X-tendo

eXTENDing the energy performance assessment and certification schemes via a mOdular approach

GUIDELINES

Local Air Pollution Contributor Index

BETA version
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X-tendo — Local Air Pollution Contributor Index — NAPE

Input data - assessed building

Type of building
PL - Single-family residential buildings

Onsite heat production by fuel combustion

	Delivered energy kWh/(m²·year)	Fuel and technology name
Source 1	40,0	EMEP - Gaseous fuels - Conventional boilers (to 50 kW)
Source 2	0,0	Not applicable

Add to the drop-down list

Onsite power generation or combined heat and power by fuel combustion

	Delivered energy kWh/(m²·year)	Fuel and technology name
Source 3	0,0	Not applicable

Add to the drop-down list

Energy from onsite renewable energy sources or external sources

	Delivered energy kWh/(m²·year)	Description
Other	15,0	Heat, cold and electricity from external networks and local RES

Input data - reference building

Method of determining the reference emission
Method 1 - The unitary emission of the reference building by type of building and the reverence fuel and technology name.

Method 1 - The reverence fuel and technology name

	Participation	Fuel and technology name
Source 1	100%	EMEP - Gaseous fuels - Conventional boilers (to 50 kW)
Source 2	0%	Not applicable

Method 2 - The unitary emissions values representative for reference building [(g/(m²·year)]

PM10	PM2,5	NOx	SOx	CO
2,00	1,00	4,00	10,00	5,00

Delivered energy

PL - Single-family residential buildings

Reference building / Assessed building

■ Energy from onsite sources by fuel combustion
■ Energy from onsite renewable energy sources or external sources

Local Air Pollution Contributor Index

Very low

Worksheet 1
Unitary emissions

Unitary emission of assessed building [g/(m²·year)]

Pollutant	PM10	PM2,5	NOx	SOx	CO
Source 1	0,029	0,029	6,048	0,043	3,168
Source 2	0,000	0,000	0,000	0,000	0,000
Source 3	0,000	0,000	0,000	0,000	0,000
UE_{AB}	0,03	0,03	6,05	0,04	3,17

Unitary emission of reference building [g/(m²·year)]

Pollutant	PM10	PM2,5	NOx	SOx	CO
Source 1	0,047	0,047	9,828	0,070	5,148
Source 2	0,000	0,000	0,000	0,000	0,000
UE_{RB}	0,05	0,05	9,83	0,07	5,15

The relative emission indicator [-]

$REI = UE_{AB}/UE_{RB}$

Pollutant	PM10	PM2,5	NOx	SOx	CO
REI	0,62	0,62	0,62	0,62	0,62

Worksheet 2
Methodology of determining the Local Air Pollution Contributor Index

Rate	Limit values of the REI		
Zero		REI =	0
Very low	0	< REI <	0,71
Low	0,71	< REI ≤	1
Moderate	1	< REI ≤	1,41
Sufficient	1,41	< REI ≤	2
High	2	< REI ≤	2,83
Very high	2,83	< REI ≤	4
Dangerouse	4	< REI	

Legal Notice

TABLE OF CONTENT

1 OVERVIEW

The proposed method considers fossil fuel used in the building for heat and electricity generation for the functions included in the national EPC system. In the local air pollution contributor index assessment method, the calculated building emissions will be compared with reference emission and for each pollutant, an index level will be assigned. Using the amount of building energy use and the type of the building energy source (type of fuel), the building emission indicators (PM_{10}, $PM_{2.5}$, NO_x, SO_x, CO) are calculated. Next, the reference emission indicators are calculated using reference delivered energy and reference energy sources. The reference values will be estimated based on national regulations. Using calculated values, the ratio of building to reference emission indicators will be calculated. The ratio of leading pollutant (the highest value of indicator) will be assessed using a scale of indexes (scale: zero, very low, low, moderate, sufficient, high, very high, dangerous). The indexes show what the building impact on outdoor air pollution in comparison with reference values is. The very low index means that pollutant emission from the assessed building is much lower than for reference building. Thus, the contribution of building in local smog development is very low.

