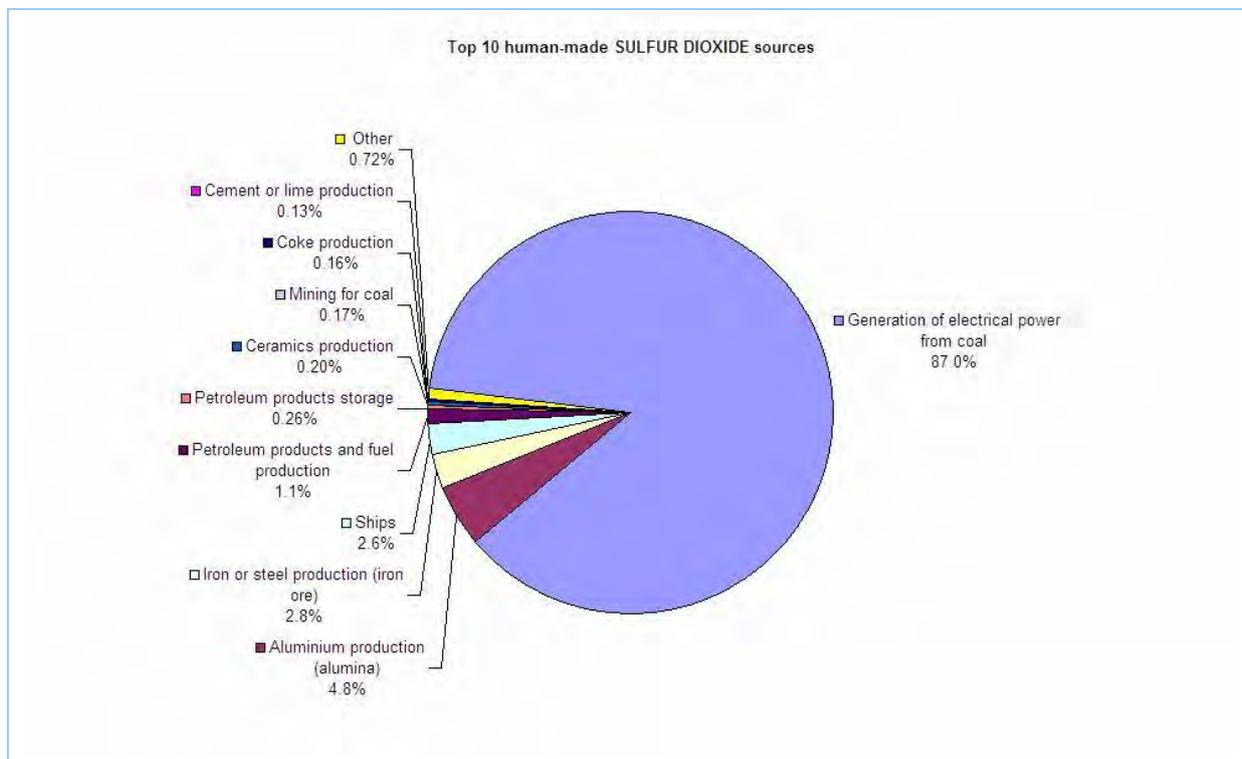
Table ES-10 presents total estimated annual emissions, proportions and cumulative proportions for the top 10 human-made sources of sulfur dioxide in the whole GMR and the Sydney, Newcastle, Wollongong and Non Urban regions.

