

# 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.

In the tables, dotted cells indicate combinations of fuel and source without consumption.  
Last update: November 2021

## CO<sub>2</sub>, SO<sub>2</sub> and heavy metals - Stationary and mobile combustion

**Table 1. General emission factors for CO<sub>2</sub>, SO<sub>2</sub> and heavy metals**

	CO <sub>2</sub> tonne/tonne <sup>2</sup>	SO <sub>2</sub> <sup>1</sup> kg/tonne <sup>2</sup>	Pb g/tonne <sup>2</sup>	Cd g/tonne <sup>2</sup>	Hg g/tonne <sup>2</sup>	As g/tonne <sup>2</sup>	Cr g/tonne <sup>2</sup>	Cu g/tonne <sup>2</sup>
Coal .....	2.52	16 <sup>3</sup>	0.2 <sup>3</sup>	0.003 <sup>3</sup>	0.05 <sup>3</sup>	0.089 <sup>3</sup>	0.065 <sup>3</sup>	0.087 <sup>3</sup>
Coke .....	3.19	18	0.2 <sup>3</sup>	0.003 <sup>3</sup>	0.05 <sup>3</sup>	0.089 <sup>3</sup>	0.065 <sup>3</sup>	0.087 <sup>3</sup>
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	<b>0.010</b>	0.03 <sup>4</sup>	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	<b>0.382</b>	0.07	0.01	0.03	0.05	0.04	0.05
Jet kerosene .....	3.15	<b>0.318</b>	0.07	0.01	0.03	0.05	0.05	0.05
Auto diesel .....	3.17 <sup>5</sup>	<b>0.0156<sup>6</sup></b>	0.1	0.01	0.0023	0.05	0.05	1.7
Marine gas oil/diesel .....	3.17	<b>1.156</b>	0.1	0.01	0.05	0.05	0.04	0.05
Light fuel oils .....	3.17	<b>1.442</b>	0.1	0.01	0.05	0.05	0.04	0.05
Heavy distillate .....	3.17	<b>5.3826</b>	0.1	0.01	0.05	0.05	0.04	0.05
Heavy fuel oil .....	3.2	<b>18.62<sup>7</sup></b>	1	0.1	0.2	0.057	1.35	0.53
Crude oil .....	3.2	<b>17.88</b>	1	0.1	0.2	0.057	1.35	0.53
Bio ethanol <sup>10</sup> .....	1.91	0.0092	0.03	0.01	0.01	0.05	0.05	1.7
Bio diesel <sup>10</sup> .....	2.85	0.0148	0.1	0.01	0	0.05	0.05	1.7
Natural gas (1000 Sm <sup>3</sup> ) .....	1.99/ <b>2.34<sup>8</sup></b>	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	0.348	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 .....	<b>0.5498<sup>9</sup></b>	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

<sup>1</sup> Applies to 2019 for petroleum products; the factors change yearly, in accordance with changes in the sulphur content in the products.

<sup>2</sup> Natural gas: 1000 Sm<sup>3</sup>.

<sup>3</sup> Exceptions: Direct-fired furnaces in cement production = 9.1 and small stoves in households = 20.

<sup>4</sup> From 1997 - considerably higher earlier years. Earlier used factors are not shown in this Appendix.

<sup>5</sup> Bio ethanol and bio diesel are established as separate products

<sup>6</sup> Applies to road traffic.

<sup>7</sup> Stationary combustion.

<sup>8</sup> Respectively dry gas (domestic use) and rich gas (continental shelf).

<sup>9</sup> The factor increases through the period, from 0.4874 in 1990. Exact figures can be given at request.

<sup>10</sup> CO<sub>2</sub> emission from biofuels are set to 0 in the statistics Emissions to air. They are included in international reports.

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 SO<sub>2</sub> (kg/tonne)**

Years	V11 Motor gasoline/V23 Bio ethanol	V13 Kerosene (heating)	V14 Jet kerosene	V15 Auto diesel/V24 Bio diesel/V25 fossil part of bio 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
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	0.016	0.016	0.016	0.016	1.156	1.44	5.383	18.6	37.4

**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 CO<sub>2</sub>/1000 Sm<sup>3</sup> natural gas**

Sector	Source	Fuel	Component	1990-1994	1995	1996	1997	1998	1999	2000	2001	2002*
230600.1	S.02	V31	CO <sub>2</sub>	2.34	2.29	2.3	2.3	2.31	2.5	2.48	2.47	2.45
230600.1	S.1B2C	V31	CO <sub>2</sub>	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<sub>4</sub>, N<sub>2</sub>O, NO<sub>x</sub>, NMVOC, CO, particles and PAH

