

# 5.A - Biological Treatment of Waste: Solid Waste Disposal on Land

## Short description

| Category Code | Method          |                 |                 |       |    | AD |    |    |    |      | EF  |     |     |                  |                   |
|---------------|-----------------|-----------------|-----------------|-------|----|----|----|----|----|------|-----|-----|-----|------------------|-------------------|
| 5.A           | T1              |                 |                 |       |    | NS |    |    |    |      | D   |     |     |                  |                   |
| Key Category  | SO <sub>2</sub> | NO <sub>x</sub> | NH <sub>3</sub> | NMVOC | CO | BC | Pb | Hg | Cd | Diox | PAH | HCB | TSP | PM <sub>10</sub> | PM <sub>2.5</sub> |
| 5.A           | -               | -               | -               | -/-   | -  | -  | -  | -  | -  | -    | -   | -   | -/- | -/-              | -/-               |

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

| Methods   |                                 |
|-----------|---------------------------------|
| <b>D</b>  | Default                         |
| <b>RA</b> | Reference Approach              |
| <b>T1</b> | Tier 1 / Simple Methodology *   |
| <b>T2</b> | Tier 2*                         |
| <b>T3</b> | Tier 3 / Detailed Methodology * |
| <b>C</b>  | CORINAIR                        |
| <b>CS</b> | Country Specific                |
| <b>M</b>  | Model                           |

\* as described in the EMEP/CORINAIR Emission Inventory Guidebook - 2007, in the group specific chapters.

| AD - Data Source for Activity Data |                                      |
|------------------------------------|--------------------------------------|
| <b>NS</b>                          | National Statistics                  |
| <b>RS</b>                          | Regional Statistics                  |
| <b>IS</b>                          | International Statistics             |
| <b>PS</b>                          | Plant Specific data                  |
| <b>AS</b>                          | Associations, business organisations |
| <b>Q</b>                           | specific questionnaires, surveys     |
| EF - Emission Factors              |                                      |
| <b>D</b>                           | Default (EMEP Guidebook)             |
| <b>C</b>                           | Confidential                         |
| <b>CS</b>                          | Country Specific                     |
| <b>PS</b>                          | Plant Specific data                  |

In category **5.A**, NMVOC and PM<sub>2.5</sub> emissions from managed disposal in landfills are reported in accordance with review recommendation DE-5A-2017-0001. In addition to that, for the sake of completeness, PM<sub>10</sub> and TSP emissions were also reported.

In the period since 1990 (and previously, to some extent), a number of legal provisions have been issued pertaining to Germany's waste-management sector, and a number of relevant measures have been initiated. These moves have had a strong impact on trends in emissions from waste-landfilling. Relevant developments have included intensified collection of biodegradable waste from households and the commercial sector, intensified collection of other recyclable materials, such as glass, paper/cardboard, metals and plastics; separate collection of packaging and recycling of packaging. In addition, incineration of settlement waste has been expanded, and mechanical biological treatment of residual waste has been introduced. As a result, the amounts of landfilled settlement waste decreased very sharply from 1990 to 2006, and stabilised at a low level since 2006. Today over half of settlement waste produced in Germany is collected separately and gleaned for recyclable materials (separate collection of recyclable materials and biodegradable waste). National statistical data are used (see sub-chapter "activity- data").

In 2004, about 2000 landfills of relevance for this category were in operation in the Federal Republic of Germany. In June 2005, in keeping with new, stricter requirements under the Ordinance on Environmentally Compatible Storage of Waste from Human Settlements (Abfallablagerungsverordnung) and the Landfill Ordinance (Deponieverordnung), nearly half of those landfills were closed. As a result, in 2017 less than 1100 landfills, divided into 5 deposition classes are still in operation.

Also, pursuant to regulations in force since June 2005, landfilling of biodegradable waste is no longer permitted - for conformance with pertinent requirements, settlement waste and other biodegradable waste must be pre-treated via thermal or mechanical-biological processes. All these measures have had strong impact on the formation of NMVOC, PM<sub>2.5</sub>, PM<sub>10</sub> and TSP so that their emissions decreased significantly since 1990.

## Methodolgy

For the estimation of NMVOC, Germany decided against the proposed EF of the EMEP/EEA Guidebook 2016, but instead for the Tier 1 approach of the US-EPA which is also reproduced there (Part B, 5.A, chap. 3.2.2, p. 5; <sup>1)</sup>). According to national experts in the field, the approach of the US-EPA is more likely to produce better data, because the ratio between NMVOC (1.3 %) and CH<sub>4</sub> (98.7 %) in VOC from landfill gas is scientifically sound and assumed to be the very same in Germany. Also, already existing and published data for methane emissions from landfills, derived from the IPCC-FOD Waste Model (see NIR of Germany), can be used.

