Emission factors used in the estimations of emissions from combustion

(Last update: Jan. 18. 2017)

In the calculations the numbers are used with the highest available accuracy. In these tables though, they are only shown rounded off.

In the tables, dotted cells indicate combinations of fuel and source without consumption.

CO_2, SO_2 and heavy metals - Stationary and mobile combustion

Table 1. General emission factors for CO_2, SO_2 and heavy metals

	CO_2 tonne/tonne[2]	SO_2[1] kg/tonne[2]	Pb g/tonne[2]	Cd g/tonne[2]	Hg g/tonne[2]	As g/tonne[2]	Cr g/tonne[2]	Cu g/tonne[2]
Coal	2.52	*16*[3]	*0.2*[3]	*0.003*[3]	*0.05*[3]	*0.089*[3]	*0.065*[3]	*0.087*[3]
Coke	3.19	18	*0.2*[3]	*0.003*[3]	*0.05*[3]	*0.089*[3]	*0.065*[3]	*0.087*[3]
Petrol coke	3.59	18	*0.2*	*0.003*	*0.05*	*0.089*	*0.065*	*0.087*
Charcoal	0	0.32	0.8	0.38	0.02	0.01	0.68	0.18
Motor gasoline	3.13	**0.001**	**0.03**[4]	0.01	0,0084	0.05	0.05	1.7
Aviation gasoline	3.13	0.4	675.7	0.01	0	0.05	0.05	1.7
Kerosene (heating)	3.15	**0.346**	0.07	0.01	0.03	0.05	0.04	0.05
Jet kerosene	3.15	**0.274**	0.07	0.01	0.03	0.05	0.05	0.05
Auto diesel	3.17[5]	**0.015**[6]	0.1	0.01	0,0023	0.05	0.05	1.7
Marine gas oil/diesel	3.17	**1.158**	0.1	0.01	0.05	0.05	0.04	0.05
Light fuel oils	3.17	**0.928**	0.1	0.01	0.05	0.05	0.04	0.05
Heavy distillate	3.17	**4.375**	0.1	0.01	0.05	0.05	0.04	0.05
Heavy fuel oil	3.2	**17.84**[7]	1	0.1	0.2	0.057	1.35	0.53
Natural gas (1000 Sm^3)	1.99**/2.34**[8]	0	0.00025	0.002	0.001	0.004	0.021	0.016
LPG	3	0	0	0	0	0.004	0.021	0.016
Refinery gas	2.8	0	0	0	0	0.004	0.021	0.016
CO gas	1.571	0	0	0	0	0.004	0.021	0.016
Fuel gas	2.5	0	0	0	0	0.004	0.021	0.016
Landfill gas	0	0.019	0	0	0	0.004	0.021	0.016
Biogas	0	0	0.00025	0.0017	0.001	0.0038	0.021	0.016
Fuel wood	0	0.2	0.05	0.1	0.010244	0.159	0.152	0.354
Wood waste	0	0.37	0.05	0.1	0.010244	0.159	0.152	0.354
Wood pellets	0	0.37	0.05	0.1	0.1	0.159	0.152	0.354
Wood briquettes	0	0.37	0.05	0.1	0.1	0.159	0.152	0.354
Black liquor	0	0.37	0.05	0.1	0.010244	0.159	0.152	0.354
Municipal waste	**0.5498**[9]	1.4	**0.00304**	**0.00015**	**0.00016**	0.022	0.001	0.000985
Special waste	3.2	9.2	14	0.6	0.2	1	31	25

[1] Applies to 2015 for petroleum products; the factors change yearly, in accordance with changes in the sulphur content in the products.
[2] For natural gas: 1000 Sm^3.
[3] Exceptions: Direct-fired furnaces in cement production = 9.1 and small stoves in households = 20.
[4] From 1997 - considerably higher earlier years. Earlier used factors are not shown in this Appendix.
[5] From 2006 the emission factor has been corrected for use of bio diesel, which not causes emissions of CO_2: 2006: 3.159, 2007: 3.114, 2008: 3.029, 2009: 3.007, 2010: 2.992, 2011: 3.006, 2012: 2.989, 2013: 2.989, 2014: 3.000, 2015: 2.990.
[6] Applies to road traffic. Weighted average of duty-free and dutiable auto diesel.
[7] Stationary combustion.
[8] Respectively dry gas (domestic use) and rich gas (continental shelf).
[9] The factor increases through the period, from 0.4874 in 1990. Exact figures can be given at request.
Numbers in italics have exceptions for some sectors, see table 2 and 5. Bold numbers are different for different years, see table B3, B4 and B5.
Source: Rosland (1987), (Norwegian pollution control authority (1990), (Sandgren *et al.* (1996), Finstad *et al*. (2001) Finstad et al. (2002) and Finstad *and Rypdal* (2003).

Table 2. Exceptions from the general emission factors for heavy metals: Solid fuels in small stoves (households)

	Pb g/tonne	Cd g/tonne	Hg g/tonne	As g/tonne	Cr g/tonne	Cu g/tonne
Coal	2.5	0.15	0.3	1.2	0.9	1.2
Coke	2.5	0.15	0.3	1.2	0.9	1.2

Table 3. Time series for variable emission factors for SO_2 (kg/tonne)

Years	V11 Motor gasoline	V13 Kerosene (heating)	V14 Jet kerosene	V15 Auto diesel				V17 Marine gas oil/diesel	V18 Light fuel oils	V19 Heavy distillate	V20 Heavy fuel oil (LS-oil)	V20 Heavy fuel oil (NS-oil)
	General	General	General	General	M.1A3B.1 Passenger cars	M.1A3B.2 Light duty vehicles	M.1A3B.3 Heavy duty vehicles	General	General	General	General	General
1980	1	0.2	0.2	6.6	.	.	.	6.6	6.6	15	19	46
1987	0.7	0.4	0.4	4.4	.	.	.	4.4	4.4	9	19	44
1989	0.6	0.4	0.4	3.4	.	.	.	3.4	3.4	7.6	18.2	40
1990	0.6	0.3	0.3	3.2	.	.	.	3.2	3.2	6	17	39.4
1991	0.6	0.38	0.38	2.8	.	.	.	2.8	2.8	4.6	16.8	43.6
1992	0.6	0.32	0.32	2.6	.	.	.	2.6	2.6	4.4	16.4	42.6
1993	0.6	0.42	0.42	2.2	.	.	.	2.2	2.2	4.4	16.2	45.8
1994	0.6	0.36	0.36	1.4	.	.	.	1.4	1.4	4.2	14.2	44.8
1995	0.24	0.46	0.46	1.4	.	.	.	1.4	1.4	4.6	11.8	43.4
1996	0.22	0.46	0.5	1.2	.	.	.	1.2	1.2	3.8	12.6	46.6
1997	0.16	0.46	0.46	1.2	.	.	.	1.2	1.2	3.8	12.6	47.2
1998	0.16	0.42	0.42	0.8	.	.	.	1.8	1.8	4.2	12.4	42.8
1999	0.22	0.32	0.32	0.6	.	.	.	1.6	1.6	4.4	12.8	39
2000	0.18	0.36	0.36	1.4	0.1174	0.1174	0.1174	1.8	1.8	4.6	14.4	31
2001	0.18	0.46	0.46	0.8	0.0885	0.0885	0.0885	1.8	1.8	4.8	13.2	44.4
2002	0.2	0.32	0.32	0.6	0.0708	0.0708	0.0708	1.6	1.2	4.8	12	43.8
2003	0.1	0.3	0.3	0.8	0.0748	0.0748	0.0748	2	0.8	4.6	14	44.2
2004	0.06	0.3	0.3	0.8	0.0748	0.0748	0.0748	1.8	0.8	5	14.2	44.2
2005	0.01	0.28	0.28	0.8	0.0278	0.0278	0.0278	1.8	0.8	4.6	13.6	39.2
2006	0.01	0.27	0.27	1.38	0.0393	0.0393	0.0393	2	1.38	4.44	10.4	26.2
2007	0.01	0.296	0.296	0.73	0.0244	0.0244	0.0244	1.53	0.73	4.17	17.8	20
2008	0.01	0.286	0.286	0.786	0.0285	0.0285	0.0285	1.562	0.986	3.098	17.5	28.5
2009	0.01	0.302	0.371	0.016	0.016	0.016	0.016	1.069	0.949	4.31	17.4	27.8
2010	0.01	0.324	0.294	0.015	0.015	0.015	0.015	1.184	0.978	4.31	17.5	28
2011	0.01	0.334	0.296	0.015	0.015	0.015	0.015	1.196	0.984	4.32	17.8	28.4
2012	0.01	0.326	0.294	0.015	0.015	0.015	0.015	1.038	0.658	4.295	17.5	27.4
2013	0.009	0.298	0.252	0.014	0.014	0.014	0.014	1.026	0.642	3.957	15.4	26.4
2014	0.01	0.342	0.252	0.014	0.014	0.014	0.014	1.054	0.648	4.263	15.5	27.0
2015	0.01	0.346	0.274	0.015	0.015	0.015	0.015	1.158	0.928	4.375	17.8	28.6

Table 4. Time series for variable emission factors for heavy metals, stationary combustion. g/tonne

			1990-1991			1992-		
Sector	Source	Fuel	Pb	Cd	Hg	Pb	Cd	Hg
General	S.03	V51	0.0085	0.00047	0.00035	0.00304	0.00015	0.00016

Table 5. Exceptions with time series for variable emission factors for natural gas combusted by oil exploration, tonne CO_2/1000 Sm^3 natural gas

Sector	Source	Fuel	Component	1990-1994	1995	1996	1997	1998	1999	2000	2001	2002*
230600.1	S.02	V31	CO_2	2.34	2.29	2.3	2.3	2.31	2.5	2.48	2.47	2.45
230600.1	S.1B2C	V31	CO_2	2.34	2.42	2.34	2.34	2.34	2.48	2.52	2.42	2.47

