ENVIRONMENTAL SERIES No. 355

Air

Pollutant emissions from road transport 1980 - 2030

Swiss Agency for the Environment, Forests and Landscape SAEFL

ENVIRONMENTAL SERIES No. 355

Air

Pollutant emissions from road transport 1980-2030

Published by the Swiss Agency for the Environment, Forests and Landscape SAEFL
Berne, 2004

Editor
Swiss Agency for the Environment, Forests and
Landscape (SAEFL)
*SAEFL is an agency of the Federal Department
of Environment, Transport, Energy and Communications
(DETEC)*

Authors
Mario Keller & René Zbinden
INFRAS
Mühlemattstrasse 45
CH-3007 Berne

SAEFL consultants
Felix Reutimann
Air Pollution and NIR Division
Transport Section

Cover pictures
© SAEFL/Docuphot and Informato AG

Distributed by
Swiss Agency for the Environment, Forests and Landscape
Documentation
CH–3003 Berne
Fax + 41 (0)31 324 02 16
E-mail: docu@buwal.admin.ch
Internet: www.buwalshop.ch

Order number and price
SRU-355-E / CHF 20.– (incl. VAT)

CONTENTS

ABSTRACTS

Report SRU 355 is an update of the previously published documentation on pollutant emissions from road transport in Switzerland. It covers the period from 1980 to 2030. On the basis of internationally co-ordinated emission studies, detailed emission factors have been defined for all motorised road vehicles and for various regulated and non-limited air pollutants. Emissions of air pollutants have been projected on the basis of traffic data recorded in Switzerland. Generally speaking, the findings confirm previous forecasts. Some new findings have been obtained, however, primarily relating to NO_x emissions. The higher emission factors for heavy-duty motor vehicles and the sharp increase in the proportion of diesel passenger cars indicate a considerably slower reduction in the future than previously assumed.

This report serves as a valuable basis for all groups interested in past and future pollutant emissions. The most important findings for evaluating a broad variety of projects will flow into national and international statistics.

Keywords

Motor vehicle exhaust emissions; pollutant emissions; road transport

---

Der Bericht SRU 355 ist eine Aktualisierung der bisher erschienenen Unterlagen zu den Luftschadstoffemissionen des Strassenverkehrs in der Schweiz. Er deckt neu den Zeithorizont von 1980 bis 2030 ab. Aus den international abgestimmten Emissionsuntersuchungen wurden detaillierte Emissionsfaktoren für alle motorisierten Strassenfahrzeuge und für diverse reglementierte und nicht limitierte Luftschadstoffe ermittelt. Gestützt auf die in der Schweiz erhobenen Verkehrsdaten wurden die Emissionen der Luftschadstoffe hochgerechnet. Die Ergebnisse bestätigten mehrheitlich die bisherigen Prognosen. Neue Erkenntnisse ergaben sich allerdings hauptsächlich in Bezug auf die NO_x-Emissionen. Die höheren Emissionsfaktoren der schweren Motorwagen sowie der massiv ansteigende Anteil Diesel-Personenwagen führen zu einer deutlich langsameren Absenkung in der Zukunft als bisher angenommen.

Der Bericht ist eine wertvolle Grundlage für alle an der bisherigen und zukünftigen Luftschadstoff-Emissionsentwicklung interessierten Kreise. Die für die Beurteilung verschiedenster Projekte wichtigen Resultate werden in die nationalen und internationalen Statistiken einfliessen.

Keywords

Abgase Strassenfahrzeuge; Luftschadstoffemissionen; Strassenverkehr

Le rapport numéro 355 des Cahiers de l'environnement est une mise à jour des documents publiés jusqu'à présent sur le thème des émissions polluantes du trafic routier en Suisse. Il couvre désormais la période d'un demi-siècle qui va de 1980 à 2030. A partir d'études sur les émissions, coordonnées à l'échelon international, des coefficients d'émission précis ont pu être déterminés pour tous les véhicules automobiles routiers ainsi que pour diverses substances polluantes faisant ou non l'objet de réglementations et de limitations. Les émissions polluantes ont été calculées en fonction des données du trafic routier relevées en Suisse. Les résultats confirment largement les prévisions actuelles. Cependant des nouvelles connaissances ont été acquises, notamment en ce qui concerne les émissions de NOx. Les coefficients d'émission plus élevés des poids lourds ainsi que la forte croissance de l'effectif des voitures diesel conduisent à une diminution des émissions polluantes nettement plus lente que l'estimation réalisée jusqu'ici.
Le présent rapport constitue une précieuse référence pour tous les milieux intéressés par l'évolution actuelle et future des émissions polluantes. Ses résultats, importants pour l'évaluation de toutes sortes de projets, vont venir enrichir les statistiques nationales et internationales.

Mots-clés
Gaz d'échappement des véhicules routiers; émissions polluantes; trafic routier

---

Il rapporto n. 355 della Serie di scritti sull'ambiente (SRU 355) costituisce un aggiornamento delle pubblicazioni esistenti in materia di emissioni di inquinanti atmosferici provocate dal traffico stradale in Svizzera. Rispetto a dette pubblicazioni, copre un periodo di tempo più lungo, che va dal 1980 al 2030. A partire dagli studi sulle emissioni, coordinati a livello internazionale, sono stati rilevati dei fattori di emissione dettagliati per tutti i veicoli stradali a motore e per diversi inquinanti atmosferici, regolamentati e non. Sulla base dei dati sul traffico raccolti in Svizzera sono poi state calcolate le emissioni di inquinanti atmosferici. I risultati hanno per lo più confermato le previsioni, fornendo tuttavia anche elementi nuovi, soprattutto per quanto riguarda le emissioni di NOx. In seguito ai più elevati fattori di emissione dei veicoli pesanti ed al notevole aumento delle automobili diesel, in futuro il processo di riduzione delle emissioni sarà più lento del previsto. Il rapporto rappresenta un prezioso riferimento per tutti gli ambienti interessati all'andamento attuale e futuro delle emissioni di inquinanti atmosferici. I risultati, importanti per la valutazione dei più disparati tipi di progetti, confluiranno nelle statistiche nazionali ed internazionali.

Parole chiave
Gas di scarico dei veicoli stradali; emissioni di inquinanti atmosferici; traffico stradale

FOREWORD

Road transport is a major source of air pollution. In order to reduce emissions, we need to gain precise information about the emission behaviour of motor vehicles. For this reason, hundreds of vehicles were measured within the scope of an internationally co-ordinated measurement programme in order to record pollutant emissions and use the findings for making forecasts for the future. As a result of the countless measurements that were carried out it was possible to reliably calculate emission levels as well as incorporate all recent vehicle technologies and exhaust emission levels.

This study shows that the introduction of new exhaust regulations resulted in a significant reduction in emissions of CO, HC, No_x and particles, and will continue to do so in the future. However, additional measures are still required in order to secure compliance with ambient air quality limits aimed at preventing damage to health and the environment, and internationally defined critical pollution levels for sensitive ecological systems. Another problem that has to be overcome concerns the stagnation of CO_2 emissions at a high level, since they give rise to an undesirable warming of the earth's atmosphere.

Most of the findings in this report confirm the figures obtained from earlier studies and the predicted significant reduction of emission levels in the future. Nonetheless, there were also a few surprises: for example, the comprehensive measurements carried out on heavy duty vehicles under real operating conditions revealed considerably higher emissions of nitric oxides than was to be expected in view of the respective exhaust standards. Other unexpected findings included the fact that, in some cases, emission factors for light duty vehicles were found to be considerably higher than assumed on the basis of earlier measurements.