**Table ES-10: Top 10 human-made sources of sulfur dioxide in each region**

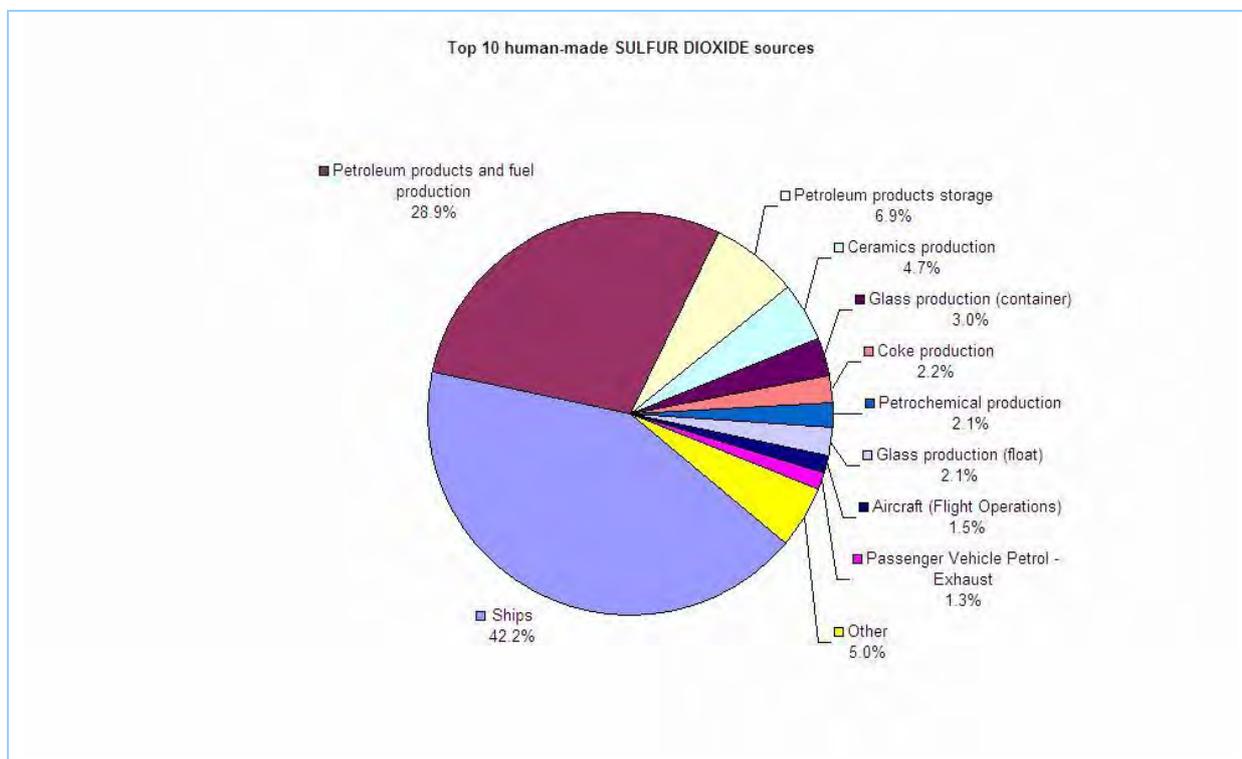
Module	Activity	Emissions (tonne/year)	Proportions (%)	Cumulative Proportions (%)
<b>Top 10 human-made SULFUR DIOXIDE sources in the GMR</b>				
Industrial	Generation of electrical power from coal	251,437	87.03	87.03
Industrial	Aluminium production (alumina)	13,857	4.80	91.82
Industrial	Iron or steel production (iron ore)	8,216	2.84	94.67
Off-road mobile	Ships	7,557	2.62	97.28
Industrial	Petroleum products and fuel production	3,119	1.08	98.36
Industrial	Petroleum products storage	737	0.26	98.62
Industrial	Ceramics production	581	0.20	98.82
Industrial	Mining for coal	496	0.17	98.99
Industrial	Coke production	455	0.16	99.15
Industrial	Cement or lime production	379	0.13	99.28
Human-made	Other	2,085	0.72	100.00
<b>Top 10 human-made SULFUR DIOXIDE sources in the Sydney region</b>				
Off-road mobile	Ships	4,538	42.22	42.22
Industrial	Petroleum products and fuel production	3,111	28.94	71.17
Industrial	Petroleum products storage	737	6.86	78.03
Industrial	Ceramics production	505	4.69	82.72
Industrial	Glass production (container)	327	3.05	85.77
Industrial	Coke production	237	2.20	87.97
Industrial	Petrochemical production	229	2.13	90.10
Industrial	Glass production (float)	223	2.08	92.18
Off-road mobile	Aircraft (flight operations)	160	1.48	93.66
On-road mobile	Passenger vehicle petrol - exhaust	144	1.34	95.00
Human-made	Other	537	5.00	100.00
<b>Top 10 human-made SULFUR DIOXIDE sources in the Newcastle region</b>				
Industrial	Aluminium production (alumina)	10,119	87.29	87.29
Off-road mobile	Ships	1,292	11.15	98.43
Industrial	Slaughtering or processing of animals	65	0.56	99.00
Industrial	Chemical production	65	0.56	99.55
On-road mobile	Passenger vehicle petrol - exhaust	9.73	$8.40 \times 10^{-2}$	99.64
Industrial	Iron or steel production (scrap metal)	8.91	$7.69 \times 10^{-2}$	99.71
Domestic-commercial	Solid fuel burning (domestic)	8.01	$6.91 \times 10^{-2}$	99.78
Industrial	Bitumen mixing	4.42	$3.82 \times 10^{-2}$	99.82
Off-road mobile	Aircraft (flight operations)	2.88	$2.49 \times 10^{-2}$	99.85
Off-road mobile	Industrial vehicles and equipment	2.68	$2.31 \times 10^{-2}$	99.87
Human-made	Other	15	0.13	100.00

Module	Activity	Emissions (tonne/year)	Proportions (%)	Cumulative Proportions (%)
<b>Top 10 human-made SULFUR DIOXIDE sources in the Wollongong region</b>				
Industrial	Iron or steel production (iron ore)	8,216	90.65	90.65
Off-road mobile	Ships	551	6.08	96.73
Industrial	Coke production	219	2.41	99.14
Industrial	General chemicals storage	31	0.34	99.49
Industrial	Metal plating or coating	24	0.27	99.76
Domestic-commercial	Solid fuel burning (domestic)	5.29	$5.84 \times 10^{-2}$	99.81
On-road mobile	Passenger vehicle petrol – exhaust	5.15	$5.68 \times 10^{-2}$	99.87
Industrial	Generation of electrical power from gas	2.76	$3.05 \times 10^{-2}$	99.90
Off-road mobile	Industrial vehicles and equipment	1.41	$1.55 \times 10^{-2}$	99.92
On-road mobile	Light duty commercial petrol – exhaust	1.36	$1.50 \times 10^{-2}$	99.93
Human-made	Other	6.20	$6.85 \times 10^{-2}$	100.00
<b>Top 10 human-made SULFUR DIOXIDE sources in the Non Urban region</b>				
Industrial	Generation of electrical power from coal	251,437	97.64	97.64
Industrial	Aluminium production (alumina)	3,738	1.45	99.09
Off-road mobile	Ships	1,176	0.46	99.55
Industrial	Mining for coal	495	0.19	99.74
Industrial	Cement or lime production	371	0.14	99.88
Industrial	Ceramics production	76	$2.97 \times 10^{-2}$	99.91
Off-road mobile	Industrial vehicles and equipment	53	$2.07 \times 10^{-2}$	99.93
Commercial	Log sawmilling	49	$1.92 \times 10^{-2}$	99.95
On-road mobile	Passenger vehicle petrol – exhaust	22	$8.46 \times 10^{-3}$	99.96
Domestic-commercial	Solid fuel burning (domestic)	20	$7.81 \times 10^{-3}$	99.97
Human-made	Other	78	$3.02 \times 10^{-2}$	100.00

