2014 Hong Kong Emission Inventory Report

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1 INTRODUCTION

1.1 The Environmental Protection Department (EPD) compiles the Hong Kong Air Pollutant Emission Inventory every year to analyze the air pollution condition and the major emission sources which helps formulate the air quality management strategy in Hong Kong. The emission inventory for Hong Kong was first uploaded to EPD's website in March 2000.

1.2 This report presents the 2014 Hong Kong Emission Inventory. It describes:

(i) the emission inventory by source category in 2014 (Chapter 3);
(ii) the emission trends from 1997 to 2014 for six major air pollutants (Chapter 4);
(iii) the sectoral analyses for seven emission source categories (Chapter 5); and
(iv) the emission reduction plan up to 2020 (Chapter 6).

2 SCOPE OF EMISSION INVENTORY

2.1 The emission inventory comprises estimates of the emissions from seven source categories for six major air pollutants, namely: sulphur dioxide (SO_2), nitrogen oxides (NOx), respirable suspended particulates (RSP or PM_{10}), fine suspended particulates (FSP or $PM_{2.5}$), volatile organic compounds (VOC), and carbon monoxide (CO). The emission sources include public electricity generation, road transport, navigation, civil aviation, other combustion sources, non-combustion sources, and biomass burning. Starting from this year, emission inventory of biomass burning has been added to improve the coverage of local emission inventory.

2.2 Other combustion sources are defined as sources involving combustion, other than public electricity generation, road transport, navigation and civil aviation. Major contributing sources in this sector include non-road mobile machineries operating in construction sites and container terminals.

2.3 Non-combustion sources are defined as those remaining sources that do not involve combustion and only VOC, RSP and FSP emissions are significant. Under this category, the major sources for VOC include paints and associated solvents, consumer products and printing, whereas those for RSP and FSP include paved road dust, cooking fume, construction dust and quarry production.

2.4 Biomass burning is the burning of living and dead vegetation mainly due to human activities. In Hong Kong, the only contributing source in this sector is emissions from hill fires which can produce a large amount of particulates.

3 2014 EMISSION INVENTORY

3.1 The table below shows the breakdown of air pollutant emissions by source category in 2014, while **Annex 1** shows the changes in emissions between 2013 and 2014.

Breakdown of 2014 Emission Inventory

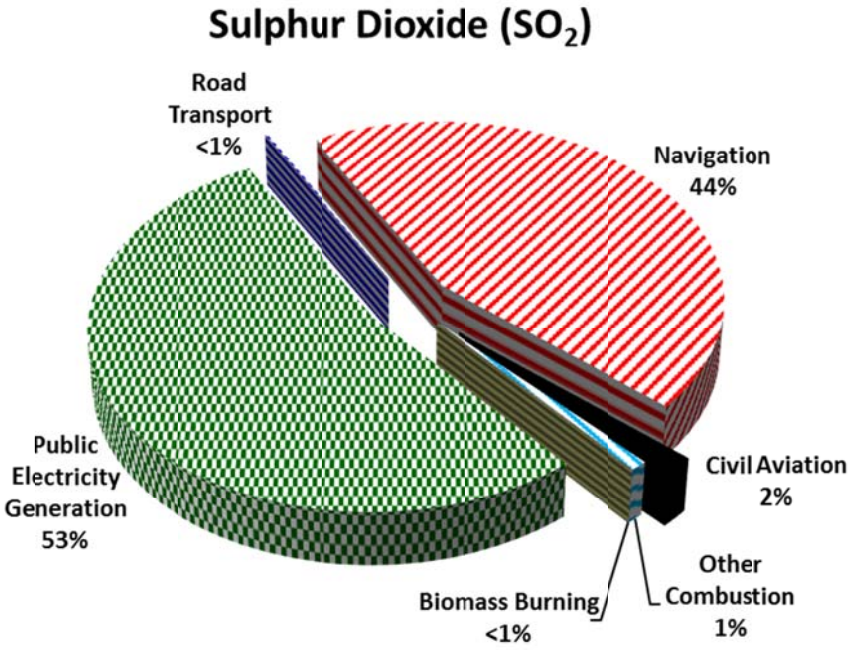
Pollution Sources	Emissions (Tonnes)					
	SO_2	**NOx**	**RSP**	**FSP**	**VOC**	**CO**
Public Electricity Generation	16,880	36,210	980	450	470	3,960
Road Transport	40	21,200	830	760	5,380	39,400
Navigation	14,000	36,200	2,100	1,940	3,830	12,690
Civil Aviation	510	5,500	60	60	610	3,590
Other Combustion	280	10,440	820	750	1,070	5,630
Non-combustion	N/A	N/A	910	470	15,600	N/A
Biomass Burning	0	20	210	170	60	660
Total Emissions	31,710	109,570	5,900	4,600	27,020	65,930

Note: - All figures are rounded to the nearest ten.
- "N/A" denotes not applicable.
- There may be slight discrepancies between the sums of individual items and the total emissions shown in the table because of rounding.

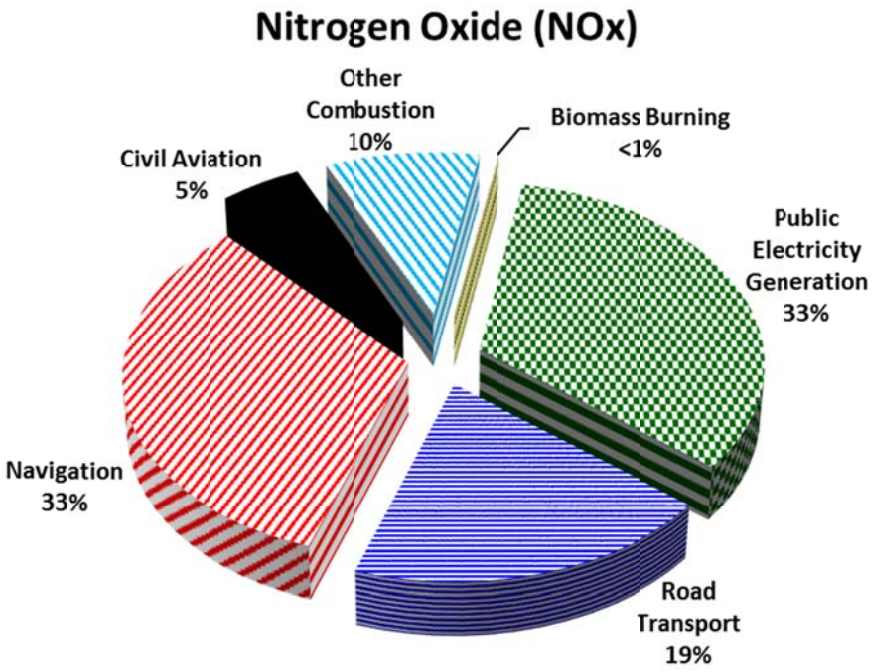
3.2 A summary of updates to the emission inventories is appended at **Annex 2**.

