

# Adjustment DE-A regarding NO<sub>x</sub> from Road Vehicles

## PREFACE

When deriving proposals for national emission ceilings for negotiations of the 1999 Gothenburg Protocol, sector-specific emission estimates for the year 2010 were calculated at IIASA using a set of scenarios which assumed various technological abatement measures, policy incentives, and legislation available / in place or planned at that time. As a result, the 2010 emission by road transport in Germany was estimated at NO<sub>x</sub>, (IIASA, 1999) <sup>1)</sup>. The over-all 2010 national emission ceiling (NEC) for NO<sub>x</sub>, was set to 1,081 kt. When negotiating the EU NEC Directive two years later, Germany agreed to reduce its NO<sub>x</sub>, emissions further, resulting in a NEC of 1,051 kt.

In its 2016 NEC emissions reporting, Germany provided a national total for NO<sub>x</sub>, emissions of 1,337 kt for 2010. However, this total includes emissions from agricultural soils and other source categories not accounted for when setting the NEC. In addition, some assumptions made in 1999, including on emission factors from road traffic, turned out to be wrong in reality. Like in many other European countries, non-compliance with the 2010 NEC as set in 1999 was partly not caused by failed national mitigation policies, but by changes beyond the control of, and unforeseen by, the individual Party or Member State.

In order to differentiate such changes from policy failures in the responsibility of the individual Parties to the Gothenburg Protocol, a procedure (Inventory Adjustment) allowing the adjustment of emissions resulting from new emission categories, changes in estimation methodologies, emission factors etc. provided within the EMEP/EEA Guidebook, or other effects beyond national control with respect to complying to emission reduction obligations (EB, 2012a & c) <sup>2), 3)</sup> was agreed. This procedure is applicable also for existing NECs (EB, 2012b) <sup>4)</sup>.

With respect to road transport, such an unforeseeable effect was the partial failure of several so-called “Euro norms” set on the EU level to reduce emissions from road vehicles. In this report, Germany presents an estimate of the NO<sub>x</sub>, emissions resulting from the partial failure of the mitigation policy reflected by the Euro norms, and lays out the calculations leading to these estimates.

## REASONS FOR MISSING THE GOTHENBURG CEILINGS

The TREMOD methodology applied for estimating emissions from road transportation in Germany has changed over time. These changes include updates of emission factors (EF) for various pollutants and other changes such as an extension of vehicle classification (and thus inclusion of emission factors associated with these new vehicle sub-categories) to improve the estimation's accuracy.

The main changes occurred for the emission factors and for the Heavy Duty Vehicles (HDV) fleet structure. This last point led to changes in emissions because of the reallocation of activities (consumption/traffic) between the sub-categories of vehicles.

For the formalism of the adjustments, it is difficult to flag whether the modifications for road transport are due to “methodological changes” or due to “changes of emission factor”. Therefore, only the term “change of methodology” will be used (even if at the NFR reporting level this may seem like a simple change in EFs).

So far as road transport is concerned, the inability to attain the emission ceiling is most likely to have been affected by a combination of technological changes within the fleet (which of course made their way into the several versions of TREMOD) combined with greater than originally expected dieselisation of the fleet.

## ANALYSING THE PROBLEM: THE EUROPEAN PERSPECTIVE BASED ON COPERT

Already in 2011, these effects were demonstrated by Ntziachristos and Papageorgiou (2011) <sup>5)</sup>. Here, the impacts of changing model versions and activity data in the context of meeting the EU NEC Directive ceiling commitments were examined for four European countries including Germany. Unfortunately, this comparison study was carried out within a COPERT environment. Therefore, the results gained cannot be transferred to the German TREMOD environment on a one-to-one level but nonetheless allow a highly illustrative insight in the reasons for not meeting the set ceiling. The study modeled fuel consumption and NO<sub>x</sub>, emissions for four selected countries (Germany, France, Netherlands and Belgium) and found higher NO<sub>x</sub>, emissions were estimated for the road transport sector than originally modelled by the RAINS model of IIASA (which underpinned the setting of 2010 ceilings). For Germany, this study shows that with the same activity data set (LIFE+

EC4MACS data from Amann et al. (2010)), NO<sub>x</sub>, emissions estimated with COPERT II vs. COPERT 4 (v8.0) increase from 410 kt to 518 kt due to methodological changes, a difference of 282 kt. An additional consideration of changes in AD would lead to 620 kt of NO<sub>x</sub>. However, as changes in AD are no valid adjustment reason, the latter value is for information only.

This was mainly due to: \* NO<sub>x</sub>, emission factors updated in COPERT 4 that did not follow the reductions as set by the emission standards for diesel passenger cars; \* important part of diesel fuel consumption in the total fuel consumption of the road traffic.

The results of this study showed that it is the combination of different parameters which might affect the ability (to different extents) of a Party to attain the emission ceilings. In other words, the exceeding of NO<sub>x</sub>, ceilings for road transport is due to:

### Changes in methodology and emission factors

As these technologically driven changes (as reflected in the evolution of the different so-called Euro norms) lie outside the country's responsibility, current methodology and EFs have to be adjusted in a way to allow the comparison of the actual inventory and the Gothenburg ceilings.

### Changes in the activity data

As the development of mileage driven and fuels used within a country (Germany: stronger dieselisation then originally expected) is of the country's responsibility, this effect has to be excluded from any adjustment estimation.

## IN-COUNTRY ANALYSIS: THE TREMOD PERSPECTIVE

### INITIAL ASSUMPTION

In order to estimate the effect of NO<sub>x</sub>, emissions resulting from the failure of the so-called Euro norms, the following procedure has been agreed by expert review teams in the last two years:

**proposed amount of adjustable emissions = current AD x current EF - current AD x original EF = current AD x (current EF - original EF) = current EM - "artificial" current EM<sup>1</sup>**

<sup>1</sup> "artificial" current emissions = virtual current emissions assuming no changes in emission factors

$$EM_{\text{adjustment}} = AD_{\text{current}} * EF_{\text{current}} - AD_{\text{current}} * EF_{\text{original}} = AD_{\text{current}} * (EF_{\text{current}} - EF_{\text{original}}) = EM_{\text{current}} - EM_{\text{current-artificial}}$$

with \* **EM<sub>adjustment</sub>**, = amount of emissions to be subtracted from National Totals \* **AD<sub>current</sub>**, = AD from latest TREMOD version as used for current submission \* **EF<sub>current</sub>**, = EF from latest TREMOD version as used for current submission \* **EF<sub>original</sub>**, = EF from TREMOD version used at the time NEC ceilings were set (here: TREMOD 3.1) \* **EM<sub>current</sub>**, = EM estimated from AD and EF from latest TREMOD version = EM reported for NFR 1.A.3.b with latest submission \* **EM<sub>current-artificial</sub>**, = EM estimated from AD from latest TREMOD version and EF from TREMOD version used at the time NEC ceilings were set (here: TREMOD 3.1)

### APPLYING THE ORIGINAL METHODOLOGY

#### FRAMEWORK INFORMATION

The methodology used for estimating Germany's exhaust emissions from road transport when determining emissions ceilings of the Gothenburg Protocol (1999), was the second version of the EMEP/CORINAIR guidebook corresponding to COPERT II software. This method proposed NO<sub>x</sub>, emission factors for

- passenger cars (PC): up to Euro 1
- light commercial vehicles (LCV2): up to Euro 1
- heavy duty vehicles (HDV): pre-EURO I only (conventional)

Back then, without better knowledge, the emission factors for the most recent standards were derived by directly applying the expected reductions in emission standards.

However, as Germany does not use COPERT for compiling its road transport emissions inventory but a national model called

TREMODO, the following comparison has to be carried out between the oldest version of TREMOD still available and the version as applied for the current inventory submission (2020).

Unfortunately, the oldest TREMOD version available for such comparison is TREMOD 3.1 from 2002<sup>6)</sup>, including the following set of NO<sub>x</sub>, emission factors:

- passenger cars (PC): up to Euro 4
- light commercial vehicles (LCV): up to Euro 4
- heavy duty vehicles (HDV) only up to EURO V

However, as this version includes the technological development since 1999 (when the ceilings were set based on COPERT II), the results from this analysis and the adjustment proposal based upon these results are likely to slightly underestimate the effect of technological changes since 1999 and must therefore be considered conservative.

## THE COMPARISON

### Application of the original NO<sub>x</sub>, methodology to the current road transport background activity data

The *basic activity data* (such as over-all fuel sold and traffic mileages by vehicle type, by fuel or by Euro regulation) implemented in TREMOD 3.1 differ significantly from those of the current TREMOD version especially for the more recent years as of 2005. In addition, *specific activity data* (such as fuel consumptions per vehicle type, per fuel or per Euro regulation) strongly depend on the TREMOD version.

Within this report, Germany re-estimates the NO<sub>x</sub>, emission within the TREMOD 3.1 model. To isolate the requested information, the original TREMOD 3.1 activity data was combined with emission factors from both TREMOD 3.1 and the currently used TREMOD 6.02 (Knörr et al., 2019a)<sup>7)</sup>.

### Description of the updated methodology used

The updated methodology, used in 2019 (for NFR submission 2021) and implemented in version 6.12 of the TREMOD software, considers emission factors of

- passenger cars (PC) up to Euro 6d
- light commercial vehicles (LCV) up to Euro 6d
- heavy duty vehicles (HDV) up to EURO VI

and

- motorized two-wheelers (M2W) up to Euro 4

### Comparison of emission estimates made using the original and updated methodologies

The values of NO<sub>x</sub>, emissions presented in the table below are estimated with:

- TREMOD 3.1 model equations as initial methodology

and ,

- TREMOD 6.12 equations as methodology applied for NEC submission 2021.

The activity data applied to initial (here: oldest available) and most recent methodology, are those of the latest inventory provided with NEC submission 2021.

Table 1: Resulting adjustment proposal 2020

| for year                   | 2010          | 2011          | 2012          | 2013          | 2014          | 2015          | 2016          | 2017          | 2018          |
|----------------------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|---------------|
| <b>proposed adjustment</b> | <b>-297.8</b> | <b>-302.3</b> | <b>-301.3</b> | <b>-306.1</b> | <b>-294.5</b> | <b>-269.0</b> | <b>-244.3</b> | <b>-214.9</b> | <b>-174.6</b> |

The following screenshots show the TREMOD 3.1 / TREMOD 6.12 implementation comparisons per vehicle type/fuel/Euro regulation.

### **Activity Data**

\* **current:** from TREMOD 6.12, as reported with the latest inventory submission

\* **adjusted:** has to be similar to **current** AD!

\* **difference:** as only recent AD are to be used for adjustment estimations, this value must be zero!

### Implied Emission Factor

\* **current:** representing the ratio of current emissions and current AD

\* **adjusted:** representing the ratio of adjusted emissions and current AD

\* **difference:** shows percentual difference

### NO<sub>x</sub>, Emissions

\* **current:** from TREMOD 6.12, as reported with the latest inventory submission

