

Emission factors used in the estimations of emissions from combustion

In the calculations the numbers are used with the highest available accuracy. In these tables though, they are only shown rounded off. Factors from latest year means the latest statistical year.

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

Statistical year: 2023

Last update: November 2024

CO₂, SO₂ and heavy metals - Stationary and mobile combustion

Tabell 1 General emission factors for CO₂, SO₂ and heavy metals

	CO ₂	SO ₂ ¹	Pb	Cd	Hg	As	Cr	Cu
	tonne/tonne ²	kg/tonne ²	g/tonne ²	g/tonne ²	g/tonne ²	g/tonne ²	g/tonne ²	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	0.0094	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	0.348	0.07	0.01	0.03	0.05	0.04	0.05
Jet kerosene	3.15	0.284	0.07	0.01	0.03	0.05	0.05	0.05
Diesel	3.17 ⁵	0.0152 ⁶	0.1	0.01	0.0023	0.05	0.05	1.7
Marine gas oil/diesel	3.17	1.144	0.1	0.01	0.05	0.05	0.04	0.05
Light fuel oils/biofuel oils	3.17	0.942	0.1	0.01	0.05	0.05	0.04	0.05
Heavy distillate	3.17	4.4256	0.1	0.01	0.05	0.05	0.04	0.05
Heavy fuel oil	3.2	18.26 ⁷	1	0.1	0.2	0.057	1.35	0.53
Bio ethanol ¹⁰	1.91	0.0092	0.03	0.01	0.01	0.05	0.05	1.7
Bio diesel ¹⁰	2.85	0.0148	0.1	0.01	0	0.05	0.05	1.7
Bio Jet kerosene ¹⁰	3.15	0.278	0.07	0.01	0.03	0.05	0.05	0.05
Natural gas (1000 Sm ³)	1.99/2.04/2.34 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
Petrol coke gas	0	0	0	0	0	0.0038	0.021	0.016
Fuel wood	0	0.348	0.487	0.16	0.0025	0.00036	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	0.592 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 Petroleum products: Factors last year, The factors change yearly, in accordance with changes in the sulphur content in the products.

² Natural gas: 1000 Sm³.

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 Bio ethanol and bio diesel are established as separate products

⁶ Applies to road traffic.

⁷ Stationary combustions

⁸ Respectively dry gas (domestic use) and rich gas (continental shelf)

⁹ The factor increases through the period from 0.4874 in 1990 to 0.592 in 2018. The factor is constant after 2018.

¹⁰ CO₂ emission from biofuels are set to 0 in the statistics Emissions to air. They are included in international reports.

¹¹ Factor for SO₂ is used for newer wood stoves (1998 or newer) and open fireplaces. For older wood stoves (S.05) a value of 0.33669 is used, and for gas turbines (S.02) a value of 0.2 is used.

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	Cd	Hg	As	Cr	Cu
	g/tonne	g/tonne	g/tonne	g/tonne	g/tonne	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 SO₂ (kg/tonne)

	V11 Motor gasoline /V23 Bio ethanol	V13 Kerosene (heating)	V14 JetKerosene /V26 Bio-jet kerosene	V15 Diesel/ V24, V27 Bio diesel/ V25 fossil part of bio diesel				V17 Marine gas oil/diesel , B17 Marine gas oil bio	V18 Light fuel oils/ V28 Bio 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
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	0.117	0.117	0.117	1.8	1.8	4.6	14.4	31
2001	0.18	0.46	0.46	0.8	0.089	0.089	0.089	1.8	1.8	4.8	13.2	44.4
2002	0.2	0.32	0.32	0.6	0.071	0.071	0.071	1.6	1.2	4.8	12	43.8
2003	0.1	0.3	0.3	0.8	0.075	0.075	0.075	2	0.8	4.6	14	44.2
2004	0.06	0.3	0.3	0.8	0.075	0.075	0.075	1.8	0.8	5	14.2	44.2
2005	0.01	0.28	0.28	0.8	0.028	0.028	0.028	1.8	0.8	4.6	13.6	39.2
2006	0.01	0.27	0.27	1.38	0.039	0.039	0.039	2	1.38	4.44	10.4	26.2
2007	0.01	0.296	0.296	0.73	0.024	0.024	0.024	1.53	0.73	4.17	17.8	20
2008	0.01	0.286	0.286	0.786	0.029	0.029	0.029	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
2016	0.009	0.372	0.286	0.015	0.015	0.015	0.015	1.188	0.986	4.586	17.9	29.2
2017	0.009	0.362	0.278	0.015	0.015	0.015	0.015	1.066	0.95	4.428	17.9	28.4
2018	0.009	0.344	0.282	0.015	0.015	0.015	0.015	1.07	0.95	4.427	17.9	28.6
2019	0.009	0.342	0.274	0.015	0.015	0.015	0.015	1.058	1.22	4.427	17.8	26.8
2020	0.010	0.382	0.318	0.017	0.016	0.016	0.016	1.156	1.44	5.383	18.6	37.4
2021	0.009	0.348	0.278	0.015	0.015	0.015	0.015	1.134	0.942	4.4256		
2022	0.009	0.348	0.284	0.015	0.015	0.015	0.015	1.144	0.942	4.4256	18.26	28.2
2023	0.009	0.348	0.284	0.015	0.015	0.015	0.015	1.144	0.942	4.4256	18.26	28.2

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

Sector	Source	Fuel	1990-1991			1992-		
			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 CO₂/1000 Sm³ natural gas

Sector	Source	Fuel	Component	1990-1994	1995	1996	1997	1998	1999	2000	2001	2002 ¹
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