The successes that have been achieved through more stringent exhaust regulations will also have to be put into perspective in the future. The latest surveys on traffic volumes that were carried out by the Swiss Federal Office for Spatial Development indicate that these will continue to grow in the future. This especially applies to motorcycles, light duty vehicles and passenger cars, in which categories the traffic volume is expected to increase sharply. On the other hand, the impact of the Swiss performance-based heavy vehicle fee is proving to be positive: in the area of goods transport, growth has slowed considerably in comparison with earlier forecasts.

This report was supported by the Swiss Federal Roads Authority and the Swiss Federal Office of Energy. With its comprehensive statistics and data relating to emissions from road transport, it functions as an important tool for evaluating specific projects and assessing measures aimed at limiting pollutant emissions from motorised road traffic.

Gerhard Leutert
Head of Air Pollution Control and NIR division

SUMMARY

Measuring pollutants from road transport has a fairly lengthy history in Switzerland: the first SAEFL report (no. 55) on this topic dates back to the mid-1980s. It was followed by comprehensive and internationally co-ordinated research activities that were concluded in 1995 and resulted in the publication of Report 255 and the Handbook of Emission Factors in Road Transport (HBEFA 1.1). A supplement was published in 2000, together with version 1.2 of the Handbook. This report takes the form of a further update of emission perspectives. The Handbook of Emission Factors in Road Transport was also updated and released as version 2.1. It incorporates findings from national measurement programmes as well as from other international projects (COST 346 and ARTEMIS, a project from the EU's fifth framework programme), specifically the criteria for updating emission factors for heavy duty motor vehicles. The emission factors for motorcycles and scooters, as well as for light duty vehicles, were also fundamentally revised, and in the area of passenger cars the latest measurements of EURO 2 and EURO 3 vehicles were integrated and certain model components (e.g. for cold start) were adapted to the latest findings.

At the same time, the traffic quantity data were updated. In the area of heavy motor vehicles, the revised perspectives of the Swiss Federal Office for Spatial Planning were applied, which now assume slower growth versus earlier forecasts. By contrast, in other vehicle categories (namely motorcycles and light duty vehicles) the volumes are expected to increase more sharply. Slightly higher growth is also anticipated in the area of passenger cars.

Fig. S-1 shows the updated emission trends versus the figures indicated in Report 255/Supplement. All regulated pollutants (CO, HCs, NOx and particles) have undergone pronounced reductions. The latest trends largely confirm earlier estimates, and they only deviate from previous calculations in one or two areas. For example, in the period from 1995 to approx. 2010, the reduction in pollutant emissions is now expected to be slower than was assumed a few years ago. This especially applies to NO_x emissions, where the reduction in the period from 1995 to 2000 was considerably lower than expected. This is primarily attributable to the fact that emissions from HDVs in category EURO 2 are considerably higher than was to be expected on the basis of the emission limits. In addition, as a consequence of the increased proportion of diesel-fuelled vehicles in the passenger car and light duty vehicle segments, the estimated emission level for 2010 is now approximately one-third higher than the original figure. The differences with respect to HC emissions are only slight, even though evaporation emissions from motorcycles and scooters have been

additionally taken into account. The most striking change concerns particles, especially during the 1980s. This difference is attributable to the fact that estimates concerning particle emissions from petrol-fuelled vehicles were incorporated into the updated figures for the first time. On the other hand, the sharp increase in diesel passenger cars will give rise to higher particle emissions in the future. CO_2 emissions, which contribute towards the warming of the earth's atmosphere, are stagnating at a high level, even though motor vehicles are constantly growing more efficient.

Finally, a comparison between the trends in emissions and immissions from all sources, based on the example of nitric oxides, shows a close degree of similarity: here, immissions fell by 37 percent, and emissions by 36 percent. Nonetheless, additional measures are required in order to comply with the prescribed immission limits for preventing damage to health and the environment.

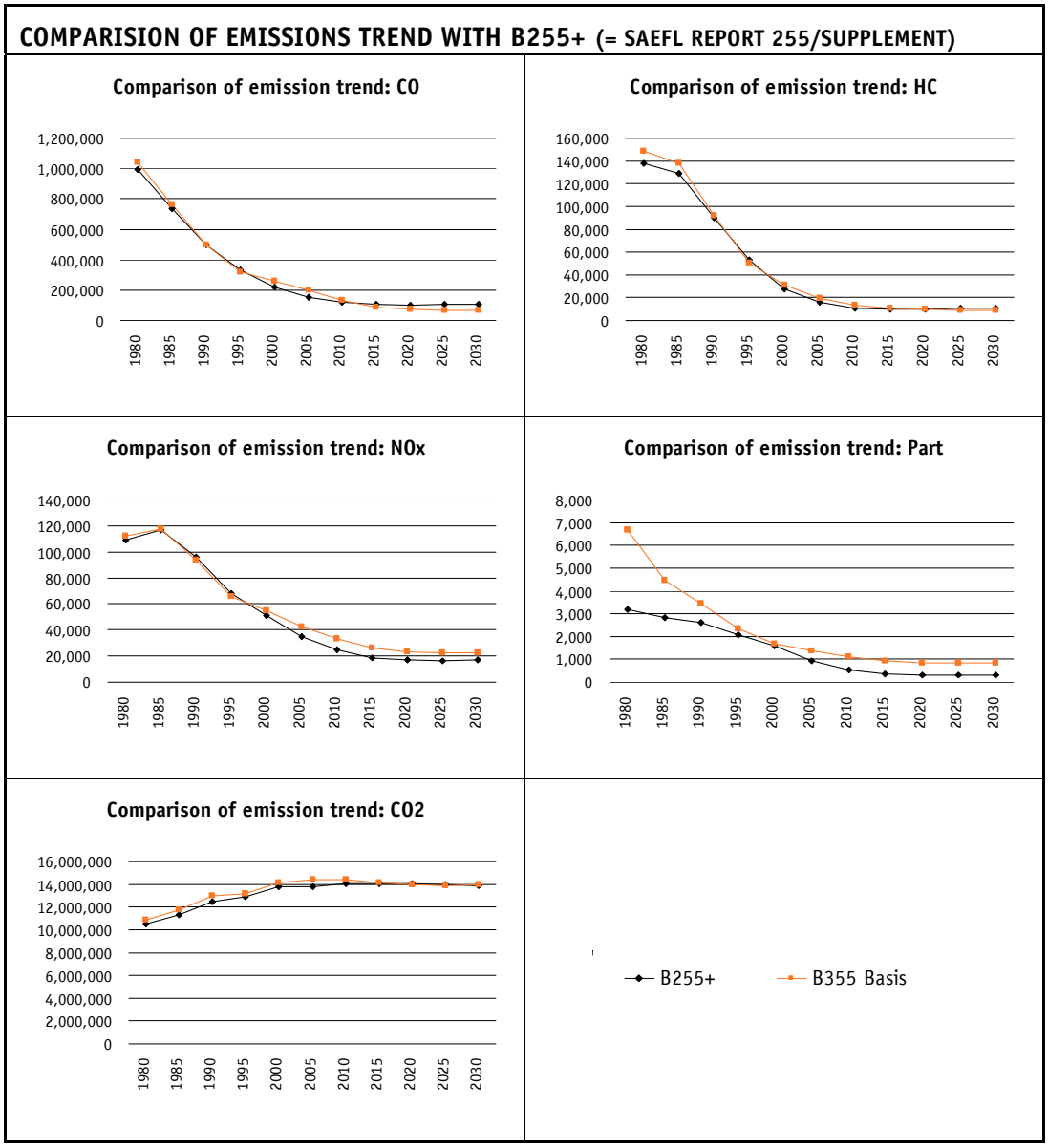


Fig. S-1 Comparison of updated emissions trend (B355) with the findings of SAEFL Report 255/Supplement (B255+).

