1.B.2.c - Venting and Flaring

Category Code	**Method**					**AD**				**EF**					
1.B.2.c	T2					AS				CS					
Key Category	**NO_x**	**NMVOC**	**SO_2**	**NH_3**	**$PM_{2.5}$**	**PM_{10}**	**TSP**	**BC**	**CO**	**PB**	**Cd**	**Hg**	**Diox**	**PAH**	**HCB**
1.B.2.c	-/-	-/-	-/-	-	-/-	-/-	-/-	-/-	-/-	-	-	-/-	-	-	-

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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

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Pursuant to general requirements of the Technical Instructions on Air Quality Control TA Luft (2002), gases, steam, hydrogen and hydrogen sulphide released from pressure valves and venting equipment must be collected in a gas-collection system. Wherever possible, gases so collected are burned in process combustion. Where such use is not possible, the gases are piped to a flare. Flares used for flaring of such gases must fulfill at least the requirements for flares for combustion of gases from operational disruptions and from safety valves. For refineries and other types of plants in categories 1.B.2, flares are indispensable safety components. In crude-oil refining, excessive pressures can build up in process systems, for various reasons. Such excessive pressures have to be reduced via safety valves, to prevent tanks and pipelines from bursting. Safety valves release relevant products into pipelines that lead to flares. Flares carry out controlled burning of gases released via excessive pressures. When in place, flare-gas recovery systems liquify the majority of such gases and return them to refining processes or to refinery combustion systems. In the process, more than 99 % of the hydrocarbons in the gases are converted to CO_2 and H_2O. When a plant has such systems in operation, its flarehead will seldom show more than a small pilot flame.

Table 1: Activity data applied for 1.B.2.c

	Unit	**1990**	**1995**	**2000**	**2005**	**2010**	**2015**	**2020**	**2021**
Flared natural gas	millions of m^3	36	33	36	18.7	12.1	10.5	14.1	11.1
Refined crude-oil quantity	millions of t	107	96.5	107.6	114.6	95.4	93.4	84.0	84.1

Flaring takes place in extraction and pumping systems and at refineries. In refineries, flaring operations are subdivided into regular operations and start-up / shut-down operations in connection with disruptions.

Table 2: Emission factors applied for flaring emissions in natural gas extraction, in [kg/ 1000 m^3]

Source of emission factor	**Substance**	**Unit**	**Value**
Flaring emissions in natural gas extraction	NMVOC	kg/ 1000 m^3	0.005
Flaring emissions in natural gas extraction	NO_x	kg/ 1000 m^3	1.269
Flaring emissions in natural gas extraction	SO_2	kg/ 1000 m^3	8.885
Flaring emissions in natural gas extraction	CO	kg/ 1000 m^3	0.726

Source of emission factor	**Substance**	**Unit**	**Value**
Flaring emissions at petroleum production facilities	NO_x	kg/t	0.008
Flaring emissions at petroleum production facilities	SO_2	kg/t	0.010
Flaring emissions at petroleum production facilities	CO	g/t	0.1

Source of emission factor	**Substance**	**Unit**	**Value**
Flaring emissions at refineries: normal flaring operations	NMVOC	kg/m^3	0.004
Flaring emissions at refineries: normal flaring operations	CO	kg/m^3	0.001
Flaring emissions at refineries: normal flaring operations	SO_2	kg/m^3	0.003
Flaring emissions at refineries: normal flaring operations	NO_x	g/m^3	0.4

Source of emission factor	**Substance**	**Unit**	**Value**
Flaring emissions at refineries: disruptions of flaring operations	NMVOC	kg/t	0.001
Flaring emissions at refineries: disruptions of flaring operations	CO	kg/t	0.001
Flaring emissions at refineries: disruptions of flaring operations	SO_2	kg/t	0.007
Flaring emissions at refineries: disruptions of flaring operations	NO_x	kg/t	0.004

The emission factors have been derived from the 2004 and 2008 emissions declarations Theloke et al. 2013 1). In 2019, they were updated for CH_4, N_2O, CO, NMVOC, NO_x and SO_2, on the basis of Bender & von Müller, 2019 2). Venting emissions are taken into account in category 1.B.2.b.iii. The SO_2 emissions are obtained from the activity data for the flared natural gas (Table 178) and an emission factor of 0.140 kg / 1,000 m^3, a factor which takes account of an average H_2S content of 5 % by volume. The emission factors are determined on the basis of emissions reports, crude-oil-refining capacity and total capacity utilisation at German refineries. The guide for this work consists of the evaluation assessment of Theloke et al. (2013) 3).

Recalculations

Please refer to overarching chapter 1.B - Fugitive Emissions from fossil fuels

Planned improvements

Currently no improvements are planned.

References

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1), 3) Theloke, J., Kampffmeyer, T., Kugler, U., Friedrich, R., Schilling, S., Wolf, L., & Springwald, T. (2013). Ermittlung von Emissionsfaktoren und Aktivitätsraten im Bereich IPCC (1996) 1.B.2.a. i-vi - Diffuse Emissionen aus Mineralöl und Mineralölprodukten (Förderkennzeichen 360 16 033). Stuttgart.

2) Bender, M., & von Müller, G. (2019). Konsolidierung der Treibhausgasemissionsberechnungen unter der 2. Verpflichtungsperiode des Kyoto-Protokolls und der neuen Klimaschutz-Berichterstattungs-pflichten an die EU (FKZ 3716 41 107 0).