

# 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> “artificial” current emissions = virtual current emissions assuming no changes in emission factors 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



$$\begin{aligned} EM_{\text{adjustment}} &= AD_{\text{current}} * EF_{\text{current}} - AD_{\text{current}} * EF_{\text{original}} = AD_{\text{current}} * (EF_{\text{current}} - EF_{\text{original}}) = \\ &EM_{\text{current}} - EM_{\text{current "artificial"}} \end{aligned}$$

with

- **EM „adjustment,,** = amount of emissions to be subtracted from National Totals
- **AD „current,,** = AD from latest TREMOD version as used for current submission
- **EF „current,,** = EF from latest TREMOD version as used for current submission
- **EF „original,,** = EF from TREMOD version used at the time NEC ceilings were set (here: TREMOD 3.1)
- **EM „current,,** = EM estimated from AD and EF from latest TREMOD version = EM reported for NFR 1.A.3.b with latest submission
- **EM „current-“artificial”,,** = 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 TREMOD, 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 (2021).

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 6.12 (Knörr et al., 2021a) <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	2019
<b>proposed adjustment</b>	<b>-296.1</b>	<b>-300.7</b>	<b>-300.4</b>	<b>-305.2</b>	<b>-294.9</b>	<b>-274.9</b>	<b>-250.9</b>	<b>-221.1</b>	<b>-179.6</b>	<b>-144.8</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

NFR 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 [TJ]	in [%]	in [kg/TJ]	in [kg/TJ]	in [%]	in [kg]	in [kg]	in [kg]	in [%]
1.A.3.b.i	gasoline		795.957	795.957	0%	97.55	84.99	-13%	77.644.842	67.690.906	9.953.935	-13%
1.A.3.b.i	diesel oil		629.380	629.380	0%	429.45	160.51	-63%	227.341.096	84.970.461	142.370.635	-63%
1.A.3.b.ii	gasoline		6.325	6.325	0%	255.87	214.75	-16%	1.618.432	1.358.328	260.104	-16%
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	-72%
1.A.3.b.iii	gasoline		48.844	48.844	0%	823.00	482.55	-42%	29.931.266	23.183.732	6.747.534	-23%
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	-39%
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	-48%
1.A.3.b TOTAL		2010	2.079.608	2.079.608	0%			0%	645.965.162	349.851.206	296.113.956	-46%
1.A.3.b.i	gasoline		794.688	794.688	0%	92.09	81.61	-11%	73.185.851	64.851.951	8.333.900	-11%
1.A.3.b.i	diesel oil		553.564	553.564	0%	434.12	159.22	-63%	240.313.791	88.138.959	152.174.832	-63%
1.A.3.b.ii	gasoline		6.118	6.118	0%	229.35	198.57	-13%	1.403.081	1.214.776	188.305	-13%
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	-74%
1.A.3.b.iii	gasoline		47.355	47.355	0%	592.65	448.99	-24%	28.071.221	21.268.323	6.804.898	-24%
1.A.3.b.iii	diesel oil		563.891	563.891	0%	410.38	244.97	-40%	231.410.271	138.135.342	93.273.929	-40%
1.A.3.b.iv	gasoline		19.289	19.289	0%	110.79	171.60	54%	2.137.002	3.299.162	-1.162.160	-54%
1.A.3.b TOTAL		2011	2.106.883	2.106.883	0%			0%	632.365.736	331.625.655	300.740.081	-48%
1.A.3.b.i	gasoline		750.957	750.957	0%	85.73	78.00	-9%	64.379.994	58.677.229	5.802.765	-9%
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	-64%
1.A.3.b.ii	gasoline		5.657	5.657	0%	218.93	193.15	-12%	1.238.520	1.092.662	145.859	-12%
1.A.3.b.ii	diesel oil		114.350	114.350	0%	481.91	128.17	-75%	55.106.362	13.741.354	41.365.008	-75%
1.A.3.b.iii	gasoline		50.902	50.902	0%	533.22	384.33	-28%	27.141.913	19.563.200	7.578.704	-28%
1.A.3.b.iii	diesel oil		589.585	589.585	0%	381.33	224.00	-41%	234.829.180	132.064.753	92.764.428	-41%
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	-61%
1.A.3.b TOTAL		2012	2.084.964	2.084.964	0%			0%	616.721.438	316.391.343	300.420.094	-49%
1.A.3.b.i	gasoline		749.114	749.114	0%	89.35	74.85	-7%	60.190.007	56.071.797	4.118.211	-7%
1.A.3.b.i	diesel oil		589.131	589.131	0%	437.14	158.71	-64%	257.633.728	93.499.010	164.134.718	-64%
1.A.3.b.ii	gasoline		5.578	5.578	0%	202.80	184.07	-9%	1.131.209	1.026.727	104.482	-9%
1.A.3.b.ii	diesel oil		118.777	118.777	0%	480.60	114.93	-76%	57.083.533	13.690.488	43.433.045	-76%
1.A.3.b.iii	gasoline		51.716	51.716	0%	509.64	360.06	-29%	26.350.969	18.620.843	7.730.126	-29%
1.A.3.b.iii	diesel oil		600.139	600.139	0%	353.06	287.93	-19%	211.887.531	124.788.469	87.099.062	-41%
1.A.3.b.iv	gasoline		18.229	18.229	0%	104.34	175.30	68%	1.902.688	3.197.038	-1.294.351	-68%
1.A.3.b TOTAL		2013	2.132.683	2.132.683	0%			0%	616.079.063	316.854.371	300.224.692	-50%
1.A.3.b.i	gasoline		752.526	752.526	0%	76.03	73.09	-4%	57.215.533	54.988.921	2.216.612	-4%
1.A.3.b.i	diesel oil		626.845	626.845	0%	435.87	159.12	-63%	272.876.061	95.613.892	173.262.169	-63%
1.A.3.b.ii	gasoline		5.845	5.845	0%	190.34	176.49	-7%	1.112.584	1.031.612	80.972	-7%
1.A.3.b.ii	diesel oil		128.578	128.578	0%	475.56	110.96	-77%	61.546.575	14.267.237	46.879.338	-77%
1.A.3.b.iii	gasoline		49.143	49.143	0%	468.37	339.99	-27%	23.017.115	16.708.234	6.308.881	-27%
1.A.3.b.iii	diesel oil		572.754	572.754	0%	314.05	196.05	-38%	179.874.133	112.285.582	67.588.551	-38%
1.A.3.b.iv	gasoline		18.673	18.673	0%	100.59	179.24	78%	1.878.294	3.345.794	-1.467.499	-78%
1.A.3.b TOTAL		2014	2.153.563	2.153.563	0%			0%	597.120.297	302.252.271	294.868.025	-49%
1.A.3.b.i	gasoline		715.156	715.156	0%	74.30	71.73	-4%	53.190.787	51.300.983	1.889.805	-4%