¹For the years after 2002 reported emissions are used

Aviation - CH₄, N₂O, NO_x, NMVOC, CO, particles and PAH

Table 6. General emission factors for aviation

Source	Fuel	CH ₄ kg/ tonne	N ₂ O 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.11 Jet/turboprop 0-1000 m	V14 Jet kerosene/ V26 Bio-jetkerosene	0.166	0.1	12.453	1.495	14.774	0	0.129	0.06
M.1A3A.12 Jet/turboprop cruise	V14 Jet kerosene/ V26 Bio-jetkerosene	0	0.1	15.419	0.318	3.3	0	0.154	0.06
M.1A3A.21 Helicopter 0-1000 m	V14 Jet kerosene/ V26 Bio-jetkerosene	3.2	0.1	6.67	28.8	36.6	0	0.025	0.06
M.1A3A.22 Helicopter cruise	V14 Jet kerosene/ V26 Bio-jetkerosene	0	0.1	6.67	32	36.6	0	0.007	0.06
M.1A3A.31 Small aircraft 0-1000 m	V14 Jet kerosene/ Bio- jetkerosene ¹	0.727	0.1	4.739	6.543	21.583	0	0	0
M.1A3A.32 Small aircraft cruise	V14 Jet kerosene/ V26 Bio- jetkerosene ¹	0	0.1	6.679	1.077	3.598	0	0	0.06
M.1A3A.11 Jet/turboprop 0-1000 m	V12 Aviation gasoline	0.166	0.1	12.586	1.495	13.994	0	0.144	2
M.1A3A.12 Jet/turboprop cruise	V12 Aviation gasoline	0	0.1	15.640	0.330	3.267	0	0.183	2
M.1A3A.21 Helicopter 0-1000 m	V12 Aviation gasoline	1.891	0.1	3.019	17.022	926.929	0	0.025	2
M.1A3A.22 Helicopter cruise	V12 Aviation gasoline	0	0.1	2.92	19.48	926	0	0.007	2
M.1A3A.31 Small aircraft 0-1000 m	V12 Aviation gasoline	0.727	0.1	4.739	6.5432	21.583	0	0	2
M.1A3A.32 Small aircraft cruise	V12 Aviation gasoline	0	0.1	6.679	1.077	3.598	0	0	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.11 Jet/turboprop 0-1000 m	V14 Jet kerosene/ V26 Bio Jet kerosene	0.005	0.009	0.003	0.011
M.1A3A.12 Jet/turboprop cruise	V14 Jet kerosene/ V26 Bio Jet kerosene	0.005	0.009	0.003	0.011
M.1A3A.21 Helicopter 0- 1000 m	V14 Jet kerosene/ V26 Bio Jet kerosene	0.005	0.009	0.003	0.011
M.1A3A.22 Helicopter cruise	V14 Jet kerosene/ V26 Bio Jet kerosene	0.005	0.009	0.003	0.011
M.1A3A.31 Small aircraft 0-1000 m	V14 Jet kerosene/ V26 Bio Jet kerosene	0.005	0.009	0.003	0.011
M.1A3A.32 Small aircraft cruise	V14 Jet kerosene/ V26 Bio Jet kerosene	0.005	0.009	0.003	0.011
M.1A3A.11 Jet/turboprop 0-1000 m	V12 Aviation gasoline	0.005	0.009	0.003	0.011
M.1A3A.12 Jet/turboprop cruise	V12 Aviation gasoline	0.005	0.009	0.003	0.011
M.1A3A.21 Helicopter 0- 1000 m	V12 Aviation gasoline	0.005	0.009	0.003	0.011
M.1A3A.22 Helicopter cruise	V12 Aviation gasoline	0.005	0.009	0.003	0.011
M.1A3A.31 Small aircraft 0-1000 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

¹Factors are from 2022. There were no jet kerosene/bio-jetkerosene in small aircrafts in 2023

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

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

Table 7. Time series, variable emission factors for aviation, jet kerosene/bio-jet kerosene¹

Component	Year	General			
		M.1A3A.11	M.1A3A.12	M.1A3A.31	M.1A3A.32
		(LTO 0-1000 m)	(cruise)	(LTO 0-1000 m)	(cruise)
CH ₄	1989-2010	0.187	0	0.429	0
	2011	0.19	0	0.467	0
	2012	0.188	0	0.453	0
	2013	0.189	0	0.498	0
	2014	0.192	0	0.543	0
	2015	0.189	0	0.524	0
	2016	0.186	0	0.5	0
	2017	0.178	0	0.47	0
	2018	0.171	0	0.471	0
	2019	0.166	0	0.402	0
	2020	0.215	0	0.432	0
	2021	0.221	0	0.391	0
	2022	0.166	0	0.727	0
NO _x	1989-2010	11.24	14.379	4.792	6.732
	2011	11.384	14.623	4.785	11.7
	2012	11.681	14.794	4.788	6.729
	2013	11.959	14.97	4.78	6.703
	2014	12.109	15.029	4.772	6.71
	2015	12.331	15.344	4.775	6.716
	2016	12.084	15.191	4.78	6.714
	2017	12.598	15.677	4.785	6.714
	2018	12.782	15.784	4.785	6.716
	2019	12.86	15.82	4.797	6.723
	2020	12.624	16.01	4.792	6.717
	2021	12.331	15.569	4.799	6.729
	2022	12.586	15.640	4.739	6.679
NMVOC	1989-2010	1.685	0.342	3.858	6.738
	2011	1.708	0.35	4.202	0.441
	2012	1.687	0.349	4.076	0.463
	2013	1.697	0.343	4.483	0.636
	2014	1.725	0.345	4.888	0.59
	2015	1.703	0.347	4.718	0.609
	2016	1.672	0.344	4.502	0.675
	2017	1.599	0.335	4.234	0.665
	2018	1.537	0.329	4.238	0.601
	2019	1.495	0.325	3.621	0.562
	2020	1.938	0.404	3.892	0.534
	2021	1.986	0.493	3.522	0.493
	2022	1.495	0.330	6.543	1.077

Table 7 (cont.) Time series, variable emission factors for aviation, jet kerosene/bio-jet kerosene

Component	Year	General			
		M.1A3A.11 (LTO 0-1000 m)	M.1A3A.12 (cruise)	M.1A3A.31 (LTO 0-1000 m)	M.1A3A.32 (cruise)
CO	1989-2010	15.897	3.472	18.753	0.406
	2011	15.987	3.433	19.116	2.2
	2012	15.644	3.379	18.983	2.243
	2013	15.331	3.217	19.412	2.626
	2014	15.188	3.162	19.839	2.528
	2015	14.979	3.155	19.659	2.57
	2016	15.014	3.196	19.432	2.717
	2017	14.29	3.062	19.149	2.691
	2018	13.729	2.948	19.154	2.552
	2019	13.582	2.95	18.504	2.465
	2020	16.01	3.765	18.789	2.409
	2021	17.011	4.164	18.4	2.318
	2022	13.994	3.267	21.583	3.598
TSP, PM ₁₀ , PM _{2.5}	1989-2010	0.113	0.15	0	0
	2011	0.117	0.15	0	0
	2012	0.12	0.152	0	0
	2013	0.122	0.155	0	0
	2014	0.123	0.155	0	0
	2015	0.126	0.16	0	0
	2016	0.122	0.155	0	0
	2017	0.125	0.158	0	0
	2018	0.122	0.158	0	0
	2019	0.123	0.161	0	0
	2020	0.139	0.154	0	0
	2021	0.153	0.163	0	0
	2022	0.144	0.183	0	0

¹See Table 6 for factors in the last statistical year.