The scheme of Local Air Pollution Contributor Index estimation procedure is presented in Figure 1 below.
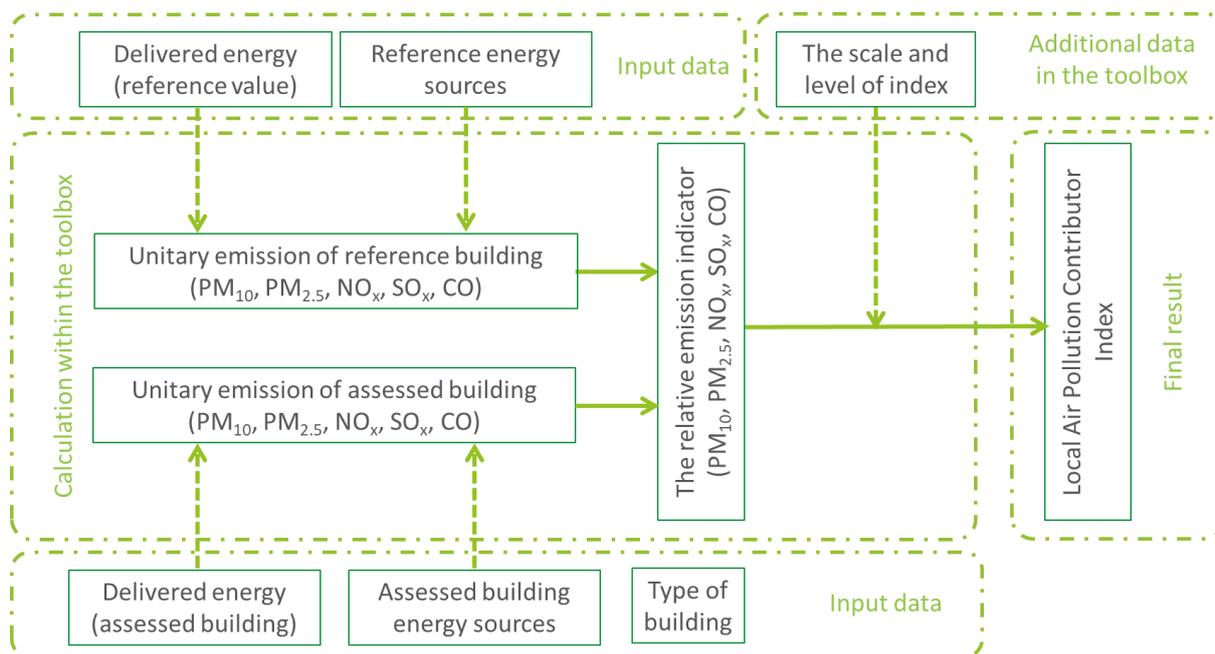

Figure 1 – Scheme of Local Air Pollution Contributor Index estimation procedure

2 GUIDELINES

2.1 Definitions

Definitions:

- ⊙ **delivered energy**

  energy, expressed per energy carrier, supplied to the technical building systems through the assessment boundary to satisfy the uses taken into account or to produce the exported energy

- ⊙ **energy carrier**

  substance or phenomenon that can be used to produce mechanical work or heat or to operate chemical or physical processes

- ⊙ **energy source**

  source from which useful energy can be extracted or recovered either directly or by means of a conversion or transformation process

- ⊙ **on-site**

  building, the premises and the parcel of land on which the building(s) is located

- ⊙ **external sources**

  heat, cool and electricity from external networks (thermal energy and electrical energy from the grid)

- ⊙ **reference value**

  standard legal or calculated value against which an emissions indicator is compared

- ⊙ **assessed building (unit)**

  building or part of the building resp. building unit that is the object of the energy performance assessment

2.2 Input data

1. The window in Figure 2

   (A) The user selects the type of assessed building.
   - Select from the drop-down list a suitable type of building. Each building contains an assigned reference value of delivered energy – value from national technical and construction regulations [kWh/(m²year)]. This value will be shown in the bar chart „Delivered energy" as „Reference building" which is shown in Figure 5.
   - To add a new type of building and/or reference value of delivered energy to the drop-down list, go to the „Show and add" window and select „List of reference building types" (Figure 4). In the displayed table, the user can define a new „Type of building" and assign the reference delivered energy value.