**Table 6. General emission factors for aviation**

Source	Fuel	CH <sub>4</sub> kg/ tonne	N <sub>2</sub> O kg/ tonne	NO <sub>x</sub> kg/ tonne	NMVOC kg/ tonne	CO kg/ tonne	NH <sub>3</sub> kg/ tonne	TSP, PM <sub>10</sub> , PM <sub>2.5</sub> kg/tonne	Dioxins µg I- TEQ/ tonne
M.1A3A.11 Jet/turboprop 0-1000 m	V14 Jet kerosene	<b>0.215</b>	0.1	<b>12.624</b>	<b>1.938</b>	<b>16.01</b>	0	<b>0.139</b>	0.06
M.1A3A.12 Jet/turboprop cruise	V14 Jet kerosene	0	0.1	<b>16.01</b>	<b>0.404</b>	<b>3.765</b>	0	<b>0.154</b>	0.06
M.1A3A.21 Helicopter 0-1000 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.31 Small aircraft 0-1000 m	V14 Jet kerosene	<b>0.432</b>	0.1	<b>4.792</b>	<b>3.892</b>	<b>18.789</b>	0	0	0
M.1A3A.32 Small aircraft cruise	V14 Jet kerosene	0	0.1	<b>6.738</b>	<b>0.406</b>	<b>2.125</b>	0	0	0.06
M.1A3A.11 Jet/turboprop 0-1000 m	V12 Aviation gasoline	<b>0.215</b>	0.1	<b>12.624</b>	<b>1.938</b>	<b>16.010</b>	0	<b>0.139</b>	2
M.1A3A.12 Jet/turboprop cruise	V12 Aviation gasoline	0	0.1	<b>16.010</b>	<b>0.404</b>	<b>3.765</b>	0	<b>0.154</b>	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	0.402	0.1	<b>4.792</b>	<b>3.892</b>	<b>18.789</b>	0	0	2
M.1A3A.32 Small aircraft cruise	V12 Aviation gasoline	0	0.1	<b>6.738</b>	<b>0.406</b>	<b>2.125</b>	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	0.005	0.009	0.003	0.011
M.1A3A.12 Jet/turboprop cruise	V14 Jet kerosene	0.005	0.009	0.003	0.011
M.1A3A.21 Helicopter 0-1000 m	V14 Jet kerosene	0.005	0.009	0.003	0.011
M.1A3A.22 Helicopter cruise	V14 Jet kerosene	0.005	0.009	0.003	0.011
M.1A3A.31 Small aircraft 0-1000 m	V14 Jet kerosene	0.005	0.009	0.003	0.011
M.1A3A.32 Small aircraft cruise	V14 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

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 kerosene: EEA (2013), Aviation gasoline: Aarhus University (2016)

**Table 7. Exceptions from the general factors for aviation**

Component	Emission factor	Fuel	Source	Sectors
CH <sub>4</sub>	0.35	V14 Jet kerosene	M1A3A.21	248422
NO <sub>x</sub>	13.857	V14 Jet kerosene	M1A3A.21	248422
NO <sub>x</sub>	11.7	V14 Jet kerosene	M.1A3A.32	248422
NM VOC	7.372	V14 Jet kerosene	M1A3A.21	248422
NM VOC	4.3	V14 Jet kerosene	M.1A3A.22	248422
CO	23.236	V14 Jet kerosene	M1A3A.21	248422
CO	20.9	V14 Jet kerosene	M.1A3A.22	248422

**Table 8. Time series, variable emission factors for aviation, jet kerosene**

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 <sub>4</sub>	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
NO <sub>x</sub>	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
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

**Table 8 (cont.) Time series for variable emission factors for aviation**

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)
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
TSP, PM <sub>10</sub> , PM <sub>2.5</sub>	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

Source: Statistics Norway

## Road traffic - CH<sub>4</sub>, N<sub>2</sub>O, NO<sub>x</sub>, NMVOC, CO, NH<sub>3</sub>, particles and PAH

**Table 9. General emission factors for road traffic**

Source	Fuel	CH <sub>4</sub> kg/tonne	N <sub>2</sub> O kg/tonne	NO <sub>x</sub> kg/tonne	NMVOC kg/tonne	CO kg/tonne	NH <sub>3</sub> kg/tonne	TSP, PM <sub>10</sub> kg/tonne	PM <sub>2.5</sub> kg/tonne	Dioxins µg I- TEQ/tonne
M.1A3B.1 Passenger car	V11 Motor gasoline	<b>0.258</b>	<b>0.017</b>	<b>2.624</b>	<b>4.828</b>	<b>30.397</b>	<b>0.561</b>	<b>0.024</b>	<b>0.024</b>	0.1
	V15 Auto diesel	<b>0.111</b>	<b>0.134</b>	<b>15.856</b>	<b>0.317</b>	<b>2.801</b>	<b>0.042</b>	<b>0.176</b>	<b>0.167</b>	0.1
	V23 Bio ethanol	<b>0.258</b>	<b>0.017</b>	<b>2.624</b>	<b>4.828</b>	<b>30.397</b>	<b>0.561</b>	<b>0.024</b>	<b>0.024</b>	0.1
	V24 Bio diesel	<b>0.111</b>	<b>0.134</b>	<b>15.856</b>	<b>0.317</b>	<b>2.801</b>	<b>0.042</b>	<b>0.176</b>	<b>0.167</b>	0.1
	V25 Bio diesel	<b>0.111</b>	<b>0.134</b>	<b>15.856</b>	<b>0.317</b>	<b>2.801</b>	<b>0.042</b>	<b>0.176</b>	<b>0.167</b>	0.1
	V32 LPG	1.134	<b>0.04</b>	<b>1.49</b>	<b>0.296</b>	<b>13.327</b>	<b>0.406</b>	<b>0.024</b>	<b>0.024</b>	0.06
M.1A3B.2 Other light duty cars	V11 Motor gasoline	<b>0.595</b>	<b>0.056</b>	<b>6.645</b>	<b>10.646</b>	<b>115.354</b>	<b>0.555</b>	<b>0.084</b>	<b>0.084</b>	0.1
	V15 Auto diesel	<b>0.096</b>	<b>0.115</b>	<b>13.093</b>	<b>0.159</b>	<b>2.483</b>	<b>0.047</b>	<b>0.311</b>	<b>0.296</b>	0.1
	V23 Bio ethanol	<b>0.595</b>	<b>0.056</b>	<b>6.645</b>	<b>10.646</b>	<b>115.354</b>	<b>0.555</b>	<b>0.084</b>	<b>0.084</b>	0.1
	V24 Bio diesel	<b>0.096</b>	<b>0.115</b>	<b>13.093</b>	<b>0.159</b>	<b>2.483</b>	<b>0.047</b>	<b>0.311</b>	<b>0.296</b>	0.1
	V25 Bio diesel	<b>0.096</b>	<b>0.115</b>	<b>13.093</b>	<b>0.159</b>	<b>2.483</b>	<b>0.047</b>	<b>0.311</b>	<b>0.296</b>	0.1
M.1A3B.3 Heavy duty vehicles	V11 Motor gasoline	<b>0.791</b>	<b>0.036</b>	<b>32.336</b>	<b>22.875</b>	<b>27.441</b>	<b>0.01</b>	<b>0</b>	<b>0</b>	0.1
	V15 Auto diesel	<b>0.005</b>	<b>0.113</b>	<b>7.965</b>	<b>0.209</b>	<b>3.489</b>	<b>0.033</b>	<b>0.151</b>	<b>0.143</b>	0.1
	V23 Bio ethanol	<b>0.791</b>	<b>0.036</b>	<b>32.336</b>	<b>22.875</b>	<b>27.441</b>	<b>0.01</b>	<b>0</b>	<b>0</b>	0.1
	V24 Bio diesel	<b>0.005</b>	<b>0.113</b>	<b>7.965</b>	<b>0.209</b>	<b>3.489</b>	<b>0.033</b>	<b>0.151</b>	<b>0.143</b>	0.1
	V25 Bio diesel	<b>0.005</b>	<b>0.113</b>	<b>7.965</b>	<b>0.209</b>	<b>3.489</b>	<b>0.033</b>	<b>0.151</b>	<b>0.143</b>	0.1
	V31/V37 Natural gas/Bio gas	14.463	0.189	<b>7.255</b>	<b>0.042</b>	<b>1.257</b>	0	<b>0.11</b>	<b>0.11</b>	0.05
M.1A3B.4 1 Moped	V11 Motor gasoline	<b>22.926</b>	<b>0.051</b>	<b>3.036</b>	<b>103.686</b>	<b>177.995</b>	<b>0.051</b>	<b>10.127</b>	<b>10.127</b>	0.1
	V23 Bio ethanol	<b>22.926</b>	<b>0.051</b>	<b>3.036</b>	<b>103.686</b>	<b>177.995</b>	<b>0.051</b>	<b>10.127</b>	<b>10.127</b>	0.1
M.1A3B.4 2 Motorcycle	V11 Motor gasoline	<b>2.418</b>	<b>0.051</b>	<b>4.714</b>	<b>29.214</b>	<b>218.792</b>	<b>0.051</b>	<b>0.181</b>	<b>0.181</b>	0.1
	V23 Bio ethanol	<b>2.418</b>	<b>0.051</b>	<b>4.714</b>	<b>29.214</b>	<b>218.792</b>	<b>0.051</b>	<b>0.181</b>	<b>0.181</b>	0.1

