

1.A.3.d i (i) - International maritime navigation

Short description

Under NFR category **1.A.3.d i (i)**, emissions from international maritime navigation fuelling in and starting from German harbours are reported.

Method	AD	EF	Key Category
T1, T2, T3	NS, M	CS, M	<i>not included in key category analysis</i>

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

Methods	
D	Default
RA	Reference Approach
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/CORINAIR Emission Inventory Guidebook - 2007, 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, surveys
EF - Emission Factors	
D	Default (EMEP Guidebook)
C	Confidential
CS	Country Specific
PS	Plant Specific data

The source category includes international deep sea fishery and international marine transport. Emissions from fuel consumption for international transports of ocean-going ships are not reported as part of total national inventories.

Method

Activity data

Primary fuel delivery data (primary activity data, PAD) for *international maritime navigation* is included in line 6 - 'International Deep-Sea Bunkers' of the National Energy Balances (NEB) (AGEB, 2019) ¹⁾ together with respective data for IMO-registered ships used in *national maritime transport* (see 1.A.3.d ii (a)), *fishing* (see 1.A.4.c iii) and *military navigation* (see 1.A.5.b iii).

The AD applied for *international maritime navigation* therefore represents the remains of primary fuel delivery data from NEB line 6 minus the modelled consumption data estimated for non-IMO ships in 1.A.3.d ii (a), 1.A.4.c iii and 1.A.5.b iii:

$$\text{AD}_{\text{1.A.3.d i}} = \text{PAD}_{\text{NEB line 6}} - \text{AD}_{\text{1.A.3.d ii (a) - IMO}} - \text{AD}_{\text{1.A.4.c iii - IMO}} - \text{AD}_{\text{1.A.5.b iii - IMO}}$$

Table 1: Annual fuel consumption, in terajoules

	1990	1995	2000	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Diesel Oil	12,748	12,919	13,664	11,993	15,817	17,524	13,105	14,412	16,662	15,370	12,594	12,414	13,674	33,088	28,093	22,924	15,419	
Heavy Fuel Oil	68,484	56,323	60,984	78,182	78,257	96,625	96,017	85,865	86,934	86,687	81,171	71,364	67,670	57,850	74,837	58,781	39,287	
Σ 1.A.3.d i (i)	~81,232	~69,242	~74,648	~90,175	~94,074	~114,149	~109,122	~100,277	~103,596	~102,057	~93,765	~83,778	~81,344	~90,938	~102,930	~81,705	~54,706	

source: own estimates based on ²⁾

gallery size="medium" : 1A3di_AD.png gallery

Consumption of heavy oil has been increasing since 1984 as a result of high petroleum prices, global increases in transports and increasing maritime use of diesel engines that can run on heavy oil. The emissions fluctuations that occurred in the navigation sector in 1992 and 1996 were caused by trade and oil crises.

++ Emission factors

For **main pollutants** and **particulate matter**, modelled emission factors are available from (Deichnik, K. (2019)) ³⁾.

Here, for **sulphur dioxide** and **particulate matter**, annual values are available representing the impact of fuel sulphur legislation. In addition, regarding SO_x, the increasing operation of so-called scrubbers in order to fulfil emission limits especially within SECA areas is reflected for heavy fuel oil.

Table 2: Annual country-specific emission factors, in kg/TJ

	= 1990	= 1995	= 2000	= 2005	= 2006	= 2007	= 2008	= 2009	= 2010	= 2011	= 2012	= 2013	= 2014	= 2015	= 2016	= 2017	= 2018			
< Diesel oil																				
~ NH ₃ ,3,,	> 0.32	> 0.32	> 0.32	> 0.32	> 0.32	> 0.32	> 0.32	> 0.32	> 0.32	> 0.32	> 0.32	> 0.32	> 0.32	> 0.33	> 0.32	> 0.32	> 0.32			