3.3 The following pie charts show the percentage share of emissions by source category for each pollutant in 2014.

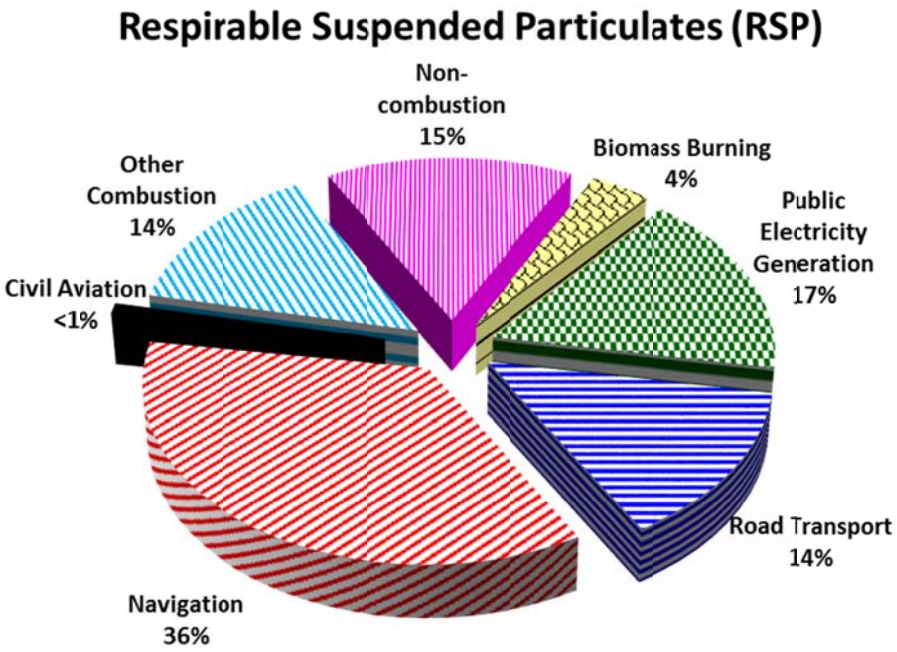
Total SO_2 emission = 31,710 Tonnes



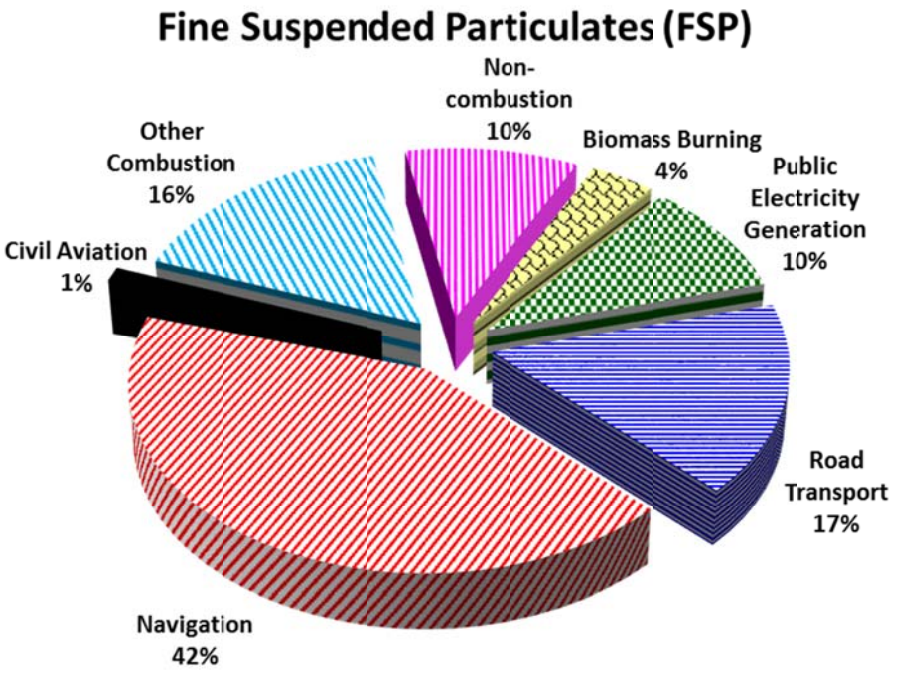
Total NOx emission = 109,570 Tonnes



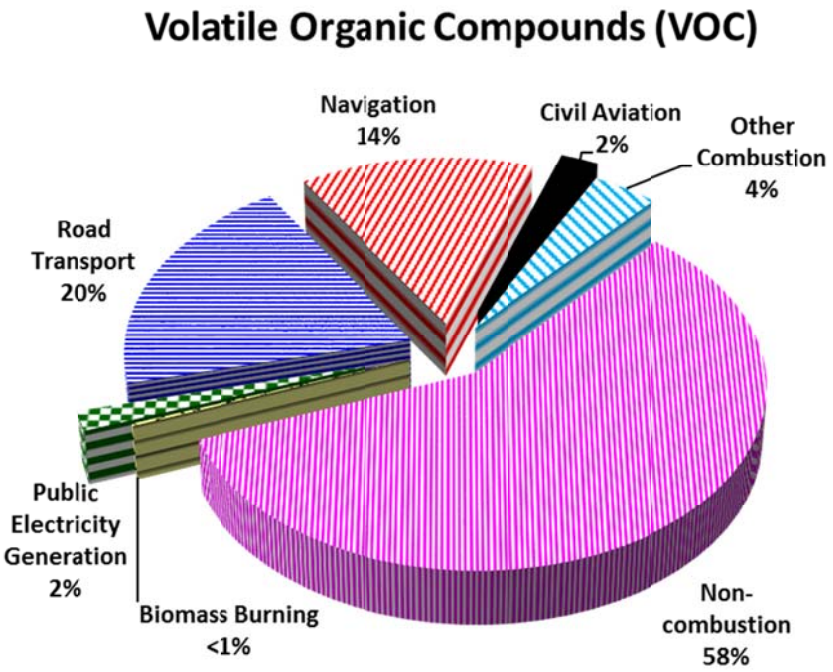
Total RSP emission = 5,900 Tonnes



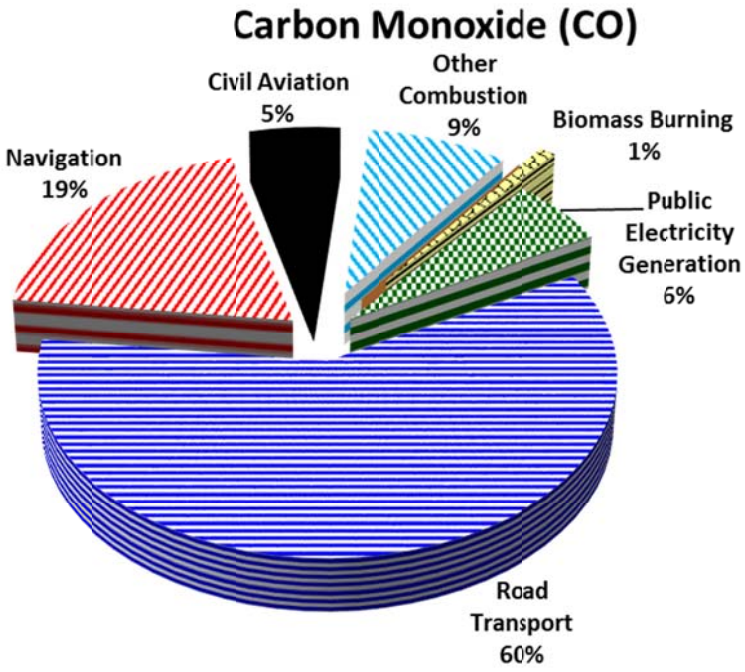
Total FSP emission = 4,600 Tonnes



Total VOC emission = 27,020 Tonnes

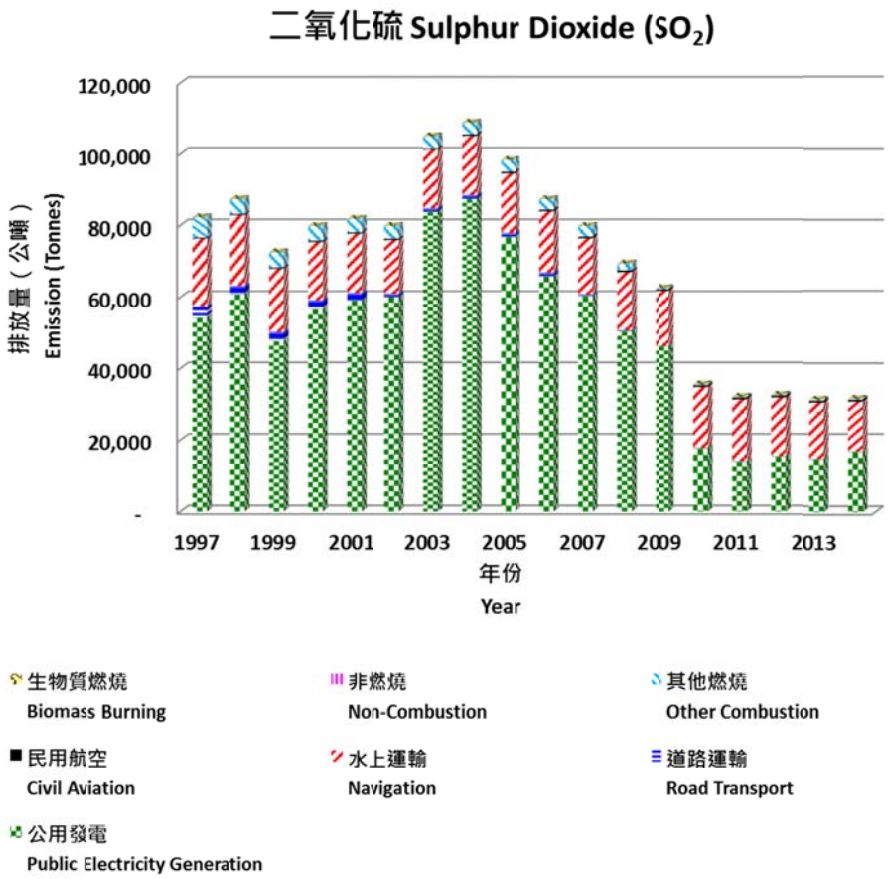


Total CO emission = 65,930 Tonnes



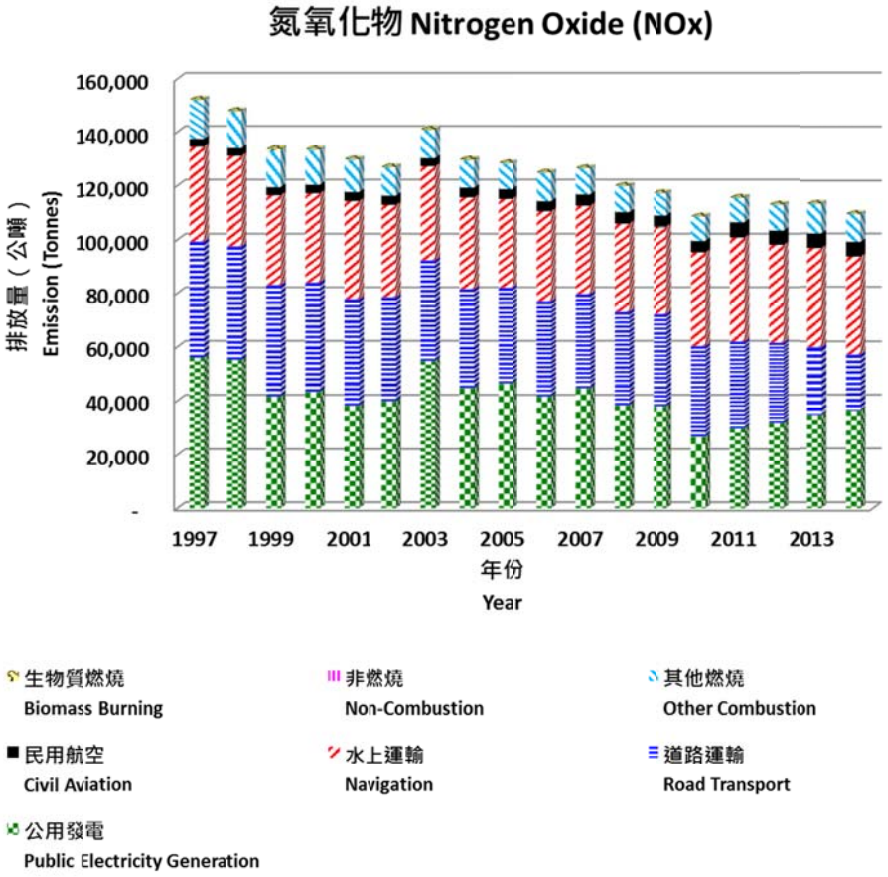
4 EMISSION TRENDS FROM 1997 TO 2014

SO_2 Emission Trend



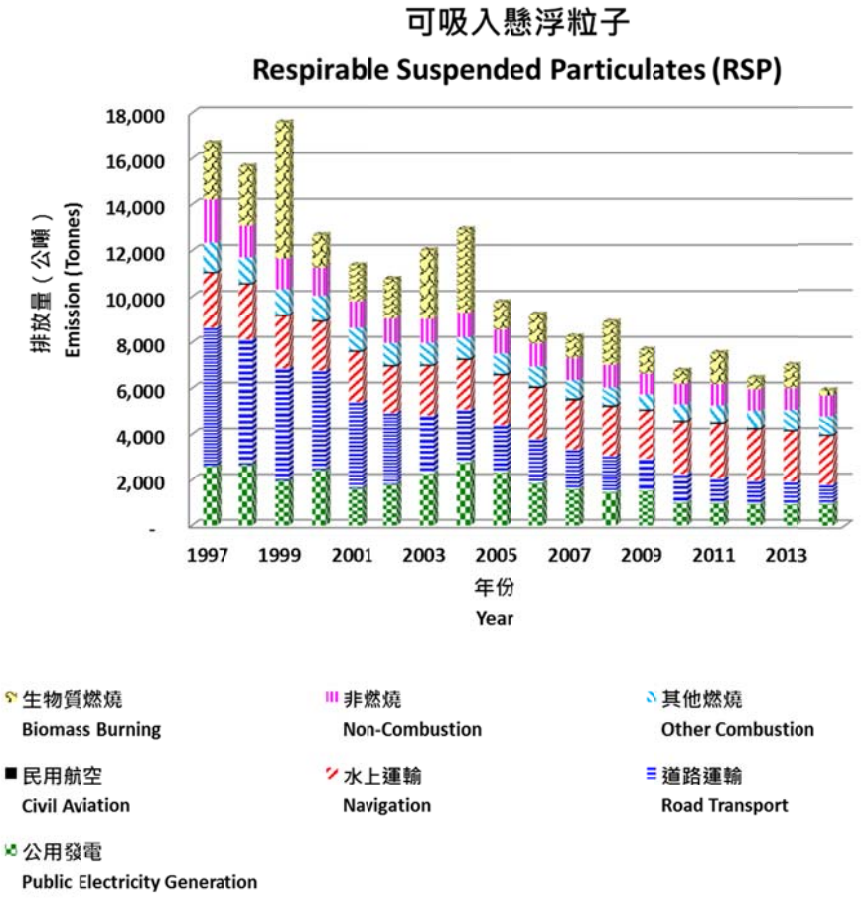
4.1 Between 1997 and 2014, SO_2 emissions decreased by 61% which was mainly caused by the decline in emissions from the public electricity generation sector. Public electricity generation sectors and navigation were the top two sources of SO_2 emissions, accounting for 53% and 44% of total SO_2 emissions in 2014, respectively.