1. INTRODUCTION

Measuring pollutants has meanwhile become something of a tradition in Switzerland: the first SAEFL report (no. 55) on this topic dates back to the mid-1980s (SAEFL 1986) and relied largely on specialised literature. However, a variety of gaps in knowledge were subsequently identified, and for this reason it was decided to initiate a comprehensive research project in the first half of the 1990s together with Germany and Austria with the aim of studying emissions from motor vehicles in greater depth. At the same time, pollutant emissions from road traffic in Switzerland were calculated for the period from 1950 to 2010. The findings from this project were documented at the end of 1995 in SAEFL Report no. 255 ("Pollutant emissions from road transport, 1950-2010") [SAEFL 1995]. At the same time the emission factors were summarised and published as a special guide [INFRAS 1995, HBEFA Version 1.1] intended to serve as a tool for a variety of applications such as compiling emission catalogues, environment impact assessments, etc. In the second half of the 1990s, some of the background conditions began to change, most notably in the area of exhaust regulations in Europe (and thus in Switzerland too), in which new emission limits were defined. In view of this, the guide to emission factors was updated for the first time in spring 1999 – again in collaboration with the environmental authorities of Germany and Austria – and was released as Version 1.2 (CD-ROM, INFRAS 1999). This was followed by a revision of Report 255 (SAEFL 2000, supplement), which reflected foreseeable structural changes such as the step-by-step increase of the HDV limit from 28 to 40 tonnes, and the introduction of the capacity-based heavy goods vehicle fee. It was already apparent at the time of publication of the above mentioned reports and documents that there was still plenty of work to be done, and that the associated activities should be co-ordinated at the international level. Co-operation was continued under the title, "D-A-CH", and in the meantime representatives from Holland and Sweden have also become involved. One of the main gaps in previously existing data concerned measurements for heavy motor vehicles, which were only available for vehicles from the 1980s. It was possible to intensify international co-operation in this area by co-ordinating the associated activities with two international projects (COST 346 and ARTEMIS, a project from the EU's fifth framework programme). This move resulted in comparatively comprehensive series of measurements that were placed at the disposal of the "D-A-CH" group, and vice versa, the findings of "D-A-CH" are also being passed on the two ongoing international projects.

In the meantime, the Handbook of Emission Factors in Road Transport has been updated again as of spring 2004 (HBEFA Version 2.1, INFRAS 2004a). This version includes emission

factors based on new readings, i.e. for heavy motor vehicles, and a variety of other points have been revised and updated. It contains emission-relevant data for Germany, Austria and Switzerland, and a dedicated web site has meanwhile been set up (www.hbefa.net), which includes an online version. The bases on which the Handbook has been prepared, as well as additions and modifications, are described in separate documents that are also available from the above web site.

This report analyses the updated emissions trend in the area of road transport in Switzerland, and reflects changes in both emission levels and traffic data. The adjustments of emission criteria are only dealt with briefly here, since they are explained in detail in the above-cited bases for the Handbook [INFRAS 2004a]. Since the various changes also have retrospective effects, the time series has been recalculated from 1980 onwards. At the same time, the time frame has been extended to 2030. In addition to a basic scenario, a number of sensitivity observations have been included in this report, which has been structured along similar lines to the latest supplement: chapter 2 describes the changes in fundamental emission criteria, chapter 3 depicts the quantitative data on which the emission calculations are based, and Chapter 4 presents the findings as well as a comparison with the previous emission estimates dating from 2000.

2. UPDATE OF EMISSION FUNDAMENTALS

The methodology for calculating emissions has remained essentially unchanged versus Report 255 (SAEFL 1999), but attention has been paid to the results of new measurements and models, a variety of assumptions have been modified to reflect the changed circumstances, and some additional criteria have been introduced. As before, wherever measurements are lacking – i.e. for future vehicle concepts – the emission factors have been estimated on the basis of fall-off rates that are oriented on the trend with respect to future emission limits in accordance with current legislation (e.g. for EURO 4, EURO 5). The following changes in terms of content were taken into account for calculating emission levels (cf. report on basis for HBEFA Version 2.1, INFRAS 2004a); also www.hbefa.net):

- Passenger cars:
  - New emission measurements up to EURO 3 (petrol) or EURO 2 (diesel).
  - New dependencies of cold-start excess on external temperature, and new cool-start curves for petrol cars (EURO 2 upwards).
- Light duty vehicles:

  - › New emission measurements up to EURO 2 (petrol) or EURO 1 (diesel).
  - › A distinction is now made between size categories “M1+N1-I“, “N1-II” and “N1-III” (previously no distinction was made).
  - › All emission factors are now indicated for an average load of 30% (previously 0%).
  - › New dependencies of cold-start excess on external temperature, and new cool-start curves for light duty petrol-driven vehicles (EURO 2 upwards).
- › Motorcycles and motor scooters:
  - › All emission factors have been completely revised and updated, including those for earlier concepts.
  - › Hydrocarbon emissions due to evaporation losses after switching off the engine are now taken into account.
  - › Adoption of future EURO 3 standard.
- › Heavy motor vehicles (HDVs and buses):
  - › All emission factors have been completely revised and updated, including those for earlier concepts.
  - › New measurements of engine maps for EURO 1, EURO 2 and EURO 3 (previously: most recent measurements represented 1980s models).
- › N_2O and NH_3 emissions now dependent on road category (motorway, rural, urban).
- › Inclusion of influence of changed fuel qualities – based on findings from international EU projects such as ARTEMIS and COST 346, which in turn have referred to EPEFE activities or updates.
- › Inclusion of recent developments in vehicle fleet (e.g. proportion of diesel cars). Here the three countries concerned used a uniform procedure for modelling the fleet composition.
- › Revision of fuel consumption of passenger cars based on measurements, respectively CO_2 emissions of new vehicles over the past few years.

3. UPDATE OF TRAFFIC FUNDAMENTALS

3.1. METHODOLOGY

Carefully calculated traffic data are essential for determining the trend in pollutant emissions. For the purpose of preparing the Handbook of Emission Factors (HBEFA 2.1), a great deal of importance was therefore attached to the continued development of the corresponding model components and improving the necessary elementary data. As with the previous calculations of road transport emissions (SAEFL 1995, SAEFL 2000), three traffic-related factors have to be taken into account:

› Traffic volumes, i.e. primarily distances (in vehicle kilometres), but also starting and stopping processes (for calculating cold-start and evaporation losses), as well as vehicle fleet (for evaporation emissions).
› Traffic composition, i.e. composition of traffic volumes by emission categories, as well by type of engine (petrol/diesel) and size category (weight or engine capacity).
› Driving behaviour, i.e. division of traffic volumes into different so called traffic situations characterised by different speed and acceleration patterns.

