

Annex IIIa – Emission factors

EUROSTAT GRANT FOR 2016: QUALITY IMPROVEMENTS OF AIR EMISSION ACCOUNTS AND EXTENSION OF PROVIDED TIME-SERIES

PART A.1

MAJOR IMPROVEMENTS OF DATA QUALITY FOR HOUSEHOLDS

Emission factors for households' combustion of solid fuels, natural gas and fuel oil

This annex provides the emission factors of four groups of air pollutants: **main air pollutants** (NO_x, CO, NMVOC, SO_x, NH₃), **particulate matter** (TSP, PM₁₀, PM_{2.5}, BC), **heavy metals** (Pb, Cd, Hg, As, Cr, Cu, Ni, Se, Zn) **and persistent organic pollutants** (PCBs, PCDD/F, PAHs, HCB), and three **greenhouse gases** (CO₂, CH₄, N₂O). Two sources of information were used to provide relevant emission factors.

Country specific emission factors for combustion of solid fuels (hard and brown coal, briquettes, coal and wood), natural gas and fuel oil were obtained from results of VEC VŠB¹⁰ measurement at low and nominal heat rating. These data were provided in the cooperation with the air quality modellers' team (Air Quality Department, SHMÚ) throughout their active participation in the project *LIFE Integrated Project: Implementation of Air Quality Plan for Małopolska Region – Małopolska in a healthy atmosphere*.⁵ The values were set for over-fire boilers, under-fire boilers, gasification boilers and automatic boilers.

Emission factors of air pollutants for two additional categories for **fireplaces, stoves, masonry/built-in tile stoves** (tables 3-14 and 3-17) **modern masonry/built-in tile stoves and pellets stoves** (table 3-25) were obtained from the EMEP/EEA Guidebook 2016 (tier 2). The GHGs emission factors for relevant fuel types were taken from IPCC Guidelines, tier 1 methodology. For category Modern masonry/built-in tile stoves and pellets stoves, emission factors only for combustion of wood, wooden pellets and briquettes were available.

The tables below provide emission factors used in this project to calculate emissions from domestic heating.