NOx Emission Trend



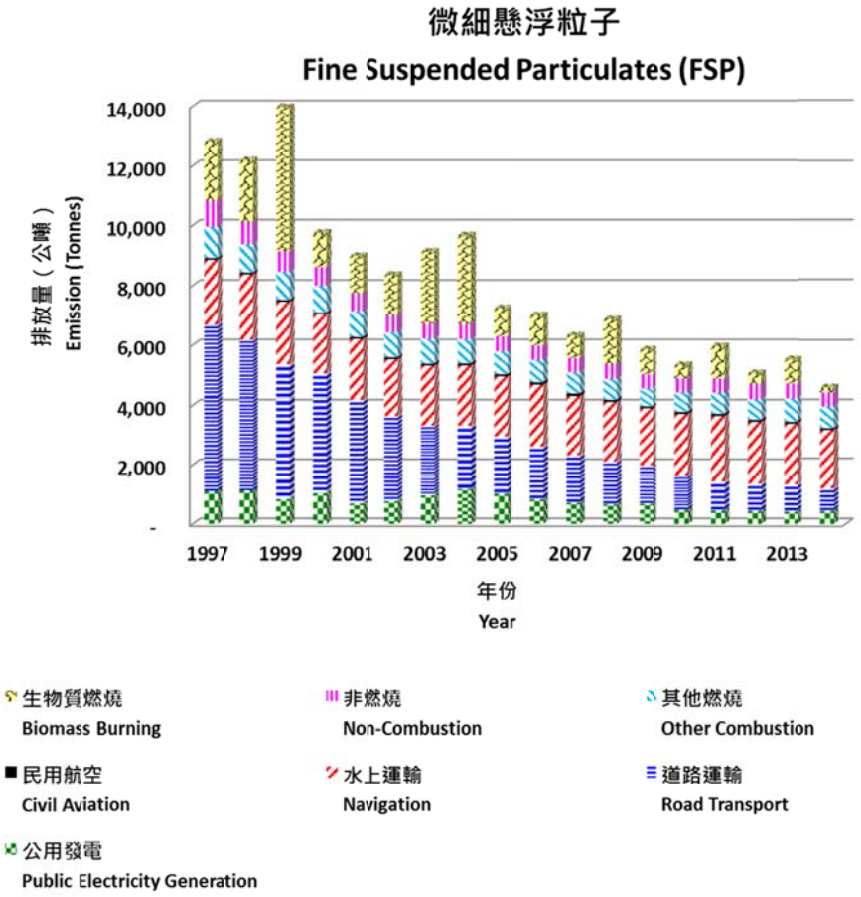
4.2 Between 1997 and 2014, NOx emissions decreased by 28%. Public electricity generation, navigation and road transport sectors were the top three sources of NOx emissions, accounting for 33%, 33% and 19% of total NOx emissions in 2014, respectively.

RSP Emission Trend



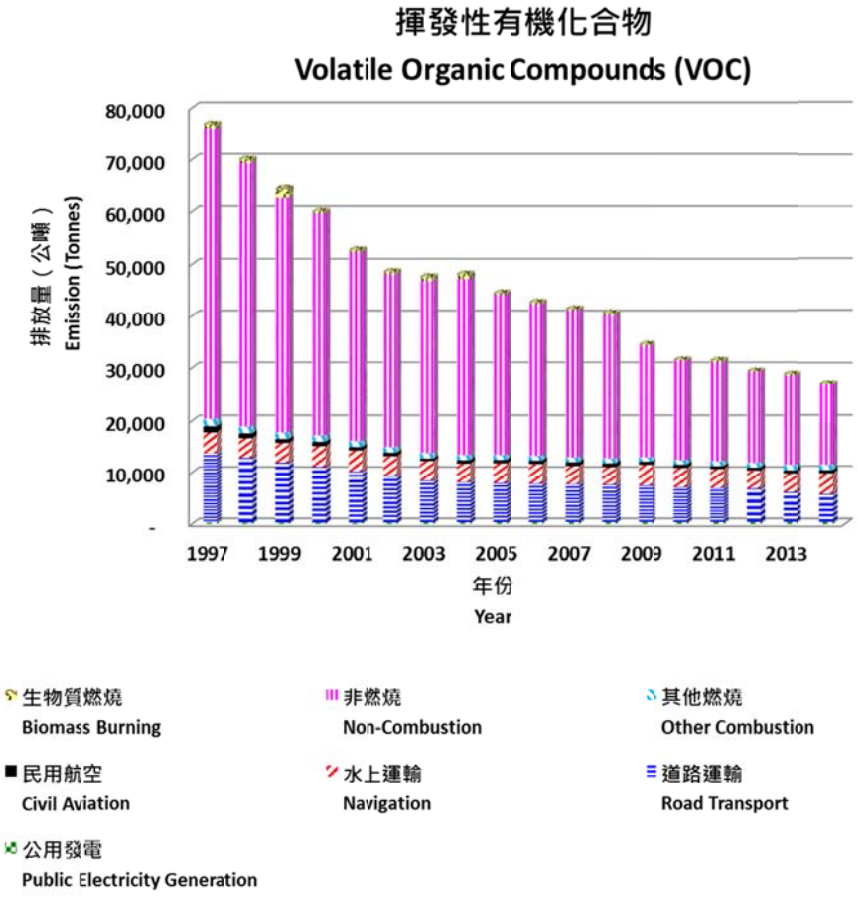
4.3 Between 1997 and 2014, RSP emissions decreased by 65% which was mainly caused by the decline in emissions from the road transport and biomass burning sectors. Navigation, public electricity generation, and non-combustion sectors were the top three sources of RSP emissions, accounting for 36%, 17% and 15% of total RSP emissions in 2014, respectively.

FSP Emission Trend



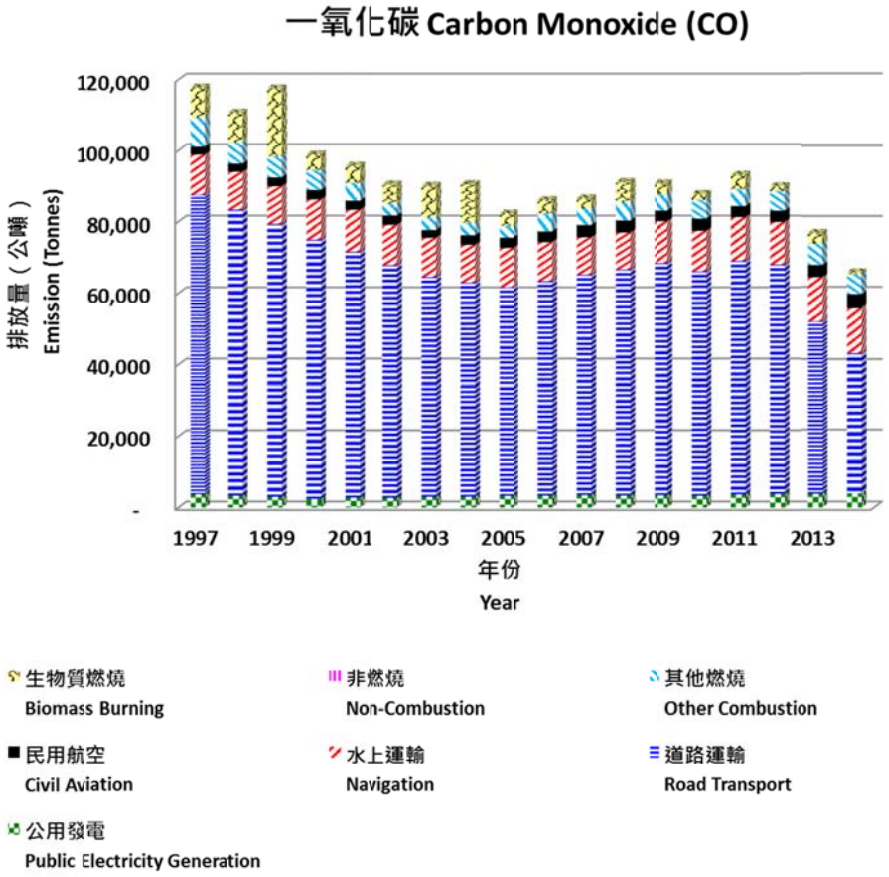
4.4 As FSP is a fraction of RSP, they share similar emission sources and emission trends. Between 1997 and 2014, FSP emissions decreased by 64%. Navigation, road transport, and other combustion sectors were the top three sources of FSP emissions, accounting for 42%, 17% and 16% of total FSP emissions in 2014, respectively.

VOC Emission Trend



4.5 Between 1997 and 2014, VOC emissions decreased by 65% which was mainly due to the decline in emissions from non-combustion and road transport sectors. Non-combustion and road transport sectors were the top two sources of VOC emissions, accounting for 58% and 20% of total VOC emissions in 2014, respectively.

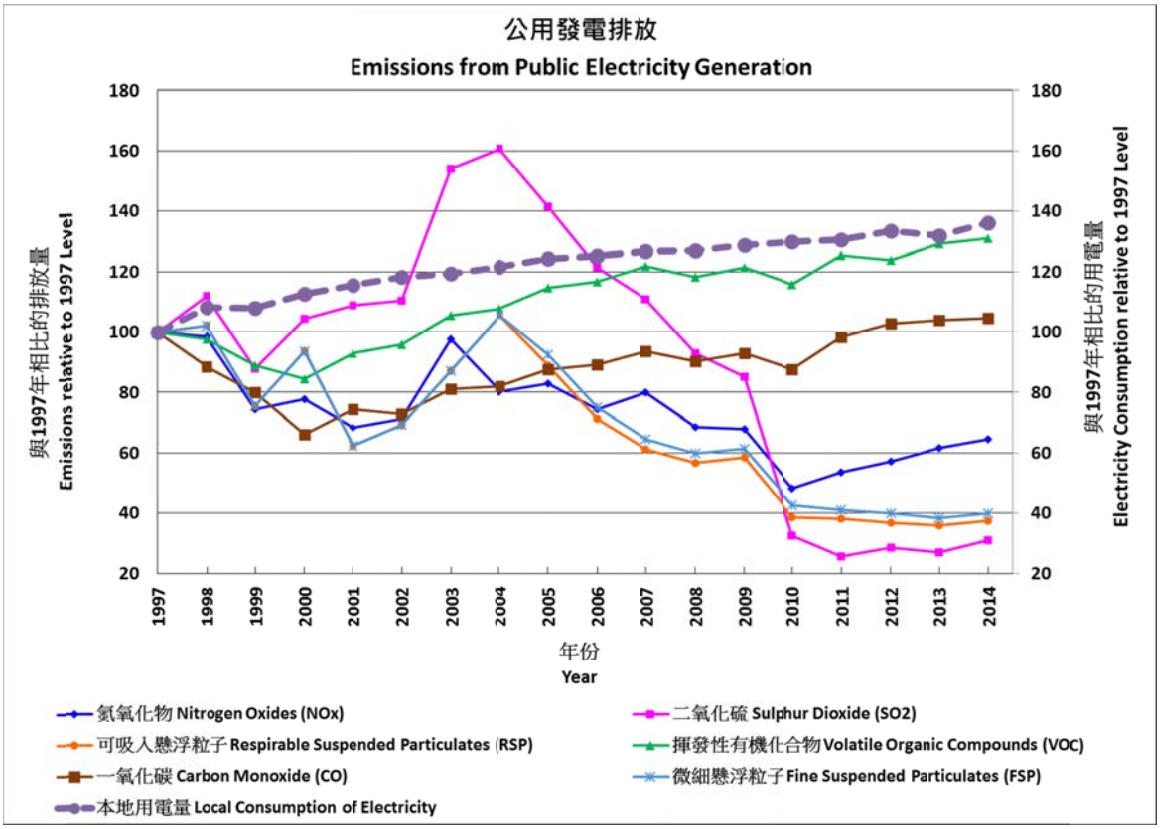
CO Emission Trend



4.6 Between 1997 and 2014, CO emissions decreased by 44% which was mainly due to the decline in emissions from the road transport sector. Road transport was the major CO emitter, accounting for 60% of total CO emissions in 2014.