Bold numbers are different for different years, but only the 2019 data are shown here, except for CH<sub>4</sub> (table 10) and N<sub>2</sub>O (table 11).

Source: Results from Statistics Norway's use of HBEFA 4.1(INFRAS), Finstad *et al.* (2001). PAH-profile: Aarhus University (2016)



**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
	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 2019 data are shown here, except for CH<sub>4</sub> (table 10) and N<sub>2</sub>O (table 11).

Source: Results from Statistics Norway's use of HBEFA 4.1 (INFRAS), Finstad *et al.* (2001). PAH-profile: Aarhus University (2016)

**Table 10. Average CH<sub>4</sub> emission factors for road traffic including cold start emissions and evaporation, g CH<sub>4</sub>/ 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 .....	1.7	1.676	0.735	11.752	2.669	0.158	0.085	0.133
1991 .....	1.652	1.693	0.74	11.835	2.518	0.152	0.084	0.132
1992 .....	1.599	1.679	0.743	11.875	2.38	0.142	0.082	0.128
1993 .....	1.565	1.655	0.754	12.058	2.247	0.117	0.072	0.118
1994 .....	1.515	1.617	0.766	12.237	2.145	0.119	0.078	0.12
1995 .....	1.454	1.557	0.778	12.431	2.069	0.113	0.074	0.112
1996 .....	1.275	1.412	0.751	12	1.881	0.105	0.068	0.1
1997 .....	1.217	1.39	0.776	12.408	1.99	0.107	0.069	0.097
1998 .....	1.097	1.29	0.767	12.261	1.984	0.099	0.06	0.078
1999 .....	1.008	1.226	0.767	13.772	2.04	0.083	0.05	0.061
2000 .....	0.96	1.181	0.803	17.238	2.29	0.08	0.048	0.058
2001 .....	0.854	1.06	0.77	19.489	2.323	0.071	0.043	0.049
2002 .....	0.785	0.997	0.769	22.706	2.436	0.067	0.04	0.046
2003 .....	0.714	0.944	0.761	24.552	2.507	0.063	0.039	0.043
2004 .....	0.642	0.888	0.751	25.232	2.549	0.06	0.036	0.04
2005 .....	0.614	0.887	0.785	26.415	2.663	0.059	0.036	0.039
2006 .....	0.569	0.851	0.794	26.385	2.685	0.055	0.033	0.036
2007 .....	0.547	0.829	0.814	26.597	2.746	0.053	0.032	0.033
2008 .....	0.519	0.786	0.812	26.08	2.708	0.05	0.029	0.03
2009 .....	0.493	0.746	0.804	25.451	2.738	0.049	0.027	0.025
2010 .....	0.46	0.694	0.809	25.384	3.501	0.049	0.024	0.02
2011 .....	0.449	0.694	0.82	25.558	3.551	0.056	0.025	0.017
2012 .....	0.427	0.673	0.813	25.227	3.449	0.063	0.029	0.015
2013 .....	0.402	0.655	0.805	24.868	3.302	0.067	0.034	0.013
2014 .....	0.371	0.631	0.783	24.111	3.098	0.07	0.037	0.011
2015 .....	0.352	0.63	0.786	24.122	2.985	0.076	0.042	0.009
2016 .....	0.326	0.612	0.77	23.549	2.802	0.082	0.046	0.008
2017 .....	0.303	0.593	0.772	23.695	2.694	0.094	0.056	0.007
2018 .....	0.284	0.591	0.781	23.566	2.603	0.104	0.067	0.006
2019 .....	0.277	0.601	0.801	23.693	2.554	0.108	0.08	0.005
2020 .....	0.258	0.595	0.791	22.926	2.418	0.111	0.096	0.005