¹⁰ <https://powietrze.malopolska.pl/en/life-project/>

Table 30: Emission factors - Hard Coal

EF – Hard Coal		Lower heat output					Nominal heat output				
Air pollutant	unit	Over-fire boilers	Under-fire boilers	Gasification boilers	Automatic boilers	Fireplaces, stoves, masonry/built-in tile stoves	Over-fire boilers	Under-fire boilers	Gasification boilers	Automatic boilers	Fireplaces, stoves, masonry/built-in tile stoves
NO _x	g/GJ	83.82	125.22	167.38	189.78	100.00	129.01	162.67	167.38	196.04	100.00
CO	g/GJ	10052.37	3532.51	739.81	164.95	5000.00	4935.44	2625.31	739.81	383.50	5000.00
NM VOC	g/GJ	4575.26	812.65	72.13	2.90	600.00	488.88	631.28	72.13	5.37	600.00
SO _x	g/GJ	712*Sp	712*Sp	712*Sp	712*Sp	900.00	712*Sp	712*Sp	712*Sp	712*Sp	900.00
NH ₃	g/GJ	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
TSP	g/GJ	2707.85	247.40	80.08	45.75	500.00	642.35	212.61	80.08	71.07	500.00
PM ₁₀	%TSP	91.00	91.00	91.00	91.00	450.00*	91.00	91.00	91.00	91.00	450.00*
PM _{2.5}	%TSP	89.60	89.60	89.60	89.60	450.00*	89.60	89.60	89.60	89.60	450.00*
BC	%PM _{2.5}	6.40	6.40	6.40	6.40	6.40	6.40	6.40	6.40	6.40	6.40
Pb	mg/GJ	28.49	11.66	32.27	32.27	100.00	28.49	11.66	32.27	32.27	100.00
Cd	mg/GJ	0.24	0.14	0.14	0.14	1.00	0.24	0.14	0.14	0.14	1.00
Hg	mg/GJ	0.87	0.74	0.62	0.62	5.00	0.87	0.74	0.62	0.62	5.00
As	mg/GJ	5.59	0.40	2.67	2.67	1.50	5.59	0.40	2.67	2.67	1.50
Cr	mg/GJ	16.31	6.41	2.00	2.00	10.00	16.31	6.41	2.00	2.00	10.00
Cu	mg/GJ	6.84	1.98	12.45	12.45	20.00	6.84	1.98	12.45	12.45	20.00
Ni	mg/GJ	4.92	0.58	3.75	3.75	10.00	4.92	0.58	3.75	3.75	10.00
Se	mg/GJ	8.39	5.65	4.30	4.30	2.00	8.39	5.65	4.30	4.30	2.00
Zn	mg/GJ	52.73	7.61	19.99	19.99	200.00	52.73	7.61	19.99	19.99	200.00
PCBs	µg/GJ	2.12	4.31	16.11	16.11	170.00	2.12	4.31	16.11	16.11	170.00
PCDD/F	ng I-TEQ/GJ	0.14	0.35	2.20	2.20	1.00	0.14	0.35	2.20	2.20	1.00
b(a)p	mg/GJ	504.78	29.53	39.22	2.71	250.00	316.19	185.99	39.22	0.13	250.00
b(b)f	mg/GJ	476.38	51.52	68.00	2.80	400.00	262.86	125.72	68.00	1.10	400.00
b(k)f	mg/GJ	143.35	16.25	12.95	0.70	150.00	109.67	88.68	12.95	0.36	150.00
I(1,2,3-cd)p	mg/GJ	246.41	17.89	35.50	3.82	120.00	246.92	113.70	35.50	0.46	120.00
Total 1-4	mg/GJ	1370.92	115.19	155.67	10.02	920.00	935.63	514.09	155.67	2.05	920.00
HCB	µg/GJ	2447.65	1299.94	22.79	22.79	0.62	2447.65	1299.94	22.79	22.79	0.62
CO ₂	g/GJ	88224.24	89611.75	91188.81	92475.08	94600.00	87439.72	85444.70	91188.81	88725.03	94600.00
CH ₄	g/GJ	300.00	300.00	300.00	300.00	300.00	300.00	300.00	300.00	300.00	300.00
N ₂ O	g/GJ	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50

Note: Sp – sulphur content in a raw sample of solid fuels (% weight);

* unit of EF is g/GJ

- Source: VEC VŠB measurements, Czech Republic, LIFE Integrated Project Malopolska
- Source: EMEP/EEA Guidebook 2016
- Source: IPCC Guideline 2006 for Wood/Wood waste (default value/*lower value)