   (B) The user defines the sources of on-site heat production by fuel combustion based on EPC.
   - In yellow cells, the user enters a value of delivered energy [kWh/(m2year)]. The toolbox allows to define two separated on-site heat energy sources (source 1 and 2).
   - In red cells, the user selects from the drop-down list suitable type of fuel and combustion technology for each source.
   - If the assessed building does not have a second energy source from fuel combustion, assign 0 and choose „Not applicable".
   - To add a new combustion technology to the drop-down list, go to the „Show and add" window and select „Emission factors for fuel combustion" (Figure 4). In the displayed table user can define new combustion technology and assign the emission factors.

   The toolbox includes the database emission factors for a different type of default fuel and combustion technology. These values are taken from EMEP/EEA air pollutant emission inventory guidebook 2019 - Party B: Technical chapters: 1.A.4 Small combustion 2019, Denmark, 2019 (2).

   (C) The user defines the sources of on-site power generation (electricity production) or combined heat and power by fuel combustion.
   - In yellow cells, the user enters a value of delivered energy [kWh/(m²year)] – the energy used in EPC.
   - In red cells, the user selects from the drop-down list suitable type of fuel and combustion technology.
   - If the assessed building does not have a power generation or combined heat and power by fuel combustion, assign 0 and choose „Not applicable".

(D) The user defines the sum of delivered energy [kWh/(m²year)] from on-site renewable energy sources or external sources.

- This cell is dedicated to heat, cool and electricity from external networks and local RES (district heating, district cooling thermal energy and electrical energy from the grid).
- This value is not taken into consideration in the calculations. It will be shown in the bar chart as „Energy from on-site renewable energy sources or external sources" (Figure 5) as a part of delivered energy to the assessed building.

Input data 1 - assessed building

Type of building

(A)

PL - Multi-family residential buildings

Add to the drop-down list

Onsite heat production by fuel combustion

(B)

	Delivered energy kWh/(m²·year)	Fuel and technology name
Source 1	40,0	EMEP - Gaseous fuels - Conventional boilers (to 50 kW)
Source 2	0,0	Not applicable

Add to the drop-down list

Onsite power generation or combined heat and power by fuel combustion

(C)

	Delivered energy kWh/(m²·year)	Fuel and technology name
Source 3	0,0	Not applicable

Add to the drop-down list

Energy from onsite renewable energy sources or external sources

(D)

	Delivered energy kWh/(m²·year)	Description
Other	15,0	Heat, cold and electricity from external networks and local RES

Figure 2 – Input data of assessed building

2. The window in Figure 3

(A) The user selects the method of determining the reference emission.

- **Method 1** – The unitary emission of the reference building will be calculated based on the selected type of building and defined fuel and technology name.
- **Method 2** - The unitary emissions values representative for reference building is known.

(B) The user fills in these fields if method 1 is selected.

- The user defines the type of fuel and combustion technology for a reference building.

- In the bright red cells, the user can define two energy sources in the reference building, which will produce energy according to specified participation.
- The default value is 100%, which means that the reference building has only one energy source.
- In the red cells, the user selects the type of fuel and combustion technology used to produce heat (on-site) in the reference building.
- If the reference building has only one energy source, assign 0 and choose „Not applicable" in the second line (source 2).

(C) The user fills in these fields if method 2 is selected.

- In the bright red cells, the user can define the unitary emission values representative for the reference building for each type of pollution.

Input data - reference building

(A)

Method of determining the reference emission

Method 1 - The unitary emission of the reference building by type of building, fuel and technology name.

(B)

Method 1 - The reference fuel and technology name

	Participation	Fuel and technology name
Source 1	*100%*	*EMEP - Gaseous fuels - Conventional boilers (to 50 kW)*
Source 2	*0%*	*Not applicable*

(C)

Method 2 - The unitary emissions values representative for reference building [(g/(m^2·year)]

PM10	PM2,5	NOx	SOx	CO
2,00	1,00	4,00	10,00	5,00

Figure 3 – Selectin of the method for determining the reference emission

3. The window in Figure 4
   - The user can show and add new values to the list of reference building types and emission factors for fuel combustion.