The first two elements have been completely revised and more closely aligned with one another, while the third has been adopted more or less without modification from previous models. Mileages (vehicle kilometres) are now calculated on a bottom-up basis in accordance with the following formula:

*Mileage in Switzerland (per annum) = vehicle fleet * specific mileage (per annum and vehicle)*

On the one hand the statistics concerning distances covered in the past years can thus be reproduced, while on the other hand it is possible to calculate the future trend with respect to distances using assumptions concerning the vehicle fleet and specific mileage in a consistent manner. In addition, it is possible to comprehensibly model the distribution of new technologies in the vehicle fleet and mileage components. Thus traffic composition and mileage trend can be determined in the same model and with the same procedure (cf. **Fig. 1**). In the context of the Handbook of Emission Factors, this model was used in order to determine the fleet compositions of all three countries (Germany, Austria and Switzerland).

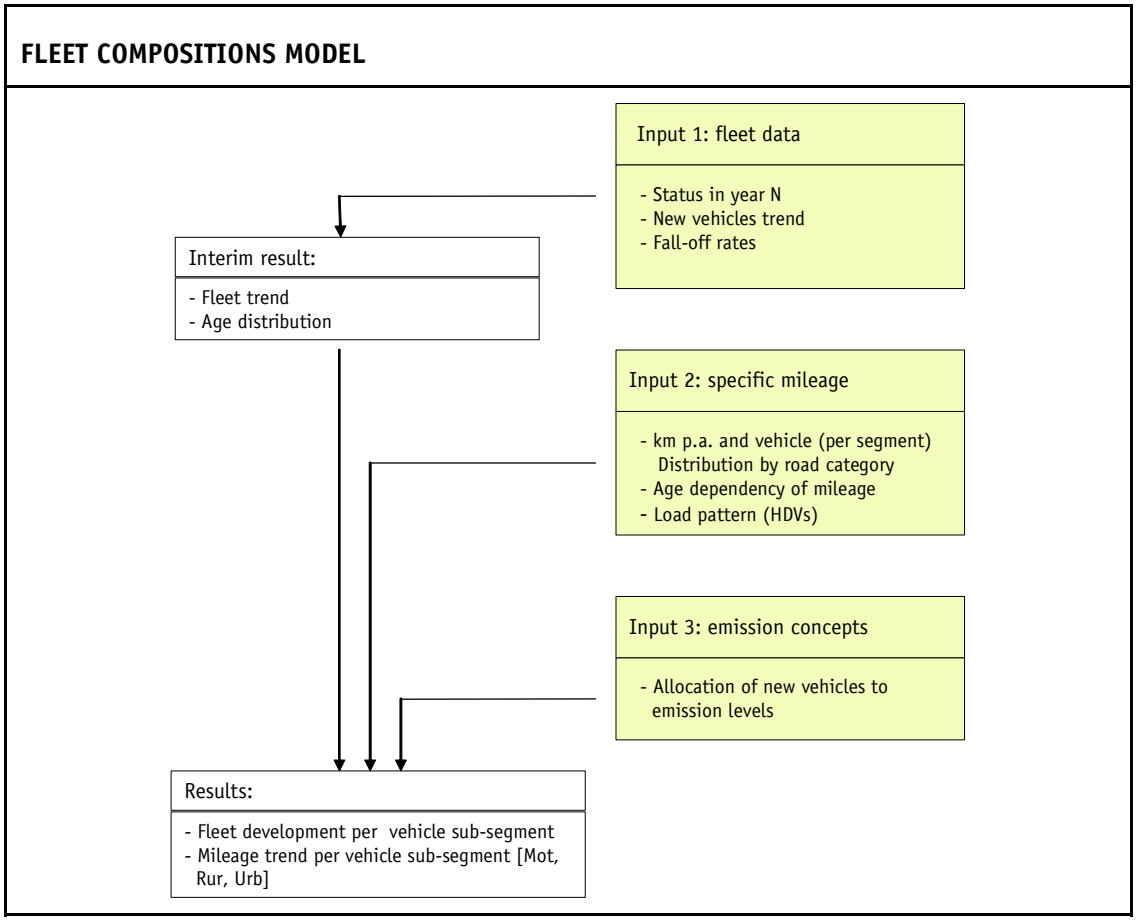


Fig. 1:Calculation of fleet and mileage trends, and fleet composition by vehicle segment.

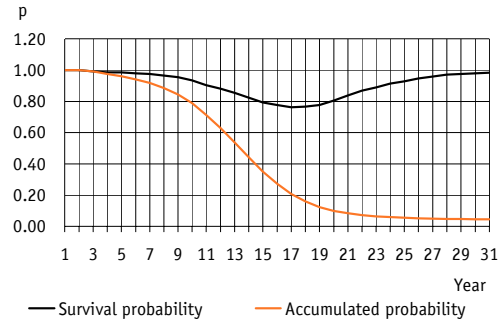
The calculation procedure is essentially divided into the following three steps:

› Step 1: **fleet input**

The first step is to model the fleet trend. The past trend is depicted on the basis of statistics of the Federal Vehicle Inspection Office concerning fleet and age distribution. Age distribution is required in order to allocate the vehicles to the corresponding emission levels in step 3. The future trend is estimated by taking a reference year, i.e. the last year, for which statistics exist (in the present case, 2002) and making assumptions concerning new registrations and life-time probabilities (or equivalent fall-off rates). In this way, the vehicle fleet for each future reference year can be depicted as the total of anticipated new registrations and the remaining vehicles from each year of registration – a model that closely corresponds to reality. Here the relatively stable fall-off rates over the course of time form a sound basis for projection. On the other hand, the comparatively uncertain trend concerning new registrations only has a minor influence since the annual volume of new regis-

trations is less than 10% of the vehicle fleet. This procedure is carried out separately for each vehicle category, though additional differentiation is made within these categories, e.g. for passenger cars by 6 sub-segments, i.e. diesel / petrol vehicles and three engine capacities (1.4 l, 1.4-2 l and >2 l). **Fig. 2** below shows an example of a life-time probability curve (left) and the trend of the passenger car fleet including age distribution (right).

DEPICTION OF FLEET TREND (EXAMPLE FOR PASSENGER CARS)



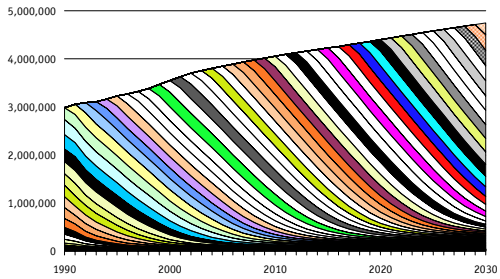


Fig. 2 The graph on the left depicts the life-time probability curve for passenger cars (status, 2001/2002). The black line shows the probability that a vehicle will still be in circulation in the following year; the orange curve shows the accumulated values (=life-time function) and indicates the probability that a vehicle will remain in circulation for x years. The vehicle fleet (passenger cars) is shown on the right, including new registrations and gradual elimination of vehicles from circulation. With a vertical line in a given reference year it is possible to read off the corresponding age distribution.