*For the years after 2002 reported emissions are used

Aviation - CH_4, N_2O, NO_X, NMVOC, CO, particles and PAH

Table 6. General emission factors for aviation

Source	Fuel	CH_4 kg/ tonne	N_2O kg/ tonne	NO_X kg/ tonne	NMVOC kg/ tonne	CO kg/ tonne	NH_3 kg/ tonne	TSP, PM_{10}, $PM_{2.5}$ kg/tonne	Dioxins µg I-TEQ/ tonne
M.1A3A.111 Jet/turboprop 0-100 m	V14 Jet kerosene	***0.129***	0.1	*12.968*	*1.164*	*10.952*	0	0.064	0.06
M.1A3A.112 Jet/turboprop 100-1000 m	V14 Jet kerosene	***0.129***	0.1	*12.968*	*1.164*	*10.952*	0	0.064	0.06
M.1A3A.12 Jet/turboprop cruise	V14 Jet kerosene	0	0.1	*14.650*	*0.707*	*11.351*	0	0.102	0.06
M.1A3A.211 Helicopter 0-100 m	V14 Jet kerosene	*3.2*	0.1	6.67	*28.8*	*36.6*	0	0.025	0.06
M.1A3A.212 Helicopter 100-1000 m	V14 Jet kerosene	*3.2*	0.1	6.67	*28.8*	*36.6*	0	0.025	0.06
M.1A3A.22 Helicopter cruise	V14 Jet kerosene	0	0.1	6.67	*32*	*36.6*	0	0.007	0.06
M.1A3A.311 Small aircraft 0-100 m	V12 Aviation gasoline	0.129	0.1	*12.968*	*1.164*	*10.952*	0	0.064	2
M.1A3A.312 Small aircraft 100-1000 m	V12 Aviation gasoline	0.129	0.1	*12.968*	*1.164*	*10.952*	0	0.064	2
M.1A3A.32 Small aircraft cruise	V12 Aviation gasoline	0	0.1	*14.650*	*0.707*	*11.351*	0	0.102	2

Table 6 (cont.). General emission factors for aviation

Source	Fuel	benzo(a)pyrene g/tonne	benzo(b)fluoranthene g/tonne	benzo(k)fluoranthene g/tonne	indeno(1,2,3_cd)pyrene g/tonne
M.1A3A.111 Jet/turboprop 0-100 m	V14 Jet kerosene	NE	NE	NE	NE
M.1A3A.112 Jet/turboprop 100-1000 m	V14 Jet kerosene	NE	NE	NE	NE
M.1A3A.12 Jet/turboprop cruise	V14 Jet kerosene	NE	NE	NE	NE
M.1A3A.211 Helicopter 0-100 m	V14 Jet kerosene	NE	NE	NE	NE
M.1A3A.212 Helicopter 100-1000 m	V14 Jet kerosene	NE	NE	NE	NE
M.1A3A.22 Helicopter cruise	V14 Jet kerosene	NE	NE	NE	NE
M.1A3A.311 Small aircraft 0-100 m	V12 Aviation gasoline	0.005	0.009	0.003	0.011
M.1A3A.312 Small aircraft 100-1000 m	V12 Aviation gasoline	0.005	0.009	0.003	0.011
M.1A3A.32 Small aircraft cruise	V12 Aviation gasoline	0.005	0.009	0.003	0.011

Numbers in italics have exceptions for some sectors, see table 7, and bold numbers are different for different years, see table 8.

In the estimation update for CH_4, NO_X, NMVOC, CO and particles, which was based on the new EEA (2013) factors, no distinction are made between flight phases in 0-100 m altitude and 100-1000 m altitude. Furthermore, emission factors for jet/turboprop and small aircraft are weighted together.

Source: Finstad *et al*. (2001), Finstad *et al*. (2002), EEA (2013). PAHs: Jet keorsone: EEA (2013), Aviation gasoiline: Aarhus University (2016)

Table 7. Exceptions from the general factors for aviation

Component	Emission factor		Fuel	Source	Sectors
CH_4	0.35	V14	Jet kerosene	M.1A3A.111-112, M1A3A.211-212	248422
NO_X	13.51	V14	Jet kerosene	M.1A3A.111, M1A3A.211	248422
NO_X	13.29	V14	Jet kerosene	M.1A3A.112, M1A3A.212	248422
NO_X	11.7	V14	Jet kerosene	M.1A3A.12, M.1A3A.22	248422
NMVOC	7.43	V14	Jet kerosene	M.1A3A.111, M1A3A.211	248422
NMVOC	7.36	V14	Jet kerosene	M.1A3A.112, M1A3A.212	248422
NMVOC	4.3	V14	Jet kerosene	M.1A3A.12, M.1A3A.22	248422
CO	23.67	V14	Jet kerosene	M.1A3A.111, M1A3A.211	248422
CO	23.15	V14	Jet kerosene	M.1A3A.112, M1A3A.212	248422
CO	20.9	V14	Jet kerosene	M.1A3A.12, M.1A3A.22	248422
CH_4	0.090	V12, 14	Aviation gasoline, jet kerosene	M.1A3A.11x, M1A3A.31x	235100.2N
CH_4	0	V12, 14	Aviation gasoline, jet kerosene	M.1A3A.12, M1A3A.32	235100.2N
NO_X	12.559	V12, 14	Aviation gasoline, jet kerosene	M.1A3A.11x, M1A3A.31x	235100.2N
NO_X	13.857	V12, 14	Aviation gasoline, jet kerosene	M.1A3A.12, M1A3A.32	235100.2N
NMVOC	0.810	V12, 14	Aviation gasoline, jet kerosene	M.1A3A.11x, M1A3A.31x	235100.2N
NMVOC	0.246	V12, 14	Aviation gasoline, jet kerosene	M.1A3A.12, M1A3A.32	235100.2N
CO	9.903	V12, 14	Aviation gasoline, jet kerosene	M.1A3A.11x, M1A3A.31x	235100.2N
CO	2.547	V12, 14	Aviation gasoline, jet kerosene	M.1A3A.12, M1A3A.32	235100.2N
TSP, PM_{10}, $PM_{2.5}$	0.074	V12, 14	Aviation gasoline, jet kerosene	M.1A3A.11x, M1A3A.31x	235100.2N
TSP, PM_{10}, $PM_{2.5}$	0.142	V12, 14	Aviation gasoline, jet kerosene	M.1A3A.12, M1A3A.32	235100.2N

Table 8. Time series for variable emission factors for aviation. Factors for 1989, 1995, 2000 and 2012 are calculated as given in the table. Factors for 1990-1994, 1996-1999 and 2001-2011 are calculated by linear interpolation. Factors after 2012 are kept constant. In the 2012 calculation source M.1A3A.111 and M.1A3A.112 are weighted together.

		General			235100.2N		665100.2
Component	*Year*	*M.1A3A.111 (LTO 0-100 m)*	*M.1A3A.112 (LTO 100-1000 m)*	*M.1A3A.12 (cruise)*	*M.1A3A.111 (LTO 0-100 m)*	*M.1A3A.112 (LTO 100-1000 m)*	*M.1A3A.12 (cruise)*
CH_4	1989	0.086	0.014	0.000	0.041	0.007	0.000
	1995	0.858	0.141	0.000	0.086	0.014	0.000
	2000	0.175	0.029	0.000	0.144	0.025	0.000
	2012	0.129	0.129	0.000	0.090	0.090	0.000
NO_X	1989	6.772	13.049	12.119	7.762	14.958	12.755
	1995	9.296	17.913	11.001	7.745	14.924	11.989
	2000	7.579	14.605	14.032	7.327	14.884	11.750
	2012	12.968	12.968	14.650	12.559	12.559	13.857
NMVOC	1989	0.775	0.127	0.554	0.365	0.060	0.675
	1995	7.725	1.265	0.963	0.773	0.127	3.369
	2000	1.576	0.258	0.507	1.293	0.221	0.366
	2012	1.164	1.164	0.707	0.810	0.810	0.246
CO	1989	19.768	2.145	6.947	14.173	1.538	4.191
	1995	27.204	2.952	12.147	15.118	1.640	8.459
	2000	21.239	2.305	7.808	16.925	2.659	3.866
	2012	10.952	10.952	11.351	9.903	9.903	2.547
TSP, PM_{10}, $PM_{2.5}$	1989	0.039	0.039	0.094	0.048	0.048	0.658
	1995	0.056	0.056	0.102	0.075	0.075	1.325
	2000	0.057	0.057	0.155	0.075	0.075	1.325
	2012	0.064	0.064	0.102	0.074	0.074	0.142

Road traffic - CH_4, N_2O, NO_X, NMVOC, CO, NH_3, particles and PAH

Table 9. General emission factors for road traffic

Source	Fuel	CH_4 kg/tonne	N_2O kg/tonne	NO_X kg/tonne	NMVOC kg/tonne	CO kg/tonne	NH_3 kg/tonne	TSP, PM_{10} kg/tonne	$PM_{2.5}$ kg/tonne	Dioxins µg I-TEQ/tonne
M.1A3B.1 Passenger car	V11 Motor gasoline	**0.312**	**0.035**	**3.512**	**5.528**	**36.697**	**1.036**	**0.041**	**0.041**	**0.1**
	V15 Auto diesel	**0.012**	**0.084**	**9.222**	**0.485**	**2.695**	**0.019**	**0.273**	**0.259**	0.1
	V31 Natural gas	0	0	0.871	0.065	1.693	0	0.122	0.122	0.05
	V32 LPG	0	**0.045**	**1.163**	0	**11.999**	0	**0.033**	**0.033**	0.06
M.1A3B.2 Other light duty cars	V11 Motor gasoline	**0.525**	**0.085**	**6.386**	**9.704**	**100.020**	**0.821**	**0.083**	**0.083**	**0.1**
	V15 Auto diesel	**0.009**	**0.060**	**9.719**	**0.382**	**2.518**	**0.014**	**0.515**	**0.489**	0.1
M.1A3B.3 Heavy duty vehicles	V11 Motor gasoline	**0.576**	**0.044**	**27.969**	**16.767**	**22.266**	**0.018**	0	0	**0.1**
	V15 Auto diesel	**0.008**	**0.094**	**12.245**	**0.329**	**3.822**	**0.008**	**0.203**	**0.192**	**0.1**
	V31/V37 Natural gas/ Biogas	0	0	**8.274**	0	**5.901**	**0.008**	**0.026**	**0.026**	0.05
M.1A3B.41 Moped	V11 Motor gasoline	**24.707**	**0.052**	**3.254**	**108.829**	**193.621**	**0.052**	0	0	**0.1**
M.1A3B.42 Motorcycle	V11 Motor gasoline	**1.643**	**0.058**	**4.108**	**19.100**	**192.334**	**0.058**	0	0	**0.1**