5 SECTORAL ANALYSES

Sectoral analysis for "Public electricity generation"

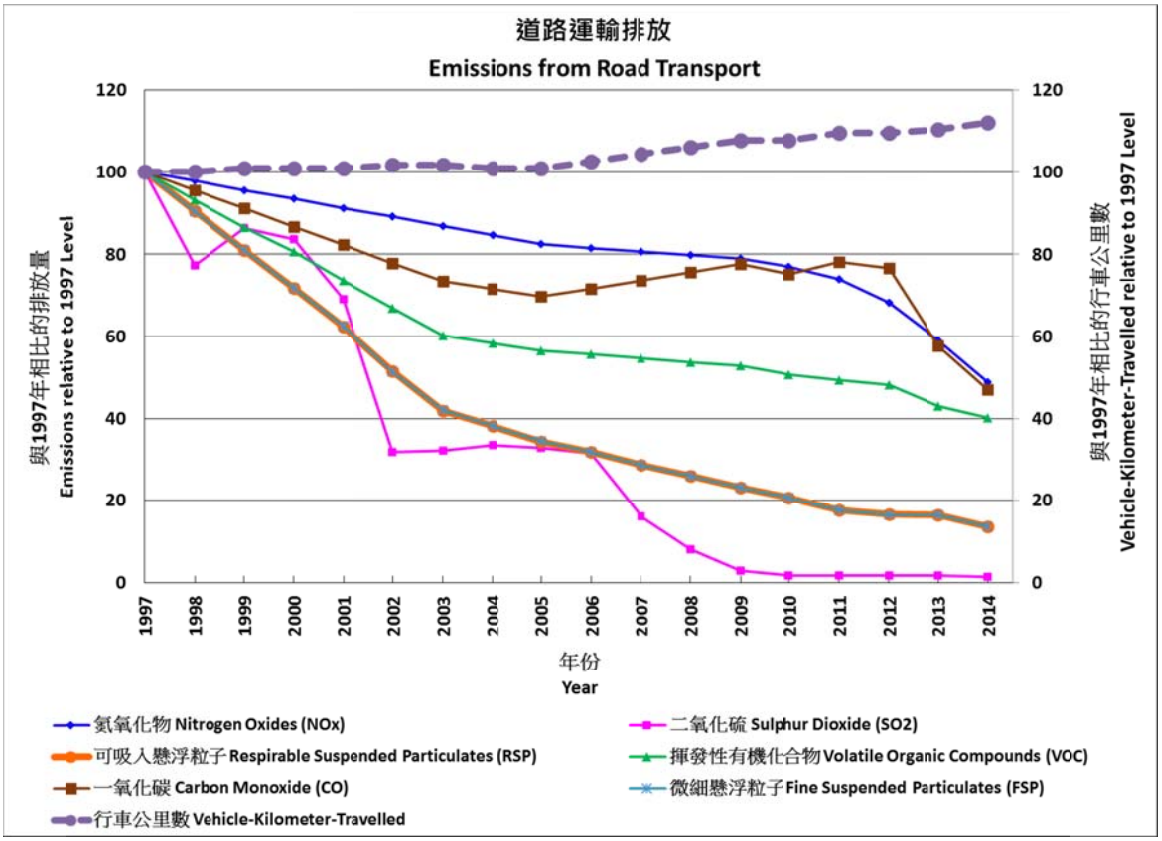


5.1 Power sector had been a major contributor to SO_2, NOx and RSP emissions. Subsequent to the imposition of statutory emission caps on power plants, its SO_2 emissions reduced substantially by 69%; NOx emissions by 35% and RSP emissions by 62% from 1997 to 2014, despite an increase of electricity consumption of 36%. In 2014, the emissions of SO_2, NOx and RSP accounted for 53%, 33% and 17% of the total emissions, respectively.

5.2 That said, the emissions of NOx, CO and VOC showed gentle rising trends from 2010 to 2014 due to the increased use of coal during the period.

5.3 The EPD has progressively tightened the emission caps since 2005. In 2008, we stipulated the stringent emission caps for 2010 and beyond through the first Technical Memorandum (TM) for power plants. The latest fifth TM was issued in 2015 to further tighten the emissions of air pollutants from 2020 onwards. By 2020, the emission caps of SO_2, NOx and RSP would be reduced by 69%, 50% and 54% respectively, compared to the emission caps for 2010. In order to meet the emission caps, power companies have to switch to clean fuel including natural gas and low emission coal, and prioritize the use of coal-fired generation units equipped with advanced emission control equipment in the coming years.

Sectoral analysis for "Road transport"

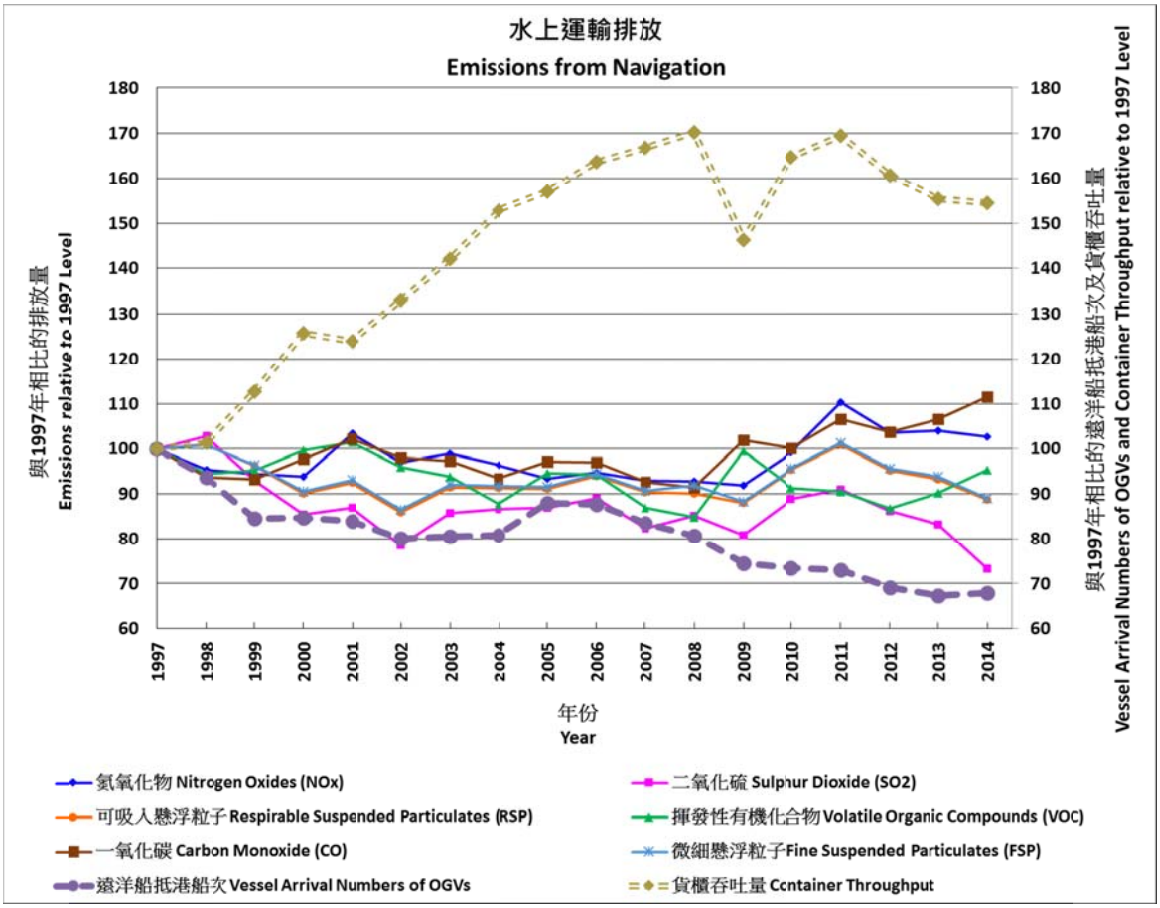


5.4 Road transport was a major emission source of NOx, RSP, FSP, VOC and CO, accounting for 19%, 14%, 17%, 20% and 60% of the total emissions in 2014, respectively. Overall, the emissions from road transport decreased by 51% to 99% from 1997 to 2014, despite an increase in vehicle-kilometer-travelled of 12%.

5.5 The substantial decreases in NOx, RSP, FSP, VOC and CO emissions from 2010 to 2014 could be attributable to an array of vehicle emission control programmes, which include the progressive tightening of vehicle emission standards from Euro III in 2001 to Euro V in 2012, providing a one-off subsidy to vehicle owners for the replacement of the catalytic convertors and oxygen sensors of petrol / Liquefied Petroleum Gas (LPG) taxis and light buses, launching an incentive-cum-regulatory scheme to progressively phase out some 82,000 pre-Euro IV diesel commercial vehicles by end 2019, and strengthening the emissions control for LPG and petrol vehicles by deploying roadside remote sensing equipment to detect excessive emissions from petrol and LPG vehicles.

5.6 As for SO_2, the vehicle emissions stayed at a very low level in the past few years because of the introduction of Euro V diesel in December 2007, whose sulphur content is capped at 0.001%.

Sectoral analysis for "Navigation"



5.7 Emissions from navigation sector were relatively steady between 1997 and 2013. In 2014, the emissions of SO_2, RSP and FSP decreased substantially because of the implementation of the Air Pollution Control (Marine Light Diesel) Regulation which imposes a statutory sulphur limit of 0.05% on locally supplied marine light diesel (a 90 per cent reduction from the previous level of 0.5%). The VOC emissions are of a small amount in absolute terms, so they can be subject to huge fluctuations in terms of percentage difference. In 2014, the emissions of SO_2, NO_x, RSP and FSP accounted for 44%, 33%, 36% and 42% of the total emissions, respectively.

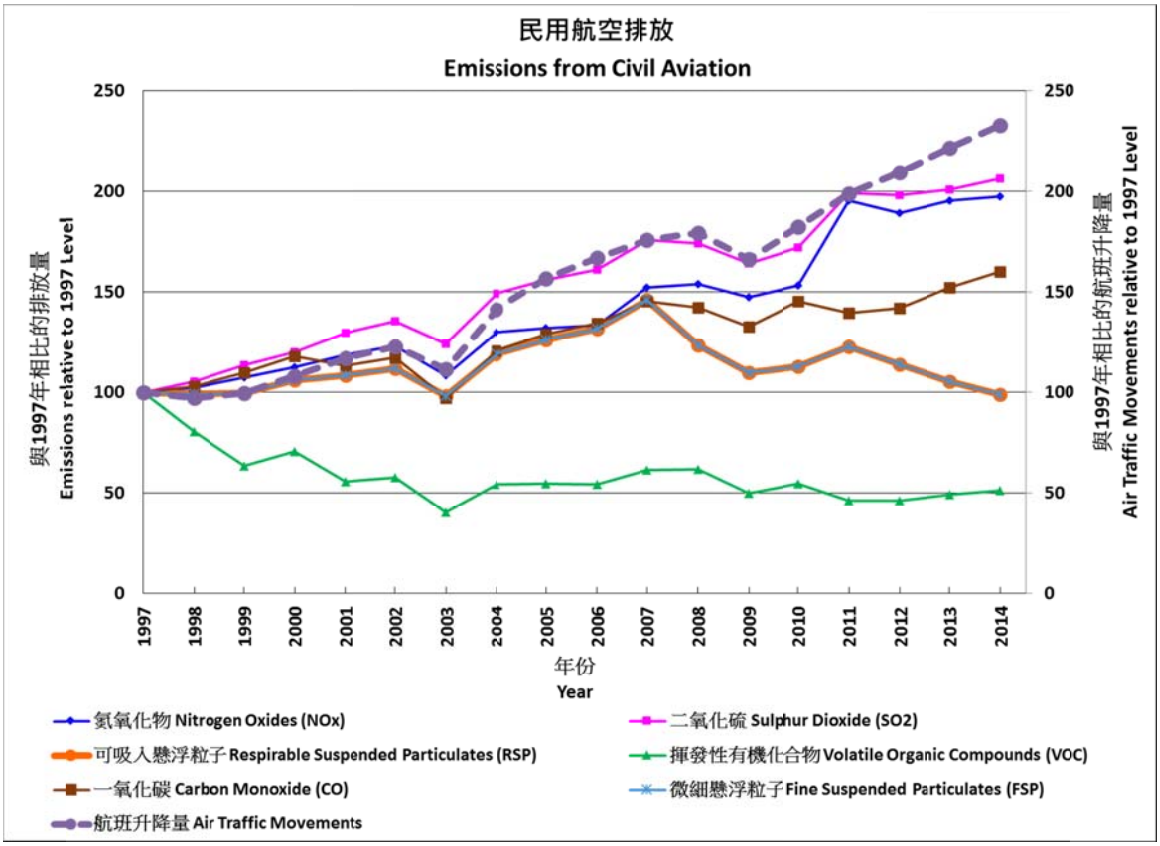
5.8 Among vessels, ocean going vessels (OGVs) were major emitters. The following are worth noting-

(i) the arrival numbers of OGVs decreased by 32% between 1997 and 2014 though the container throughput increased by 54%; and

(ii) as compared with 2010, the arrival numbers of OGVs decreased by 8% and container throughput by 6% in 2014.

