

## Review of the consistency of PM, HM and POP emission factors – 6D Other Waste and use of tobacco (3D3)

The following categories are reviewed:

- Compost production
- Sludge spreading
- Car fires
- Building fires
- Use of tobacco (3D3-other product use)

### Other Waste (6D)

A review of the consistency of the categories in section 6D has led to no recommendation for compost production or sludge spreading.

### Car fires

GB2009-Table 0-1 Tier 2 emission factors for source category 6.D Other waste, car fire

Tier 2 emission factors					
NFR Source Category	Code	Name			
6.D	6.D	Other waste			
Fuel	NA				
SNAP (if applicable)					
Technologies/Practices	Car fire				
Region or regional conditions					
Abatement technologies					
Not applicable	NH3				
Not estimated	NOx, CO, NMVOC, SOx, Pb, Cd, Hg, As, Cr, Cu, Ni, Se, Zn, Aldrin, Chlordane, Chlordecone, Dieldrin, Endrin, Heptachlor, Heptabromo-biphenyl, Mirex, Toxaphene, HCH, DDT, PCB, Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Indeno(1,2,3-cd)pyrene, Total 4 PAHs, HCB, PCP, SCCP				
Pollutant	Value	Unit	95% confidence interval		Reference
			Lower	Upper	
TSP	2.3	kg/fire	1	5	Aasestad (2007)
PM10	2.3	kg/fire	1	5	Aasestad (2007)
PM2.5	2.3	kg/fire	1	5	Aasestad (2007)
PCDD/F	0.047	µg/fire	0.02	0.1	Aasestad (2007)

The unit of the PCDD/F EF for car fires has not been reported correctly. Aasestad (2007) refers to Hansen (2000) who refers to a German experiment, according to Hansen (2000) this experiment “has shown a generation of dioxin of 0.044 and 0.052 mg I-TEQ for two different cars”.

It is recommended that the EF for PCDD/F is changed to 0.048 mg/fire with reference to Hansen (2000).

Tier 2 emission factors		
NFR source category	Code	Name
6.D	6.D	Other waste
Fuel	NA	
SNAP (if applicable)		
Technologies/Practices	Car fire	
Region or regional		

conditions					
Abatement technologies					
Not applicable					
Not estimated	SO <sub>2</sub> , NO <sub>x</sub> , NMVOC, CO, NH <sub>3</sub> , As, Cd, Cr, Cu, Hg, Ni, Pb, Se, Zn, HCB, Benzo(a)pyrene, Benzo(b)fluoranthene, benzo(k), fluoranthene, Indeno(1,2,3-cd)pyrene, PCBs				
Pollutant	Value	Unit	95 % confidence interval		Reference
			Lower	Upper	
TSP	2.3	kg/fire	1	5	Aasestad (2007)
PM <sub>10</sub>	2.3	kg/fire	1	5	Aasestad (2007)
PM <sub>2.5</sub>	2.3	kg/fire	1	5	Aasestad (2007)
PCDD/F	0.048	mg/fire	0.02	0.1	Hansen (2000)

## Building fires

**GB2009-Table 0-2 Tier 2 emission factors for source category 6.D Other waste, detached house fire**

Tier 2 emission factors					
	Code	Name			
NFR Source Category	6.D	Other waste			
Fuel	NA				
SNAP (if applicable)					
Technologies/Practices	Detached house fire				
Region or regional conditions					
Abatement technologies					
Not applicable	NH3				
Not estimated	NO <sub>x</sub> , CO, NMVOC, SO <sub>x</sub> , Ni, Se, Zn, Aldrin, Chlordane, Chlordecone, Dieldrin, Endrin, Heptachlor, Heptabromo-biphenyl, Mirex, Toxaphene, HCH, DDT, PCB, Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Indeno(1,2,3-cd)pyrene, Total 4 PAHs, HCB, PCP, SCCP				
Pollutant	Value	Unit	95% confidence interval		Reference
			Lower	Upper	
TSP	0.14	kg/fire	0.07	0.3	Aasestad (2007)
PM10	0.14	kg/fire	0.07	0.3	Aasestad (2007)
PM2.5	0.14	kg/fire	0.07	0.3	Aasestad (2007)
Pb	0.42	mg/fire	0.2	1	Aasestad (2007)
Cd	0.85	mg/fire	0.4	2	Aasestad (2007)
Hg	0.85	mg/fire	0.4	2	Aasestad (2007)
As	1.4	mg/fire	0.7	3	Aasestad (2007)
Cr	1.3	mg/fire	0.7	3	Aasestad (2007)
Cu	3	mg/fire	1.5	9	Aasestad (2007)
PCDD/F	1.4	µg/fire	0.7	3	Aasestad (2007)