Emissions for PM<sub>2.5</sub>, PM<sub>10</sub> and TSP, reported under this category, are calculated using the Tier 1 approach of the EMEP/EEA Guidebook 2016, where the emission factors are 0.033 [g/t], 0.219 [g/t] and 0.463 [g/t] (Part B, 5.A, chap. 3.2.2, Table 3-1, p. 5; <sup>2)</sup>). The EFs are multiplied with the total amount of solid waste (AD) treated in managed above-ground landfills, following the standard equation:

$$EM = AD * EF$$

## Activity data

Data from 1990 until 2005 are made available for the UBA by the National Statistical Agency by means of a direct data provision (Statistisches Bundesamt, January 2019; <sup>3)</sup>). Data for 1991+1992 and 1994+1995 are not available and have been interpolated.

From 2006 until today, Official statistical data (Statistisches Bundesamt, Fachserie 19, Reihe 1: Abfallentsorgung (Waste management), Table 2.1; <sup>4)</sup>) are used for the estimation. The data are published on a yearly basis with an exception for the actual year of reporting. The activity data for the actual year of reporting are obtained, initially, by carrying the relevant data from the previous year forward, in unchanged form. In the following year, when the actual activity data for the given year becomes available, they replace the data that were carried forward. With regard to emissions from landfills, this procedure has only a very small impact on the total emissions in the relevant current report year.

## Emission factors

See above under Methodology.

## Uncertainties

The AD from Statistisches Bundesamt usually have an uncertainty of  $\pm 3\%$  whereas the uncertainties for the PMs and TSP emission factors, according to the EMEP/EEA Guidebook (Part B, 5.A, chap. 3.2.2, Table 3-1, p. 5), were estimated to be:

|                         |              |
|-------------------------|--------------|
| <b>PM<sub>2.5</sub></b> | -99% / +385% |
| <b>PM<sub>10</sub></b>  | -99% / +379% |
| <b>TSP</b>              | -99% / +377% |

Due to the fact that for the ratio of NMVOC and CH<sub>4</sub> in VOC from landfill gas no range is given in the EMEP-Guidebook, the overall uncertainty for the emission estimation of NMVOC is estimated by expert judgement to be  $\pm 50\%$ .

## Recalculations

Regular back-calculations are required annually for the previous year, since the waste statistics of the Federal Statistical Office are published with a one-year delay for the data on the quantities and compositions of waste deposited, so that the

current reporting year must therefore be estimated. The estimate is replaced in the following year with the then current data.

Since the recalculation required as a result is very small overall in each year, it will not be reported additionally here.

In this year's reporting there was a need for correction in addition to the reasons described above. In the past, an incorrect CH<sub>4</sub> content (41% instead of 45%) was expected for landfills in the landfill and decommissioning phase in 2016, which also has an impact in 2015 and 2017. In addition, there was a marginal calculation error in the summation of sewage sludge going to landfill. For the reasons given above, a recalculation was necessary (see following table).

Recalculation: Methane and PM+TSP-emissions from SWDS

|                           |      |      | 2015    | 2016    | 2017    | 2018    |
|---------------------------|------|------|---------|---------|---------|---------|
| CH <sub>4</sub> from SWDS | [kt] | 2021 | 357,495 | 334,910 | 317,972 | 302,231 |
|                           |      | 2020 | 362,047 | 343,444 | 322,518 | 303,136 |
| NMVOC                     | [kt] | 2021 | 4,709   | 4,411   | 4,188   | 3,981   |
|                           |      | 2020 | 4,769   | 4,524   | 4,248   | 3,993   |
| PM <sub>2.5</sub>         | [t]  | 2021 | -       | -       | -       | 1,504   |
|                           |      | 2020 | -       | -       | -       | 1,518   |
| PM <sub>10</sub>          | [t]  | 2021 | -       | -       | -       | 9,983   |
|                           |      | 2020 | -       | -       | -       | 10,071  |
| TSP                       | [t]  | 2021 | -       | -       | -       | 21,106  |
|                           |      | 2020 | -       | -       | -       | 21,291  |

## Planned improvements

Currently no improvements are planned.

<sup>1)</sup> , <sup>2)</sup>

EMEP/EEA, 2016: EMEP/EEA air pollutant emission inventory guidebook 2016, Copenhagen, 2016

<sup>3)</sup>

Statistisches Bundesamt, Data provision by Mail, 14.01.2019; Data are confidential; Wiesbaden

<sup>4)</sup>

Statistisches Bundesamt, Fachserie FS 19, Reihe 1: Abfallentsorgung; Wiesbaden; URL:

<https://www.destatis.de/DE/Publikationen/Thematisch/UmweltstatistischeErhebungen/Abfallwirtschaft/Abfallentsorgung.html>