› Step 2: Depiction of **mileage**:

The mileage characteristics of the various vehicle categories are entered in the form of a second data set. Firstly the specific mileage for each vehicle category has to be defined (in kilometres per annum and vehicle). The mileage combined with the vehicle fleet figure results in the absolute mileage for each year. At the same time, the mileage is distributed over the three road categories (motorways, rural roads, urban roads). The various segments[1] now have different mileage characteristics; for example, diesel cars have a higher figure than petrol cars, heavy motor vehicles have a higher mileage than light motor vehicles, etc. For this reason, the same inputs are processed segment-specifically (specific mileage p.a., distribution over road categories) in a second step. Since this dual procedure (same inputs at vehicle category level as at segment level) can give rise to inconsistencies, a mathematical adjustment is made in order to ensure that the total figures over all seg-

1 Here, "segment" refers to a vehicle group (within a vehicle category) with the same type (petrol/diesel) and size (dimensions, cubic capacity) of engine.

ments are consistent with the mileage figures per vehicle category. Here it is the key figures per vehicle category that are of relevance, since the empirical basis is more reliable than the basis per segment. At the same time it is also possible to reflect segment-specific differences. In addition, the age dependency (per segment) is taken into consideration, since as a rule newer vehicles indicate a better mileage performance than older ones. With heavy duty vehicles, two additional inputs are taken into account: figures recorded in the motor vehicle statistics refer to traction vehicles (HDV or semi-trailer tractors). For emission purposes, however, it is overall weights that are relevant, so alongside solo trucks, semi-trailers and articulated vehicles also have to be included. It is therefore necessary to separate mileage figures for HDVs into solo and articulated vehicles, which is now possible on the basis of empirical data relating to the Swiss performance-based heavy vehicle fee. For the same reason, the load rate – which is another necessary input for characterising the mileage performance of heavy duty vehicles – is also relevant.

› Step 3: Depiction of **emission concepts**:

The third input data set establishes the link to the emissions side. Here the emission category to which new vehicles from a given year of manufacture are to be allocated is defined for each year. In this way it is possible to estimate the proportions of the various emission categories for all reference years from the combination with the fleet development differentiated by age (cf. **Fig. 3**). This procedure is carried out at the segment level. At the same time, the corresponding mileage figures per segment are also known, and from these the proportions of the various vehicle sub-segments can be calculated – weighted once by fleet and once by mileage, as required for the Handbook's emission factors.

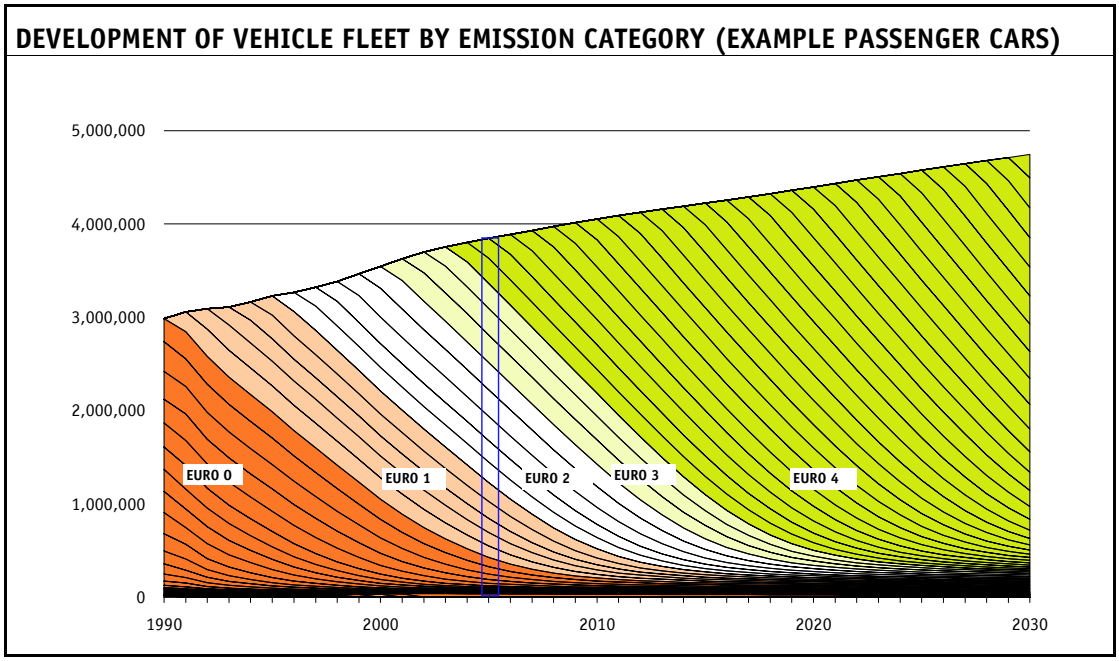


Fig. 3 This graph shows the development of the fleet by year of construction. Each segment framed in black represents a group of vehicles with the corresponding year of manufacture, and these are coloured in accordance with their main emission category. The blue rectangle indicates the status as of (in the above example) 2005. The coloured sections inside the rectangle reflect the vehicle fleet composition by emission category in 2005.

3.2. TREND IN TRAFFIC VOLUMES

3.2.1. MILEAGE

It is not possible to directly estimate how the mileage figures will develop in Switzerland[2]. Instead we have to rely on a variety of indicators and surveys. The applied models have to be constantly adapted on the basis of ongoing developments, and this in turn means that, in the updated traffic quantity data, certain figures from the past also have to be adjusted versus Report 255/Supplement (SAEFL 2000). The figures in this report relating to total mileage are primarily based on publications of the Swiss Federal Statistical Office (SFSO 2001, SFSO 2002). The sole exception here concerns HDVs, for which adjustments have been carried out and retrospective corrections have been made on the basis of data recorded in association with the collection of the Swiss performance-based heavy vehicle fee, and studies concerning the perspectives for freight transport[3]. The respective trends are described briefly below.

2 With the exception of mileage for HDVs: here it is possible to collect practically complete statistics thanks to the introduction of the Swiss performance-based heavy vehicle fee.

3 HDV-mileage was based on a not yet entirely defined data network from ECOPLAN. After revising the first draft, only sligt differencies were found (in total per annum 2020 about 1%), what will have now consequencies for the conclusions.

Please refer to **Fig. 4** for an overview in graphic form, and to Annex A2 for a summary of the respective figures. For details concerning the traffic trend, please refer to INFRAS 2004b.

Passenger cars

Up until 2001, figures relating to traffic volumes were based on SFSO 2002. Mileage figures after 1995 rose slightly more sharply than expected versus Report 255/Supplement (SAEFL 2000). This was primarily attributable to the increased volume of new vehicle registrations combined with a constantly increasing service life of passenger cars during this period. For 2020 the assumptions of the Federal Office for Spatial Development have been adopted in view of the fact that the preparation of a scenario for private motor transport has not yet been completed. These assumptions, which are based on an evaluation of related literature (ARE 2002), anticipate traffic growth of between 16 and 31 percent versus 2000. The emission calculations are based on the median (i.e. +23.5 percent in 2020 versus 2000). This is equivalent to a slight easing of growth in comparison with the current trend. The trend with respect to new registrations from 2003 onwards was estimated on the basis of the above criteria together with the additional assumption that the specific mileage per vehicle will remain more or less constant[4].