**GB2009-Table 0-3 Tier 2 emission factors for source category 6.D Other waste, undetached house fire**

Tier 2 emission factors					
	Code	Name			
NFR Source Category	6.D	Other waste			
Fuel	NA				
SNAP (if applicable)					
Technologies/Practices	Undetached house fire				
Region or regional conditions					
Abatement technologies					
Not applicable	NH3				
Not estimated	NOx, CO, NMVOC, SOx, Ni, Se, Zn, Aldrin, Chlordane, Chlordecone, Dieldrin, Endrin, Heptachlor, Heptabromo-biphenyl, Mirex, Toxaphene, HCH, DDT, PCB, Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Indeno(1,2,3-cd)pyrene, Total 4 PAHs, HCB, PCP, SCCP				
Pollutant	Value	Unit	95% confidence interval		Reference
			Lower	Upper	
TSP	0.06	kg/fire	0.03	0.1	Aaestad (2007)
PM10	0.06	kg/fire	0.03	0.1	Aaestad (2007)
PM2.5	0.06	kg/fire	0.03	0.1	Aaestad (2007)
Pb	0.18	mg/fire	0.1	0.4	Aaestad (2007)
Cd	0.36	mg/fire	0.2	0.7	Aaestad (2007)
Hg	0.36	mg/fire	0.2	0.7	Aaestad (2007)
As	0.58	mg/fire	0.3	1	Aaestad (2007)
Cr	0.55	mg/fire	0.3	1	Aaestad (2007)
Cu	1.3	mg/fire	0.7	3	Aaestad (2007)
PCDD/F	0.62	µg/fire	0.3	1	Aaestad (2007)

**GB2009-Table 0-4 Tier 2 emission factors for source category 6.D Other waste, apartment building fire**

Tier 2 emission factors					
	Code	Name			
NFR Source Category	6.D	Other waste			
Fuel	NA				
SNAP (if applicable)					
Technologies/Practices	Apartment building fire				
Region or regional conditions					
Abatement technologies					
Not applicable	NH3				
Not estimated	NOx, CO, NMVOC, SOx, Ni, Se, Zn, Aldrin, Chlordane, Chlordecone, Dieldrin, Endrin, Heptachlor, Heptabromo-biphenyl, Mirex, Toxaphene, HCH, DDT, PCB, Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Indeno(1,2,3-cd)pyrene, Total 4 PAHs, HCB, PCP, SCCP				
Pollutant	Value	Unit	95% confidence interval		Reference
			Lower	Upper	
TSP	0.04	kg/fire	0.02	0.1	Aaestad (2007)
PM10	0.04	kg/fire	0.02	0.1	Aaestad (2007)
PM2.5	0.04	kg/fire	0.02	0.1	Aaestad (2007)
Pb	0.13	mg/fire	0.07	0.3	Aaestad (2007)
Cd	0.26	mg/fire	0.1	0.5	Aaestad (2007)
Hg	0.26	mg/fire	0.1	0.5	Aaestad (2007)
As	0.41	mg/fire	0.2	0.8	Aaestad (2007)
Cr	0.39	mg/fire	0.2	0.8	Aaestad (2007)
Cu	0.91	mg/fire	0.5	2	Aaestad (2007)
PCDD/F	0.44	µg/fire	0.2	1	Aaestad (2007)

