2031 Territory-Wide Emission Inventory

2031 Emissions (tonnes)	SO2	NOx	RSP	FSP	VOC	CO	Remark
Public Electricity Generation	10399	25950	750	750	397	3181	Third Technical Memorandum for Allocation of Emission Allowances in Respect of Specified Licenses; VOC / CO was based on 2010 VOC / CO to NOx ratio
Road Transportation	231	4360	261	240	929	17018	Based on traffic flow and Emfac 2.6 at 2031
Navigation	3710	33897	933	858	4323	13434	See separate marine emission spreadsheet but not include emission from HK Transit vessel; FSP / RSP =0.92 [Note 1]
Civil Aviation (3RS)	781	9451	220	91	674	4756	Yr 2031 3RS ATM determined in Present Study
Other Fuel Combustion (exclude IWMF and Sludge Facilities)	309	10993	898	701	980	5889	Population growth rate based on 2010 population data (i.e 7,067,800) and 2031 population data (i.e 8,160,900) [2,3]
Non - combustion	0	0	1037	809	23673	0	Population growth rate based on 2010 population data (i.e 7,067,800) and 2031 population data (i.e 8,160,900) [2,3]
Total	15430	84652	4100	3449	30976	44278	

Note [1]: FSP and RSP ratio based on ICF International "Current Methodologies in Preparing Mobile Source Port - Related Emission Inventories", USEPA, Final Report, 2009
[2]: "Hong Kong 2010 - Hong Kong: The Facts", Information Services Department, HKSAR, 2011
[3]: "Hong Kong Population Projections 2012 - 2041", Census and Statistics Department, HKSAR, 2012

Marine Emission Inventory for 2031

Vessel Type	Code	SO2	NOx	PM10	PM2.5	VOC	CO
Macau Ferry		157	5327	131	120	203	456
PRD Ferry		12	542	11	10	23	53
RTV		87	3834	96	88	120	646
Total (RV)		**255**	**9,702**	**237**	**218**	**346**	**1,155**

Vessel Type	Code	SO2	NOx	PM10	PM2.5	VOC	CO
Chemical Carrier / Tanker	OGV_A	11	39	2	1	2	5
Conventional Cargo Vessel	OGV_B	74	215	8	7	11	26
Cruise / Ferry	OGV_C	851	3994	101	93	216	499
Dry Bulk Carrier	OGV_D	97	332	13	12	18	41
FCCV DWT <10,000	OGV_F1	29	92	3	3	5	12
FCCV DWT 10,000 - 19,999	OGV_F2	159	498	20	18	30	66
FCCV DWT 20,000 - 29,999	OGV_F3	251	843	32	29	50	112
FCCV DWT 30,000 - 39,999	OGV_F4	193	689	25	23	41	93
FCCV DWT 40,000 - 49,999	OGV_F5	101	370	13	12	25	52
FCCV DWT 50,000 - 74,999	OGV_F6	718	2878	99	91	182	408
FCCV DWT 75,000 - 99,999	OGV_F7	270	1126	38	35	72	163
FCCV DWT > 100,000	OGV_F8	339	1410	46	43	88	208
Gas Carrier / Tanker	OGV_G	10	33	2	1	2	4
Oil Tanker	OGV_I	144	331	16	15	18	40
Others	OGV_Others	44	261	7	7	13	30
Total (OGV)		**3292**	**13112**	**424**	**390**	**773**	**1758**

Vessel Type	Code	SO2	NOx	PM10	PM2.5	VOC	CO
Local Vessel (Ferry)		20	1441	28	26	25	286
Local Vessel (Others)		142	9641	244	224	3179	10234
Total (Local Vessel)		**162**	**11082**	**272**	**250**	**3204**	**10520**

Marine Emission Inventory for 2010

Vessel Type	Code	SO2	NOx	PM10	PM2.5	VOC	CO
Macau Ferry		976	3886	132	0	127	284
PRD Ferry		184	995	27	0	36	82
RTV		760	3738	136	0	105	566
Total (RV)		**1,920**	**8,619**	**295**	**-**	**267**	**932**