Source: Results from Statistics Norway's use of HBEFA 4.1 (INFRAS)

**Table 10 (cont.) Average CH<sub>4</sub> emission factors for road traffic including cold start emissions and evaporation, g CH<sub>4</sub>/kg fuel**

	V23 Bio ethanol					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 .....	1.7	1.676	0.735	11.752	2.669	0.158	0.085	0.133
1991 .....	1.652	1.693	0.74	11.835	2.518	0.152	0.084	0.132
1992 .....	1.599	1.679	0.743	11.875	2.38	0.142	0.082	0.128
1993 .....	1.565	1.655	0.754	12.058	2.247	0.117	0.072	0.118
1994 .....	1.515	1.617	0.766	12.237	2.145	0.119	0.078	0.12
1995 .....	1.454	1.557	0.778	12.431	2.069	0.113	0.074	0.112
1996 .....	1.275	1.412	0.751	12	1.881	0.105	0.068	0.1
1997 .....	1.217	1.39	0.776	12.408	1.99	0.107	0.069	0.097
1998 .....	1.097	1.29	0.767	12.261	1.984	0.099	0.06	0.078
1999 .....	1.008	1.226	0.767	13.772	2.04	0.083	0.05	0.061
2000 .....	0.96	1.181	0.803	17.238	2.29	0.08	0.048	0.058
2001 .....	0.854	1.06	0.77	19.489	2.323	0.071	0.043	0.049
2002 .....	0.785	0.997	0.769	22.706	2.436	0.067	0.04	0.046
2003 .....	0.714	0.944	0.761	24.552	2.507	0.063	0.039	0.043
2004 .....	0.642	0.888	0.751	25.232	2.549	0.06	0.036	0.04
2005 .....	0.614	0.887	0.785	26.415	2.663	0.059	0.036	0.039
2006 .....	0.569	0.851	0.794	26.385	2.685	0.055	0.033	0.036
2007 .....	0.547	0.829	0.814	26.597	2.746	0.053	0.032	0.033
2008 .....	0.519	0.786	0.812	26.08	2.708	0.05	0.029	0.03
2009 .....	0.493	0.746	0.804	25.451	2.738	0.049	0.027	0.025
2010 .....	0.46	0.694	0.809	25.384	3.501	0.049	0.024	0.02
2011 .....	0.449	0.694	0.82	25.558	3.551	0.056	0.025	0.017
2012 .....	0.427	0.673	0.813	25.227	3.449	0.063	0.029	0.015
2013 .....	0.402	0.655	0.805	24.868	3.302	0.067	0.034	0.013
2014 .....	0.371	0.631	0.783	24.111	3.098	0.07	0.037	0.011
2015 .....	0.352	0.63	0.786	24.122	2.985	0.076	0.042	0.009
2016 .....	0.326	0.612	0.77	23.549	2.802	0.082	0.046	0.008
2017 .....	0.303	0.593	0.772	23.695	2.694	0.094	0.056	0.007
2018 .....	0.284	0.591	0.781	23.566	2.603	0.104	0.067	0.006
2019 .....	0.277	0.601	0.801	23.693	2.554	0.108	0.08	0.005
2020 .....	0.258	0.595	0.791	22.926	2.418	0.111	0.096	0.005

Source: Results from Statistics Norway's use of HBEFA 4.1 (INFRAS)

**Table 11. Average N<sub>2</sub>O emission factors for road traffic including cold start emissions and evaporation, g N<sub>2</sub>O/ 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	0.102	0.092	0.034	0.047	0.045	0	0	0.038
1991	0.109	0.093	0.034	0.047	0.045	0	0	0.038
1992	0.115	0.095	0.034	0.048	0.044	0	0	0.038
1993	0.123	0.102	0.035	0.048	0.045	0	0	0.034
1994	0.133	0.11	0.035	0.049	0.045	0	0	0.037
1995	0.144	0.121	0.036	0.05	0.045	0.004	0.005	0.036
1996	0.152	0.127	0.034	0.048	0.043	0.013	0.015	0.036
1997	0.16	0.143	0.036	0.05	0.045	0.026	0.024	0.038
1998	0.156	0.148	0.035	0.049	0.044	0.038	0.031	0.038
1999	0.155	0.156	0.035	0.049	0.044	0.043	0.035	0.033
2000	0.159	0.167	0.037	0.052	0.046	0.053	0.042	0.033
2001	0.155	0.177	0.035	0.049	0.044	0.057	0.044	0.03
2002	0.155	0.194	0.035	0.049	0.045	0.063	0.047	0.029
2003	0.15	0.172	0.035	0.049	0.044	0.068	0.051	0.028
2004	0.145	0.174	0.035	0.048	0.044	0.071	0.054	0.026
2005	0.086	0.165	0.036	0.051	0.046	0.078	0.059	0.026
2006	0.082	0.163	0.036	0.051	0.047	0.081	0.062	0.025
2007	0.081	0.164	0.037	0.052	0.048	0.088	0.067	0.027
2008	0.078	0.155	0.037	0.052	0.048	0.091	0.068	0.031
2009	0.073	0.146	0.037	0.052	0.048	0.091	0.067	0.037
2010	0.067	0.128	0.037	0.052	0.051	0.092	0.064	0.046
2011	0.063	0.125	0.038	0.053	0.051	0.099	0.066	0.062
2012	0.056	0.116	0.037	0.052	0.051	0.106	0.069	0.073
2013	0.049	0.106	0.037	0.052	0.05	0.109	0.071	0.078
2014	0.041	0.095	0.036	0.05	0.049	0.109	0.071	0.088
2015	0.035	0.089	0.036	0.05	0.049	0.111	0.073	0.094
2016	0.03	0.079	0.035	0.049	0.048	0.112	0.075	0.097
2017	0.026	0.071	0.035	0.049	0.048	0.121	0.085	0.104
2018	0.022	0.065	0.036	0.05	0.049	0.127	0.096	0.11
2019	0.02	0.062	0.037	0.051	0.051	0.131	0.106	0.113
2020	0.017	0.056	0.036	0.051	0.051	0.134	0.115	0.113