**GB2009-Table 0-5 Tier 2 emission factors for source category 6.D Other waste, industrial building fire**

Tier 2 emission factors					
	Code	Name			
NFR Source Category	6.D	Other waste			
Fuel	NA				
SNAP (if applicable)					
Technologies/Practices	Industrial building fire				
Region or regional conditions					
Abatement technologies					
Not applicable	NH3				
Not estimated	NOx, CO, NMVOC, SOx, Ni, Se, Zn, Aldrin, Chlordane, Chlordecone, Dieldrin, Endrin, Heptachlor, Heptabromo-biphenyl, Mirex, Toxaphene, HCH, DDT, PCB, Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Indeno(1,2,3-cd)pyrene, Total 4 PAHs, HCB, PCP, SCCP				
Pollutant	Value	Unit	95% confidence interval		Reference
			Lower	Upper	
TSP	0.03	kg/fire	0.01	0.1	Aasestad (2007)
PM10	0.03	kg/fire	0.01	0.1	Aasestad (2007)
PM2.5	0.03	kg/fire	0.01	0.1	Aasestad (2007)
Pb	0.08	mg/fire	0.04	0.2	Aasestad (2007)
Cd	0.16	mg/fire	0.1	0.3	Aasestad (2007)
Hg	0.16	mg/fire	0.1	0.3	Aasestad (2007)
As	0.25	mg/fire	0.1	0.5	Aasestad (2007)
Cr	0.24	mg/fire	0.1	0.5	Aasestad (2007)
Cu	0.57	mg/fire	0.3	1	Aasestad (2007)
PCDD/F	0.27	µg/fire	0.1	0.5	Aasestad (2007)

Not enough time was available in the current project to make a complete review of the emission factors for accidental building fires. The EFs given by Aasestad (2007) contains many assumptions for Norwegian conditions that may not be accurate outside Norway. It is recommended that new EFs are found for building fires, possibly two sets of data for residential buildings and industrial buildings respectively and in the units of mass emission per m<sup>2</sup> burnt. In addition could be given a number of default average areas of different building types, giving reporting countries the option of using country specific or default values for some of the assumptions already included in the EFs from Aasestad (2007).

In this project, only the consistency of the GB2009 EFs is reviewed. After personal contact with Kristin Aasestad, it has been confirmed that the units in GB2009 Tables 3-4 to 3-7 are a factor 1000 too low.

**Table 0-6 Tier 2 emission factors for source category 6.D Other waste, detached house fire**

Tier 2 emission factors					
	Code	Name			
NFR source category	6.D	Other waste			
Fuel	NA				
SNAP (if applicable)					
Technologies/Practices	Detached house fires				
Region or regional conditions					
Abatement technologies					
Not applicable					
Not estimated	SO <sub>2</sub> , NO <sub>x</sub> , NMVOC, CO, NH <sub>3</sub> , Ni, Se, Zn, HCB, Benzo(a)pyrene, Benzo(b)fluoranthene, benzo(k), fluoranthene, Indeno(1,2,3-cd)pyrene, PCBs				
Pollutant	Value	Unit	95 % confidence interval		Reference
			Lower	Upper	
TSP	143.82	kg/fire	71.9	287.6	Aasestad (2007) <sup>†</sup>
PM <sub>10</sub>	143.82	kg/fire	71.9	287.6	Aasestad (2007) <sup>†</sup>
PM <sub>2.5</sub>	143.82	kg/fire	71.9	287.6	Aasestad (2007) <sup>†</sup>
As	1.35	g/fire	0.7	2.7	Aasestad (2007) <sup>†</sup>
Cd	0.85	g/fire	0.4	1.7	Aasestad (2007) <sup>†</sup>
Cr	1.29	g/fire	0.6	2.6	Aasestad (2007) <sup>†</sup>
Cu	2.99	g/fire	1.5	6.0	Aasestad (2007) <sup>†</sup>
Hg	0.85	g/fire	0.4	1.7	Aasestad (2007) <sup>†</sup>

Pb	0.42	g/fire	0.2	0.8	Aaestad (2007)*
PCDD/F	1.44	mg/fire	0.7	2.9	Aaestad (2007)*

\*Personal contact with Kristin Aaestad has provided a correction of the units which are inaccurate in the text of Aaestad (2007)