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	-63%
1.A.3.b.ii	gasoline		5.793	5.793	0%	187.12	172.80	-8%	1.083.927	1.000.999	82.928	-8%
1.A.3.b.ii	diesel oil		135.386	135.386	0%	489.35	187.96	-77%	63.605.443	14.607.490	48.997.953	-77%
1.A.3.b.iii	gasoline		52.287	52.287	0%	458.96	327.99	-29%	23.997.817	17.149.448	6.848.370	-29%
1.A.3.b.iii	diesel oil		589.411	589.411	0%	266.69	187.51	-30%	157.189.675	110.620.703	46.568.973	-30%
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	-82%
1.A.3.b TOTAL		2015	2.161.976	2.161.976	0%			0%	575.931.265	301.877.596	274.053.670	-48%
1.A.3.b.i	gasoline		715.272	715.272	0%	79.93	76.65	-4%	50.736.367	50.535.049	201.318	0%
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	-61%
1.A.3.b.ii	gasoline		5.926	5.926	0%	180.27	171.05	-5%	1.068.292	1.013.678	54.614	-5%
1.A.3.b.ii	diesel oil		144.068	144.068	0%	456.12	185.62	-77%	65.712.732	15.216.007	50.496.725	-77%
1.A.3.b.iii	gasoline		54.157	54.157	0%	424.73	388.24	-7%	23.002.109	16.833.117	6.168.992	-27%
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	-20%
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	-89%
1.A.3.b TOTAL		2016	2.207.339	2.207.339	0%			0%	553.790.558	302.901.820	250.897.738	-45%
1.A.3.b.i	gasoline		724.571	724.571	0%	67.66	69.88	3%	49.026.074	50.634.714	-1.607.640	-3%
1.A.3.b.i	diesel oil		696.592	696.592	0%	390.65	161.95	-59%	272.126.091	112.810.721	159.315.370	-59%
1.A.3.b.ii	gasoline		6.186	6.186	0%	171.15	167.18	-2%	1.058.799	1.034.211	24.588	-2%
1.A.3.b.ii	diesel oil		153.284	153.284	0%	424.66	183.89	-76%	65.093.930	15.925.216	49.168.714	-76%
1.A.3.b.iii	gasoline		53.382	53.382	0%	370.80	286.71	-23%	19.793.901	15.304.828	4.489.073	-23%
1.A.3.b.iii	diesel oil		596.263	596.263	0%	195.02	175.92	-10%	116.671.141	106.246.508	11.424.633	-10%
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	-98%
1.A.3.b TOTAL		2017	2.251.437	2.251.437	0%			0%	525.549.410	304.469.986	221.079.424	-42%
1.A.3.b.i	gasoline		699.027	699.027	0%	64.42	68.36	6%	45.032.996	47.786.817	-2.753.820	-6%
1.A.3.b.i	diesel oil		666.074	666.074	0%	371.66	163.30	-56%	247.556.063	108.768.604	138.787.459	-56%
1.A.3.b.ii	gasoline		6.315	6.315	0%	158.22	160.11	1%	999.199	1.011.138	-11.939	-1%
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	-73%
1.A.3.b.iii	gasoline		51.634	51.634	0%	309.75	263.53	-15%	15.993.526	13.607.106	2.386.420	-15%
1.A.3.b.iii	diesel oil		585.186	585.186	0%	171.18	172.10	1%	180.173.337	180.710.869	-537.532	-1%
1.A.3.b.iv	gasoline		18.497	18.497	0%	89.66	184.61	106%	1.658.588	3.414.767	-1.756.209	-106%
1.A.3.b TOTAL		2018	2.180.993	2.180.993	0%			0%	478.758.206	291.139.612	179.618.593	-38%
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	-10%
1.A.3.b.i	diesel oil		663.841	663.841	0%	345.81	165.07	-52%	229.566.088	109.582.982	119.983.106	-52%
1.A.3.b.ii	gasoline		6.683	6.683	0%	146.08	153.25	5%	976.219	1.034.150	-57.931	-5%
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	-71%
1.A.3.b.iii	gasoline		52.939	52.939	0%	274.41	247.81	-10%	14.527.012	13.118.578	1.408.434	-10%
1.A.3.b.iii	diesel oil		595.913	595.913	0%	153.35	169.17	10%	91.380.760	106.809.376	-15.428.616	-10%
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	-117%
1.A.3.b TOTAL		2019	2.202.880	2.202.880	0%			0%	437.268.744	292.497.497	144.771.248	-33%

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	-10%	25.915.925	10.189.262	-7.716.663	-30%
		Car 2	96.425	96.425	0%	172.95	135.63	-22%	16.580.020	13.020.026	-3.589.995	-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	-37.859	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%	592.55	514.25	-13%	77.646.042	67.650.586	-9.995.456	-13%
	Diesel Oil	pre-Cars	10.339	10.339	0%	318.13	264.95	-15%	383.760	327.256	-56.504	-15%
		Car 1	10.339	10.339	0%	294.42	245.17	-17%	3.064.428	2.741.387	-325.121	-17%
		Car 2	50.088	50.088	0%	406.90	279.19	-40%	29.372.795	10.974.210	-9.398.584	-40%
		Car 3	134.025	134.025	0%	542.54	170.54	-69%	72.645.173	23.929.276	-48.716.957	-67%
		Car 4	279.154	279.154	0%	304.37	140.58	-53%	107.299.180	39.243.811	-68.055.349	-63%
		Car 5	53.547	53.547	0%	434.70	140.58	-68%	23.276.735	7.527.796	-15.749.029	-68%
		Car 6	334	334	0%	257.62	140.58	-45%	85.044	46.553	-38.491	-45%
		Diesel oil total	529.380	529.380	0%	429.45	140.55	-67%	227.347.096	84.970.461	-142.376.635	-63%
		Pkx Total	1,325,337	1,325,337	0%	238.12	155.14	-36%	364.985,938	152,421,367	-152,564,570	-42%
1.A.3.b.i. Light Duty Vehicles (LDVs)	Gasoline	pre-Cars	1,249	1,249	0%	627.99	545.95	-12%	783.320	686.871	-96.449	-12%
		Car 1	367	367	0%	361.95	297.39	-16%	368.969	186.620	-208.358	-56%
		Car 2	1,393	1,393	0%	264.75	184.41	-30%	368.840	256.917	-111.931	-30%
		Car 3	856	856	0%	82.47	30.83	-63%	70.631	77.625	6.994	10%
		Car 4	2,420	2,420	0%	36.32	44.90	24%	87.987	188.679	28.772	34%
		Car 5	49	49	0%	15.34	44.90	193%	750	2,218	1,468	193%
		Car 6	0	0	0%	0	0	0%	0	0	0	0%
		Gasoline total	6,345	6,345	0%	255.87	254.75	-1%	1,478.832	1,358,328	-120,504	-8%
	Diesel Oil	pre-Cars	4,876	4,876	0%	425.99	386.79	-9%	2,077.142	1,436.983	-640.239	-30%
		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	153.18	-54%	4,420.280	2,534.731	-1,885.629	-43%
		Car 3	33,249	33,249	0%	531.91	150.58	-72%	17,655.883	5,085.760	-12,569.123	-72%
