

# 1.A.3.b v - Gasoline Evaporation

## Short description

In category 1.A.3.b v - Road Transport: Gasoline evaporation fugitive emissions from the evaporation of gasoline from road vehicles are reported.

| Category Code | Method          |                 |                 |        |    | AD    |    |    |    |      | EF    |     |     |                  |                   |
|---------------|-----------------|-----------------|-----------------|--------|----|-------|----|----|----|------|-------|-----|-----|------------------|-------------------|
| 1.A.3.b v     | T2              |                 |                 |        |    | NS, M |    |    |    |      | CS, M |     |     |                  |                   |
| Key Category  | SO <sub>2</sub> | NO <sub>x</sub> | NH <sub>3</sub> | NM VOC | CO | BC    | Pb | Hg | Cd | Diox | PAH   | HCb | TSP | PM <sub>10</sub> | PM <sub>2.5</sub> |
| 1.A.3.b v     | -               | -               | -               | L/T    | -  | -     | -  | -  | -  | -    | -     | -   | -   | -                | -                 |

## Methodology

### Activity data

Specific data for gasoline evaporation from road vehicles are generated within TREMOD <sup>1)</sup>. - The following table provides an overview of annual amounts of gasoline evaporated from road vehicles in Germany.

Table 1: Annual amount of gasoline evaporated from road vehicles, in kilotonnes

|                    | 1990          | 1995         | 2000         | 2005         | 2006         | 2007         | 2008         | 2009         | 2010         | 2011         | 2012         | 2013         | 2014         | 2015         | 2016         | 2017         | 2018         | 2019         | 2020         |
|--------------------|---------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|
| <b>PCs</b>         | 10,915        | 9,222        | 8,541        | 7,514        | 7,078        | 6,694        | 6,382        | 6,328        | 6,173        | 6,085        | 5,775        | 5,725        | 5,718        | 5,502        | 5,498        | 5,605        | 5,321        | 5,336        | 4,914        |
| <b>LDVs</b>        | 174           | 164          | 147          | 95           | 85           | 76           | 66           | 60           | 55           | 51           | 46           | 43           | 47           | 49           | 53           | 59           | 63           | 68           | 69           |
| <b>Mopeds</b>      | 48            | 41           | 43           | 47           | 48           | 52           | 54           | 62           | 58           | 57           | 54           | 56           | 56           | 59           | 59           | 58           | 58           | 59           | 60           |
| <b>Motorcycles</b> | 102           | 94           | 198          | 215          | 207          | 198          | 184          | 168          | 154          | 142          | 131          | 124          | 129          | 136          | 138          | 143          | 135          | 139          | 144          |
| <b>Σ 1.A.3.b v</b> | <b>11,283</b> | <b>9,521</b> | <b>8,928</b> | <b>7,871</b> | <b>7,417</b> | <b>7,020</b> | <b>6,686</b> | <b>6,618</b> | <b>6,440</b> | <b>6,335</b> | <b>6,006</b> | <b>5,948</b> | <b>5,951</b> | <b>5,745</b> | <b>5,748</b> | <b>5,865</b> | <b>5,577</b> | <b>5,601</b> | <b>5,187</b> |

source: TREMOD 6.02 <sup>2)</sup>

### (Implied) Emission factors

Tier3 emission factors representing the effect of mitigation technologies are derived from TREMOD (Knörr et al., 2020a) <sup>3)</sup>.