Show and add

List of reference building types
Emission factors for fuel combustion
Emission factors for combined heat and power by fuel combustion

Figure 4 – Potential new values for the list of reference building types and emission factors for fuel combustion

2.3 Calculation within the toolbox

4. The window in Figure 5
    - The bar chart compares the delivered energy from the reference building and assessed building.
    - Energy from on-site sources by fuel combustion is marked in yellow.
    - Energy from on-site renewable energy sources or external sources is marked in green.
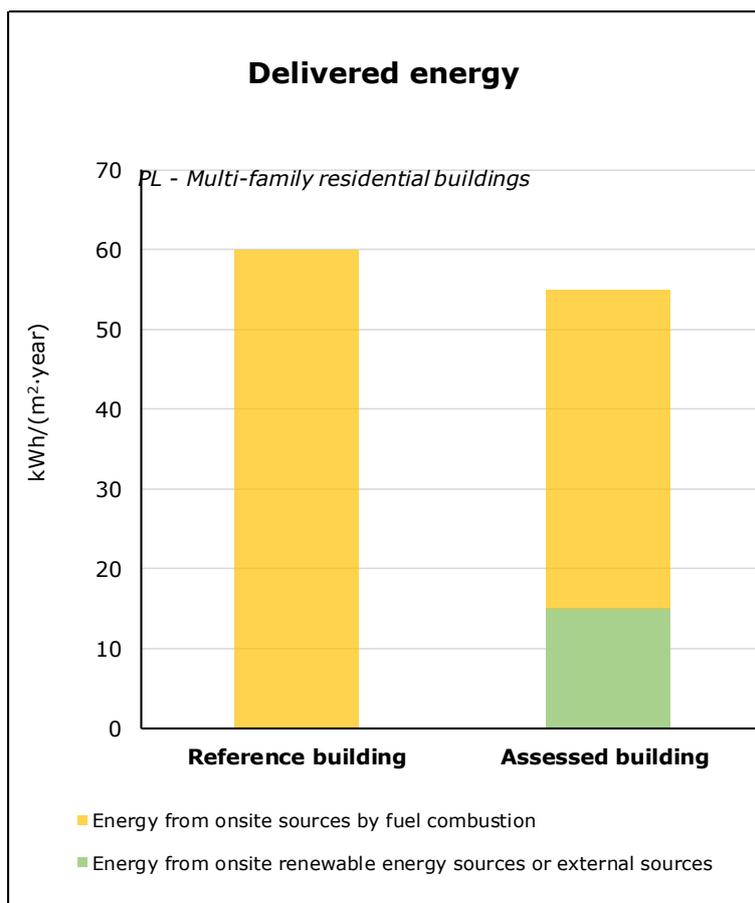
Figure 5 – Comparison of the delivered energy from the reference building and assessed building

5. The window in Figure 6
    (A) The table presents unitary emissions for each energy source and type of pollutant in the assessed building [g/(m²·year)].

    (B) The table presents unitary emission for each source of energy and type of pollutant in the reference building [g/(m²·year)]
    - If the user selects method 1 the sheet automatically fills out all cells after the fuel and combustion technology for a reference building are defined.
    - If the user selects method 2 the sheet will show the reference values of the unitary emissions in grey cells.

(C) The table presents the relative emission indicator (REI) for each type of pollutant. The highest value is used to determine the Local Air Pollution Contributor Index (LAPCI) level for assessed building. The scales and levels of indexes are shown in Figure 8. The calculation procedure is presented in the next chapter.