Table 9 (cont.). General emission factors for road traffic

Source	Fuel	benzo(a)pyrene g/tonne	benzo(b)fluoranthene g/tonne	benzo(k)fluoranthene g/tonne	indeno(1,2,3_cd)pyrene g/tonne
M.1A3B.1 Passenger car	V11 Motor gasoline	**0.030**	**0.034**	**0.024**	**0.037**
	V15 Auto diesel	**0.114**	**0.127**	**0.100**	**0.106**
	V31 Natural gas	0	0	0	0
	V32 LPG	**0.026**	**0.030**	**0.021**	**0.033**
M.1A3B.2 Other light duty cars	V11 Motor gasoline	**0.029**	**0.035**	**0.024**	**0.038**
	V15 Auto diesel	**0.114**	**0.127**	**0.100**	**0.106**
M.1A3B.3 Heavy duty vehicles	V11 Motor gasoline	**0.014**	**0.083**	**0.092**	**0.021**
	V15 Auto diesel	**0.028**	**0.169**	**0.189**	**0.043**
	V31/V37 Natural gas/ Biogas	0	0	0	0
M.1A3B.41 Moped	V11 Motor gasoline	0.040	0.040	NE	NE
M.1A3B.42 Motorcycle	V11 Motor gasoline	0.040	0.040	NE	NE

Bold numbers are different for different years, but only the 2015 data are shown here, except for CH_4 (table 10) and N_2O (table 11).
Source: Results from Statistiics Norway's use of HBEFA (INFRAS 2009), Finstad *et al*. (2001). PAH-profile: Aarhus University (2016)

Table 10. Average CH_4 emission factors for road traffic including cold start emissions and evaporation, g CH_4/ kg fuel

	V11 Motor gasoline					V15 Auto diesel		
	Passenger car	Other light duty cars	Heavy duty vehicles	Moped	Motorcycle	Passenger car	Other light duty cars	Heavy duty vehicles
1990	1.641	1.865	0.576	12.878	3.600	0.109	0.097	0.082
1991	1.602	1.869	0.580	12.952	3.423	0.105	0.094	0.082
1992	1.557	1.838	0.581	12.968	3.256	0.096	0.089	0.078
1993	1.512	1.777	0.582	12.999	3.055	0.077	0.074	0.068
1994	1.457	1.703	0.583	13.027	2.896	0.084	0.085	0.073
1995	1.396	1.609	0.586	13.082	2.774	0.081	0.082	0.071
1996	1.270	1.472	0.576	12.862	2.585	0.076	0.076	0.066
1997	1.218	1.425	0.592	13.219	2.815	0.078	0.078	0.066
1998	1.104	1.290	0.576	12.871	2.895	0.074	0.071	0.056
1999	1.016	1.202	0.573	14.392	3.047	0.071	0.066	0.052
2000	0.964	1.147	0.588	17.636	3.173	0.067	0.063	0.049
2001	0.850	1.001	0.564	19.949	3.052	0.057	0.054	0.043
2002	0.775	0.916	0.563	23.218	3.061	0.050	0.049	0.040
2003	0.699	0.846	0.557	25.096	2.958	0.045	0.045	0.038
2004	0.624	0.777	0.549	25.748	2.792	0.039	0.041	0.035
2005	0.591	0.758	0.573	26.933	2.770	0.035	0.038	0.034
2006	0.543	0.713	0.579	26.893	2.576	0.030	0.033	0.032
2007	0.518	0.686	0.596	27.214	2.394	0.026	0.029	0.029
2008	0.485	0.646	0.597	26.787	2.138	0.023	0.024	0.026
2009	0.457	0.613	0.594	26.293	2.011	0.020	0.021	0.022
2010	0.426	0.579	0.585	25.648	1.896	0.017	0.017	0.018
2011	0.411	0.575	0.593	25.840	1.861	0.016	0.016	0.015
2012	0.387	0.560	0.592	25.655	1.816	0.015	0.014	0.013
2013	0.364	0.546	0.589	25.428	1.765	0.014	0.012	0.012
2014	0.335	0.528	0.575	24.754	1.684	0.013	0.011	0.010
2015	0.312	0.525	0.576	24.707	1.643	0.012	0.009	0.008

Source: Results from Statistics Norway's use of HBEFA (INFRAS 2009)

Table 11. Average N_2O emission factors for road traffic including cold start emissions and evaporation, g N_2O/ kg fuel

	V11 Motor gasoline					V15 Auto diesel		Heavy duty vehicles
	Passenger car	Other light duty cars	Heavy duty vehicles	Moped	Motorcycle	Passenger car	Other light duty cars	
1990	0.099	0.109	0.044	0.052	0.057	0	0	0.033
1991	0.105	0.109	0.044	0.052	0.057	0	0	0.032
1992	0.110	0.111	0.044	0.052	0.057	0	0	0.031
1993	0.117	0.116	0.044	0.052	0.058	0	0	0.026
1994	0.125	0.123	0.045	0.052	0.058	0	0	0.030
1995	0.135	0.133	0.045	0.052	0.058	0.003	0.005	0.030
1996	0.146	0.142	0.044	0.052	0.057	0.009	0.012	0.030
1997	0.155	0.157	0.045	0.053	0.059	0.018	0.020	0.033
1998	0.153	0.160	0.044	0.052	0.057	0.027	0.026	0.032
1999	0.154	0.167	0.044	0.051	0.057	0.036	0.034	0.033
2000	0.160	0.180	0.045	0.053	0.059	0.046	0.041	0.033
2001	0.155	0.177	0.043	0.051	0.056	0.050	0.043	0.030
2002	0.156	0.203	0.043	0.051	0.056	0.056	0.046	0.029
2003	0.152	0.178	0.043	0.050	0.056	0.062	0.049	0.027
2004	0.147	0.167	0.042	0.049	0.055	0.066	0.052	0.026
2005	0.087	0.168	0.044	0.052	0.058	0.073	0.057	0.026
2006	0.083	0.164	0.044	0.052	0.059	0.076	0.060	0.025
2007	0.081	0.164	0.046	0.054	0.060	0.083	0.064	0.028
2008	0.077	0.155	0.046	0.054	0.060	0.086	0.065	0.031
2009	0.073	0.145	0.045	0.053	0.060	0.086	0.064	0.037
2010	0.067	0.132	0.045	0.052	0.059	0.083	0.060	0.047
2011	0.062	0.126	0.045	0.053	0.059	0.085	0.061	0.062
2012	0.056	0.116	0.045	0.053	0.059	0.087	0.062	0.073
2013	0.048	0.105	0.045	0.053	0.059	0.087	0.062	0.077
2014	0.040	0.093	0.044	0.051	0.057	0.086	0.061	0.088
2015	0.035	0.085	0.044	0.052	0.058	0.084	0.060	0.094

Source: Results from Statistics Norway's use of HBEFA (INFRAS 2009)

Navigation - CH_4, N_2O, NO_X, NMVOC, CO, particles and POPs

Table 12. General emission factors for navigation

	CH_4 kg/ tonne	N_2O kg/ tonne	NO_X kg/ tonne	NMVOC kg/tonne	CO kg/ tonne	NH_3 kg/ tonne	TSP, PM_{10} kg/ tonne	$PM_{2.5}$ kg/ tonne	Dioxins µg I-TEQ/ tonne
V17 Marine gas oil/diesel, V18 Light fuel oils	*0.23*	*0.08*	***43.76***	*2.4*	*2.9*	0	1.6	1.5	4
V19 Heavy distillate, V20 Heavy fuel oil	*0.23*	*0.08*	***43.76***	*2.4*	*2.9*	0	5.4	5.1	4
V31 Natural gas (1000 Sm^3)	**48.64**	0.07	4.0	0.814	2.143	0	0.032	0.032	0.05

Table 12 (cont.). General emission factors for navigation

	benzo(a)pyrene g/tonne	benzo(b)fluoranthene g/tonne	benzo(k)fluoranthene g/tonne	indeno(1,2,3_cd)pyrene g/tonne
V17 Marine gas oil/diesel	0.006	0.028	0.013	0.051
V19 Heavy distillate	0.003	0.009	0.004	0.009
V20 Heavy fuel oil	0.003	0.008	0.004	0.008
V31 Natural gas (1000 Sm^3)	0.000025	0.000102	0.000039	0.000038

Numbers in italics have exceptions for some sectors, see table 13, and bold numbers are different for different years, see tables 14-16.
Source: Flugsrud and Rypdal (1996), Tornsjø (2001), Finstad *et al.* (2001), Finstad *et al.* (2002b), Finstad *et al.* (2003), Bremnes Nielsen and Stenersen (2010). PAHs: Aarhus University (2016) and EEA (2013).

Table 13. Exceptions from the general factors for navigation

Component	Emission factor (kg/tonne)	Fuel		Sector
CH_4	0.8	V17	Marine gas oil/diesel	230600.1 -230600.3
CH_4	1.9	V20	Heavy fuel oil	230600.1 -230600.3
N_2O	0.02	V17	Marine gas oil/diesel	230600.1 -230600.3
NO_X	**36.60**	V17, 19, 20	Marine gas oil/diesel, light fuel oils, heavy distillate, heavy fuel oil	230310.N
NO_X	54	V17, 20	Marine gas oil/diesel, light fuel oils, heavy distillate, Heavy fuel oil	230600.1 -230600.3
NO_X	**46.58**	V17, 19, 20	Marine gas oil/diesel, light fuel oils, heavy distillate, heavy fuel oil	248422
NMVOC	**1.4**	V17, 18, 19, 20	Marine gas oil/diesel, light fuel oils, heavy distillate, heavy fuel oil	230310.N
NMVOC	**2.3**	V17, 19, 20	Marine gas oil/diesel, light fuel oils, heavy distillate, heavy fuel oil	248422
NMVOC	5	V17	Marine gas oil/diesel, light fuel oils	230600.1 -230600.3
NMVOC	**5**	V19, 20	Heavy distillate, heavy fuel oil	230600.1 -230600.3
CO	7.9	V17, 18, 19, 20	Marine gas oil/diesel, light fuel oils, heavy distillate, heavy fuel oil	230310.N
CO	**1.6**	V17, 18, 19, 20	Marine gas oil/diesel, light fuel oils, heavy distillate, heavy fuel oil	230600.1
CO	7	V17, 19, 20	Marine gas oil/diesel, light fuel oils, heavy distillate, heavy fuel oil	230600.1 -230600.3
CO	2.3	V17, 19, 20	Marine gas oil/diesel, light fuel oils, heavy distillate, heavy fuel oil	248422