5.9 In 2014, shipping companies continued their voluntary ship emissions reduction scheme, the Fair Winds Charter, by capping the sulphur content of the fuel of their OGVs at 0.5% when the OGVs were at berth here. The Government also reduced by half the port facilities and light dues of OGVs using fuel with sulphur content not more than 0.5% while berthing.

Sectoral analysis for "Civil aviation"

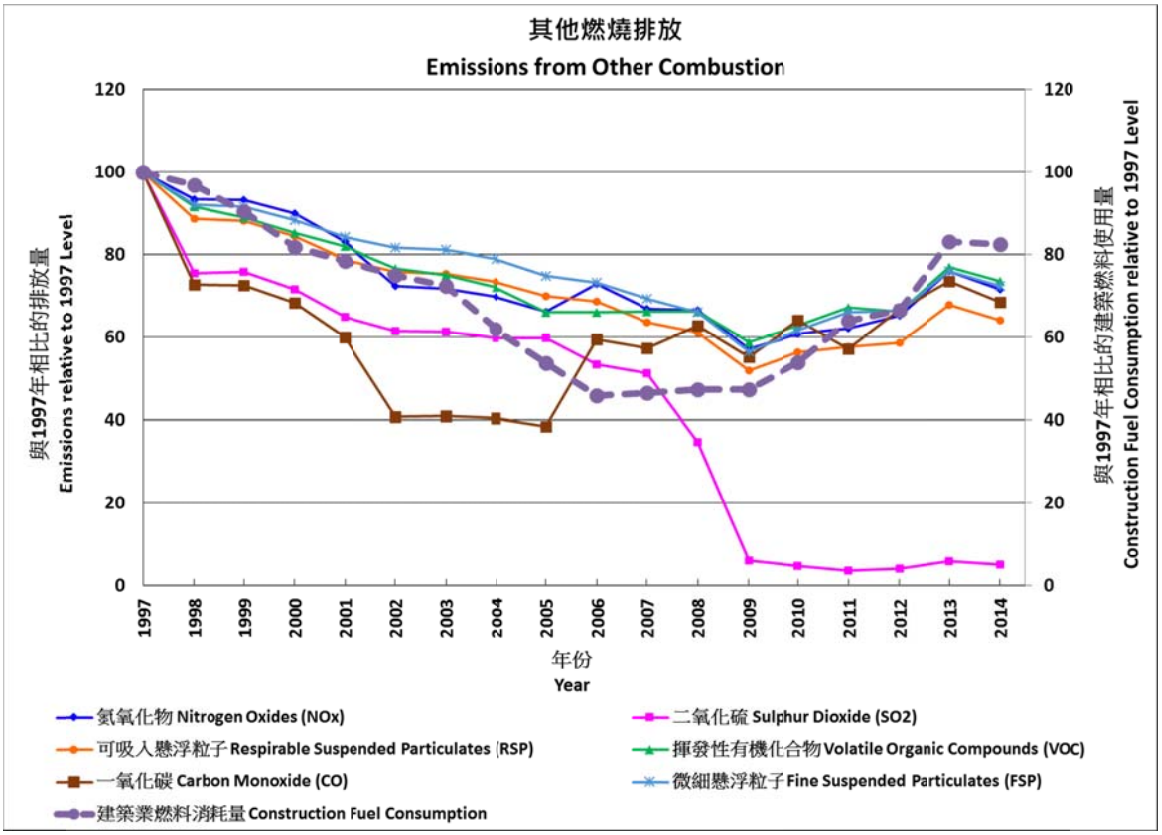


5.10 Emissions from civil aviation accounted for less than 6% of the total local emissions of air pollutants in 2014. From 1997 to 2014, the air traffic movements increased by 133% and the emissions of NO_x and SO_2 increased by a similar extent.

5.11 On the contrary, the emissions of RSP and FSP showed a decreasing trend from 2010 to 2014 due to the increased use of fixed ground power and pre-conditioned air systems for aircraft at parking stands of the Hong Kong International Airport (HKIA). Such measures reduce the operation time of onboard fuel combustion auxiliary power generation units (APU), and thereby reduce particulate emissions. In December 2014, the use of APU at frontal stands was banned.

5.12 The Civil Aviation Department (CAD) has adopted the standards set out at Annex 16 to the Convention on International Civil Aviation, Volume 2, Part III, Chapter 2 to certify the engines installed on aircraft using the HKIA in order to reduce their emissions. This document specifies the standards for four types of emissions that an aircraft engine has to meet, including NOx and CO. Besides, since October 2009, CAD has introduced new air routes which have shorter travelling distances for aircraft arriving from the west and the north of Hong Kong. Each arrival flight from the Mainland, South East Asia and Europe has been able to save up to about 210 kilometres in flight distance or 14 minutes in flight time. In 2014, around 73,000 flights adopted these shortened routes, which not only achieve fuel saving, but also reduce emissions from aircraft.

Sectoral analysis for "Other combustion"

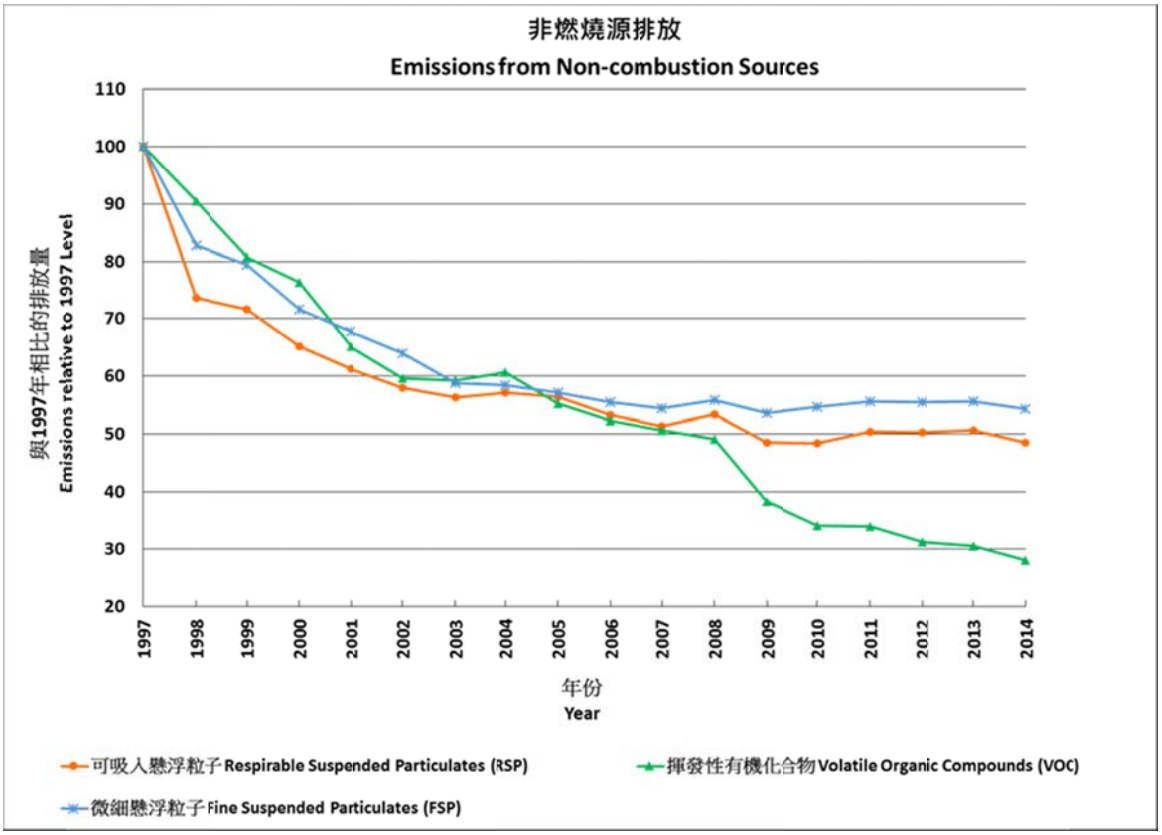


5.13 Other combustion sector is one of the important sources of RSP and FSP emissions, accounting for 14% and 16% of the total emissions in 2014, respectively. Overall, the emissions decreased by 26% to 95% from 1997 to 2014.

5.14 Major contributing sources in this sector are non-road mobile machineries (NRMMs), especially construction machinery, which accounted for 70%, 74% and 69% of RSP, FSP and NOx emissions respectively in 2014. However, the fuel consumption growth in the construction industry leveled off in 2014. The emission reductions in 2014 compared to 2013 could be attributable to the reduction in emissions from NRMMs in marine cargo terminals as a result of wider use of electric and LPG-powered NRMMs in replacement of the diesel-driven ones.

5.15 The SO_2 emissions from this sector have been reduced to a very low level since the Air Pollution Control (Fuel Restriction) Regulation tightened the cap on the sulphur content of diesel used in industrial and commercial sectors from 0.5% to 0.005% in October 2008. Information collected from the Customs and Excise Department indicated that since January 2009, only Euro V diesel (with sulphur content not exceeding 0.001%) has been imported for industrial and construction use.

Sectoral analysis for "Non-combustion sources"

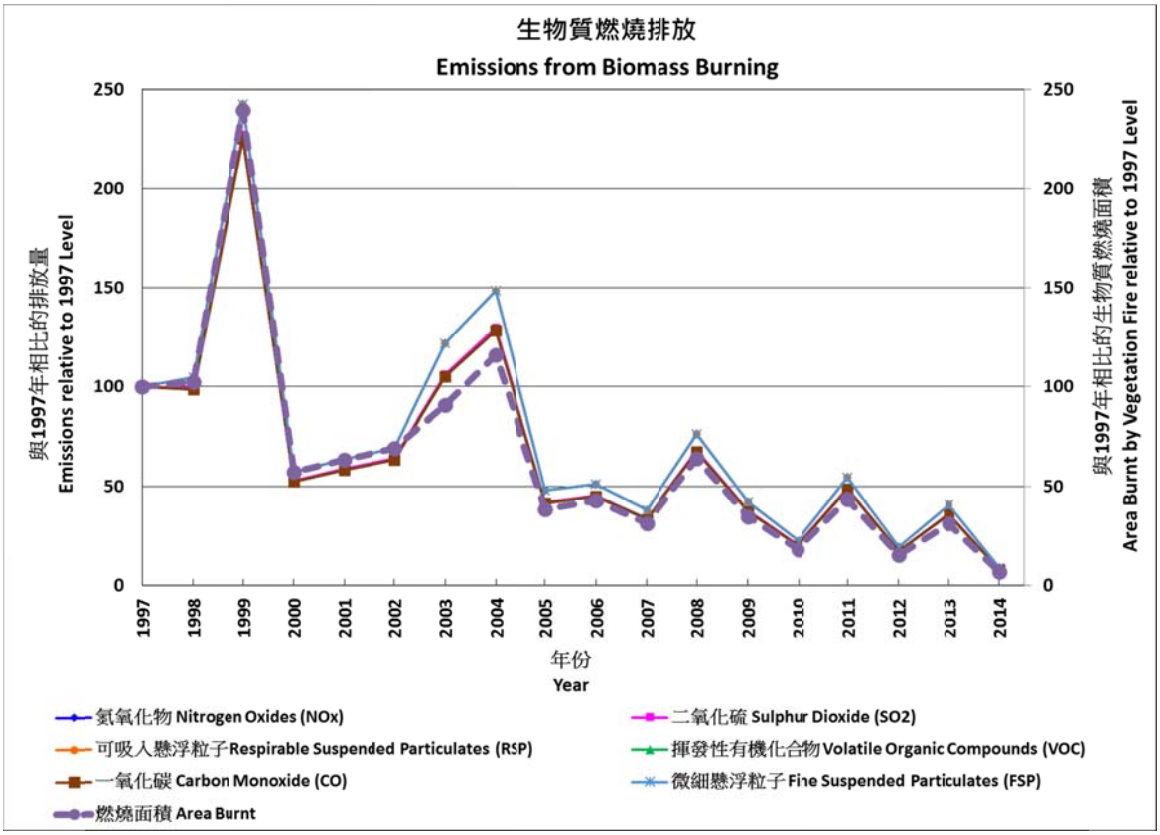


5.16 Non-combustion sources sector contributes considerably to local VOC emissions, accounting for 58% in 2014, whereas its contributions to local RSP and FSP emissions in 2014 were 15% and 10%, respectively. Overall, the emissions of the sector decreased by 46% to 72% from 1997 to 2014.