Worksheet 1

Unitary emissions

(A) **Unitary emission of assessed building [g/(m²·year)]**

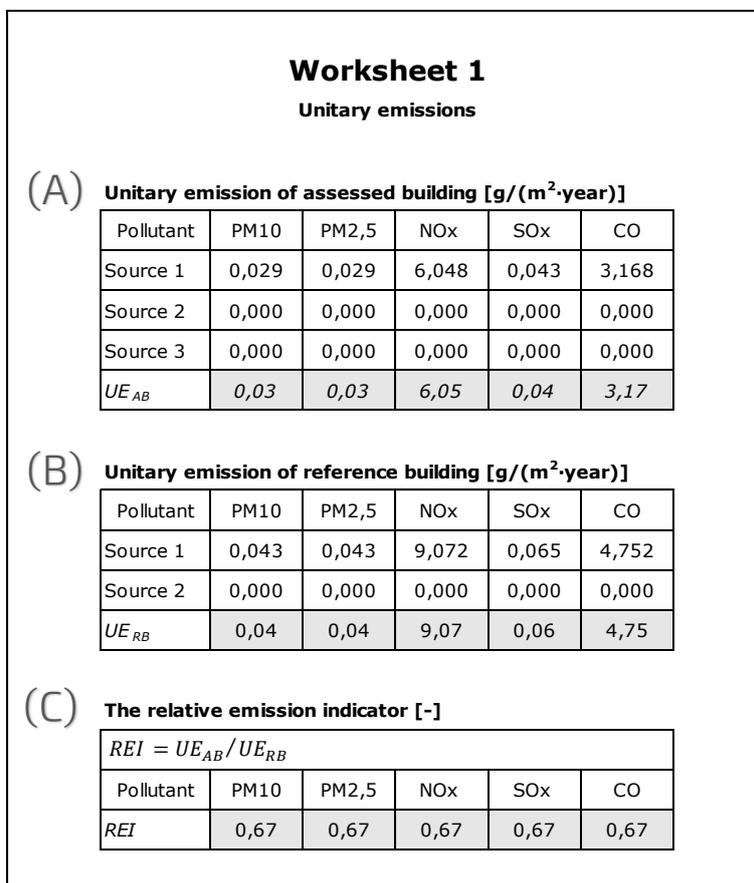| Pollutant	PM10	PM2,5	NOx	SOx	CO
Source 1	0,029	0,029	6,048	0,043	3,168
Source 2	0,000	0,000	0,000	0,000	0,000
Source 3	0,000	0,000	0,000	0,000	0,000
UE_{AB}	0,03	0,03	6,05	0,04	3,17

(B) **Unitary emission of reference building [g/(m²·year)]**

Pollutant	PM10	PM2,5	NOx	SOx	CO
Source 1	0,043	0,043	9,072	0,065	4,752
Source 2	0,000	0,000	0,000	0,000	0,000
UE_{RB}	0,04	0,04	9,07	0,06	4,75

(C) **The relative emission indicator [-]**

$REI = UE_{AB}/UE_{RB}$					
Pollutant	PM10	PM2,5	NOx	SOx	CO
REI	0,67	0,67	0,67	0,67	0,67

Figure 6 – Unitary emissions for each energy source and type of pollutant in the assessed building (A), unitary emission for each source of energy and type of pollutant in the reference building (B) and relative emission indicator (REI) for each type of pollutant (C)

2.4 Final result

6. The window in Figure 7
   - The level of Local Air Pollution Contributor Index (LAPCI) for the assessed building is shown in the graph and the level description.
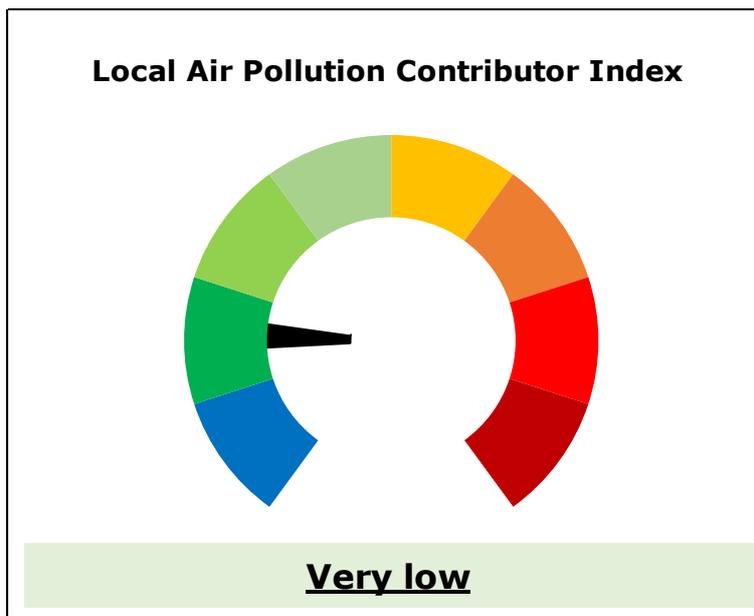
Figure 7 – Level of Local Air Pollution Contributor Index (LAPCI) for the assessed building