		Car 4	54,581	54,581	0%	491.42	80.69	-84%	26,021.036	4,040.722	-21,980.314	-84%
		Car 5	1,629	1,629	0%	427.50	80.69	-81%	696.286	144.434	-551.772	-79%
		Car 6	0	0	0%	10,173	80.69	-92%	7	4	-3	-43%
		Diesel oil total	113,450	113,450	0%	476.34	134.94	-72%	54,043,533	15,351,584	-38,691,949	-72%
		LDVs Total	179,775	179,775	0%	464.70	139.18	-70%	55,658,966	16,689,913	-38,969,053	-70%
1.A.3.b.ii. Heavy Duty Vehicles (HDVs)	Gasoline	pre-Cars	3,382	3,382	0%	1096.25	1028.78	-6%	3,674.087	3,432.644	-221.423	-6%
		Car 1	2,826	2,826	0%	749.41	732.14	-2%	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	-30%	10,865.776	7,289.299	-2,797.567	-26%
		Car 4	5,461	5,461	0%	448.63	351.65	-22%	2,650.016	1,921.527	-628.489	-23%
		Car 5	10,326	10,326	0%	337.28	182.33	-46%	3,882.417	1,882.644	-1,999.773	-51%
		Car 6	0	0	0%	0	0	0%	0	0	0	0%
		Buses Total	48,044	48,044	0%	623.80	482.55	-23%	29,931,286	23,183,732	-6,747,554	-23%
	Diesel Oil	pre-Cars	10,185	10,185	0%	1040.16	787.37	-24%	10,510.623	7,754.138	-2,756.485	-26%
		Car 1	5,677	5,677	0%	758.59	575.55	-24%	4,261.383	3,287.681	-973.702	-23%
		Car 2	38,558	38,558	0%	817.62	524.79	-35%	31,525.526	20,234.619	-11,290.907	-36%
		Car 3	169,023	169,023	0%	636.28	374.48	-41%	161,136.182	99,617.271	-61,518.911	-38%
		Car 4	69,636	69,636	0%	368.34	280.62	-24%	27,183.867	20,146.636	-7,037.231	-26%
		Car 5	283,934	283,934	0%	276.42	151.65	-45%	78,643.643	43,115.897	-35,527.746	-45%
		Car 6	0	0	0%	0	0	0%	0	0	0	0%
		Trucks Total	566,741	566,741	0%	446.67	271.83	-39%	293,148,243	154,696,160	-138,452,083	-47%
1.A.3.b.iii. Motorised Two-Wheelers (MTWs)	Gasoline	pre-Cars	7,973	7,973	0%	122.80	149.18	22%	372.721	1,189.393	216.502	58%
		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	184.21	31%	585.362	686.681	101.319	17%
		Car 3	2,950	2,950	0%	38.11	184.21	381%	116.180	657.032	452.834	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%
		MTWs Total	19,712	19,712	0%	113.68	148.43	30%	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	148.23	-32%	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 [kg]		
1.A.3.a.i. Passenger Cars	Gasoline	pre-Cars	13.063	13.063	0%	592.96	534.68	-9%	7.720.235	6.979.435	-748.801	-9%	
		Car 1	61.979	61.979	0%	347.86	340.16	-2%	21.560.430	18.884.961	-6.475.479	-31%	
		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%	25.00	43.68	60%	17	20	3	18%	
		Gasoline total	794.688	794.688	0%	52.69	51.65	-2%	73.185.851	64.851.551	-8.333.900	-11%	
	Diesel Oil	pre-Cars	1.711	1.711	0%	318.90	264.95	-15%	212.023	183.197	-28.826	-15%	
		Car 1	8.426	8.426	0%	297.32	245.85	-17%	2.585.115	2.239.987	-345.119	-17%	
		Car 2	42.514	42.514	0%	407.93	279.27	-40%	17.384.549	9.321.916	-7.962.634	-46%	
		Car 3	121.429	121.429	0%	555.36	170.55	-69%	67.437.053	21.681.386	-45.755.667	-68%	
		Car 4	264.943	264.943	0%	388.88	143.48	-63%	162.817.881	30.889.755	-131.928.126	-80%	
		Car 5	113.047	113.047	0%	435.12	143.48	-67%	49.536.960	16.332.974	-33.203.984	-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%	313.499.642	152.990.510	-160.509.132	-51%	
1.A.3.b.i. Heavy Duty Vehicles (HDVs)	Gasoline	pre-Cars	1.084	1.084	0%	629.25	545.95	-12%	1.682.014	1.390.373	-291.641	-17%	
		Car 1	283	283	0%	819.74	584.47	-29%	243.289	86.158	-157.132	-65%	
		Car 2	1.184	1.184	0%	268.66	191.68	-29%	310.529	223.189	-87.340	-28%	
		Car 3	783	783	0%	85.97	35.39	-59%	67.320	74.782	7.381	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	2	203%	
		Gasoline total	6.118	6.118	0%	229.35	186.57	-18%	1.483.081	1.254.776	-228.305	-15%	
	Diesel Oil	pre-Cars	3.995	3.995	0%	425.99	386.79	-9%	1.689.280	1.225.682	-463.598	-28%	
		Car 1	4.787	4.787	0%	399.71	276.24	-30%	1.984.260	1.030.426	-953.835	-48%	
		Car 2	10.816	10.816	0%	336.90	153.29	-54%	3.644.582	2.091.063	-1.553.519	-43%	
		Car 3	28.876	28.876	0%	541.53	150.54	-72%	15.037.249	4.348.078	-10.689.171	-71%	
1.A.3.b.ii. Heavy Duty Vehicles (HDVs)	Diesel Oil	Car 4	60.032	60.032	0%	402.82	89.26	-82%	30.079.914	5.420.811	-24.659.104	-82%	
		Car 5	6.609	6.609	0%	448.01	89.26	-80%	2.930.190	584.364	-2.345.826	-80%	
		Car 6	0	0	0%	161.21	89.26	-43%	14	6	-6	-43%	
		Diesel oil total	115.961	115.961	0%	485.58	126.92	-74%	55.844.598	15.788.142	-40.126.376	-74%	
1.A.3.b.iii. Heavy Duty Vehicles (HDVs)	Diesel Oil	LDVs total	122.085	122.085	0%	488.92	130.95	-73%	17.447.999	19.932.898	2.484.897	14%	
		pre-Cars	2.620	2.620	0%	100.63	101.18	6%	2.836.189	2.671.331	-164.778	-6%	
		Car 1	2.258	2.258	0%	752.91	711.45	-5%	1.699.781	1.696.297	-3.484	0%	
		Car 2	3.024	3.024	0%	804.17	653.36	-20%	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	1.881.274	-418.064	-18%	
		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%	
	1.A.3.b.iii. Heavy Duty Vehicles (HDVs)	Diesel Oil	Buses total	47.365	47.365	0%	902.69	448.99	-50%	28.071.221	21.896.323	-6.884.898	-25%
			pre-Cars	8.044	8.044	0%	100.67	103.88	3%	8.365.423	6.144.933	-2.218.491	-26%
			Car 1	4.384	4.384	0%	758.16	574.04	-23%	3.288.422	2.535.327	-772.844	-23%
			Car 2	29.277	29.277	0%	817.37	550.61	-30%	23.947.723	15.292.377	-7.744.499	-30%
			Car 3	121.581	121.581	0%	636.16	436.56	-30%	77.271.520	45.310.423	-31.961.097	-30%
			Car 4	68.430	68.430	0%	290.35	289.43	-0%	32.977.784	15.969.685	-6.468.019	-20%