Figure ES-32, Figure ES-33, Figure ES-34, Figure ES-35 and Figure ES-36 show the proportions of total estimated annual emissions for the top 10 human-made sources of sulfur dioxide in the whole GMR and the Sydney, Newcastle, Wollongong and Non Urban regions, respectively.



**Figure ES-32: Top 10 human-made sources of sulfur dioxide in the GMR**



**Figure ES-33: Top 10 human-made sources of sulfur dioxide in the Sydney region**

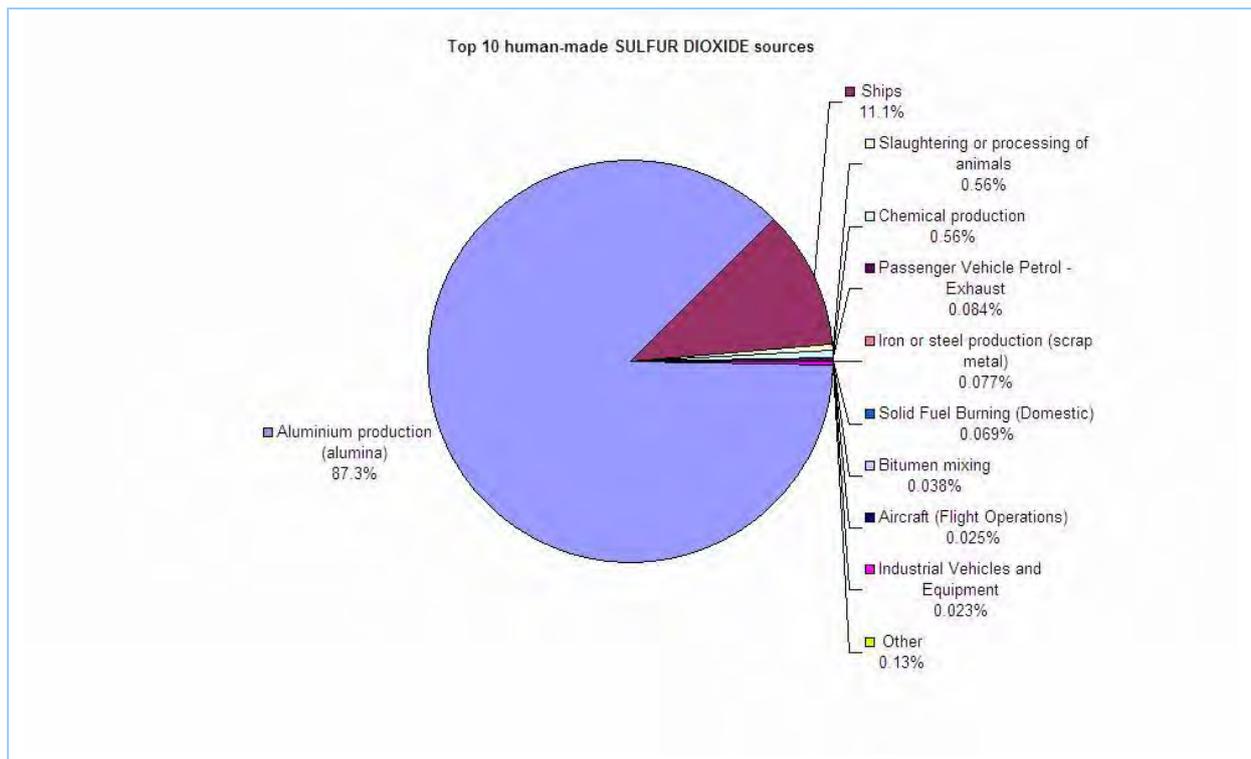


Figure ES-34: Top 10 human-made sources of sulfur dioxide in the Newcastle region