Source: Statistics Norway

Road traffic - CH₄, N₂O, NO_x, NMVOC, CO, NH₃, particles and PAH

Table 8. General emission factors for road traffic

Source	Fuel	CH ₄ kg/tonne	N ₂ O 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.1A3B.1 Passenger car	V11 Motor gasoline	0.212	0.013	2.132	4.027	26.212	0.403	0.021	0.1
	V15 Auto diesel	0.113	0.135	11.554	0.261	2.380	0.042	0.126	0.1
	V23 Bio ethanol	0.212	0.013	2.132	4.027	26.212	0.403	0.021	0.1
	V24 Bio diesel	0.113	0.135	11.554	0.261	2.380	0.042	0.126	0.1
	V25 Bio diesel	0.113	0.135	11.554	0.261	2.380	0.042	0.126	0.1
	V32 LPG	1.133	0.041	0.972	0.231	9.819	0.382	0.001	0.06
M.1A3B.2 Other light duty cars	V11 Motor gasoline	0.456	0.034	5.917	8.514	97.116	0.327	0.074	0.1
	V15 Auto diesel	0.122	0.132	9.790	0.115	2.226	0.061	0.217	0.1
	V23 Bio ethanol	0.456	0.034	5.917	8.514	97.116	0.327	0.074	0.1
	V24 Bio diesel	0.122	0.132	9.790	0.115	2.226	0.061	0.217	0.1
	V25 Bio diesel	0.122	0.132	9.790	0.115	2.226	0.061	0.217	0.1
	V31/V37 Natural gas/Biogás	0.368	0	1.026	0.032	1.482	0	0.013	0.05
M.1A3B.3 Heavy duty vehicles	V11 Motor gasoline	0.684	0.031	27.325	19.794	22.873	0.009	0	0.1
	V15 Auto diesel	0.004	0.119	5.613	0.151	2.539	0.037	0.079	0.1
	V23 Bio ethanol	0.684	0.031	27.325	19.794	22.873	0.009	0	0.1
	V24 Bio diesel	0.004	0.119	5.613	0.151	2.539	0.037	0.079	0.1
	V25 Bio diesel	0.004	0.119	5.613	0.151	2.539	0.037	0.079	0.1
	V31/V37 Natural gas/Biogás	0.368	0	1.026	0.032	1.482	0	0.013	0.05
M.1A3B.41 Moped	V11 Motor gasoline	17.344	0.042	2.385	81.505	143.923	0.042	8.459	0.1
	V23 Bio ethanol	17.344	0.042	2.385	81.505	143.923	0.042	8.459	0.1
M.1A3B.42 Motorcycle	V11 Motor gasoline	1.451	0.043	2.502	15.932	80.670	0.043	0.270	0.1
	V23 Bio ethanol	1.451	0.043	2.502	15.932	80.670	0.043	0.270	0.1

Table 8 (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
	V23 Bio ethanol	0.03	0.03	0.02	0.04
	V24 Bio diesel	0.11	0.13	0.1	0.11
	V25 Bio diesel	0.11	0.13	0.1	0.11
	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
	V23 Bio ethanol	0.03	0.03	0.02	0.04
	V24 Bio diesel	0.11	0.13	0.1	0.11
	V25 Bio diesel	0.11	0.13	0.1	0.11
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
	V23 Bio ethanol	0.01	0.08	0.09	0.02
	V24 Bio diesel	0.03	0.17	0.19	0.04
	V25 Bio diesel	0.03	0.17	0.19	0.04
	V31/V37 Natural gas/Biogas	0	0	0	0
M.1A3B.41 Moped	V11 Motor gasoline	0.040	0.040	NE	NE
	V23 Bio ethanol	0.040	0.040	NE	NE
M.1A3B.42 Motorcycle	V11 Motor gasoline	0.040	0.040	NE	NE
	V23 Bio ethanol	0.040	0.040	NE	NE

Bold numbers are different for different years, but only the latest year are shown here, except for CH₄ (table 10) and N₂O (table 11).

Source: Results from Statistics Norway's use of HBEFA 4.2 (INFRAS), Finstad *et al.* (2001). PAH-profile: Aarhus University (2016)

Table 9. Average CH4 emission factors for road traffic incl. cold start emissions and evaporation, g CH4/ kg fuel¹

	V11 Motor gasoline/ V23 Bio ethanol					V15 Auto diesel/ V24 Bio diesel/V25 Fossil part of FAME		
	Passenger car	Other light duty cars	Heavy duty vehicles	Moped	Motorcycle	Passenger car	Other light duty cars	Heavy duty vehicles
1990	1.696	1.672	0.764	11.785	2.676	0.153	0.082	0.135
1991	1.648	1.684	0.774	11.928	2.538	0.148	0.081	0.134
1992	1.595	1.667	0.779	12.015	2.408	0.138	0.079	0.130
1993	1.561	1.641	0.793	12.238	2.281	0.114	0.070	0.119
1994	1.512	1.602	0.807	12.449	2.182	0.116	0.075	0.122
1995	1.450	1.540	0.821	12.665	2.108	0.110	0.072	0.114
1996	1.273	1.395	0.793	12.235	1.918	0.102	0.066	0.101
1997	1.214	1.372	0.821	12.660	2.030	0.105	0.067	0.098
1998	1.094	1.271	0.811	12.513	2.025	0.096	0.059	0.079
1999	1.006	1.209	0.812	14.059	2.083	0.081	0.049	0.062
2000	0.958	1.178	0.835	17.260	2.293	0.078	0.047	0.059
2001	0.851	1.053	0.805	19.570	2.333	0.070	0.042	0.049
2002	0.782	0.988	0.806	22.852	2.451	0.065	0.039	0.046
2003	0.711	0.933	0.799	24.755	2.528	0.062	0.038	0.044
2004	0.639	0.876	0.791	25.475	2.574	0.058	0.036	0.041
2005	0.611	0.874	0.828	26.700	2.692	0.058	0.035	0.039
2006	0.566	0.837	0.837	26.701	2.717	0.054	0.032	0.037
2007	0.545	0.815	0.858	26.954	2.783	0.052	0.031	0.034
2008	0.516	0.772	0.856	26.468	2.748	0.049	0.028	0.030
2009	0.491	0.734	0.847	25.867	2.782	0.048	0.026	0.026
2010	0.462	0.686	0.822	25.171	2.764	0.049	0.025	0.020
2011	0.452	0.683	0.834	25.387	2.840	0.055	0.027	0.017
2012	0.429	0.661	0.827	25.075	2.774	0.062	0.031	0.015
2013	0.404	0.640	0.818	24.704	2.663	0.066	0.036	0.013
2014	0.373	0.614	0.794	23.918	2.500	0.069	0.039	0.011
2015	0.354	0.609	0.803	23.849	2.410	0.075	0.043	0.009
2016	0.327	0.587	0.781	23.125	2.260	0.082	0.047	0.007
2017	0.305	0.564	0.778	23.104	2.168	0.096	0.057	0.007
2018	0.285	0.553	0.776	22.655	2.074	0.105	0.068	0.006
2019	0.278	0.557	0.789	22.601	2.029	0.110	0.081	0.005
2020	0.258	0.543	0.770	21.604	1.906	0.112	0.097	0.005
2021	0.251	0.538	0.765	20.845	1.802	0.108	0.101	0.004
2022	0.231	0.504	0.734	19.250	1.647	0.107	0.109	0.004

¹See Table 8 for factors in the last statistical year.