\* **adjusted:** estimated based on TREMOD 3.1 methodology and TREMOD 6.12 AD

\* **adjustment:** adjusted emissions minus current emissions

\* **difference:** percentual difference between current and adjusted emissions

Adjustment overview for years 2010 to 2019

| NER Code      | Fuel       | Year | Activity Data |           |            | Implied Emission Factor |          |            | NO <sub>x</sub> Emissions |             |                       |
|---------------|------------|------|---------------|-----------|------------|-------------------------|----------|------------|---------------------------|-------------|-----------------------|
|               |            |      | current       | adjusted  | difference | current                 | adjusted | difference | current                   | adjusted    | adjustment difference |
|               |            |      | in [TJ]       |           | in [%]     | in [kg/TJ]              |          | in [%]     | in [kg]                   |             | in [%]                |
| 1.A.3.b.i     | gasoline   |      | 795.957       | 795.957   | 0%         | 97.55                   | 94.99    | -13%       | 77.644.842                | 67.959.906  | 9.683.935             |
| 1.A.3.b.i     | diesel oil |      | 529.390       | 529.390   | 0%         | 429.45                  | 160.51   | -63%       | 227.341.056               | 84.370.461  | 142.970.635           |
| 1.A.3.b.ii    | gasoline   |      | 6.325         | 6.325     | 0%         | 255.87                  | 214.75   | -16%       | 1.618.432                 | 1.358.328   | 260.104               |
| 1.A.3.b.ii    | diesel oil |      | 113.450       | 113.450   | 0%         | 476.34                  | 134.96   | -72%       | 54.040.533                | 15.311.584  | 38.728.949            |
| 1.A.3.b.iii   | diesel oil |      | 46.844        | 46.844    | 0%         | 623.00                  | 482.55   | -23%       | 29.931.266                | 23.183.732  | 6.747.534             |
| 1.A.3.b.iii   | diesel oil |      | 566.741       | 566.741   | 0%         | 446.67                  | 271.83   | -39%       | 253.148.243               | 154.056.160 | 99.092.083            |
| 1.A.3.b.iv    | gasoline   |      | 19.712        | 19.712    | 0%         | 113.68                  | 168.43   | 48%        | 2.240.749                 | 3.320.034   | -1.079.285            |
| 1.A.3.b TOTAL |            | 2010 | 2.079.608     | 2.079.608 | 0%         |                         |          | 0%         | 645.965.162               | 349.851.206 | 296.113.956           |
| 1.A.3.b.i     | gasoline   |      | 794.688       | 794.688   | 0%         | 92.09                   | 81.61    | -11%       | 73.185.851                | 64.351.951  | 8.833.900             |
| 1.A.3.b.i     | diesel oil |      | 553.564       | 553.564   | 0%         | 434.12                  | 159.22   | -63%       | 248.313.791               | 88.138.959  | 160.174.832           |
| 1.A.3.b.ii    | gasoline   |      | 6.118         | 6.118     | 0%         | 229.35                  | 198.57   | -13%       | 1.403.081                 | 1.214.776   | 188.305               |
| 1.A.3.b.ii    | diesel oil |      | 115.967       | 115.967   | 0%         | 481.55                  | 126.92   | -74%       | 55.844.518                | 14.718.142  | 41.126.376            |
| 1.A.3.b.iii   | diesel oil |      | 47.365        | 47.365    | 0%         | 592.65                  | 448.99   | -24%       | 28.071.221                | 21.286.323  | 6.884.898             |
| 1.A.3.b.iii   | diesel oil |      | 563.891       | 563.891   | 0%         | 419.38                  | 244.97   | -40%       | 231.410.271               | 138.136.342 | 93.273.929            |
| 1.A.3.b.iv    | gasoline   |      | 19.289        | 19.289    | 0%         | 119.79                  | 171.60   | 54%        | 2.137.602                 | 3.299.162   | -1.162.160            |
| 1.A.3.b TOTAL |            | 2011 | 2.100.883     | 2.100.883 | 0%         |                         |          | 0%         | 632.365.736               | 331.625.655 | 300.740.081           |
| 1.A.3.b.i     | gasoline   |      | 750.957       | 750.957   | 0%         | 85.73                   | 78.00    | -9%        | 64.379.994                | 58.577.229  | 5.802.765             |
| 1.A.3.b.i     | diesel oil |      | 555.245       | 555.245   | 0%         | 435.96                  | 158.66   | -64%       | 242.062.902               | 88.096.699  | 153.966.203           |
| 1.A.3.b.ii    | gasoline   |      | 5.657         | 5.657     | 0%         | 218.93                  | 193.15   | -12%       | 1.238.520                 | 1.092.662   | 145.859               |
| 1.A.3.b.ii    | diesel oil |      | 114.350       | 114.350   | 0%         | 481.91                  | 128.17   | -75%       | 55.106.382                | 13.741.354  | 41.365.028            |
| 1.A.3.b.iii   | diesel oil |      | 50.902        | 50.902    | 0%         | 533.22                  | 384.33   | -28%       | 27.141.913                | 19.563.208  | 7.578.704             |
| 1.A.3.b.iii   | diesel oil |      | 589.585       | 589.585   | 0%         | 381.33                  | 224.00   | -41%       | 224.829.180               | 132.064.753 | 92.764.428            |
| 1.A.3.b.iv    | gasoline   |      | 18.268        | 18.268    | 0%         | 107.43                  | 173.28   | 61%        | 1.962.546                 | 3.165.439   | -1.202.893            |
| 1.A.3.b TOTAL |            | 2012 | 2.084.964     | 2.084.964 | 0%         |                         |          | 0%         | 616.721.438               | 316.391.343 | 300.420.094           |
| 1.A.3.b.i     | gasoline   |      | 749.114       | 749.114   | 0%         | 80.35                   | 74.85    | -7%        | 60.190.007                | 56.071.797  | 4.118.211             |
| 1.A.3.b.i     | diesel oil |      | 589.131       | 589.131   | 0%         | 437.14                  | 158.71   | -64%       | 257.533.728               | 93.499.010  | 164.034.718           |
| 1.A.3.b.ii    | gasoline   |      | 5.578         | 5.578     | 0%         | 202.80                  | 184.07   | -9%        | 1.131.209                 | 1.026.727   | 104.482               |
| 1.A.3.b.ii    | diesel oil |      | 116.777       | 116.777   | 0%         | 489.60                  | 114.93   | -76%       | 57.003.533                | 13.690.488  | 43.333.045            |
| 1.A.3.b.iii   | diesel oil |      | 81.716        | 81.716    | 0%         | 509.54                  | 369.96   | -29%       | 26.350.969                | 18.420.843  | 7.930.126             |
| 1.A.3.b.iii   | diesel oil |      | 600.139       | 600.139   | 0%         | 353.06                  | 287.93   | -19%       | 211.887.531               | 124.788.459 | 87.099.072            |
| 1.A.3.b.iv    | gasoline   |      | 18.229        | 18.229    | 0%         | 194.34                  | 175.38   | -9%        | 1.902.668                 | 3.197.038   | -1.294.361            |
| 1.A.3.b TOTAL |            | 2013 | 2.132.683     | 2.132.683 | 0%         |                         |          | 0%         | 616.078.663               | 316.854.371 | 300.224.292           |
| 1.A.3.b.i     | gasoline   |      | 752.526       | 752.526   | 0%         | 75.03                   | 73.09    | -3%        | 57.215.533                | 54.988.921  | 2.216.612             |
| 1.A.3.b.i     | diesel oil |      | 626.845       | 626.845   | 0%         | 435.87                  | 159.12   | -63%       | 272.876.061               | 99.613.892  | 173.262.169           |
| 1.A.3.b.ii    | gasoline   |      | 5.845         | 5.845     | 0%         | 190.34                  | 176.49   | -7%        | 1.112.584                 | 1.031.612   | 80.972                |
| 1.A.3.b.ii    | diesel oil |      | 128.578       | 128.578   | 0%         | 475.56                  | 110.96   | -77%       | 61.146.575                | 14.267.237  | 46.879.338            |
| 1.A.3.b.iii   | diesel oil |      | 45.143        | 45.143    | 0%         | 468.37                  | 339.99   | -27%       | 23.017.115                | 16.708.234  | 6.308.881             |
| 1.A.3.b.iii   | diesel oil |      | 672.754       | 672.754   | 0%         | 314.05                  | 196.05   | -38%       | 179.874.133               | 112.285.582 | 67.588.551            |
| 1.A.3.b.iv    | gasoline   |      | 18.673        | 18.673    | 0%         | 100.59                  | 179.24   | 78%        | 1.878.294                 | 3.346.794   | -1.468.499            |
| 1.A.3.b TOTAL |            | 2014 | 2.153.563     | 2.153.563 | 0%         |                         |          | 0%         | 597.120.297               | 362.252.271 | 234.868.025           |
| 1.A.3.b.i     | gasoline   |      | 715.156       | 715.156   | 0%         | 74.38                   | 71.73    | -4%        | 53.190.787                | 51.300.983  | 1.889.805             |
| 1.A.3.b.i     | diesel oil |      | 645.555       | 645.555   | 0%         | 426.19                  | 159.80   | -63%       | 275.130.233               | 103.163.501 | 171.966.732           |
| 1.A.3.b.ii    | gasoline   |      | 5.793         | 5.793     | 0%         | 187.12                  | 172.80   | -8%        | 1.083.927                 | 1.000.999   | 82.928                |
| 1.A.3.b.ii    | diesel oil |      | 135.396       | 135.396   | 0%         | 469.35                  | 187.96   | -77%       | 63.505.443                | 14.607.490  | 48.897.953            |
| 1.A.3.b.iii   | diesel oil |      | 52.287        | 52.287    | 0%         | 458.96                  | 327.99   | -29%       | 23.997.817                | 17.149.448  | 6.848.370             |
| 1.A.3.b.iii   | diesel oil |      | 589.411       | 589.411   | 0%         | 266.69                  | 187.51   | -30%       | 157.189.675               | 116.529.703 | 40.659.973            |
| 1.A.3.b.iv    | gasoline   |      | 18.459        | 18.459    | 0%         | 99.32                   | 180.65   | 82%        | 1.833.362                 | 3.334.472   | -1.501.090            |
| 1.A.3.b TOTAL |            | 2015 | 2.161.576     | 2.161.576 | 0%         |                         |          | 0%         | 575.931.265               | 361.877.596 | 214.053.670           |
| 1.A.3.b.i     | gasoline   |      | 715.272       | 715.272   | 0%         | 79.93                   | 78.65    | -2%        | 50.736.967                | 50.535.049  | 201.918               |
| 1.A.3.b.i     | diesel oil |      | 675.119       | 675.119   | 0%         | 410.36                  | 160.76   | -61%       | 277.041.660               | 108.535.230 | 168.506.430           |
| 1.A.3.b.ii    | gasoline   |      | 5.926         | 5.926     | 0%         | 189.27                  | 171.06   | -9%        | 1.068.292                 | 1.013.678   | 54.614                |
| 1.A.3.b.ii    | diesel oil |      | 144.068       | 144.068   | 0%         | 458.12                  | 185.62   | -77%       | 65.712.732                | 15.216.007  | 50.496.726            |
| 1.A.3.b.iii   | diesel oil |      | 54.157        | 54.157    | 0%         | 424.73                  | 388.24   | -7%        | 23.002.109                | 16.893.117  | 6.308.992             |
| 1.A.3.b.iii   | diesel oil |      | 594.013       | 594.013   | 0%         | 226.31                  | 180.97   | -20%       | 134.431.899               | 107.496.262 | 26.935.637            |
| 1.A.3.b.iv    | gasoline   |      | 18.785        | 18.785    | 0%         | 95.14                   | 181.66   | 89%        | 1.805.897                 | 3.412.476   | -1.606.579            |
| 1.A.3.b TOTAL |            | 2016 | 2.207.339     | 2.207.339 | 0%         |                         |          | 0%         | 553.799.556               | 362.901.820 | 190.897.736           |
| 1.A.3.b.i     | gasoline   |      | 724.571       | 724.571   | 0%         | 67.66                   | 69.88    | 3%         | 49.026.074                | 50.634.714  | -1.608.640            |
| 1.A.3.b.i     | diesel oil |      | 696.592       | 696.592   | 0%         | 399.65                  | 161.95   | -59%       | 272.126.091               | 112.810.721 | 159.315.370           |
| 1.A.3.b.ii    | gasoline   |      | 6.186         | 6.186     | 0%         | 171.15                  | 167.18   | -2%        | 1.058.799                 | 1.034.211   | 24.588                |
| 1.A.3.b.ii    | diesel oil |      | 153.294       | 153.294   | 0%         | 424.66                  | 183.89   | -76%       | 66.093.930                | 15.925.216  | 50.168.714            |
| 1.A.3.b.iii   | diesel oil |      | 53.382        | 53.382    | 0%         | 378.80                  | 286.71   | -23%       | 19.793.501                | 15.304.828  | 4.488.673             |
| 1.A.3.b.iii   | diesel oil |      | 596.263       | 596.263   | 0%         | 195.02                  | 175.92   | -9%        | 116.671.141               | 105.248.508 | 11.422.633            |
| 1.A.3.b.iv    | gasoline   |      | 19.160        | 19.160    | 0%         | 92.83                   | 183.39   | 98%        | 1.778.674                 | 3.513.787   | -1.735.114            |
| 1.A.3.b TOTAL |            | 2017 | 2.251.437     | 2.251.437 | 0%         |                         |          | 0%         | 525.549.410               | 364.469.906 | 161.079.424           |
| 1.A.3.b.i     | gasoline   |      | 699.027       | 699.027   | 0%         | 64.42                   | 68.36    | 6%         | 45.032.596                | 47.786.817  | -2.753.820            |
| 1.A.3.b.i     | diesel oil |      | 666.074       | 666.074   | 0%         | 371.66                  | 163.30   | -56%       | 247.656.063               | 108.768.604 | 138.887.459           |
| 1.A.3.b.ii    | gasoline   |      | 6.315         | 6.315     | 0%         | 158.22                  | 168.11   | 1%         | 999.159                   | 1.011.138   | -11.939               |
| 1.A.3.b.ii    | diesel oil |      | 154.259       | 154.259   | 0%         | 384.71                  | 182.69   | -73%       | 59.344.525                | 15.840.310  | 43.504.215            |
| 1.A.3.b.iii   | diesel oil |      | 51.634        | 51.634    | 0%         | 399.75                  | 263.53   | -35%       | 15.993.526                | 13.607.106  | 2.386.420             |
| 1.A.3.b.iii   | diesel oil |      | 585.186       | 585.186   | 0%         | 171.18                  | 172.10   | 1%         | 188.173.337               | 188.710.869 | -537.532              |
| 1.A.3.b.iv    | gasoline   |      | 18.497        | 18.497    | 0%         | 89.66                   | 184.61   | 106%       | 1.658.568                 | 3.414.767   | -1.756.209            |
| 1.A.3.b TOTAL |            | 2018 | 2.180.993     | 2.180.993 | 0%         |                         |          | 0%         | 478.758.206               | 291.139.612 | 179.618.593           |
| 1.A.3.b.i     | gasoline   |      | 704.691       | 704.691   | 0%         | 62.30                   | 68.45    | 10%        | 43.901.941                | 48.238.025  | -4.336.084            |
| 1.A.3.b.i     | diesel oil |      | 683.841       | 683.841   | 0%         | 345.81                  | 165.07   | -52%       | 229.566.068               | 109.582.982 | 119.983.106           |
| 1.A.3.b.ii    | gasoline   |      | 6.683         | 6.683     | 0%         | 146.08                  | 153.25   | 5%         | 976.219                   | 1.024.160   | -47.931               |
| 1.A.3.b.ii    | diesel oil |      | 159.183       | 159.183   | 0%         | 347.42                  | 181.90   | -71%       | 55.303.535                | 16.221.445  | 39.082.090            |
| 1.A.3.b.iii   | diesel oil |      | 52.939        | 52.939    | 0%         | 274.41                  | 247.81   | -9%        | 14.527.012                | 13.118.578  | 1.408.434             |
| 1.A.3.b.iii   | diesel oil |      | 595.913       | 595.913   | 0%         | 153.35                  | 169.17   | 10%        | 91.380.700                | 100.809.376 | -9.428.676            |
| 1.A.3.b.iv    | gasoline   |      | 18.750        | 18.750    | 0%         | 86.05                   | 186.83   | 117%       | 1.613.450                 | 3.502.941   | -1.889.491            |
| 1.A.3.b TOTAL |            | 2019 | 2.202.000     | 2.202.000 | 0%         |                         |          | 0%         | 437.268.744               | 292.497.497 | 144.771.248           |

| Adjustment details for 2020            |            |                         |           |            |                         |          |            |                           |             |             |              |      |
|--|------------|-------------------------|-----------|------------|-------------------------|----------|------------|---------------------------|-------------|-------------|--------------|------|
| NFR Code                               | Fuel       | Activity Data           |           |            | Implied Emission Factor |          |            | NO <sub>x</sub> Emissions |             |             |              |      |
|  |            | current                 | adjusted  | difference | current                 | adjusted | difference | current                   | adjusted    | adjustment  | difference   |      |
|  |            | in [t]                  | in [t]    | in [%]     | in [g/t]                | in [g/t] | in [%]     | in [kg]                   | in [kg]     | in [kg]     | in [kg]      |      |
| 1.A.3.a.i. Passenger Cars              | Gasoline   | pre-Cars                | 13.685    | 13.685     | 0%                      | 584.75   | 514.25     | -12%                      | 7.955.060   | 6.986.917   | -958.143     | -12% |
|  |            | Car 1                   | 36.541    | 36.541     | 0%                      | 338.50   | 297.71     | -12%                      | 25.915.925  | 19.189.262  | -7.716.663   | -30% |
|  |            | Car 2                   | 96.425    | 96.425     | 0%                      | 172.95   | 135.63     | -22%                      | 16.580.020  | 13.020.026  | -3.568.995   | -22% |
|  |            | Car 3                   | 133.139   | 133.139    | 0%                      | 58.51    | 70.18      | 20%                       | 7.790.384   | 9.343.433   | 1.553.129    | 20%  |
|  |            | Car 4                   | 444.991   | 444.991    | 0%                      | 42.27    | 42.19      | 0%                        | 18.911.389  | 18.773.529  | -137.859     | 0%   |
|  |            | Car 5                   | 31.234    | 31.234     | 0%                      | 18.61    | 42.19      | 127%                      | 581.142     | 1.317.737   | 736.595      | 127% |
|  |            | Car 6                   | 0         | 0          | 0%                      | 25.08    | 42.19      | 67%                       | 2           | 2           | 0            | 0%   |
|  |            | Gasoline total          | 795.057   | 795.057    | 0%                      | 92.55    | 84.59      | -9%                       | 37.644.042  | 31.650.586  | -5.993.455   | -16% |
|  | Diesel Oil | pre-Cars                | 1.249     | 1.249      | 0%                      | 627.99   | 545.95     | -13%                      | 183.760     | 157.255     | -26.505      | -15% |
|  |            | Car 1                   | 10.338    | 10.338     | 0%                      | 294.42   | 245.17     | -17%                      | 3.044.428   | 2.741.387   | -302.521     | -10% |
|  |            | Car 2                   | 50.088    | 50.088     | 0%                      | 406.90   | 279.19     | -31%                      | 20.372.795  | 10.974.210  | -9.398.584   | -46% |
|  |            | Car 3                   | 134.025   | 134.025    | 0%                      | 542.54   | 170.54     | -69%                      | 72.645.173  | 23.929.276  | -48.715.897  | -67% |
|  |            | Car 4                   | 279.154   | 279.154    | 0%                      | 304.37   | 140.58     | -53%                      | 187.299.180 | 39.243.811  | -148.055.369 | -81% |
|  |            | Car 5                   | 53.547    | 53.547     | 0%                      | 434.70   | 140.58     | -68%                      | 23.275.735  | 7.527.796   | -15.747.939  | -68% |
|  |            | Car 6                   | 334       | 334        | 0%                      | 257.62   | 140.58     | -45%                      | 85.044      | 46.953      | -38.091      | -45% |
|  |            | Diesel oil total        | 529.380   | 529.380    | 0%                      | 429.45   | 160.55     | -63%                      | 227.347.096 | 84.970.461  | -142.376.635 | -63% |
|  |            | Pkx Total               | 1,325,337 | 1,325,337  | 0%                      | 238.12   | 155.14     | -35%                      | 364,985,938 | 152,621,367 | -212,364,570 | -58% |
|  | Gasoline   | pre-Cars                | 1.249     | 1.249      | 0%                      | 627.99   | 545.95     | -13%                      | 183.760     | 157.255     | -26.505      | -15% |
|  |            | Car 1                   | 36.541    | 36.541     | 0%                      | 338.50   | 297.71     | -12%                      | 25.915.925  | 19.189.262  | -7.716.663   | -30% |
|  |            | Car 2                   | 96.425    | 96.425     | 0%                      | 172.95   | 135.63     | -22%                      | 16.580.020  | 13.020.026  | -3.568.995   | -22% |
|  |            | Car 3                   | 133.139   | 133.139    | 0%                      | 58.51    | 70.18      | 20%                       | 7.790.384   | 9.343.433   | 1.553.129    | 20%  |
|  |            | Car 4                   | 444.991   | 444.991    | 0%                      | 42.27    | 42.19      | 0%                        | 18.911.389  | 18.773.529  | -137.859     | 0%   |
|  |            | Car 5                   | 31.234    | 31.234     | 0%                      | 18.61    | 42.19      | 127%                      | 581.142     | 1.317.737   | 736.595      | 127% |
| 1.A.3.b.i. Light Duty Vehicles (LDVs)  | Gasoline   | pre-Cars                | 1.249     | 1.249      | 0%                      | 627.99   | 545.95     | -13%                      | 183.760     | 157.255     | -26.505      | -15% |
|  |            | Car 1                   | 36.541    | 36.541     | 0%                      | 338.50   | 297.71     | -12%                      | 25.915.925  | 19.189.262  | -7.716.663   | -30% |
|  |            | Car 2                   | 96.425    | 96.425     | 0%                      | 172.95   | 135.63     | -22%                      | 16.580.020  | 13.020.026  | -3.568.995   | -22% |
|  |            | Car 3                   | 133.139   | 133.139    | 0%                      | 58.51    | 70.18      | 20%                       | 7.790.384   | 9.343.433   | 1.553.129    | 20%  |
|  |            | Car 4                   | 444.991   | 444.991    | 0%                      | 42.27    | 42.19      | 0%                        | 18.911.389  | 18.773.529  | -137.859     | 0%   |
|  |            | Car 5                   | 31.234    | 31.234     | 0%                      | 18.61    | 42.19      | 127%                      | 581.142     | 1.317.737   | 736.595      | 127% |
|  |            | Gasoline total          | 6.345     | 6.345      | 0%                      | 255.87   | 254.75     | -0%                       | 1,419,832   | 1,358,126   | -61,706      | -4%  |
|  | Diesel Oil | pre-Cars                | 4.876     | 4.876      | 0%                      | 425.99   | 385.79     | -9%                       | 2,077,142   | 1,436,903   | -640,239     | -31% |
|  |            | Car 1                   | 9.989     | 9.989      | 0%                      | 399.18   | 276.24     | -30%                      | 2,389,080   | 1,289,636   | -1,099,444   | -46% |
|  |            | Car 2                   | 13.126    | 13.126     | 0%                      | 336.76   | 135.18     | -59%                      | 4,420,280   | 2,534,731   | -1,885,549   | -43% |
|  |            | Car 3                   | 33.249    | 33.249     | 0%                      | 531.91   | 150.58     | -72%                      | 17,655,883  | 5,085,760   | -12,570,123  | -71% |
|  |            | Car 4                   | 54.581    | 54.581     | 0%                      | 491.42   | 80.69      | -84%                      | 26,021,036  | 4,940,722   | -21,080,314  | -81% |
|  |            | Car 5                   | 1,629     | 1,629      | 0%                      | 427.50   | 80.69      | -81%                      | 696,296     | 144,434     | -551,772     | -79% |
|  |            | Car 6                   | 0         | 0          | 0%                      | 15.73    | 80.69      | -81%                      | 7           | 4           | -3           | -43% |
|  |            | Diesel oil total        | 113,450   | 113,450    | 0%                      | 416.34   | 134.94     | -68%                      | 54,043,533  | 15,311,584  | -38,731,949  | -72% |
|  |            | LDVs Total              | 175,775   | 175,775    | 0%                      | 464.70   | 139.18     | -70%                      | 55,658,966  | 16,649,913  | -39,009,053  | -70% |
|  | Diesel Oil | pre-Cars                | 3.382     | 3.382      | 0%                      | 709.25   | 193.78     | -73%                      | 3,674,087   | 3,452,644   | -221,443     | -6%  |
|  |            | Car 1                   | 2,826     | 2,826      | 0%                      | 749.41   | 172.14     | -77%                      | 2,117,871   | 2,125,595   | 7,723        | 0%   |
|  |            | Car 2                   | 10,152    | 10,152     | 0%                      | 801.96   | 643.47     | -20%                      | 8,140,119   | 6,532,213   | -1,607,906   | -20% |
|  |            | Car 3                   | 15,890    | 15,890     | 0%                      | 633.22   | 437.25     | -31%                      | 13,065,776  | 7,289,299   | -5,776,477   | -44% |
|  |            | Car 4                   | 5,461     | 5,461      | 0%                      | 448.63   | 351.65     | -21%                      | 2,650,016   | 1,921,527   | -728,489     | -28% |
|  |            | Car 5                   | 10,326    | 10,326     | 0%                      | 337.28   | 182.33     | -46%                      | 3,882,417   | 1,882,644   | -1,999,773   | -51% |
| 1.A.3.b.ii. Heavy Duty Vehicles (HDVs) | Diesel Oil | pre-Cars                | 48,044    | 48,044     | 0%                      | 623.80   | 482.55     | -23%                      | 29,931,266  | 23,185,732  | -6,745,534   | -23% |
|  |            | Car 1                   | 10,185    | 10,185     | 0%                      | 1040.16  | 787.37     | -24%                      | 10,510,623  | 7,754,136   | -2,756,487   | -26% |
|  |            | Car 2                   | 5,677     | 5,677      | 0%                      | 758.59   | 575.55     | -24%                      | 4,261,383   | 3,287,681   | -973,702     | -23% |
|  |            | Car 3                   | 38,558    | 38,558     | 0%                      | 817.62   | 524.79     | -36%                      | 31,525,526  | 20,234,619  | -11,290,907  | -36% |
|  |            | Car 4                   | 169,023   | 169,023    | 0%                      | 636.28   | 274.48     | -57%                      | 161,136,182 | 59,617,271  | -101,518,911 | -63% |
|  |            | Car 5                   | 69,635    | 69,635     | 0%                      | 368.34   | 280.62     | -24%                      | 27,183,867  | 20,146,636  | -7,037,231   | -26% |
|  |            | Car 6                   | 283,934   | 283,934    | 0%                      | 276.42   | 151.65     | -45%                      | 79,543,643  | 43,115,897  | -36,427,746  | -46% |
|  |            | Trucks Total            | 566,741   | 566,741    | 0%                      | 446.67   | 271.83     | -39%                      | 293,148,243 | 154,696,160 | -138,452,083 | -49% |
|  | Gasoline   | pre-Cars                | 7,973     | 7,973      | 0%                      | 122.80   | 149.18     | 22%                       | 972,721     | 1,189,393   | 216,672      | 22%  |
|  |            | Car 1                   | 5,231     | 5,231      | 0%                      | 123.77   | 165.74     | 34%                       | 647,479     | 887,039     | 239,560      | 34%  |
|  |            | Car 2                   | 3,587     | 3,587      | 0%                      | 141.16   | 194.21     | 38%                       | 585,362     | 696,661     | 111,299      | 38%  |
|  |            | Car 3                   | 2,950     | 2,950      | 0%                      | 38.11    | 184.21     | 381%                      | 116,189     | 567,032     | 450,843      | 381% |
|  |            | Car 4                   | 0         | 0          | 0%                      | 0        | 0          | 0%                        | 0           | 0           | 0            | 0%   |
|  |            | Car 5                   | 0         | 0          | 0%                      | 0        | 0          | 0%                        | 0           | 0           | 0            | 0%   |
|  |            | HDVs Total              | 19,172    | 19,172     | 0%                      | 113.68   | 168.43     | 48%                       | 2,243,149   | 3,326,034   | 1,082,885    | 48%  |
|  |            | 1.A.3.b. Road Transport | 2,879,688 | 2,879,688  | 0%                      | 219.62   | 168.23     | -26%                      | 645,965,162 | 349,851,296 | -296,113,866 | -46% |