Light duty vehicles

The mileage figures for light duty vehicles were re-estimated (including retrospectively) by the Swiss Federal Statistical Office (SFSO 2001) in view of the introduction of the Swiss heavy vehicle fee (HVF). The revised figures for the period from 1990 to 1995 were slightly higher than before. Growth rates were considerably higher in the second half of the 1990s, and as a result the new figures for 2000 were 17 percent above the level anticipated in Report 255/Supplement. This increase was primarily attributable to growth in sales of large diesel commercial vehicles (N1-III). It must be assumed that this growth was at least partially due to a shift from Heavy duty vehicles to light commercial vehicles following the introduction of the Swiss performance-based HVF. We have assumed that sales will continue to climb, even though they fell sharply in 2003, partly due to the difficult economic situation, but also because the higher figures prior to 2003 were triggered by advance purchases of light motor vehicles in view of the introduction of the HVF. By contrast, specific mileage figures remained constant for each segment. But since the proportion of heavier commercial

4 Assumption: recovery of the number of new registrations after 2003 – 2010 to the average level of the 1990s, after 2010 average increase of approx, 0.4 percent p.a.

vehicles with relatively high mileage rates is expected to continue to rise, the specific mileage relating to the overall light-duty vehicle fleet will also increase up to 2010, and is only expected to stabilise after this date. Mileage figures for the period from 2000 to 2010 are therefore higher than previously estimated, and will only match those cited in Report 255/Supplement in the years thereafter.

Heavy duty vehicles

For 2001 and 2002 we have practically complete mileage figures for Switzerland thanks to the data relating to the HVF, and at the same time the perspectives for freight transport have been completely revised (ProgTrans/Infras 2004). The anticipated volumes have therefore undergone considerable modification:

› In absolute terms the mileage figures have been somewhat overestimated in the past, and they have therefore been adjusted accordingly for the years up to 2000.[5]
› The data relating to the HVF were used for 2001 and 2002.
› For 2003 and after, the figures of ProgTrans/Infras 2004 are based on significantly lower forecasts concerning the traffic and mileage trends versus earlier years.

Coaches

Mileage figures up to 1998 are practically unchanged versus Report 255/Supplement (SAEFL 2000). However, the vehicle fleet showed a downward tendency in subsequent years. The increase in mileage figures that was forecast in SFSO 2001 failed to materialise – in fact, a slight decline was recorded. It is assumed that these figures will stabilise in the future. At first glance, the discrepancy between earlier estimates appears to be considerable, but it should be noted here that the contribution by coaches to overall emissions from road transport is negligible and the adjustments that have been carried out have practically no influence on the results.

Buses

Mileage figures for public transport buses are practically unchanged versus Report 255/Supplement (SAEFL 2000). The fact that the increase in the vehicle fleet was slightly higher than previously anticipated gave rise to a slight upward trend in mileage figures. In

5 Within the scope of the revision of freight transport perspectives (ProgTrans/INFRAS 2004), the data in GVF Report 2/99 (GVF 1999) were adjusted for the period from 1998 to 2000. No adjusted estimates are available for earlier years, so the previous figures were therefore adapted in 1998 in proportion to the relative changes.

the same way as coaches, buses make a comparatively minor contribution to overall emissions from road transport in Switzerland.

Motorcycles (motor cycles and mopeds)

Motor cycles and mopeds are now grouped together in a single category instead of being treated as separate types of vehicles as was the case in Report 255/Supplement (SAEFL 2000). Here the mileage figures rose much more sharply in the second half of the 1990s than originally anticipated. This trend was primarily attributable to a boom in motor scooters, but above-average growth was also recorded in the area of large motorcycles. It is assumed that the trend with respect to new registrations will remain constant in the future. Since there are currently more new registrations than cancellations, as well as a shift towards segments with comparatively high specific mileage rates, the overall mileage will continue to increase. This means that the figures are higher in comparison with those cited in Report 255/Supplement.

Fig. 4 Mileage trend for the various vehicle categories: updated figures (B355) versus Report 255/Supplement [SAEFL 2000] (shown in million vehicle kilometres per annum)

3.2.2. FLEETS, STARTS AND STOPS

Excess emissions from starts, as well as evaporation emissions, are calculated for passenger cars and light duty vehicles in addition to warm emissions, and evaporation emissions are also shown for motorcycles. This means that, in addition to the mileage trend, forecasts concerning the development of vehicle fleets as well as the number of start and stop procedures have to be made for the above mentioned vehicle categories.

As we can see from Fig. 1, the fleet development is an integral component in the new model for calculating mileage figures. This ensures that the assumed fleet trend is consistent with the mileage scenarios. The criteria cited in chapter 3.2.1 therefore also apply to fleet trends. The corresponding data are shown in Annex A2.

The factors relating to the number of starts and stops per day have been adopted directly from Report 255/Supplement (SAEFL 2000). Until now there were no figures for motorcycles and scooters, and an average distance of 5 kilometres has been assumed. This results in an estimated 1.5 starts and stops per vehicle per day for 2000 (versus approx. 2.75 for passenger cars).

3.3. TRAFFIC COMPOSITIONS

This term refers to the composition of the vehicle fleet within a given vehicle category, not to the composition of traffic on the road by vehicle category. Data concerning this composition are essential for making emission calculations. Fleet trend and fleet compositions are now integrated components of the model for calculating volumes. The most important assumptions for each vehicle category are outlined below.

Passenger cars

The most pronounced change in composition versus Report 255/Supplement (SAEFL 2000) is the sharp increase in the proportion of diesel cars since the end of the 1990s (cf. **Fig. 5**). In 2003 the proportion of diesel cars among new vehicle registrations was already as high as 21.5 percent ("auto-schweiz" 2004)[6]. The basic scenario assumes a further increase in the proportion of new vehicles to 30 percent up to 2010, after which it is expected to stabilise at this level. Since diesel vehicles tend to indicate a high specific mileage, their proportion to the overall mileage is expected to rise to around 40 percent by 2030. By way of comparison:

6 Here it is interesting to note that a significant proportion of diesel cars in particular are in the heavy vehicles category for which higher emission limitslimits apply. However, this trend was indirectly taken into account for calculating emissions in that such vehicles belong to the respective population, so the resulting emission factors are representative for the effective fleet.

in Report 255/Supplement (SAEFL 2000) it was assumed that the proportion would remain more or less constant at between 8 and 9 percent.

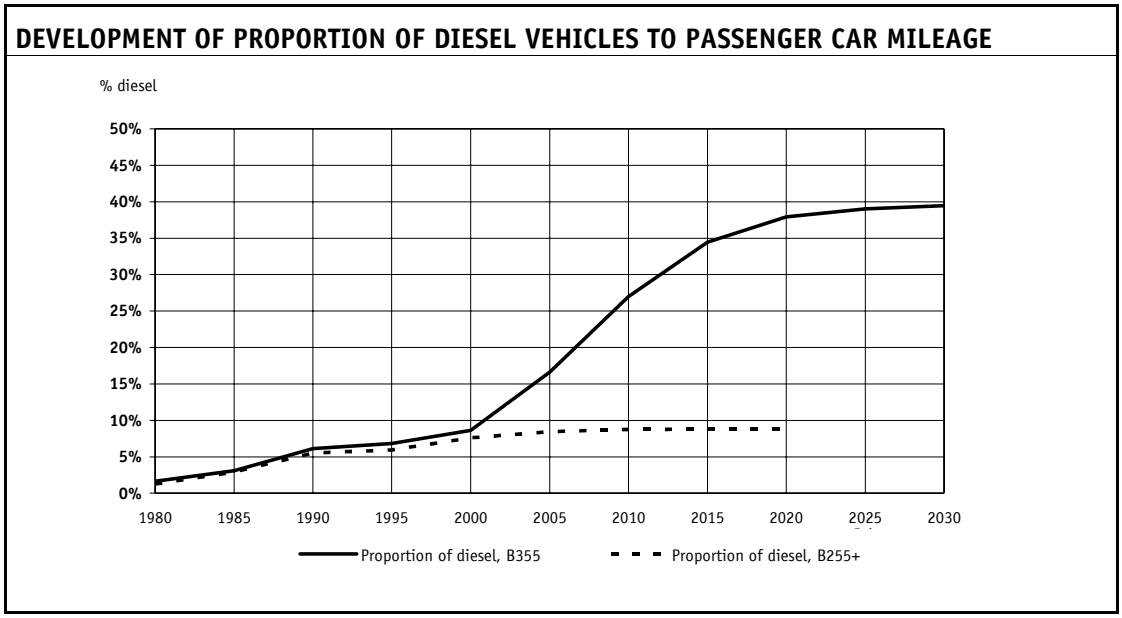


Fig. 5 Development of mileage-weighted proportion of diesel passenger cars, 1980 to 2003. Comparison between Report 355 and Report 255/Supplement