7. The window in Figure 8
   - The relative emission indicator (REI) limit values for each level of the Local Air Pollution Contributor Index (LAPCI) are given in the table below.
   - The boundaries of the REI are based on a non-linear scale ($Y = \sqrt{2}^{(n-nref)}$) according to ISO 52003-1:2017 rating method with a single reference point (3).

Worksheet 2

**Methodology of determining
the Local Air Pollution Contributor Index**

Rate	Limit values of the REI		
Zero		REI =	0
Very low	0	< REI ≤	0,71
Low	0,71	< REI ≤	1
Moderate	1	< REI ≤	1,41
Sufficient	1,41	< REI ≤	2
High	2	< REI ≤	2,83
Very high	2,83	< REI ≤	4
Dangerouse	4	< REI	

Figure 8 – Relative emission indicator (REI) limit values for each level of the Local Air Pollution Contributor Index (LAPCI)

3 CALCULATION WITHIN THE TOOLBOX

3.1 Calculation procedure

1. The user selects the type of assessed building. The reference value of delivered energy is loaded (DE_{RB}).

2. The user defines the type and values of delivered energy and combustion technology in assessed building (DE_{AB}).

$DE_{AB,S1}$ $[kWh/(m^2 \cdot year)]$ – energy source 1

$DE_{AB,S2}$ $[kWh/(m^2 \cdot year)]$ – energy source 2

$DE_{AB,S3}$ $[kWh/(m^2 \cdot year)]$ – energy source 3

$DE_{AB,O}$ $[kWh/(m^2 \cdot year)]$ – other

3. The emission factors for each type of pollutant and each energy source are loaded (E_i).

E_{PM10} $[g/GJ]$ – emission factor for PM10

$E_{PM2.5}$ $[g/GJ]$ – emission factor for PM2.5

E_{NOx} $[g/GJ]$ – emission factor for NOx

E_{SOx} $[g/GJ]$ – emission factor for SOx

E_{CO} $[g/GJ]$ – emission factor for CO

4. The unitary emission of the assessed building is calculated (UE_{AB}).

$$UE_{AB,PM10} = \sum_{n=S1}^{S3} DE_{AB,n} \cdot E_{CO,n} \left[\frac{g}{m^2 \cdot year}\right]$$

...

$$UE_{AB,CO} = \sum_{n=S1}^{S3} DE_{AB,n} \cdot E_{PM10,n} \left[\frac{g}{m^2 \cdot year}\right]$$

5. The unitary emission of the reference building is calculated.

$$UE_{RB,PM10} = \sum_{n=S1}^{S2} DE_{RB,n} \cdot E_{PM10,n} \left[\frac{g}{m^2 \cdot year}\right]$$

...

$$UE_{RB,CO} = \sum_{n=S1}^{S2} DE_{RB,n} \cdot E_{CO,n} \left[\frac{g}{m^2 \cdot year}\right]$$

6. The relative emission indicator is calculated (REI)

$$REI = \max\{REI_{PM10}, REI_{PM2.5}, REI_{NOx}, REI_{SOx}, REI_{CO}\}$$

where:

$$REI_{PM10} = \frac{UE_{AB,PM10}}{UE_{RB,PM10}} \ [-]$$

...

$$REI_{PMCO} = \frac{UE_{AB,CO}}{UE_{RB,CO}} \ [-]$$

7. The relative emission indicator (REI) values are matched to the scale and level of the index (Figure 8).

3.2 List of reference building types

The user must complete subsequent cells in the table shown in **Figure 9** (marked red) to add a new type of building and assign the value of delivered energy.