**Table 11 (cont.) Average N<sub>2</sub>O emission factors for road traffic including cold start emissions and evaporation, g N<sub>2</sub>O/kg fuel**

	V23 Bio ethanol					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	0.102	0.092	0.034	0.047	0.045	0	0	0.038
1991	0.109	0.093	0.034	0.047	0.045	0	0	0.038
1992	0.115	0.095	0.034	0.048	0.044	0	0	0.038
1993	0.123	0.102	0.035	0.048	0.045	0	0	0.034
1994	0.133	0.11	0.035	0.049	0.045	0	0	0.037
1995	0.144	0.121	0.036	0.05	0.045	0.004	0.005	0.036
1996	0.152	0.127	0.034	0.048	0.043	0.013	0.015	0.036
1997	0.16	0.143	0.036	0.05	0.045	0.026	0.024	0.038
1998	0.156	0.148	0.035	0.049	0.044	0.038	0.031	0.038
1999	0.155	0.156	0.035	0.049	0.044	0.043	0.035	0.033
2000	0.159	0.167	0.037	0.052	0.046	0.053	0.042	0.033
2001	0.155	0.177	0.035	0.049	0.044	0.057	0.044	0.03
2002	0.155	0.194	0.035	0.049	0.045	0.063	0.047	0.029
2003	0.15	0.172	0.035	0.049	0.044	0.068	0.051	0.028
2004	0.145	0.174	0.035	0.048	0.044	0.071	0.054	0.026
2005	0.086	0.165	0.036	0.051	0.046	0.078	0.059	0.026
2006	0.082	0.163	0.036	0.051	0.047	0.081	0.062	0.025
2007	0.081	0.164	0.037	0.052	0.048	0.088	0.067	0.027
2008	0.078	0.155	0.037	0.052	0.048	0.091	0.068	0.031
2009	0.073	0.146	0.037	0.052	0.048	0.091	0.067	0.037
2010	0.067	0.128	0.037	0.052	0.051	0.092	0.064	0.046
2011	0.063	0.125	0.038	0.053	0.051	0.099	0.066	0.062
2012	0.056	0.116	0.037	0.052	0.051	0.106	0.069	0.073
2013	0.049	0.106	0.037	0.052	0.05	0.109	0.071	0.078
2014	0.041	0.095	0.036	0.05	0.049	0.109	0.071	0.088
2015	0.035	0.089	0.036	0.05	0.049	0.111	0.073	0.094
2016	0.03	0.079	0.035	0.049	0.048	0.112	0.075	0.097
2017	0.026	0.071	0.035	0.049	0.048	0.121	0.085	0.104
2018	0.022	0.065	0.036	0.05	0.049	0.127	0.096	0.11
2019	0.02	0.062	0.037	0.051	0.051	0.131	0.106	0.113
2020	0.017	0.056	0.036	0.051	0.051	0.134	0.115	0.113

Source: Results from Statistics Norway's use of HBEFA 4.1 (INFRAS)

## Navigation - CH<sub>4</sub>, N<sub>2</sub>O, NO<sub>x</sub>, NMVOC, CO, particles and POPs

**Table 12. General emission factors for navigation**

	CH <sub>4</sub> kg/ tonne	N <sub>2</sub> O kg/ tonne	NO <sub>x</sub> kg/ tonne	NMVOC kg/tonne	CO kg/ tonne	NH <sub>3</sub> kg/ tonne	TSP, PM <sub>10</sub> kg/ tonne	PM <sub>2.5</sub> kg/ tonne	Dioxins µg I- TEQ/ tonne
V17 Marine gas oil/diesel, V18 Light fuel oils	0.23	0.08	<b>33.11</b>	2.4	2.9	0	1.6	1.5	4
V19 Heavy distillate, V20 Heavy fuel oil	0.23	0.08	<b>33.11</b>	2.4	2.9	0	5.4	5.1	4
V31 Natural gas (1000 Sm <sup>3</sup> )	32.49	0.07	4.88	0.81	2.14	0	0.03	0.03	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 <sup>3</sup> )	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), Tormsjø (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 <sub>4</sub>	0.8 V17	Marine gas oil/diesel	230600.1 -230600.3, 230910
CH <sub>4</sub>	1.9 V20	Heavy fuel oil	230600.1 -230600.3, 230910
N <sub>2</sub> O	0.02 V17	Marine gas oil/diesel	230600.1 -230600.3, 230910
NO <sub>x</sub>	<b>28.60</b> V17, 19, 20	Marine gas oil/diesel, light fuel oils, heavy distillate, heavy fuel oil	230310.N
NO <sub>x</sub>	54 V17	Marine gas oil/diesel, light fuel oils, heavy distillate, Heavy fuel oil	230600.1 -230600.3, 230910
NO <sub>x</sub>	<b>46.58</b> 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, 230910
NMVOC	5 V19, 20	Heavy distillate, heavy fuel oil	230600.1 -230600.3, 230910
CO	7.9 V17, 18, 19, 20	Marine gas oil/diesel, light fuel oils, heavy distillate, heavy fuel oil	230310.N
CO	7 V17, 19, 20	Marine gas oil/diesel, light fuel oils, heavy distillate, heavy fuel oil	230600.1 -230600.3, 230910
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<sub>x</sub>**