Light duty vehicles

For light duty vehicles, a distinction is now made by size category as well as by type of fuel. The three groups as defined in legislation on exhaust emissions are M+N1_I / N1_II / N1_III). The trend towards large diesel-fuelled vehicles also becomes apparent from the mileage proportions (cf. **Fig. 6**). According to the current assumptions, diesel-fuelled light duty vehicles (category N1-III) will account for approx. 70 percent of the mileage in 2030.

Significantly higher proportions of diesel-fuelled light duty vehicles are also assumed versus Report 255/Supplement (SAEFL 2000). At that time it was assumed that the proportion to overall mileage would stabilise at around 40 percent, but a figure of close to 60 percent is now already being estimated for 2003.

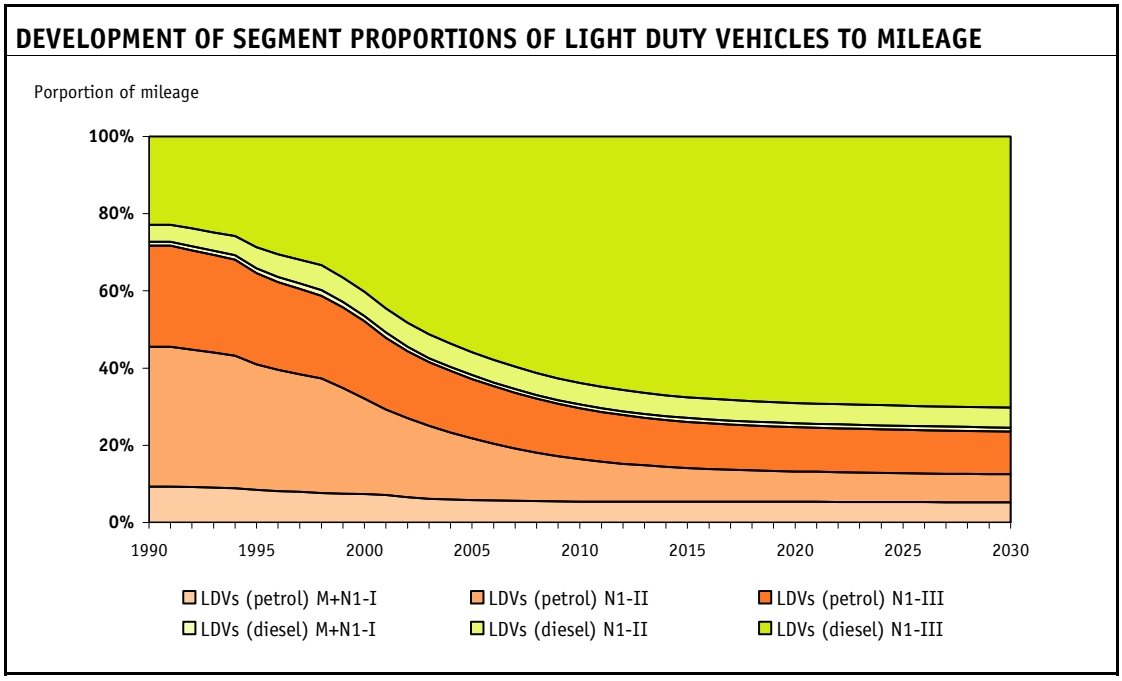


Fig. 6 Mileage proportions of the various types of utility vehicles in the period from 1990 to 2030

Heavy duty vehicles

The increase in the weight limit for HDVs from 28 to 40 tonnes, and the introduction of the Swiss heavy vehicle fee in 2001, have changed the composition of the HDV fleet. As far as the emission trend is concerned it is not so much the legally permissible weight as the real vehicle weight that is of relevance. Although a weight limit of 28 tonnes was in effect in Switzerland until 2000, it may be assumed that vehicles with a technical total weight of 40 tonnes were already on Switzerland's roads before that date, but they were usually operated with a correspondingly reduced load. The increase of the weight limit and simultaneous introduction of the HVF in 2001 therefore had impacts at different levels: on the one hand, capacity utilisation rose drastically and immediate organisational measures were taken[7], while on the other hand there was an added incentive to buy (large) new vehicles of the newest emission levels, since these would be subject to a lower HVF. Preparing a model for HDVs was also more complex since a distinction was made between their country of origin (Switzerland, other countries) on the one hand and the type of transport (domestic, import/export, transit) on the other. The graph below shows the resulting development of the HDV fleet composition.

7 Increased use of "cleaner" vehicles with relatively low HVF rates, less use of older vehicles than would be normal for their age.

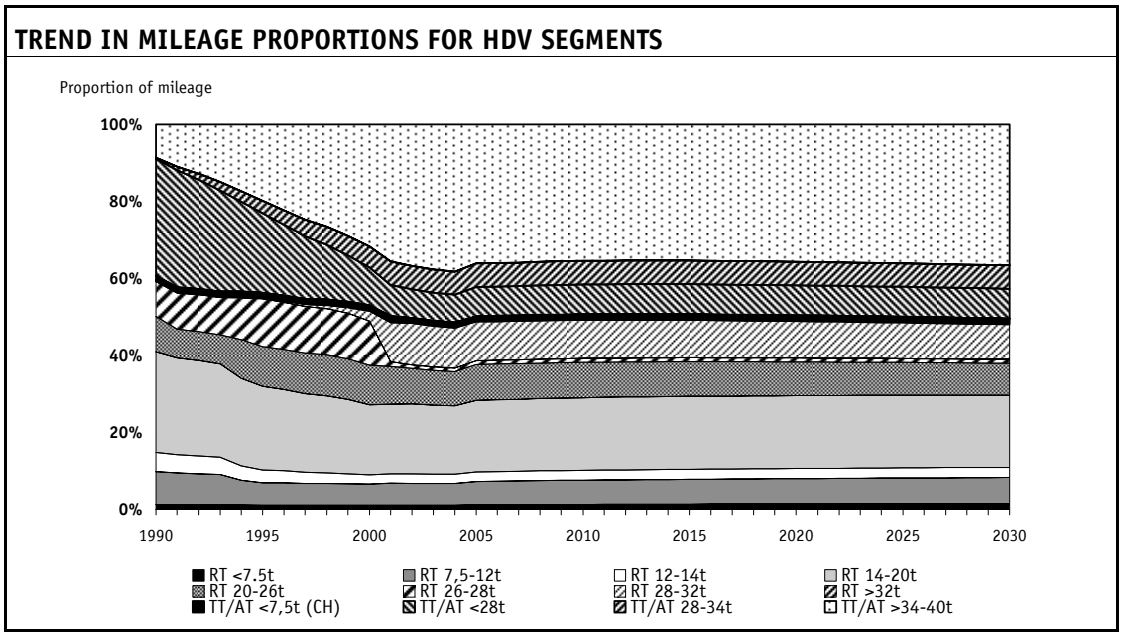


Fig. 7 Development of mileage proportions of heavy duty vehicles in the period from 1990 to 2030

Motorcycles

There are two trends with respect to motorcycles that had an impact on the segment trend (cf. **Fig. 8**:

› Instead of mopeds, it is the proportion of motor scooters that is currently increasing very rapidly. Since the service life of these vehicles is relatively short, the fleet stabilises itself comparatively quickly, assuming that new registrations remain constant.

