

1.A.3.c - Transport: Railways

Short description

In category 1.A.3.c - Railways, emissions from fuel combustion in German railways and from the related abrasion and wear of contact line, braking systems and tyres on rails are reported.

Method	AD	EF	Key Category
T1, T2	NS, M	CS, D, M	L: TSP, PM _{2.5} , L&T: PM ₁₀ , PM _{2.5} , L: TSP
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		

Germany's railway sector is undergoing a long-term modernisation process, aimed at making electricity the main energy source for rail transports. Use of electricity, instead of diesel fuel, to power locomotives has been continually increased, and electricity now provides 80% of all railway traction power. Railways' power stations for generation of traction current are allocated to the stationary component of the energy sector (1.A.1.a) and are not included in the further description that follows here. In energy input for trains of German railways, diesel fuel is the only energy source that plays a significant role apart from electric power.

Method

Activity Data

Basically, total inland deliveries of *diesel oil* are available from the National Energy Balances (NEBs) (AGEB, 2019)¹. This data is based upon sales data of the Association of the German Petroleum Industry (MWV)². As a recent revision of MWV data on diesel oil sales for the years 2005 to 2009 has not yet been adopted to the respective NEBs, this original MWV data has been used for this five years.

Data on the consumption of biodiesel in railways is provided in the NEBs as well, from 2004 onward. But as the NEBs do not provide a solid time series regarding most recent years, the data used for the inventory is estimated based on the prescribed shares of biodiesel to be added to diesel oil.

Small quantities of *solid fuels* are used for historical steam engines vehicles operated mostly for tourism and exhibition purposes. Official fuel delivery data are available for lignite, through 2002, and for hard coal, through 2000, from the NEBs. In order to complete these time series, a study was carried out in 2012 by Hedel, R., and Kunze, J. (2012)³⁾. During this study, questionnaires were provided to any known operator of historical steam engines in Germany. Here, due to limited data archiving, nearly complete data could only be gained for years as of 2005. For earlier years, in order to achieve a solid time series, conservative gap filling was applied. A follow-up study to gain original consumption data for 2015 was carried out in 2016 by Illichmann, S. (2016)⁴⁾.

Table 1: Overview of activity-data sources for domestic fuel sales to railway operators

Activity	data source / quality of activity data
combustion of:	
Diesel oil	1990-2004: NEB lines 74 and 61: 'Schienenverkehr' / 2005-2009: MWV annual report, table: 'Sektoraler Verbrauch von Dieselmotorkraftstoff' / from 2010: NEB line 61
Biodiesel	calculated from official blending rates
Hard coal	1990-1994: NEB lines 74; 1995-2004: interpolated data; from 2005: original data from studies; 2016: forward extrapolation
Hard coal coke	1990-1997: NEB lines 74 and 61; 1998-2004: interpolated data; from 2005: original data from studies; 2016: forward extrapolation
Raw lignite	from 1990: NEB lines 74 and 61
Lignite briquettes	from 1990: NEB lines 74 and 61
abrasion and wear of contact line, braking systems and tyres on rails:	
transport performance data	in Mio ptkm (performance-ton-kilometers) derived from the TREMOD model

Table 2: Annual fuel consumption in German railways, in terajoules

	1990	1995	2000	2005	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Diesel Oil	38,458	31,054	25,410	18,142	14,626	14,730	13,514	13,771	12,283	13,321	13,775	11,344	10,961	
Biodiesel	0	0	0	397	949	966	882	798	745	720	724	602	633	
Liquids TOTAL	38,458	31,054	25,410	18,539	15,575	15,696	14,396	14,569	13,028	14,041	14,499	11,946	11,594	
Lignite Briquettes	0.00	0.00	431.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Raw Lignite	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Hard Coal	576	250	250	255	314	345	357	352	341	339	340	340	340	
Hard Coal Coke	0	86	1	1	1	1	1	1	1	1	1	1	1	
Solids TOTAL	576	336	682	256	315	346	357	353	342	340	341	341	341	

The EF provided in ⁵⁾ represent summatory values for (i) the fuel's and (ii) the lubricant's heavy-metal content as well as (iii) engine wear. Here, there might be no heavy metals contained in the biofuels. But since the specific shares of (i), (ii) and (iii) cannot be separated, and since the contributions of lubricant and engine wear might be dominant, the same emission factors are applied to biodiesel.

bibliography : 1 : AGEb (2019): Working Group on Energy Balances (Arbeitsgemeinschaft Energiebilanzen (Hrsg.), AGEb): Energiebilanz für die Bundesrepublik Deutschland; URL: <https://ag-energiebilanzen.de/7-0-Bilanzen-1990-2017.html>, Köln & Berlin, 2019. : 2 : MWV (2019): Association of the German Petroleum Industry (Mineralölwirtschaftsverband, MWV): Annual Report 2018, page 65, Table 'Sektoraler Verbrauch von Dieselmotorkraftstoff 2012-2016'; URL: https://www.mwv.de/wp-content/uploads/2016/06/180830_MWV_Jahresbericht-2018_RZ_Web_es_small.pdf, Berlin, 2019. : 3 : Hedel, R., & Kunze, J. (2012): Recherche des jährlichen Kohleeinsatzes in historischen Schienenfahrzeugen seit 1990. Probst & Consorten Marketing-Beratung. Dresden, 2012. : 4 : Illichmann, S. (2016): Recherche des Festbrennstoffeinsatzes historischer Schienenfahrzeuge in Deutschland 2015, Probst & Consorten Marketing-Beratung. Study carried out for UBA; FKZ 363 01 392; not yet published; Dresden, 2016. : 5 : Knörr et al. (2019a): Knörr, W., Heidt, C., Gores, S., & Bergk, F.: ifeu Institute for Energy and Environmental Research (Institut für Energie- und Umweltforschung Heidelberg gGmbH, ifeu): Fortschreibung des Daten- und Rechenmodells: Energieverbrauch und Schadstoffemissionen des motorisierten Verkehrs in Deutschland 1960-2035, sowie TREMOD 5.81, im Auftrag des Umweltbundesamtes, Heidelberg & Berlin, 2019. : 6 : EMEP/EEA (2019): EMEP/EEA air pollutant emission inventory guidebook 2019, <https://www.eea.europa.eu/publications/emep-eea-guidebook-2019/part-b-sectoral-guidance-chapters/1-energy/1-a-combustion/1-a-3-c-railways/view>; Copenhagen, 2019. : 7 : Rentz et al. (2008): Nationaler Durchführungsplan unter dem Stockholmer Abkommen zu persistenten organischen Schadstoffen (POPs), im Auftrag des Umweltbundesamtes, FKZ 205 67 444, UBA

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¹⁾ (bibcite 1)

²⁾ (bibcite 2)

³⁾ (bibcite 3)

⁴⁾ (bibcite 4)

⁵⁾ (bibcite 5)