Table 31: Emission factors - Brown Coal

EF – Brown Coal		Lower heat output					Nominal heat output				
Air pollutant	unit	Over-fire boilers	Under-fire boilers	Gasification boilers	Automatic boilers	Fireplaces, stoves, masonry/built-in tile stoves	Over-fire boilers	Under-fire boilers	Gasification boilers	Automatic boilers	Fireplaces, stoves, masonry/built-in tile stoves
NOx	g/GJ	64.68	69.29	114.05	171.46	100.00	100.91	87.54	129.68	197.97	100.00
CO	g/GJ	18959.12	13654.69	3338.08	637.13	5000.00	5078.09	4427.59	585.47	500.49	5000.00
NM VOC	g/GJ	4316.42	3504.10	370.80	26.17	600.00	1449.11	429.24	42.94	12.25	600.00
SOx	g/GJ	712*Sp	712*Sp	712*Sp	712*Sp	900.00	712*Sp	712*Sp	712*Sp	712*Sp	900.00
NH ₃	g/GJ	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
TSP	g/GJ	2576.78	1022.16	116.27	31.78	500.00	947.09	179.52	22.63	43.88	500.00
PM ₁₀	%TSP	91.00	91.00	91.00	91.00	450.00*	91.00	91.00	91.00	91.00	450.00*
PM _{2.5}	%TSP	89.60	89.60	89.60	89.60	450.00*	89.60	89.60	89.60	89.60	450.00*
BC	%PM _{2.5}	6.40	6.40	6.40	6.40	6.40	6.40	6.40	6.40	6.40	6.40
Pb	mg/GJ	14.08	24.18	19.65	41.45	20.00	14.08	24.18	19.65	41.45	20.00
Cd	mg/GJ	0.33	0.58	0.89	0.47	1.00	0.33	0.58	0.89	0.47	1.00
Hg	mg/GJ	8.78	2.61	1.83	2.97	10.00	8.78	2.61	1.83	2.97	10.00
As	mg/GJ	8.01	8.66	16.36	19.22	100.00	8.01	8.66	16.36	19.22	100.00
Cr	mg/GJ	83.37	3.00	9.65	11.43	5.00	83.37	3.00	9.65	11.43	5.00
Cu	mg/GJ	10.20	5.34	7.88	25.59	1.50	10.20	5.34	7.88	25.59	1.50
Ni	mg/GJ	7.89	3.32	7.13	7.09	10.00	7.89	3.32	7.13	7.09	10.00
Se	mg/GJ	2.33	2.23	5.80	4.55	2.00	2.33	2.23	5.80	4.55	2.00
Zn	mg/GJ	43.06	76.45	96.73	100.35	200.00	43.06	76.45	96.73	100.35	200.00
PCBs	µg/GJ	3.32	1.39	0.51	3.84	170.00	3.32	1.39	0.51	0.64	170.00
PCDD/F	ng I-TEQ/GJ	0.06	0.03	0.00	0.02	1.00	0.06	0.03	0.00	0.03	1.00
b(a)p	mg/GJ	275.98	134.35	7.30	4.78	250.00	384.62	124.37	0.69	0.08	250.00
b(b)f	mg/GJ	138.53	117.80	10.24	5.05	400.00	214.50	54.42	1.64	0.71	400.00
b(k)f	mg/GJ	118.40	60.74	3.25	4.22	150.00	165.83	58.01	0.78	0.20	150.00
I(1,2,3-cd)p	mg/GJ	143.87	87.71	5.45	8.10	120.00	182.98	50.97	0.63	0.34	120.00
Total 1-4	mg/GJ	676.78	400.61	26.24	22.16	920.00	947.93	287.78	3.74	1.34	920.00
HCB	µg/GJ	2.00	2.00	0.52	777.09	0.62	2.00	2.00	0.52	0.75	0.62
CO ₂	g/GJ	82423.33	85355.01	90882.80	90474.39	101000.00	87152.27	84851.90	88335.09	86864.79	101000.00
CH ₄	g/GJ	300.00	300.00	300.00	300.00	300.00	300.00	300.00	300.00	300.00	300.00
N ₂ O	g/GJ	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50

Note: Sp – sulphur content in a raw sample of solid fuels (% weight)

* unit of EF is g/GJ

Source: VEC VŠB measurements, Czech Republic, LIFE Integrated Project Małopolska

Source: EMEP/EEA Guidebook 2016

Source: IPCC Guideline 2006 for Wood/Wood waste (default value/*lower value)