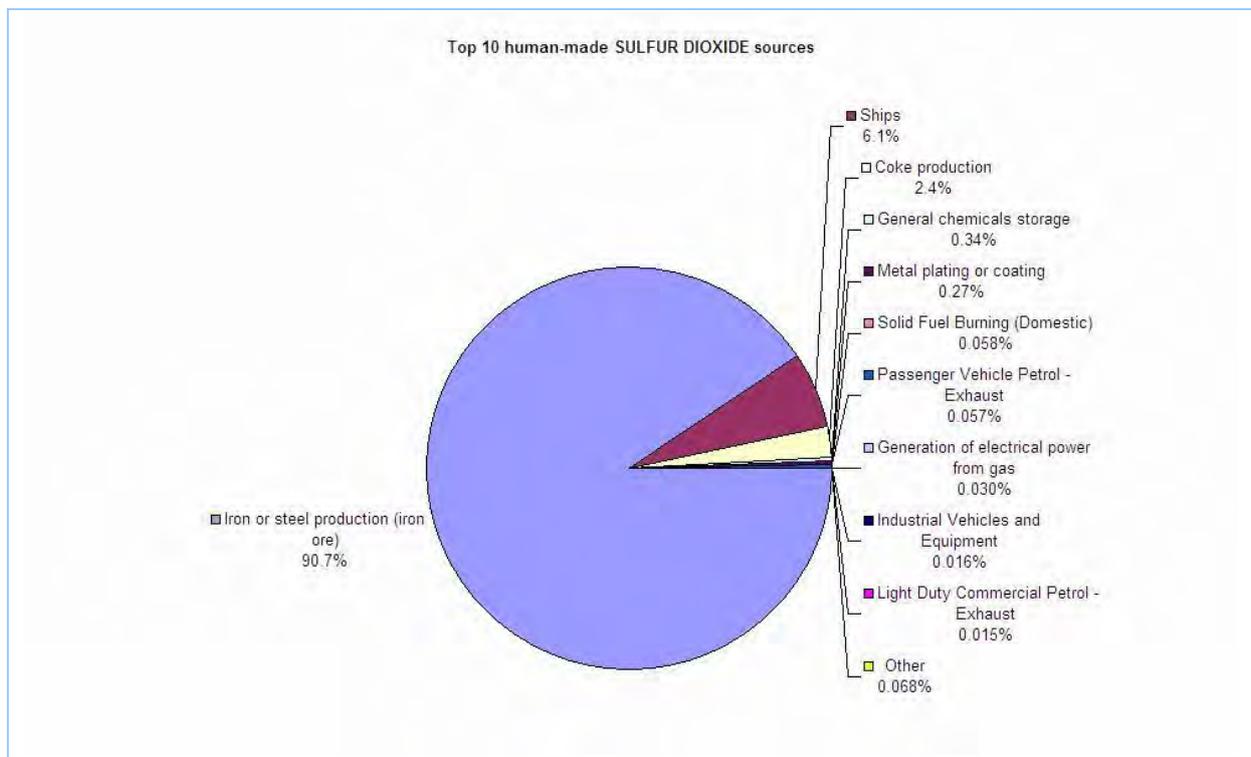
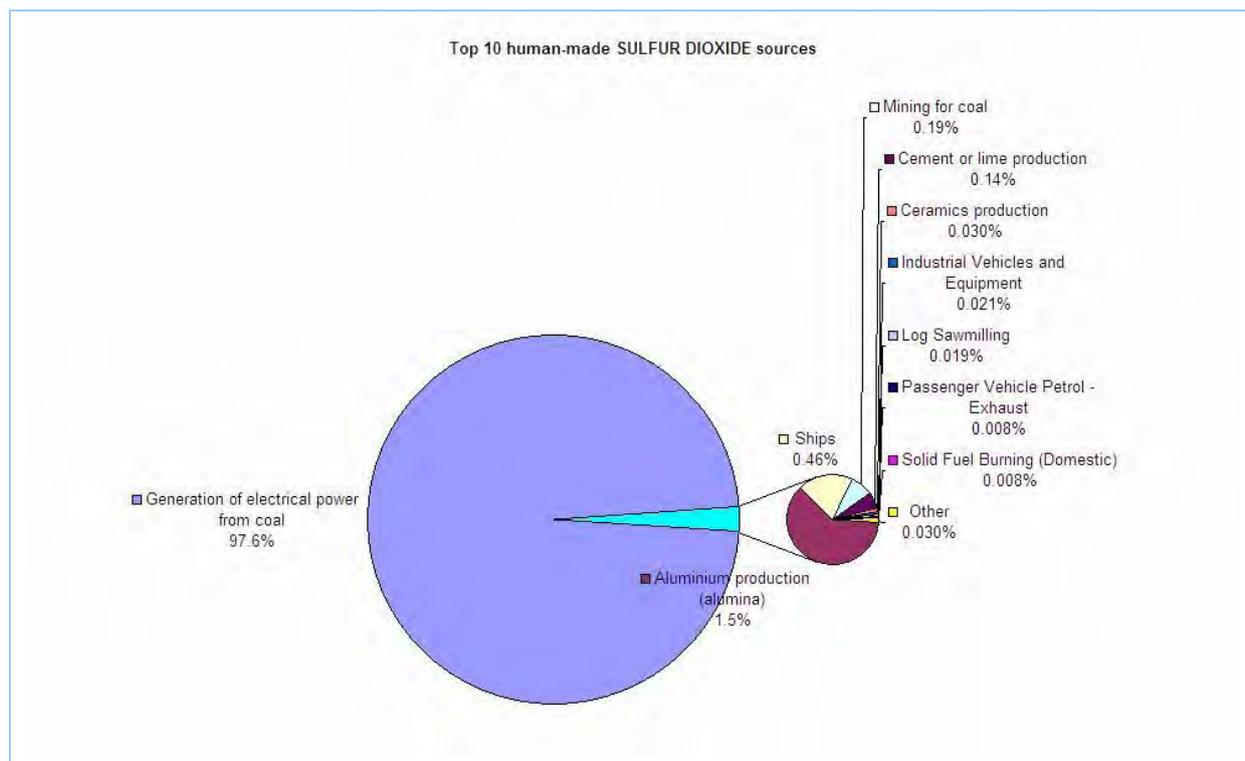


Figure ES-35: Top 10 human-made sources of sulfur dioxide in the Wollongong region



**Figure ES-36: Top 10 human-made sources of sulfur dioxide in the Non Urban region**

Table ES-11 presents total estimated annual emissions, proportions and cumulative proportions for the top 10 human-made sources of VOC in the whole GMR and the Sydney, Newcastle, Wollongong and Non Urban regions.