Table 2: Overview of implied emission factors per vehicle type, in kg/t

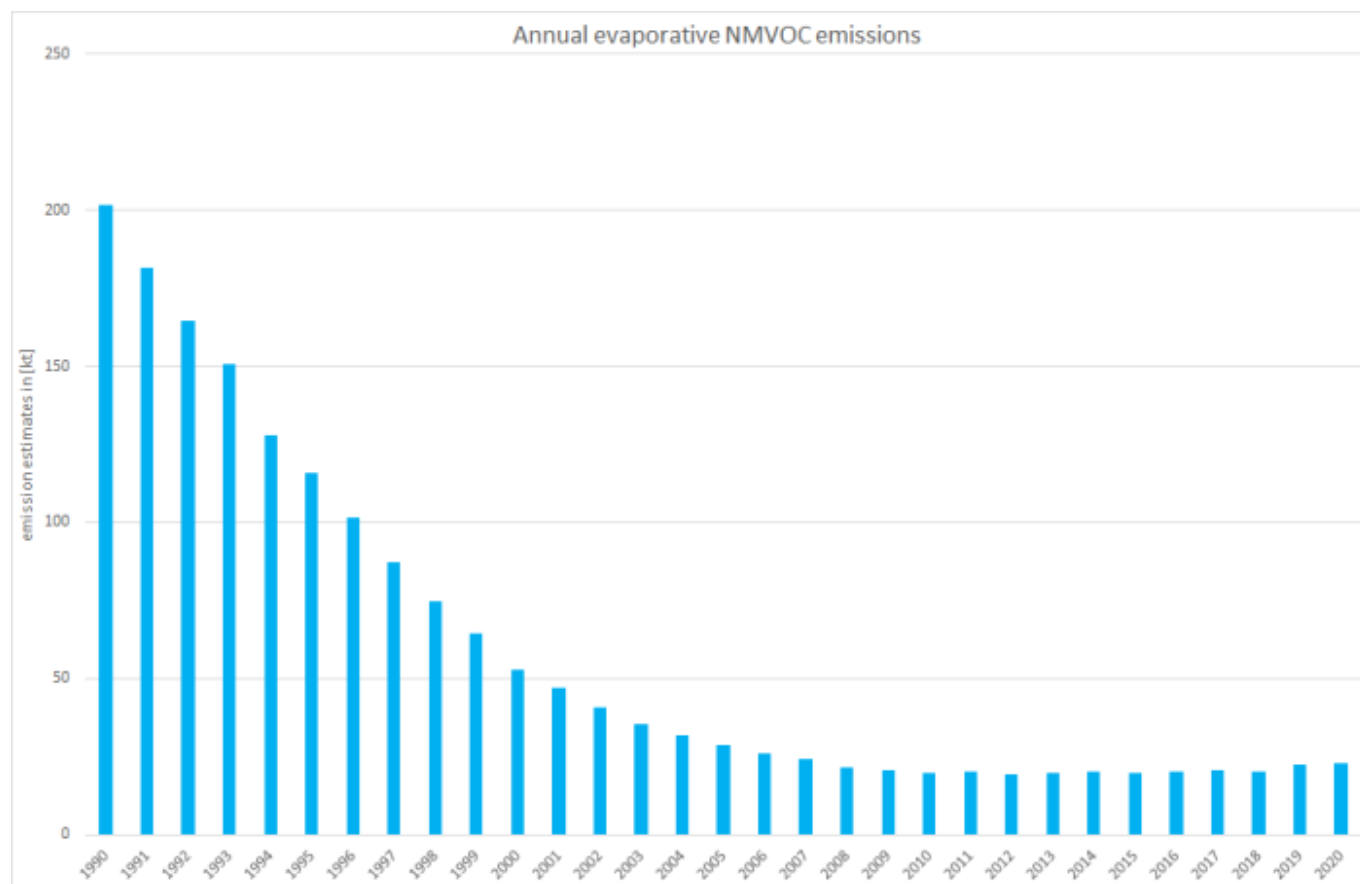
|                    | 1990 | 1995 | 2000 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 |
|--------------------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|
| <b>PCs</b>         | 17.7 | 11.9 | 5.51 | 3.14 | 2.96 | 2.94 | 2.67 | 2.58 | 2.56 | 2.63 | 2.66 | 2.73 | 2.79 | 2.86 | 2.91 | 2.93 | 3.00 | 3.42 |
| <b>LDVs</b>        | 23.6 | 19.2 | 12.9 | 8.9  | 8.67 | 8.22 | 6.67 | 6.26 | 5.91 | 5.83 | 5.47 | 5.50 | 5.11 | 5.00 | 4.76 | 4.45 | 4.01 | 3.80 |
| <b>Mopeds</b>      | 37.4 | 19.2 | 18.4 | 16.4 | 16.1 | 15.5 | 15.2 | 14.6 | 14.6 | 14.7 | 14.7 | 14.5 | 14.5 | 14.3 | 14.3 | 14.4 | 14.3 | 14.3 |
| <b>Motorcycles</b> | 23.3 | 24.8 | 16.2 | 15.8 | 16.1 | 16.5 | 16.1 | 17.4 | 18.8 | 20.5 | 21.8 | 23.6 | 23.3 | 22.5 | 22.7 | 22.5 | 23.1 | 22.7 |

## Discussion of emission trends

Table: Outcome of Key Category Analysis

|      |               |
|------|---------------|
| for: | <b>NM VOC</b> |
| by:  | Level & Trend |

NFR 1.A.3.b v is key source for emissions of Non-Methane Volatile Organic Compounds - NM VOC. (*fugitive emissions only; no NM VOC emissions from fuel combustion included*)



Since its maximum level of over 11,000 kilotonnes in 1990, the amount of evaporated gasoline is decreasing - and so are the related NMVOC emissions. The amounts of evaporated gasoline are connected directly with those of gasoline consumed. Here, the decrease becomes sharper from 2000 onwards following a growing switch from gasoline to diesel oil especially in passenger cars. Here, the annual amounts of NMVOC emissions from evaporation not only depend directly on the amount of evaporated gasoline but also on the number of vehicles equipped with mitigation technologies. Thus, the decrease is sharpest straight after 1990 and since then slowing down.