Source: Results from Statistics Norway's use of HBEFA 4.2 (INFRAS)

Table 10. Average N2O emission factors for road traffic incl. cold start emissions and evaporation, g N2O/ kg fuel¹

	V11 Motor gasoline/ V23 Bio ethanol					V15 Auto diesel/ V24 Bio diesel/V25 Fossil part of FAME		
	Passenger car	Other light duty cars	Heavy duty vehicles	Moped	Motorcycle	Passenger car	Other light duty cars	Heavy duty vehicles
1990	0.103	0.092	0.035	0.047	0.045	-	-	0.039
1991	0.109	0.093	0.035	0.048	0.045	-	-	0.038
1992	0.116	0.095	0.035	0.048	0.045	-	-	0.038
1993	0.124	0.101	0.036	0.049	0.045	-	-	0.034
1994	0.133	0.109	0.037	0.050	0.046	-	-	0.037
1995	0.143	0.120	0.037	0.051	0.046	0.004	0.005	0.037
1996	0.151	0.126	0.036	0.049	0.044	0.013	0.014	0.036
1997	0.160	0.141	0.037	0.051	0.046	0.026	0.023	0.039
1998	0.156	0.146	0.037	0.050	0.045	0.037	0.030	0.038
1999	0.155	0.154	0.037	0.050	0.045	0.042	0.034	0.033
2000	0.159	0.167	0.038	0.052	0.046	0.052	0.041	0.034
2001	0.154	0.176	0.037	0.050	0.045	0.055	0.043	0.031
2002	0.154	0.193	0.037	0.050	0.045	0.062	0.046	0.029
2003	0.150	0.171	0.036	0.049	0.045	0.067	0.050	0.028
2004	0.145	0.172	0.036	0.049	0.044	0.070	0.052	0.027
2005	0.086	0.163	0.038	0.051	0.047	0.076	0.058	0.027
2006	0.082	0.161	0.038	0.052	0.047	0.079	0.061	0.026
2007	0.081	0.161	0.039	0.053	0.049	0.086	0.065	0.028
2008	0.078	0.153	0.039	0.053	0.049	0.089	0.067	0.032
2009	0.073	0.143	0.039	0.052	0.048	0.090	0.066	0.038
2010	0.071	0.129	0.038	0.051	0.048	0.091	0.064	0.047
2011	0.067	0.124	0.038	0.052	0.048	0.098	0.067	0.062
2012	0.060	0.114	0.038	0.052	0.048	0.106	0.070	0.074
2013	0.052	0.104	0.038	0.051	0.047	0.110	0.073	0.080
2014	0.043	0.092	0.036	0.050	0.046	0.110	0.073	0.089
2015	0.037	0.084	0.037	0.050	0.046	0.112	0.075	0.097
2016	0.031	0.074	0.036	0.049	0.045	0.113	0.078	0.099
2017	0.027	0.065	0.036	0.048	0.045	0.122	0.089	0.107
2018	0.023	0.058	0.035	0.048	0.046	0.129	0.100	0.113
2019	0.021	0.055	0.036	0.049	0.047	0.132	0.110	0.117
2020	0.018	0.048	0.035	0.048	0.047	0.136	0.119	0.117
2021	0.017	0.046	0.035	0.047	0.047	0.130	0.119	0.115
2022	0.015	0.040	0.034	0.045	0.045	0.129	0.122	0.114

¹See Table 8 for factors in the last statistical year.

Source: Results from Statistics Norway's use of HBEFA 4.2 (INFRAS)

Navigation - CH₄, N₂O, NO_x, NMVOC, CO, particles and POPs

Table 11. General emission factors for navigation

	CH ₄ kg/ tonne	N ₂ O 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, B17 Bio marine gas oil, V18 Light fuel oils	0.23	0.08	26.24	2.4	2.9	0	1.6	1.5	4
V19 Heavy distillate, V20 Heavy fuel oil	0.23	0.08	26.24	2.4	2.9	0	5.4	5.1	4
V31 Natural gas (1000 Sm ³)	32.49	0.07	4.88	0.81	2.14	0	0.03	0.03	0.05

Table 11 (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, B17 Bio marine gas oil	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 12, and bold numbers are different for different years, see tables 13-15.

Source: Flugsrud and Rypdal (1996), Tørnsjø (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 12. Exceptions from the general factors for navigation

Component	Emission factor (kg/tonne)	Fuel	Sector
CH ₄	0.8 V17, B17	Marine gas oil/diesel, Bio marine gas oil	230600.1 -230600.3, 230910
CH ₄	1.9 V20	Heavy fuel oil	230600.1 -230600.3, 230910
N ₂ O	0.02 V17, B17	Marine gas oil/diesel, Bio marine gas oil	230600.1 -230600.3, 230910
NO _x	54 V17, B17	Marine gas oil/diesel, light fuel oils, heavy distillate, Heavy fuel oil, Bio marine gas oil	230600.1 -230600.3, 230910
NO _x	46.58 V17, 19, 20, B17	Marine gas oil/diesel, light fuel oils, heavy distillate, heavy fuel oil, Bio marine gas oil	248422
NO _x	23.80 V17, 19, 20, B17	Marine gas oil/diesel, light fuel oils, heavy distillate, heavy fuel oil, Bio marine gas oil	230310.N
NMVOC	1.4 V17, 18, 19, 20, B17	Marine gas oil/diesel, light fuel oils, heavy distillate, heavy fuel oil, Bio marine gas oil	230310.N
NMVOC	2.3 V17, 19, 20, B17	Marine gas oil/diesel, light fuel oils, heavy distillate, heavy fuel oil, Bio marine gas oil	248422
NMVOC	5 V17, B17	Marine gas oil/diesel, light fuel oils, Bio marine gas oil	230600.1 -230600.3, 230910
NMVOC	5 V19, 20	Heavy distillate, heavy fuel oil	230600.1 -230600.3, 230910
CO	7.9 V17, 18, 19, 20, B17	Marine gas oil/diesel, light fuel oils, heavy distillate, heavy fuel oil, Bio marine gas oil	230310.N
CO	7 V17, 19, 20, B17	Marine gas oil/diesel, light fuel oils, heavy distillate, heavy fuel oil, Bio marine gas oil	230600.1 -230600.3, 230910
CO	2.3 V17, 19, 20, B17	Marine gas oil/diesel, light fuel oils, heavy distillate, heavy fuel oil, Bio marine gas oil	248422

Bold numbers are different for different years, but only the latest year are shown here

Source: Flugsrud and Rypdal (1996), Tørnsjø (2001), Finstad *et al.* (2001), Finstad *et al.* (2002b), Finstad *et al.* (2003), Bremnes Nielsen and Stenersen (2010)