**Table 0-5 Tier 2 emission factors for source category 6.D Other waste, undetached house fire**

Tier 2 emission factors					
	Code	Name			
NFR source category	6.D	Other waste			
Fuel	NA				
SNAP (if applicable)					
Technologies/Practices	Undetached house fires				
Region or regional conditions					
Abatement technologies					
Not applicable					
Not estimated	SO <sub>2</sub> , NO <sub>x</sub> , NMVOC, CO, NH <sub>3</sub> , Ni, Se, Zn, HCB, Benzo(a)pyrene, Benzo(b)fluoranthene, benzo(k), fluoranthene, Indeno(1,2,3-cd)pyrene, PCBs				
Pollutant	Value	Unit	95 % confidence interval		Reference
			Lower	Upper	
TSP	61.62	kg/fire	30.8	123.2	Aaestad (2007)*
PM <sub>10</sub>	61.62	kg/fire	30.8	123.2	Aaestad (2007)*
PM <sub>2.5</sub>	61.62	kg/fire	30.8	123.2	Aaestad (2007)*
As	0.58	g/fire	0.3	1.2	Aaestad (2007)*
Cd	0.36	g/fire	0.2	0.7	Aaestad (2007)*
Cr	0.55	g/fire	0.3	1.1	Aaestad (2007)*
Cu	1.28	g/fire	0.6	2.6	Aaestad (2007)*
Hg	0.36	g/fire	0.2	0.7	Aaestad (2007)*
Pb	0.18	g/fire	0.1	0.4	Aaestad (2007)*
PCDD/F	0.62	mg/fire	0.3	1.2	Aaestad (2007)*

\*Personal contact with Kristin Aaestad has provided a correction of the units which are inaccurate in the text of Aaestad (2007)

**Table 0-6 Tier 2 emission factors for source category 6.D Other waste, apartment building fire**

Tier 2 emission factors					
	Code	Name			
NFR source category	6.D	Other waste			
Fuel	NA				
SNAP (if applicable)					
Technologies/Practices	Apartment building fires				
Region or regional conditions					
Abatement technologies					
Not applicable					
Not estimated	SO <sub>2</sub> , NO <sub>x</sub> , NMVOC, CO, NH <sub>3</sub> , Ni, Se, Zn, HCB, Benzo(a)pyrene, Benzo(b)fluoranthene, benzo(k), fluoranthene, Indeno(1,2,3-cd)pyrene, PCBs				
Pollutant	Value	Unit	95 % confidence interval		Reference
			Lower	Upper	
TSP	43.78	kg/fire	21.9	87.6	Aaestad (2007)*
PM <sub>10</sub>	43.78	kg/fire	21.9	87.6	Aaestad (2007)*
PM <sub>2.5</sub>	43.78	kg/fire	21.9	87.6	Aaestad (2007)*
As	0.41	g/fire	0.2	0.8	Aaestad (2007)*
Cd	0.26	g/fire	0.1	0.5	Aaestad (2007)*
Cr	0.39	g/fire	0.2	0.8	Aaestad (2007)*
Cu	0.91	g/fire	0.5	1.8	Aaestad (2007)*
Hg	0.26	g/fire	0.1	0.5	Aaestad (2007)*
Pb	0.13	g/fire	0.1	0.3	Aaestad (2007)*
PCDD/F	0.44	mg/fire	0.2	0.9	Aaestad (2007)*

\*Personal contact with Kristin Aaestad has provided a correction of the units which are inaccurate in the text of Aaestad (2007)