Sector	General	230310.N	248422
Fuel	V17-20	V17, 19, 20	V17, 19, 20
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	57.96	52.01	49.6
2007	57.18	51.9	49.39
2008	56.8	51.8	49.17
2009	56.51	51.69	48.95
2010	55.9	51.58	48.74
2011	55.55	51.48	48.52
2012	54.61	50.93	48.31
2013	53.35	49.9	48.09
2014	52.1	47.41	47.88
2015	50.84	45.17	47.66
2016	49.58	43.64	47.44
2017	48.33	43.36	47.23
2018	47.07	40.94	47.01
2019	45.81	37.97	46.8
2020	44.56	36.6	46.58

Source: (Flugsrud *et al.* 2010 and Vandenbussche 2019)

**Table 15. Time series for variable emission factors for navigation, general, natural gas, CH<sub>4</sub>**

	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

**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	7
230600.1-230600.3, 230910	V19,20	6.4			5					
248422	V17-20		2.2			2.3				

### Other mobile sources including railways - CH<sub>4</sub>, N<sub>2</sub>O, NO<sub>x</sub>, NMVOC, CO, NH<sub>3</sub>, particles and POPs

**Table 17. General emission factors for other mobile sources**

		CH <sub>4</sub> kg/tonne	N <sub>2</sub> O kg/tonne	NO <sub>x</sub> kg/tonne	NMVOC kg/tonne	CO kg/tonne	NH <sub>3</sub> kg/Tonne	TSP, PM <sub>10</sub> kg/tonne	PM <sub>2.5</sub> 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 Auto diesel	0.18	1.2	47	4	11	0.007	3.8	3.61	0.1
M.1A3E.21 Small boats 2 stroke	V11 Motor gasoline	5.1	0.02	<b>7.73</b>	<b>92.77</b>	415	0	8	8	<b>0.1</b>
	V23 Bio ethanol	5.1	0.02	<b>7.73</b>	<b>92.77</b>	415	0	8	8	<b>0.1</b>
M.1A3E.22 Small boats 4 stroke	V11 Motor gasoline	1.7	0.08	<b>36.3</b>	<b>46.65</b>	1 000	0	1	1	<b>0.1</b>
	V15 Auto diesel	0.18	0.03	<b>38.93</b>	<b>7.22</b>	25	0	4	4	0.1
	V23 Bio ethanol	1.7	0.08	<b>36.3</b>	<b>46.65</b>	1 000	0	1	1	<b>0.1</b>
M.1A3E.31 Motorized equipment 2 stroke	V11 Motor gasoline	6	0.02	2 <sup>1</sup>	500	700	0	8	8	<b>0.1</b>
	V23 Bio ethanol	1.7	0.08	12	40	1 000	0	1	1	<b>0.1</b>
M.1A3E.32 Motorized equipment 4t	V11 Motor gasoline	2.2	0.07	10	110	1 200	0	1	1	<b>0.1</b>
	V15 Auto diesel	0.17	0.14	<b>12.23</b>	<b>0.84</b>	<b>6.07</b>	0.008	<b>0.09</b>	<b>0.09</b>	0.1
	V18 Light fuel oils	0.17	1.3	50	6	15	0.005	7.1	6.75	0.1
	V23 Bio ethanol	2.2	0.07	10	110	1 200	0	1	1	<b>0.1</b>



**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
M.1A3C Railway	V01 Coal	0.007	0.01	0.004	0.003
	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
	V23 Bio ethanol	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
	V23 Bio ethanol	0.040	0.040	0	0
M.1A3E.31 Motorized equipment 2 stroke	V11 Motor gasoline	0.040	0.040	0	0
	V23 Bio ethanol	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
	V23 Bio ethanol	0.040	0.040	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 2019 figures are presented here.