Table 32: Emission factors - Coal Briquettes

EF – Coal Briquettes		Lower heat output					Nominal heat output				
Air pollutant	Unit	Over-fire boilers	Under-fire boilers	Gasification boilers	Automatic boilers	Fireplaces, stoves, masonry/built-in tile stoves	Over-fire boilers	Under-fire boilers	Gasification boilers	Automatic boilers	Fireplaces, stoves, masonry/built-in tile stoves
NO _x	g/GJ	51.36	71.88	114.05	171.46	60.00	51.36	71.88	129.68	197.97	60.00
CO	g/GJ	13907.20	5934.51	3338.08	637.13	5000.00	13907.20	5934.51	585.47	500.49	5000.00
NM VOC	g/GJ	2844.26	871.56	370.80	26.17	600.00	2844.26	871.56	42.94	12.25	600.00
SO _x	g/GJ	712*Sp	712*Sp	712*Sp	712*Sp	500.00	712*Sp	712*Sp	712*Sp	712*Sp	500.00
NH ₃	g/GJ	NE	NE	NE	NE	5.00	NE	NE	NE	NE	5.00
TSP	g/GJ	916.45	84.03	116.27	31.78	500.00	916.45	84.03	22.63	43.88	500.00
PM ₁₀	%TSP	91.00	91.00	91.00	91.00	450.00*	91.00	91.00	91.00	91.00	450.00*
PM _{2.5}	%TSP	89.60	89.60	89.60	89.60	450.00*	89.60	89.60	89.60	89.60	450.00*
BC	%PM _{2.5}	6.40	6.40	6.40	6.40	6.40	6.40	6.40	6.40	6.40	9.84
Pb	mg/GJ	14.08	24.18	19.65	41.45	100.00	14.08	24.18	19.65	41.45	100.00
Cd	mg/GJ	0.33	0.58	0.89	0.47	0.50	0.33	0.58	0.89	0.47	0.50
Hg	mg/GJ	8.78	2.61	1.83	2.97	3.00	8.78	2.61	1.83	2.97	3.00
As	mg/GJ	8.01	8.66	16.36	19.22	1.50	8.01	8.66	16.36	19.22	1.50
Cr	mg/GJ	83.37	3.00	9.65	11.43	10.00	83.37	3.00	9.65	11.43	10.00
Cu	mg/GJ	10.20	5.34	7.88	25.59	20.00	10.20	5.34	7.88	25.59	20.00
Ni	mg/GJ	7.89	3.32	7.13	7.09	10.00	7.89	3.32	7.13	7.09	10.00
Se	mg/GJ	2.33	2.23	5.80	4.55	1.00	2.33	2.23	5.80	4.55	1.00
Zn	mg/GJ	43.06	76.45	96.73	100.35	200.00	43.06	76.45	96.73	100.35	200.00
PCBs	µg/GJ	3.32	1.39	0.51	3.84	170.00	3.32	1.39	0.51	0.64	170.00
PCDD/F	ng I-TEQ/GJ	0.06	0.03	0.00	0.02	0.50	0.06	0.03	0.00	0.03	0.50
b(a)p	mg/GJ	106.58	21.83	7.30	4.78	100.00	106.58	21.83	0.69	0.08	100.00
b(b)f	mg/GJ	256.71	31.40	10.24	5.05	170.00	256.71	31.40	1.64	0.71	170.00
b(k)f	mg/GJ	80.50	18.72	3.25	4.22	100.00	80.50	18.72	0.78	0.20	100.00
I(1,2,3-cd)p	mg/GJ	182.02	15.05	5.45	8.10	80.00	182.02	15.05	0.63	0.34	80.00
Total 1-4	mg/GJ	625.81	87.00	26.24	22.16	450.00	625.81	87.00	3.74	1.34	450.00
HCB	µg/GJ	2.00	2.00	0.52	777.09	0.62	2.00	2.00	0.52	0.75	0.62
CO ₂	g/GJ	93706.97	97918.73	90882.80	90474.39	97500.00	93706.97	97918.73	88335.09	86864.79	97500.00
CH ₄	g/GJ	300.00	300.00	300.00	300.00	300.00	300.00	300.00	300.00	300.00	300.00
N ₂ O	g/GJ	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50

Note: Sp – sulphur content in a raw sample of solid fuels (% weight)

* unit of EF is g/GJ

	Source: VEC VŠB measurements, Czech Republic, LIFE Integrated Project Małopolska
--	--

	Source: EMEP/EEA Guidebook 2016
--	---------------------------------

	Source: IPCC Guideline 2006 for Wood/Wood waste (default value/*lower value)
--	--

