5.C.2 - Open Burning of Waste

Category Code	Method					AD					EF				
5.C.2	CS					Q					D, CS				
Key Category	**SO_2**	**NO_x**	**NH_3**	**NMVOC**	**CO**	**BC**	**Pb**	**Hg**	**Cd**	**Diox**	**PAH**	**HCB**	**TSP**	**PM_{10}**	**$PM_{2.5}$**
5.C.2	-/-	-/-	-	-/-	-/-	-/-	-/-	-	-/-	-/-	-/-	-	-/-	-/-	-/T

T = key source by Trend **L** = key source by Level

Methods	
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 the group specific chapters.

AD - Data Source for Activity Data	
NS	National Statistics
RS	Regional Statistics
IS	International Statistics
PS	Plant Specific data
As	Associations, business organisations
Q	specific Questionnaires (or surveys)
M	Model / Modelled
C	Confidential

EF - Emission Factors	
D	Default (EMEP Guidebook)
C	Confidential
CS	Country Specific
PS	Plant Specific data
M	Model / Modelled

Within NFR sub-category 5.C.2 - Open Burning of Waste, the German emissions inventory provides emissions from registered bonfires and other wooden materials burnt outdoors. Emissions from bonfires are key source for PM2.5 and PM10, but in principle of minor priority due to discontinuous appearance.

Please see chapter regarding farming/plantation waste: https://thg.thuenen.de/iir-de/sector/agriculture/field_burning/start - 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 NOx, SO2, CO, NMVOC, particulate matter (PM2.5, 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 completly.

Activity data

Activity data for this category are based on data from a step by step calculation: After the evaluation of the questionaires 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. The mainly 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:

Type of fire (quantity of wooden wastes)	Unit	1990	1995	2000	2005	2010	2015	2016	2017	2018	2019	2020
All bonfires in sum	t	431,394	414,276	397,157	380,038	362,919	345,800	342,376	339,466	336,556	319,531	135,170