Vessel Type	Code	SO2	NOx	PM10	PM2.5	VOC	CO
Chemical Carrier / Tanker	OGV_A	56	52	6	0	2	5
Conventional Cargo Vessel	OGV_B	324	346	37	0	14	31
Cruise / Ferry	OGV_C	668	991	74	0	40	93
Dry Bulk Carrier	OGV_D	521	443	52	0	18	41
FCCV DWT <10,000	OGV_F1	151	148	15	0	7	14
FCCV DWT 10,000 - 19,999	OGV_F2	841	801	93	0	37	79
FCCV DWT 20,000 - 29,999	OGV_F3	1327	1356	150	0	60	135
FCCV DWT 30,000 - 39,999	OGV_F4	1020	1107	118	0	49	113
FCCV DWT 40,000 - 49,999	OGV_F5	530	595	64	0	30	63
FCCV DWT 50,000 - 74,999	OGV_F6	3791	4626	469	0	219	491
FCCV DWT 75,000 - 99,999	OGV_F7	1425	1810	178	0	86	196
FCCV DWT > 100,000	OGV_F8	1789	2266	221	0	107	250
Gas Carrier / Tanker	OGV_G	57	44	6	0	2	4
Oil Tanker	OGV_I	785	442	64	0	18	40
Others	OGV_Others	239	348	28	0	13	30
Total (OGV)		**13526**	**15377**	**1577**	**0**	**700**	**1586**

Vessel Type	Code	SO2	NOx	PM10	PM2.5	VOC	CO
Local Vessel (Ferry)		245	1972	56	0	31	352
Local Vessel (Others)		1194	8997	332	0	2664	8576
Total (Local Vessel)		**1439**	**10969**	**388**	**0**	**2695**	**8928**

Marine Emission - Growth Rate

Ocean-Going Vessel and Local Vessels	Code	2010	2031	Ratio of 2031 to 2010	Remark
CT Ocean-going (OG)		12723	19270	1.51	Port of HK Statistical Table; Data from HKPCF 05/06 and linear projection
Non CT Ocean-going (OG)		13245	2280	0.17	Port of HK Statistical Table; Data from HKPCF 05/06 and linear projection
OG (Total)	OGV F, OGV B	25968	21550	0.83	Port of HK Statistical Table; Data from HKPCF 05/06 and linear projection
River trade	RTV	91039	103960	1.14	Port of HK Statistical Table; Data from HKPCF 05/06 and linear projection
Passenger Vessel (Cruise)	OGV C	2305	12390	5.38	Port of HK Table; Data developed by linear extrapolation based on HK Tourist Board (2005) "Major Findings of the 2004 Study on Cruise Terminal Facilities Development in HK"
Ferries and Launches	LV Ferry	590	480	0.81	Marine Dept "Assessment of Typhoon Shelter Space Requirements 2009 - 2025"; Data developed by linear extrapolation
Passenger and Trading Vessels	LV Others	140	70	0.50	Marine Dept "Assessment of Typhoon Shelter Space Requirements 2009 - 2025"; Data developed by linear extrapolation
Lighters & Barges	LV Others	1050	1350	1.29	Marine Dept "Assessment of Typhoon Shelter Space Requirements 2009 - 2025"; Data developed by linear extrapolation
Fishing Vessels	LV Others	0	0	1.00	Marine Dept "Assessment of Typhoon Shelter Space Requirements 2009 - 2025"; Data developed by linear extrapolation
Passenger and Trading Vessels, Lighters & Barges	LV Others (Total)	1190	1420	1.19	Marine Dept "Assessment of Typhoon Shelter Space Requirements 2009 - 2025"; Data developed by linear extrapolation
Non container OG	OGV except OGV F and OGV B	4372	4372	1.00	Port of HK Statistical Table; The growth rate is assumed to be 0

River Vessel	Code	2010	2020	Ratio of 2031 to 2010	Remark
RV Macau	RV Macau	59810	64711	3.70%	25% reduction due to HZMB; UST Report
RV PRD	RV PRD	28319	24336	0.64	Assume zero growth after at 2020; Based on Table 11-3 of UST report

NOx - Control Measures

OGV

SO2 Measures: Phasing out of old vessel due to the change in Nox emission technology

NOx (adjustment Factor); pg 143 UST "Study on Marine Vessels Emission Inventory" 2009 Report

NOx	2010	2015	2020	2031	2031 / 2010	Remark
ME	0.8829	0.8152	0.7802	0.6618	0.7496	2031 reduction factor is based on extrapolation
AE	0.8829	0.825	0.7891	0.6823	0.7727	2031 reduction factor is based on extrapolation

RTV and LV

Measures: Incorporating in local legislation on the latest standards of the International Maritime Organization on Vessel Emission, Legislative Council Panel on Economic Development CB(1)1317/12-13(03)

		n <130	130 < n < 2000	n >=2000
Tier 1	36526	17	$45 \times n^{-0.2}$	9.8
Tier II	40544	14.4	$44 \times n^{-0.23}$	7.7
Reduction:		-15%	-18%	-21%