| Adjustment details for 2021                       |                         |                  |           |            |                         |          |            |                           |             |             |              |      |
|---|-------------------------|------------------|-----------|------------|-------------------------|----------|------------|---------------------------|-------------|-------------|--------------|------|
| NFR Code  | Fuel                    | Activity Data    |           |            | Implied Emission Factor |          |            | NO <sub>x</sub> Emissions |             |             |              |      |
|   |                         | current          | adjusted  | difference | current                 | adjusted | difference | current                   | adjusted    | adjustment  | difference   |      |
|   |                         | in [t]           | in [t]    | in [%]     | in [g/t]                | in [g/t] | in [%]     | in [kg]                   | in [kg]     | in [kg]     | in [%]       |      |
| 1.A.3.a.i. Passenger Cars                         | Gasoline                | pre-Cars         | 13.063    | 13.063     | 0%                      | 592.96   | 534.68     | -10%                      | 7.720.235   | 6.979.435   | -748.801     | -10% |
|   |                         | Car 1            | 61.979    | 61.979     | 0%                      | 347.96   | 340.16     | -2%                       | 21.560.430  | 18.884.961  | -2.675.479   | -12% |
|   |                         | Car 2            | 87.083    | 87.083     | 0%                      | 178.38   | 136.58     | -24%                      | 15.620.983  | 11.883.782  | -3.737.191   | -24% |
|   |                         | Car 3            | 124.330   | 124.330    | 0%                      | 61.94    | 71.52      | 16%                       | 7.683.891   | 8.891.671   | 1.207.780    | 16%  |
|   |                         | Car 4            | 442.185   | 442.185    | 0%                      | 43.94    | 43.68      | 0%                        | 19.384.914  | 19.376.439  | -8.475       | 0%   |
|   |                         | Car 5            | 66.057    | 66.057     | 0%                      | 18.58    | 43.68      | 135%                      | 1.227.381   | 2.085.636   | 1.658.255    | 135% |
|   |                         | Car 6            | 1         | 1          | 0%                      | 25.06    | 43.68      | 69%                       | 17          | 20          | 3            | 15%  |
|   |                         | Gasoline total   | 794.688   | 794.688    | 0%                      | 92.69    | 81.65      | -12%                      | 73.185.851  | 64.851.951  | -8.333.900   | -11% |
|   | Diesel Oil              | pre-Cars         | 1.711     | 1.711      | 0%                      | 318.90   | 264.56     | -16%                      | 531.683     | 453.187     | -78.496      | -15% |
|   |                         | Car 1            | 8.426     | 8.426      | 0%                      | 297.32   | 245.65     | -18%                      | 2.585.115   | 2.239.987   | -345.128     | -14% |
|   |                         | Car 2            | 42.514    | 42.514     | 0%                      | 407.93   | 279.27     | -32%                      | 17.384.549  | 9.321.916   | -8.062.633   | -46% |
|   |                         | Car 3            | 121.429   | 121.429    | 0%                      | 555.36   | 170.55     | -69%                      | 67.437.053  | 21.681.386  | -45.755.667  | -72% |
|   |                         | Car 4            | 264.943   | 264.943    | 0%                      | 388.88   | 143.48     | -63%                      | 182.817.881 | 30.889.755  | -151.928.126 | -83% |
|   |                         | Car 5            | 113.047   | 113.047    | 0%                      | 435.12   | 143.48     | -67%                      | 49.536.960  | 16.332.974  | -33.203.986  | -67% |
|   |                         | Car 6            | 695       | 695        | 0%                      | 259.59   | 143.48     | -45%                      | 180.582     | 99.754      | -80.828      | -45% |
|   |                         | Diesel oil total | 553.564   | 553.564    | 0%                      | 434.12   | 159.92     | -63%                      | 249.313.791 | 88.138.959  | -161.174.832 | -63% |
|   |                         | Pkx Total        | 1.348.252 | 1.348.252  | 0%                      | 232.52   | 153.47     | -35%                      | 371.899.642 | 152.990.910 | -218.908.732 | -59% |
|   | Gasoline                | pre-Cars         | 1.084     | 1.084      | 0%                      | 629.25   | 545.95     | -13%                      | 182.254     | 157.255     | -25.000      | -14% |
|   |                         | Car 1            | 283       | 283        | 0%                      | 818.74   | 584.47     | -29%                      | 243.289     | 86.158      | -157.131     | -65% |
|   |                         | Car 2            | 1.184     | 1.184      | 0%                      | 268.66   | 191.66     | -29%                      | 310.529     | 223.189     | -87.340      | -28% |
|   |                         | Car 3            | 783       | 783        | 0%                      | 85.97    | 95.39      | 11%                       | 67.320      | 74.782      | 7.462        | 11%  |
|   |                         | Car 4            | 2.562     | 2.562      | 0%                      | 37.38    | 46.51      | 24%                       | 95.786      | 119.162     | 23.376       | 24%  |
|   |                         | Car 5            | 241       | 241        | 0%                      | 16.13    | 46.51      | 189%                      | 3.882       | 11.190      | 7.308        | 189% |
|   |                         | Car 6            | 0         | 0          | 0%                      | 15.33    | 46.51      | 203%                      | 1           | 2           | 1            | 203% |
|   |                         | Gasoline total   | 6.118     | 6.118      | 0%                      | 229.35   | 186.57     | -23%                      | 1.481.081   | 1.243.716   | -237.365     | -16% |
| Light Duty Vehicles (LDV)                         | pre-Cars                | 3.995            | 3.995     | 0%         | 425.39                  | 386.79   | -9%        | 1.689.280                 | 1.225.662   | -472.598    | -28%         |      |
|   | Car 1                   | 4.787            | 4.787     | 0%         | 356.71                  | 275.24   | -23%       | 1.894.360                 | 1.030.425   | -863.935    | -46%         |      |
|   | Car 2                   | 10.816           | 10.816    | 0%         | 336.90                  | 193.23   | -43%       | 3.644.582                 | 2.091.083   | -1.553.500  | -43%         |      |
|   | Car 3                   | 28.225           | 28.225    | 0%         | 541.53                  | 150.54   | -72%       | 18.527.249                | 4.348.078   | -14.179.171 | -76%         |      |
|   | Car 4                   | 60.032           | 60.032    | 0%         | 402.82                  | 89.26    | -82%       | 39.079.914                | 5.420.811   | -33.659.104 | -87%         |      |
|   | Car 5                   | 6.609            | 6.609     | 0%         | 144.05                  | 89.26    | -38%       | 2.930.190                 | 584.364     | -2.345.826  | -80%         |      |
|   | Car 6                   | 0                | 0         | 0%         | 161.21                  | 89.26    | -43%       | 14                        | 6           | -8          | -43%         |      |
|   | Diesel oil total        | 115.961          | 115.961   | 0%         | 485.55                  | 126.92   | -74%       | 55.844.588                | 15.718.142  | -40.126.376 | -74%         |      |
| LDVs Total  | 122.085                 | 122.085          | 0%        | 408.92     | 130.55                  | -68%     | 17.247.599 | 19.532.898                | 2.285.299   | 13%         |              |      |
| 1.A.3.a.ii. Heavy Duty Vehicles (HDV)             | pre-Cars                | 2.620            | 2.620     | 0%         | 1002.69                 | 1019.78  | 6%         | 2.836.189                 | 2.671.331   | -164.778    | -6%          |      |
|   | Car 1                   | 2.258            | 2.258     | 0%         | 752.91                  | 711.45   | -6%        | 1.699.781                 | 1.696.297   | -3.484      | 0%           |      |
|   | Car 2                   | 3.024            | 3.024     | 0%         | 854.35                  | 653.36   | -24%       | 2.281.125                 | 1.537.559   | -743.566    | -33%         |      |
|   | Car 3                   | 16.887           | 16.887    | 0%         | 633.16                  | 457.38   | -28%       | 9.425.880                 | 6.889.054   | -2.536.827  | -27%         |      |
|   | Car 4                   | 5.131            | 5.131     | 0%         | 448.88                  | 351.81   | -21%       | 2.303.338                 | 1.681.274   | -622.064    | -27%         |      |
|   | Car 5                   | 13.396           | 13.396    | 0%         | 336.60                  | 182.62   | -46%       | 4.589.052                 | 2.486.399   | -2.092.653  | -46%         |      |
|   | Car 6                   | 0                | 0         | 0%         | 0                       | 0        | 0%         | 0                         | 0           | 0           | 0%           |      |
|   | Buses Total             | 47.365           | 47.365    | 0%         | 902.65                  | 448.59   | -50%       | 28.071.221                | 21.286.323  | -6.884.898  | -25%         |      |
| 1.A.3.a.iii. Heavy Duty Vehicle: Trucks & Lorries | pre-Cars                | 8.044            | 8.044     | 0%         | 1030.67                 | 1753.88  | 70%        | 8.365.423                 | 6.144.933   | -2.210.491  | -26%         |      |
|   | Car 1                   | 4.384            | 4.384     | 0%         | 758.16                  | 574.04   | -24%       | 3.280.422                 | 2.535.327   | -742.844    | -23%         |      |
|   | Car 2                   | 29.277           | 29.277    | 0%         | 817.37                  | 550.61   | -33%       | 23.947.723                | 12.926.277  | -11.021.446 | -46%         |      |
|   | Car 3                   | 121.581          | 121.581   | 0%         | 636.16                  | 436.56   | -31%       | 77.271.520                | 45.310.423  | -31.961.097 | -41%         |      |
|   | Car 4                   | 68.430           | 68.430    | 0%         | 290.35                  | 289.43   | -0%        | 32.977.784                | 15.969.685  | -16.988.100 | -48%         |      |
|   | Car 5                   | 342.175          | 342.175   | 0%         | 276.29                  | 152.63   | -45%       | 96.589.479                | 52.019.687  | -44.569.792 | -45%         |      |
|   | Car 6                   | 0                | 0         | 0%         | 0                       | 0        | 0%         | 0                         | 0           | 0           | 0%           |      |
|   | Trucks Total            | 563.891          | 563.891   | 0%         | 418.38                  | 244.97   | -40%       | 215.470.271               | 138.136.342 | -77.333.929 | -36%         |      |
| 1.A.3.b.iv. Motorised Two-Wheelers (M2W)          | pre-Cars                | 7.389            | 7.389     | 0%         | 322.96                  | 150.24   | -53%       | 969.588                   | 1.110.170   | 21.580      | 22%          |      |
|   | Car 1                   | 4.885            | 4.885     | 0%         | 134.72                  | 108.26   | -19%       | 599.299                   | 888.547     | 289.248     | 35%          |      |
|   | Car 2                   | 3.544            | 3.544     | 0%         | 137.85                  | 194.58   | 41%        | 488.552                   | 688.693     | 200.141     | 41%          |      |
|   | Car 3                   | 3.560            | 3.560     | 0%         | 39.59                   | 194.58   | 382%       | 160.553                   | 688.693     | 528.140     | 382%         |      |
|   | Car 4                   | 0                | 0         | 0%         | 0                       | 0        | 0%         | 0                         | 0           | 0           | 0%           |      |
|   | Car 5                   | 0                | 0         | 0%         | 0                       | 0        | 0%         | 0                         | 0           | 0           | 0%           |      |
|   | M2Ws Total              | 19.289           | 19.289    | 0%         | 119.79                  | 177.04   | 54%        | 2.137.082                 | 3.299.162   | 1.162.080   | 54%          |      |
|   | 1.A.3.b. Road Transport | Total            | 2.180.883 | 2.180.883  | 0%                      | 305.90   | 157.85     | -49%                      | 632.363.736 | 321.625.655 | -310.738.081 | -49% |