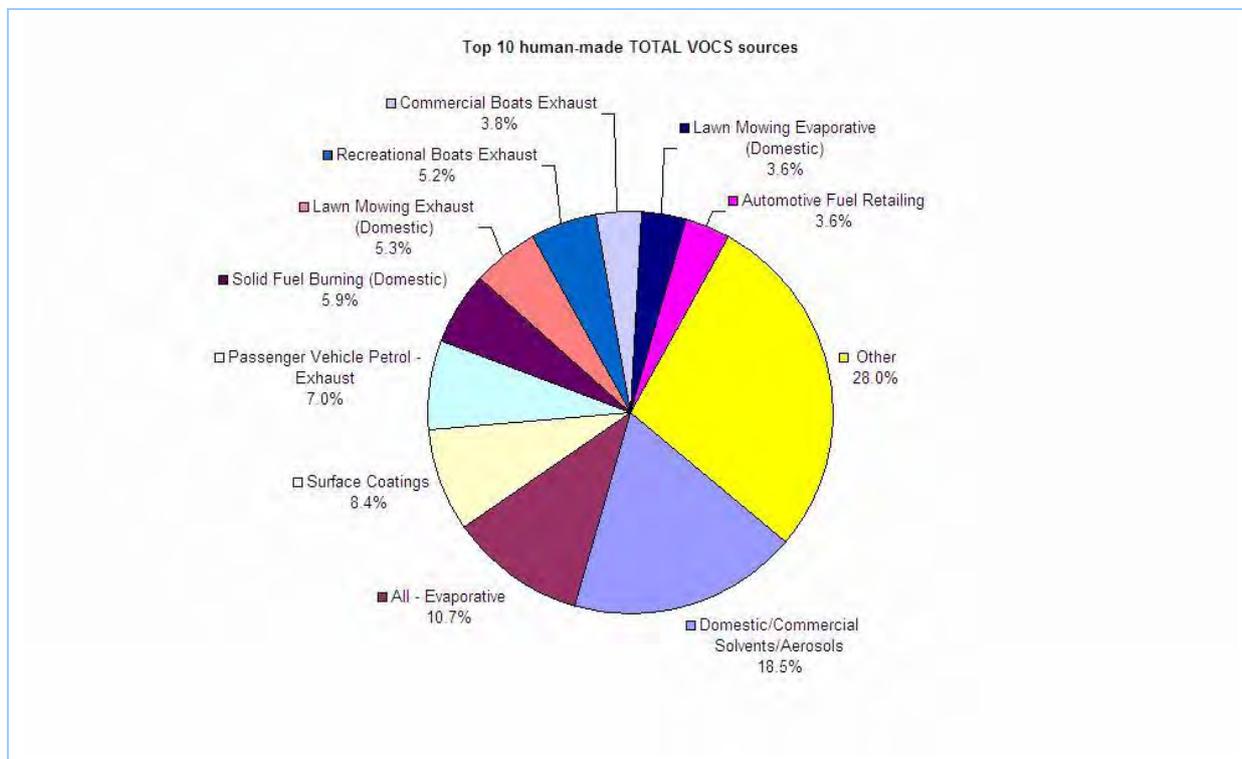
**Table ES-11: Top 10 human-made sources of VOC in each region**

Module	Activity	Emissions (tonne/year)	Proportions (%)	Cumulative Proportions (%)
<b>Top 10 human-made TOTAL VOLATILE ORGANIC COMPOUNDS sources in the GMR</b>				
Domestic-commercial	Domestic/commercial solvents/aerosols	25,274	18.45	18.45
On-road mobile	All - evaporative	14,632	10.68	29.14
Domestic-commercial	Surface coatings	11,561	8.44	37.58
On-road mobile	Passenger vehicle petrol - exhaust	9,647	7.04	44.62
Domestic-commercial	Solid fuel burning (domestic)	8,027	5.86	50.48
Domestic-commercial	Lawn mowing exhaust (domestic)	7,282	5.32	55.80
Off-road mobile	Recreational boats exhaust	7,139	5.21	61.01
Off-road mobile	Commercial boats exhaust	5,224	3.81	64.83
Domestic-commercial	Lawn mowing evaporative (domestic)	4,917	3.59	68.42
Commercial	Automotive fuel retailing	4,907	3.58	72.00
Human-made	Other	38,347	28.00	100.00
<b>Top 10 human-made TOTAL VOLATILE ORGANIC COMPOUNDS sources in the Sydney region</b>				
Domestic-commercial	Domestic/commercial solvents/aerosols	19,905	20.13	20.13
On-road mobile	All - evaporative	11,512	11.64	31.77
Domestic-commercial	Surface coatings	9,012	9.11	40.88
On-road mobile	Passenger vehicle petrol - exhaust	7,789	7.88	48.76
Domestic-commercial	Solid fuel burning (domestic)	5,952	6.02	54.78
Domestic-commercial	Lawn mowing exhaust (domestic)	5,400	5.46	60.24
Domestic-commercial	Lawn mowing evaporative (domestic)	3,647	3.69	63.93
Domestic-commercial	Lawn mowing exhaust (public open spaces)	3,489	3.53	67.45
Off-road mobile	Recreational boats exhaust	3,383	3.42	70.88
Commercial	Automotive fuel retailing	2,936	2.97	73.85
Human-made	Other	25,864	26.15	100.00
<b>Top 10 human-made TOTAL VOLATILE ORGANIC COMPOUNDS sources in the Newcastle region</b>				
Domestic-commercial	Domestic/commercial solvents/aerosols	1,276	15.98	15.98
On-road mobile	All - evaporative	855	10.71	26.69
Off-road mobile	Commercial boats exhaust	686	8.59	35.27
Domestic-commercial	Surface coatings	622	7.79	43.06
On-road mobile	Passenger vehicle petrol - exhaust	537	6.72	49.78
Domestic-commercial	Solid fuel burning (domestic)	497	6.23	56.01
Domestic-commercial	Lawn mowing exhaust (domestic)	451	5.65	61.66
Commercial	Automotive fuel retailing	389	4.87	66.53
Off-road mobile	Recreational boats exhaust	351	4.40	70.93
Domestic-commercial	Lawn mowing evaporative (domestic)	305	3.82	74.74
Human-made	Other	2,017	25.26	100.00