~ NMVOC	> 48.7	> 48.7	> 48.7	> 48.7	> 48.7	> 48.7	> 48.7	> 48.7	> 48.7	> 48.7	> 48.7	> 48.4	> 48.0	> 44.8	> 44.7	> 45.0	> 45.2				
~ NO _x	> 1,070	> 1,070	> 1,070	> 1,070	> 1,070	> 1,070	> 1,070	> 1,069	> 1,069	> 1,069	> 1,069	> 1,073	> 1,077	> 1,151	> 1,132	> 1,157	> 1,128				
~ SO _x	> 465.5	> 419.0	> 232.8	> 186.2	> 186.2	> 186.2	> 139.7	> 69.8	> 69.8	> 65.2	> 54.5	> 52.6	> 50.5	> 40.7	> 40.6	> 40.7	> 40.8				
~ PM _{2.5}	1		> 352.4	> 318.0	> 176.5	> 141.2	> 141.3	> 141.3	> 105.9	> 53.0	> 53.0	> 49.6	> 49.5	> 49.1	> 49.1	> 52.7	> 54.5	> 54.5	> 53.1		
~ PM ₁₀	> 377.1	> 340.3	> 188.9	> 151.0	> 151.2	> 151.2	> 113.3	> 56.7	> 56.7	> 53.0	> 53.0	> 52.5	> 52.6	> 56.4	> 58.3	> 58.3	> 56.9				
~ TSP	> 377.1	> 340.3	> 188.9	> 151.0	> 151.2	> 151.2	> 113.3	> 56.7	> 56.7	> 53.0	> 53.0	> 52.5	> 52.6	> 56.4	> 58.3	> 58.3	> 56.9				
~ BC	2		> 109.2	> 98.6	> 54.7	> 43.8	> 43.8	> 43.8	> 32.8	> 16.4	> 16.4	> 15.4	> 15.3	> 15.2	> 15.2	> 16.3	> 16.9	> 16.9	> 16.5		
~ CO	> 127	> 128	> 128	> 128	> 128	> 128	> 128	> 128	> 128	> 128	> 128	> 127	> 128	> 134	> 139	> 138	> 136				
< Heavy fuel oil																					
~ NH ₃	> 0.34	> 0.34	> 0.34	> 0.34	> 0.34	> 0.34	> 0.34	> 0.34	> 0.34	> 0.34	> 0.34	> 0.34	> 0.35	> 0.33	> 0.33	> 0.34	> 0.35				
~ NMVOC	> 36.6	> 36.6	> 36.6	> 36.6	> 36.6	> 36.6	> 36.6	> 36.6	> 36.6	> 36.6	> 36.6	> 37.6	> 37.8	> 30.0	> 36.8	> 30.4	> 28.3				
~ NO _x	> 1,379	> 1,378	> 1,378	> 1,378	> 1,378	> 1,378	> 1,378	> 1,378	> 1,378	> 1,377	> 1,379	> 1,382	> 1,393	> 1,348	> 1,245	> 1,360	> 1,503				
~ SO _x	> 1,319	> 1,332	> 1,323	> 1,336	> 744	> 742	> 742	> 744	> 496	> 496	> 496	> 496	> 506	> 47.5	> 49.3	> 46.4	> 49.8				
~ PM _{2.5}	1		> 479	> 483	> 480	> 485	> 270	> 269	> 269	> 270	> 180	> 180	> 180	> 184	> 187	> 151	> 205	> 153	> 123		
~ PM ₁₀	> 526	> 532	> 528	> 533	> 297	> 296	> 296	> 297	> 198	> 198	> 198	> 203	> 206	> 166	> 226	> 168	> 135				
~ TSP	> 526	> 532	> 528	> 533	> 297	> 296	> 296	> 297	> 198	> 198	> 198	> 203	> 206	> 166	> 226	> 168	> 135				
~ BC	2		> 57.4	> 58.0	> 57.6	> 58.2	> 32.4	> 32.3	> 32.3	> 32.4	> 21.6	> 21.6	> 21.6	> 22.1	> 22.4	> 18.1	> 24.7	> 18.3	> 14.7		
~ CO	> 162	> 162	> 162	> 162	> 162	> 162	> 162	> 162	> 162	> 162	> 162	> 162	> 167	> 165	> 198	> 167	> 134				
1																					
2																					

NOTE: For the country-specific emission factors applied for particulate matter, no clear indication is available, whether or not condensables are included.