| Adjustment details for 2023              |            |                         |           |            |                         |          |            |                           |             |             |              |      |
|--|------------|-------------------------|-----------|------------|-------------------------|----------|------------|---------------------------|-------------|-------------|--------------|------|
| NFR Code                                 | Fuel       | Activity Data           |           |            | Implied Emission Factor |          |            | NO <sub>x</sub> Emissions |             |             |              |      |
|  |            | current                 | adjusted  | difference | current                 | adjusted | difference | current                   | adjusted    | adjustment  | difference   |      |
|  |            | in [t]                  | in [t]    | in [%]     | in [g/t]                | in [g/t] | in [%]     | in [kg]                   | in [kg]     | in [kg]     | in [%]       |      |
| 1.A.3.a.i.<br>Passenger Cars             | Gasoline   | pre-Cars                | 11,581    | 11,581     | 0%                      | 607.72   | 635.38     | -52%                      | 7,035,041   | 6,189,785   | -836,256     | -52% |
|  |            | Car 1                   | 47,487    | 47,487     | 0%                      | 348.56   | 341.62     | -31%                      | 16,571,746  | 11,426,129  | -5,145,617   | -31% |
|  |            | Car 2                   | 72,781    | 72,781     | 0%                      | 194.27   | 137.82     | -29%                      | 13,487,749  | 10,035,380  | -3,372,369   | -29% |
|  |            | Car 3                   | 189,443   | 189,443    | 0%                      | 63.89    | 72.62      | 14%                       | 6,927,963   | 7,875,172   | 947,209      | 14%  |
|  |            | Car 4                   | 489,541   | 489,541    | 0%                      | 45.39    | 45.13      | -1%                       | 18,541,881  | 18,436,736  | -105,145     | -1%  |
|  |            | Car 5                   | 181,961   | 181,961    | 0%                      | 18.61    | 45.13      | 142%                      | 1,887,355   | 4,681,311   | 2,793,956    | 142% |
|  |            | Car 6                   | 282       | 282        | 0%                      | 25.06    | 45.13      | 74%                       | 7,339       | 12,736      | 5,399        | 74%  |
|  |            | Gasoline total          | 750,267   | 750,267    | 0%                      | 85.73    | 78.88      | -8%                       | 64,379,964  | 58,577,229  | -5,802,735   | -9%  |
|  | Diesel Oil | pre-Cars                | 1,487     | 1,487      | 0%                      | 311.98   | 284.56     | -9%                       | 463,963     | 383,872     | -80,091      | -9%  |
|  |            | Car 1                   | 6,660     | 6,660      | 0%                      | 267.79   | 246.44     | -11%                      | 1,980,364   | 1,771,787   | -208,577     | -11% |
|  |            | Car 2                   | 33,967    | 33,967     | 0%                      | 406.82   | 279.27     | -40%                      | 13,987,432  | 7,445,646   | -6,541,787   | -40% |
|  |            | Car 3                   | 183,539   | 183,539    | 0%                      | 564.82   | 176.63     | -69%                      | 58,389,037  | 18,434,837  | -39,954,200  | -69% |
|  |            | Car 4                   | 234,943   | 234,943    | 0%                      | 398.41   | 146.46     | -62%                      | 91,724,190  | 34,488,997  | -57,235,193  | -62% |
|  |            | Car 5                   | 173,112   | 173,112    | 0%                      | 434.89   | 146.46     | -66%                      | 75,284,364  | 25,353,375  | -49,930,989  | -66% |
|  |            | Car 6                   | 1,557     | 1,557      | 0%                      | 259.84   | 146.46     | -44%                      | 484,664     | 220,086     | -264,578     | -44% |
|  |            | Diesel oil total        | 555,245   | 555,245    | 0%                      | 455.96   | 158.66     | -64%                      | 242,962,982 | 88,096,639  | -154,866,343 | -64% |
|  |            | FCs Total               | 1,305,262 | 1,305,262  | 0%                      | 234.61   | 152.29     | -35%                      | 386,442,896 | 146,673,867 | -239,769,029 | -35% |
|  | Gasoline   | pre-Cars                | 962       | 962        | 0%                      | 632.36   | 645.95     | 2%                        | 687,779     | 821,166     | 133,417      | 2%   |
|  |            | Car 1                   | 232       | 232        | 0%                      | 803.24   | 193.22     | -86%                      | 199,985     | 70,295      | -129,691     | -86% |
|  |            | Car 2                   | 989       | 989        | 0%                      | 271.16   | 195.74     | -28%                      | 268,134     | 133,538     | -134,596     | -28% |
|  |            | Car 3                   | 835       | 835        | 0%                      | 89.38    | 98.33      | 10%                       | 14,623      | 82,082      | 7,459        | 10%  |
|  |            | Car 4                   | 2,030     | 2,030      | 0%                      | 38.49    | 47.58      | 24%                       | 78,155      | 96,691      | 18,545       | 24%  |
|  |            | Car 5                   | 610       | 610        | 0%                      | 16.36    | 47.58      | 182%                      | 9,941       | 29,011      | 19,069       | 182% |
|  |            | Car 6                   | 0         | 0          | 0%                      | 15.37    | 47.58      | 210%                      | 2           | 6           | 4            | 210% |
|  |            | Gasoline total          | 5,657     | 5,657      | 0%                      | 218.93   | 193.15     | -12%                      | 1,238,520   | 1,092,662   | -145,858     | -12% |
| 1.A.3.b.i.<br>Light Duty Vehicles (LDVs) | Gasoline   | pre-Cars                | 3,281     | 3,281      | 0%                      | 424.46   | 386.79     | -9%                       | 1,368,754   | 1,062,093   | -306,661     | -9%  |
|  |            | Car 1                   | 3,666     | 3,666      | 0%                      | 398.34   | 276.24     | -40%                      | 1,445,980   | 1,017,634   | -428,346     | -40% |
|  |            | Car 2                   | 8,479     | 8,479      | 0%                      | 336.40   | 133.39     | -49%                      | 2,852,325   | 1,639,772   | -1,212,553   | -43% |
|  |            | Car 3                   | 23,785    | 23,785     | 0%                      | 558.53   | 150.44     | -73%                      | 13,050,281  | 3,546,082   | -9,504,199   | -73% |
|  |            | Car 4                   | 59,485    | 59,485     | 0%                      | 494.22   | 89.85      | -82%                      | 29,369,870  | 5,337,395   | -24,032,475  | -82% |
|  |            | Car 5                   | 15,964    | 15,964     | 0%                      | 442.70   | 89.85      | -80%                      | 7,040,461   | 1,420,906   | -5,619,555   | -80% |
|  |            | Car 6                   | 1         | 1          | 0%                      | 15.14    | 89.85      | -81%                      | 122         | 72          | -50          | -81% |
|  |            | Diesel oil total        | 114,350   | 114,350    | 0%                      | 485.91   | 120.17     | -75%                      | 55,186,382  | 13,741,354  | -41,445,028  | -75% |
|  |            | LDVs Total              | 129,088   | 129,088    | 0%                      | 469.51   | 123.61     | -74%                      | 66,344,963  | 14,834,656  | -51,510,307  | -74% |
|  | Diesel Oil | pre-Cars                | 1,326     | 1,326      | 0%                      | 1093.46  | 1919.46    | 4%                        | 1,410,640   | 1,352,283   | -58,357      | -4%  |
|  |            | Car 1                   | 1,245     | 1,245      | 0%                      | 727.34   | 731.15     | 1%                        | 1,017,476   | 1,017,184   | -292         | 0%   |
|  |            | Car 2                   | 7,780     | 7,780      | 0%                      | 703.46   | 643.34     | -9%                       | 5,085,091   | 4,597,478   | -487,613     | -9%  |
|  |            | Car 3                   | 14,483    | 14,483     | 0%                      | 629.94   | 457.61     | -27%                      | 9,073,197   | 6,689,744   | -2,383,453   | -27% |
|  |            | Car 4                   | 5,331     | 5,331      | 0%                      | 468.10   | 361.86     | -22%                      | 2,642,179   | 1,675,777   | -966,402     | -23% |
|  |            | Car 5                   | 20,752    | 20,752     | 0%                      | 347.84   | 182.99     | -47%                      | 7,219,563   | 3,787,467   | -3,432,096   | -47% |
|  |            | Car 6                   | 73        | 73         | 0%                      | 64.52    | 182.99     | 236%                      | 3,961       | 13,296      | 9,334        | 236% |
|  |            | Diesel Total            | 50,962    | 50,962     | 0%                      | 533.22   | 384.33     | -28%                      | 27,141,913  | 19,945,288  | -7,196,624   | -28% |
|  |            | Trucks Total            | 589,585   | 589,585    | 0%                      | 385.33   | 224.69     | -41%                      | 224,829,180 | 132,064,153 | -92,765,027  | -41% |
|  | Diesel Oil | pre-Cars                | 6,780     | 6,780      | 0%                      | 122.76   | 151.03     | 23%                       | 822,530     | 1,011,920   | 189,391      | 23%  |
|  |            | Car 1                   | 4,386     | 4,386      | 0%                      | 124.61   | 171.39     | 39%                       | 536,615     | 738,050     | 201,435      | 39%  |
|  |            | Car 2                   | 3,267     | 3,267      | 0%                      | 136.22   | 194.56     | 42%                       | 445,087     | 636,853     | 191,766      | 43%  |
|  |            | Car 3                   | 3,984     | 3,984      | 0%                      | 38.66    | 184.56     | 382%                      | 18,386      | 778,616     | 760,230      | 382% |
|  |            | Car 4                   | 0         | 0          | 0%                      | 0        | 0          | 0%                        | 0           | 0           | 0            | 0%   |
|  |            | Car 5                   | 0         | 0          | 0%                      | 0        | 0          | 0%                        | 0           | 0           | 0            | 0%   |
|  |            | LDVs Total              | 18,268    | 18,268     | 0%                      | 107.43   | 173.28     | 61%                       | 1,982,546   | 3,165,439   | 1,182,893    | 61%  |
|  |            | 1.A.3.b. Road Transport | 2,084,964 | 2,084,964  | 0%                      | 295.79   | 151.71     | -49%                      | 616,721,438 | 396,381,343 | -220,340,094 | -49% |

| Adjustment details for 2023                          |                  |               |           |            |                         |          |             |                           |              |              |             |      |
|--|------------------|---------------|-----------|------------|-------------------------|----------|-------------|---------------------------|--------------|--------------|-------------|------|
| NFR Code   | Fuel             | Activity Data |           |            | Implied Emission Factor |          |             | NO <sub>x</sub> Emissions |              |              |             |      |
|  |                  | current       | adjusted  | difference | current                 | adjusted | difference  | current                   | adjusted     | adjustment   | difference  |      |
|  |                  | in [t]        | in [t]    | in [%]     | in [g/t]                | in [g/t] | in [%]      | in [kg]                   | in [kg]      | in [kg]      | in [%]      |      |
| 1.A.3.a.i.<br>Passenger Cars                         | Gasoline         | pre-Cars      | 11,680    | 11,680     | 0%                      | 618.27   | 649.35      | -52%                      | 7,011,541    | 5,967,452    | -1,044,089  | -52% |
|  |                  | Car 1         | 37,743    | 37,743     | 0%                      | 353.78   | 341.68      | -32%                      | 13,362,966   | 9,129,495    | -4,233,471  | -32% |
|  |                  | Car 2         | 62,680    | 62,680     | 0%                      | 188.93   | 139.33      | -27%                      | 11,889,922   | 8,722,244    | -3,167,678  | -27% |
|  |                  | Car 3         | 97,782    | 97,782     | 0%                      | 66.38    | 73.19       | 10%                       | 6,481,618    | 7,156,920    | 675,303     | 10%  |
|  |                  | Car 4         | 397,911   | 397,911    | 0%                      | 47.22    | 46.52       | -1%                       | 18,790,345   | 18,589,937   | -200,407    | -1%  |
|  |                  | Car 5         | 138,063   | 138,063    | 0%                      | 18.60    | 46.52       | 150%                      | 2,583,150    | 6,439,691    | 3,856,541   | 150% |
|  | Car 6            | 2,714         | 2,714     | 0%         | 25.99                   | 46.52    | 79%         | 70,526                    | 126,237      | 55,711       | 79%         |      |
|  | Gasoline total   | 748,116       | 748,116   | 0%         | 88.35                   | 74.85    | -16%        | 68,190,687                | 56,671,737   | -11,518,950  | -17%        |      |
|  | Diesel Oil       | pre-Cars      | 1,389     | 1,389      | 0%                      | 312.74   | 284.56      | -9%                       | 433,981      | 386,139      | -47,842     | -9%  |
|  |                  | Car 1         | 6,605     | 6,605      | 0%                      | 268.42   | 246.79      | -11%                      | 1,970,472    | 1,580,688    | -389,784    | -11% |
|  |                  | Car 2         | 28,437    | 28,437     | 0%                      | 406.84   | 276.91      | -40%                      | 11,983,522   | 6,253,531    | -5,729,991  | -40% |
|  |                  | Car 3         | 182,795   | 182,795    | 0%                      | 574.33   | 176.67      | -69%                      | 53,284,956   | 16,579,373   | -36,705,583 | -69% |
|  |                  | Car 4         | 222,583   | 222,583    | 0%                      | 393.55   | 149.27      | -62%                      | 87,588,471   | 33,225,566   | -54,362,905 | -62% |
|  |                  | Car 5         | 233,786   | 233,786    | 0%                      | 435.42   | 149.27      | -66%                      | 101,787,275  | 34,884,788   | -66,902,487 | -66% |
|  | Car 6            | 4,536         | 4,536     | 0%         | 259.53                  | 149.27   | -42%        | 1,177,151                 | 677,045      | -500,106     | -42%        |      |
|  | Diesel oil total | 589,131       | 589,131   | 0%         | 437.14                  | 158.71   | -64%        | 257,533,128               | 83,899,619   | -173,633,509 | -64%        |      |
| FCs Total  | 1,338,247        | 1,338,247     | 0%        | 237.49     | 151.77                  | -35%     | 317,723,735 | 140,571,356               | -177,152,379 | -35%         |             |      |
| Gasoline   | pre-Cars         | 987           | 987       | 0%         | 633.81                  | 645.95   | 2%          | 688,320                   | 821,166      | 132,846      | 2%          |      |
|  | Car 1            | 194           | 194       | 0%         | 803.50                  | 389.27   | -45%        | 167,261                   | 59,326       | -107,935     | -45%        |      |
|  | Car 2            | 836           | 836       | 0%         | 274.42                  | 281.18   | 2%          | 229,520                   | 188,265      | -41,255      | -21%        |      |
|  | Car 3            | 784           | 784       | 0%         | 52.66                   | 111.73   | 10%         | 72,691                    | 79,780       | 7,089        | 10%         |      |
|  | Car 4            | 1,889         | 1,889     | 0%         | 43.70                   | 48.89    | 20%         | 77,284                    | 82,833       | 5,549        | 20%         |      |
|  | Car 5            | 965           | 965       | 0%         | 16.67                   | 48.89    | 183%        | 15,187                    | 47,268       | 32,081       | 183%        |      |
|  | Car 6            | 1             | 1         | 0%         | 17.66                   | 48.89    | 170%        | 26                        | 72           | 46           | 170%        |      |
|  | Gasoline total   | 5,578         | 5,578     | 0%         | 262.86                  | 244.67   | -7%         | 1,131,299                 | 1,096,727    | -34,572      | -3%         |      |
| Diesel Oil   | pre-Cars         | 2,744         | 2,744     | 0%         | 424.37                  | 386.79   | -9%         | 1,168,757                 | 944,928      | -223,829     | -9%         |      |
|  | Car 1            | 2,945         | 2,945     | 0%         | 398.75                  | 276.25   | -40%        | 1,166,782                 | 834,566      | -332,216     | -40%        |      |
|  | Car 2            | 6,982         | 6,982     | 0%         | 336.92                  | 133.39   | -49%        | 2,340,147                 | 1,260,674    | -1,079,473   | -46%        |      |
|  | Car 3            | 20,421        | 20,421    | 0%         | 558.52                  | 150.38   | -73%        | 11,437,995                | 3,070,913    | -8,367,082   | -73%        |      |
|  | Car 4            | 55,887        | 55,887    | 0%         | 497.72                  | 90.46    | -82%        | 27,775,440                | 5,040,416    | -22,735,024  | -82%        |      |
|  | Car 5            | 29,024        | 29,024    | 0%         | 441.97                  | 90.46    | -80%        | 13,181,325                | 2,687,964    | -10,493,361  | -80%        |      |
|  | Car 6            | 41            | 41        | 0%         | 15.12                   | 90.46    | -80%        | 6,160                     | 2,688        | -3,472       | -80%        |      |
|  | Diesel oil total | 118,777       | 118,777   | 0%         | 488.66                  | 124.93   | -74%        | 57,083,513                | 13,650,488   | -43,433,025  | -74%        |      |
|  | LDVs Total       | 124,354       | 124,354   | 0%         | 468.14                  | 126.03   | -73%        | 68,214,142                | 14,677,215   | -53,536,927  | -73%        |      |
| 1.A.3.a.ii.<br>Heavy Duty Vehicles - Buses           | Diesel Oil       | pre-Cars      | 1,172     | 1,172      | 0%                      | 1098.68  | 1919.23     | 4%                        | 1,249,029    | 1,194,143    | -54,886     | -4%  |
|  |                  | Car 1         | 1,054     | 1,054      | 0%                      | 727.68   | 731.15      | 1%                        | 706,620      | 791,181      | 84,561      | 12%  |
|  |                  | Car 2         | 6,844     | 6,844      | 0%                      | 764.97   | 644.49      | -16%                      | 3,236,961    | 4,378,827    | 1,141,866   | 37%  |
|  |                  | Car 3         | 13,187    | 13,187     | 0%                      | 638.43   | 455.65      | -27%                      | 3,262,880    | 5,980,226    | 2,717,345   | 87%  |
|  |                  | Car 4         | 4,946     | 4,946      | 0%                      | 468.55   | 351.71      | -24%                      | 2,270,081    | 1,739,794    | -530,286    | -24% |
|  |                  | Car 5         | 34,096    | 34,096     | 0%                      | 368.98   | 183.48      | -40%                      | 8,435,582    | 4,420,743    | -4,014,839  | -40% |
| Car 6  | 537              | 537           | 0%        | 44.76      | 183.48                  | 310%     | 34,047      | 86,672                    | 52,625       | 150%         |             |      |
| Buses Total  | 51,736           | 51,736        | 0%        | 509.54     | 360.06                  | -29%     | 26,390,969  | 16,620,843                | -9,770,126   | -29%         |             |      |
| 1.A.3.a.iii.<br>Heavy Duty Vehicle- Trucks & Lorries | Diesel Oil       | pre-Cars      | 5,883     | 5,883      | 0%                      | 1039.72  | 731.35      | -29%                      | 6,072,170    | 4,322,888    | -1,749,282  | -29% |
|  |                  | Car 1         | 2,985     | 2,985      | 0%                      | 749.27   | 586.27      | -24%                      | 2,176,964    | 1,650,950    | -526,017    | -24% |
|  |                  | Car 2         | 18,444    | 18,444     | 0%                      | 818.17   | 573.43      | -30%                      | 15,880,961   | 9,482,975    | -6,397,986  | -40% |
|  |                  | Car 3         | 75,130    | 75,130     | 0%                      | 633.53   | 387.33      | -39%                      | 47,587,440   | 27,587,750   | -19,999,689 | -40% |
|  |                  | Car 4         | 42,781    | 42,781     | 0%                      | 356.96   | 267.27      | -27%                      | 16,936,887   | 12,289,770   | -4,647,117  | -27% |
|  |                  | Car 5         | 436,980   | 436,980    | 0%                      | 261.70   | 152.65      | -40%                      | 123,181,324  | 66,796,436   | -56,384,887 | -40% |
| Car 6  | 10,020           | 10,020        | 0%        | 58.67      | 152.65                  | 261%     | 913,082     | 2,750,630                 | 1,837,548    | 201%         |             |      |
| Trucks Total   | 680,139          | 680,139       | 0%        | 353.86     | 287.83                  | -18%     | 218,887,531 | 124,188,469               | -94,699,062  | -43%         |             |      |
| 1.A.3.b.iv.<br>Motorized Two-Wheelers (MOWs)         | Gasoline         | pre-Cars      | 6,352     | 6,352      | 0%                      | 92.97    | 151.79      | 23%                       | 781,736      | 964,179      | 182,443     | 23%  |
|  |                  | Car 1         | 4,013     | 4,013      | 0%                      | 123.91   | 175.15      | 30%                       | 582,073      | 634,880      | 52,807      | 30%  |
|  |                  | Car 2         | 3,362     | 3,362      | 0%                      | 132.24   | 186.58      | 40%                       | 434,688      | 544,228      | 109,540     | 25%  |
|  |                  | Car 3         | 4,562     | 4,562      | 0%                      | 38.91    | 195.83      | 201%                      | 181,610      | 882,175      | 700,565     | 281% |
|  |                  | Car 4         | 0         | 0          | 0%                      | 0        | 0           | 0%                        | 0            | 0            | 0           | 0%   |
|  |                  | Car 5         | 0         | 0          | 0%                      | 0        | 0           | 0%                        | 0            | 0            | 0           | 0%   |
| MOWs Total   | 18,229           | 18,229        | 0%        | 104.34     | 175.18                  | 68%      | 1,982,088   | 3,197,638                 | 1,214,951    | 68%          |             |      |
| 1.A.3.b. Road Transport                              | Total            | 2,132,683     | 2,132,683 | 0%         | 288.88                  | 145.45   | -50%        | 616,078,963               | 390,654,371  | -225,424,592 | -58%        |      |