Table 33: Emission factors - Coke

EF – Coke		Lower heat output					Nominal heat output				
Air pollutant	Unit	Over-fire boilers	Under-fire boilers	Gasification boilers	Automatic boilers	Fireplaces, stoves, masonry/built-in tile stoves	Over-fire boilers	Under-fire boilers	Gasification boilers	Automatic boilers	Fireplaces, stoves, masonry/built-in tile stoves
NOx	g/GJ	83.82	125.22	167.38	189.78	60.00	129.01	162.67	167.38	196.04	60.00
CO	g/GJ	10052.37	3532.51	739.81	164.95	5000.00	4935.44	2625.31	739.81	383.50	5000.00
NMVOG	g/GJ	4575.26	812.65	72.13	2.90	600.00	488.88	631.28	72.13	5.37	600.00
SOx	g/GJ	712*Sp	712*Sp	712*Sp	712*Sp	500.00	712*Sp	712*Sp	712*Sp	712*Sp	500.00
NH ₃	g/GJ	NE	NE	NE	NE	5.00	NE	NE	NE	NE	5.00
TSP	g/GJ	2707.85	247.40	80.08	45.75	350.00	642.35	212.61	80.08	71.07	350.00
PM ₁₀	%TSP	91.00	91.00	91.00	91.00	330.00*	91.00	91.00	91.00	91.00	330.00*
PM _{2.5}	%TSP	89.60	89.60	89.60	89.60	330.00*	89.60	89.60	89.60	89.60	330.00*
BC	%PM _{2.5}	6.40	6.40	6.40	6.40	9.84	6.40	6.40	6.40	6.40	9.84
Pb	mg/GJ	28.49	11.66	32.27	32.27	100.00	28.49	11.66	32.27	32.27	100.00
Cd	mg/GJ	0.24	0.14	0.14	0.14	0.50	0.24	0.14	0.14	0.14	0.50
Hg	mg/GJ	0.87	0.74	0.62	0.62	3.00	0.87	0.74	0.62	0.62	3.00
As	mg/GJ	5.59	0.40	2.67	2.67	1.50	5.59	0.40	2.67	2.67	1.50
Cr	mg/GJ	16.31	6.41	2.00	2.00	10.00	16.31	6.41	2.00	2.00	10.00
Cu	mg/GJ	6.84	1.98	12.45	12.45	20.00	6.84	1.98	12.45	12.45	20.00
Ni	mg/GJ	4.92	0.58	3.75	3.75	10.00	4.92	0.58	3.75	3.75	10.00
Se	mg/GJ	8.39	5.65	4.30	4.30	1.00	8.39	5.65	4.30	4.30	1.00
Zn	mg/GJ	52.73	7.61	19.99	19.99	200.00	52.73	7.61	19.99	19.99	200.00
PCBs	µg/GJ	2.12	4.31	16.11	16.11	170.00	2.12	4.31	16.11	16.11	170.00
PCDD/F	ng I-TEQ/GJ	0.14	0.35	2.20	2.20	0.50	0.14	0.35	2.20	2.20	0.50
b(a)p	mg/GJ	504.78	29.53	39.22	2.71	100.00	316.19	185.99	39.22	0.13	100.00
b(b)f	mg/GJ	476.38	51.52	68.00	2.80	170.00	262.86	125.72	68.00	1.10	170.00
b(k)f	mg/GJ	143.35	16.25	12.95	0.70	100.00	109.67	88.68	12.95	0.36	100.00
I(1,2,3-cd)p	mg/GJ	246.41	17.89	35.50	3.82	80.00	246.92	113.70	35.50	0.46	80.00
Total 1-4	mg/GJ	1370.92	115.19	155.67	10.02	450.00	935.63	514.09	155.67	2.05	450.00
HCB	µg/GJ	2447.65	1299.94	22.79	22.79	0.62	2447.65	1299.94	22.79	22.79	0.62
CO ₂	g/GJ	88224.24	89611.75	91188.81	92475.08	95700.00	87439.72	85444.70	91188.81	88725.03	95700.00
CH ₄	g/GJ	300.00	300.00	300.00	300.00	300.00	300.00	300.00	300.00	300.00	300.00
N ₂ O	g/GJ	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50

Note: Sp – sulphur content in a raw sample of solid fuels (% weight)

* unit of EF is g/GJ

Source: VEC VŠB measurements, Czech Republic, LIFE Integrated Project Małopolska
Source: EMEP/EEA Guidebook 2016
Source: IPCC Guideline 2006 for Wood/Wood waste (default value/*lower value)

