

5.C.2 - Open Burning of Waste

Category Code	Method					AD					EF				
5.C.2	CS					Q					D, CS				
	NO _x	NM VOC	SO ₂	NH ₃	PM _{2.5}	PM ₁₀	TSP	BC	CO	Pb	Cd	Hg	Diox	PAH	HCB
Key Category:	-/-	-/-	-/-	-	-/T	-/-	-/-	-/-	-/-	-/-	-/-	-	-/-	-/-	-

Method(s) applied	
D	Default
T1	Tier 1 / Simple Methodology *
T2	Tier 2*
T3	Tier 3 / Detailed Methodology *
C	CORINAIR
CS	Country Specific
M	Model
* as described in the EMEP/EEA Emission Inventory Guidebook - 2019, in category chapters.	
(source for) Activity Data	
NS	National Statistics
RS	Regional Statistics
IS	International Statistics
PS	Plant Specific
As	Associations, business organisations
Q	specific Questionnaires (or surveys)
M	Model / Modelled
C	Confidential
(source for) Emission Factors	
D	Default (EMEP Guidebook)
CS	Country Specific
PS	Plant Specific
M	Model / Modelled
C	Confidential

Within NFR sub-category 5.C.2 - Open Burning of Waste, the German emissions inventory provides only emissions from allowed bonfires and from other wooden materials burnt outdoors. Emissions from bonfires are key source for PM_{2.5} and PM₁₀, but in principle of minor priority due to discontinuous appearance.

Please see chapter regarding farming/plantation waste: [3.F - Field burning of agricultural residues](#) - this is banned by law in Germany. So there is no gap of reporting.

Emissions from open burning of wood and green waste for traditional purposes, so-called bonfires such as Easter fires, are reported model-based. In addition to biogenic carbon dioxide, emissions of NO_x, SO₂, CO, NMVOC, particulate matter (PM_{2.5}, PM₁₀ and TSP), Polycyclic Aromatic Hydrocarbons (PAHs) and Heavy Metals are covered so far.

Method

For developing of a estimation frame a survey regarding the number of such bonfires was carried out by an expert work ¹⁾. As the result, questionnaires from municipalities and statistical projections for Germany for the year 2016 were checked. The project has shown a declining trend since 1990. On the basis of expert judgement, a further reduction of emissions in the future is expected.

As discussed on Review 2020 regarding all relevant sources: A comparison shows that the volume of bonfires is significantly higher than the volume of campfires. In terms of number, however, the two types of fires are similar. Due to the large fluctuations of the minimum/maximum values, the median was proposed in study. In our view the estimation of bonfires emissions is conservative and completely.

Activity data

Activity data for this category are based on data from a step by step calculation: After the evaluation of the questionnaires an extrapolation of the volume and the number of bonfires was made for Germany. For the years since 2019, it became visible that, in addition to the model-based continuous decrease in activities, special aspects must be taken into account: Because of the restrictions on public activities during the pandemic, modeling of less traditional events was searched for.

Two types of fires were already classified in the expert project: camp fires in the more private sector and, most importantly, Easter Fires in the more public sector. The calculations are now considered separately and the camp fires are modeled with a continued steady decline.

Here, Easter fires follow an approach about general percentage decreases and additionally in 2019 five percentage points decrease corresponding to various cancels due to forest fire risk. In 2020, an additional 70 percent decrease was modeled due to cancellations for pandemic response (no complete cancellation in Germany because there were exceptions and follow-up events). The following values are the result of evaluation:

Table 1: Total annual mass of bonfires, in metric tonnes [t]

1990	1995	2000	2005	2010	2015	2020	2021
431,394	414,276	397,157	380,038	362,919	345,800	135,170	134.297

Emission factors

As discussed on Review 2020 regarding EF used and referenced: We use different EF from different references instead the EF of Table 3-1 Tier 1 emission factors for source category 5.C.2 Small-scale waste burning, because the Tier 1 EF seem not suitable for the burning of wooden wastes. We consider both fresh wood (garden and park waste) and dry wood (without coatings etc.). We have tried to find relevant parallels, especially because of the burning of fresh wood with regard to forest fires. But regarding the EF from GB 2019 we will evaluate the use as shown in the following table:

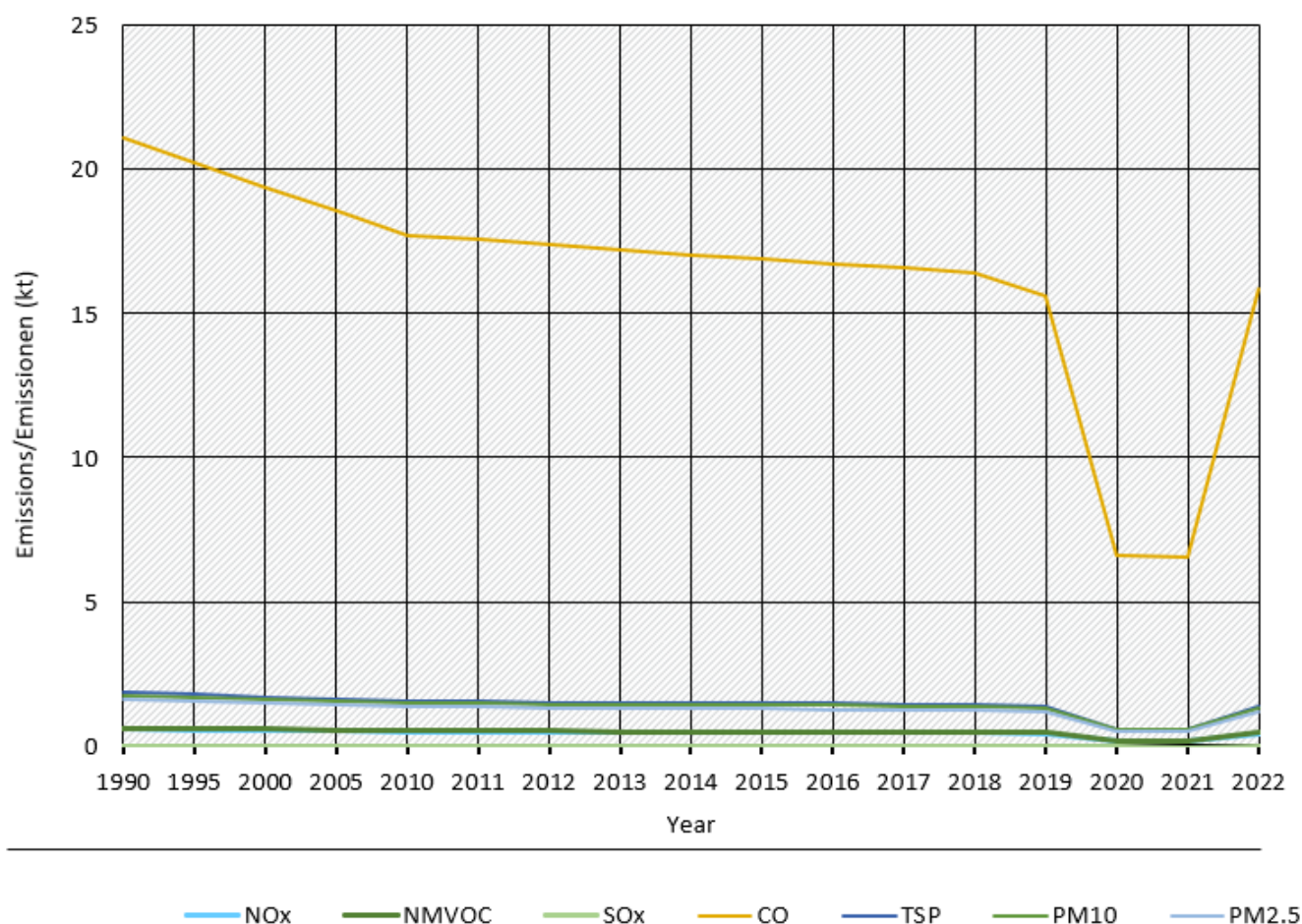
	value	unit	Current reference	Planned improvement
CO	58.0	kg/ t	GB 2016 small combustion Table 3-6: Tier 1 emission factors for NFR source category 1.A.4.b, using biomass	to use EF from GB 2019 5.C.2, table 3-2: 48.8 kg/ t
NO_x	0.9	kg/ t	Research results from literature: wood burning as it was documented in Ireland's IIR	to use EF from GB 2019 5.C.2, table 3-2: 1.38 kg/ t
SO₂	0.2	kg/ t	Research results from literature: wood burning as it was documented in Ireland's IIR	to use EF from GB 2019 5.C.2, table 3-2: 0.03 kg/ t
NM VOC	47.0	kg/ t	not correct used, error in data handling	to use EF from GB 2019 5.C.2, table 3-2: 1.47 kg/ t
TSP	17.0	kg/ t	GB 2016 Forest fires, table 3-1, according 'wood burned'	to use EF from GB 2019 5.C.2, table 3-2: 4.31
PM₁₀	11.0	kg/ t	GB 2016 Forest fires, table 3-1, according 'wood burned'	to use EF from GB 2019 5.C.2, table 3-2: 4.13 kg/ t
PM_{2.5}	9.0	kg/ t	GB 2016 Forest fires, table 3-1, according 'wood burned'	to use EF from GB 2019 5.C.2, table 3-2: 3.76 kg/ t
BC	0.81	kg/ t	GB 2016 Forest fires, table 3-1, according 'wood burned'	to use EF from GB 2019 5.C.2, table 3-2: 28% of PM _{2.5}
PCDD/F	10.0	µg/ t	GB 2019 5.C.2, table 3-1	No further
PAH	3.39	g/ t	sum of single compounds	No further
B[a]P	1.3	g/ t	IIR Ireland ²⁾	No further (GB with dry matter problem)
B[b]F	1.5	g/ t	IIR Ireland ³⁾	No further (GB with dry matter problem)
B[k]F	0.5	g/ t	IIR Ireland ⁴⁾	No further (GB with dry matter problem)
I[...]P	0.09	g/ t	IIR Ireland ⁵⁾	No further, Gap in GB
Pb	0.32	g/ t	GB 2019 5.C.2, table 3-2	No further
Cd	0.13	g/ t	GB 2019 5.C.2, table 3-2	No further