5.17 Major contributing sources for VOC in this sector are emissions from the use of paints, printing inks and associated solvents, and consumer products, which accounted for 83% of non-combustion sources VOC emissions in 2014. As compared with 2008, the VOC emissions from non-combustion sources decreased by 43% in 2014 mainly because of the enforcement of the Air Pollution Control (Volatile Organic Compounds) Regulation since 2007.

5.18 The Regulation prohibits the import and local manufacture of regulated products with VOC contents exceeding the legal limits and controls emissions from lithographic heatset web printing machines. The regulated products include 6 categories of consumer products, 51 types of architectural paints, 7 types of printing inks, 14 types of vehicle refinishing paints, 36 types of vessel and pleasure craft paints and 47 types of adhesives and sealants.

Sectoral analysis for "Biomass Burning"



5.19 Emissions from biomass burning accounted for less than 4% of the total local emissions of six air pollutants in 2014. From 1997 to 2014, the area burnt due to biomass burning decreased by 93% and the emissions of FSP and RSP decreased by a similar extent.

5.20 The only contributing source in this sector is emissions from hill fires.

6 EMISSION REDUCTION PLAN UP TO 2020

6.1 The Hong Kong SAR and Guangdong Provincial Governments have long been collaborating to improve air quality in the Pearl River Delta (PRD) Region[1]. Over the past years, the two Governments significantly reduced the emissions of four major pollutants, namely SO_2, NOx, RSP and VOC. At the meeting of Hong Kong-Guangdong Joint Working Group on Sustainable Development and Environmental Protection held in November 2012, both sides endorsed a new set of emission reduction targets/ranges up to 2020, using 2010 as the base year (details in **Annex 4**). Both sides have been implementing additional pollution control measures on this basis for bringing continuous improvement to the regional air quality.

6.2 To achieve continuous improvement of the air quality, a series of emission reduction measures are being implemented. On reducing vehicular emissions, we will continue to phase out progressively the pre-Euro IV diesel commercial vehicles by the end of 2019, strengthen the emission control of petrol and liquefied petroleum gas vehicles using roadside remote sensing equipment, subsidise the franchised bus companies to retrofit the Euro II and Euro III franchised buses with selective catalytic reduction devices and prepare for tightening vehicular emissions standards to Euro VI for newly registered vehicles.

6.3 On reducing vessel emissions, we have introduced new regulations to cap the sulphur content of locally-supplied marine light diesel at 0.05 per cent. We will mandate ocean-going vessels to switch to low sulphur fuel (with sulphur content not exceeding 0.5%) while at berth in 2015. By that time, Hong Kong will become the first port in Asia to mandate the fuel switch at berth. We are also collaborating with the mainland authorities to implement measures to reduce vessel emissions in the waters of the Pearl River Delta, with a view to taking forward the fuel switch of ocean going vessels while at berth in the short run and establishing an emission control area in the long run.

6.4 On reducing emissions from power plants, we will continue to require the power plants to adopt the best practicable means to reduce emissions and use more natural gas for electricity generation so as to meet our emission caps imposed on power sector. Besides, we will continue to collaborate with the Guangdong authorities to further improve the regional air quality.

6.5 Such measures will help us to achieve the emission reduction targets for 2020, and to meet broadly the existing Air Quality Objectives by 2020.

6.6 The changes in emissions in 2014 compared with emissions in 2010 in Hong Kong are shown in the following table.

[1] PRD Region refers to the whole territory of HKSAR and the Pearl River Delta Economic Zone (PRDEZ). PRDEZ includes Guangzhou, Shenzhen, Zhuhai, Dongguan, Zhongshan, Foshan, Jiangmen, Huizhou (Huicheng, Huiyang, Huidong, Boluo), and Zhaoqing (Duanzhou, Dinghu, Gaoyao, Sihui).

Table 6-1 Changes in emissions between 2010 and 2014

Pollutant	Emissions (Tonnes)			2015 Emission Reduction Targets
	2010	2014	Change in Emission	
SO_2	35,490	31,710	-11%	-25%
NOx	108,500	109,570	+1.0%	-10%
RSP	6,750	5,900	-13%	-10%
VOC	31,560	27,020	-14%	-5%
Note: Emission figures are presented in the nearest ten.				

6.7 Compared with the base year of 2010, SO_2, RSP and VOC emissions in 2014 decreased by 11% to 14%, while NOx emissions slightly increased by 1%. In the coming year, the power plants would be required to use more natural gas in power generation in order to meet the tightened emission caps set out in the Second Technical Memorandum. We expect that the emissions of SO_2 and NOx will be reduced substantially in 2015.

- End -

Annex 1 – Breakdown of Emission Inventory by Source Categories from 2013 to 2014

Pollutant	Source Categories	Emissions (Tonnes)	
		2013	**2014**
SO_2	Public Electricity Generation	14,680	16,880
	Road Transport	50	40
	Navigation	15,890	14,000
	Civil Aviation	500	510
	Other Combustion	320	280
	Non-combustion	N/A	N/A
	Biomass Burning	20	0
	Total	**31,460**	**31,710**
NOx	Public Electricity Generation	34,580	36,210
	Road Transport	25,600	21,200
	Navigation	36,630	36,200
	Civil Aviation	5,450	5,500
	Other Combustion	11,080	10,440
	Non-combustion	N/A	N/A
	Biomass Burning	110	20
	Total	**113,440**	**109,570**
RSP	Public Electricity Generation	940	980
	Road Transport	990	830
	Navigation	2,210	2,100
	Civil Aviation	60	60
	Other Combustion	860	820
	Non-combustion	950	910
	Biomass Burning	990	210
	Total	**7,000**	**5,900**
FSP	Public Electricity Generation	430	450
	Road Transport	910	760
	Navigation	2,040	1,940
	Civil Aviation	60	60
	Other Combustion	790	750
	Non-combustion	480	470
	Biomass Burning	810	170
	Total	**5,530**	**4,600**

Pollutant	Source Categories	Emissions (Tonnes)	
		2013	**2014**
VOC	Public Electricity Generation	460	470
	Road Transport	5,760	5,380
	Navigation	3,620	3,830
	Civil Aviation	590	610
	Other Combustion	1,120	1,070
	Non-combustion	17,000	15,600
	Biomass Burning	280	60
	Total	**28,830**	**27,020**
CO	Public Electricity Generation	3,930	3,960
	Road Transport	48,400	39,400
	Navigation	12,120	12,690
	Civil Aviation	3,410	3,590
	Other Combustion	6,060	5,630
	Non-combustion	N/A	N/A
	Biomass Burning	3,070	660
	Total	**76,990**	**65,930**

Note: - All figures are rounded to the nearest ten.
- "N/A" denotes not applicable.
- There may be slight discrepancies between the sums of individual items and the totals shown in the table because of rounding.

Annex 2 – Summary of Updates to the Emission Inventory

1. Making reference to international developments and technological advancement, we have been updating the methodologies to compile emission inventories including the collection of most updated data with an aim to provide a better support to the management of air quality. Whenever the compilation methodology is updated, new activity data are collated, or errors in the estimates are identified, we will follow international practice to update the emission inventory and to revise the emission inventories for past years as far as practicable based on the updated methods and data to enable consistent and reliable emission trend analysis to be made.

2. Recalculation of historical emission inventories is widely adopted by environmental agencies such as European Environmental Agency of the European Community, California Air Resources Board (CARB), United Nations Environment Programme (UNEP), Intergovernmental Panel on Climate Change (IPCC), etc. when methods are changed or refined, when new sources categories are included in the inventory or when assumptions used in the estimates are revised.

3. Since the publication of the emission inventory on EPD's website in 2000, EPD have made a number of updates to the emission compilation and recalculated the historical emissions.

4. Major updates to the emission inventories in recent years are highlighted below.

i. EPD commissioned a comprehensive study on the marine emission inventory in 2008, which was completed in 2012. The study collected extensive local vessel activity data and reviewed the latest emission compilation methodologies of advanced places such as the Port of Los Angeles of the USA. The study concluded that these latest emission compilation methodologies can provide more realistic estimates of marine emissions. Based on the study findings, we updated the previous emission inventories for marine vessels. The updated emissions from vessels were higher than the previous ones.

ii. EPD have been conducting emission measurements for on-road vehicles by means of remote sensing equipment and advanced portable emission measurement systems (PEMS). The measurements have provided a more robust basis for us to estimate vehicle emissions. They have also found that vehicles with inadequate maintenance, e.g. LPG vehicles with worn-out catalytic converters, could emit considerably above their normal levels. We made use of the findings to update our vehicle emission estimation model and compile the vehicle emission inventory.

iii. Since the implementation of the Air Pollution Control (Volatile Organic Compounds) Regulation in April 2007, we have used the sales report data submitted by importers under the Regulation to compile VOC emissions of regulated products including six types of consumer products (air fresheners, hairsprays, multi-purpose lubricants, floor wax strippers, insecticides and insect repellents), printing inks and architectural paints. In October 2009, we amended the Regulation to further regulate the VOC contents of vehicle refinishing paints, marine paints (vessels and pleasure craft paints), adhesive and sealants and started to compile the VOC emissions from these paints based on their sales report data. Emissions from cleansing solvents during the application of paints have also been estimated. To compile VOC emissions for the regulated products, we also made reference to EPD's studies on printing industry, solvent usage for coatings and VOC-containing products, and survey data for marine paints to assess emissions from VOC-containing products.

5. Updates to the emission inventories since their first publication in March 2000 are summarized in the table below. Based on the latest updates, we have recalculated historical emission inventories from 1997 to 2013. Comparisons between the previous and recalculated inventories are shown in **Annex 3**.

Update Date	**Emission Inventory Revised**	**Revisions and Updates**
March 2000	1990-1998	• First publication of emission inventory for PM, SO_2, NOx, NMVOCs and CO from combustion sources at the EPD's website.
December 2000	1990-1999	• Amended emission inventory for Public Electricity Generation, Road Transport and Other Fuel Combustion sources.
December 2001	1990-2000	• Amended combustion sources emissions (including emission factors for VOC emissions from coal-fired electricity generation units, vehicle kilometer travel (VKT) for Road Transport, emission estimation methods for Navigation and Civil Aviation and surrogates for Other Fuel Combustion emissions).
February 2003	1990-2001	• Replaced Census and Statistics Department (C&SD) retained import data for fuel with Energy End-use data from Electrical and Mechanical Services Department (EMSD). • Amended VKT data.
June 2004	1990-2002	• Replaced emission estimated using emission factors with sophisticated EMFAC-HK model to estimate emissions from Road Transport. • Included additional emission sources for RSP and VOC. • Replaced 2000 to 2001 Public Electricity Generation emissions for SO_2, NOx and PM with data provided the power companies.
January to March 2005	1990-2003	• Amended 2000 to 2002 SO_2, NOx and PM emissions for Public Electricity Generation according to data provided by the power companies. • Updated emissions estimated using the EMFAC-HK model. • Amended 2001-02 emissions using Energy End-Use Data from EMSD. • Excluded Biogenic VOC emission sources from total VOC emission.
December 2005	1990-2004	• Amended 2002-03 emissions using Energy End-Use Data from EMSD. • Updated emission factors for VOC emissions from the printing industry.
December 2006	1990-2005	• Amended 2003 to 2004 SO_2, NOx and PM emissions for Public Electricity Generation according to data provided by the power companies. • Updated fuel use for vehicles to calculate 1998 to 2004 SO_2 emissions. • Updated emission factors for VOC emissions from the printing industry.