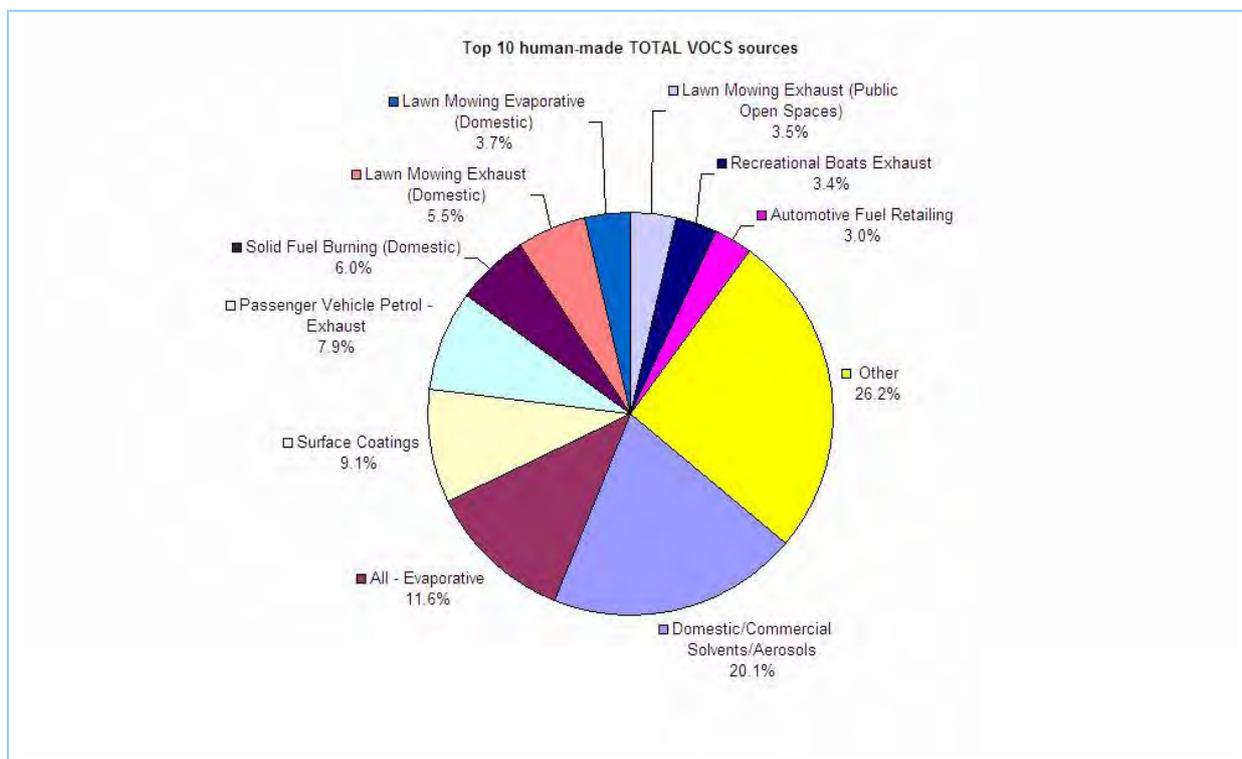
2008 Calendar Year Consolidated Natural and Human-Made Emissions: Results  
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Module	Activity	Emissions (tonne/year)	Proportions (%)	Cumulative Proportions (%)
<b>Top 10 human-made TOTAL VOLATILE ORGANIC COMPOUNDS sources in the Wollongong region</b>				
Domestic-commercial	Domestic/commercial solvents/aerosols	940	18.05	18.05
Industrial	Iron or steel production (iron ore)	452	8.69	26.74
Domestic-commercial	Surface coatings	449	8.63	35.38
On-road mobile	All - evaporative	436	8.38	43.76
Off-road mobile	Recreational boats exhaust	373	7.17	50.93
Domestic-commercial	Solid fuel burning (domestic)	328	6.31	57.24
Domestic-commercial	Lawn mowing exhaust (domestic)	298	5.73	62.96
On-road mobile	Passenger vehicle petrol - exhaust	293	5.64	68.60
Commercial	Automotive fuel retailing	292	5.62	74.22
Domestic-commercial	Lawn mowing evaporative (domestic)	201	3.87	78.08
Human-made	Other	1,141	21.92	100.00
<b>Top 10 human-made TOTAL VOLATILE ORGANIC COMPOUNDS sources in the Non Urban region</b>				
Domestic-commercial	Domestic/commercial solvents/aerosols	3,154	12.68	12.68
Off-road mobile	Recreational boats exhaust	3,032	12.19	24.86
Off-road mobile	Industrial vehicles and equipment	2,607	10.48	35.34
Off-road mobile	Commercial boats exhaust	2,264	9.10	44.44
On-road mobile	All - evaporative	1,828	7.35	51.79
Domestic-commercial	Surface coatings	1,478	5.94	57.73
Commercial	Automotive fuel retailing	1,290	5.18	62.91
Domestic-commercial	Solid fuel burning (domestic)	1,248	5.02	67.93
Domestic-commercial	Lawn mowing exhaust (domestic)	1,133	4.55	72.48
On-road mobile	Passenger vehicle petrol - exhaust	1,029	4.13	76.62
Human-made	Other	5,817	23.38	100.00