Trends in emissions

All trends in emissions correspond to trends of AD. No rising trends are to identify.

Trends of Emissions in Germany in NFR category Bonfires

Emissions by pollutant / Emissionen nach Schadstoff



* Base Year for PM = 1995 / Basisjahr für Feinstäube (PM) ist 1995

Quelle: German Environment Agency, National inventory for the German reporting on atmospheric emissions since 1990, (11/2023)

Emission trends of bonfires

Recalculations

Recalculations were necessary due to corrected emission factors. The significant changes can be shown as an absolute difference over time as follows:

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Recalculations in NFR 5.C.2



For **pollutant-specific information on recalculated emission estimates for Base Year and 2020**, please see the pollutant specific recalculation tables following [chapter 8.1 - Recalculations](#).

¹⁾ Wagner & Steinmetzer, 2018: Jörg Wagner, Sonja Steinmetzer, INTECUS GmbH Abfallwirtschaft und umweltintegratives Management: Erhebung der Größen und Zusammensetzung von Brauchtums- und Lagerfeuern durch kommunale Befragungen; URL: https://www.umweltbundesamt.de/sites/default/files/medien/1410/publikationen/2018-02-19_texte_11-2018_lager-brauchtu-msfeuer.pdf; UBA-Texte 11/2018

^{2), 3), 4), 5)} (EF is referenced to a former research project called 'Use of charcoal, tobacco etc.'. This was a literature research, which is only available via UBA library in German. The EF is relating wood burning as it was documented in Ireland's IIR