Table 34: Emission factors - Dry Wood / Wooden Briquettes and Pellets

EF – Dry Wood		Lower heat output						Nominal heat output					
Air pollutant	Unit	Over-fire boilers	Under-fire boilers	Gasific. boilers	Auto. boilers	Fireplaces, stoves, masonry/built-in tile stoves	Modern masonry/built-in tile stoves and pellets stoves	Over-fire boilers	Under-fire boilers	Gasific. boilers	Auto. boilers	Fireplaces, stoves, masonry/built-in tile stoves	Modern masonry/built-in tile stoves and pellets stoves
NO _x	g/GJ	49.23	46.62	39.27	87.66	50.00	80.00	61.93	67.79	83.38	87.90	50.00	80.00
CO	g/GJ	7244.93	5460.72	4775.36	769.46	4000.00	300.00	4851.83	4170.79	2507.17	157.89	4000.00	300.00
NM ₁₀ VOC	g/GJ	2210.97	1544.99	977.64	24.12	600.00	10.00	705.79	823.76	286.43	2.44	600.00	10.00
SO _x	g/GJ	11.00	11.00	11.00	11.00	11.00	11.00	11.00	11.00	11.00	11.00	11.00	11.00
NH ₃	g/GJ	74.00	37.00	37.00	12.00	74.00	12.00	74.00	37.00	37.00	12.00	74.00	12.00
TSP	g/GJ	458.22	325.47	118.66	16.46	880.00	31.00	97.92	95.22	48.97	10.21	880.00	31.00
PM ₁₀	%TSP	95.00	95.00	95.00	95.00	840.00*	29.00*	95.00	95.00	95.00	95.00	840.00*	29.00*
PM _{2.5}	%TSP	92.50	92.50	92.50	92.50	820.00*	29.00*	92.50	92.50	92.50	92.50	820.00*	29.00*
BC	%PM _{2.5}	10.00	10.00	10.00	10.00	10.00	15.00	10.00	10.00	10.00	10.00	10.00	15.00
Pb	mg/GJ	2.79	16.89	13.25	13.25	27.00	27.00	2.79	16.89	13.25	13.25	27.00	27.00
Cd	mg/GJ	10.96	0.97	1.29	1.29	13.00	13.00	10.96	0.97	1.29	1.29	13.00	13.00
Hg	mg/GJ	7.22	4.18	1.90	1.90	0.56	0.56	7.22	4.18	1.90	1.90	0.56	0.56
As	mg/GJ	1.14	1.14	0.42	0.42	0.19	0.19	1.14	1.14	0.42	0.42	0.19	0.19
Cr	mg/GJ	39.63	3.10	3.71	3.71	23.00	23.00	39.63	3.10	3.71	3.71	23.00	23.00
Cu	mg/GJ	9.34	2.97	5.68	5.68	6.00	6.00	9.34	2.97	5.68	5.68	6.00	6.00
Ni	mg/GJ	5.07	2.73	1.63	1.63	2.00	2.00	5.07	2.73	1.63	1.63	2.00	2.00
Se	mg/GJ	2.07	0.29	0.39	0.39	0.50	0.50	2.07	0.29	0.39	0.39	0.50	0.50
Zn	mg/GJ	26.59	26.59	61.62	61.62	512.00	512.00	26.59	26.59	61.62	61.62	512.00	512.00
PCBs	µg/GJ	2.03	4.35	0.73	0.73	0.06	0.01	2.33	4.35	0.73	0.73	0.06	0.01
PCDD/F	ng I-TEQ/GJ	0.01	0.02	0.01	0.01	0.80	0.10	0.02	0.02	0.01	0.01	0.80	0.10
b(a)p	mg/GJ	253.68	97.76	9.04	1.39	121.00	10.00	92.14	68.01	17.51	0.22	121.00	10.00
b(b)f	mg/GJ	126.61	117.71	16.74	1.77	111.00	16.00	72.38	34.07	10.51	0.79	111.00	16.00
b(k)f	mg/GJ	85.62	42.03	3.82	0.47	42.00	5.00	47.86	26.10	6.10	0.16	42.00	5.00
I(1,2,3-cd)p	mg/GJ	105.60	53.16	5.54	1.79	71.00	4.00	61.49	48.81	10.48	0.15	71.00	4.00
Total 1-4	mg/GJ	571.51	310.66	35.15	5.43	345.00	35.00	273.88	176.99	44.60	1.33	345.00	35.00
HCB	µg/GJ	2.40	0.58	17.18	17.18	5.00	5.00	2.40	0.58	17.18	17.18	5.00	5.00
CO ₂	g/GJ	96506.14	98131.50	97814.06	102737.57	112000.00	95000.00*	94338.23	89095.47	95948.30	105972.78	112000.00	95000.00*
CH ₄	g/GJ	300.00	300.00	300.00	300.00	300.00	100.00*	300.00	300.00	300.00	300.00	300.00	100.00*
N ₂ O	g/GJ	4.00	4.00	4.00	4.00	4.00	1.00*	4.00	4.00	4.00	4.00	4.00	1.00*