Table 13. Time series for variable emission factors for navigation. NO_x¹

Sector	General	230310.N	248422
Fuel	V17-20, B17	V17, 19, 20, B17	V17, 19, 20, B17
1990	56.85	52.11	50.17
1991	56.8	52.11	50.17
1992	56.89	52.11	50.17
1993	56.77	52.11	50.17
1994	56.82	52.11	50.17
1995	56.68	52.11	50.17
1996	57.23	52.11	50.17
1997	57.47	52.11	50.17
1998	57.41	52.11	50.17
1999	56.82	52.11	50.17
2000	57.82	52.12	49.82
2006	55.55	51.48	48.52
2007	54.61	50.93	48.31
2008	53.36	49.9	48.09
2009	52.10	47.41	47.88
2010	50.84	45.17	47.66
2011	49.58	43.63	47.44
2012	48.32	43.36	47.23
2013	47.07	40.93	47.01
2014	45.81	37.97	46.80
2015	44.56	36.6	46.58
2016	42.27	35.0	46.58
2017	39.98	33.4	46.58
2018	37.69	31.8	46.58
2019	35.4	30.2	46.58
2020	33.11	28.6	46.58
2021	30.82	27.0	46.58
2022	28.53	25.40	46.58

¹See Table 11 and 12 for factors in the last statistical year.

Source: Flugsrud and Rypdal (1996), Tørnsjø (2001), Finstad *et al.* (2001), Finstad *et al.* (2002b), Finstad *et al.* (2003), Bremnes Nielsen and Stenersen (2010)

Table 14. Time series for variable emission factors for navigation, general, natural gas, CH₄

	2001- 2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015-	
2000	31.43	31.35	51.67	54.39	54.55	54.43	36.81	38.83	41.65	42.73	40.67	36.69	34.59	32.83	32.49

Source: Flugsrud and Rypdal (1996), Tørnsjø (2001), Finstad *et al.* (2001), Finstad *et al.* (2002b), Finstad *et al.* (2003), Bremnes Nielsen and Stenersen (2010)

Table 15. 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	7
230600.1- 230600.3,230910, 248422	V19,20	6.4			5				
	V17-20		2.2			2.3			

Source: Flugsrud and Rypdal (1996), Tørnsjø (2001), Finstad *et al.* (2001), Finstad *et al.* (2002b), Finstad *et al.* (2003), Bremnes Nielsen and Stenersen (2010)

Other mobile sources including railways - CH₄, N₂O, NO_x, NMVOC, CO, NH₃, particles and POPs

Table 16. General emission factors for other mobile sources

		CH ₄ kg/ tonne	N ₂ O 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.1A3C Railway	V01 Coal	0.28	0.04	3	1.1	3	0	1.6/1.14	0.82	1.6
	V15 Diesel/ V27 Biodiesel	0.18	1.2	47	4	11	0.007	1.52	1.44	0.1
M.1A3E.1 Snow scooter	V11 Motor gasoline/ V23 Bioethanol	22.31	0.05	3.07	104.84	185.13	0.05	10.88	10.88	0.1
M.1A3E.21 Small boats 2 stroke	V11 Motor gasoline/ V23 Bioethanol	5.1	0.02	7.79	91.75	415	0	8	8	0.1
M.1A3E.22 Small boats 4 stroke	V11 Motor gasoline/ V23 Bioethanol	1.7	0.08	36.76	44.99	1 000	0	1	1	0.1
	V15 Diesel/ V27 Biodiesel	0.18	0.03	38.68	7.27	25	0	4	4	0.1
M.1A3E.32 Motorized equipment 4 stroke	V11 Motor gasoline/ V23 Bioethanol	2.2	0.07	10	110	1 200	0	1	1	0.1
	V15 Diesel/ V27 Biodiesel	0.17	0.14	12.22	0.84	6.07	0.008	0.09	0.09	0.1

Table 16 (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
M.1A3C Railway	V01 Coal	0.007	0.01	0.004	0.003
	V15 Diesel/ V27 Biodiesel	0.030	0.050	0	0
M.1A3E.21 Small boats 2 stroke	V11 Motor gasoline/ V23 Bioethanol	0.040	0.040	0	0
M.1A3E.22 Small boats 4 stroke	V11 Motor gasoline/ V23 Bioethanol	0.040	0.040	0	0
	V15 Diesel/ V27 Biodiesel	0.030	0.050	0	0
M.1A3E.32 Motorized equipment 4 stroke	V11 Motor gasoline/ V23 Bioethanol	0.040	0.040	0	0
	V15 Diesel/ V27 Biodiesel	0.030	0.050	0	0

¹Before 1995 the emission factor was 1.3.

Bold figures changes annually. Only factors from last statistical year are presented here.

Numbers in italics have exceptions for some sectors, see next table.

Sources: Emep/EEA Guidebook 2019, 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 17. Exceptions from the general factors for greenhouse gases and precursors for other mobile sources

Component	Emission factor (kg/tonne)		Fuel	Source	Sectors
CH ₄	5.5	V11/V23	Motor gasoline/ Bioethanol	M.1A3E.32 Motorized equipment 4 stroke	330000
N ₂ O	0.08	V11/V23	Motor gasoline/ Bioethanol	M.1A3E.32 Motorized equipment 4 stroke	230500-233320
N ₂ O	0.13	V15/V27	Diesel/ Biodiesel	M.1A3E.32 Motorized equipment 4 stroke	230100-230210
NO _x	10.47	V15/V27	Diesel/ Biodiesel	M.1A3E.32 Motorized equipment 4 stroke	230100-230210
NMVO	1.34	V15/V27	Diesel/ Biodiesel	M.1A3E.32 Motorized equipment 4 stroke	230100-230200
CO	7.85	V15/V27	Diesel/ Biodiesel	M.1A3E.32 Motorized equipment 4 stroke	230100-230210
TSP, PM ₁₀	1.09	V15/V27	Diesel/ Biodiesel	M.1A3E.32 Motorized equipment 4 stroke	230100-230210
PM _{2.5}	1.09	V15/V27	Diesel/ Biodiesel	M.1A3E.32 Motorized equipment 4 stroke	230100-230210

Bold figures changes annually. Only factors for the latest statistical year are presented here.

Time series for NO_x are presented in table 18.

Table 18. Time series for NO_x emission factors, diesel and biodiesel in motorized equipment 4 stroke¹

Table 16: Time series for NO_x emission factors, diesel and biodiesel in motorized equipment 4 stroke

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	2016	2017	2018	2019	2020
General	28.6	24.8	21.6	19.8	18.5	17.1	16.1	15.3	14.5	13.5	13.0	12.78	12.56	12.42	12.27	12.23
230100-230210	24.1	23.3	22.3	21.3	20.3	19.3	18.3	17.5	16.8	15.9	15.1	14.37	13.61	12.95	12.39	11.81

Sector	2021	2022
General	12.23	12.23
230100-230210	11.64	11.15

¹See Table 16 and 17 for factors in the last statistical year.

