SUPPLEMENT 1

The procedure for calculating the SO_x emission factor from fuel sulphur content is given below. The units are given in parenthesis.

SFOC = Specific Fuel Oil Consumption (g/kWh)
SC = Sulphur content of fuel (mass-%)
M(S) = Molar mass of sulphur (g/mol)
$M(SO_2)$ = Molar mass of sulphu dioxide (g/mol)
n(S) = number of moles of sulphur (mol)
$n(SO_2)$ = number of mols of sulphur dioxide (mol)
m(S) = mass of sulphur (g)
$m(SO_2)$ = mass of sulphur dioxide (g)

$$n(S) = \frac{m(S)}{M(S)} = \frac{SFOC * SC}{M(S)} = \frac{200 \ \ g/kWh \ \ * \ \ 0.015}{32.0655 \ \ \text{g/mol}} = 0.09356 \ \ \text{mol/kWh}$$

$$\text{n(S)} = \text{n}(SO_2)$$

$$\text{m}(SO_2) = \text{M}(SO_2) * \text{n}(SO_2) = 64.06436 \ \ \text{g/mol} * 0.09356 \ \ \text{mol/kWh} = 5.994 \ \ \text{g/kWh}$$

The procedure for calculating the CO_2 emission factor is given below. The units are given in parenthesis.

SFOC = Specific Fuel Oil Consumption (g/kWh)
CC = Carbon content of fuel (mass-%)
M(C) = Molar mass of carbon (g/mol)
n(C) = number of mols of carbon (mol)
m(C) = mass of carbon (g)
M(CO2) = molar mass of carbon dioxide (g/mol)
n(CO2) = number of mols of carbon dioxide (mol)
m(CO2) = mass of carbon dioxide (g)

$$n(C) = \frac{m(C)}{M(C)} = \frac{SFOC * CC}{M(C)} = \frac{200 \ \ g/kWh \ \ * \ \ 0.85}{12.01 \ \ \text{g/mol}} = 14.15487 \ \ \text{mol/kWh}$$

$$\text{n(C)} = \text{n}(CO_2)$$

$$\text{m}(CO_2) = \text{M}(CO_2) * \text{n}(CO_2) = 44.00886 \ \ \text{g/mol} * 14.15487 \ \ \text{mol/kWh} = 622.94 \ \ \text{g/kWh}$$

Note that the carbon content of the diesel fuel varies depending on the type of fuel from 85 (HFO) to 88 (MDO, MGO) mass-%. The lower value was used in this example.

SUPPLEMENT II

Specific emissions classified by ship type and build year are shown in the table below. The number of ships of each type and age group is presented in the first and second columns, total travelled distance in the third, total NO_x, SO_x and CO_2 emissions in columns four, five and six. Specific emissions (NO_x, SO_x and CO_2) per vessel kilometre (kg/km) are presented in columns seven, eight and nine. RORO = Roll On – Roll Off cargo ships, CONT = Container ships, T_CRD = Crude Oil tankers, T_PROD = Oil Product tankers, BULK = Bulk Cargo ships, RoPax = Roll On – Roll Off cargo/Passenger ships, GC = General Cargo ships. Age groups: 2000 = Jan 1st 2000 – 31st Dec 2007, 1990's = Jan 1st 1990 – 31st Dec 1999, 1980's = 1st Jan 1980 – 31st Dec 1989, 1970's = 1st Jan 1970 – 31st Dec 1979. The emissions from these classes represent 88 % of all NO_x, 90 % of SO_x and 88 % of CO_2 released from ships in the Baltic Sea area in 2007.

Shiptype	*Ships*	*Distance/km*	*NO_x, tons*	*SO_x, tons*	*CO_2, tons*	*NO_x, kg/km*	*SO_x, kg/km*	CO_2, kg/km
ROPAX,2000	25	274735	2130	875	104954	7.75	3.19	382
RORO,2000	34	278114	1832	852	101464	6.59	3.07	365
T_CRD,1980's	7	8798	51	11	2466	5.79	1.30	280
T_CRD,2000	65	260453	1759	588	69758	6.75	2.26	268
ROPAX,1990's	60	523066	2611	960	131588	4.99	1.84	252
T_CRD,1990's	26	47665	297	95	11875	6.22	2.00	249
ROPAX,1980's	65	518631	2606	868	126038	5.02	1.67	243
CONT,1980's	14	37228	200	63	8094	5.37	1.70	217
BULK,2000	38	72336	350	113	14272	4.84	1.56	197
T_PROD,2000	39	140188	604	203	25455	4.31	1.45	182
RORO,1970's	24	181062	709	267	31083	3.91	1.48	172
T_CHEM,2000	156	547047	2053	695	89456	3.75	1.27	164
RORO,1980's	16	93009	298	116	14760	3.20	1.24	159
CONT,2000	85	546060	1819	657	85148	3.33	1.20	156
RORO,1990's	34	295577	890	397	46022	3.01	1.34	156
BULK,1990's	47	104287	388	124	15725	3.72	1.19	151
T_PROD,1980's	29	70668	198	60	9642	2.80	0.85	136
BULK,1980's	89	236572	788	250	32111	3.33	1.05	136
ROPAX,1970's	32	174942	453	171	22768	2.59	0.98	130
T_PROD,1990's	19	49406	127	40	5930	2.57	0.80	120
T_CHEM,1990's	90	307429	736	252	34737	2.39	0.82	113
CONT,1990's	50	263403	602	233	29114	2.29	0.89	111
CONT,1970's	4	9690	26	8	1064	2.68	0.85	110
T_CHEM,1980's	38	98217	206	66	9109	2.09	0.67	93
BULK,1970's	47	155486	327	111	14236	2.10	0.71	92
T_CRD,1970's	6	7150	11	4	585	1.55	0.51	82
T_CHEM,1970's	15	48285	66	20	3291	1.37	0.42	68
GC,2000	258	809469	1027	413	51433	1.27	0.51	64
GC,1990's	362	1148754	1396	539	68726	1.22	0.47	60
T_PROD,1970's	15	31126	26	7	1336	0.84	0.23	43
GC,1980's	352	940321	776	277	37629	0.83	0.29	40
GC,1970's	257	713379	527	192	25011	0.74	0.27	35