Note: Sp – sulphur content in a raw sample of solid fuels (% weight)

* unit of EF is g/GJ

	Source: VEC VŠB measurements, Czech Republic, LIFE Integrated Project Małopolska
	Source: EMEP/EEA Guidebook 2016
	Source: IPCC Guideline 2006 for Wood/Wood waste (default value/*lower value)

Table 35: Emission factors - Wet Wood

EF – Wet Wood		Lower heat output						Nominal heat output					
Air pollutant	Unit	Over-fire boilers	Under-fire boilers	Gasific. boilers	Auto. boilers	Fireplaces, stoves, masonry/ built-in tile stoves	Modern masonry/ built-in tile stoves and pellets stoves	Over-fire boilers	Under-fire boilers	Gasific. boilers	Auto. boilers	Fireplaces, stoves, masonry/ built-in tile stoves	Modern masonry/ built-in tile stoves and pellets stoves
NO _x	g/GJ	48.04	58.13	48.68	87.66	50.00	80.00	58.25	67.79	68.26	87.90	50.00	80.00
CO	g/GJ	8708.79	7872.03	6593.96	769.46	4000.00	300.00	7730.92	4170.79	2899.75	157.89	4000.00	300.00
NM VOC	g/GJ	2912.64	2670.35	1595.19	24.12	600.00	10.00	1672.94	823.76	203.19	2.44	600.00	10.00
SO _x	g/GJ	11.00	11.00	11.00	11.00	11.00	11.00	11.00	11.00	11.00	11.00	11.00	11.00
NH ₃	g/GJ	74.00	37.00	37.00	12.00	74.00	12.00	74.00	37.00	37.00	12.00	74.00	12.00
TSP	g/GJ	819.05	682.39	271.92	16.46	880.00	31.00	482.64	95.22	46.66	10.21	880.00	31.00
PM ₁₀	%TSP	95.00	95.00	95.00	95.00	840.00*	29.00*	95.00	95.00	95.00	95.00	840.00*	29.00*
PM _{2,5}	%TSP	92.50	92.50	92.50	92.50	820.00*	29.00*	92.50	92.50	92.50	92.50	820.00*	29.00*
BC	%PM _{2,5}	10.00	10.00	10.00	10.00	10.00	15.00	10.00	10.00	10.00	10.00	10.00	15.00
Pb	mg/GJ	2.79	16.89	13.25	13.25	27.00	27.00	2.79	16.89	13.25	13.25	27.00	27.00
Cd	mg/GJ	10.96	0.97	1.29	1.29	13.00	13.00	10.96	0.97	1.29	1.29	13.00	13.00
Hg	mg/GJ	7.22	4.18	1.90	1.90	0.56	0.56	7.22	4.18	1.90	1.90	0.56	0.56
As	mg/GJ	1.14	1.14	0.42	0.42	0.19	0.19	1.14	1.14	0.42	0.42	0.19	0.19
Cr	mg/GJ	39.63	3.10	3.71	3.71	23.00	23.00	39.63	3.10	3.71	3.71	23.00	23.00
Cu	mg/GJ	9.34	2.97	5.68	5.68	6.00	6.00	9.34	2.97	5.68	5.68	6.00	6.00
Ni	mg/GJ	5.07	2.73	1.63	1.63	2.00	2.00	5.07	2.73	1.63	1.63	2.00	2.00
Se	mg/GJ	2.07	0.29	0.39	0.39	0.50	0.50	2.07	0.29	0.39	0.39	0.50	0.50
Zn	mg/GJ	26.59	26.59	61.62	61.62	512.00	512.00	26.59	26.59	61.62	61.62	512.00	512.00
PCBs	µg/GJ	4.36	4.35	0.73	0.73	0.06	0.01	4.47	4.35	0.73	0.73	0.06	0.01
PCDD/F	ng I-TEQ/GJ	0.04	0.02	0.01	0.01	0.80	0.10	0.02	0.02	0.01	0.01	0.80	0.10
b(a)p	mg/GJ	191.31	75.00	52.53	1.39	121.00	10.00	230.56	68.01	2.89	0.22	121.00	10.00
b(b)f	mg/GJ	179.77	108.05	60.81	1.77	111.00	16.00	156.91	34.07	6.16	0.79	111.00	16.00
b(k)f	mg/GJ	144.19	39.88	49.11	0.47	42.00	5.00	108.67	26.10	1.63	0.16	42.00	5.00
I(1,2,3-cd)p	mg/GJ	153.29	39.26	27.17	1.79	71.00	4.00	208.62	48.81	2.64	0.15	71.00	4.00
Total 1-4	mg/GJ	668.56	262.19	189.63	5.43	NA	NA-	704.76	176.99	13.31	1.33	-NA	NA
HCb	µg/GJ	2.40	0.58	17.18	17.18	5.00	5.00	2.40	0.58	17.18	17.18	5.00	5.00
CO ₂	g/GJ	102657.99	99138.08	104962.87	102737.57	112000.00	95000.00*	98955.64	89095.47	101570.93	105972.78	112000.00	95000.00*
CH ₄	g/GJ	300.00	300.00	300.00	300.00	300.00	100.00*	300.00	300.00	300.00	300.00	300.00	100.00*
N ₂ O	g/GJ	4.00	4.00	4.00	4.00	4.00	1.00*	4.00	4.00	4.00	4.00	4.00	1.00*