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

Table 19. Time series for variable emission factors for other mobile sources

Fuel	Component	1980-1990	1991	1992	1993	1994	1995	1996	1997-
V11 Gasoline/ V23 Bioethanol	Dioxins	1.32	1.11	0.95	0.69	0.25	0.23	0.11	0.1

Fuel Wood - CH₄, N₂O, NO_x, NMVOC, CO, NH₃, particles and PAH

Table 20. Emission factors, V41 Fuel Wood, kg/tonne

	S.05 Small stoves (produced before 1998)	S.07 Fireplace
CH ₄	16.1445	5.3
N ₂ O	0.032	0.032
NO _x	0.97	1.3
NMVOC	31.819	7
CO	166.769	126.3
NH ₃	0.066	0.066
TSP	24.145	17.3
PM ₁₀	23.13	17
PM _{2.5}	20.855	16.4

Source: Seljeskog *et al.* (2017), Skreiberg *et al.* (2023).

Table 21. Emission factors, V41 Fuel wood, kg/tonne, S.06 Small stoves (produced after 1998)

Year	CH ₄	N ₂ O	NO _x	NMVOC	NH ₃	CO	PM ₁₀	PM _{2.5}
1998	7.979	0.041	0.998	31.819	0.066	166.769	12.902	11.916
1999	7.885	0.041	0.997	31.433	0.066	164.968	12.813	11.838
2000	7.737	0.041	0.997	30.826	0.066	162.118	12.670	11.713
2001	7.557	0.041	0.996	30.093	0.066	158.659	12.494	11.559
2002	7.361	0.040	0.995	29.292	0.066	154.858	12.296	11.386
2003	7.157	0.040	0.994	28.459	0.066	150.881	12.086	11.202
2004	6.950	0.040	0.993	27.617	0.066	146.838	11.869	11.011
2005	6.744	0.039	0.991	26.780	0.066	142.801	11.648	10.818
2006	6.541	0.039	0.990	25.959	0.066	138.816	11.427	10.623
2007	6.344	0.038	0.989	25.159	0.066	134.914	11.207	10.428
2008	6.153	0.038	0.987	24.385	0.066	131.115	10.989	10.236
2009	5.968	0.037	0.986	23.637	0.066	127.430	10.775	10.046
2010	5.790	0.037	0.985	22.918	0.066	123.869	10.564	9.860
2011	5.619	0.037	0.983	22.227	0.066	120.432	10.358	9.677
2012	5.454	0.036	0.982	21.565	0.066	117.122	10.157	9.498
2013	5.297	0.036	0.981	20.931	0.066	113.937	9.960	9.323
2014	5.146	0.035	0.979	20.324	0.066	110.875	9.769	9.152
2015	5.001	0.035	0.978	19.743	0.066	107.933	9.582	8.985
2016	4.863	0.035	0.976	19.187	0.066	105.107	9.400	8.823
2017	4.730	0.034	0.975	18.656	0.066	102.394	9.224	8.664
2018	4.603	0.034	0.974	18.147	0.066	99.788	9.052	8.510
2019	4.482	0.034	0.972	17.661	0.066	97.285	8.885	8.360
2020	4.365	0.033	0.971	17.196	0.066	94.882	8.722	8.214
2021	4.254	0.033	0.970	16.750	0.066	92.574	8.564	8.072
2022	4.147	0.033	0.968	16.324	0.066	90.356	8.411	7.933
2023	4.147	0.033	0.968	16.324	0.066	90.356	8.411	7.933

Source: Skreiberg *et al.* (2023)

Table 22. Emission factors, V41 Fuel Wood, g/tonne

Component	S.05	S.06	S.07
	Small stoves (produced before 1998)	Small stoves (produced after 1998)	Fireplace
benzo(a)pyrene .	0.737	0.006	0.819
benzo(b)fluoranthene	1.160	0.010	1.289
benzo(k)fluoranthene	0.271	0.003	0.301
indeno(1,2,3_cd)pyrene	0.531	0.005	0.590

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

Table 23. Emission factors, V41 Fuel Wood, ug/tonne

Component	S.05	S.06	S.07
	Small stoves (produced before 1998)	Small stoves (produced after 1998)	Fireplace
Dioxins	9.9375	3.758	5.9

Source: Seljeskog et al. (2017).

CH₄ - Stationary combustion

Table 24. General emission factors, kg CH₄/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 (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	.	.	.	.	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, B17 Marine gas oil bio	V18 Light fuels/V28 biofuel oil	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 next table.

Source: IPCC (2006), Sandgren *et al.* (1996), Karlsvik (1995) and The Norwegian oil industry association (1994).

Table 25. Exceptions from the general factors for CH₄, stationary combustion (kg CH₄/tonne fuel)

Emission factor		Fuel	Source	Sectors
0.1293	V13, V17, B17, 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 Sm³)	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, V38	CO gas, Petrol coke 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

N₂O - Stationary combustion

Table 26. General emission factors. kg N₂O/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	<i>0.0036</i>	0.0049
S.02 Gas turbines	.	.	.	.	.	.	.	.	.	<i>0.0036</i>	.
S.03 Boilers	0.0422	0.0428	0.021	.	0.065	0.0144	0.0691	0.0619	.	<i>0.0036</i>	0.0049
S.04 Small stoves	0.0422	0.0428	.	.	.	.	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, B17 Marine gas oil bio	V18 Light fuel oils/V28 biofuel oil	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 next table.

Source: IPCC (2006), Sandgren *et al.* (1996) and The Norwegian oil industry association (1994).

Table 27. Exceptions from the general factors for N₂O. Stationary combustion (kg N₂O/1000 Sm³ 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
0.0005	V38 Petrol coke gas	All	230500-233530

NO_x - Stationary combustion

Table 28. 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 briquettes	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	.	.	.	.	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, B17 Marine gas oil bio	V18 Light fuel oils/V28 biofuel oil	V19 Heavy distillate	V20 Heavy fuel oil		
S.01 Direct- fired furnaces	5.4	.	5.4	.	.	54	.	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		
S.04 Small stoves	.	.	.	2.3	2.5	.	2.5	2.5	.		
S.1B2C Flares	.	0.17	.	.	.	.	.	.	.		
	V38 Petrol coke gas	V51 Municipal waste	V52 Special waste								
S.01 Direct- fired furnaces	.	.	5								
S.02 Gas turbines	.	.	.								
S.03 Boilers	3	1.365	4.2								
S.04 Small stoves	.	.	.								
S.1B2C Flares	.	.	.								

Numbers in italics have exceptions for some sectors, see next table.

Source: Rosland (1987). Fuel wood factor based on data from annual surveys on use of fuel wood in households.

Table 29. 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	B17, 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	231922, 233511
1.4	V01, 02	Coal, coke	S.04 Small stoves	330000

Bold figures change annually, see next table.

