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German GHG emissions inventory: Estimating emissions from mobile sources

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Different qualities of activity data - From simplest tier1 approaches to flight-specific estimations

By rule of thumb: CRF 1.A.4.c iii – National deep sea fishing

AD: EC Fleet Register[1] database, expert judgement / EF: IPCC & EMEP/EEA tier1 defaults or derived from CRF 1.C.1.b – International Navigation

Until the re-submission 2010, Germany did not include emissions from national deep sea fishing in its national emissions inventories with no such activity provided in the National Energy Balance (NEB[2]). - Asked to provide such data during the 2010 UNFCCC in-country review, due to a lack of statistics, the inventory compilers had to implement a very conservative approach for estimating activity data based upon the annual size of the German deep sea fishing fleet, installed engine power per ship (both data taken from EC Fleet Register) and an average factor for diesel oil consumption per work ([kg/kWh]).

As the number of ships and hence their installed engine power remain quite stable over the last years, both estimated fuel consumption and emissions remain at the same level for several years.

A piece of the cake: CRF 1.A.3.e ii – Other Transportation and CRF 1.A.4.c ii – Other Sectors: Agriculture, mobile

AD: calculated from NEB sum parameter / EF: CS (GHG) + default (EMEP/EEA tier1)

Here, fuel consumption data is not available directly from the NEB, too, but included in NEB line 67: "Trade, commerce, services and other consumers". As fuel consumption of military vehicles is included as well and this data can be achieved separately from different statistics, total fuel consumption of CRFs 1.A.3.e ii and 1.A.4.c ii is deduced by subtracting military fuel consumption from

[1] Fleet Register of the European Commission: http://ec.europa.eu/fisheries/fleet/

[2] The National Energy Balances for Germany is being published by the Working Group on Energy Balances (Arbeitsgemeinschaft Energiebilanzen). Preface to the Energy Balances for the Federal Republic of Germany: http://www.ag-energiebilanzen.de/viewpage.php?idpage=229

NEB line 67. The distribution onto both CRFs happens using the same distribution ratio of 0.42 CRF 1.A.3.e ii and 0.58 CRF 1.A.4.c ii for each year of the time series.

Straight forward: CRFs 1.A.3.c – Railways and 1.A.3.d – National Navigation

AD: NEB, Federal Office of Economics and Export Control (BAFA[3]), Association of the German Petroleum Industry (MWV[4]) / EF: tier 2 CS (for GHG) + default (EMEP/EEA tier1)

For these two source categories, separate AD is provided within NEB (fuel consumption) and MWV/BAFA Official Mineral Oil Data (fuel consumption + lubricants).

For CRF 1.A.3.d, one issue still unresolved is the missing distribution of diesel oil consumption onto domestic and international inland navigation with no statistical data available.

Cellular: 1.A.3.b – Road Transportation

AD: (NEB), Federal Motor Transport *Authority (KBA)[5], Federal Statistical Office (DESTATIS)[6], modelled, measured (mileage) / EF: tier3 CS - measured, modelled*

Here, general AD is available directly from NEBs, too, but as road transport requires tier3 reporting, far more detailed computing has to be carried out within the TREMOD[7] model. Within TREMOD, a sophisticated framework is administered, including data on annual fleet composition, mileage and very specific emission factors (for certain types of passenger cars, light duty vehicles etc. with or without mitigation technologies, on urban and rural roads or autobahn; based on Handbook of Emission Factors[8]). These data allows the calculation of technology specific activity data and emissions per kilometre.

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[3] The BAFA (Bundesamt für Wirtschaft und Ausfuhrkontrolle, http://www.bafa.de/bafa/en/index.html) is publisher of the annual Official Mineral Oil Data for Germany: http://www.bafa.de/bafa/de/energie/mineraloel_rohoel/amtliche_mineraloeldaten/index.html

[4] The MWV (Mineralölwirtschaftsverband) compiles and publishes the "Mineralöldaten": http://www.mwv.de/index.php/daten/statistikeninfoportal

[5] The Federal Motor Transport Authority (Kraftfahrtbundesamt, KBA, http://www.kba.de/cln_033/nn_261078/EN/Home__en/homepage__node.html?__nnn=true) amongst others administers the Central Vehicle Register for Germany: http://www.kba.de/cln_033/nn_261078/EN/ZentraleRegister__en/ZFZR__en/zfzr__inhalt__en.html

[6] Federal Statistical Office (Statistisches Bundesamt, DESTATIS) https://www.destatis.de/EN/Meta/Sitemap/Sitemap.html

[7] TREMOD (TRansport Emissions MODel) is comparable to the COPERT (http://www.emisia.com/copert/General.html) model used in many countries. It is being administered and maintained by ifeu - Institute for Energy and Environmental Research, Wilckensstraße 3, D-69120 Heidelberg, Germany; phone: +49 (0) 6221 / 47 67 -0, fax: +49 (0) 6221 / 47 67 -19, e-Mail: ifeu@ifeu.de

[8] The Handbook Emission Factors for Road Transport (HBEFA) provides emission factors for all current vehicle categories (PC, LDV, HGV, urban buses, coaches and motor cycles), each divided into different categories, for a wide variety of traffic situations. Emission factors for all regulated and the most important non-regulated pollutants as well as fuel consumption and CO2 are included. Version HBEFA 3.1 (Jan. 2010) is available and can be ordered online: http://www.hbefa.net/e/index.html

For emission reporting purposes, specific emissions are then divided by the corresponding fuel consumption data. The resulting implied emission factors (IEF, in [kg/ TJ]) as well as the tier3 AD are then transferred to the CSE where emissions are re-estimated with respect to energy instead of mileage.

Quite Atomic: 1.A.3.a – Civil Aviation

AD: NEB, DESTATIS, Eurocontrol[9], modelled / EF: CS (CO_2) + tier2 & 3 defaults (tier1 for avgas)

For reporting emissions from civil aviation, a rather quick and broad evolution took place within the last few years: Where emissions were estimated via a tier1 approach until submission 2009, tier2a was implemented (separate estimates for LTO and cruise) for submission 2010, followed immediately by tier3a in submission 2011.

Today, emissions could be estimated on a flight specific level at least for common airliners starting from the 27 largest German airports: All necessary data such as the number of starts from German airports, the type of aircraft, its destination etc. are collected and provided to the inventory compilers by the German Federal Statistical Office (DESTATIS) and Eurocontrol.

As for CRF 1.A.3.b, this huge number of annual data is computed in a certain model for estimating emissions from civil aviation: TREMOD AV[10] was developed as an additional module of the TREMOD system. Here, specific fuel consumption and emissions are estimated literally for each single airliner flight using technology specific LTO fuel consumption and emission factors provided by both IPCC and EMEP/EEA. For commercial flights from other airports as well a large number of non-commercial flights (by small piston engine aircraft, helicopters, microlights etc.) several assumptions are implemented in the model.

For emissions reporting, as described for road transport, more aggregated IEF are produced within TREMOD AV allowing the estimation of corresponding but less “atomic” emissions within CSE.

Number of flights (for 2009):

- commercial - from 27 selected airports: 1.04 Mio
- commercial - from other airports: 0.43 Mio
- non-commercial: 1.11 Mio

[9] Eurocontrol (European Organisation for the Safety of Air Navigation): http://www.eurocontrol.int/
[10] TREMOD AV final project report (German version only): http://www.uba.de/uba-info-medien/4357.html