Table 14. Time series for variable emission factors for navigation. NO_X

Sector	Fuel	1990-1999	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999		
General	V17-20		56.85	56.80	56.89	56.77	56.82	56.68	57.23	57.47	57.41	56.82		

			2000	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
														45.11	43.76
General	V17-20		57.82	56.51	55.90	55.55	54.61	53.25	51.90	50.54	49.18	47.83	46.47		
230310.N	V17, 19, 20	52.11	52.12	51.69	51.58	51.48	50.93	49.90	47.41	45.17	43.64	43.36	40.94	37.97	36.60
248422	V17, 19, 20	50.17	49.82	48.95	48.74	48.52	48.31	48.09	47.88	47.66	47.44	47.23	47.01	46.80	46.58

Source: (Flugsrud *et al.* 2010)

Table 15. Time series for variable emission factors for navigation. CH_4

Sector	Fuel	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013-15
General	V31	31.43	31.43	31.43	49.99	52.71	54.55	54.43	36.81	38.83	41.65	42.73	40.59	46.83	48.64

Table 16. Time series for variable emission factors for navigation. NMVOC and CO

Sector	Fuel	NMVOC						CO	
		1980-1990	1980-1997	1980-1998	1991-	1998-	1999-	1980-1997	1998-
General	V17-20							3.1	2.9
230310.N	V17-20			1.5			1.4		
230600.1	V17-20							2	1.6
230600.1,230910	V19,20	6.4			5				
230600.1,230910	V 20								
248422	V17-20		2.2			2.3			

Other mobile sources including railways - CH_4, N_2O, NO_X, NMVOC, CO, NH_3, particles and POPs

Table 17. General emission factors for other mobile sources

		CH_4 kg/ tonne	N_2O kg/ tonne	NO_X kg/ tonne	NMVOC kg/ tonne	CO kg/ tonne	NH_3 kg/ Tonne	TSP, PM_{10} kg/ tonne	$PM_{2.5}$ kg/ tonne	Dioxins µg I-TEQ/ tonne
	V01 Coal	0.28	0.04	3	1.1	3	0	1.6/1.14	0.82	1.6
M.1A3C Railway	V15 Auto diesel	0.18	1.2	47	4	11	0.007	3.8	3.8	0.1
M.1A3E.21 Small boats 2 stroke	V11 Motor gasoline	5.1	0.02	6	240	415	0	8	8	**0.1**
M.1A3E.22 Small boats 4 stroke	V11 Motor gasoline	1.7	0.08	12	40	1 000	0	1	1	**0.1**
	V15 Auto diesel	0.18	0.03	54	27	25	0	4	4	0.1
M.1A3E.31 Motorized equipment 2 stroke	V11 Motor gasoline	6	0.02	**2**[1]	500	700	0	8	8	**0.1**
M.1A3E.32 Motorized equipment 4t	V11 Motor gasoline	*2.2*	*0.07*	10	110	1 200	0	1	1	**0.1**
	V15 Auto diesel	0.*17*	0.139	**13.0**	***1.0***	***6.1***	0.008	***0.2***	**0.2**	0.1
	V18 Light fuel oils	0.17	1.3	*50*	*6*	*15*	0.005	*7.1*	6.*75*	0.1

Other mobile sources including railways - CH_4, N_2O, NO_X, NMVOC, CO, NH_3, particles and POPs

Table 17 (cont.). General emission factors for other mobile sources

		benzo(a)pyrene g/tonne	benzo(b)fluoranthene g/tonne	benzo(k)fluoranthene g/tonne	indeno(1,2,3_cd)pyrene g/tonne
	V01 Coal	0.007	0.01	0.004	0.003
M.1A3C Railway	V15 Auto diesel	0.030	0.050	0	0
M.1A3E.21 Small boats 2 stroke	V11 Motor gasoline	0.040	0.040	0	0
M.1A3E.22 Small boats 4 stroke	V11 Motor gasoline	0.040	0.040	0	0
	V15 Auto diesel	0.030	0.050	0	0
M.1A3E.31 Motorized equipment 2 stroke	V11 Motor gasoline	0.040	0.040	0	0
M.1A3E.32 Motorized equipment 4t	V11 Motor gasoline	0.040	0.040	0	0
	V15 Auto diesel	0.030	0.050	0	0
	V18 Light fuel oils	0.030	0.050	0	0

M.1A3E.1 Snow scooter has the same emission factors as M.1A3B.41 Moped, see table 9.
Bold numbers are different for different years, but only 2015 figures are presented here.
[1]Before 1995 the emission factor was 1.3.
Numbers in italics have exceptions for some sectors, see tables 18–19.
Sources: Bang (1993), Bang *et al.* (1999), Finstad *et al*. (2001), Finstad *et al*. (2002b), Finstad *et al*. (2003), Winther and Nielsen (2006), EEA (2013).

Table 18. Exceptions from the general factors for greenhouse gases and precursors for other mobile sources

Component	Emission factor (kg/tonne)	Fuel		Source	Sectors
CH_4	6.2	V11	Motor gasoline	M.1A3E.31 Motorized equipment 2 stroke	230100
CH_4	3.7	V11	Motor gasoline	M.1A3E.32 Motorized equipment 4 stroke	230100
CH_4	7.7	V11	Motor gasoline	M.1A3E.31 Motorized equipment 2 stroke	230210
CH_4	8.1	V11	Motor gasoline	M.1A3E.31 Motorized equipment 2 stroke	330000
CH_4	5.5	V11	Motor gasoline	M.1A3E.32 Motorized equipment 4 stroke	330000
CH_4	0.18	V15	Auto diesel	M.1A3E.32 Motorized equipment 4 stroke	330000
N_2O	0.08	V11	Motor gasoline	M.1A3E.32 Motorized equipment 4 stroke	230500-233320
N_2O	0.132	V15	Auto diesel	M.1A3E.32 Motorized equipment 4 stroke	230100-230210
NO_X	**15.1**	V15	Auto diesel	M.1A3E.32 Motorized equipment 4 stroke	230100-230210
NO_X	54	V18	Light fuel oils	M.1A3E.32 Motorized equipment 4 stroke	230100
NO_X	52	V18	Light fuel oils	M.1A3E.32 Motorized equipment 4 stroke	230210
NO_X	47	V18	Light fuel oils	M.1A3E.32 Motorized equipment 4 stroke	230710-230892, 234910
NO_X	48	V18	Light fuel oils	M.1A3E.32 Motorized equipment 4 stroke	232360, 248422
NO_X	46	V18	Light fuel oils	M.1A3E.32 Motorized equipment 4 stroke	234110-234120
NMVOC	**1.8**	V15	Auto diesel	M.1A3E.32 Motorized equipment 4 stroke	230100-230200
NMVOC	7.2	V18	Light fuel oils	M.1A3E.32 Motorized equipment 4 stroke	230100

NMVOC	5.7	V18	Light fuel oils	M.1A3E.32 Motorized equipment 4 stroke	230210
NMVOC	4	V18	Light fuel oils	M.1A3E.32 Motorized equipment 4 stroke	230710-230892,234910
NMVOC	4.8	V18	Light fuel oils	M.1A3E.32 Motorized equipment 4 stroke	232360, 248422
NMVOC	3.8	V18	Light fuel oils	M.1A3E.32 Motorized equipment 4 stroke	234110-234120
CO	**10.0**	V15	Auto diesel	M.1A3E.32 Motorized equipment 4 stroke	230100-230210
CO	25	V18	Light fuel oils	M.1A3E.32 Motorized equipment 4 stroke	230100
CO	20	V18	Light fuel oils	M.1A3E.32 Motorized equipment 4 stroke	230210
CO	11	V18	Light fuel oils	M.1A3E.32 Motorized equipment 4 stroke	230710-230892, 234910
CO	17	V18	Light fuel oils	M.1A3E.32 Motorized equipment 4 stroke	234110-234120
CO	18	V18	Light fuel oils	M.1A3E.32 Motorized equipment 4 stroke	248422

Bold numbers are different for different years, time series for NO_x are presented in table 20.

Table 19. Exceptions from the general factors for other pollutants for other mobile sources

Component	Emission factor (kg/tonne)	Fuel		Source	Sectors
TSP, PM_{10}	**1.7**	V15	Auto diesel	M.1A3E.32 Motorized equipment 4 stroke	230100-230210
TSP, PM_{10}	3.8	V18	Light fuel oils	M.1A3E.32 Motorized equipment 4 stroke	230710-230892, 234910
TSP, PM_{10}	4.2	V18	Light fuel oils	M.1A3E.32 Motorized equipment 4 stroke	232360
TSP, PM_{10}	5.3	V18	Light fuel oils	M.1A3E.32 Motorized equipment 4 stroke	234110-234120
TSP, $PM1_0$	5.4	V18	Light fuel oils	M.1A3E.32 Motorized equipment 4 stroke	248422
$PM_{2.5}$	**1.6**	V15	Auto diesel	M.1A3E.32 Motorized equipment 4 stroke	230100-230210
$PM_{2.5}$	3.61	V18	Light fuel oils	M.1A3E.32 Motorized equipment 4 stroke	230710-230892, 234910
$PM_{2.5}$	3.99	V18	Light fuel oils	M.1A3E.32 Motorized equipment 4 stroke	232360
$PM_{2.5}$	5.04	V18	Light fuel oils	M.1A3E.32 Motorized equipment 4 stroke	234110-234120
$PM_{2.5}$	5.13	V18	Light fuel oils	M.1A3E.32 Motorized equipment 4 stroke	248422

Bold numbers are different for different years, but only 2015 figures are presented here.

Table 20. Time series for NO_X emission factors for use of auto diesel in motorized equipment 4t

Sector	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
General	46.3	46.4	46.4	46.4	46.5	46.6	46.7	46.8	46.0	43.9	41.9	40.2	37.8	35.0	31.8
230100-230210	27.1	27.0	26.7	26.5	26.4	26.4	26.5	26.6	26.6	26.5	26.4	26.2	25.8	25.4	24.9

Sector	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
General	28.6	24.8	21.6	19.8	18.5	17.1	16.1	15.3	14.5	13.5	13.0
230100-230210	24.1	23.3	22.3	21.3	20.3	19.3	18.3	17.5	16.8	15.9	15.1

Source: Winther and Nielsen (2006). Data for 2005 and later are extrapolations.