For information on the **emission factors for heavy-metal and POP exhaust emissions**, please refer to [Appendix 2.3 - Heavy Metal \(HM\) exhaust emissions from mobile sources](#) and [Appendix 2.4 - Persistent Organic Pollutant \(POP\) exhaust emissions from mobile sources](#)].

+ Trends of exhaust emissions from international navigation

NFR 1.A.3.d i is not considered in the key category analysis.

Emission trends for unregulated pollutants (such as **NH₃**, **NO_x**, **NMVOC** and **CO**, all **HM** and **POPs**) with only slight changes in the annual over-all IEFs applied, follow the trends in fuel consumption and the shares of diesel and heavy fuel oil:

[gallery size="medium" : EM_1A3di_NH3.png : EM_1A3di_Cd.png gallery](#)

On the other hand, the emission trends for **SO_x**, and **PM**, both depending on the fuel's sulphur content, follow not only the trends in fuel consumption but do also reflect fuel-sulphur legislation:

[gallery size="medium" : EM_1A3di_SO2.png : EM_1A3di_PM.png gallery](#)

+ Recalculations

Resulting from changes in the fuel consumption data computed within ⁴⁾ for *domestic* maritime navigation, the **activity data** for 2017 for *international* maritime navigation have been revised.

Table 3: Revised fuel consumption data 2017, in terajoules

=	= Diesel oil	= Heavy fuel oil	= over-all consumption
~ Submission 2020	> 22,924	> 58,781	> 81,828
~ Submission 2019	> 23,165	> 58,781	> 82,069
~ absolute change	> -241	> 0.00	> -241
~ relative change	> -1.04%	> 0.00%	> -0.29%

In contrast, all country-specific and default **emission factors applied remain unrevised** compared to last year's submission.

For more information on **recalculated emission estimates for Base Year and 2017**, please see the pollutant-specific recalculation tables following chapter [8.1 - Recalculations](#)].

+ Uncertainties

Uncertainty estimates for **activity data** of mobile sources derive from research project FKZ 360 16 023: "Ermittlung der Unsicherheiten der mit den Modellen TREMOD und TREMOD-MM berechneten Luftschadstoffemissionen des landgebundenen Verkehrs in Deutschland" by Knörr et al. (2009) ⁵⁾.

+ Planned improvements

Besides routine maintenance and further development of the BSH model, no improvements are planned.

bibliography : 1 : AGEB, 2019: Working Group on Energy Balances (Arbeitsgemeinschaft Energiebilanzen (Hrsg.), AGEB): Energiebilanz für die Bundesrepublik Deutschland; URL: <http://www.ag-energiebilanzen.de/7-0-Bilanzen-1990-2017.html>, Köln & Berlin, 2019. : 2 : Deichnik, K. (2019): Aktualisierung und Revision des Modells zur Berechnung der spezifischen Verbräuche und Emissionen des von Deutschland ausgehenden Seeverkehrs. from Bundesamts für Seeschifffahrt und Hydrographie (BSH); Hamburg, 2019. : 3 : EMEP/EEA (2019): EMEP/EEA air pollutant emission inventory guidebook 2019, URL: <https://www.eea.europa.eu/publications/emep-eea-guidebook-2019>; Copenhagen, 2019. : 4 : Rentz et al., 2008: Nationaler Durchführungsplan unter dem Stockholmer Abkommen zu persistenten organischen Schadstoffen (POPs), im Auftrag des Umweltbundesamtes, FKZ 205 67 444, UBA Texte | 01/2008, January 2008; URL: <http://www.umweltbundesamt.de/en/publikationen/nationaler-durchfuehrungsplan-unter-stockholmer> : 5 : Knörr et al. (2009): Knörr, W., Heldstab, J., & Kasser, F.: Ermittlung der Unsicherheiten der mit den Modellen TREMOD und TREMOD-MM berechneten Luftschadstoffemissionen des landgebundenen Verkehrs in Deutschland; final report; URL: <https://www.umweltbundesamt.de/sites/default/files/medien/461/publikationen/3937.pdf>, FKZ 360 16 023, Heidelberg & Zürich, 2009. **bibliography**

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- ¹⁾ (bibcite 1)
 - ²⁾ (bibcite 2)
 - ³⁾ (bibcite 2)
 - ⁴⁾ (bibcite 2)
 - ⁵⁾ (bibcite 5)