		Return to the calculator		

		Type of building (drop-down list)		
No.	Prefix	Type of building	Type of building (drop-down list)	Delivered energy (reference value) kWh/(m²·year)
1	PL	Single-family residential buildings	PL - Single-family residential buildings	65
2	PL	Multi-family residential buildings	PL - Multi-family residential buildings	60
3	PL	Collective residence buildings	PL - Collective residence buildings	70
4	PL	Public buildings, healthcare	PL - Public buildings, healthcare	175
5	PL	Public building, other	PL - Public building, other	40
6	PL	Outbuilding, storage and production building	PL - Outbuilding, storage and production building	60
7	*Prefix*	*Type of building*	Prefix - Type of building	*value*
8			-	
9			-	

Figure 9 – List of reference building types

3.3 Emission factors for fuel combustion

The user must complete subsequent cells in the table shown in **Figure 10** (marked red) to add a new combustion technology and assign the emission factors.

Return to the calculator

References

Prefix EMEP - EMEP/EEA, EMEP/EEA air pollutant emission inventory guidebook 2019 - Party B: Technical chapters: 1.A.4 Small combustion 2019, Denmark, 2019.

						PM10	PM2.5	NOx	SOx	CO	
			Emission factors (drop-down list)								
No.	Prefix	Fuel	Technology name	Technology name (description)	Index	[g/GJ]	[g/GJ]	[g/GJ]	[g/GJ]	[g/GJ]	Others
1		Not applicable			Not applicable	0	0	0	0	0	
2	EMEP	Solid fuels (excluding biomas)	Open fireplaces (to 50 kW)	Basic equpment - open fireplaces	EMEP - Solid fue	330	330	60	500	5000	*Table 3.12*
3	EMEP	Gaseous fuels	Partly closed/closed fireplaces (to 50 kW)	Appliances - Fireplaces	EMEP - Gaseous	2,2	2,2	60	0,3	30	*Table 3.13*
4	EMEP	Solid fuels (excluding biomas)	Conventional stoves (to 50 kW)	Conventional radiating stoves burning solid fuels excl	EMEP - Solid fue	450	450	100	900	5000	*Table 3.14*
5	EMEP	Solid fuels (excluding biomas)	Conventional boilers (to 50 kW)	Conventional underfire boilers burning solid fuels excl	EMEP - Solid fue	225	201	158	900	4787	*Table 3.15*
6	EMEP	Gaseous fuels	Conventional boilers (to 50 kW)	Standard domestic boilers including condensing boiler	EMEP - Gaseous	0,2	0,2	42	0,3	22	*Table 3.16*
7	EMEP	Gas oil	Conventional stoves (to 50 kW)	Conventional stoves burning liquid/gas fuels	EMEP - Gas oil -	2,2	2,2	34	60	111	*Table 3.17*
8	EMEP	Gas oil	Conventional boilers (to 50 kW)	Standard domestic boilers including condensing boiler	EMEP - Gas oil -	1,5	1,5	69	79	3,7	*Table 3.18*
9	EMEP	Coal	Advanced stoves (<50 kW)	Advanced and ecolabelled stoves	EMEP - Coal - A	240	220	150	450	2000	*Table 3.19*
10	EMEP	Coal	Standard boilers (from 50 kW to 1 MW)	Standard boilers including fixed and moving grate tec	EMEP - Coal - S	190	170	160	900	2000	*Table 3.20*
11	EMEP	Coal	Standard boilers (from 1 MW to 50 MW)	Standard boilers including fixed and moving grate tec	EMEP - Coal - S	76	72	180	900	200	*Table 3.21*
12	EMEP	Coal	Boilers (to 1 MW) - manual feed technology	Advanced Tier inventory compilation for manual feed	EMEP - Coal - B	140	130	200	450	1500	*Table 3.22*