Table 21. Time series for variable emission factors for other mobile sources

Fuel	Component	1980-1990	1991	1992	1993	1994	1995	1996	1997-
V11 Gasoline	Dioxins	1.32	1.11	0.95	0.69	0.25	0.23	0.11	0.1

CH_4 - Stationary combustion

Table 22. General emission factors, kg CH_4/tonne fuel

Source	V01 Coal	V02 Coke	V03 Petrol coke	V41 Fuel wood	V42 Wood waste	V43 Black liquor	V44 Wood pellets	V45 Wood briquettes	V04 Charcoal	V31 Natural gas (1 000 Sm^3)	V33 Refinery gas
S.01 Direct-fired furnaces	0.0281	0.285	0.105	.	.	.	.	.	5.9	*0.1775*	0.0486
S.02 Gas turbines	.	.	.	.	.	.	.	.	.	0.91	.
S.03 Boilers	8.43	8.55	0.35	.	*0.1788*	0.0216	0.1901	*0.1703*	.	*0.1775*	0.0486
S.04 Small stoves	8.43	8.55	.	6.1463	.	.	5.184	.	6.0	.	.
S.1B2C Flares	.	.	.	.	.	.	.	.	.	0.24	0.28

	V34 CO gas	V36 Landfill gas	V35 Fuel gas	V32 LPG	V13 Kerosene (heating)	V17 Marine gas oil/ diesel	V18 Light fuel oils	V19 Heavy distillate	V20 Heavy fuel oil	V51 Municipal waste	V52 Special waste
S.01 Direct-fired furnaces	0.0067	.	0.05	.	.	*0.431*	.	*0.431*	*0.406*	.	1.218
S.02 Gas turbines	.	*0.251*	.	.	.	-	.	.	.	.	.
S.03 Boilers	*0.0067*	*0.251*	0.05	*0.2305*	*0.431*	*0.431*	*0.431*	*0.431*	*0.406*	0.345	1.218
S.04 Small stoves	.	.	.	0.2305	0.431	.	0.431	0.431	.	.	.
S.1B2C Flares	.	0.37	0.054.	.	.	.	.	.	.	.	.

Numbers in italics have exceptions for some sectors, see table 23.
Source: IPCC (2006), Sandgren *et al.* (1996), Karlsvik (1995) and The Norwegian oil industry association (1994).

Table 23. Exceptions from the general factors for CH_4, stationary combustion (kg CH_4/tonne fuel)

Emission factor	Fuel	Source	Sectors
0.1293	V13, V17, V18, V19	Kerosene (heating), marine diesel; light fuel oil, heavy distillate	S.01 Direct fired furnaces, S.03 Boilers	230500-233530
0.1218	V20	Heavy fuel oil	S.01 Direct fired furnaces, S.03 Boilers	230500-233530
0.0461	V32	LPG	S.03 Boilers	230500-233530
0.0403	V31	Natural gas (1000 Sm^3)	S.01 Direct fired furnaces. S.03 Boilers	230600.1- 230600.3, 230910, 234950
0.0355	V31	Natural gas (1000 Sm3)	S.01 Direct fired furnaces. S.03 Boilers	230500-233530
0	V34	CO gas	S.03 Boilers	231922
0.0502	V36	Landfill gas	S.02 Gas turbines, S.03 Boilers	230500-233530
0.4875	V42	Wood waste	S.03 Boilers	230500-233530
4.644	V45	Wood briquettes	S.03 Boilers	330000

N_2O - Stationary combustion

Table 24. General emission factors. kg N_2O/tonne fuel

Source	V01 Coal	V02 Coke	V03 Petrol coke	V41 Fuel wood	V42 Wood waste	V43 Black liquor	V44 Wood pellets	V45 Wood briquettes	V04 Char-coal	V31 Natural gas (1000 Sm^3)	V33 Refinery gas
S.01 Direct-fired furnaces	0.0422	0.0428	0.021	.	.	.	.	.	0.12	*0.0036*	0.0049
S.02 Gas turbines	.	.	.	.	.	.	.	.	.	*0.0036*	.
S.03 Boilers	0.0422	0.0428	0.021	.	0.065	0.0144	0.0691	0.0619	.	*0.0036*	0.0049
S.04 Small stoves	0.0422	0.0428	.	0.082	.	.	0.0691	.	0.03	.	.
S.1B2C Flares	.	.	.	.	.	.	.	.	.	0.02	0.024

	V34 Blast furnace gas	V36 Landfill gas	V35 Fuel gas	V32 LPG	V13 Kero-sene (heating)	V17 Marine gas oil/ diesel	V18 Light fuel oils	V19 Heavy distillate	V20 Heavy fuel oil	V51 Municipal waste	V52 Special waste
S.01 Direct-fired furnaces	0.0007	0.005	0.005	.	.	0.0259	.	0.0259	0.0244	.	0.1624
S.02 Gas turbines	.	0.005	.	.	.	0.0259	.	.	.	.	.
S.03 Boilers	0.0007	0.005	0.005	0.0046	0.0259	0.0259	0.0259	0.0259	0.0244	0.046	0.1624
S.04 Small stoves	.	.	.	0.0046	0.0259	.	0.0259	0.0259	.	.	.
S.1B2C Flares	.	0.0015	0.024	.	.	.	.	.	.	.	.

Numbers in italics have exceptions for some sectors, see table 25.
Source: IPCC (2006), Sandgren *et al.* (1996) and The Norwegian oil industry association (1994).

Table 25. Exceptions from the general factors for N_2O. Stationary combustion (kg N_2O/1000 Sm^3 natural gas)

Emission factor	Fuel		Source	Sectors
0.0040	V31	Natural gas	S.01 Direct-fired furnaces, S.02 Gas turbines, S.03 Boilers	230600.1-230600.3, 230910,234950

NO_X - Stationary combustion

Table 26. General emission factors. kg NO_X/tonne fuel

Source	V01 Coal	V02 Coke	V03 Petrol coke	V41 Fuel wood	V42 Wood waste	V43 Black liquor	V44 Wood pellets	V45 Wood bri-quettes	V04 Char-coal	V31 Natural gas (1000 Sm^3)	V33 Refinery gas
S.01 Direct-fired furnaces ..	16	20	20	.	.	.	.	.	2.68	*5.95*	5.4
S.02 Gas turbines ...	.	.	.	.	.	.	.	.	.	*6.27*	.
S.03 Boilers	*3*	*3*	3.4	.	0.9	0.9	1.3	1.3	.	2.55	*3*
S.04 Small stoves	*3*	*3*	.	**0.988**	.	.	1.1	.	1.4	.	.
S.1B2C Flares	.	.	.	.	.	.	.	.	.	12	7

	V34 Blast furnace gas	V36 Landfill gas	V35 Fuel gas	V32 LPG	V13 Kerosene (heating)	V17 Marine gas oil/ diesel	V18 Light fuel oils	V19 Heavy distillate	V20 Heavy fuel oil	V51 Municipal waste	V52 Special waste
S.01 Direct-fired furnaces	5.4	.	5.4	.	.	70	.	*5*	*5*	.	5
S.02 Gas turbines	.	.	.	.	.	16	.	.	.	.	.
S.03 Boilers	*3*	0.01	*3*	2.3	3	*2.5*	*2.5*	*2.5*	*4.2*	1.365	*4.2*
S.04 Small stoves	.	.	.	2.3	2.5	.	2.5	2.5	.	.	.
S.1B2C Flares	.	0.17	.	.	.	.	.	.	.	.	.

Numbers in italics have exceptions for some sectors, see table 27, and bold numbers are different for different years, see table 28.
Source: Rosland (1987). Fuel wood factor based on data from annual surveys on use of fuel wood in households.

Table 27. Exceptions from the general factors for NO_X. Stationary combustion. kg NO_X /tonne fuel

Emission factor	Fuel	Source	Sectors
24	V19, 20, 52 Heavy distillate, heavy fuel oil, special waste	S.01 Direct-fired furnaces	231910.2, 232350
6.13	V31 Natural gas (1000 Sm^3)	S.01 Direct-fired furnaces	232014
9.5	V19, 20 Heavy distillate, heavy fuel oil	S.01 Direct-fired furnaces	232360
8.681	V31 Natural gas (1000 Sm^3)	S.02 Gas turbines	230600.1
1,4	V31 Natural gas (1000 Sm^3)	S.1B2C Flares	230600.1
3	V17, 18, 19 Fuel oils	S.03 Boilers	230500-233320
4.5	V01 Coal	S.03 Boilers	230500-233320
3.4	V02 Coke	S.03 Boilers	230500-233320
5	V20, 52 Heavy fuel oil, special waste	S.03 Boilers	230500-233320
2.9	V35 Fuel gas	S.03 Boilers	232011-232050, 232411-232442
0.01	V34 CO gas	S.03 Boilers	233510-233530
6.27	V33 Refinery gas	S.02 Gas turbines	233511
1.4	V01, 02 Coal, coke	S.04 Small stoves	330000

Table 28. Time series for variable emission factors for NO_X. Stationary combustion. kg NO_X /tonne fuel

Sector	Source	Fuel	1980-1990	1991	1992-1994	1995	1996-1998	1999-2004	2005	2006	2007	2008	2009	2010
General	S.04	V41	0.982	0.981	0.982	0.981	0.982	0.981	0.985	0.984	0.987	0.988	0.987	0.988

Sector	Source	Fuel	2011	2012	2013	2014	2015
General	S.04	V41	0.986	0.985	0.988	0.989	0.988

Sector	Source	Fuel	1980-1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000-
230600.1	S.02	V31	8.223	8.172	8.234	8.444	8.617	8.874	9.128	9.185	9.528	9.087	8.681

NMVOC - Stationary combustion

Table 29. General emission factors. kg NMVOC/tonne fuel

Source	V01 Coal	V02 Coke	V03 Petrol coke	V41 Fuel wood	V42 Wood waste	V43 Black liquor	V44 Wood pellets	V45 Wood bri-quettes	V04 Char coal	V31 Natural gas (1000 Sm^3)	V33 Re finery gas
S.01 Direct-fired furnaces	0	0	0	.	.	.	.	.	8.85	*0*	0.1
S.02 Gas turbines	.	.	.	.	.	.	.	.	.	0.24	.
S.03 Boilers	*1.1*	0.6	0.6		*1.30*		1.3	1.3	.	0.085	0.1
S.04 Small stoves	*1.1*	0.6	.	7.0	.	.	6.501	.	10	.	.
S.1B2C Flares .	.	.	.	.	.	.	.	.	.	0.06	13.5

	V34 CO gas	V36 Landfill gas	V35 Fuel gas	V32 LPG	V13 Kero sene (heating)	V17 Marine gas oil/ diesel	V18 Light fuel oils	V19 Heavy distillate	V20 Heavy fuel oil	V51 Munici-pal waste	V52 Special waste
S.01 Direct-fired furnaces	*0*	.	*0*	.	.	5	.	*0.3*	*0.3*	.	*0.3*
S.02 Gas turbines	.	.	.	.	.	0.03	.	.	.	.	.
S.03 Boilers	*0.1*	0	*0.1*	*0.1*	0.4	*0.4*	*0.4*	*0.4*	0.3	0.7	0.3
S.04 Small stoves	.	.	.	0.1	*0.4*	.	0.4	0.4	.	.	
S.1B2C Flares	.	0	.	.	.	.	.	.	.	.	.