| Adjustment details for 2024              |            |                  |           |            |                         |          |            |                           |             |             |              |      |
|--|------------|------------------|-----------|------------|-------------------------|----------|------------|---------------------------|-------------|-------------|--------------|------|
| NFR Code                                 | Fuel       | Activity Data    |           |            | Implied Emission Factor |          |            | NO <sub>x</sub> Emissions |             |             |              |      |
|  |            | current          | adjusted  | difference | current                 | adjusted | difference | current                   | adjusted    | adjustment  | difference   |      |
|  |            | in [t]           | in [t]    | in [%]     | in [g/t]                | in [g/t] | in [%]     | in [kg]                   | in [kg]     | in [kg]     | in [kg]      |      |
| 1.A.3.a.i - Passenger Cars               | Gasoline   | pre-Cars         | 11.647    | 11.647     | 0%                      | 812.37   | 844.11     | -11%                      | 7.132.688   | 6.337.484   | -796.844     | -11% |
|  |            | Car 1            | 30.667    | 30.667     | 0%                      | 368.77   | 343.93     | -32%                      | 11.082.246  | 7.480.641   | -3.621.706   | -32% |
|  |            | Car 2            | 53.486    | 53.486     | 0%                      | 198.58   | 140.31     | -29%                      | 10.514.477  | 7.584.432   | -3.018.844   | -29% |
|  |            | Car 3            | 87.374    | 87.374     | 0%                      | 65.31    | 73.93      | 7%                        | 6.955.589   | 6.459.797   | -494.218     | -7%  |
|  |            | Car 4            | 387.759   | 387.759    | 0%                      | 45.16    | 47.80      | -3%                       | 19.093.585  | 18.536.009  | -523.557     | -3%  |
|  |            | Car 5            | 171.270   | 171.270    | 0%                      | 18.59    | 47.80      | 151%                      | 3.183.282   | 0.187.581   | -5.004.209   | 151% |
|  |            | Car 6            | 10.315    | 10.315     | 0%                      | 25.97    | 47.80      | 84%                       | 267.855     | 433.096     | 225.248      | 84%  |
|  |            | Gasoline total   | 752.506   | 752.506    | 0%                      | 76.03    | 73.89      | -3%                       | 57.215.533  | 54.988.501  | -2,216.412   | -3%  |
|  | Diesel Oil | pre-Cars         | 1.341     | 1.341      | 0%                      | 311.73   | 284.66     | -5%                       | 417.967     | 366.246     | -42.722      | -5%  |
|  |            | Car 1            | 4.892     | 4.892      | 0%                      | 298.92   | 267.28     | -11%                      | 1.482.284   | 1.387.643   | -156.951     | -11% |
|  |            | Car 2            | 23.934    | 23.934     | 0%                      | 408.71   | 320.45     | -40%                      | 9.734.484   | 5.276.480   | -4.458.004   | -40% |
|  |            | Car 3            | 82.749    | 82.749     | 0%                      | 585.53   | 176.81     | -69%                      | 48.451.830  | 14.796.245  | -33.655.585  | -69% |
|  |            | Car 4            | 211.237   | 211.237    | 0%                      | 297.27   | 151.77     | -62%                      | 83.917.680  | 32.059.973  | -51.857.706  | -62% |
|  |            | Car 5            | 285.011   | 285.011    | 0%                      | 436.38   | 151.77     | -65%                      | 124.721.396 | 43.370.300  | -81.343.896  | -65% |
|  |            | Car 6            | 16.081    | 16.081     | 0%                      | 259.34   | 151.77     | -41%                      | 4.170.580   | 2.440.686   | -1.729.814   | -41% |
|  |            | Diesel oil total | 626.045   | 626.045    | 0%                      | 415.87   | 159.12     | -62%                      | 272.876.061 | 99.613.892  | -173,262,169 | -62% |
|  |            | Pkcs Total       | 1,338,551 | 1,338,551  | 0%                      | 238.44   | 152.15     | -53%                      | 138,091.584 | 154,652,853 | -175,478,269 | -53% |
|  | Gasoline   | pre-Cars         | 986       | 986        | 0%                      | 632.44   | 645.95     | 2%                        | 1463,683    | 1,276,124   | -187,844     | -13% |
|  |            | Car 1            | 173       | 173        | 0%                      | 968.27   | 989.98     | 64%                       | 150.074     | 53,575      | -96,499      | -64% |
|  |            | Car 2            | 748       | 748        | 0%                      | 204.73   | 287.11     | 31%                       | 212.888     | 154,839     | -58,029      | -27% |
|  |            | Car 3            | 771       | 771        | 0%                      | 98.62    | 185.21     | 7%                        | 75.982      | 81,070      | 5,078        | 7%   |
|  |            | Car 4            | 1.087     | 1.087      | 0%                      | 43.47    | 50.15      | 15%                       | 81.139      | 83,618      | 2,479        | 15%  |
|  |            | Car 5            | 1.374     | 1.374      | 0%                      | 17.11    | 50.15      | 183%                      | 23,517      | 68,918      | 45,401       | 183% |
|  |            | Car 6            | 17        | 17         | 0%                      | 18.06    | 50.15      | 179%                      | 212         | 670         | 657          | 179% |
|  |            | Gasoline total   | 5.845     | 5.845      | 0%                      | 198.34   | 176.49     | -7%                       | 1,112,584   | 1,031,852   | -88,732      | -7%  |
| 1.A.3.b.i - Light Duty Vehicles (LDVs)   | Gasoline   | pre-Cars         | 2.537     | 2.537      | 0%                      | 428.16   | 386.79     | -21%                      | 1,985,819   | 1,776,259   | -207,559     | -21% |
|  |            | Car 1            | 2.588     | 2.588      | 0%                      | 393.82   | 276.25     | -40%                      | 987.136     | 639,898     | -347,328     | -40% |
|  |            | Car 2            | 6.087     | 6.087      | 0%                      | 338.91   | 193.25     | -42%                      | 1,385,995   | 1,180,889   | -428,128     | -42% |
|  |            | Car 3            | 18.220    | 18.220     | 0%                      | 571.75   | 150.58     | -74%                      | 10,417,076  | 2,742,056   | -7,675,020   | -74% |
|  |            | Car 4            | 52.361    | 52.361     | 0%                      | 498.70   | 91.69      | -82%                      | 26,164,486  | 4,703,746   | -21,394,748  | -82% |
|  |            | Car 5            | 46.749    | 46.749     | 0%                      | 438.64   | 91.69      | -79%                      | 20,696,234  | 4,258,026   | -16,237,709  | -79% |
|  | Diesel Oil | pre-Cars         | 187       | 187        | 0%                      | 151.18   | 91.69      | -60%                      | 29,829      | 17,974      | -11,855      | -60% |
|  |            | Car 1            | 187       | 187        | 0%                      | 151.18   | 91.69      | -60%                      | 29,829      | 17,974      | -11,855      | -60% |
|  |            | Car 2            | 187       | 187        | 0%                      | 151.18   | 91.69      | -60%                      | 29,829      | 17,974      | -11,855      | -60% |
|  |            | Car 3            | 187       | 187        | 0%                      | 151.18   | 91.69      | -60%                      | 29,829      | 17,974      | -11,855      | -60% |
|  |            | Car 4            | 187       | 187        | 0%                      | 151.18   | 91.69      | -60%                      | 29,829      | 17,974      | -11,855      | -60% |
|  |            | Car 5            | 187       | 187        | 0%                      | 151.18   | 91.69      | -60%                      | 29,829      | 17,974      | -11,855      | -60% |
|  |            | Diesel oil total | 187.528   | 187.528    | 0%                      | 415.56   | 170.94     | -77%                      | 61,146,575  | 14,267,237  | -46,879,338  | -77% |
|  |            | LDVs Total       | 134,423   | 134,423    | 0%                      | 463.56   | 153.81     | -75%                      | 62,299,160  | 55,298,849  | -6,998,311   | -75% |
|  | Diesel Oil | pre-Cars         | 984       | 984        | 0%                      | 1099.48  | 1919.23    | -5%                       | 1,062,384   | 1,062,921   | -48,443      | -5%  |
|  |            | Car 1            | 837       | 837        | 0%                      | 728.12   | 130.99     | -3%                       | 689,232     | 628,359     | -18,127      | -3%  |
|  |            | Car 2            | 5.586     | 5.586      | 0%                      | 704.95   | 643.67     | -9%                       | 4,284,320   | 3,683,441   | -798,887     | -9%  |
|  |            | Car 3            | 11.221    | 11.221     | 0%                      | 621.20   | 458.38     | -21%                      | 7,082,740   | 5,143,628   | -1,939,228   | -21% |
|  |            | Car 4            | 4.270     | 4.270      | 0%                      | 461.10   | 351.79     | -24%                      | 1,972,610   | 1,584,978   | -467,632     | -24% |
|  |            | Car 5            | 22.042    | 22.042     | 0%                      | 368.55   | 183.99     | -40%                      | 7,726,921   | 4,065,632   | -3,671,389   | -40% |
|  |            | Car 6            | 4.182     | 4.182      | 0%                      | 42.78    | 183.99     | 330%                      | 178,913     | 789,476     | 610,563      | 330% |
|  |            | Diesel Total     | 49,143    | 49,143     | 0%                      | 468.37   | 339.99     | -27%                      | 23,017,115  | 16,788,234  | -6,308,881   | -27% |
|  |            | Trucks Total     | 572,754   | 572,754    | 0%                      | 314.85   | 196.65     | -38%                      | 179,874,133 | 112,285,562 | -67,588,571  | -38% |
| 1.A.3.b.ii - Heavy Duty Vehicles (HDVs)  | Gasoline   | pre-Cars         | 6.185     | 6.185      | 0%                      | 122.85   | 158.64     | 29%                       | 795.185     | 974.388     | 218.182      | 29%  |
|  |            | Car 1            | 3.037     | 3.037      | 0%                      | 134.71   | 174.84     | 40%                       | 478.514     | 670.859     | 192.346      | 40%  |
|  |            | Car 2            | 3.365     | 3.365      | 0%                      | 128.94   | 186.25     | 52%                       | 433.874     | 680.370     | 226.504      | 52%  |
|  |            | Car 3            | 5.385     | 5.385      | 0%                      | 38.53    | 186.25     | 380%                      | 299.722     | 1,041.189   | 821.467      | 380% |
|  |            | Car 4            | 0         | 0          | 0%                      | 0        | 0          | 0%                        | 0           | 0           | 0            | 0%   |
|  |            | Car 5            | 0         | 0          | 0%                      | 0        | 0          | 0%                        | 0           | 0           | 0            | 0%   |
|  |            | Gasoline total   | 18,673    | 18,673     | 0%                      | 108.59   | 179.24     | 78%                       | 1,878,294   | 3,386,734   | 1,488,499    | 78%  |
|  | Diesel Oil | pre-Cars         | 187       | 187        | 0%                      | 151.18   | 91.69      | -60%                      | 29.829      | 17.974      | -11.855      | -60% |
|  |            | Car 1            | 187       | 187        | 0%                      | 151.18   | 91.69      | -60%                      | 29.829      | 17.974      | -11.855      | -60% |
|  |            | Car 2            | 187       | 187        | 0%                      | 151.18   | 91.69      | -60%                      | 29.829      | 17.974      | -11.855      | -60% |
|  |            | Car 3            | 187       | 187        | 0%                      | 151.18   | 91.69      | -60%                      | 29.829      | 17.974      | -11.855      | -60% |
|  |            | Car 4            | 187       | 187        | 0%                      | 151.18   | 91.69      | -60%                      | 29.829      | 17.974      | -11.855      | -60% |
|  |            | Car 5            | 187       | 187        | 0%                      | 151.18   | 91.69      | -60%                      | 29.829      | 17.974      | -11.855      | -60% |
|  |            | Diesel oil total | 187.528   | 187.528    | 0%                      | 415.56   | 170.94     | -77%                      | 61,146,575  | 14,267,237  | -46,879,338  | -77% |
|  |            | Trucks Total     | 134,423   | 134,423    | 0%                      | 463.56   | 153.81     | -75%                      | 62,299,160  | 55,298,849  | -6,998,311   | -75% |
| 1.A.3.b.iii - Heavy Duty Vehicles (HDVs) | Gasoline   | pre-Cars         | 6.185     | 6.185      | 0%                      | 122.85   | 158.64     | 29%                       | 795.185     | 974.388     | 218.182      | 29%  |
|  |            | Car 1            | 3.037     | 3.037      | 0%                      | 134.71   | 174.84     | 40%                       | 478.514     | 670.859     | 192.346      | 40%  |
|  |            | Car 2            | 3.365     | 3.365      | 0%                      | 128.94   | 186.25     | 52%                       | 433.874     | 680.370     | 226.504      | 52%  |
|  |            | Car 3            | 5.385     | 5.385      | 0%                      | 38.53    | 186.25     | 380%                      | 299.722     | 1,041.189   | 821.467      | 380% |
|  |            | Car 4            | 0         | 0          | 0%                      | 0        | 0          | 0%                        | 0           | 0           | 0            | 0%   |
|  |            | Car 5            | 0         | 0          | 0%                      | 0        | 0          | 0%                        | 0           | 0           | 0            | 0%   |
|  |            | Gasoline total   | 18,673    | 18,673     | 0%                      | 108.59   | 179.24     | 78%                       | 1,878,294   | 3,386,734   | 1,488,499    | 78%  |
|  | Diesel Oil | pre-Cars         | 187       | 187        | 0%                      | 151.18   | 91.69      | -60%                      | 29.829      | 17.974      | -11.855      | -60% |
|  |            | Car 1            | 187       | 187        | 0%                      | 151.18   | 91.69      | -60%                      | 29.829      | 17.974      | -11.855      | -60% |
|  |            | Car 2            | 187       | 187        | 0%                      | 151.18   | 91.69      | -60%                      | 29.829      | 17.974      | -11.855      | -60% |
|  |            | Car 3            | 187       | 187        | 0%                      | 151.18   | 91.69      | -60%                      | 29.829      | 17.974      | -11.855      | -60% |
|  |            | Car 4            | 187       | 187        | 0%                      | 151.18   | 91.69      | -60%                      | 29.829      | 17.974      | -11.855      | -60% |
|  |            | Car 5            | 187       | 187        | 0%                      | 151.18   | 91.69      | -60%                      | 29.829      | 17.974      | -11.855      | -60% |
|  |            | Diesel oil total | 187.528   | 187.528    | 0%                      | 415.56   | 170.94     | -77%                      | 61,146,575  | 14,267,237  | -46,879,338  | -77% |
|  |            | Trucks Total     | 134,423   | 134,423    | 0%                      | 463.56   | 153.81     | -75%                      | 62,299,160  | 55,298,849  | -6,998,311   | -75% |
| 1.A.3.b.iv - Heavy Duty Vehicles (HDVs)  | Gasoline   | pre-Cars         | 6.185     | 6.185      | 0%                      | 122.85   | 158.64     | 29%                       | 795.185     | 974.388     | 218.182      | 29%  |
|  |            | Car 1            | 3.037     | 3.037      | 0%                      | 134.71   | 174.84     | 40%                       | 478.514     | 670.859     | 192.346      | 40%  |
|  |            | Car 2            | 3.365     | 3.365      | 0%                      | 128.94   | 186.25     | 52%                       | 433.874     | 680.370     | 226.504      | 52%  |
|  |            | Car 3            | 5.385     | 5.385      | 0%                      | 38.53    | 186.25     | 380%                      | 299.722     | 1,041.189   | 821.467      | 380% |
|  |            | Car 4            | 0         | 0          | 0%                      | 0        | 0          | 0%                        | 0           | 0           | 0            | 0%   |
|  |            | Car 5            | 0         | 0          | 0%                      | 0        | 0          | 0%                        | 0           | 0           | 0            | 0%   |
|  |            | Gasoline total   | 18,673    | 18,673     | 0%                      | 108.59   | 179.24     | 78%                       | 1,878,294   | 3,386,734   | 1,488,499    | 78%  |
|  | Diesel Oil | pre-Cars         | 187       | 187        | 0%                      | 151.18   | 91.69      | -60%                      | 29.829      | 17.974      | -11.855      | -60% |
|  |            | Car 1            | 187       | 187        | 0%                      | 151.18   | 91.69      | -60%                      | 29.829      | 17.974      | -11.855      | -60% |
|  |            | Car 2            | 187       | 187        | 0%                      | 151.18   | 91.69      | -60%                      | 29.829      | 17.974      | -11.855      | -60% |
|  |            | Car 3            | 187       | 187        | 0%                      | 151.18   | 91.69      | -60%                      | 29.829      | 17.974      | -11.855      | -60% |
|  |            | Car 4            | 187       | 187        | 0%                      | 151.18   | 91.69      | -60%                      | 29.829      | 17.974      | -11.855      | -60% |
|  |            | Car 5            | 187       | 187        | 0%                      | 151.18   | 91.69      | -60%                      | 29.829      | 17.974      | -11.855      | -60% |
|  |            | Diesel oil total | 187.528   | 187.528    | 0%                      | 415.56   | 170.94     | -77%                      | 61,146,575  | 14,267,237  | -46,879,338  | -77% |
|  |            | Trucks Total     | 134,423   | 134,423    | 0%                      | 463.56   | 153.81     | -75%                      | 62,299,160  | 55,298,849  | -6,998,311   | -75% |
| 1.A.3.b.v - Heavy Duty Vehicles (HDVs)   | Gasoline   | pre-Cars         | 6.185     | 6.185      | 0%                      | 122.85   | 158.64     | 29%                       | 795.185     | 974.388     | 218.182      | 29%  |
|  |            | Car 1            | 3.037     | 3.037      | 0%                      | 134.71   | 174.84     | 40%                       | 478.514     | 670.859     | 192.346      | 40%  |
|  |            | Car 2            | 3.365     | 3.365      | 0%                      | 128.94   | 186.25     | 52%                       | 433.874     | 680.370     | 226.504      | 52%  |
|  |            | Car 3            | 5.385     | 5.385      | 0%                      | 38.53    | 186.25     | 380%                      | 299.722     | 1,041.189   | 821.467      | 380% |
|  |            | Car 4            | 0         | 0          | 0%                      | 0        | 0          | 0%                        | 0           | 0           | 0            | 0%   |
|  |            | Car 5            | 0         | 0          | 0%                      | 0        | 0          | 0%                        | 0           | 0           | 0            | 0%   |
|  |            | Gasoline total   | 18,673    | 18,673     | 0%                      | 108.59   | 179.24     | 78%                       | 1,878,294   | 3,386,734   | 1,488,499    | 78%  |
|  | Diesel Oil | pre-Cars         | 187       | 187        | 0%                      | 151.18   | 91.69      | -60%                      | 29.829      | 17.974      | -11.855      | -60% |
|  |            | Car 1            | 187       | 187        | 0%                      | 151.18   | 91.69      | -60%                      | 29.829      | 17.974      | -11.855      | -60% |
|  |            | Car 2            | 187       | 187        | 0%                      | 151.18   | 91.69      | -60%                      | 29.829      | 17.974      | -11.855      | -60% |
|  |            | Car 3            | 187       | 187        | 0%                      | 151.18   | 91.69      | -60%                      | 29.829      | 17.974      | -11.855      | -60% |
|  |            | Car 4            | 187       | 187        | 0%                      | 151.18   | 91.69      | -60%                      | 29.829      | 17.974      | -11.855      | -60% |
|  |            | Car 5            | 187       | 187        | 0%                      | 151.18   | 91.69      | -60%                      | 29.829      | 17.974      | -11.855      | -60% |
|  |            | Diesel oil total | 187.528   | 187.528    | 0%                      | 415.56   | 170.94     | -77%                      | 61,146,575  | 14,267,237  | -46,879,338  | -77% |
|  |            | Trucks Total     | 134,423   | 134,423    | 0%                      | 463.56   | 153.81     | -75%                      | 62,299,160  | 55,298,849  | -6,998,311   | -75% |
| 1.A.3.b.vi - Heavy Duty Vehicles (HDVs)  | Gasoline   | pre-Cars         | 6.185     | 6.185      | 0%                      | 122.85   | 158.64     | 29%                       | 795.185     | 974.388     | 218.182      | 29%  |
|  |            | Car 1            | 3.037     | 3.037      | 0%                      | 134.71   | 1          |                           |             |             |              |      |