Update Date	Emission Inventory Revised	Revisions and Updates
January 2008	1990-2006	• Replaced Power Plant PM emissions with RSP emissions using emission factors from USEPA. • Updated emission factors for emission from non-road mobile equipment at the airport, container terminal and construction sites. • Included VOC emissions from evaporation of gasoline. • Included RSP emissions from tyre, brake and road wear. • Amended estimation method for VOC emissions from printing industry and fuel storage tanks. • Updated emission factors for Civil Aviation emission sources.
January 2009	1990-2007	• Used information collected from Government Departments and shipping industry to estimate emissions from local vessels. • Updated emission factors for emission from non-road mobile equipment at the airport and container terminal.
September 2012	1997-2010	• Based on the results from the Marine Emission Study report completed in 2012 to update emissions from Navigation. Additional information for fuel use and vessel activities were used to calculate the emission. • • Used updated version of EMFAC-HK (version 2.1) for Road Transport emission estimation. • Used updated version of EDMS (version 5.1.3) for Civil Aviation emission estimation. • Included emissions from auxiliary power units of the aircrafts parking at the gates of the airport. • Used sales report data to calculate VOC emissions from products controlled under the VOC Regulation. • Used further local reported and survey data for VOC emission calculation. • Used new reported and survey results to calculate emissions from Other Fuel Combustion sources. • Included RSP emissions from construction sites and cooking; Included VOC emissions from storage of naphthalene, aviation fuel and use of cleaning solvents associated with paint use.
February 2013	1997-2011	• Used C&SD data to derive fuel consumption data for construction sector from 1997 to 2011. • Amended VOC emissions from architectural paints in 2010 due to a correction in the paint consumption data.

Update Date	Emission Inventory Revised	Revisions and Updates
January 2014	1997-2012	• We compiled the emission inventory of FSP as it is one of the major air pollutants stipulated in the new Air Quality Objectives (AQOs) which takes effect from 1 January 2014. • Emissions of OGVs during shifting between berthing locations were compiled since more detailed vessel activity data were collected from the Marine Department. • New surrogates for fuel consumption for the construction and industrial sectors were derived from C&SD data since the previously used Energy End-Use data from EMSD are no longer suitable after a major revision. • Having regard to the real world developments, the sulphur content of aviation fuel, duration of landing and take-off cycles of aircraft at Hong Kong International Airport and hence the air pollutant emissions from Civil Aviation sector have been updated. • Screen printing emissions were updated according to additional survey data to cover emissions in the application of screen printing inks on non-paper substrates, of which this type of inks was exempted from the VOC Regulation.
January 2015	2009-2012	• VOC emissions from architectural paints in 2012 were updated using VOC contents of the latest sales reports submitted by importers. • VOC emissions from screen printing from 2009 to 2012 were revised based on our latest survey which revealed a reduction in the local use of non-regulated screen printing ink.
January 2016	1997-2014	• Emissions from asphalt production plants were estimated. • Emissions from Sludge Treatment Facility (STF) were estimated. • Emissions from landfill gas flaring were estimated. • Emissions from biomass burning were estimated. • Other Fuel Combustion sector was renamed as Other Combustion sector to better reflect the nature of the sources covered. • Radar data from CAD and chock-on chock-off data from AAHK were obtained to refine the emission inventory for Civil Aviation sector. • Used updated version of EMFAC-HK (version 3.1.1) for Road Transport emission estimation.

Annex 3 – Comparison between the Previous and Recalculated Inventories from 1997 to 2013

Table A3-1 Changes in SO_2 emission inventories from 1997 to 2013

Year	SO_2 (Tonnes)		
	Previous*	Recalculated*	% Changes
1997	82,260	82,330	0%
1998	87,310	87,390	0%
1999	72,480	72,660	0%
2000	79,750	79,830	0%
2001	81,730	81,820	0%
2002	79,750	79,860	0%
2003	104,850	104,980	0%
2004	108,680	108,830	0%
2005	98,320	98,340	0%
2006	87,350	87,360	0%
2007	79,820	79,860	0%
2008	69,430	69,470	0%
2009	62,580	62,600	0%
2010	35,490	35,490	0%
2011	32,120	32,180	0%
2012	32,710	32,740	0%
2013	31,280	31,460	1%

* Figures are rounded to the nearest ten.

Figure A3-1 SO_2 emissions trend from 1997 to 2013

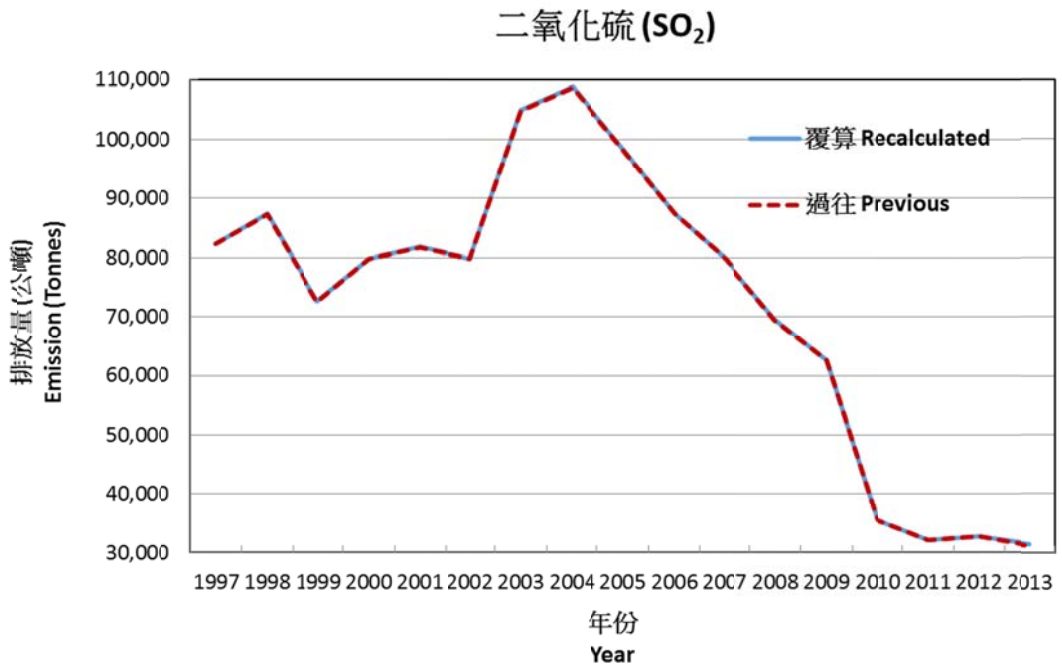


Table A3-2 Changes in NOx emission inventories from 1997 to 2013

Year	NOx (Tonnes)		
	Previous*	Recalculated*	% Changes
1997	148,630	152,280	2%
1998	144,640	147,980	2%
1999	130,280	133,690	3%
2000	131,110	133,560	2%
2001	127,830	129,880	2%
2002	125,230	126,950	1%
2003	139,740	141,030	1%
2004	129,000	129,780	1%
2005	129,170	128,460	-1%
2006	125,630	124,920	-1%
2007	126,940	126,560	0%
2008	120,220	120,000	0%
2009	116,210	117,240	1%
2010	108,360	108,500	0%
2011	116,240	115,540	-1%
2012	114,510	112,960	-1%
2013	113,220	113,440	0%

* Figures are rounded to the nearest ten.

Figure A3-2 NOx emission trend from 1997 to 2013

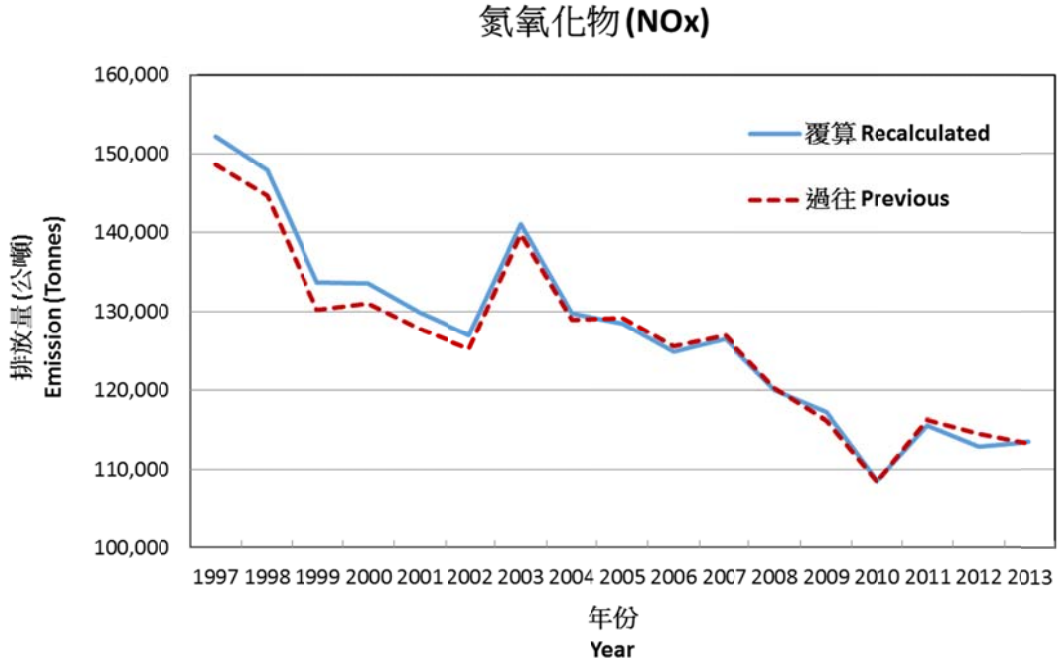
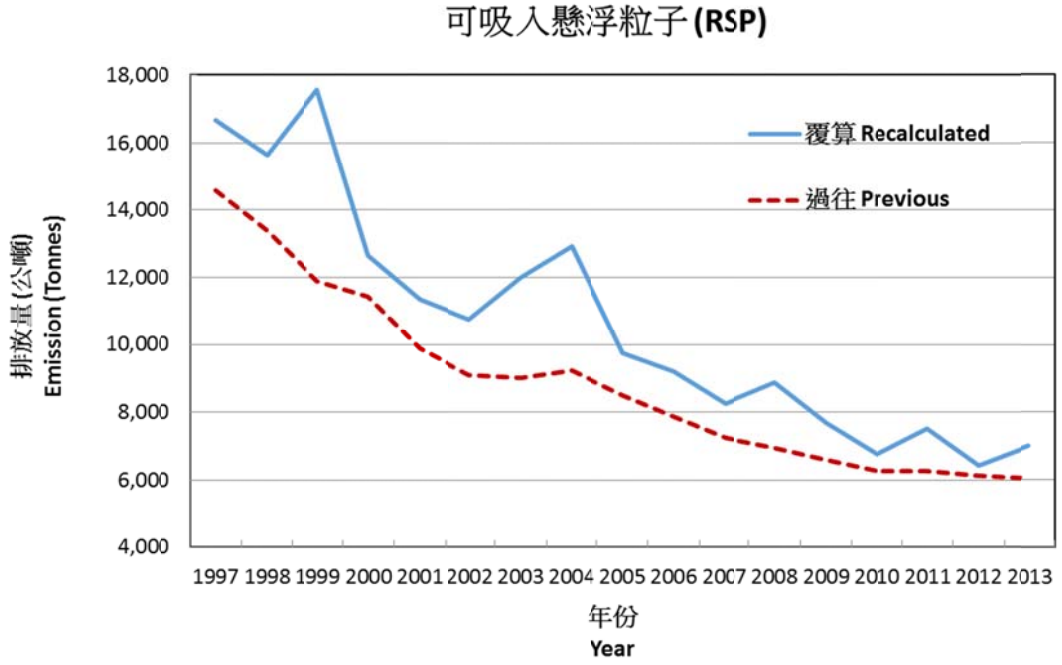


Table A3-3 Changes in RSP emission inventories from 1997 to 2013

Year	RSP (Tonnes)		
	Previous*	Recalculated*	% Changes
1997	14,580	16,660	14%
1998	13,380	15,640	17%
1999	11,880	17,570	48%
2000	11,420	12,660	11%
2001	9,880	11,350	15%
2002	9,080	10,750	18%
2003	9,000	12,010	33%
2004	9,220	12,910	40%
2005	8,490	9,740	15%
2006	7,870	9,200	17%
2007	7,240	8,250	14%
2008	6,960	8,880	28%
2009	6,590	7,670	16%
2010	6,270	6,750	8%
2011	6,280	7,520	20%
2012	6,140	6,430	5%
2013	6,040	7,000	16%

* Figures are rounded to the nearest ten.