**Table 0-7 Tier 2 emission factors for source category 6.D Other waste, industrial building fire**

Tier 2 emission factors		
	Code	Name
NFR source category	6.D	Other waste
Fuel	NA	

SNAP (if applicable)					
Technologies/Practices	Apartment building fires				
Region or regional conditions					
Abatement technologies					
Not applicable					
Not estimated	SO <sub>2</sub> , NO <sub>x</sub> , NMVOC, CO, NH <sub>3</sub> , Ni, Se, Zn, HCB, Benzo(a)pyrene, Benzo(b)fluoranthene, benzo(k), fluoranthene, Indeno(1,2,3-cd)pyrene, PCBs				
Pollutant	Value	Unit	95 % confidence interval		Reference
			Lower	Upper	
TSP	27.23	kg/fire	13.6	54.5	Aasestad (2007)*
PM <sub>10</sub>	27.23	kg/fire	13.6	54.5	Aasestad (2007)*
PM <sub>2.5</sub>	27.23	kg/fire	13.6	54.5	Aasestad (2007)*
As	0.25	g/fire	0.1	0.5	Aasestad (2007)*
Cd	0.16	g/fire	0.1	0.3	Aasestad (2007)*
Cr	0.24	g/fire	0.1	0.5	Aasestad (2007)*
Cu	0.57	g/fire	0.3	1.1	Aasestad (2007)*
Hg	0.16	g/fire	0.1	0.3	Aasestad (2007)*
Pb	0.08	g/fire	0.04	0.2	Aasestad (2007)*
PCDD/F	0.27	mg/fire	0.1	0.5	Aasestad (2007)*

\*Personal contact with Kristin Aasestad has provided a correction of the units which are inaccurate in the text of Aasestad (2007)

## Use of tobacco (3D3)

All EFs and references in the following table are selected from Hoem (2005), table 7.4. Unfortunately, there is an error with the units in the table from where the GB data was selected, and this error is now present in the GB. Units in table 3-9 should be corrected to per kg instead of per ton, for the reference, see any Norwegian IIR 2006-2012.

Furthermore, the Cu and Cr EFs have been switched; Cu should be the larger one. (Finstad and Rypdal, 2003)

**Table 0-7 Tier 2 emission factors for source category 3.D.3 Other product use, Tobacco combustion**

Tier 2 emission factors					
	Code	Name			
NFR Source Category	3.D.3	Other product use			
Fuel	NA				
SNAP (if applicable)					
Technologies/Practices	Tobacco combustion				
Region or regional conditions					
Abatement technologies					
Not applicable	NH3				
Not estimated	SO <sub>x</sub> , Ni, Se, Zn, Aldrin, Chlordane, Chlordecone, Dieldrin, Endrin, Heptachlor, Heptabromo-biphenyl, Mirex, Toxaphene, HCH, DDT, PCB, Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Indeno(1,2,3-cd)pyrene, HCB, PCP, SCCP				
Pollutant	Value	Unit	95% confidence interval		Reference
			Lower	Upper	
NO <sub>x</sub>	3.5	g/ton tobacco	2	7	Statistics Norway, Directorate for Health (1990)
CO	122	g/ton tobacco	60	250	Statistics Norway, Directorate for Health (1990)
NMVOC	4.8	g/ton tobacco	2	10	Statistics Norway, Directorate for Health (1990)
TSP	40	g/ton tobacco	20	80	TNO (2002)
PM10	40	g/ton tobacco	20	80	TNO (2002)
PM2.5	40	g/ton tobacco	20	80	TNO (2002)
Pb	0.05	mg/ton tobacco	0.03	0.1	Finstad et al. (2001)
Cd	0.1	mg/ton tobacco	0.05	0.2	Finstad et al. (2001)
Hg	0.1	mg/ton tobacco	0.05	0.2	Finstad et al. (2001)
As	0.16	mg/ton tobacco	0.08	0.3	Finstad and Rypdal (2003)
Cr	0.35	mg/ton tobacco	0.2	0.7	Finstad and Rypdal (2003)
Cu	0.15	mg/ton tobacco	0.08	0.3	Finstad and Rypdal (2003)
PCDD/F	1.3	ng/ton tobacco	0.7	3	Finstad et al. (2002)
Total 4 PAHs	8.3	mg/ton tobacco	4	20	Finstad et al. (2001)

The following literature study includes the assumption that one cigarette contains 1 g of tobacco and one cigar contains 5 g of tobacco.