<sup>1</sup>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 <sub>4</sub>	6.2	V11	Motor gasoline	M.1A3E.31 Motorized equipment 2 stroke	230100
CH <sub>4</sub>	3.7	V11	Motor gasoline	M.1A3E.32 Motorized equipment 4 stroke	230100
CH <sub>4</sub>	7.7	V11	Motor gasoline	M.1A3E.31 Motorized equipment 2 stroke	230210
CH <sub>4</sub>	8.1	V11	Motor gasoline	M.1A3E.31 Motorized equipment 2 stroke	330000
CH <sub>4</sub>	5.5	V11	Motor gasoline	M.1A3E.32 Motorized equipment 4 stroke	330000
CH <sub>4</sub>	0.18	V15	Auto diesel	M.1A3E.32 Motorized equipment 4 stroke	330000
CH <sub>4</sub>	6.2	V23	Bio ethanol	M.1A3E.31 Motorized equipment 2 stroke	230100
CH <sub>4</sub>	3.7	V23	Bio ethanol	M.1A3E.32 Motorized equipment 4 stroke	230100
CH <sub>4</sub>	7.7	V23	Bio ethanol	M.1A3E.31 Motorized equipment 2 stroke	230210
CH <sub>4</sub>	8.1	V23	Bio ethanol	M.1A3E.31 Motorized equipment 2 stroke	330000
CH <sub>4</sub>	5.5	V23	Bio ethanol	M.1A3E.32 Motorized equipment 4 stroke	330000
N <sub>2</sub> O	0.08	V11	Motor gasoline	M.1A3E.32 Motorized equipment 4 stroke	230500-233320
N <sub>2</sub> O	0.132	V15	Auto diesel	M.1A3E.32 Motorized equipment 4 stroke	230100-230210
N <sub>2</sub> O	0,08	V23	Bio ethanol	M.1A3E.32 Motorized equipment 4 stroke	230500-233320
NO <sub>x</sub>	<b>11.81</b>	V15	Auto diesel	M.1A3E.32 Motorized equipment 4 stroke	230100-230210
NO <sub>x</sub>	54	V18	Light fuel oils	M.1A3E.32 Motorized equipment 4 stroke	230100
NO <sub>x</sub>	52	V18	Light fuel oils	M.1A3E.32 Motorized equipment 4 stroke	230210
NO <sub>x</sub>	47	V18	Light fuel oils	M.1A3E.32 Motorized equipment 4 stroke	230710-230892, 234910
NO <sub>x</sub>	48	V18	Light fuel oils	M.1A3E.32 Motorized equipment 4 stroke	232360, 248422
NO <sub>x</sub>	46	V18	Light fuel oils	M.1A3E.32 Motorized equipment 4 stroke	234110-234120
NM VOC	<b>1.48</b>	V15	Auto diesel	M.1A3E.32 Motorized equipment 4 stroke	230100-230200
NM VOC	7.2	V18	Light fuel oils	M.1A3E.32 Motorized equipment 4 stroke	230100
NM VOC	5.7	V18	Light fuel oils	M.1A3E.32 Motorized equipment 4 stroke	230210
NM VOC	4	V18	Light fuel oils	M.1A3E.32 Motorized equipment 4 stroke	230710-230892, 234910
NM VOC	4.8	V18	Light fuel oils	M.1A3E.32 Motorized equipment 4 stroke	232360, 248422
NM VOC	3.8	V18	Light fuel oils	M.1A3E.32 Motorized equipment 4 stroke	234110-234120
CO	<b>8.46</b>	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<sub>x</sub> 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 <sub>10</sub>	<b>1.28</b>	V15	Auto diesel	M.1A3E.32 Motorized equipment 4 stroke	230100-230210
TSP, PM <sub>10</sub>	3.8	V18	Light fuel oils	M.1A3E.32 Motorized equipment 4 stroke	230710-230892, 234910
TSP, PM <sub>10</sub>	4.2	V18	Light fuel oils	M.1A3E.32 Motorized equipment 4 stroke	232360
TSP, PM <sub>10</sub>	5.3	V18	Light fuel oils	M.1A3E.32 Motorized equipment 4 stroke	234110-234120
TSP, PM <sub>10</sub>	5.4	V18	Light fuel oils	M.1A3E.32 Motorized equipment 4 stroke	248422
PM <sub>2.5</sub>	<b>1.21</b>	V15	Auto diesel	M.1A3E.32 Motorized equipment 4 stroke	230100-230210
PM <sub>2.5</sub>	3.61	V18	Light fuel oils	M.1A3E.32 Motorized equipment 4 stroke	230710-230892, 234910
PM <sub>2.5</sub>	3.99	V18	Light fuel oils	M.1A3E.32 Motorized equipment 4 stroke	232360
PM <sub>2.5</sub>	5.04	V18	Light fuel oils	M.1A3E.32 Motorized equipment 4 stroke	234110-234120
PM <sub>2.5</sub>	5.13	V18	Light fuel oils	M.1A3E.32 Motorized equipment 4 stroke	248422

Bold numbers are different for different years, but only 2019 figures are presented here.

**Table 20. Time series for NO<sub>x</sub> 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	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

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

## Fuel Wood - CH<sub>4</sub>, N<sub>2</sub>O, NO<sub>x</sub>, NMVOC, CO, NH<sub>3</sub>, particles and PAH

**Table 22. Emission factors Fuel Wood V41, kg/tonne**

Component	S.05 Small stoves (produced before 1998)	S.06 Small stoves (produced after 1998)	S.07 Fireplace
CH <sub>4</sub> .....	16.1445	3.883	5.3
N <sub>2</sub> O .....	0.032	0.032	0.032
NO <sub>x</sub> .....	0.97	0.97	1.3
NMVOC .....	22.284	15.218	7
CO .....	102.025	85.73	126.3
NH <sub>3</sub> .....	0.066	0.066	0.066
TSP .....	24.145	8.44	17.3
PM <sub>10</sub> .....	23.13	8.3	17
PM <sub>2.5</sub> .....	20.855	7.85	16.4

Source: Seljeskog *et al.* (2017).

**Table 23. Emission factors Fuel Wood V41, g/tonne**

Component	S.05 Small stoves (produced before 1998)	S.06 Small stoves (produced after 1998)	S.07 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 24. Emission factors Fuel Wood V41, ug/tonne**

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

Source: Seljeskog *et al.* (2017).

## CH<sub>4</sub> - Stationary combustion

**Table 25. General emission factors, kg CH<sub>4</sub>/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 <sup>3</sup> )	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	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 26. Exceptions from the general factors for CH<sub>4</sub>, stationary combustion (kg CH<sub>4</sub>/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 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	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<sub>2</sub>O - Stationary combustion

**Table 27. General emission factors. kg N<sub>2</sub>O/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 <sup>3</sup> )	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	.	.	.	.	0.0691	.	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 28. Exceptions from the general factors for N<sub>2</sub>O. Stationary combustion (kg N<sub>2</sub>O/1000 Sm<sup>3</sup> 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<sub>x</sub> - Stationary combustion

**Table 29. General emission factors. kg NO<sub>x</sub>/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 gas (1000 Sm <sup>3</sup> )	V31 Natural gas	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	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	.	.	54	.	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 30. Exceptions from the general factors for NO<sub>x</sub>. Stationary combustion. kg NO<sub>x</sub> /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 <sup>3</sup> )	S.01 Direct-fired furnaces 232014
9.5	V19, 20	Heavy distillate, heavy fuel oil	S.01 Direct-fired furnaces 232360
<b>8.681</b>	V31	Natural gas (1000 Sm <sup>3</sup> )	S.02 Gas turbines 230600.1
1,4	V31	Natural gas (1000 Sm <sup>3</sup> )	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 231922, 233511
1.4	V01, 02	Coal, coke	S.04 Small stoves 330000