## Recalculations

Due to a broad revision of the TREMOD model carried out to keep in line with the new HBEFA 4.1, **activity data** and **emission factors** have been checked and **revised for all years**.

Table 3: Revised annual amounts of evaporated gasoline, in kilotonnes

|                        | 1990   | 1995   | 2000   | 2005   | 2006   | 2007   | 2008   | 2009   | 2010   | 2011   | 2012   | 2013   | 2014  | 2015  | 2016  | 2017  | 2018  |
|------------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|-------|-------|-------|-------|-------|
| <b>Submission 2021</b> | 11.239 | 9.521  | 8.928  | 7.871  | 7.417  | 7.020  | 6.686  | 6.618  | 6.440  | 6.335  | 6.006  | 5.949  | 5.952 | 5.749 | 5.756 | 5.880 | 5.598 |
| <b>Submission 2020</b> | 11.267 | 9.561  | 8.964  | 7.895  | 7.424  | 7.030  | 6.695  | 6.625  | 6.447  | 6.342  | 6.015  | 5.959  | 5.948 | 5.747 | 5.730 | 5.752 | 5.392 |
| <b>absolute change</b> | -28,8  | -40,6  | -35,4  | -23,6  | -6,25  | -9,92  | -8,21  | -7,54  | -7,08  | -6,71  | -8,68  | -10,4  | 3,91  | 1,96  | 26,5  | 128   | 205   |
| <b>relative change</b> | -0,26% | -0,42% | -0,39% | -0,30% | -0,08% | -0,14% | -0,12% | -0,11% | -0,11% | -0,11% | -0,14% | -0,18% | 0,07% | 0,03% | 0,46% | 2,22% | 3,81% |

In addition, the NMVOC **emission factors** applied were revised for all years. However, this revision can only be displayed for the implied emission factors:

Table 4: Revised implied emission factors for NMVOC emissions from evaporated gasoline, in kg/t

|                        | 1990 | 1995 | 2000 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 |
|------------------------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|
| <b>PASSENGER CARS</b>  |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
| <b>Submission 2021</b> | 17,7 | 11,9 | 5,51 | 3,14 | 2,96 | 2,94 | 2,67 | 2,58 | 2,56 | 2,63 | 2,66 | 2,73 | 2,79 | 2,86 | 2,91 | 2,93 | 3,00 |