Table 30. Time series for variable emission factors for NO_x. Stationary combustion. kg NO_x /tonne fuel

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 31. 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	.	.	.	.	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, B17 Marine gas oil bio	V18 Light fuel oils/V28 biofuel oil	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	.	.	.	.	.	.	.	.	.

V38
Petrol coke gas

S.01 Direct-fired furnaces	.
S.02 Gas turbines	.
S.03 Boilers	0.1
S.04 Small stoves	.
S.1B2C Flares	.

Numbers in italics have exceptions for some sectors, see next table.

Source: Rosland (1987) and Sandgren *et al.* (1996).

Table 32. Exceptions from the general factors, 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	B17, V17, 18, 19, 28	Fuel oils/biofuel oil	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 33. 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	.	.	.	.	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, B17 Marine gas oil bio	V18 Light fuel oils/ V28 biofuel oil	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	.	.	.	.	.	.	.	.	.
	V38 Petrol coke gas										
S.01 Direct-fired furnaces	0										
S.02 Gas turbines	0										
S.03 Boilers	0										
S.04 Small stoves	0										
S.1B2C Flares	0										

Numbers in italics have exceptions for some sectors, see next table.

Table 34. Exceptions from the general factors, 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
7	V17, B17	Marine gas oil/diesel	S.01 Direct-fired furnaces 230910, 230600.2
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	B17, V17, 18, 19, 28	Fuel oils/Biofuel oil	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

NH₃ - Stationary combustion

Table 35. General emission factors. kg NH₃/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, B17 Marine gas oil bio	V18 Light fuel oils/biofuel oil	V19 Heavy dis- tillate	V20 Heavy fuel oil
S.04 Small stoves	.	.	.	0.0656	.	.	0.0656	.	0	0.0354	.	.	.	.	.	.	.	.	.	.
All other sources	0	0	0	.	0	0	0	0	1.09	0.0354	0	0	0	0	0	0	0	0	0	0

Source	V51 Municipal waste	V52 Special waste	V38 Petrol coke gas
S.04 Small stoves	.	.	.
All other sources	0	0	0

Table 36. Emission factors for solid biomass, industry and other stationary combustion, . kg NH₃/tonne fuel

Sector	V42 Wood Waste	V44 Wood Pellets	V45 Wood Briquettes
All Sources, Industry	0,2016	0,02736	0,018576
All sources, other stationary combustion	0,0168	0,01728	0,01548

Particulate matter - Stationary combustion

Table 37. General emission factors. kg particle component/tonne fuel

[illegible]

Table 37 (cont.) General emission factors. kg particle component/tonne fuel

		V34 CO gas	V36 Landfill gas	V35 Fuel gas	V32 LPG	V38 Petrol coke gas	V13 Kerosene (heating)	V17 Marine gas oil/ diesel, B17 Marine gas oil bio	V18 Light fuel oils/V28 biofuel oil	V19 Heavy distillate	V20 Heavy fuel oil	V51 Municipal waste	V52 Special waste
TSP	S.01 Direct-fired furnaces	0.144	.	0.144	.	0.144	.	0.286	.	*	*	.	5.68
TSP	S.02 Gas turbines	.	.	.	.	0.144	.	0.286	.	.	.	.	.
TSP	S.03 Boilers	0.144	0.144	0.144	0.136	0.144	0.296	0.286	0.286	*	*	0.05	5.68
TSP	S.04 Small stoves	.	.	.	0.136	0.144	0.3	.	0.3	.	.	.	.
TSP	S.1B2C Flares	.	0.144	.	.	0.144	.	.	.	.	.	.	.
PM ₁₀	S.01 Direct-fired furnaces	0.144	.	0.144	.	0.144	.	0.143	.	*	*	.	4.87
PM ₁₀	S.02 Gas turbines	.	.	.	.	0.144	.	0.143	.	.	.	.	.
PM ₁₀	S.03 Boilers	0.144	0.144	0.144	0.136	0.144	0.148	0.143	0.15	*	*	0.05	4.87
PM ₁₀	S.04 Small stoves	.	.	.	0.136	0.144	0.16	.	0.155	.	.	.	.
PM ₁₀	S.1B2C Flares	.	0.144	.	.	0.144	.	.	.	.	.	.	.
PM _{2.5}	S.01 Direct-fired furnaces	0.144	.	0.144	.	0.144	.	0.036	.	*	*	.	3.2
PM _{2.5}	S.02 Gas turbines	.	.	.	.	0.144	.	0.036	.	.	.	.	.
PM _{2.5}	S.03 Boilers	0.144	0.144	0.144	0.136	0.144	0.037	0.12	0.12	*	*	0.05	3.2
PM _{2.5}	S.04 Small stoves	.	.	.	0.136	0.144	0.12	.	0.119	.	.	.	.
PM _{2.5}	S.1B2C Flares	.	0.144	.	.	0.144	.	.	.	.	.	.	.

Numbers in italics have exceptions for some sectors, see next table.

General emission factors for all sources for heavy distillate and heavy fuel oil are given in table 37 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 38. Exceptions from the general factors for particles

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 (B17, V17, B17, V17, 18)	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 39. General particle emission factors for heavy distillate and heavy fuel oil for all sources, kg particle component /tonne fuel

Fuel	Com-ponent	1990	1991	1992	1993	1994	1995	1996-1997	1998	1999	2000-
V19	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
	PM _{2.5}	0.450	0.400	0.393	0.393	0.385	0.400	0.371	0.385	0.393	0.400
V20	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
	PM _{2.5}	0.761	0.754	0.741	0.735	0.671	0.593	0.619	0.613	0.625	0.677

Factors dependent on sulphur content.