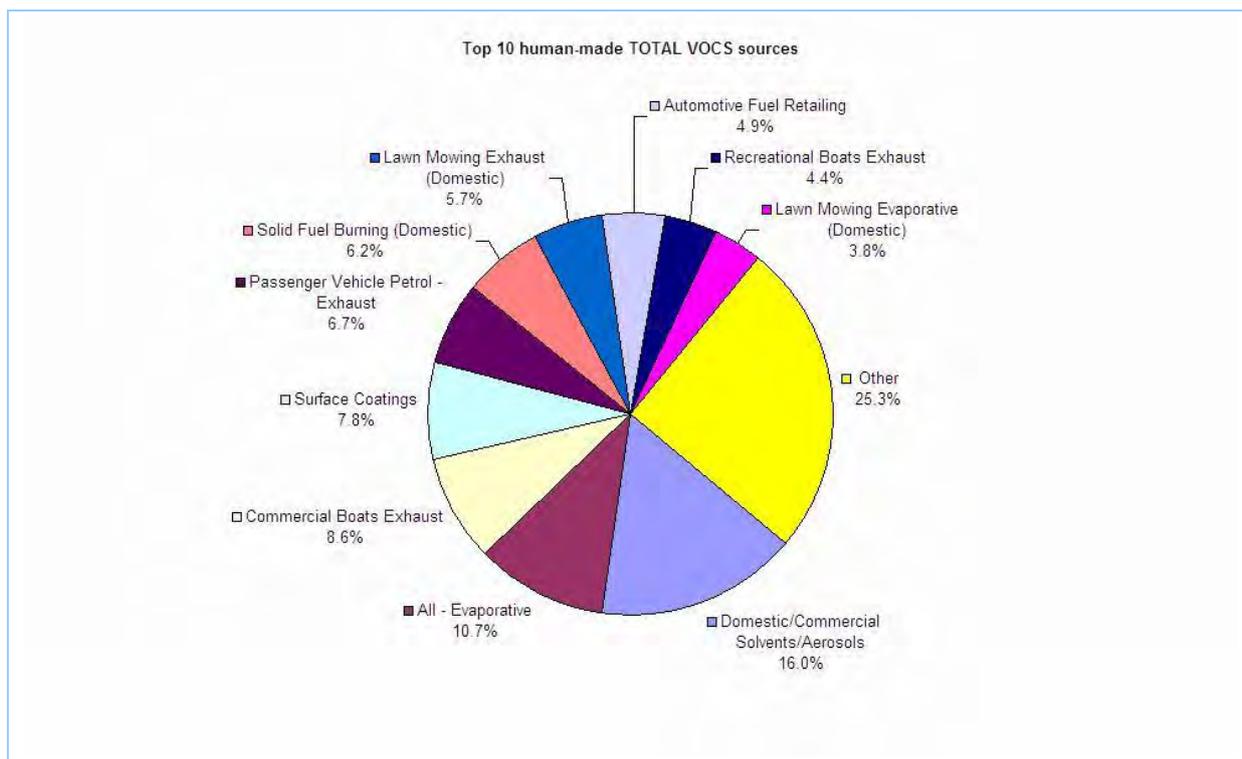
Figure ES-37, Figure ES-38, Figure ES-39, Figure ES-40 and Figure ES-41 show the proportions of total estimated annual emissions for the top 10 human-made sources of VOC in the whole GMR and the Sydney, Newcastle, Wollongong and Non Urban regions, respectively.