13	EMEP	Coal	Boilers (to 1 MW) - automatic feed technology	Advanced Tier inventory compilation for automatic fe	EMEP - Coal - B	78	70	165	450	350	*Table 3.23*
14	EMEP	Fuel oil	Standard boilers (from 50 kW to 1 MW)	Standard boilers using liquid based fuels	EMEP - Fuel oil -	3	3	100	140	40	*Table 3.24*
15	EMEP	Fuel oil	Standard boilers (from 1 MW to 50 MW)	Standard boilers using liquid based fuels	EMEP - Fuel oil -	40	30	100	140	40	*Table 3.25*
16	EMEP	Gaseous fuels	Standard boilers (from 50 kW to 1 MW)	Gas fired boilers	EMEP - Gaseous	0,45	0,45	73	1,4	24	*Table 3.26*
17	EMEP	Gaseous fuels	Standard boilers (from 1 MW to 50 MW)	Gas fired boilers	EMEP - Gaseous	0,45	0,45	40	0,3	30	*Table 3.27*
18	EMEP	Gaseous fuels	Gas turbines (from 50 kW to 50 MW)		EMEP - Gaseous	0,2	0,2	48	0,5	4,8	*Table 3.28*
19	EMEP	Gas oil	Gas turbines (from 50 kW to 50 MW)		EMEP - Gas oil -	9,5	9,5	83	46	2,6	*Table 3.29*
20	EMEP	Gaseous fuels	Stationary reciprocating engines (from 50 kW to 50 MW)		EMEP - Gaseous	2	2	135	0,5	56	*Table 3.30*
21	EMEP	Gas oil	Stationary reciprocating engines (from 50 kW to 50 MW)		EMEP - Gas oil -	30	30	942	48	130	*Table 3.31*
22	EMEP	Wood	Open fireplaces (to 50 kW)	Open fireplaces burning wood	EMEP - Wood -	840	820	50	11	4000	*Table 3.39*
23	EMEP	Wood and similar wood waste	Conventional stoves (to 50 kW)	Conventional stoves burning wood and similar wood w	EMEP - Wood an	760	740	50	11	4000	*Table 3.40*
24	EMEP	Wood	High-efficiency stoves (to 50 kW)	High-efficiency stoves burning wood	EMEP - Wood -	380	370	80	11	4000	*Table 3.41*
25	EMEP	Wood	Advanced/ecolabbelled stoves and boilers (to 50 kW)	Advanced/ecolabbelled stoves and boilers burning wo	EMEP - Wood -	95	93	95	11	2000	*Table 3.42*
26	EMEP	Wood and similar wood waste	Conventional boilers (to 50 kW)	Conventional boilers <50 kW burning wood and similar	EMEP - Wood an	480	470	80	11	4000	*Table 3.43*
27	EMEP	Wood pellets	Pellet stoves and boilers (to 50 kW)	Pellet stoves and boilers burning wood pellets	EMEP - Wood pe	60	60	80	11	300	*Table 3.44*
28	EMEP	Wood	Wood combustion (from 1 MW to 50 MW) - Boilers		EMEP - Wood -	38	37	210	11	300	*Table 3.45*
29	EMEP	Wood	Wood combustion (to 1 MW) - Boilers		EMEP - Wood -	100,5	98,5	91	11	435	*Table 3.46*
30	EMEP	Wood	Wood combustion (to 1 MW) - Manual Boilers		EMEP - Wood -	163	160	91	11	570	*Table 3.47*
31	*Prefix*	*Fuel*	*tecchnology name*	*additional description*	Prefix - Fuel - te	*0*	*0*	*0*	*0*	*0*	*additional description 2*
32					- -						
33					- -						

Figure 10 – Emission factors for fuel combustion

REFERENCES

(1) ISO 54000-1 2017, Energy performance of buildings – Overarching EPB assessment – Part 1: General framework and procedures

(2) EMEP/EEA air pollutant emission inventory guidebook 2019 – Party B: Technical chapters: 1.A.4 Small combustion 2019, Denmark, 2019.

(3) ISO 52003-1:2017, Energy performance of buildings — Indicators, requirements, ratings and certificates — Part 1: General aspects and application to the overall energy performance

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