Numbers in italics have exceptions for some sectors, see table 30.
Source: Rosland (1987) and Sandgren *et al.* (1996).

Table 30. Exceptions from the general factors for NMVOC. Stationary combustion. kg NMVOC/tonne fuel

Emission factor	Fuel		Source	Sectors
0	V 19, 20, 52	Heavy distillate, heavy fuel oil, special waste	S.01 Direct-fired furnaces	231910.2, 232350
0.1	V34	CO gas	S.01 Direct-fired furnaces	231910.2
0.085034	V31	Natural gas (1000 Sm^3)	S.01 Direct-fired furnaces	232014
0.9	V19, 20	Heavy distillate, heavy fuel oil	S.01 Direct-fired furnaces	232360
0.8	V01	Coal	S.03 Boilers	230500-233320
0	V32, 34, 35, 42	LPG, CO gas, fuel gas, wood waste	S.03 Boilers	230500-233320, 231711, 232011-232050, 233510-233530
0.6	V17, 18, 19	Fuel oils	S.03 Boilers	330000
10	V01	Coal	S.04 Small stoves	330000
0.6	V13	Kerosene (heating)	S.04 Small stoves	330000

CO - Stationary combustion

Table 31. General emission factors. kg CO/tonne fuel

Source	V01 Coal	V02 Coke	V03 Petrol coke	V41 Fuel wood	V42 Wood waste	V43 Black liquor	V44 Wood pellets	V45 Wood briquettes	V04 Char coal	V31 Natural gas (1000 Sm^3)	V33 Re finery gas
S.01 Direct-fired furnaces	0	26.16	0	.	.	.	.	.	16.82.	0	0
S.02 Gas turbines	.	.	.	.	.	.	.	.	.	1.7	.
S.03 Boilers	3	26.16	3	.	*15*	0	15	15	.	0	0
S.04 Small stoves	3	26.16	.	**93.4**	.	.	2.6	.	100	.	.
S.1B2C Flares	.	.	.	.	.	.	.	.	.	*1.5*	*0*

	V34 CO gas	V36 Landfill gas	V35 Fuel gas	V32 LPG	V13 Kero sene (heating)	V17 Marine gas oil/ diesel	V18 Light fuel oils	V19 Heavy distillate	V20 Heavy fuel oil	V51 Municipal waste	V52 Special waste
S.01 Direct-fired furnaces	*0*	.	*0*	.	.	5	.	*0.2*	*0.2*	.	*0.2*
S.02 Gas turbines	.	.	.	.	.	0.7	.	.	.	.	.
S.03 Boilers	0	0	0	*0.5*	2	*2*	2	2	*0.4*	2.8	*0.4*
S.04 Small stoves	.	.	.	0.5	*2*	.	2	2	.	.	.
S.1B2C Flares	.	0.04	.	.	.	.	.	.	.	.	.

Numbers in italics have exceptions for some sectors, see table 32, and bold numbers are different for different years, see table 33.

Table 32. Exceptions from the general factors for CO. Stationary combustion. kg CO/tonne fuel

Emission factor	Fuel		Source	Sectors
0	V 19, 20, 52	Heavy distillate, heavy fuel oil, special waste	S.01 Direct-fired furnaces	231910.2, 232350, 232360
0.01	V34	CO gas	S.01 Direct-fired furnaces	231910.2
0.2	V20. 52	Heavy fuel oil, special waste	S.03 Boilers	230500-233320
0	V32, 42	LPG, wood waste	S.03 Boilers	230500-233320, 231711
6.5	V17, 18, 19	Fuel oils	S.03 Boilers	330000
100	V01, 02	Coal, coke	S.04 Small stoves	330000
6.5	V13	Kerosene (heating)	S.04 Small stoves	330000
1.7	V31	Natural gas (1000 Sm^3)	S.1B2C Flares	231922

Table 33. Time series for variable emission factors for CO. Stationary combustion. kg CO/tonne fuel

Sector	Source	Fuel	1980-1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
General	S.04	V41	149.1	148.4	146.3	142.6	137.6	131.0	122.2	111.5	115.5	111.9	110.6	107.9	105.0

Sector	Source	Fuel	2010	2011	2012	2013	2014	2015
General	S.04	V41	103.3	101.2	99.2	96.1	96.7	93.4

NH_3 - Stationary combustion

Table 34. General emission factors. kg NH_3/tonne fuel

Source	V01 Coal	V02 Coke	V03 Petrol coke	V41 Fuel wood	V42 Wood waste	V43 Black liquor	V44 Wood pellets	V45 Wood bri-quettes	V04 Char-coal	V31 Natural gas (1000 Sm^3)	V33 Re-finery gas	V34 CO gas	V36 Land-fill gas	V35 Fuel gas	V32 LPG	V13 Kero-sene (heating)	V17 Marine gas oil/ diesel	V18 Light fuel oils	V19 Heavy dis-tillate	V20 Heavy fuel oil	V51 Munici-pal waste	V52 Special waste
S.04 Small stoves	.	.	.	0.066	.	.	0.066	.	0	.	.	.	.	.	.	.	.	.	.	.	.	.
All other sources	0	0	0	.	0	0	0	0	1.09	0	0	0	0	0	0	0	0	0	0	0	0	0

Particulate matter - Stationary combustion

Table 35. General emission factors. kg particle component/tonne fuel

Com-ponent	Source	V01 Coal	V02 Coke	V03 Petrol coke	V41 Fuel wood	V42 Wood waste	V43 Black liquor	V44 Wood pellets	V45 Wood briquettes	V04 Char coal	V31 Natural gas (1000 Sm^3)	V33 Refinery gas
TSP	S.01 Direct-fired furnaces	*1.6*	1.6	1.6	.	.	.	.	.	4.43.	0.122	0.144
TSP	S.02 Gas turbines	.	.	.	.	.	.	.	.	.	0.122	.
TSP	S.03 Boilers	*1.6*	1.6	1.6	.	2.69	0	2.69	2.69	.	0.122	0.144
TSP	S.04 Small stoves	4.2	2.85	3.5	**17.16**	.	.	1.1	.	2.4	.	.
TSP	S.1B2C Flares	.	.	.	.	.	.	.	.	.	0.002	0.144
PM_{10}	S.01 Direct-fired furnaces	*1.14*	1.14	1.14	.	.	.	.	.	4.22	0.122	0.144
PM_{10}	S.02 Gas turbines	.	.	.	.	.	.	.	.	.	0.122	.
PM_{10}	S.03 Boilers	*1.14*	1.14	1.14	.	2.52	0	2.52	2.52	.	0.122	0.144
PM_{10}	S.04 Small stoves	2.8	1.71	2.1	**16.82**	.	.	1.1	.	2.4	.	.
PM_{10}	S.1B2C Flares	.	.	.	.	.	.	.	.	.	0.002	0.144
$PM_{2.5}$	S.01 Direct-fired furnaces	*0.82*	0.82	0.82	.	.	.	.	.	4.13	0.122	0.144
$PM_{2.5}$	S.02 Gas turbines	.	.	.	.	.	.	.	.	.	0.122	.
$PM_{2.5}$	S.03 Boilers	*0.82*	0.82	0.82	.	*2,52*	0	2.52	2.52	.	0.122	0.144
$PM_{2.5}$	S.04 Small stoves	0.86	0.86	1.5	**16.31**	.	.	1.1	.	2.4	.	.
$PM_{2.5}$	S.1B2C Flares	.	.	.	.	.	.	.	.	.	0.002	0.144

Com-ponent	Source	V34 CO gas	V36 Landfill gas	V35 Fuel gas	V32 LPG	V13 Kerosene (heating)	V17 Marine gas oil/ diesel	V18 Light fuel oils	V19 Heavy distillate	V20 Heavy fuel oil	V51 Municipal waste	V52 Special waste
TSP	S.01 Direct-fired furnaces	0.144	.	0.144	.	.	0.286	.	*	*	.	*5.68*
TSP	S.02 Gas turbines	.	.	.	.	.	0.286	.	.	.	.	.
TSP	S.03 Boilers	0.144	0.144	0.144	0.136	0.296	0.286	0.286	*	*	*0.05*	*5.68*
TSP	S.04 Small stoves	.	.	.	0.136	*0.3*	.	0.3	.	.	.	.
TSP	S.1B2C Flares	.	0.144	.	.	.	.	.	.	.	.	.
PM_{10}	S.01 Direct-fired furnaces	0.144	.	0.144	.	.	0.143	.	*	*	.	*4.87*
PM_{10}	S.02 Gas turbines	.	.	.	.	.	0.143	.	.	.	.	.
PM_{10}	S.03	0.144	0.144	0.144	0.136	0.148	0.143	*0.15*	*	*	*0.05*	*4.87*

	Boilers											
PM_{10}	S.04 Small stoves	.	.	.	0.136	0.16	.	0.155	.	.	.	.
PM_{10}	S.1B2C Flares	.	0.144	.	.	.	.	.	.	.	.	.
$PM_{2.5}$	S.01 Direct-fired furnaces	0.144	.	0.144	.	.	0.036	.	*	*	.	*3.2*
$PM_{2.5}$	S.02 Gas turbines	.	.	.	.	.	0.036	.	.	.	.	.
$PM_{2.5}$	S.03 Boilers	0.144	0.144	0.144	0.136	0.037	*0.12*	*0.12*	*	*	*0.05*	*3.2*
$PM_{2.5}$	S.04 Small stoves	.	.	.	0.136	*0.12*	.	0.119	.	.	.	.
$PM_{2.5}$	S.1B2C Flares	.	0.144	.	.	.	.	.	.	.	.	.