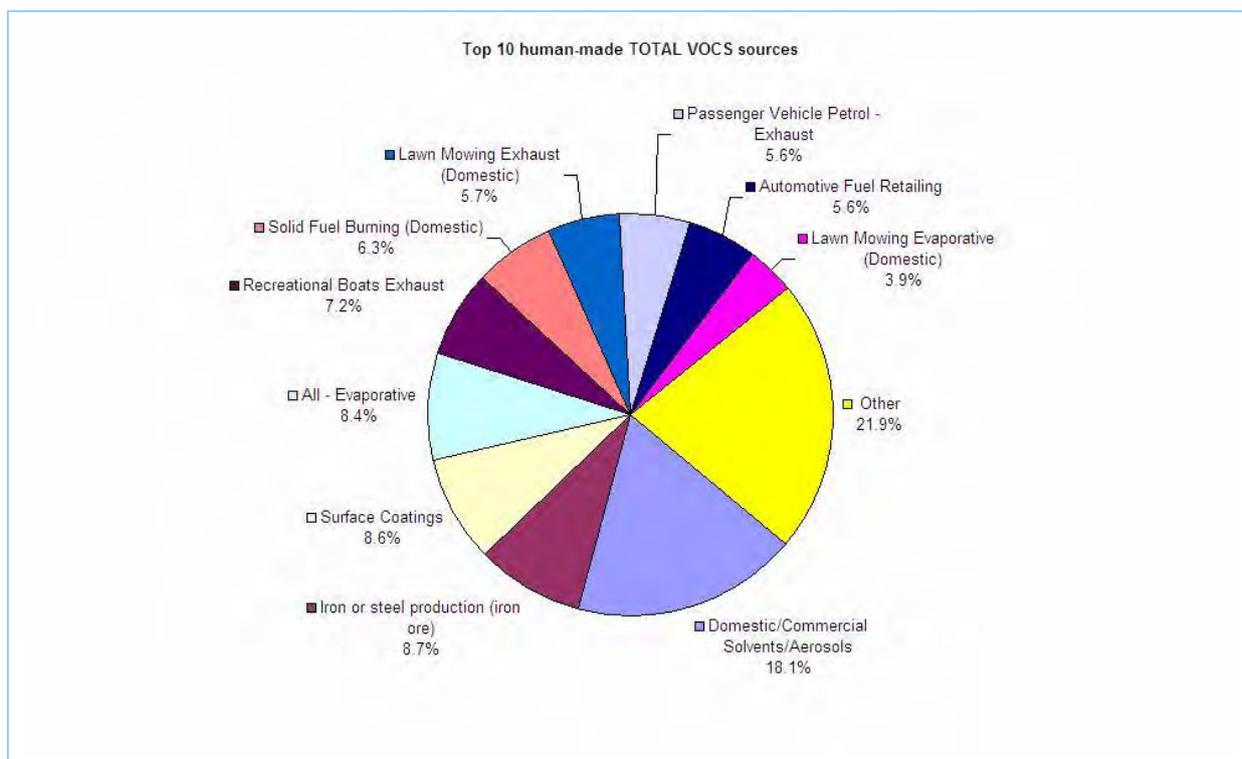
**Figure ES-37: Top 10 human-made sources of VOC in the GMR**



**Figure ES-38: Top 10 human-made sources of VOC in the Sydney region**



**Figure ES-39: Top 10 human-made sources of VOC in the Newcastle region**



**Figure ES-40: Top 10 human-made sources of VOC in the Wollongong region**

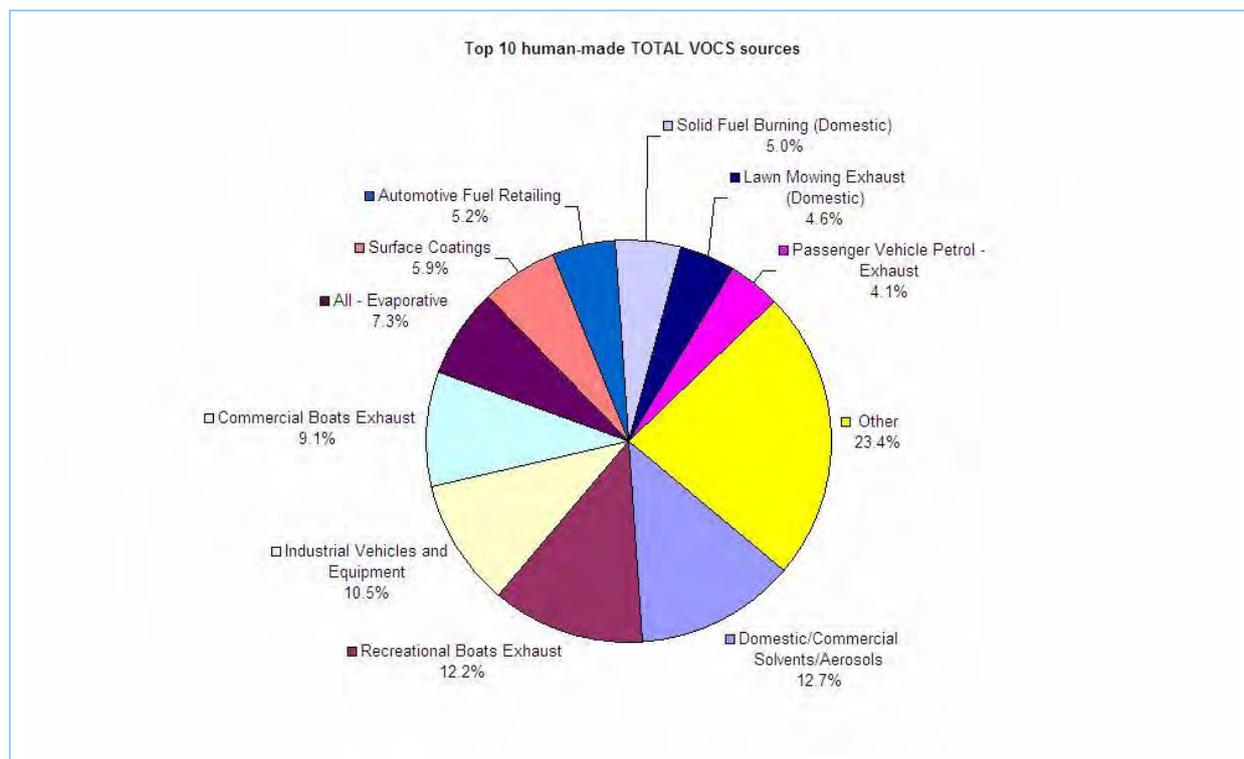


Figure ES-41: Top 10 human-made sources of VOC in the Non Urban region