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

POPs (Persistent Organic Pollutants) - Stationary combustion

Table 40. General emission factors for PAH, g/tonne

Component	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 Sm³)	V33 Refinery gas
benzo(a)pyrene .	S.01 Direct- fired furn- aces	0.00002	0.00002	0.00002	.	.	.	.	.	0.007	0.00002	0.00003
benzo(a)pyrene .	S.02 Gas turbines	.	.	.	.	.	.	.	.	.	0.00002	.
benzo(a)pyrene .	S.03 Boilers	0.007	0.007	0.007	.	0.0001	0.0001	0.0001	0.0001	.	0.00002	0.00003
benzo(a)pyrene .	S.04 Small stoves	2.81	2.85	3.5	.	.	.	2.091	2.091.	3.5695	.	.
benzo(b)fluoranthene	S.01 Direct- fired furnaces	0.001	0.001	0.001	.	.	.	.	.	0.010	0.00003	0.00004
benzo(b)fluoranthene	S.02 Gas turbines	.	.	.	.	.	.	.	.	.	0.00003	.
benzo(b)fluoranthene	S.03 Boilers	0.010	0.010	0.010	.	0.0075	0.0075	0.0075	0.0075	.	0.00003	0.00004
benzo(b)fluoranthene	S.04 Small stoves	4.777	4.845	5.95	.	.	.	1.918	1.918	3.2745	.	.
benzo(k)fluoranthene	S.01 Direct- fired furnaces	0.0008	0.0008	0.001	.	.	.	.	.	0.004	0.00003	0.00004
benzo(k)fluoranthene	S.02 Gas turbines	.	.	.	.	.	.	.	.	.	0.00003	.
benzo(k)fluoranthene	S.03 Boilers	0.004	0.004	0.004	.	0.0075	0.0075	0.0075	0.0075	.	0.00003	0.00004
benzo(k)fluoranthene	S.04 Small stoves	3.653	2.85	3.5	.	.	.	0.726	0.726.	1.239	.	.
indeno(1,2,3_cd)pyrene	S.01 Direct- fired furnaces	0.00003	0.00003	0.00004	.	.	.	.	.	0.003	0.00003	0.00004
indeno(1,2,3_cd)pyrene	S.02 Gas turbines	.	.	.	.	.	.	.	.	.	0.00003	.
indeno(1,2,3_cd)pyrene	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	S.04 Small stoves	2.248	2.28	2.8	.	.	.	1.227	1.227.	2.0945	.	.

Table 40 (cont.). General emission factors for PAH, g/tonne

Component	Source	V34 Blast furn- ace gas	V36 Landfill gas	V35 Fuel gas	V32 LPG	V38 Petrol coke gas	V13 Kerosene (heating)	V17 Marine gas oil/ diesel, B17 Marine gas oil bio	V18 Light fuel oils/V28 biofuel oil	V19 Heavy dis- tillate	V20 Heavy fuel oil	V51 Municipal waste ¹	V52 Special waste
benzo(a)pyrene	S.01 Direct- fired furn- aces	0.00001	.	0.00004	.	0.00004	.	NE	.	NE	NE	.	0.077
benzo(a)pyrene	S.02 Gas turbines	.	0.00003	.	.	.	.	NE	.	.	.	.	.
benzo(a)pyrene	S.03 Boilers	0.00001	0.00003	0.00004	2.5816E- 08	0.00004	0.00002	NE	0.00002	NE	NE	0.00001	0.077
benzo(a)pyrene	S.04 Small stoves	.	.	.	2.5816E- 08	.	0.003	.	0.003	.	.	.	.
benzo(b)fluoranthene	S.01 Direct- fired furnaces	0.00003	.	0.00015	.	0.00015	.	0.00019	.	0.00019	0.00018	.	0.609
benzo(b)fluoranthene	S.02 Gas turbines	.	0.00004	.	.	.	.	0.00019	.	.	.	.	.
benzo(b)fluoranthene	S.03 Boilers	0.00001	0.00004	0.00015	3.8724E- 08	0.00015	0.00001	0.00003	0.00001	0.00019	0.00018	0.00002	0.609
benzo(b)fluoranthene	S.04 Small stoves	.	.	.	3.8724E- 08	.	0.002	.	0.002	.	.	.	.
benzo(k)fluoranthene	S.01 Direct- fired furnaces	0.00001	.	0.00006	.	0.00006	.	0.00019	.	0.00019	0.00018	.	0.069
benzo(k)fluoranthene	S.02 Gas turbines	.	0.00004	.	.	.	.	0.00019	.	.	.	.	.
benzo(k)fluoranthene	S.03 Boilers	0.00001	0.00004	0.00006	3.8724E- 08	0.00006	0.00002	0.00003	0.00002	0.00019	0.00018	0.00001	0.069
benzo(k)fluoranthene	S.04 Small stoves	.	.	.	3.8724E- 08	.	0.003	.	0.003	.	.	.	.
indeno(1,2,3_cd)pyrene	S.01 Direct- fired furnaces	0.00001	.	0.00005	.	0.00005	.	0.0003	.	0.00030	0.00028	.	0.061
indeno(1,2,3_cd)pyrene	S.02 Gas turbines	.	0.00004	.	.	.	.	0.0003	.	.	.	.	.
indeno(1,2,3_cd)pyrene	S.03 Boilers	0.00001	0.00004	0.00005	3.8724E- 08	0.00005	0.00005	0.00004	0.00005	0.00030	0.00028	0.00001	0.061
indeno(1,2,3_cd)pyrene	S.04 Small stoves	.	.	.	3.8724E- 08	.	0.007	.	0.007	.	.	.	.

NE = Not estimated.

¹Emission 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). EEA (2013), EEA (2016), Allerup *et. al* (2015). Fuel wood factor: annual surveys on use of fuel wood in households.

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	.	10	.	.
Dioxins µg I- TEQ/tonne	S.1B2C Flares	.	.	.	.	.	.	.	.	.	0.05	0
		V34 CO gas	V36 Landfill gas	V35 Fuel gas	V32 LPG	V13 Kerosene (heating)	V17 Marine gas oil/ diesel, B17 Marine gas oil bio oils/V28 biofuel oil	V18 Light fuel	V19 Heavy distillate	V20 Heavy fuel oil	V51 Municipal 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	.	.	.	.	.	.	.	.	.
		V38 Petrol coke gas										
Dioxins µg I- TEQ/tonne	S.01 Direct- fired furnaces	0										
Dioxins µg I- TEQ/tonne	S.02 Gas turbines	.										
Dioxins µg I- TEQ/tonne	S.03 Boilers	0										
Dioxins µg I- TEQ/tonne	S.04 Small stoves	.										
Dioxins µg I- TEQ/tonne	S.1B2C Flares	.										

Numbers in italics have exceptions for some sectors, see next table.

Source: Finstad *et al.* (2002).

Table 42. Exceptions from the general factors for POPs

Emission factor (ug dioxin/tonne)	Fuel	Source	Sectors
0.2	V19, 20 Heavy distillate, heavy fuel oil	S.03 Boilers	330000

References

- 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>
- 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>
- EEA (2019): *EMEP-EEA air pollutant emission inventory guidebook*. [EMEP/EEA air pollutant emission inventory guidebook 2019 — European Environment Agency](http://www.eea.europa.eu/publications/emep-eea-guidebook-2019)
- 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: *Handbook emission factors for road transport (HBEFA)* <https://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
- 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
- Seljeskog M., Goile F., Skreiberg Ø. (2017): *Recommended revisions of Norwegian emission factors for wood stoves*. Energy Procedia 105 (2017) 1022 – 1028.
- Skreiberg Ø., Seljeskog M., Kausch F., Khalil R. (2023): *Emission levels and emission factors for modern wood stoves*. Chemical Engineering Transactions 105 (2023) 241-246.
- 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
- 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
- Vandenbussche, V. (2020): *Notat – Forskjeller i drivstoff og utslippstall mellom NOx-fond, AIS data fra Kystverket og statistikk fra MDir/SSB, Nox-fondet*

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