Note: Sp – sulphur content in a raw sample of solid fuels (% weight)

* unit of EF is g/GJ

Source: VEC VŠB measurements, Czech Republic, LIFE Integrated Project Małopolska

Source: EMEP/EEA Guidebook 2016

Source: IPCC Guideline 2006 for Wood/Wood waste (default value/*lower value)

Table 36: Emission factors - Natural Gas and Fuel Oil

Air pollutant	Unit	Natural gas	Fuel oil
NO _x	g/GJ	38.1679	47.2813
CO	g/GJ	9.3952	13.9480
NM _{VO} C	g/GJ	1.8790	8.0378
SO _x	g/GJ	58,7*S	472,8*S
NH ₃	g/GJ	NE	NE
TSP	g/GJ	0.5872	50.3546
PM ₁₀	%TSP	100.0000	100.0000
PM _{2,5}	%TSP	100.0000	100.0000
BC	%PM _{2,5}	5.3500	8.5000
Pb	mg/GJ	0.0015	0.0120
Cd	mg/GJ	0.0003	0.0010
Hg	mg/GJ	0.6800	0.1200
As	mg/GJ	0.1200	0.0020
Cr	mg/GJ	0.0008	0.2000
Cu	mg/GJ	0.0001	0.1300
Ni	mg/GJ	0.0005	0.0050
Se	mg/GJ	0.0110	0.0020
Zn	mg/GJ	0.0015	0.4200
PCBs	µg/GJ	NA	NA
PCDD/F	ng I-TEQ/GJ	0.0015	0.0059
b(a)p	mg/GJ	0.0006	0.0800
b(b)f	mg/GJ	0.0008	0.0400
b(k)f	mg/GJ	0.0008	0.0700
I(1,2,3-cd)p	mg/GJ	0.0008	0.1600
Total 1-4	mg/GJ	0.0031	0.3500
HCB	µg/GJ	NA	NA
CO ₂	g/GJ	5610.0000	77400.0000
CH ₄	g/GJ	5.0000	10.0000
N ₂ O	g/GJ	0.1000	0.6000

Note: Sp – sulphur content in a raw sample of solid fuels (% weight)

Source: VEC VŠB measurements, Czech Republic, LIFE Integrated Project Małopolska

Source: EMEP/EEA Guidebook 2016

Source: IPCC Guideline 2006 for Wood/Wood waste (default value/*lower value)