Figure A3-3 RSP emission trend from 1997 to 2013[§]



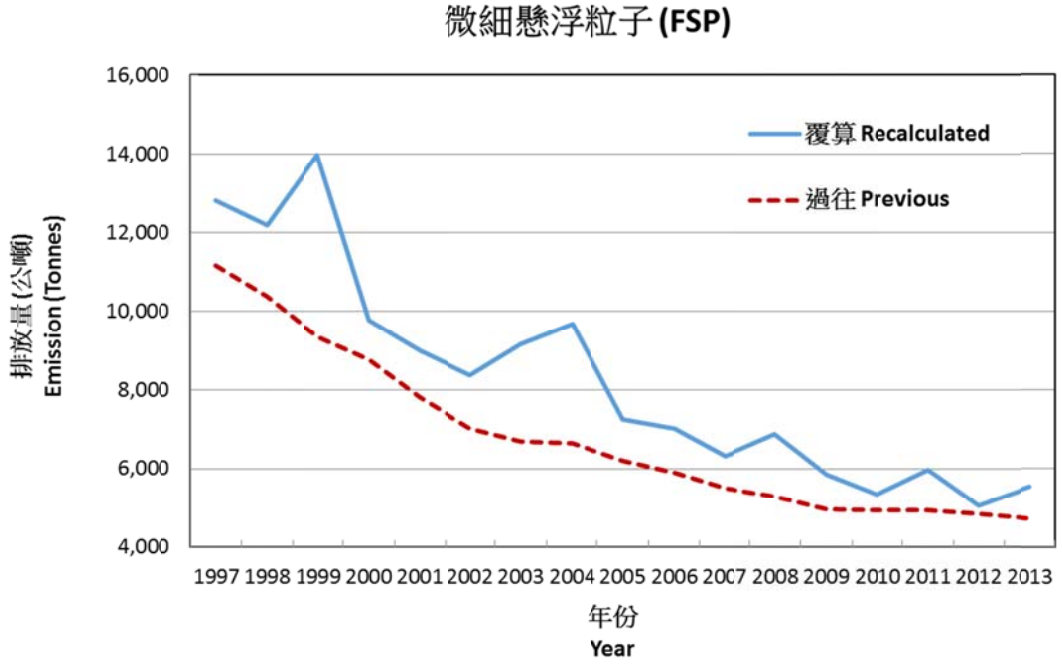
[§] The large discrepancies between recalculated and previous emission inventories for RSP arose from the inclusion of emissions from biomass burning.

Table A3-4 Changes in FSP emission inventories from 1997 to 2013

Year	FSP (Tonnes)		
	Previous*	Recalculated*	% Changes
1997	11,150	12,820	15%
1998	10,370	12,190	17%
1999	9,350	13,980	49%
2000	8,750	9,760	11%
2001	7,800	9,000	15%
2002	7,010	8,370	19%
2003	6,680	9,150	37%
2004	6,640	9,660	46%
2005	6,210	7,240	17%
2006	5,900	7,010	19%
2007	5,490	6,320	15%
2008	5,290	6,870	30%
2009	4,960	5,850	18%
2010	4,940	5,330	8%
2011	4,950	5,970	20%
2012	4,840	5,060	5%
2013	4,740	5,530	16%

* Figures are rounded to the nearest ten.

Figure A3-4 FSP emission trend from 1997 to 2013[§]



[§] The large discrepancies between recalculated and previous emission inventories for FSP arose from the inclusion of emissions from biomass burning.

Table A3-5 Changes in VOC emission inventories from 1997 to 2013

Year	VOC (Tonnes)		
	Previous*	Recalculated*	% Changes
1997	81,390	76,890	-6%
1998	74,130	70,090	-5%
1999	67,010	64,470	-4%
2000	63,630	60,120	-6%
2001	56,060	52,830	-6%
2002	51,520	48,640	-6%
2003	49,910	47,640	-5%
2004	49,790	48,200	-3%
2005	46,470	44,510	-4%
2006	44,290	42,710	-4%
2007	42,810	41,430	-3%
2008	41,480	40,640	-2%
2009	35,560	34,570	-3%
2010	32,870	31,560	-4%
2011	32,370	31,480	-3%
2012	30,620	29,390	-4%
2013	29,420	28,830	-2%

* Figures are rounded to the nearest ten.

Figure A3-5 VOC emission trend from 1997 to 2013

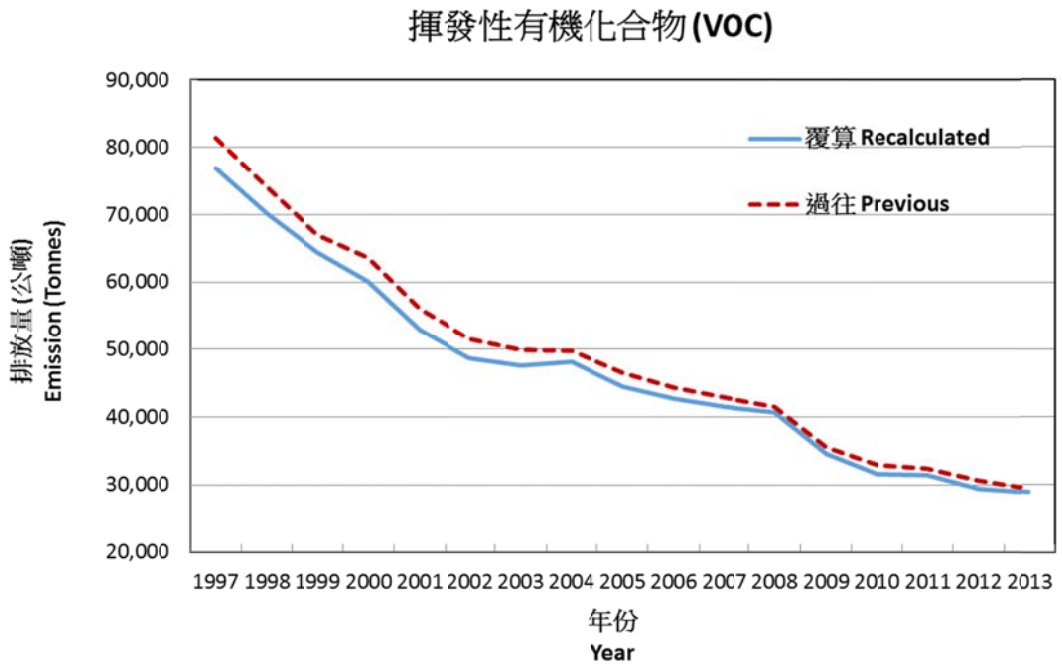
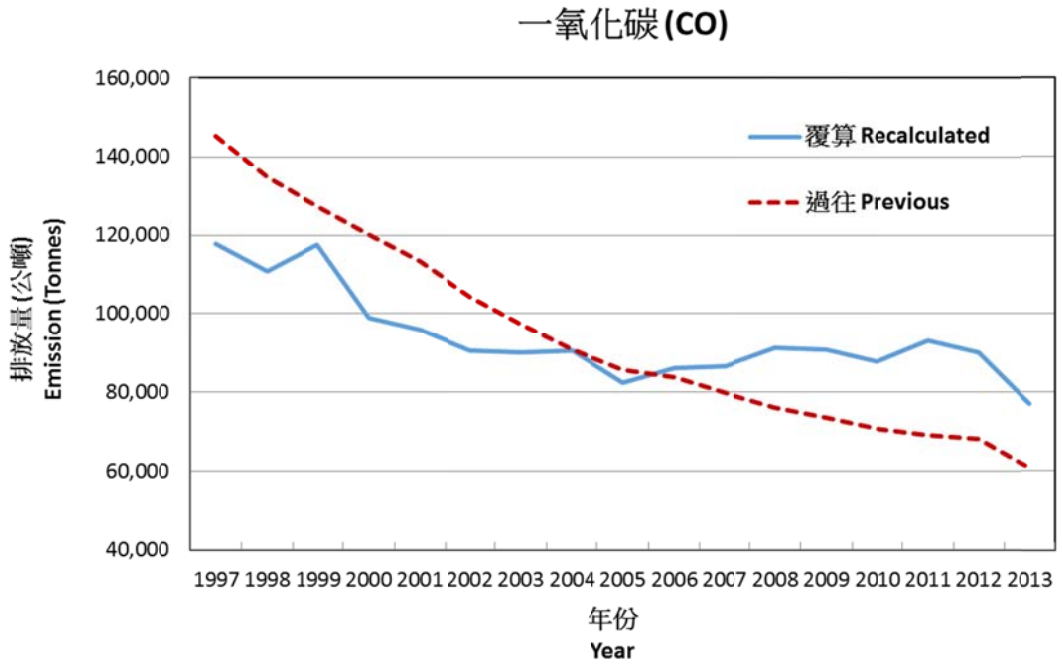


Table A3-6 Changes in CO emission inventories from 1997 to 2013

Year	CO (Tonnes)		
	Previous*	Recalculated*	% Changes
1997	145,220	117,880	-19%
1998	134,730	110,730	-18%
1999	127,230	117,610	-8%
2000	120,120	98,970	-18%
2001	113,270	95,800	-15%
2002	104,330	90,510	-13%
2003	97,240	90,140	-7%
2004	90,710	90,610	0%
2005	85,690	82,390	-4%
2006	83,800	86,150	3%
2007	79,790	86,610	9%
2008	76,210	91,230	20%
2009	73,450	90,820	24%
2010	70,670	87,820	24%
2011	69,090	93,230	35%
2012	68,300	90,030	32%
2013	60,790	76,990	27%

* Figures are rounded to the nearest ten.

Figure A3-6 CO emission trend from 1997 to 2013[§]



[§] The large discrepancies between recalculated and previous emission inventories for CO arose from the use of the updated version of EMFAC-HK (version 3.1.1).

Annex 4 –Emission Reduction Targets / Ranges up to 2020

At the 12th meeting of Hong Kong-Guangdong Joint Working Group on Sustainable Development and Environmental Protection held in November 2012, the two governments endorsed a new set of emission reduction targets/ranges up to 2020, using 2010 as the base year (see table below). The two governments have been implementing emission reduction measures for achieving the emission reduction targets.

Pollutant	Area	2015 Emission Reduction Target* (%)	2020 Emission Reduction Range* (%)
SO_2	Hong Kong	-25%	-35% ~ -75%
	PRD Economic Zone	-16%	-20% ~ -35%
NOx	Hong Kong	-10%	-20% ~ -30%
	PRD Economic Zone	-18%	-20% ~ -40%
RSP	Hong Kong	-10%	-15% ~ -40%
	PRD Economic Zone	-10%	-15% ~ -25%
VOC	Hong Kong	-5%	-15%
	PRD Economic Zone	-10%	-15% ~ -25%

*Emission reduction targets/ranges using 2010 as the base year.

Both Governments started the mid-term review study in February 2015 to conclude the emission reductions for 2015 and finalize the emission reduction targets for 2020. The results are expected to be announced in 2017.