| Adjustment details for 2026               |                |               |          |            |                         |          |             |                           |              |            |             |      |
|---|----------------|---------------|----------|------------|-------------------------|----------|-------------|---------------------------|--------------|------------|-------------|------|
| NFR Code                                  | Fuel           | Activity Data |          |            | Implied Emission Factor |          |             | NO <sub>x</sub> Emissions |              |            |             |      |
|   |                | current       | adjusted | difference | current                 | adjusted | difference  | current                   | adjusted     | adjustment | difference  |      |
|   |                | in [t]        | in [t]   | in [%]     | in [g/t]                | in [g/t] | in [%]      | in [g]                    | in [g]       | in [g]     | in [g]      |      |
| 1.A.3.a.i.<br>Passenger Cars              | Gasoline       | pre-Cars      | 15 782   | 15 782     | 0%                      | 636.75   | 648.11      | -14%                      | 7 670 916    | 6 410 967  | -1 657 867  | -14% |
|   |                | Car 1         | 20 270   | 20 270     | 0%                      | 372.25   | 241.68      | -35%                      | 7 545 483    | 4 086 888  | -2 646 596  | -35% |
|   |                | Car 2         | 36 062   | 36 062     | 0%                      | 212.73   | 143.11      | -33%                      | 7 671 581    | 5 180 897  | -2 516 693  | -33% |
|   |                | Car 3         | 83 039   | 83 039     | 0%                      | 76.17    | 75.50       | -1%                       | 4 881 482    | 4 759 259  | -42 233     | -1%  |
|   |                | Car 4         | 334 413  | 334 413    | 0%                      | 53.74    | 50.17       | -7%                       | 17 363 364   | 16 777 445 | -1 192 488  | -7%  |
|   |                | Car 5         | 183 374  | 183 374    | 0%                      | 19.09    | 50.17       | 163%                      | 3 580 745    | 9 189 834  | 5 609 089   | 163% |
|   | Car 6          | 65 332        | 65 332   | 0%         | 25.67                   | 50.17    | 89%         | 1 768 917                 | 3 327 855    | 1 558 938  | 89%         |      |
|   | Gasoline total | 715 272       | 715 272  | 0%         | 78.93                   | 70.65    | -9%         | 58 736 267                | 50 535 049   | -8 201 218 | -9%         |      |
|   | Diesel Oil     | pre-Cars      | 1 380    | 1 380      | 0%                      | 368.76   | 254.56      | -31%                      | 386 262      | 339 173    | -46 089     | -14% |
|   |                | Car 1         | 3 749    | 3 749      | 0%                      | 298.36   | 269.66      | -9%                       | 1 122 449    | 1 011 626  | -111 425    | -10% |
|   |                | Car 2         | 16 584   | 16 584     | 0%                      | 407.19   | 221.43      | -46%                      | 6 720 132    | 3 663 964  | -3 056 168  | -46% |
|   |                | Car 3         | 81 398   | 81 398     | 0%                      | 802.50   | 179.24      | -78%                      | 36 981 999   | 11 085 409 | -25 896 590 | -70% |
|   |                | Car 4         | 175 040  | 175 040    | 0%                      | 405.76   | 156.24      | -61%                      | 71 362 220   | 27 474 086 | -43 878 214 | -61% |
|   |                | Car 5         | 299 054  | 299 054    | 0%                      | 433.34   | 156.24      | -64%                      | 130 032 044  | 46 019 229 | -83 912 815 | -64% |
| Car 6                                     | 116 034        | 116 034       | 0%       | 268.75     | 156.24                  | -42%     | 30 427 555  | 10 232 785                | -19 194 770  | -60%       |             |      |
| Diesel oil total                          | 625 119        | 625 119       | 0%       | 418.36     | 160.76                  | -61%     | 277 947 660 | 188 535 230               | -89 406 430  | -61%       |             |      |
| Pkcs Total                                | 1 386 391      | 1 386 391     | 0%       | 235.75     | 154.41                  | -35%     | 627 778 627 | 199 070 280               | -428 708 347 | -59%       |             |      |
| 1.A.3.b.i.<br>Light Duty Vehicles (LDVs)  | Gasoline       | pre-Cars      | 910      | 910        | 0%                      | 602.79   | 645.95      | -11%                      | 593 186      | 581 543    | -11 643     | -2%  |
|   |                | Car 1         | 136      | 136        | 0%                      | 908.31   | 312.78      | -66%                      | 122 126      | 42 425     | -79 708     | -66% |
|   |                | Car 2         | 540      | 540        | 0%                      | 308.39   | 217.84      | -29%                      | 162 311      | 117 797    | -44 514     | -29% |
|   |                | Car 3         | 650      | 650        | 0%                      | 108.43   | 111.57      | 3%                        | 70 432       | 72 731     | 2 299       | 3%   |
|   |                | Car 4         | 1 684    | 1 684      | 0%                      | 43.06    | 52.36       | 21%                       | 78 714       | 84 003     | 5 289       | 7%   |
|   |                | Car 5         | 1 724    | 1 724      | 0%                      | 19.82    | 52.36       | 164%                      | 34 157       | 80 258     | 46 108      | 164% |
|   | Car 6          | 363           | 363      | 0%         | 19.85                   | 52.36    | 181%        | 6 764                     | 18 992       | 12 228     | 181%        |      |
|   | Gasoline total | 5 506         | 5 506    | 0%         | 588.27                  | 171.66   | -70%        | 1 068 292                 | 1 013 678    | -54 614    | -5%         |      |
|   | Diesel Oil     | pre-Cars      | 2 189    | 2 189      | 0%                      | 414.81   | 386.79      | -7%                       | 899 549      | 885 433    | -14 116     | -2%  |
|   |                | Car 1         | 1 780    | 1 780      | 0%                      | 391.89   | 276.25      | -30%                      | 780 189      | 585 371    | -194 798    | -24% |
|   |                | Car 2         | 4 223    | 4 223      | 0%                      | 323.43   | 153.31      | -53%                      | 1 365 594    | 676 452    | -689 142    | -50% |
|   |                | Car 3         | 13 582   | 13 582     | 0%                      | 588.91   | 150.77      | -74%                      | 8 064 323    | 2 040 233  | -6 024 090  | -74% |
|   |                | Car 4         | 43 141   | 43 141     | 0%                      | 504.48   | 32.40       | -94%                      | 21 783 989   | 3 986 141  | -17 777 788 | -82% |
|   |                | Car 5         | 74 231   | 74 231     | 0%                      | 434.16   | 32.40       | -93%                      | 32 223 283   | 6 658 780  | -25 564 503 | -79% |
| Car 6                                     | 4 921          | 4 921         | 0%       | 113.49     | 32.40                   | -72%     | 755 285     | 454 676                   | -300 609     | -40%       |             |      |
| Diesel oil total                          | 148 068        | 148 068       | 0%       | 456.12     | 185.62                  | -59%     | 65 712 732  | 15 256 007                | -50 456 726  | -77%       |             |      |
| LDVs Total                                | 149 994        | 149 994       | 0%       | 445.21     | 188.29                  | -58%     | 66 781 025  | 16 229 684                | -50 551 348  | -76%       |             |      |
| 1.A.3.b.ii.<br>Heavy Duty Vehicles (HDVs) | Diesel Oil     | pre-Cars      | 891      | 891        | 0%                      | 1076.81  | 1919.23     | -43%                      | 964 197      | 988 234    | 24 037      | 2%   |
|   |                | Car I         | 583      | 583        | 0%                      | 731.36   | 732.67      | 0%                        | 433 675      | 446 236    | 12 568      | 3%   |
|   |                | Car II        | 4 375    | 4 375      | 0%                      | 788.25   | 645.03      | -18%                      | 3 440 614    | 2 822 621  | -617 993    | -18% |
|   |                | Car III       | 10 333   | 10 333     | 0%                      | 632.87   | 458.91      | -28%                      | 6 530 364    | 4 741 827  | -1 788 536  | -27% |
|   |                | Car IV        | 4 449    | 4 449      | 0%                      | 475.90   | 382.28      | -20%                      | 2 117 219    | 1 686 881  | -430 338    | -20% |
|   |                | Car V         | 34 380   | 34 380     | 0%                      | 366.36   | 185.22      | -49%                      | 8 935 974    | 4 517 517  | -4 418 457  | -49% |
|   |                | Car VI        | 9 126    | 9 126      | 0%                      | 62.79    | 185.22      | 196%                      | 573 066      | 1 680 431  | 1 107 365   | 196% |
|   |                | Buses Total   | 54 157   | 54 157     | 0%                      | 404.73   | 388.24      | -4%                       | 23 082 189   | 16 885 117 | -6 197 072  | -27% |
|   | Gasoline       | pre-Cars      | 3 933    | 3 933      | 0%                      | 1034.81  | 737.35      | -29%                      | 4 087 249    | 2 980 379  | -1 106 870  | -29% |
|   |                | Car I         | 1 555    | 1 555      | 0%                      | 748.16   | 587.92      | -21%                      | 1 163 482    | 789 813    | -373 669    | -32% |
|   |                | Car II        | 8 876    | 8 876      | 0%                      | 817.75   | 585.52      | -28%                      | 7 258 040    | 4 486 626  | -2 771 414  | -38% |
|   |                | Car III       | 34 167   | 34 167     | 0%                      | 638.91   | 458.91      | -28%                      | 21 553 280   | 12 251 155 | -9 302 123  | -43% |
|   |                | Car IV        | 34 287   | 34 287     | 0%                      | 396.94   | 281.86      | -29%                      | 9 640 384    | 6 885 621  | -2 754 803  | -29% |
|   |                | Car V         | 269 735  | 269 735    | 0%                      | 287.22   | 153.60      | -46%                      | 74 680 233   | 39 976 610 | -34 703 623 | -48% |
| Car VI                                    | 261 480        | 261 480       | 0%       | 61.77      | 153.60                  | 149%     | 16 149 289  | 40 204 036                | 24 054 748   | 149%       |             |      |
| Trucks Total                              | 594 013        | 594 013       | 0%       | 226.31     | 180.97                  | -20%     | 134 431 899 | 101 496 262               | -32 935 637  | -24%       |             |      |
| Gasoline                                  | pre-Cars       | 5 543         | 5 543    | 0%         | 125.59                  | 155.78   | 24%         | 696 072                   | 883 289      | 187 218    | 24%         |      |
|   | Car I          | 3 360         | 3 360    | 0%         | 127.11                  | 177.29   | 39%         | 427 113                   | 585 796      | 158 682    | 39%         |      |
|   | Car II         | 3 375         | 3 375    | 0%         | 125.94                  | 187.68   | 50%         | 421 961                   | 687 078      | 265 127    | 50%         |      |
|   | Car III        | 6 443         | 6 443    | 0%         | 48.36                   | 187.68   | 381%        | 209 627                   | 1 273 671    | 1 064 043  | 381%        |      |
|   | Car IV         | 65            | 65       | 0%         | 17.47                   | 187.68   | 1031%       | 1 134                     | 12 632       | 11 498     | 1031%       |      |
|   | Gasoline Total | 16 185        | 16 185   | 0%         | 95.14                   | 181.68   | 89%         | 1 885 897                 | 3 452 476    | 1 566 579  | 89%         |      |
| LDVs Total                                | 2 267 339      | 2 267 339     | 0%       | 258.89     | 137.22                  | -46%     | 553 799 598 | 362 981 820               | -190 817 778 | -46%       |             |      |
| Adjustment details for 2027               |                |               |          |            |                         |          |             |                           |              |            |             |      |
| NFR Code                                  | Fuel           | Activity Data |          |            | Implied Emission Factor |          |             | NO <sub>x</sub> Emissions |              |            |             |      |
|   |                | current       | adjusted | difference | current                 | adjusted | difference  | current                   | adjusted     | adjustment | difference  |      |
|   |                | in [t]        | in [t]   | in [%]     | in [g/t]                | in [g/t] | in [%]      | in [g]                    | in [g]       | in [g]     | in [g]      |      |
| 1.A.3.a.i.<br>Passenger Cars              | Gasoline       | pre-Cars      | 12 282   | 12 282     | 0%                      | 636.75   | 648.11      | -14%                      | 7 616 267    | 6 480 187  | -1 126 108  | -14% |
|   |                | Car 1         | 17 449   | 17 449     | 0%                      | 372.96   | 241.68      | -35%                      | 6 588 311    | 4 217 644  | -2 391 267  | -35% |
|   |                | Car 2         | 30 435   | 30 435     | 0%                      | 217.43   | 141.75      | -35%                      | 6 617 570    | 4 374 140  | -2 243 438  | -35% |
|   |                | Car 3         | 54 271   | 54 271     | 0%                      | 78.48    | 76.27       | -3%                       | 4 254 938    | 4 139 376  | -115 562    | -3%  |
|   |                | Car 4         | 315 086  | 315 086    | 0%                      | 54.96    | 51.26       | -7%                       | 17 316 320   | 16 511 881 | -1 194 408  | -7%  |
|   |                | Car 5         | 180 240  | 180 240    | 0%                      | 19.17    | 51.26       | 161%                      | 3 485 382    | 9 239 815  | 5 754 433   | 161% |
|   | Car 6          | 114 791       | 114 791  | 0%         | 25.65                   | 51.26    | 102%        | 3 063 235                 | 5 884 372    | 2 824 145  | 102%        |      |
|   | Gasoline total | 724 571       | 724 571  | 0%         | 67.66                   | 60.88    | -10%        | 49 046 874                | 50 634 374   | 1 607 888  | 3%          |      |
|   | Diesel Oil     | pre-Cars      | 1 790    | 1 790      | 0%                      | 368.96   | 254.56      | -31%                      | 460 963      | 347 626    | -113 337    | -24% |
|   |                | Car 1         | 3 360    | 3 360      | 0%                      | 298.17   | 271.67      | -9%                       | 1 082 288    | 910 182    | -172 106    | -9%  |
|   |                | Car 2         | 13 788   | 13 788     | 0%                      | 407.17   | 222.43      | -45%                      | 5 614 130    | 3 066 393  | -2 547 736  | -45% |
|   |                | Car 3         | 52 128   | 52 128     | 0%                      | 808.95   | 179.65      | -78%                      | 31 696 478   | 9 364 788  | -22 331 690 | -70% |
|   |                | Car 4         | 187 047  | 187 047    | 0%                      | 418.16   | 158.34      | -61%                      | 64 733 485   | 24 983 323 | -39 750 162 | -61% |
|   |                | Car 5         | 283 480  | 283 480    | 0%                      | 423.99   | 158.34      | -63%                      | 120 187 695  | 44 873 190 | -75 314 505 | -63% |
| Car 6                                     | 184 768        | 184 768       | 0%       | 262.61     | 158.34                  | -40%     | 48 521 183  | 29 255 985                | -19 265 198  | -40%       |             |      |
| Diesel oil total                          | 686 582        | 686 582       | 0%       | 398.65     | 161.95                  | -59%     | 272 126 081 | 112 890 717               | -159 235 310 | -59%       |             |      |
| Pkcs Total                                | 1 421 162      | 1 421 162     | 0%       | 225.98     | 155.61                  | -30%     | 521 152 965 | 163 485 435               | -357 667 530 | -68%       |             |      |
| 1.A.3.b.i.<br>Light Duty Vehicles (LDVs)  | Gasoline       | pre-Cars      | 940      | 940        | 0%                      | 611.41   | 645.95      | -11%                      | 612 247      | 598 878    | -13 369     | -2%  |
|   |                | Car 1         | 124      | 124        | 0%                      | 908.23   | 312.78      | -66%                      | 112 083      | 39 682     | -72 401     | -66% |
|   |                | Car 2         | 485      | 485        | 0%                      | 302.12   | 221.62      | -27%                      | 140 344      | 102 950    | -37 394     | -27% |
|   |                | Car 3         | 596      | 596        | 0%                      | 118.57   | 115.36      | -3%                       | 65 955       | 68 812     | 2 857       | 4%   |
|   |                | Car 4         | 1 476    | 1 476      | 0%                      | 58.72    | 53.38       | -9%                       | 74 877       | 78 816     | 3 938       | 5%   |
|   |                | Car 5         | 1 680    | 1 680      | 0%                      | 21.73    | 53.38       | 146%                      | 35 240       | 89 034     | 53 794      | 146% |
|   | Car 6          | 910           | 910      | 0%         | 19.18                   | 53.38    | 181%        | 17 052                    | 49 080       | 31 928     | 181%        |      |
|   | Gasoline total | 6 186         | 6 186    | 0%         | 171.55                  | 167.18   | -2%         | 1 058 799                 | 1 034 211    | -24 588    | -2%         |      |
|   | Diesel Oil     | pre-Cars      | 2 087    | 2 087      | 0%                      | 413.41   | 386.79      | -7%                       | 860 499      | 831 183    | -29 316     | -3%  |
|   |                | Car 1         | 1 538    | 1 538      | 0%                      | 398.47   | 276.25      | -30%                      | 680 795      | 511 158    | -169 638    | -24% |
|   |                | Car 2         | 3 580    | 3 580      | 0%                      | 321.26   | 153.04      | -53%                      | 1 143 793    | 687 293    | -456 501    | -40% |
|   |                | Car 3         | 11 684   | 11 684     | 0%                      | 556.30   | 150.79      | -73%                      | 6 530 364    | 2 040 233  | -4 490 131  | -73% |
|   |                | Car 4         | 43 141   | 43 141     | 0%                      | 504.48   | 32.40       | -94%                      | 21 783 989   | 3 986 141  | -17 777 788 | -82% |
|   |                | Car 5         | 74 231   | 74 231     | 0%                      | 434.16   | 32.40       | -93%                      | 32 223 283   | 6 658 780  | -25 564 503 | -79% |
| Car 6                                     | 4 921          | 4 921         | 0%       | 113.49     | 32.40                   | -72%     | 755 285     | 454 676                   | -300 609     | -40%       |             |      |
| Diesel oil total                          | 148 068        | 148 068       | 0%       | 456.12     | 185.62                  | -59%     | 65 712 732  | 15 256 007                | -50 456 726  | -77%       |             |      |
| LDVs Total                                | 149 994        | 149 994       | 0%       | 445.21     | 188.29                  | -58%     | 66 781 025  | 16 229 684                | -50 551 348  | -76%       |             |      |
| 1.A.3.b.ii.<br>Heavy Duty Vehicles (HDVs) | Diesel Oil     | pre-Cars      | 891      | 891        | 0%                      | 1076.81  | 1919.23     | -43%                      | 964 197      | 988 234    | 24 037      | 2%   |
|   |                | Car I         | 583      | 583        | 0%                      | 731.36   | 732.67      | 0%                        | 433 675      | 446 236    | 12 568      | 3%   |
|   |                | Car II        | 4 375    | 4 375      | 0%                      | 788.25   | 645.03      | -18%                      | 3 440 614    | 2 822 621  | -617 993    | -18% |
|   |                | Car III       | 10 333   | 10 333     | 0%                      | 632.87   | 458.91      | -28%                      | 6 530 364    | 4 741 827  | -1 788 536  | -27% |
|   |                | Car IV        | 4 449    | 4 449      | 0%                      | 475.90   | 382.28      | -20%                      | 2 117 219    | 1 686 881  | -430 338    | -20% |
|   |                | Car V         | 34 380   | 34 380     | 0%                      | 366.36   | 185.22      | -49%                      | 8 935 974    | 4 517 517  | -4 418 457  | -49% |
|   |                | Car VI        | 9 126    | 9 126      | 0%                      | 62.79    | 185.22      | 196%                      | 573 066      | 1 680 431  | 1 107 365   | 196% |
|   |                | Buses Total   | 54 157   | 54 157     | 0%                      | 404.73   | 388.24      | -4%                       | 23 082 189   | 16 885 117 | -6 197 072  | -27% |
|   | Gasoline       | pre-Cars      | 3 933    | 3 933      | 0%                      | 1034.81  | 737.35      | -29%                      | 4 087 249    | 2 980 379  | -1 106 870  | -29% |
|   |                | Car I         | 1 555    | 1 555      | 0%                      | 748.16   | 587.92      | -21%                      | 1 163 482    | 789 813    | -373 669    | -32% |
|   |                | Car II        | 8 876    | 8 876      | 0%                      | 817.75   | 5           |                           |              |            |             |      |