			Car 5	342.175	342.175	0%	378.29	152.63	-60%	95.589.479	52.019.687	-43.569.792	-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.iii. Heavy Duty Vehicles (HDVs)	Gasoline	pre-Cars	7.389	7.389	0%	322.96	150.24	-22%	969.588	1.110.170	21.588	22%	
		Car 1	4.885	4.885	0%	134.72	108.26	-25%	599.299	888.547	289.248	35%	
		Car 2	3.544	3.544	0%	137.85	194.58	41%	488.552	688.693	201.851	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%	
1.A.3.b.iii. Heavy Duty Vehicles (HDVs)	MGNs total	19.289	19.289	0%	119.78	171.04	54%	2.137.082	3.299.162	1.162.180	54%		
		Total	2.180.883	2.180.883	0%	305.90	157.85	-49%	632.363.736	321.625.655	-308.748.081	-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 [g/t]			in [t]				
1.A.3.a.i. Passenger Cars	Gasoline	pre-Cars	11,561	11,561	0%	607.72	635.39	-12%	7,026,041	6,189,785	-836,256	-12%
		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	172.82	-26%	13,487,749	10,039,380	-3,372,369	-25%
		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%	1,897,355	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	750,957	750,957	0%	85.73	78.89	-9%	64,379,964	58,577,229	-5,802,735	-9%	
	Diesel Oil	pre-Cars	1,487	1,487	0%	311.98	284.56	-15%	463,963	383,872	-80,091	-15%
		Car 1	6,660	6,660	0%	297.79	266.44	-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%	58,399,037	18,434,837	-39,964,200	-69%	
Car 4		234,943	234,943	0%	398.41	146.46	-62%	91,724,195	34,488,997	-57,235,198	-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%	415.96	158.66	-64%	242,962,986	88,096,639	-154,866,347	-64%		
FCs Total	1,306,202	1,306,202	0%	234.61	115.29	-50%	386,442,896	146,673,867	-239,769,029	-50%		
1.A.3.b.i. Light Duty Vehicles (LDV)	Gasoline	pre-Cars	962	962	0%	632.36	645.95	2%	607,179	621,160	13,981	2%
		Car 1	232	232	0%	803.24	383.22	-85%	199,985	70,295	-129,690	-85%
		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	18,536	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%	
	Diesel Oil	pre-Cars	3,281	3,281	0%	424.46	386.79	-9%	1,368,754	1,362,093	-6,661	-9%
		Car 1	3,666	3,666	0%	398.34	276.24	-30%	1,445,980	1,187,634	-258,346	-30%
Car 2		8,479	8,479	0%	336.40	193.39	-42%	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	3,566,082	-9,484,199	-73%	
Car 4		59,485	59,485	0%	494.22	89.85	-82%	29,369,870	5,337,398	-24,032,472	-82%	
Car 5	15,964	15,964	0%	442.70	89.85	-80%	7,040,451	1,420,906	-5,619,545	-80%		
Car 6	1	1	0%	151.94	89.85	-41%	122	72	-50	-41%		
Diesel oil total	114,350	114,350	0%	485.91	120.17	-75%	55,186,382	11,741,354	-43,445,028	-75%		
LDVs Total	120,088	120,088	0%	485.91	120.17	-74%	56,344,983	14,834,896	-41,510,087	-74%		
1.A.3.b.ii. Heavy Duty Vehicles (HDV)	Gasoline	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	131.15	-3%	1,817,476	337,184	-1,480,292	-3%
		Car 2	8,479	8,479	0%	703.46	643.34	-10%	5,085,091	4,997,478	-87,613	-10%
		Car 3	23,785	23,785	0%	558.53	150.44	-73%	13,050,281	3,566,082	-9,484,199	-73%
		Car 4	59,485	59,485	0%	494.22	89.85	-82%	29,369,870	5,337,398	-24,032,472	-82%
		Car 5	15,964	15,964	0%	442.70	89.85	-80%	7,040,451	1,420,906	-5,619,545	-80%
	Car 6	1	1	0%	151.94	89.85	-41%	122	72	-50	-41%	
	Diesel Oil	114,350	114,350	0%	485.91	120.17	-75%	55,186,382	11,741,354	-43,445,028	-75%	
	HDVs Total	120,088	120,088	0%	485.91	120.17	-74%	56,344,983	14,834,896	-41,510,087	-74%	
	1.A.3.b.iii. Heavy Duty Vehicles (HDV) - Trucks & Lorries	Gasoline	pre-Cars	1,326	1,326	0%	1093.46	1919.46	4%	1,410,640	1,352,283	-58,357
Car 1			1,245	1,245	0%	727.34	131.15	-3%	1,817,476	337,184	-1,480,292	-3%
Car 2			7,788	7,788	0%	703.46	643.34	-10%	5,085,091	4,997,478	-87,613	-10%
Car 3			14,483	14,483	0%	629.94	147.61	-21%	9,073,137	6,689,744	-2,383,393	-21%
Car 4			5,331	5,331	0%	468.10	361.86	-23%	2,642,179	1,677,777	-964,402	-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	-7,196,625	-28%	
Trucks Total		589,585	589,585	0%	385.33	224.69	-41%	224,829,180	132,064,153	-92,765,027	-41%	
1.A.3.b.iv. Motorised Two-Wheelers (MOW)		Gasoline	pre-Cars	6,190	6,190	0%	122.76	151.03	23%	822,530	1,011,520	189,301
	Car 1		4,386	4,386	0%	134.61	171.39	30%	536,615	738,050	201,435	30%
	Car 2		3,267	3,267	0%	136.22	184.56	43%	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%
	MOWs Total	18,268	18,268	0%	107.43	173.28	61%	1,982,546	3,163,439	1,180,893	61%	
	FCs Total	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 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 [g]	in [g]	in [g]	in [g]	
1.A.3.a.i. - Passenger Cars	Gasoline	pre-Cars	11.647	11.647	0%	812.37	844.11	-11%	7.132.688	6.327.484	-796.844	-11%
		Car 1	30.667	30.667	0%	368.77	343.93	-32%	11.082.246	7.480.541	-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	18.536.099	-523.557	-3%
		Car 5	171.270	171.270	0%	18.59	47.80	151%	3.183.282	0.187.581	-5.004.299	151%
		Car 6	10.315	10.315	0%	25.97	47.80	84%	267.855	433.096	225.248	84%
		Gasoline total	752.426	752.426	0%	76.40	73.89	-3%	57.215.533	54.598.521	-2,216,412	-3%
	Diesel Oil	pre-Cars	1.341	1.341	0%	311.73	284.66	-9%	417.947	364.246	-42,722	-9%
		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%	48.481.830	14.796.245	-33,685,585	-69%
		Car 4	211.237	211.237	0%	297.27	151.77	-42%	83.917.680	32,059,973	-51,857,706	-42%
		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%
		Flx Total	1,338,571	1,338,571	0%	298.44	152.15	-53%	138,091,584	154,652,853	-175,478,269	-53%
	Gasoline	pre-Cars	986	986	0%	632.44	645.95	2%	193,683	278.724	85,844	2%