Tier 2 emission factors					
	Code	Name			
NFR source category	3.D.3	Other product use			
Fuel	NA				
SNAP (if applicable)					
Technologies/Practices	Tobacco combustion				
Region or regional conditions					
Abatement technologies					
Not applicable					
Not estimated	SO <sub>2</sub> , As, Cr, Hg, Pb, Se, PCBs, HCB				
Pollutant	Value	Unit	95 % confidence interval		Reference
			Lower	Upper	
NO <sub>x</sub>	1.801	kg/Mg	1.739	1.866	Martin et al., 1997
CO	55.101	kg/Mg	53.034	57.249	Martin et al., 1997
NMVOG	4.837	kg/Mg	2.4	9.7	Sandmo, 2011
NH <sub>3</sub>	4.148	kg/Mg	3.942	4.365	Martin et al., 1997
TSP	27.0 <sup>a</sup>	kg/Mg	24.6	29.7	Schauer et al., 1998
PM <sub>10</sub>	27.0 <sup>a</sup>	kg/Mg	24.6	29.7	Schauer et al., 1998
PM <sub>2.5</sub>	27.0 <sup>a</sup>	kg/Mg	24.6	29.7	Schauer et al., 1998
Cd	5.4 <sup>b</sup>	g/Mg	1.4	21.6	Schauer et al., 1998
Cu	5.4 <sup>b</sup>	g/Mg	2.4	12.2	Schauer et al., 1998
Ni	2.7 <sup>b</sup>	g/Mg	0.7	10.8	Schauer et al., 1998
Zn	2.7 <sup>b</sup>	g/Mg	0.7	10.8	Schauer et al., 1998
PCDD/F	0.1	µg I-TEQ/Mg	0.05	0.2	UNEP toolkit, 2005
Benzo(a)pyrene	0.111 <sup>c</sup>	g/Mg	0.06	0.22	Daher et al., 2010
Benzo(b)fluoranthene	0.045 <sup>c</sup>	g/Mg	0.23	0.90	Daher et al., 2010
Benzo(k)fluoranthene	0.045 <sup>c</sup>	g/Mg	0.23	0.90	Daher et al., 2010
Indeno(1,2,3-cd)pyrene	0.045 <sup>c</sup>	g/Mg	0.23	0.90	Daher et al., 2010

<sup>a</sup>PM<sub>1.8</sub>, <sup>b</sup>EFs are calculated from 0.01 % and 0.02 % of PM<sub>1.8</sub> respectively, <sup>c</sup>Data on sidestream and mainstream smoke are calculated from Daher et al. (2010) tables 1 and 2.

Whenever sources provide a standard error for an EF value, a log-normal distribution is assumed in the calculation of lower and upper 95 % confidence intervals.

In GB2009 EFs for metal emission from wood-burning was used for tobacco smoking, it is recommended that similar data, or alternately EFs for a one-year crop like straw, are used for EFs where data on tobacco smoking are lacking (SO<sub>2</sub>, As, Cr, Hg, Pb, Se, PCBs, HCB).

### SO<sub>2</sub>, NO<sub>x</sub>, NMVOC, CO and NH<sub>3</sub>

Table xx SO<sub>2</sub>, NO<sub>x</sub>, NMVOC, CO and NH<sub>3</sub> emission factors for tobacco smoking, kg/Mg

	GB2009	Directorate for Health, 1990 <sup>*</sup>	Martin et al., 1997	Daher et al., 2010 <sup>**</sup>	Klepeis et al., 1999	Guerin et al, 1987	Litterature review by Guerin et al, 1987	Nielsen et al., 2012 <sup>****</sup>
SO <sub>2</sub>								0.40
NO <sub>x</sub>	0.0035	3.465	1.801			0.1-4.1	1.8-4.4	1.93
NMVOC	0.0048	4.837						5.77
CO	0.122	121.548	55.101	88.1	157.3 <sup>***</sup>	1.7-91	40-67	51.33
NH <sub>3</sub>			4.148			0.4-9.6	5.1-9.4	0.08

<sup>\*</sup>Source provided by Sandmo (2011), <sup>\*\*</sup>Data on sidestream and mainstream smoke are calculated from Daher et al. (2010) tables 1 and 2, <sup>\*\*\*</sup>calculated average of nine machine-smoked cigar experiments, <sup>\*\*\*\*</sup>EFs for wood (111A) in residential plants (1A4b i), SNAP 020200, the energy content used in the calculation is the average of wood pills and wood waste (16.1 GJ/Mg).