**Table 31. Time series for variable emission factors for NO<sub>x</sub>. Stationary combustion. kg NO<sub>x</sub> /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

## NM VOC - Stationary combustion

**Table 32. 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 <sup>3</sup> )	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	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 33. 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 <sup>3</sup> )	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 34. 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 <sup>3</sup> )	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	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 35. 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	231910.2, 232350, 232360
0.01	V34	CO gas	S.01 Direct-fired furnaces 231910.2
7	V17	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	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 <sup>3</sup> )	S.1B2C Flares 231922

## NH<sub>3</sub> - Stationary combustion

**Table 36. General emission factors. kg NH<sub>3</sub>/tonne fuel**

[illegible]

## 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	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 <sub>10</sub> ...S.01 Direct-fired furnaces	0.144	.	0.144	.	.	0.143	.	*	*	.	4.87
PM <sub>10</sub> ...S.02 Gas turbines	.	.	.	.	.	0.143	.	.	.	.	.
PM <sub>10</sub> ...S.03 Boilers	0.144	0.144	0.144	0.136	0.148	0.143	0.15	*	*	0.05	4.87
PM <sub>10</sub> ...S.04 Small stoves	.	.	.	0.136	0.16	.	0.155	.	.	.	.
PM <sub>10</sub> ...S.1B2C Flares	.	0.144	.	.	.	.	.	.	.	.	.
PM <sub>2.5</sub> ...S.01 Direct-fired furnaces	0.144	.	0.144	.	.	0.036	.	*	*	.	3.2
PM <sub>2.5</sub> ...S.02 Gas turbines	.	.	.	.	.	0.036	.	.	.	.	.
PM <sub>2.5</sub> ...S.03 Boilers	0.144	0.144	0.144	0.136	0.037	0.12	0.12	*	*	0.05	3.2
PM <sub>2.5</sub> ...S.04 Small stoves	.	.	.	0.136	0.12	.	0.119	.	.	.	.
PM <sub>2.5</sub> ...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 38. 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-
V19	TSP	0.803	0.714	0.701	0.701	0.688	0.714	0.663	0.688	0.701	0.714
	PM <sub>10</sub>	0.690	0.614	0.603	0.603	0.592	0.614	0.570	0.592	0.603	0.614
	PM <sub>2.5</sub>	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 <sub>10</sub>	1.161	1.151	1.131	1.121	1.023	0.905	0.944	0.934	0.954	1.033
	PM <sub>2.5</sub>	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 39. Exceptions from the general factors for particles. Stationary combustion**

Emission factor (kg TSP/tonne)	Emission factor (kg PM <sub>10</sub> /tonne)	Emission factor (kg PM <sub>2.5</sub> /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

## POPs (Persistent Organic Pollutants) - Stationary combustion

**Table 40. General emission factors for PAH**

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 Sm <sup>3</sup> )	V33 Refinery gas
benzo(a) pyrene	S.01 Direct-fired furnaces	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**

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 <sup>1</sup>	V52 Special waste
benzo(a)pyrene	S.01 Direct-fired furnaces	0.00001	.	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	0.00002	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	.	.	0.00019	.	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	0.00001	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	.	.	0.00019	.	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	0.00002	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	.	.	0.0003	.	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	0.00004	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	.	.	.	.

Bold numbers are different for different years, see table 40. NE = Not estimated. <sup>1</sup>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)

## 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 <sup>3</sup> )	V33 Refinery gas
Dioxins S.01 µg I-TEQ/tonne Direct-fired furnaces		1.6	1.6	1.6	.	.	.	.	.	2.95.	0.05	0
Dioxins S.02 µg I-TEQ Gas /tonne turbines		.	.	.	.	.	.	.	.	.	0.05	.
Dioxins S.03 µg I-TEQ Boilers /tonne		1.6	1.6	1.6	.	1	1	1	1	.	0.05	0
Dioxins S.04 µg I-TEQ Small /tonne stoves		10	10	10	.	.	.	5.9	.	10	.	.
Dioxins S.1B2C µg I-TEQ Flares /tonne		.	.	.	.	.	.	.	.	.	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 Municipal waste	V52 Special waste
Dioxins S.01 µg I-TEQ Direct-fired furnaces		0	.	0	.	.	4	.	0.1	0.1	.	4
Dioxins S.02 µg I-TEQ Gas /tonne turbines		.	.	.	.	.	4	.	.	.	.	.
Dioxins S.03 µg I-TEQ Boilers /tonne		0	0	1	0.06	0.1	0.1	0.1	0.1	0.1	0.02	4
Dioxins S.04 µg I-TEQ Small /tonne stoves		.	.	.	0.06	0.06	.	0.2	.	.	.	.
Dioxins S.1B2C µg I-TEQ Flares /tonne		.	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

- 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 NO<sub>x</sub> emission factor for ships, 2009*, MT22 F09-150, Marintek
- EEA (2013): *EMEP-EEA air pollutant emission inventory guidebook 2013* <http://www.eea.europa.eu/publications/emep-eea-guidebook-2013>
- EEA (2016): *EMEP-EEA air pollutant emission inventory guidebook 2016* <http://www.eea.europa.eu/publications/emep-eea-guidebook-2016>
- EEA (2019): *EMEP-EEA air pollutant emission inventory guidebook 2019* <https://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](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](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](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/01/04/10/rapp\\_9617/rapp\\_9617.pdf](http://www.ssb.no/emner/01/04/10/rapp_9617/rapp_9617.pdf)
- Flugsrud, K., Hoem, B. and Aasestad, K. (2010): *Utslipp til luft av NO<sub>x</sub> fra innenriks sjøfart og fiske (NO<sub>x</sub> 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](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.

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