		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%	598.34	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%	1,985,879	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	133.25	-42%	1,385,995	1,180,889	-205,126	-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%	468.70	91.69	-82%	26,164,486	4,703,746	-21,494,748	-82%
		Car 5	46.749	46.749	0%	438.44	91.69	-79%	20,496,234	4,258,026	-16,237,709	-79%
	Diesel Oil	pre-Cars	187	187	0%	151.18	91.69	-40%	29,829	17,974	-11,855	-40%
		Car 1	187	187	0%	151.18	91.69	-40%	29,829	17,974	-11,855	-40%
		Car 2	187	187	0%	151.18	91.69	-40%	29,829	17,974	-11,855	-40%
		Car 3	187	187	0%	151.18	91.69	-40%	29,829	17,974	-11,855	-40%
		Car 4	187	187	0%	151.18	91.69	-40%	29,829	17,974	-11,855	-40%
		Car 5	187	187	0%	151.18	91.69	-40%	29,829	17,974	-11,855	-40%
		Diesel oil total	187	187	0%	151.18	91.69	-40%	29,829	17,974	-11,855	-40%
		LDVs 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.ii. - Heavy Duty Vehicles (HDVs)	Gasoline	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	1300.99	-3%	659,232	628,359	30,873	-3%
		Car 2	5,586	5,586	0%	704.95	643.67	-9%	4,284,320	3,683,441	-598,807	-9%
		Car 3	11,221	11,221	0%	621.20	458.38	-27%	7,082,740	5,143,628	-1,939,228	-27%
		Car 4	4,270	4,270	0%	461.10	361.79	-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%
	Diesel Oil	pre-Cars	4,182	4,182	0%	42.78	183.99	330%	178,913	789,476	610,563	330%
		Car 1	4,182	4,182	0%	42.78	183.99	330%	178,913	789,476	610,563	330%
		Car 2	4,182	4,182	0%	42.78	183.99	330%	178,913	789,476	610,563	330%
		Car 3	4,182	4,182	0%	42.78	183.99	330%	178,913	789,476	610,563	330%
		Car 4	4,182	4,182	0%	42.78	183.99	330%	178,913	789,476	610,563	330%
		Car 5	4,182	4,182	0%	42.78	183.99	330%	178,913	789,476	610,563	330%
		Diesel oil total	49,143	49,143	0%	468.37	339.99	-27%	23,017,115	16,788,234	-6,308,881	-27%
		HDVs Total	4,182	4,182	0%	1034.34	737.35	-29%	4,945,942	3,525,898	-1,420,134	-29%
1.A.3.b.iii. - Heavy Duty Vehicles (HDVs) - Trucks & Lorries	Gasoline	pre-Cars	2,285	2,285	0%	748.66	581.41	-22%	1,800,089	1,237,759	-562,348	-22%
		Car 1	13,023	13,023	0%	817.90	510.38	-30%	11,445,862	6,565,738	-4,891,123	-30%
		Car 2	54,685	54,685	0%	632.52	384.41	-42%	36,589,077	19,927,835	-16,661,841	-42%
		Car 3	34,037	34,037	0%	396.37	285.34	-30%	13,481,158	9,711,896	-3,779,262	-30%
		Car 4	389,263	389,263	0%	282.92	153.66	-46%	110,112,782	59,688,043	-50,424,748	-46%
		Car 5	34,214	34,214	0%	63.96	153.66	189%	3,937,089	11,368,582	7,421,413	189%
	Diesel Oil	pre-Cars	572,754	572,754	0%	314.85	196.65	-38%	179,874,133	112,285,582	-67,588,551	-38%
		Car 1	572,754	572,754	0%	314.85	196.65	-38%	179,874,133	112,285,582	-67,588,551	-38%
		Car 2	572,754	572,754	0%	314.85	196.65	-38%	179,874,133	112,285,582	-67,588,551	-38%
		Car 3	572,754	572,754	0%	314.85	196.65	-38%	179,874,133	112,285,582	-67,588,551	-38%
		Car 4	572,754	572,754	0%	314.85	196.65	-38%	179,874,133	112,285,582	-67,588,551	-38%
		Car 5	572,754	572,754	0%	314.85	196.65	-38%	179,874,133	112,285,582	-67,588,551	-38%
		Diesel oil total	572,754	572,754	0%	314.85	196.65	-38%	179,874,133	112,285,582	-67,588,551	-38%
		Trucks Total	572,754	572,754	0%	314.85	196.65	-38%	179,874,133	112,285,582	-67,588,551	-38%
1.A.3.b.iv. - Motorised Two-Wheelers (MOWs)	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%	124.71	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%
		MOWs Total	18,627	18,627	0%	108.59	179.24	78%	1,878,294	3,386,734	1,488,498	78%
		LDVs Total	2,153,563	2,153,563	0%	277.27	140.35	-49%	597,120,287	362,252,271	-234,868,025	-49%

Adjustment details for 2025												
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	11.380	11.380	0%	833.33	844.11	-1%	7,266.152	6,191.942	-1,014.168	-14%
		Car 1	34.112	34.112	0%	371.34	345.71	-34%	8,963.081	5,924.574	-3,028.298	-34%
		Car 2	42,925	42,925	0%	297.78	142.69	-32%	8,918.785	6,099.659	-2,818.648	-32%
		Car 3	72,871	72,871	0%	73.86	74.74	1%	5,381.361	5,448.237	64.897	1%
		Car 4	363,474	363,474	0%	52.36	49.62	-5%	18,485.637	17,326.221	-1,159.416	-6%
		Car 5	180,783	180,783	0%	19.11	49.62	151%	3,454.481	0.881.456	-5,406.375	151%
		Car 6	29,612	29,612	0%	25.70	49.62	84%	790.781	1,451.433	652.792	84%
		Gasoline total	715,156	715,156	0%	76.38	71.73	-6%	53,196,187	51,380,983	-1,889,895	-4%
	Diesel oil total	pre-Cars	1,282	1,282	0%	313.32	284.66	-9%	367.917	339.733	-28.184	-9%
		Car 1	4,279	4,279	0%	298.14	267.84	-10%	1,261.930	1,129.989	-132.821	-10%
		Car 2	19,689	19,689	0%	407.80	220.36	-46%	8,013.587	4,339.736	-3,674.788	-46%
1.A.3.a.ii - Light Duty Vehicles (LDV)	Gasoline	pre-Cars	71,044	71,044	0%	595.91	179.64	-70%	42,271.648	12,739.492	-29,531.608	-70%
		Car 1	192,414	192,414	0%	184.47	184.47	0%	72,229.655	72,229.655	-47,323.268	-66%
		Car 2	364,356	364,356	0%	434.57	157.65	-65%	137,290.423	45,890.244	-92,400.969	-65%
		Car 3	52,576	52,576	0%	293.76	154.67	-41%	13,557.082	8,180.394	-5,356.778	-41%
		LDV total	645,565	645,565	0%	426.19	159.89	-63%	275,133.233	183,163.911	-91,969.372	-63%
		P/Cs total	1,360,721	1,360,721	0%	245.16	133.52	-53%	526,317.000	154,484.484	-371,856.516	-53%
		Car 1	979	979	0%	854.37	646.96	-25%	575.380	487.977	-7.404	-1%
		Car 2	150	150	0%	895.83	311.83	-65%	134.523	40.851	-87.872	-65%