	Age (yrs)	Fraction in 2031	Remark
Retirement Period for RTV	30	0.6667	Nikos E Mikelis, A statistical overview of ship recycling, International Symposium on Maritime Safety, Security & Environmental Protection, Athens, Sept 2007
Retirement Period for fast ferry	23.6	0.8046	http://seaphantom.com/?page_id=426 for average age; the age profile shall refer to HK Ferry Age Profile

Reduction for RTV in Yr 2031: -10%
Reduction for Fast Ferry in Yr 2031: -15%

SO2 - Control Measures

Vessel Type	Group	Description	Sulphur Content		SO2 Reduction 2031 / 2010	PM (Residue heavy Oil) g/KW/hr	PM (0.5%S) g/KW/hr	Projected PM (0.1%S) g/KW/hr	Projected PM (0.05%S) g/KW/hr	PM Reduction adopted 2031 / 2010	Remark
			2010	2030							
Local Vessel (LV)	LV Ferry	Class I	0.50%	0.05%	-90%		0.38		0.234	-38%	Assume 0.05% though the current fuel sulphur content of
	LV Others	Class II, III and IV; Government vessels	0.50%	0.05%	-90%		0.38		0.234	-38%	light diesel specified in GB252-2011 is only 0.035%.
Ocean Going Vessel (OGV)	OGV A	A. Chemical Carrier/Tanker	2.60%	0.50%	-81%	1.5	0.38	0.25		-75%	MEPC 57 of IMO: Global Sulphur cap at 0.5%
	OGV B	B. Conventional Cargo Vessel	1.81%	0.50%	-72%	1.5	0.38	0.25		-75%	MEPC 57 of IMO: Global Sulphur cap at 0.5%
	OGV C	C. Cruise/Ferry	2.11%	0.50%	-76%	1.5	0.38	0.25		-75%	MEPC 57 of IMO: Global Sulphur cap at 0.5%
	OGV D	D. Dry Bulk Carrier	2.69%	0.50%	-81%	1.5	0.38	0.25		-75%	MEPC 57 of IMO: Global Sulphur cap at 0.5%
	OGV F1	FCCV DWT Below 10,000	2.19%	0.50%	-77%	1.5	0.38	0.25		-75%	MEPC 57 of IMO: Global Sulphur cap at 0.5%
	OGV F2	FCCV DWT 10,000 – 19,999	2.19%	0.50%	-77%	1.5	0.38	0.25		-75%	MEPC 57 of IMO: Global Sulphur cap at 0.5%
	OGV F3	FCCV DWT 20,000 – 29,999	2.19%	0.50%	-77%	1.5	0.38	0.25		-75%	MEPC 57 of IMO: Global Sulphur cap at 0.5%
	OGV F4	FCCV DWT 30,000 – 39,999	2.19%	0.50%	-77%	1.5	0.38	0.25		-75%	MEPC 57 of IMO: Global Sulphur cap at 0.5%
	OGV F5	FCCV DWT 40,000 – 49,999	2.19%	0.50%	-77%	1.5	0.38	0.25		-75%	MEPC 57 of IMO: Global Sulphur cap at 0.5%
	OGV F6	FCCV DWT 50,000 – 74,999	2.19%	0.50%	-77%	1.5	0.38	0.25		-75%	MEPC 57 of IMO: Global Sulphur cap at 0.5%
	OGV F7	FCCV DWT 75,000 – 99,999	2.19%	0.50%	-77%	1.5	0.38	0.25		-75%	MEPC 57 of IMO: Global Sulphur cap at 0.5%
	OGV F8	FCCV DWT ≥ 100,000	2.19%	0.50%	-77%	1.5	0.38	0.25		-75%	MEPC 57 of IMO: Global Sulphur cap at 0.5%
	OGV G	G. Gas Carrier/Tanker	2.75%	0.50%	-82%	1.5	0.38	0.25		-75%	MEPC 57 of IMO: Global Sulphur cap at 0.5%
	OGV I	I. Oil Tanker	2.72%	0.50%	-82%	1.5	0.38	0.25		-75%	MEPC 57 of IMO: Global Sulphur cap at 0.5%
	OGV Others	Others	2.73%	0.50%	-82%	1.5	0.38	0.25		-75%	MEPC 57 of IMO: Global Sulphur cap at 0.5%
River Vessel (RV)	RV Macau		0.50%	0.05%	-90%		0.38		0.234	-38%	Assume 0.05% though the current fuel sulphur content of light diesel
	RV PRD		0.50%	0.05%	-90%		0.38		0.234	-38%	specified in GB252-2011 is only 0.035%.
	RTV	River Trade Vessel (RTV)	0.50%	0.05%	-90%		0.38		0.234	-38%	