Numbers in italics have exceptions for some sectors, see table 37, and bold numbers are different for different years, see table 38.

* General emission factors for all sources for heavy distillate and heavy fuel oil are given in table 36 for all years.

Source: Finstad *et al*. (2003). Fuel wood factor based on data from annual surveys on use of fuel wood in households

Table 36. General particle emission factors for heavy distillate and heavy fuel oil for all sources. Factors dependent on sulphur content. kg particle component /tonne fuel

Fuel	Com-po-nent	1990	1991	1992	1993	1994	1995	1996-1997	1998	1999	2000-
	TSP	0.803	0.714	0.701	0.701	0.688	0.714	0.663	0.688	0.701	0.714
	PM_{10}	0.690	0.614	0.603	0.603	0.592	0.614	0.570	0.592	0.603	0.614
V19	$PM_{2.5}$	0.450	0.400	0.393	0.393	0.385	0.400	0.371	0.385	0.393	0.400
	TSP	1.350	1.339	1.316	1.304	1.190	1.053	1.098	1.087	1.110	1.201
	PM_{10}	1.161	1.151	1.131	1.121	1.023	0.905	0.944	0.934	0.954	1.033
V20	$PM_{2.5}$	0.761	0.754	0.741	0.735	0.671	0.593	0.619	0.613	0.625	0.677

Source: Finstad *et al*. (2003).

Table 37. Exceptions from the general factors for particles. Stationary combustion

Emission factor (kg TSP/tonne)	Emission factor (kg PM_{10}/tonne)	Emission factor (kg $PM_{2.5}$/tonne)	Fuel		Source	Sectors
4.06	2.4	1.4	V52	Special waste	S.01 Direct-fired furnaces	230500-233320
5.45	3.54	1.45	V01	Coal	S.01 Direct-fired furnaces	233530
4.2	2.8	0.86	V01	Coal	S.03 Boilers	230100
.	0.143 (V18)	0.036 (V17, 18)	V17, 18	Light fuel oils	S.03 Boilers	230500-233320
4.06	2.4	1.4	V52	Special waste	S.03 Boilers	230500-233320
5.45	3.54	1.45	V01	Coal	S.03 Boilers	233530
0.5	0.5	0.5	V51	Municipal waste	S.03 Boilers	253800
0.3	0.155	0.119	V13	Kerosene (heating)	S.04 Small stoves	330000

Table 38. Time series for variable emission factors for particles. Stationary combustion. kg particle component /tonne fuel

Component	Source	Fuel	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
TSP	S.04	V41	22.24	22.24	22.24	22.25	22.26	22.25	22.26	22.27	22.24	22.05	21.68	21.22
PM_{10}	S.04	V41	21.80	21.80	21.80	21.80	21.81	21.81	21.81	21.83	21.79	21.61	21.25	20.79
$PM_{2.5}$	S.04	V41	21.13	21.13	21.13	21.14	21.15	21.14	21.15	21.16	21.12	20.95	20.60	20.16

Component	Source	Fuel	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
TSP	S.04	V41	20.62	19.82	18.85	19.10	18.80	18.66	18.41	18.16	17.96	17.78	17.65	17.33
PM_{10}	S.04	V41	20.21	19.42	18.47	18.72	18.42	18.29	18.04	17.79	17.60	17.43	17.29	16.98
$PM_{2.5}$	S.04	V41	19.59	18.83	17.91	18.15	17.86	17.73	17.49	17.25	17.06	16.89	16.77	16.46

Component	Source	Fuel	2014	2015
TSP	S.04	V41	17.35	17.16
PM_{10}	S.04	V41	17.00	16.82
$PM_{2.5}$	S.04	V41	16.48	16.31

POPs (Persistent Organic Pollutants) - Stationary combustion

Table 39. General emission factors for PAH

Compo-nent	Source	V01 Coal	V02 Coke	V03 Petrol coke	V41 Fuel wood	V42 Wood waste	V43 Black liquor	V44 Wood pellets	V45 Wood briquettes	V04 Charcoal	V31 Natural gas (1000 Sm^3)	V33 Refinery gas
benzo(a) pyrene g/tonne ..	S.01 Direct-fired furnaces	0.00002	0.00002	0.00002	.	.	.	.	.	0.007	0.00002	0.00003
benzo(a) pyrene g/tonne ..	S.02 Gas turbines	.	.	.	.	.	.	.	.	.	0.00002	.
benzo(a) pyrene g/tonne ..	S.03 Boilers	0.007	0.007	0.007	.	0.0001	0.0001	0.0001	0.0001	.	0.00002	0.00003
benzo(a) pyrene g/tonne ..	S.04 Small stoves	2.81	2.85	3.5	**0.312**	.	.	2.091	2.091.	3.5695	.	.
benzo(b) fluoranthene g/tonne ..	S.01 Direct-fired furnaces	0.001	0.001	0.001	.	.	.	.	.	0.010	0.00003	0.00004
benzo(b) fluoranthene g/tonne ..	S.02 Gas turbines	.	.	.	.	.	.	.	.	.	0.00003	.
benzo(b) fluoranthene g/tonne ..	S.03 Boilers	0.010	0.010	0.010	.	0.0075	0.0075	0.0075	0.0075	.	0.00003	0.00004
benzo(b) fluoranthene g/tonne ..	S.04 Small stoves	4.777	4.845	5.95	**0.492**	.	.	1.918	1.918	3.2745	.	.
benzo(k) fluoranthene g/tonne ..	S.01 Direct-fired furnaces	0.0008	0.0008	0.001	.	.	.	.	.	**0.**004	0.00003	0.00004
benzo(k) fluoranthene g/tonne ..	S.02 Gas turbines	.	.	.	.	.	.	.	.	.	0.00003	.
benzo(k) fluoranthene g/tonne ..	S.03 Boilers	**0.**004	**0.**004	**0.**004	.	0.0075	0.0075	0.0075	0.0075	.	0.00003	0.00004
benzo(k) fluoranthene g/tonne ..	S.04 Small stoves	3.653	2.85	3.5	**0.115**	.	.	0.726	0.726.	1.239	.	.
indeno(1,2,3_cd) pyrene g/tonne ..	S.01 Direct-fired furnaces	0.00003	0.00003	0.00004	.	.	.	.	.	0.003	0.00003	0.00004
indeno(1,2,3_cd) pyrene g/tonne ..	S.02 Gas turbines	.	.	.	.	.	.	.	.	.	0.00003	.
indeno(1,2,3_cd) pyrene g/tonne ..	S.03 Boilers	0.003	0.003	0.003	.	0.0002	0.0002	0.0002	0.0002	.	0.00003	0.00004
indeno(1,2,3_cd) pyrene g/tonne ..	S.04 Small stoves	2.248	2.28	2.8	**0.225**	.	.	1.227	1.227.	2.0945	.	.

Table 39 (cont.). General emission factors for PAH

Component	Source	V34 Blast furnace gas	V36 Landfill gas	V35 Fuel gas	V32 LPG	V13 Kero-sene (heating)	V17 Marine gas oil/ diesel	V18 Light fuel oils	V19 Heavy distillate	V20 Heavy fuel oil	V51 Municipal waste[1]	V52 Special waste
benzo(a) pyrene g/tonne ..	S.01 Direct-fired furnaces	0.00001	.	0.00004	.	.	NE	.	NE	NE	.	0.077
benzo(a) pyrene g/tonne ..	S.02 Gas turbines	.	0.00003	.	.	.	NE	.	.	.	.	.
benzo(a) pyrene g/tonne ..	S.03 Boilers	0.00001	0.00003	0.00004	2.5816E-08	0.00002	NE	0.00002	NE	NE	0.00001	0.077
benzo(a) pyrene g/tonne ..	S.04 Small stoves	.	.	.	2.5816E-08	0.003	.	0.003	.	.	.	.
benzo(b)f luoranthe ne g/tonne ..	S.01 Direct-fired furnaces	0.00003	.	0.00015	.	.	0.00019	.	0.00019	0.00018	.	0.609
benzo(b)f luoranthe ne g/tonne ..	S.02 Gas turbines	.	0.00004	.	.	.	0.00019	.	.	.	.	.
benzo(b)f luoranthe ne g/tonne ..	S.03 Boilers	0.00001	0.00004	0.00015	3.8724E-08	0.00001	0.00003	0.00001	0.00019	0.00018	0.00002	0.609
benzo(b)f luoranthe ne g/tonne ..	S.04 Small stoves	.	.	.	3.8724E-08	0.002	.	0.002	.	.	.	.
benzo(k)f luoranthe ne g/tonne ..	S.01 Direct-fired furnaces	0.00001	.	0.00006	.	.	0.00019	.	0.00019	0.00018	.	0.069
benzo(k)f luoranthe ne g/tonne ..	S.02 Gas turbines	.	0.00004	.	.	.	0.00019	.	.	.	.	.
benzo(k)f luoranthe ne g/tonne ..	S.03 Boilers	0.00001	0.00004	0.00006	3.8724E-08	0.00002	0.00003	0.00002	0.00019	0.00018	0.00001	0.069
benzo(k)f luoranthe ne g/tonne ..	S.04 Small stoves	.	.	.	3.8724E-08	0.003	.	0.003	.	.	.	.
indeno(1, 2,3_cd)p yrene g/tonne ..	S.01 Direct-fired furnaces	0.00001	.	0.00005	.	.	0.0003	.	0.00030	0.00028	.	0.061
indeno(1, 2,3_cd)p yrene g/tonne ..	S.02 Gas turbines	.	0.00004	.	.	.	0.0003	.	.	.	.	.
indeno(1, 2,3_cd)p yrene g/tonne ..	S.03 Boilers	0.00001	0.00004	0.00005	3.8724E-08	0.00005	0.00004	0.00005	0.00030	0.00028	0.00001	0.061
indeno(1, 2,3_cd)p yrene g/tonne ..	S.04 Small stoves	.	.	.	3.8724E-08	0.007	.	0.007	.	.	.	.

Bold numbers are different for different years, see table 40. NE = Not estimated. [1]Emission factor used for the years after 1995. Emission factors for the years 1990 to 1994 can be given on request.