No SO<sub>2</sub> EFs were found for tobacco smoking, it is recommended to use an EF for wood- or straw-burning in residential plants.

## Particles and metals

Table yy Particle and metal emission factors for tobacco smoking, unit/Mg

060602	Unit	GB2009	OMINEA, 2010	TNO, 2002	Finstad et al.,2001 <sup>a</sup>	Klepeis et al., 1999	Hildemann et al., 1991	Keith and Tesh, 1965 <sup>d</sup>	Schmeltz and Hoffman, 1967 <sup>d</sup>	Girman et al, 1982 <sup>d</sup>	Finstad and Rypdal, 2003 <sup>a</sup>	Guerin et al, 1987	Schauer et al., 1998	Martin et al., 1997	Nielsen et al., 2012 <sup>g</sup>
TSP	kg/Mg	0.04	9	40								58.12			8.098
PM <sub>10</sub>	kg/Mg	0.04	9	40											7.712
PM <sub>2.5</sub>	kg/Mg	0.04	9	40		8.2-43 <sup>b</sup>	20.4	40.6	31.5	10.8			27.0 <sup>e</sup>	13.674 <sup>b</sup>	7.615
As	g/Mg	0.00016									0.159				0.008
Cd	g/Mg	0.0001			0.1								5.4 <sup>f</sup>		0.016
Cr	g/Mg	0.00035									0.152				0.032
Cu	g/Mg	0.00015					1.63 <sup>c</sup>				0.354		5.4 <sup>f</sup>		0.129
Hg	g/Mg	0.0001			0.1										0.006
Ni	g/Mg												2.7 <sup>f</sup>		0.032
Pb	g/Mg	0.00005			0.05										0.644
Se	g/Mg														0.008
Zn	g/Mg						1.22 <sup>c</sup>						2.7 <sup>f</sup>		1.610

<sup>a</sup>Emission factors for wood-burning, <sup>b</sup>Respirable Suspended Particles (RSP), PM<sub>3.5</sub>, <sup>c</sup>Cu and Zn EFs are given as 0.008 % and 0.006 % of the fine mass emission rate respectively, <sup>d</sup>Sources provided by Hildemann (1991), <sup>e</sup>PM<sub>1.8</sub>, <sup>f</sup>EFs are calculated from 0.01 % and 0.02 % of PM<sub>1.8</sub> respectively. <sup>g</sup>EFs for wood (111A) in residential plants (1A4b i), SNAP 020200, the energy content used in the calculation is the average of wood pills and wood waste (16.1 GJ/Mg)

It is assumed that the all particles from tobacco smoking are smaller than 1.8 µm and thereby using Schauer et al. (1998) as the source for PM<sub>2.5</sub>, PM<sub>10</sub> and TSP.

No Emission factors were found for As, Cr, Hg, Pb and Se for tobacco smoking.



## PCBs, PCDD/Fs, PAHs and HCB

060602	Unit	GB2009	UNEP toolkit, 2005	Benestad, 1994*	Guerin et al, 1987	Daher et al., 2010**	Nielsen et al., 2012****
PCDD/F	µg I-TEQ/Mg	0.0013	0.1	0.06-0.5			6.504
Benzo(a)pyrene	g/Mg	0.0021			0.03-0.18	0.111	1.892
Benzo(b)fluoranthene	g/Mg	0.0021				0.045	1.891
Benzo(k)fluoranthene	g/Mg	0.0021				0.045	1.109
Indeno(1,2,3-cd)pyrene	g/Mg	0.0021				0.045	1.290

\*Source provided by Finstad et al. (2002), \*\*Data on sidestream and mainstream smoke are calculated from Daher et al. (2010) tables 1 and 2, \*\*\*\*EFs for wood (111A) in residential plants (1A4b i), SNAP 020200, the energy content used in the calculation is the average of wood pills and wood waste (16.1 GJ/Mg).

No sources were found for PCBs and HCB.

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