	Car 3	629	629	0%	298.27	212.94	-29%	187.533	133.879	-53.654	-29%	
	Car 4	781	781	0%	95.56	188.62	3%	73.963	76.165	2.198	3%	
	Car 5	1,720	1,720	0%	96.56	51.30	-9%	80.965	80.246	-7.298	-9%	
Car 6	1,620	1,620	0%	18.41	51.30	175%	29.912	83.086	53.274	175%		
Car 7	84	84	0%	18.71	51.30	174%	1.752	4.884	3.132	174%		
Gasoline total	5,793	5,793	0%	187.52	172.88	-8%	1,083,937	1,080,999	-2,938	-0%		
1.A.3.a.iii - Heavy Duty Vehicles (HDV)	Diesel Oil	pre-Cars	2,323	2,323	0%	418.91	386.79	-26%	968.185	712.631	-253.654	-26%
		Car 1	2,186	2,186	0%	391.47	275.25	-45%	824.270	453.227	-371.043	-45%
		Car 2	5,025	5,025	0%	324.81	193.29	-40%	1,632.286	971.286	-660.928	-40%
		Car 3	15,718	15,718	0%	258.26	150.67	-24%	3,112.414	2,305.703	-806.710	-24%
		Car 4	47,480	47,480	0%	91.73	71.74	-22%	22,782.396	2,340.298	-20,442.098	-22%
		Car 5	62,146	62,146	0%	436.13	91.74	-79%	27,090.214	5,680.295	-21,409.809	-79%
		Car 6	635	635	0%	154.91	91.74	-40%	87.768	60.230	-26.528	-40%
		LDV total	135,356	135,356	0%	888.35	181.96	-77%	63,565.843	16,681.496	-46,884.353	-77%
	HDV total	141,098	141,098	0%	437.76	170.62	-61%	64,589.570	25,686.430	-38,903.181	-61%	
	Car 1	979	979	0%	1070.34	1015.23	-5%	1,048.372	995.250	-53.126	-5%	
	Car 2	747	747	0%	738.26	751.91	3%	543.471	581.636	38.165	3%	
Car 3	5,211	5,211	0%	707.43	644.94	-10%	4,163.087	3,359.054	-804.035	-19%		
Car 4	15,782	15,782	0%	632.86	488.67	-24%	2,741.732	1,714.989	-1,026.822	-37%		
Car 5	4,686	4,686	0%	869.70	351.99	-59%	2,154.006	1,514.177	-639.829	-29%		
Car 6	36,257	36,257	0%	368.77	184.59	-49%	8,737.088	4,477.641	-4,259.427	-49%		
Car 7	5,224	5,224	0%	63.13	184.59	247%	277.542	964.226	686.684	247%		
Diesel total	52,887	52,887	0%	438.96	327.99	-26%	23,957.817	11,149.448	-12,808.378	-29%		
1.A.3.a.iv - Heavy Duty Vehicle: Trucks & Lorries	Diesel Oil	pre-Cars	4,379	4,379	0%	1034.69	737.35	-29%	4,483.571	3,184.428	-1,294.143	-29%
		Car 1	1,983	1,983	0%	748.71	553.48	-26%	1,387.291	1,025.551	-361.740	-26%
		Car 2	11,082	11,082	0%	817.38	588.97	-30%	3,072.940	2,532.440	-540.501	-20%
		Car 3	47,482	47,482	0%	516.86	381.66	-27%	12,888.779	9,724.748	-3,164.031	-24%
		Car 4	39,233	39,233	0%	356.88	287.72	-20%	11,572.860	9,294.190	-2,278.769	-20%
		Car 5	309,736	309,736	0%	264.17	153.49	-40%	83,413.973	50,645.496	-32,767.477	-40%
		Car 6	170,787	170,787	0%	67.49	153.49	167%	8,913.364	26,292.037	16,388.694	167%
		Trucks Total	589,431	589,431	0%	268.69	189.83	-30%	157,189.675	110,920.933	-46,268.742	-30%
	pre-Cars	5,744	5,744	0%	125.41	157.28	25%	720.441	953.470	183.828	25%	
	Car 1	1,517	1,517	0%	107.40	176.22	39%	444.086	619.819	171.733	39%	
	Car 2	3,382	3,382	0%	107.35	196.53	55%	430.680	664.965	236.306	55%	
Car 3	5,911	5,911	0%	48.29	196.53	309%	234.136	1,144.416	910.289	309%		
Car 4	0	0	0%	16.96	196.53	1080%	89	884	795	901%		
Car 5	0	0	0%	0	196.53	0%	0	0	0	0%		
MWVs total	18,499	18,499	0%	98.52	189.85	80%	1,833.382	5,334.472	1,501.086	80%		
1.A.3.b - Road Transport	Total	2,161,050	2,161,050	0%	265.86	129.65	-48%	575,935.265	381,697.956	-194,853.678	-48%	



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 - Passenger Cars	Gasoline	pre-Cars	15 782	15 782	0%	636.75	648.11	-16%	7 670 916	6 410 967	-1 657 867	-16%
		Car 1	20 270	20 270	0%	372.25	268.68	-28%	7 545 483	4 886 888	-2 648 596	-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%	3 580 746	9 189 834	5 609 088	163%
	Car 6	66 332	66 332	0%	26.67	50.17	88%	1 768 917	3 327 850	1 558 933	88%	
	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	1 280	1 280	0%	368.76	264.66	-28%	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	-83 212 815	-64%
	Car 6	116 034	116 034	0%	268.75	156.24	-41%	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%	
Pkx Total	1 380 391	1 380 391	0%	235.75	154.41	-35%	67 778 627	159 070 289	-168 708 367	-59%		
1.A.3.b.i - Light Duty Vehicles (LDVs)	Gasoline	pre-Cars	910	910	0%	602.79	645.36	-7%	593 186	581 543	-11 643	-2%
		Car 1	136	136	0%	908.31	312.78	-65%	122 126	42 425	-79 708	-65%
		Car 2	540	540	0%	308.39	217.84	-29%	162 311	117 797	-44 504	-27%
		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	7%	78 714	84 003	5 289	7%
		Car 5	1 726	1 726	0%	19.82	52.36	164%	34 157	80 258	46 106	164%
	Car 6	363	363	0%	19.65	52.36	181%	6 764	18 992	12 228	181%	
	Gasoline total	5 506	5 506	0%	588.27	171.66	-7%	1 068 292	1 013 678	-54 614	-5%	
	Diesel Oil	pre-Cars	2 189	2 189	0%	414.81	386.73	-7%	899 549	885 433	-13 916	-2%
		Car 1	1 780	1 780	0%	391.89	276.25	-29%	780 189	385 371	-394 798	-49%
		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	-93%	21 783 989	3 986 141	-17 777 788	-82%
		Car 5	74 231	74 231	0%	434.16	32.40	-92%	32 223 283	6 658 780	-25 564 503	-79%
	Car 6	4 921	4 921	0%	113.49	32.40	-71%	755 285	454 676	-300 609	-40%	
	Diesel oil total	148 068	148 068	0%	456.12	185.62	-77%	65 712 732	15 256 007	-50 456 726	-77%	
LDVs Total	149 994	149 994	0%	445.23	188.29	-76%	66 781 025	16 229 684	-50 551 348	-76%		
1.A.3.b.ii - Heavy Duty Vehicles (HDVs)	Diesel Oil	pre-Cars	891	891	0%	1076.81	1919.23	-43%	964 197	988 234	24 037	2%
		Car 1	583	583	0%	731.36	732.67	0%	433 675	446 236	12 568	3%
		Car 2	4 375	4 375	0%	708.25	645.03	-9%	3 440 614	2 822 621	-617 993	-18%
		Car 3	10 333	10 333	0%	632.87	458.91	-27%	6 530 364	4 741 827	-1 787 536	-27%