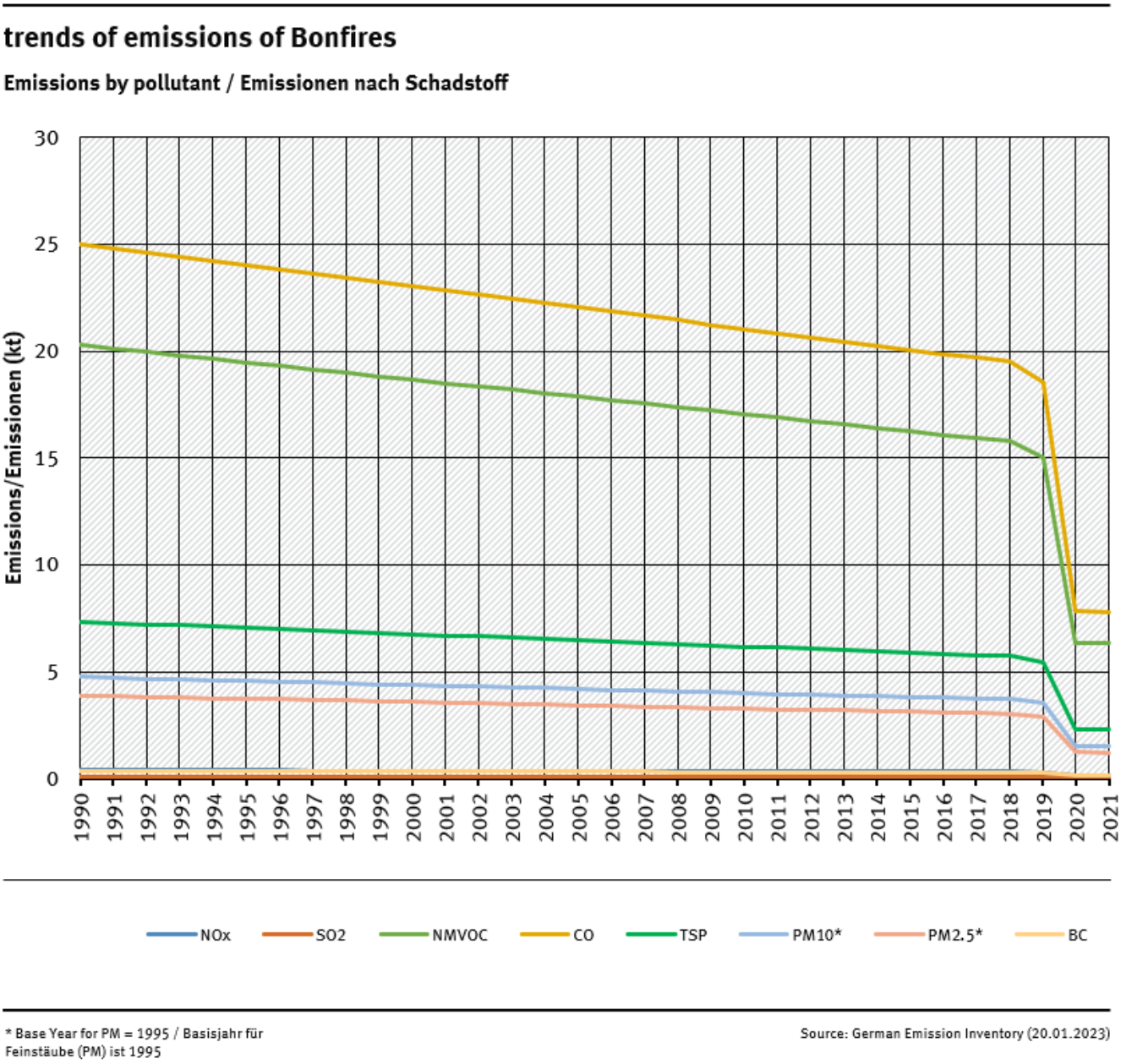
Emission factors

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:

pollutant	**figure**	**reference**
CO	58.0	GB 2016 small combustion Table 3-6: Tier 1 emission factors for NFR source category 1.A.4.b, using biomass
NOx	0.9	Research results from literature: wood burning as it was documented in Ireland's IIR
SO2	0.2	Research results from literature: wood burning as it was documented in Ireland's IIR
NMVOC	47.0	GB 2016 Forest fires, table 3-1, according 'wood burned'
TSP	17.0	GB 2016 Forest fires, table 3-1, according 'wood burned'
PM10	11.0	GB 2016 Forest fires, table 3-1, according 'wood burned'
PM2.5	9.0	GB 2016 Forest fires, table 3-1, according 'wood burned'
BC	0.81	GB 2016 Forest fires, table 3-1, according 'wood burned'
PCDD/F	10.0 µg/ t	GB 2016 Forest fires, table 3-2
PAH	0.00339	sum of single compounts
BaP	0.0013	Research results for charcoal
BbF	0.0015	Research results for charcoal
BkF	0.0005	Research results for charcoal
IxP	0.00009	Research results for charcoal
Pb	0.32 g/ t	GB 2016 Forest fires, table 3-2 [2)]
Cd	0.13 g/ t	GB 2016 Forest fires, table 3-2 [3)]

Trends in emissions

All trends in emissions correspond to trends of AD. No rising trends are to identify. In 2019, there were many bans on open fires due to increased forest fire danger.



Emission trends of bonfires

Recalculations

With **activity data** and **emission factors** remaining unrevised, no recalculations have been carried out compared to last year's submission.

For pollutant-specific information on recalculated emission estimates for Base Year and 2018, 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-brauchtumsfeuer.pdf; UBA-Texte 11/2018

[2)] , [3)]
Used EF for forest fires are provided in “g/kg wood burned” unit. Wether the EF is regarding living (fresh) wood or for a likely

dry forest is unknown.