Source: Finstad *et al*. (2001). Fuel wood factor based on data from annual surveys on use of fuel wood in households. EEA (2013), EEA (2016), . Allerup et. al (2015)

Table 40. Time series for variable emission factors for PAH[1]. Stationary combustion (g component /tonne fuel)

Component	Source	Fuel	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
benzo(a)pyrene	S.04	V41	0.74	0.74	0.74	0.74	0.74	0.74	0.74	0.74	0.74	0.72	0.69	0.66
benzo(b)fluoranthene	S.04	V41	1.17	1.17	1.17	1.17	1.17	1.17	1.17	1.17	1.16	1.13	1.09	1.03
benzo(k)fluoranthene	S.04	V41	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.27	0.26	0.25	0.24
indeno(1,2,3_cd)pyrene	S.04	V41	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.52	0.50	0.47

			2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
benzo(a)pyrene	S.04	V41	0.61	0.54	0.46	0.50	0.47	0.46	0.44	0.42	0.41	0.39	0.38	0.36
benzo(b)fluoranthene	S.04	V41	0.96	0.85	0.73	0.78	0.74	0.73	0.70	0.66	0.64	0.62	0.59	0.59
benzo(k)fluoranthene	S.04	V41	0.22	0.20	0.17	0.18	0.17	0.17	0.16	0.15	0.15	0.14	0.14	0.13
indeno(1,2,3_cd)pyrene	S.04	V41	0.44	0.39	0.33	0.36	0.34	0.33	0.32	0.30	0.29	0.28	0.27	0.26

			2014	2015
benzo(a)pyrene	S.04	V41	0.36	0.31
benzo(b)fluoranthene	S.04	V41	0.57	0.49
benzo(k)fluoranthene	S.04	V41	0.13	0.12
indeno(1,2,3_cd)pyrene	S.04	V41	0.26	0.23

Source: Emission factor: Finstad et al. (2001). PAH-profile: EEA (2013)

POPs (Persistent Organic Pollutants) - Stationary combustion

Table 41. General emission factors for dioxins

Com-ponent	Source	V01 Coal	V02 Coke	V03 Petrol coke	V41 Fuel wood	V42 Wood waste	V43 Black liquor	V44 Wood pellets	V45 Wood bri-quettes	V04 Char-coal	V31 Natural gas (1000 Sm^3)	V33 Refinery gas
Dioxins µg I-TEQ/tonne	S.01 Direct-fired furnaces	1.6	1.6	1.6	.	.	.	.	.	2.95.	0.05	0
Dioxins µg I-TEQ /tonne	S.02 Gas turbines	.	.	.	.	.	.	.	.	.	0.05	.
Dioxins µg I-TEQ /tonne	S.03 Boilers	1.6	1.6	1.6	.	1	1	1	1	.	0.05	0
Dioxins µg I-TEQ /tonne	S.04 Small stoves	10	10	10	5.9	.	.	5.9	.	10	.	.
Dioxins µg I-TEQ /tonne	S.1B2C Flares	.	.	.	.	.	.	.	.	.	0.05	0

		V34 CO gas	V36 Landfill gas	V35 Fuel gas	V32 LPG	V13 Kero-sene (heating)	V17 Marine gas oil/ diesel	V18 Light fuel oils	V19 Heavy distillate	V20 Heavy fuel oil	V51 Munici-pal waste	V52 Special waste
Dioxins µg I-TEQ /tonne	S.01 Direct-fired furnaces	0	.	0	.	.	4	.	0.1	0.1	.	4
Dioxins µg I-TEQ /tonne	S.02 Gas turbines	.	.	.	.	.	4	.	.	.	.	.
Dioxins µg I-TEQ /tonne	S.03 Boilers	0	0	1	*0.06*	0.1	0.1	*0.1*	*0.1*	*0.1*	0.02	4
Dioxins µg I-TEQ /tonne	S.04 Small stoves	.	.	.	0.06	0.06	.	0.2	.	.	.	.
Dioxins µg I-TEQ /tonne	S.1B2C Flares	.	0	.	.	.	.	.	.	.	.	.

Numbers in italics have exceptions for some sectors, see table 42.
Source: Finstad *et al*. (2002).

Table 42. Exceptions from the general factors for POPs. Stationary combustion

Emission factor (ug dioxin/tonne)	Fuel		Source	Sectors
0.2	V18, 19	Heavy distillate, heavy fuel oil	S.03 Boilers	330000

References

Allerup, J. Eklund, V., Szudy, M. and Viklund, L. (2015) *Utveckling av rapportering till CLRTAP NFR 1A och 5 map EMEP Guidebook 2013, steg 2*. SMED Rapport, ISSN 1653-8102. Stockholm: Swedish Environmental Protection Agency

Bang, J. (1996): *Utslipp av NMVOC fra fritidsbåter og bensindrevne motorredskaper (Emissions of NMVOC from leisure craft and gasoline-powered equipment)*, Oslo: National institute of technology

Bang, J., Flugsrud, K., Haakonsen, G., Holtskog, S., Larssen, S., Maldum, K.O., Rypdal, K. and Skedsmo, A. (1999): *Utslipp fra veitrafikk i Norge. Dokumentasjon av beregningsmetode, data og resultater (Emissions from road traffic in Norway - Method for estimation, input data and emission estimates)*, Report 99:04, Oslo: Norwegian pollution control authority

Bremnes Nielsen, J. and Stenersen, D. (2009): *Analysis of NOx emission factor for ships, 2009*, MT22 F09-150, Marintek

EEA (2013): *EMEP-EEA air pollutant emission inventory guidebook.* http://www.eea.europa.eu/publications/emep-eea-guidebook-2013

EEA (2016): *EMEP-EEA air pollutant emission inventory guidebook.* http://www.eea.europa.eu/publications/emep-eea-guidebook-2016

Finstad, A., Haakonsen, G., Kvingedal, E. and Rypdal, K. (2001): *Utslipp til luft av noen miljøgifter i Norge - Dokumentasjon av metode og resultater (Emissions of some hazardous chemicals to air in Norway - Documentation of methodology and results)*, Report 2001/17, Statistics Norway
http://www.ssb.no/emner/01/04/10/rapp_200117/rapp_200117.pdf

Finstad, A., Haakonsen, G. and Rypdal, K. (2002): *Utslipp til luft av dioksiner i Norge - Dokumentasjon av metode og resultater (Emissions to air of dioxins in Norway - Documentation of methodology and results)*, Report 2002/7, Statistics Norway
http://www.ssb.no/emner/01/04/10/rapp_200207/rapp_200207.pdf

Finstad, A. and Rypdal, K. (2003): *Utslipp til luft av kobber, krom og arsen i Norge - Dokumentasjon av metode og resultater (Emissions to air of copper, chromium and arsenic in Norway - Documentation of methodology and results)*, Report 2003/7, Statistics Norway
http://www.ssb.no/emner/01/04/10/rapp_200307/rapp_200307.pdf

Flugsrud, K. and Rypdal, K. (1996): *Utslipp til luft fra innenriks sjøfart, fiske og annen sjøtrafikk mellom norske havner (Emissions to air from domestic shipping, fisheries and other maritime traffic between Norwegian ports)*, Report 96/17, Statistics Norway
http://www.ssb.no/emner/01/04/rapp_9617/rapp_9617.pdf

Flugsrud, K., Hoem, B. and Aasestad, K. (2010): *Utslipp til luft av NO_x fra innenriks sjøfart og fiske (NO_x emissions to air from domestic navigation and fishing)*, Report 40/2010, Statistics Norway
http://www.ssb.no/emner/01/04/10/rapp_201040/rapp_201040.pdf

INFRAS (2009): *Handbook emission factors for road transport (HBEFA)* http://www.hbefa.net/

IPCC (2006): *2006 IPCC guidelines for national greenhouse gas inventories*, Institute for Global Environmental Strategies (IGES)

Karlsson, M.L., Wallin, P.A. and Gustavsson, L. (1992): *Emissioner från biobrensle-eldade anläggningar mellan 0,5 och 10 MW (Emissions from biofuel plants between 0,5 and 10 MW)*, SP report 1992:46, Borås: Swedish national testing and research institute.

Karlsvik, E. (1995): *Round robin test of a wood stove-emissions*, Report STF12 F95012, Trondheim: SINTEF

Norwegian institute for air research and Norwegian institute for water research (1995): *Materialstrømsanalyse av PAH, 1995 (Material flow analysis of PAHs, 1995)*, Report O-92108, Kjeller and Oslo: NILU/NIVA

The Norwegian oil industry association (1994): *Anbefalte retningslinjer for utslippsberegning. Identifisering, kvantifisering og rapportering av forbruks- og utslippsdata fra aktiviteter i norsk oljevirksomhet (Recommended guidelines for emission calculations. Identification, quantification and reporting of data on consumption and emissions from activities in the Norwegian oil and gas sector)*, Stavanger: The Norwegian oil industry association

Norwegian pollution control authority (1990): *Klimagassregnskap for Norge. Beskrivelse av utslippsmengder, drivhusstyrke og utslippsfaktorer. Bidrag til den interdepartementale klimautredningen (Greenhouse gas inventory for Norway. Emission figures, global warming potentials and emission factors. Contribution to the interministerial climate report)*, Report 1990, Oslo: Norwegian pollution control authority

Rosland, A. (1987): *Utslippskoeffesienter. Oversikt over koeffesienter for utslipp til luft og metoder for å beregne disse (Emission factors. Overview of factors for emissions to air and methods of calculating)*, Report 15.08.1987, Oslo: Norwegian pollution control authority

Sandgren, J., Heie, A. and Sverud, T. (1996): *Utslipp ved håndtering av kommunalt avfall (Emissions from municipal waste management)*, Report 96:16, Oslo: Norwegian pollution control authority

Tornsjø, B. (2001): *Utslipp til luft fra innenriks sjøfart, fiske og annen sjøtrafikk mellom norske havner (Emissions to air from fishing fleet and sea traffic between Norwegian harbours)*, Report 2001/6, Oslo: Statistics Norway

Winther, M. and Nielsen, O.-K. (2006): *Fuel use and emissions from non-road machinery in Denmark from 1985-2004 - and projections from 2005-2030*, Environmental project no. 1092 2006, National environmental research institute, Danish ministry of the environment

Aarhus University (2016): Annual Danish Informative Inventory Report to UNECE, Scientific Report from DCE – Danish Centre for Environment and Energy No. 183, http://dce2.au.dk/pub/SR183.pdf