		Car 4	4 449	4 449	0%	475.90	382.29	-20%	2 117 219	1 586 881	-530 338	-26%
		Car 5	34 380	34 380	0%	366.36	185.22	-49%	8 935 974	4 517 517	-4 418 457	-49%
		Car 6	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	-2%	23 082 189	16 885 117	-6 197 072	-27%
	Trucks	pre-Cars	3 933	3 933	0%	1034.81	737.35	-29%	4 087 249	2 980 379	-1 106 870	-29%
		Car 1	1 555	1 555	0%	748.16	587.92	-21%	1 163 482	789 813	-373 599	-33%
		Car 2	8 876	8 876	0%	817.75	585.52	-29%	7 258 047	4 486 626	-2 771 218	-38%
		Car 3	34 167	34 167	0%	638.91	588.64	-8%	21 553 280	12 251 155	-9 302 133	-43%
		Car 4	34 287	34 287	0%	396.94	281.86	-29%	9 640 384	6 885 621	-2 754 803	-29%
		Car 5	269 736	269 736	0%	287.22	153.60	-46%	74 680 233	39 976 610	-34 623 623	-46%
		Car 6	261 480	261 480	0%	61.77	153.60	149%	16 149 289	40 284 036	24 094 748	149%
		Trucks Total	584 013	584 013	0%	226.31	180.97	-20%	134 431 899	101 496 262	-32 935 637	-24%
1.A.3.b.iv - Motorised Two-Wheelers (MOWs)	Gasoline	pre-Cars	5 543	5 543	0%	125.59	155.78	24%	696 072	883 289	187 218	24%
		Car 1	3 360	3 360	0%	127.11	177.29	39%	427 113	585 796	158 682	39%
		Car 2	3 375	3 375	0%	125.94	187.68	50%	421 961	687 078	265 127	50%
		Car 3	6 443	6 443	0%	48.36	187.68	381%	209 627	1 273 671	1 064 043	508%
		Car 4	66	66	0%	17.47	187.68	1071%	1 134	12 632	11 498	1011%
		MOWs Total	16 185	16 185	0%	96.14	181.68	89%	1 885 897	3 452 476	1 566 579	89%
1.A.3.b - Road Transport	Total	2 267 339	2 267 339	0%	258.89	137.22	-46%	553 799 598	362 981 620	-190 817 978	-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 [t]	in [t]	in [t]	in [%]		
1.A.3.a.i - Passenger Cars	Gasoline	pre-Cars	12 282	12 282	0%	636.75	644.11	-14%	7 616 267	6 680 187	-1 126 108	-14%	
		Car 1	17 449	17 449	0%	372.96	241.68	-35%	6 588 211	4 217 644	-2 391 267	-35%	
		Car 2	30 435	30 435	0%	217.43	141.75	-35%	6 617 570	4 314 140	-2 303 438	-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	167%	3 485 382	9 239 815	5 754 433	167%	
	Car 6	114 791	114 791	0%	26.66	51.26	92%	3 063 235	5 884 372	2 824 146	92%		
	Gasoline total	724 571	724 571	0%	67.66	60.88	-10%	49 046 874	38 634 374	-10 406 888	-10%		
	Diesel Oil	pre-Cars	1 780	1 780	0%	368.76	264.56	-13%	483 963	347 620	-13 883	-13%	
		Car 1	3 760	3 760	0%	298.17	271.67	-9%	1 082 288	910 182	-92 116	-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%		
1.A.3.a.ii - Heavy Duty Vehicles (LDV)	Gasoline	Car 4	187 047	187 047	0%	418.16	158.34	-61%	64 733 485	24 983 323	-39 748 142	-61%	
		Car 5	283 480	283 480	0%	423.99	158.34	-63%	120 187 695	44 073 190	-76 114 405	-63%	
		Car 6	184 768	184 768	0%	262.61	158.34	-40%	48 521 183	20 255 985	-28 265 258	-46%	
		Diesel oil total	686 582	686 582	0%	398.65	161.95	-59%	272 126 081	112 890 717	-159 235 370	-59%	
		Pkx Total	1 421 162	1 421 162	0%	225.98	155.61	-30%	52 152 965	163 445 435	-115 302 538	-48%	
		Diesel Oil	pre-Cars	940	940	0%	611.41	645.36	-7%	612 247	686 978	5 322	-1%
	Car 1		124	124	0%	908.23	312.78	-65%	112 083	39 682	-72 401	-65%	
	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	4%	65 955	68 812	2 857	4%	
	1.A.3.a.iii - Light Duty Vehicles (LDV)	Gasoline	Car 4	1 476	1 476	0%	50.72	53.38	5%	74 877	78 816	3 938	5%
Car 5			1 680	1 680	0%	21.73	53.38	146%	35 240	89 034	52 796	146%	
Car 6			910	910	0%	19.18	53.38	187%	17 052	49 080	31 928	187%	
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	2 067	2 067	0%	413.41	386.73	-7%	860 499	631 163	-229 336	-26%
			Car 1	1 538	1 538	0%	398.47	276.25	-29%	680 795	331 158	-349 638	-49%
		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%	595.38	150.73	-75%	5 240 935	1 758 232	-3 482 703	-67%	
Diesel Oil		Car 4	39 600	39 600	0%	306.76	83.03	-42%	13 749 647	3 635 025	-10 114 612	-62%	
		Car 5	75 789	75 789	0%	432.66	83.03	-79%	32 790 366	7 054 565	-25 735 811	-79%	
	Car 6	19 625	19 625	0%	167.71	83.03	-39%	2 977 239	1 626 675	-1 156 564	-39%		
	Diesel oil total	153 284	153 284	0%	424.66	103.89	-76%	65 081 930	15 925 276	-49 156 714	-76%		
1.A.3.a.iv - Heavy Duty Vehicles (HDV)	Diesel Oil	LDVx Total	199 470	199 470	0%	418.83	186.35	-54%	66 152 729	36 959 427	-29 193 302	-44%	
		pre-Cars	738	738	0%	1073.33	1013.23	-5%	790 259	750 425	-39 834	-5%	
		Car 1	411	411	0%	723.97	752.57	4%	390 684	399 082	8 458	3%	
		Car 2	3 325	3 325	0%	731.91	646.73	-10%	2 523 087	2 147 480	-472 808	-10%	
		Car 3	8 678	8 678	0%	673.23	459.12	-31%	5 473 480	3 984 085	-1 494 295	-27%	
		Car 4	3 823	3 823	0%	474.07	352.49	-26%	1 912 380	1 347 680	-564 700	-29%	
	Diesel Oil	Car 5	21 913	21 913	0%	363.92	186.64	-49%	7 937 975	4 053 686	-3 884 291	-49%	
		Car 6	14 586	14 586	0%	68.52	186.64	219%	854 215	2 732 580	1 878 375	219%	
		Diesel total	53 382	53 382	0%	338.80	286.71	-23%	19 793 981	19 384 680	-4 089 873	-23%	
		pre-Cars	3 686	3 686	0%	1034.40	739.15	-29%	3 730 272	2 659 076	-1 071 256	-29%	
1.A.3.a.v - Heavy Duty Vehicle: Trucks & Lorries	Diesel Oil	Car 1	1 711	1 711	0%	748.03	583.48	-21%	902 942	614 151	-286 696	-31%	
		Car 2	1 387	1 387	0%	817.96	440.55	-46%	5 794 676	3 580 026	-2 226 851	-38%	
		Car 3	26 886	26 886	0%	626.17	345.72	-44%	18 942 041	9 852 565	-9 089 476	-48%	
		Car 4	39 082	39 082	0%	367.77	279.34	-24%	7 965 414	5 637 047	-2 368 368	-30%	
		Car 5	264 365	264 365	0%	268.16	154.36	-41%	49 280 789	31 085 347	-17 735 342	-41%	