|                            |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |
|----------------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| <b>Submission 2020</b>     | 18,82  | 12,45  | 5,63   | 3,15   | 2,98   | 2,95   | 2,68   | 2,58   | 2,56   | 2,63   | 2,66   | 2,73   | 2,80   | 2,78   | 2,84   | 2,91   | 3,03   |
| <b>absolute change</b>     | -1,12  | -0,57  | -0,12  | -0,01  | -0,02  | -0,02  | -0,01  | 0,00   | 0,00   | 0,00   | 0,00   | 0,01   | 0,00   | 0,08   | 0,07   | 0,02   | -0,02  |
| <b>relative change</b>     | -5,96% | -4,60% | -2,16% | -0,41% | -0,69% | -0,52% | -0,24% | -0,09% | 0,03%  | 0,08%  | 0,13%  | 0,20%  | -0,08% | 2,97%  | 2,54%  | 0,75%  | -0,79% |
| <b>LIGHT-DUTY VEHICLES</b> |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |
| <b>Submission 2021</b>     | 23,6   | 19,2   | 12,9   | 8,9    | 8,67   | 8,22   | 6,67   | 6,26   | 5,91   | 5,83   | 5,47   | 5,50   | 5,11   | 5,00   | 4,76   | 4,45   | 4,01   |
| <b>Submission 2020</b>     | 24,9   | 20,0   | 13,9   | 10,33  | 9,6    | 9,3    | 7,86   | 7,47   | 7,13   | 7,11   | 6,65   | 6,69   | 6,49   | 6,01   | 5,92   | 5,74   | 5,29   |
| <b>absolute change</b>     | -1,3   | -0,81  | -1,02  | -1,45  | -0,97  | -1,05  | -1,19  | -1,22  | -1,22  | -1,28  | -1,19  | -1,19  | -1,38  | -1,02  | -1,16  | -1,29  | -1,28  |
| <b>relative change</b>     | -5,21% | -4,03% | -7,35% | -14,0% | -10,1% | -11,3% | -15,1% | -16,3% | -17,2% | -18,0% | -17,8% | -17,8% | -21,2% | -16,9% | -19,6% | -22,5% | -24,2% |
| <b>MOPEDS</b>              |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |
| <b>Submission 2021</b>     | 37,4   | 19,2   | 18,4   | 16,4   | 16,1   | 15,5   | 15,2   | 14,6   | 14,6   | 14,7   | 14,7   | 14,5   | 14,5   | 14,3   | 14,3   | 14,4   | 14,3   |
| <b>Submission 2020</b>     | 37,4   | 23,7   | 21,1   | 17,6   | 17,1   | 16,4   | 15,9   | 15,1   | 15,0   | 14,9   | 14,8   | 14,6   | 14,4   | 13,8   | 13,9   | 14,0   | 14,3   |
| <b>absolute change</b>     | 0,00   | -4,49  | -2,76  | -1,25  | -1,05  | -0,83  | -0,66  | -0,49  | -0,38  | -0,27  | -0,15  | -0,04  | 0,06   | 0,47   | 0,44   | 0,41   | 0,03   |
| <b>relative change</b>     | 0,00%  | -19,0% | -13,0% | -7,10% | -6,11% | -5,07% | -4,18% | -3,23% | -2,51% | -1,78% | -1,04% | -0,30% | 0,41%  | 3,40%  | 3,17%  | 2,93%  | 0,24%  |
| <b>MOTORCYCLES</b>         |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |
| <b>Submission 2021</b>     | 23,3   | 24,8   | 16,2   | 15,8   | 16,1   | 16,5   | 16,1   | 17,4   | 18,8   | 20,5   | 21,8   | 23,6   | 23,3   | 22,5   | 22,7   | 22,5   | 23,1   |
| <b>Submission 2020</b>     | 23,3   | 24,8   | 16,2   | 15,8   | 16,5   | 16,5   | 16,1   | 17,4   | 18,8   | 20,5   | 21,8   | 23,6   | 23,3   | 21,8   | 22,2   | 22,4   | 22,4   |
| <b>absolute change</b>     | 0,00   | 0,00   | 0,00   | 0,00   | -0,46  | 0,00   | 0,00   | 0,00   | 0,00   | 0,00   | 0,01   | 0,02   | 0,00   | 0,65   | 0,44   | 0,10   | 0,66   |
| <b>relative change</b>     | 0,00%  | 0,00%  | 0,00%  | 0,00%  | -2,81% | 0,00%  | 0,00%  | 0,00%  | 0,00%  | 0,01%  | 0,05%  | 0,07%  | 0,00%  | 2,99%  | 1,98%  | 0,44%  | 2,95%  |

As a result, **NM VOC emissions from gasoline evaporation** were re-estimated as follows:

Table 6: Re-estimated NM VOC emissions, in kilotonnes

|                        | 1990  | 1995  | 2000  | 2005  | 2006  | 2007  | 2008  | 2009  | 2010  | 2011  | 2012  | 2013  | 2014  | 2015 | 2016 | 2017 | 2018 |
|------------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|------|------|------|------|
| <b>Submission 2021</b> | 201   | 116   | 52,9  | 28,6  | 25,8  | 24,4  | 21,3  | 20,5  | 19,9  | 20,0  | 19,3  | 19,6  | 20,0  | 19,9 | 20,3 | 20,8 | 20,3 |
| <b>Submission 2020</b> | 215   | 122   | 54,6  | 29,1  | 26,1  | 24,7  | 21,5  | 20,7  | 20,0  | 20,1  | 19,3  | 19,7  | 20,1  | 19,4 | 19,7 | 20,3 | 19,7 |
| <b>absolute change</b> | -13,3 | -6,30 | -1,68 | -0,49 | -0,37 | -0,31 | -0,20 | -0,16 | -0,13 | -0,11 | -0,09 | -0,08 | -0,08 | 0,51 | 0,52 | 0,53 | 0,53 |
| <b>relative change</b> | -6,2% | -5,2% | -3,1% | -1,7% | -1,4% | -1,3% | -0,9% | -0,8% | -0,6% | -0,5% | -0,5% | -0,4% | -0,4% | 2,6% | 2,6% | 2,6% | 2,7% |



For specific information on recalculated emission estimates for Base Year and 2019, please see the pollutant specific recalculation tables following chapter [8.1 - Recalculations](#).

## Planned improvements

Besides a routine revision of the underlying model, no specific improvements are planned.

<sup>1), 3)</sup> 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, im Auftrag des Umweltbundesamtes, Heidelberg & Berlin, 2020.

<sup>2)</sup> (bibcite 1)