| Adjustment details for 2018                       |            |                |           |            |        |                         |          |            |             |                           |              |            |            |
|---|------------|----------------|-----------|------------|--------|-------------------------|----------|------------|-------------|---------------------------|--------------|------------|------------|
| NFR Code  | Fuel       | Activity Data  |           |            |        | Implied Emission Factor |          |            |             | NO <sub>x</sub> Emissions |              |            |            |
|   |            | current        | adjusted  | difference | in [%] | current                 | adjusted | difference | in [%]      | current                   | adjusted     | adjustment | difference |
| 1.A.3.a.i - Passenger Cars                        | Gasoline   | pre-Cars       | 12,219    | 12,219     | 0%     | 637.58                  | 644.11   | -6%        | 7,780,965   | 6,648,721                 | -1,132,234   | -15%       |            |
|   |            | Car 1          | 14,362    | 14,362     | 0%     | 374.34                  | 341.68   | -8%        | 5,371,161   | 3,448,643                 | -1,922,518   | -36%       |            |
|   |            | Car 2          | 34,285    | 34,285     | 0%     | 221.97                  | 111.68   | -50%       | 5,360,977   | 2,688,163                 | -2,672,814   | -50%       |            |
|   |            | Car 3          | 43,642    | 43,642     | 0%     | 88.16                   | 76.96    | -13%       | 3,487,781   | 3,388,617                 | -99,164      | -3%        |            |
|   |            | Car 4          | 278,738   | 278,738    | 0%     | 55.98                   | 52.30    | -7%        | 15,683,488  | 14,576,755                | -1,106,733   | -7%        |            |
|   |            | Car 5          | 186,830   | 186,830    | 0%     | 19.35                   | 52.30    | -170%      | 3,228,282   | 8,725,688                 | 5,497,406    | 170%       |            |
|   | Diesel Oil | pre-Cars       | 159,041   | 159,041    | 0%     | 6.00                    | 52.30    | -89%       | 4,190,422   | 8,718,250                 | 4,527,828    | 89%        |            |
|   |            | Car 1          | 2,949     | 2,949      | 0%     | 303.16                  | 264.96   | -13%       | 171,670     | 245,173                   | 73,503       | 43%        |            |
|   |            | Car 2          | 10,784    | 10,784     | 0%     | 407.20                  | 222.67   | -45%       | 4,391,383   | 2,483,536                 | -1,907,848   | -45%       |            |
|   |            | Car 3          | 40,786    | 40,786     | 0%     | 812.49                  | 180.15   | -78%       | 24,932,029  | 7,333,241                 | -17,598,788  | -71%       |            |
|   |            | Car 4          | 130,534   | 130,534    | 0%     | 414.71                  | 180.40   | -56%       | 54,133,837  | 20,937,329                | -33,196,508  | -61%       |            |
|   |            | Car 5          | 251,212   | 251,212    | 0%     | 416.25                  | 180.40   | -56%       | 104,585,786 | 40,293,731                | -64,292,055  | -61%       |            |
|   | LNW Total  | 666,076        | 666,076   | 0%         | 254.87 | 180.43                  | -30%     | 58,284,140 | 35,680,446  | -22,603,700               | -39%         |            |            |
|   |            | Pre-Cars Total | 1,365,181 | 1,365,181  | 0%     | 214.34                  | 164.68   | -26%       | 262,589,060 | 156,545,471               | -106,043,589 | -40%       |            |
| 1.A.3.b.i - Light Duty Vehicles (LDV)             | Gasoline   | pre-Cars       | 911       | 911        | 0%     | 644.51                  | 645.95   | 1%         | 594,851     | 582,662                   | -12,189      | -2%        |            |
|   |            | Car 1          | 188       | 188        | 0%     | 911.58                  | 312.78   | -66%       | 98,528      | 33,895                    | -64,633      | -66%       |            |
|   |            | Car 2          | 377       | 377        | 0%     | 303.84                  | 224.45   | -26%       | 114,682     | 84,713                    | -29,969      | -26%       |            |
|   |            | Car 3          | 511       | 511        | 0%     | 111.92                  | 116.84   | 5%         | 57,282      | 60,739                    | 3,457        | 6%         |            |
|   |            | Car 4          | 1,275     | 1,275      | 0%     | 52.02                   | 54.36    | 4%         | 65,290      | 69,278                    | 3,988        | 6%         |            |
|   |            | Car 5          | 1,483     | 1,483      | 0%     | 23.70                   | 54.36    | 129%       | 35,160      | 80,626                    | 45,466       | 129%       |            |
|   | Diesel Oil | pre-Cars       | 1,643     | 1,643      | 0%     | 19.18                   | 54.36    | 182%       | 39,550      | 89,326                    | 49,776       | 182%       |            |
|   |            | Car 1          | 6,315     | 6,315      | 0%     | 154.22                  | 160.11   | 4%         | 999,199     | 1,011,138                 | 11,939       | 1%         |            |
|   |            | Car 2          | 1,872     | 1,872      | 0%     | 411.51                  | 386.79   | -6%        | 771,337     | 574,742                   | -196,595     | -26%       |            |
|   |            | Car 3          | 1,285     | 1,285      | 0%     | 389.94                  | 276.25   | -29%       | 483,129     | 272,296                   | -210,833     | -44%       |            |
|   |            | Car 4          | 2,942     | 2,942      | 0%     | 318.56                  | 193.88   | -39%       | 965,389     | 550,789                   | -414,600     | -43%       |            |
|   |            | Car 5          | 9,383     | 9,383      | 0%     | 598.10                  | 150.74   | -75%       | 5,689,152   | 1,411,299                 | -4,277,853   | -75%       |            |
|   | LNW Total  | 33,232         | 33,232    | 0%         | 508.42 | 93.81                   | -82%     | 15,929,185 | 3,117,457   | -12,811,728               | -80%         |            |            |
|   |            | Pre-Cars Total | 66,283    | 66,283     | 0%     | 432.92                  | 93.81    | -78%       | 28,684,080  | 6,217,860                 | -22,466,220  | -78%       |            |
| 1.A.3.b.ii - Heavy Duty Vehicle Buses             | Gasoline   | pre-Cars       | 39,482    | 39,482     | 0%     | 158.79                  | 93.81    | -41%       | 5,941,615   | 3,686,228                 | -2,255,387   | -38%       |            |
|   |            | Car 1          | 154,259   | 154,259    | 0%     | 384.71                  | 182.69   | -53%       | 59,344,525  | 15,880,316                | -43,464,210  | -73%       |            |
|   |            | Car 2          | 180,574   | 180,574    | 0%     | 375.86                  | 184.94   | -51%       | 69,343,125  | 16,851,449                | -52,491,676  | -73%       |            |
|   |            | Car 3          | 547       | 547        | 0%     | 1078.15                 | 1919.23  | 78%        | 589,267     | 557,147                   | -32,120      | -5%        |            |
|   |            | Car 4          | 237       | 237        | 0%     | 732.78                  | 732.57   | 0%         | 173,678     | 178,368                   | 4,690        | 3%         |            |
|   |            | Car 5          | 2,270     | 2,270      | 0%     | 787.83                  | 646.33   | -18%       | 1,780,686   | 1,487,437                 | -293,249     | -16%       |            |
|   | Diesel Oil | pre-Cars       | 6,757     | 6,757      | 0%     | 638.89                  | 459.32   | -29%       | 4,262,734   | 3,183,482                 | -1,079,252   | -25%       |            |
|   |            | Car 1          | 3,043     | 3,043      | 0%     | 473.16                  | 382.73   | -19%       | 1,439,790   | 1,073,333                 | -366,457     | -25%       |            |
|   |            | Car 2          | 18,189    | 18,189     | 0%     | 362.42                  | 186.37   | -49%       | 6,463,265   | 3,376,016                 | -3,087,249   | -48%       |            |
|   |            | Car 3          | 20,670    | 20,670     | 0%     | 64.89                   | 186.37   | 288%       | 1,176,026   | 3,682,314                 | 2,506,288    | 288%       |            |
|   |            | Car 4          | 91,634    | 91,634     | 0%     | 309.75                  | 283.53   | -8%        | 15,993,546  | 13,687,186                | -2,306,360   | -15%       |            |
|   |            | Car 5          | 3,262     | 3,262      | 0%     | 1034.82                 | 737.35   | -29%       | 3,375,359   | 2,485,071                 | -890,288     | -26%       |            |
|   | LNW Total  | 1,094          | 1,094     | 0%         | 747.82 | 468.39                  | -38%     | 918,052    | 512,378     | -405,674                  | -44%         |            |            |
|   |            | Pre-Cars Total | 5,544     | 5,544      | 0%     | 817.44                  | 581.68   | -29%       | 4,532,190   | 2,781,516                 | -1,750,674   | -39%       |            |
| 1.A.3.b.iii - Heavy Duty Vehicle Trucks & Lorries | Gasoline   | pre-Cars       | 20,583    | 20,583     | 0%     | 629.54                  | 563.68   | -11%       | 12,967,751  | 7,277,279                 | -5,690,472   | -44%       |            |
|   |            | Car 1          | 15,912    | 15,912     | 0%     | 358.89                  | 276.23   | -23%       | 6,334,421   | 4,386,424                 | -1,947,997   | -31%       |            |
|   |            | Car 2          | 154,983   | 154,983    | 0%     | 250.40                  | 154.68   | -38%       | 45,964,153  | 24,283,389                | -21,680,764  | -47%       |            |
|   |            | Car 3          | 381,799   | 381,799    | 0%     | 68.78                   | 154.68   | 125%       | 28,251,482  | 69,665,886                | 41,414,404   | 146%       |            |
|   |            | Car 4          | 585,186   | 585,186    | 0%     | 515.18                  | 172.19   | -67%       | 188,173,537 | 180,760,889               | -7,412,648   | -4%        |            |
|   |            | Car 5          | 4,940     | 4,940      | 0%     | 128.95                  | 188.61   | 46%        | 622,666     | 783,451                   | 160,785      | 26%        |            |
|   | Diesel Oil | pre-Cars       | 2,966     | 2,966      | 0%     | 128.14                  | 177.79   | 41%        | 374,114     | 527,294                   | 153,180      | 41%        |            |
|   |            | Car 1          | 3,221     | 3,221      | 0%     | 128.33                  | 188.64   | 46%        | 387,596     | 639,833                   | 252,237      | 65%        |            |
|   |            | Car 2          | 6,241     | 6,241      | 0%     | 48.24                   | 188.64   | 288%       | 21,126      | 1,239,686                 | 1,218,560    | 5784%      |            |
|   |            | Car 3          | 1,130     | 1,130      | 0%     | 58.41                   | 188.64   | 324%       | 23,966      | 224,682                   | 200,716      | 839%       |            |
|   |            | Car 4          | 0         | 0          | 0%     | 0.00                    | 188.64   | 0%         | 0           | 0                         | 0            | 0%         |            |
|   |            | Car 5          | 18,487    | 18,487     | 0%     | 85.66                   | 188.61   | 198%       | 1,658,568   | 3,434,767                 | 1,776,199    | 108%       |            |
|   | LNW Total  | 18,487         | 18,487    | 0%         | 85.66  | 188.61                  | 198%     | 1,658,568  | 3,434,767   | 1,776,199                 | 108%         |            |            |
|   |            | Pre-Cars Total | 2,180,983 | 2,180,983  | 0%     | 215.85                  | 133.49   | -38%       | 478,758,286 | 291,129,612               | -187,628,674 | -38%       |            |