		Car 6	335 065	335 065	0%	65.82	154.36	135%	21 985 366	31 755 641	9 770 275	135%	
1.A.3.a.vi - Motorized Two-Wheelers (MOW)	Gasoline	Trucks Total	598 263	598 263	0%	1055.14	175.92	-16%	116 671 141	185 246 880	68 574 633	-16%	
		pre-Cars	5 336	5 336	0%	125.91	157.13	25%	671 080	839 180	168 851	25%	
		Car 1	3 257	3 257	0%	126.39	177.06	41%	411 617	579 244	167 627	41%	
		Car 2	3 396	3 396	0%	122.55	180.33	42%	476 293	675 548	257 348	42%	
		Car 3	6 711	6 711	0%	41.22	180.33	363%	271 187	1 336 565	1 065 348	393%	
		Car 4	830	830	0%	18.26	180.33	987%	7 882	85 275	77 408	987%	
	MOWs Total	19 180	19 180	0%	92.81	183.39	98%	1 748 824	3 553 383	1 735 114	98%		
	1.A.3.b - Road Transport	Total	2 291 437	2 291 437	0%	273.43	175.23	-42%	525 563 430	384 685 986	-121 875 424	-42%	

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	-10%	7 770 965	6 648 721	-1 122 234	-14%	-15%
		Car 1	14 362	14 362	0%	374.24	341.68	-9%	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%	54.98	52.30	-5%	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%	
	Car 6	189 041	189 041	0%	6.00	52.30	0%	4 190 422	8 716 250	4 525 828	89%		
	Gasoline total	689 027	689 027	0%	64.42	68.36	-6%	45 032 286	47 186 817	2 154 531	5%		
	Diesel Oil	pre-Cars	1 363	1 363	0%	303.16	264.96	-13%	171 676	146 173	-25 503	-15%	
		Car 1	2 849	2 849	0%	298.17	272.65	-9%	962 432	775 166	-187 267	-20%	
Car 2		10 784	10 784	0%	407.20	222.87	-45%	4 391 383	2 483 536	-1 907 848	-45%		
Car 3		40 786	40 786	0%	812.49	180.15	-77%	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%		
Car 6	228 685	228 685	0%	254.87	180.40	-29%	58 284 140	35 680 446	-22 603 694	-39%			
Diesel oil total	646 074	646 074	0%	375.66	163.38	-56%	247 596 063	108 748 684	-138 847 379	-56%			
Pkx Total	1 363 181	1 363 181	0%	214.34	114.68	-46%	262 588 349	156 555 421	-106 032 928	-40%			
1.A.3.b.i - Light Duty Vehicles (LDVs)	Gasoline	pre-Cars	911	911	0%	944.51	645.95	-32%	594 851	582 662	-12 189	-2%	
		Car 1	189	189	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	69 270	3 980	4%	
		Car 5	1 483	1 483	0%	23.70	54.36	129%	35 160	80 626	45 466	129%	
	Car 6	1 643	1 643	0%	19.09	54.36	182%	39 550	89 326	49 776	182%		
	Gasoline total	6 315	6 315	0%	154.22	160.11	4%	999 199	1 011 136	11 936	1%		
	Diesel Oil	pre-Cars	1 872	1 872	0%	411.51	386.79	-6%	771 337	674 432	-96 905	-13%	
		Car 1	1 285	1 285	0%	389.84	276.25	-29%	483 129	272 286	-210 843	-44%	
Car 2		2 942	2 942	0%	318.56	193.88	-39%	965 389	550 789	-414 599	-43%		
Car 3		9 363	9 363	0%	598.10	150.74	-75%	5 689 152	1 411 299	-4 277 853	-75%		
Car 4		33 232	33 232	0%	508.42	93.81	-82%	16 929 185	3 117 457	-13 811 728	-82%		
Car 5		66 283	66 283	0%	432.92	93.81	-78%	28 684 080	6 217 860	-22 466 220	-78%		
Car 6	39 482	39 482	0%	158.79	93.81	-41%	5 941 615	3 686 228	-2 255 387	-38%			
Diesel oil total	154 259	154 259	0%	384.71	182.69	-53%	59 344 525	15 880 316	-43 464 210	-73%			
LDVs total	160 574	160 574	0%	375.86	184.94	-51%	69 343 125	16 851 449	-52 491 676	-72%			
1.A.3.b.ii - Heavy Duty Vehicles (HDVs)	Diesel Oil	pre-Cars	547	547	0%	1078.15	1919.23	-5%	589 387	557 147	-32 240	-5%	
		Car 1	237	237	0%	732.78	132.57	-82%	173 676	118 368	-55 308	-32%	
		Car 2	2 270	2 270	0%	787.83	366.73	-53%	1 780 686	1 487 437	-293 249	-16%	
		Car 3	6 757	6 757	0%	638.89	459.32	-29%	4 262 734	3 183 482	-1 079 252	-25%	
		Car 4	3 043	3 043	0%	473.16	382.73	-19%	1 439 790	1 073 333	-366 457	-25%	
		Car 5	18 189	18 189	0%	362.42	186.37	-49%	6 463 265	3 376 016	-3 087 249	-48%	
	Car 6	20 670	20 670	0%	64.99	186.37	289%	1 176 026	3 682 314	2 506 288	214%		
	Buses Total	51 634	51 634	0%	309.75	283.53	-8%	15 993 546	13 687 186	-2 306 360	-15%		
	Gasoline	pre-Cars	3 262	3 262	0%	1034.82	737.35	-29%	3 375 359	2 485 071	-890 288	-26%	
		Car 1	1 094	1 094	0%	747.82	488.39	-35%	818 052	512 378	-305 674	-37%	
Car 2		5 544	5 544	0%	817.44	581.68	-29%	4 632 180	2 781 516	-1 850 664	-39%		
Car 3		20 583	20 583	0%	629.54	563.68	-10%	12 367 751	7 277 279	-5 090 472	-44%		
Car 4		15 912	15 912	0%	358.89	276.23	-23%	6 334 421	4 386 424	-1 947 997	-31%		
Car 5		154 983	154 983	0%	250.40	154.68	-38%	45 964 153	24 283 389	-21 680 764	-47%		
Car 6	381 799	381 799	0%	68.78	154.68	125%	26 251 482	69 665 886	43 414 404	165%			
Trucks Total	585 186	585 186	0%	515.18	172.19	-66%	188 173 537	180 710 889	-7 462 648	-4%			
1.A.3.b.iii - Motorised Two-Wheelers (MTWs)	Gasoline	pre-Cars	4 940	4 940	0%	128.95	158.61	26%	622 656	783 451	160 795	26%	
		Car 1	2 966	2 966	0%	126.14	177.79	41%	374 114	527 294	153 180	41%	
		Car 2	3 221	3 221	0%	129.33	186.64	45%	387 596	639 833	252 237	65%	
		Car 3	6 241	6 241	0%	48.24	186.64	284%	251 126	1 239 686	988 560	394%	
		Car 4	1 130	1 130	0%	58.41	186.64	323%	23 066	224 682	201 616	873%	
		Car 5	0	0	0%	0.00	0.00	0%	0	0	0	0%	
	MTWs Total	18 487	18 487	0%	85.86	188.61	198%	1 658 558	3 454 767	1 796 209	108%		
	1.A.3.b. Road Transport	Total	2 180 983	2 180 983	0%	215.85	133.49	-38%	478 758 286	291 129 652	-187 628 634	-39%	

	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>	<b>-296.1</b>	<b>-300.7</b>	<b>-300.4</b>	<b>-305.2</b>	<b>-294.9</b>	<b>-274.9</b>	<b>-250.9</b>	<b>-221.1</b>	<b>-179.6</b>	<b>-144.8</b>
Change against Adjustment 2020	1.7	1.6	0.9	0.9	-0.4	-5.9	-6.6	-6.2	-5.0	

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)