| Adjustment details for 2019                      |                |                |           |            |                         |          |            |                           |             |              |              |      |
|--|----------------|----------------|-----------|------------|-------------------------|----------|------------|---------------------------|-------------|--------------|--------------|------|
| NFR Code   | Fuel           | Activity Data  |           |            | Implied Emission Factor |          |            | NO <sub>x</sub> Emissions |             |              |              |      |
|  |                | current        | adjusted  | difference | current                 | adjusted | difference | current                   | adjusted    | adjustment   | difference   |      |
|  |                | in [t]         | in [t]    | in [%]     | in [g/t]                | in [g/t] | in [%]     | in [kg]                   | in [kg]     | in [kg]      | in [%]       |      |
| 1.A.3.a.i - Passenger Cars                       | Gasoline       | pre-Cars       | 13,588    | 13,588     | 0%                      | 638.58   | 644.11     | -6%                       | 8,664,621   | 7,382,686    | -1,281,935   | -15% |
|  |                | Car 1          | 12,427    | 12,427     | 0%                      | 378.32   | 341.68     | -8%                       | 4,781,480   | 3,683,383    | -1,098,096   | -23% |
|  |                | Car 2          | 20,086    | 20,086     | 0%                      | 225.58   | 92.58      | -59%                      | 4,531,070   | 1,858,018    | -2,673,052   | -59% |
|  |                | Car 3          | 38,216    | 38,216     | 0%                      | 82.22    | 78.12      | -5%                       | 2,977,840   | 2,829,186    | -148,654     | -5%  |
|  |                | Car 4          | 295,220   | 295,220    | 0%                      | 57.04    | 53.29      | -7%                       | 14,588,285  | 13,589,621   | -998,664     | -7%  |
|  |                | Car 5          | 180,537   | 180,537    | 0%                      | 19.77    | 53.29      | -170%                     | 3,173,728   | 8,054,356    | 4,880,628    | 170% |
|  | Diesel Oil     | pre-Cars       | 285,636   | 285,636    | 0%                      | 25.63    | 53.29      | 180%                      | 5,295,099   | 11,010,782   | 5,715,683    | 180% |
|  |                | Car 1          | 184,081   | 184,081    | 0%                      | 62.36    | 68.45      | 10%                       | 43,981,941  | 48,238,025   | 4,256,084    | 10%  |
|  |                | Car 2          | 3,746     | 3,746      | 0%                      | 313.70   | 264.96     | -16%                      | 913,180     | 724,923      | -188,257     | -21% |
|  |                | Car 3          | 2,545     | 2,545      | 0%                      | 298.80   | 272.65     | -9%                       | 766,913     | 687,786      | -79,127      | -10% |
|  |                | Car 4          | 8,891     | 8,891      | 0%                      | 407.19   | 229.16     | -44%                      | 3,620,286   | 2,037,480    | -1,582,806   | -44% |
|  |                | Car 5          | 33,079    | 33,079     | 0%                      | 815.11   | 180.42     | -78%                      | 20,310,125  | 5,967,483    | -14,342,642  | -71% |
|  | LNW Total      | 111,335        | 111,335   | 0%         | 419.17                  | 182.44   | -56%       | 48,688,685                | 10,085,228  | -38,603,457  | -81%         |      |
|  |                | Pre-Cars Total | 231,784   | 231,784    | 0%                      | 419.37   | 182.44     | -56%                      | 95,117,643  | 37,650,997   | -57,466,646  | -60% |
| 1.A.3.b.i - Light Duty Vehicles (LDV)            | Gasoline       | pre-Cars       | 273,511   | 273,511    | 0%                      | 227.36   | 182.44     | -20%                      | 62,183,230  | 44,429,184   | -17,754,046  | -29% |
|  |                | Car 1          | 663,841   | 663,841    | 0%                      | 345.81   | 165.67     | -52%                      | 229,566,088 | 189,582,982  | -139,983,106 | -61% |
|  |                | Car 2          | 1,368,532 | 1,368,532  | 0%                      | 699.83   | 155.32     | -78%                      | 273,668,009 | 157,821,687  | -115,846,322 | -42% |
|  |                | Car 3          | 909       | 909        | 0%                      | 644.89   | 645.95     | 1%                        | 687,449     | 581,962      | -105,487     | -15% |
|  |                | Car 4          | 87        | 87         | 0%                      | 915.28   | 312.78     | -66%                      | 88,953      | 30,396       | -58,557      | -66% |
|  |                | Car 5          | 316       | 316        | 0%                      | 304.63   | 224.45     | -26%                      | 96,158      | 70,848       | -25,310      | -26% |
|  | Diesel Oil     | pre-Cars       | 447       | 447        | 0%                      | 112.68   | 121.47     | 8%                        | 59,355      | 54,283       | -5,072       | -8%  |
|  |                | Car 1          | 1,126     | 1,126      | 0%                      | 53.08    | 55.26      | 4%                        | 59,652      | 62,199       | 2,547        | 4%   |
|  |                | Car 2          | 1,361     | 1,361      | 0%                      | 25.34    | 55.26      | 190%                      | 34,240      | 74,680       | 40,440       | 180% |
|  |                | Car 3          | 2,420     | 2,420      | 0%                      | 18.75    | 55.26      | 180%                      | 45,383      | 133,753      | 88,370       | 180% |
|  |                | Car 4          | 6,483     | 6,483      | 0%                      | 146.88   | 153.25     | 5%                        | 974,299     | 1,044,150    | 69,851       | 7%   |
|  |                | Car 5          | 1,744     | 1,744      | 0%                      | 418.96   | 386.79     | -6%                       | 725,111     | 541,376      | -183,735     | -26% |
|  | LNW Total      | 1,079          | 1,079     | 0%         | 389.52                  | 276.25   | -29%       | 420,285                   | 232,256     | -188,029     | -45%         |      |
|  |                | Pre-Cars Total | 2,334     | 2,334      | 0%                      | 315.90   | 194.79     | -38%                      | 737,682     | 454,630      | -283,052     | -39% |
| 1.A.3.b.ii - Heavy Duty Vehicle Trucks & Lorries | Gasoline       | pre-Cars       | 7,649     | 7,649      | 0%                      | 601.11   | 150.79     | -75%                      | 4,587,943   |              |              |      |
|  |                | Car 1          | 2,714     | 2,714      | 0%                      | 512.28   | 94.57      | -82%                      | 14,788,306  | 2,714,154    | -11,993,154  | -79% |
|  |                | Car 2          | 58,714    | 58,714     | 0%                      | 434.30   | 94.57      | -78%                      | 25,499,580  | 5,632,428    | -19,867,152  | -79% |
|  |                | Car 3          | 69,931    | 69,931     | 0%                      | 148.18   | 94.57      | -36%                      | 3,614,586   | 5,672,892    | 2,058,306    | 57%  |
|  |                | Car 4          | 159,183   | 159,183    | 0%                      | 347.42   | 191.90     | -45%                      | 56,383,335  | 36,221,445   | -20,161,890  | -36% |
|  |                | Car 5          | 165,866   | 165,866    | 0%                      | 338.13   | 193.89     | -42%                      | 56,279,554  | 37,485,938   | -18,793,616  | -33% |
|  | Diesel Oil     | pre-Cars       | 489       | 489        | 0%                      | 1080.20  | 1019.23    | -6%                       | 585,887     | 476,258      | -109,629     | -19% |
|  |                | Car 1          | 147       | 147        | 0%                      | 738.37   | 732.57     | 2%                        | 188,212     | 170,593      | -17,619      | -9%  |
|  |                | Car 2          | 1,611     | 1,611      | 0%                      | 709.47   | 666.77     | -7%                       | 2,057,343   | 1,941,621    | -115,722     | -6%  |
|  |                | Car 3          | 5,789     | 5,789      | 0%                      | 824.86   | 439.85     | -47%                      | 7,066,381   | 2,422,179    | -4,644,202   | -66% |
|  |                | Car 4          | 2,717     | 2,717      | 0%                      | 473.93   | 352.84     | -26%                      | 1,382,061   | 960,413      | -421,648     | -31% |
|  |                | Car 5          | 17,130    | 17,130     | 0%                      | 362.91   | 186.64     | -49%                      | 6,212,175   | 3,180,781    | -3,031,394   | -49% |
|  | LNW Total      | 25,135         | 25,135    | 0%         | 60.43                   | 186.64   | 299%       | 1,518,961                 | 4,086,133   | 2,567,172    | 299%         |      |
|  |                | Pre-Cars Total | 52,939    | 52,939     | 0%                      | 274.41   | 247.85     | -16%                      | 14,547,072  | 15,158,078   | 1,408,434    | 10%  |
| Diesel Oil                                       | pre-Cars       | 3,140          | 3,140     | 0%         | 1034.96                 | 737.35   | -29%       | 3,260,020                 | 2,376,443   | -883,577     | -29%         |      |
|  | Car 1          | 969            | 969       | 0%         | 747.60                  | 488.34   | -35%       | 724,240                   | 453,754     | -270,486     | -37%         |      |
|  | Car 2          | 4,560          | 4,560     | 0%         | 817.42                  | 581.40   | -29%       | 3,734,343                 | 2,280,967   | -1,453,376   | -39%         |      |
|  | Car 3          | 16,377         | 16,377    | 0%         | 881.69                  | 581.40   | -34%       | 13,669,383                | 8,758,749   | -4,910,634   | -36%         |      |
|  | Car 4          | 13,137         | 13,137    | 0%         | 598.96                  | 279.43   | -53%       | 1,235,679                 | 5,089,330   | 1,646,349    | 133%         |      |
|  | Car 5          | 125,233        | 125,233   | 0%         | 26.13                   | 154.90   | -48%       | 36,960,599                | 59,481,429  | 22,520,830   | 61%          |      |
| LNW Total  | 432,488        | 432,488        | 0%        | 72.98      | 154.92                  | 110%     | 31,175,446 | 67,083,865                | 35,908,419  | 116%         |              |      |
|  | Pre-Cars Total | 595,913        | 595,913   | 0%         | 953.39                  | 189.17   | -80%       | 55,380,190                | 108,889,336 | 5,428,614    | 10%          |      |
| Diesel Oil                                       | pre-Cars       | 4,813          | 4,813     | 0%         | 125.89                  | 164.78   | 31%        | 664,997                   | 732,771     | 167,774      | 25%          |      |
|  | Car 1          | 2,035          | 2,035     | 0%         | 125.39                  | 177.29   | 41%        | 355,495                   | 582,589     | 147,113      | 41%          |      |
|  | Car 2          | 3,084          | 3,084     | 0%         | 119.33                  | 198.06   | 67%        | 303,224                   | 675,717     | 246,093      | 67%          |      |
|  | Car 3          | 6,082          | 6,082     | 0%         | 48.81                   | 188.06   | 287%       | 204,284                   | 1,161,817   | 957,533      | 463%         |      |
|  | Car 4          | 2,068          | 2,068     | 0%         | 21.69                   | 188.06   | 871%       | 23,489                    | 386,647     | 363,158      | 1554%        |      |
|  | Car 5          | 0              | 0         | 0%         | 0.00                    |          | 0%         | 0                         | 0           | 0            | 0%           |      |
| LNW Total  | 18,160         | 18,160         | 0%        | 86.05      | 186.83                  | 115%     | 1,633,650  | 3,582,941                 | 1,889,491   | 115%         |              |      |
|  | Pre-Cars Total | 2,262,080      | 2,262,080 | 0%         | 198.58                  | 132.83   | -33%       | 437,206,744               | 292,497,497 | -144,709,248 | -33%         |      |

|                                   | 2010   | 2011   | 2012   | 2013   | 2014   | 2015   | 2016   | 2017   | 2018   | 2019 |
|-----------------------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|------|
| Adjustment 2014 (accepted)        | -105.6 | -101.3 | -95.7  | -91.7  |        |        |        |        |        |      |
| Adjustment 2015 (accepted)        | -100.3 | -95.5  | -89.9  | -85.1  |        |        |        |        |        |      |
| Adjustment 2016 (accepted)        | -151.3 | -146.9 | -145.1 | -142.5 | -128.1 |        |        |        |        |      |
| Adjustment 2017 (accepted)        | -151.3 | -146.8 | -145.0 | -142.4 | -127.2 | -100.9 |        |        |        |      |
| Adjustment 2018 (accepted)        | -172.3 | -174.5 | -177.4 | -180.4 | -171.5 | -148.9 | -123.2 |        |        |      |
| Adjustment 2019 (accepted)        | -172.3 | -174.5 | -177.4 | -180.3 | -171.4 | -148.8 | -123.3 | 93.7   |        |      |
| Adjustment 2020 (accepted)        | -297.8 | -302.3 | -301.3 | -306.1 | -294.5 | -269.0 | -244.3 | -214.9 | -174.6 |      |
| <b>Adjustment 2021 (proposal)</b> |        |        |        |        |        |        |        |        |        |      |
| Change against Adjustment 2020    |        |        |        |        |        |        |        |        |        |      |

The noticeable differences between the 2017 and 2018 adjustment proposals resulted from an ad-hoc revision of the *Handbook Emission Factors for Road Transport* (HBEFA, version 3.3) in the aftermath of the so-called "Diesel-gate".<sup>8)</sup>

The even bigger changes between adjustment 2019 and adjustment proposal 2020 result from an additional rather fundamental revision of the *Handbook Emission Factors for Road Transport* now available in version 4.1 ><sup>9)</sup> strongly effecting the TREMOD model underlying Germany's emission reporting for road transport and hence any adjustments of NO<sub>x</sub>, emissions.

**With such major model revision between submissions 2019 and 2020, the current adjustment proposal differs significantly from the adjustment applied for and accepted in 2019.**

#### **Adjustment description as provided in IIRs 2014 and 2015:**

[image Description%20Adjustment%20DE-A%20-%20NOx%20from%201.A.3.b%20Road%20transport%20-%20IIRs%202014%20%26%202015.pdf](#)

**bibliography** : 1 : EB, 2012a: CLRTAP EB Decision 2012/3, ECE/EB.AIR/111/Add.1: Adjustments under the Gothenburg Protocol to emission reduction commitments or to inventories for the purposes of comparing total national emissions with them URL: [http://www.unece.org/fileadmin/DAM/env/documents/2013/air/ECE\\_EB.AIR\\_111\\_Add.1\\_ENG\\_DECISION\\_3.pdf](http://www.unece.org/fileadmin/DAM/env/documents/2013/air/ECE_EB.AIR_111_Add.1_ENG_DECISION_3.pdf) : 2 : EB, 2012b: CLRTAP EB Decision 2012/4: Provisional Application of Amendment to the Protocol to Abate Acidification, Eutrophication and Ground-level Ozone URL: [http://www.unece.org/fileadmin/DAM/env/documents/2013/air/ECE\\_EB.AIR\\_111\\_Add.1\\_ENG\\_DECISION\\_4.pdf](http://www.unece.org/fileadmin/DAM/env/documents/2013/air/ECE_EB.AIR_111_Add.1_ENG_DECISION_4.pdf) : 3 : EB, 2012c: CLRTAP EB Decision 2012/12: Guidance for adjustments under the 1999 Protocol to Abate Acidification, Eutrophication and Ground-level Ozone to emission reduction commitments or to inventories for the purposes of comparing total national emissions with them URL: [http://www.unece.org/fileadmin/DAM/env/documents/2012/EB/Decision\\_2012\\_12.pdf](http://www.unece.org/fileadmin/DAM/env/documents/2012/EB/Decision_2012_12.pdf) : 4 : IIASA, 1999: Amann, M.; Bertok, I.; Cofala, J.; Gyarfas, F.; Heyes, Chr.; Klimont, Zb.; Syri, S.; Schöpp, W.: Further analysis of scenario results obtained with the RAINS model - Interim Report to the Ministère de L'Aménagement du Territoire et de l'Environnement Direction de la Prévention des Pollutions et des Risques 20, avenue de Ségur 75302 Paris 07 SP, April 1999 - URL: <https://iiasa.ac.at/web/home/research/researchPrograms/air/policy/france3b.pdf> : 5 : ifeu, 2002: Final report to UFOPLAN study FKZ 201 45 112 (German version only): Aktualisierung des Daten- und Rechenmodells: Energieverbrauch und Schadstoffemissionen des motorisierten Verkehrs in Deutschland 1980-2020; Im Auftrag des Umweltbundesamtes; ifeu Institut für Energie- und Umweltforschung Heidelberg GmbH (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, Heidelberg, 31. Oktober 2002 : 6 : 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, 2019. : 7 : UBA, 2018: CLRTAP submission 2018, Dessau, 2018 : 8 : ECE/EB.AIR/113/Add.1, 2012: Report of the Executive Body on its thirty-first session, Decision 2012/12 on Guidance for adjustments under the 1999 Protocol to Abate Acidification, Eutrophication and Ground-level Ozone to emission reduction commitments or to inventories for the purposes of comparing total national emissions with them; URL: [http://www.unece.org/fileadmin/DAM/env/documents/2012/EB/ECE\\_EB.AIR\\_113\\_Add.1\\_ENG\\_1\\_.pdf](http://www.unece.org/fileadmin/DAM/env/documents/2012/EB/ECE_EB.AIR_113_Add.1_ENG_1_.pdf) : 9 : CEIP, 2014a: Centre on Emission Inventories and Projections (CEIP): CEIP/Adjustment RR/2014/GERMANY: Review of the 2014 Adjustment Application by Germany, URL: [https://webdab01.umweltbundesamt.at/download/adjustments2014/Adjustment\\_Review\\_Report\\_GERMANY\\_2014.pdf?cgiproxy\\_skip=1](https://webdab01.umweltbundesamt.at/download/adjustments2014/Adjustment_Review_Report_GERMANY_2014.pdf?cgiproxy_skip=1), 5 August 2014 : 10 : CEIP, 2014b: Centre on Emission Inventories and Projections (CEIP): ECE/EB.AIR/GE.1/2014/10: Review of adjustment applications 2014; URL: [http://www.ceip.at/fileadmin/inhalte/emep/pdf/2015/ece.eb.air.ge.1.2014.10.edited.ae\\_formatting\\_accepted.ko.pdf](http://www.ceip.at/fileadmin/inhalte/emep/pdf/2015/ece.eb.air.ge.1.2014.10.edited.ae_formatting_accepted.ko.pdf), 5 August 2014 : 11 : CEIP, 2015a: Centre on Emission Inventories and Projections (CEIP): CEIP/Adjustment RR/2015/Germany: Review of the 2015 Adjustment Application by Germany, URL:

[https://webdab01.umweltbundesamt.at/download/adjustments2015/Germany2015-adj.pdf?cgiproxy\\_skip=1](https://webdab01.umweltbundesamt.at/download/adjustments2015/Germany2015-adj.pdf?cgiproxy_skip=1), September 2015 : 12 : CEIP, 2015b: Centre on Emission Inventories and Projections (CEIP): CE/EB.AIR/GE.1/2015/10–ECE/EB.AIR/WG.1/2015/13: Review of adjustment applications 2015; URL: [http://www.ceip.at/fileadmin/inhalte/emep/Adjustments/ece.eb.air.ge.1.2015.10\\_ece.eb.air.wg.1.2015.13.AV.pdf](http://www.ceip.at/fileadmin/inhalte/emep/Adjustments/ece.eb.air.ge.1.2015.10_ece.eb.air.wg.1.2015.13.AV.pdf), 6 July 2015 : 13 : CEIP, 2016a: Centre on Emission Inventories and Projections (CEIP): Review of the 2016 Adjustment Application by Germany, URL: [https://webdab01.umweltbundesamt.at/download/adjustments2016/Germany2016-adj.pdf?cgiproxy\\_skip=1](https://webdab01.umweltbundesamt.at/download/adjustments2016/Germany2016-adj.pdf?cgiproxy_skip=1), 2016 : 14 : CEIP, 2016b: Centre on Emission Inventories and Projections (CEIP): ECE/EB.AIR/GE.1/2016/10–ECE/EB.AIR/WG.1/2016/18: Review of adjustment applications 2016; URL: [http://www.ceip.at/fileadmin/inhalte/emep/pdf/2016/ECE\\_EB.AIR\\_GE.1\\_2016\\_10\\_E.pdf](http://www.ceip.at/fileadmin/inhalte/emep/pdf/2016/ECE_EB.AIR_GE.1_2016_10_E.pdf), 2016 : 15 : CEIP, 2017a: Centre on Emission Inventories and Projections (CEIP): ECE/EB.AIR/GE.1/2017/10–ECE/EB.AIR/WG.1/2017/20: Review of adjustment applications 2017; URL: [http://www.ceip.at/fileadmin/inhalte/emep/pdf/2017/Advance\\_ece\\_eb\\_air\\_ge\\_1\\_2017\\_10\\_ece\\_eb\\_air\\_wg\\_1\\_2017.pdf](http://www.ceip.at/fileadmin/inhalte/emep/pdf/2017/Advance_ece_eb_air_ge_1_2017_10_ece_eb_air_wg_1_2017.pdf), 2017 : 16 : CEIP, 2018a: Centre on Emission Inventories and Projections (CEIP): ECE/EB.AIR/GE.1/2018/10–ECE/EB.AIR/WG.1/2018/21: Review of adjustment applications 2018; URL: [https://www.ceip.at/fileadmin/inhalte/emep/pdf/2018/ADJ\\_ece.eb.air.ge.1.2018.10-ece.eb.air.wg.1.2018.21\\_advance.pdf](https://www.ceip.at/fileadmin/inhalte/emep/pdf/2018/ADJ_ece.eb.air.ge.1.2018.10-ece.eb.air.wg.1.2018.21_advance.pdf), 2018 : 17 : CEIP, 2019a: Centre on Emission Inventories and Projections (CEIP): ECE/EB.AIR/GE.1/2019/10–ECE/EB.AIR/WG.1/2019/22: Review of adjustment applications 2019; URL: [https://www.ceip.at/fileadmin/inhalte/emep/pdf/2019/ECE\\_EB.AIR\\_GE.1\\_2019\\_10-1909789E.pdf](https://www.ceip.at/fileadmin/inhalte/emep/pdf/2019/ECE_EB.AIR_GE.1_2019_10-1909789E.pdf), 2019 : 18 : Keller et al. (2017): Keller, M., Hausberger, S., Matzer, C., Wüthrich, P., & Notter, B.: Handbook Emission Factors for Road Transport, version 3.3 (Handbuch Emissionsfaktoren des Straßenverkehrs 3.3) URL: [https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&cad=rja&uact=8&ved=2ahUKEwj0y67pi5foAhWB16QKHfpYDIgQFjAAegQIAhAB&url=https%3A%2F%2Fwww.hbefa.net%2Fd%2Fdocuments%2FHBEFA33\\_Hintergrundbericht.pdf&usq=AOvVaw2sOF884KtccVyWLItdt1CIZ](https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&cad=rja&uact=8&ved=2ahUKEwj0y67pi5foAhWB16QKHfpYDIgQFjAAegQIAhAB&url=https%3A%2F%2Fwww.hbefa.net%2Fd%2Fdocuments%2FHBEFA33_Hintergrundbericht.pdf&usq=AOvVaw2sOF884KtccVyWLItdt1CIZ) - Dokumentation, Bern, 2017. : 19 : Notter et al. (2019): Keller, M., Althaus, H.-J., Cox, B., Knörr, W., Heidt, Ch., Biemann, K., Räder, D.: Handbook Emission Factors for Road Transport, version 4.1 (Handbuch Emissionsfaktoren des Straßenverkehrs 4.1), HBEFA 4.1 Development Report; URL: [https://www.hbefa.net/e/documents/HBEFA41\\_Development\\_Report.pdf](https://www.hbefa.net/e/documents/HBEFA41_Development_Report.pdf), Bern, Heidelberg, 21. August 2019. [bibliography](#)

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<sup>1)</sup> (bibcite 4)

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

<sup>3)</sup> (bibcite 3)

<sup>4)</sup> (bibcite 2)

<sup>5)</sup> (bibcite 4)

<sup>6)</sup> (bibcite 5)

<sup>7)</sup> (bibcite 6)

<sup>8)</sup> (bibcite 18)

<sup>9)</sup> (bibcite 19)