› There is also a high number of new registrations of large motorcycles. Since their service life is much longer, the overall fleet is expected to grow over the long term, assuming a constant level of new registrations.

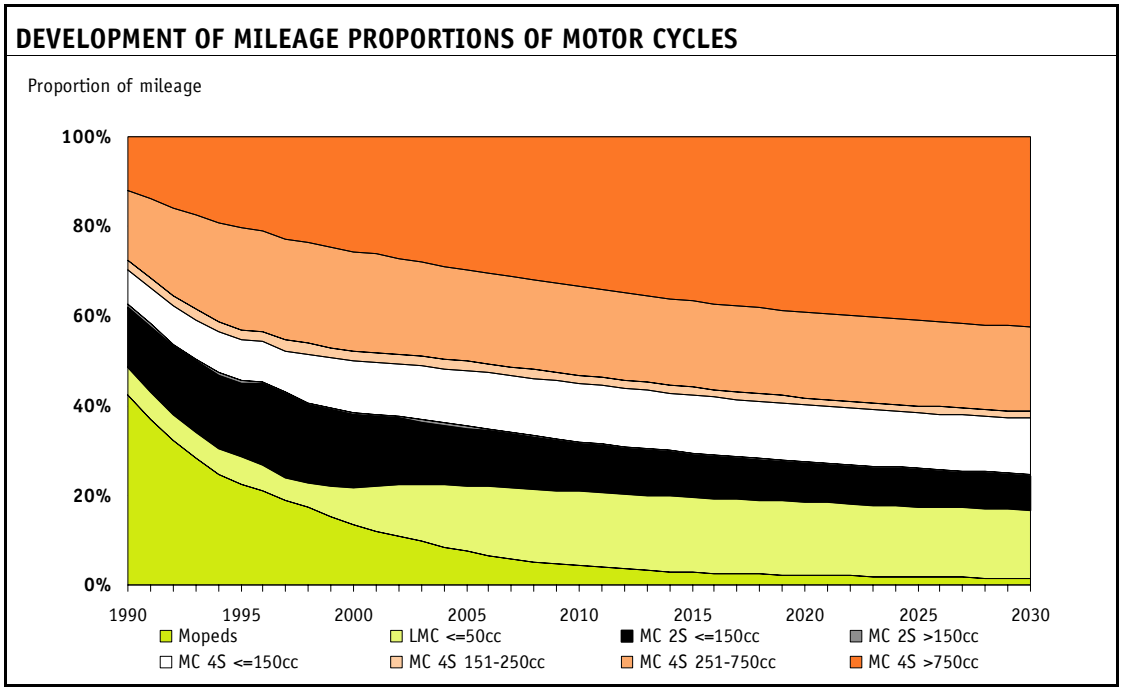


Fig. 8 Development of mileage proportions of motor cycles in the period from 1990 to 2030: mopeds, LMC: light motorcycles; MC 2S: motorcycles, 2-stroke; MC 4S: motorcycles, 4-stroke.

3.4. EMISSION CONCEPTS

The allocation of emission concepts for specific years of manufacture has only been adjusted marginally. With the exception of motorcycles, as a result of the evaluation of motor vehicle fleets in combination with type approvals there are now new statistics available. These show that new emission concepts tend to appear on the market slightly earlier than assumed in Report 255/Supplement (SAEFL 2000). However, market penetration is also slightly slower.

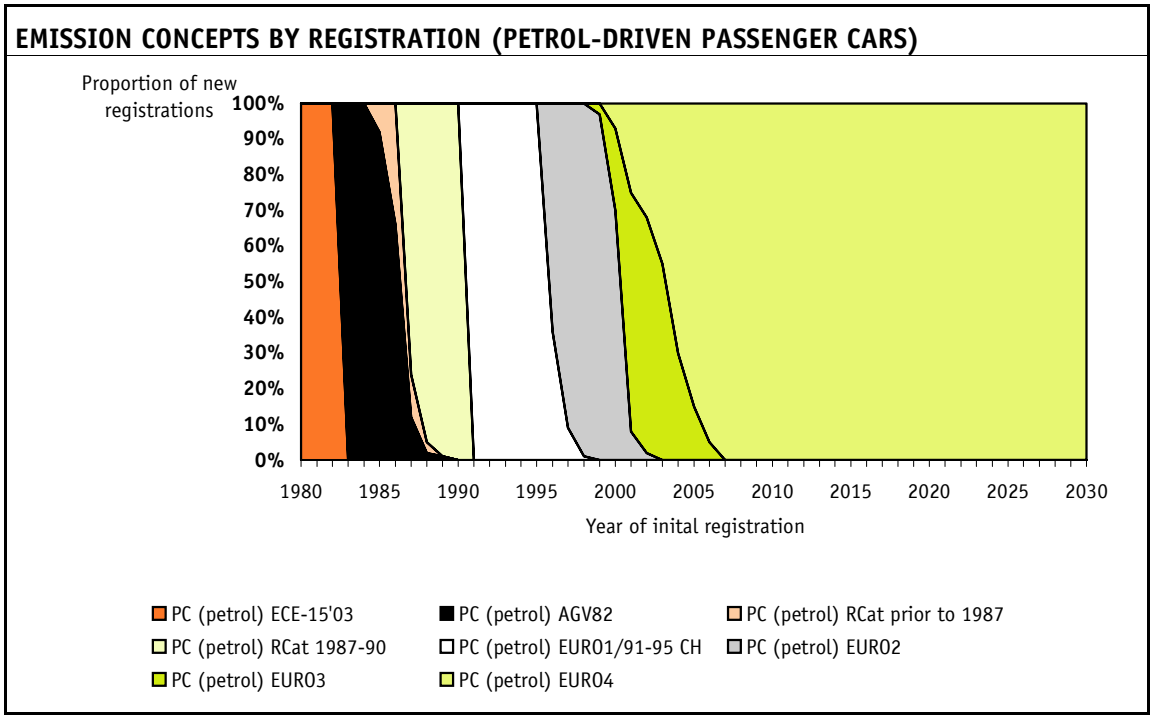


Fig. 9 Depiction of the introduction of new technological concepts in the area of petrol-driven passenger cars: EURO 4 came onto the market earlier than previously anticipated as the result of promotion measures by some cantons. However, it is also apparent here that this introduction took place on a step-by-step basis, i.e. some new vehicles still meet older standards.

The following graph shows the penetration of emission concepts in the various vehicle categories.

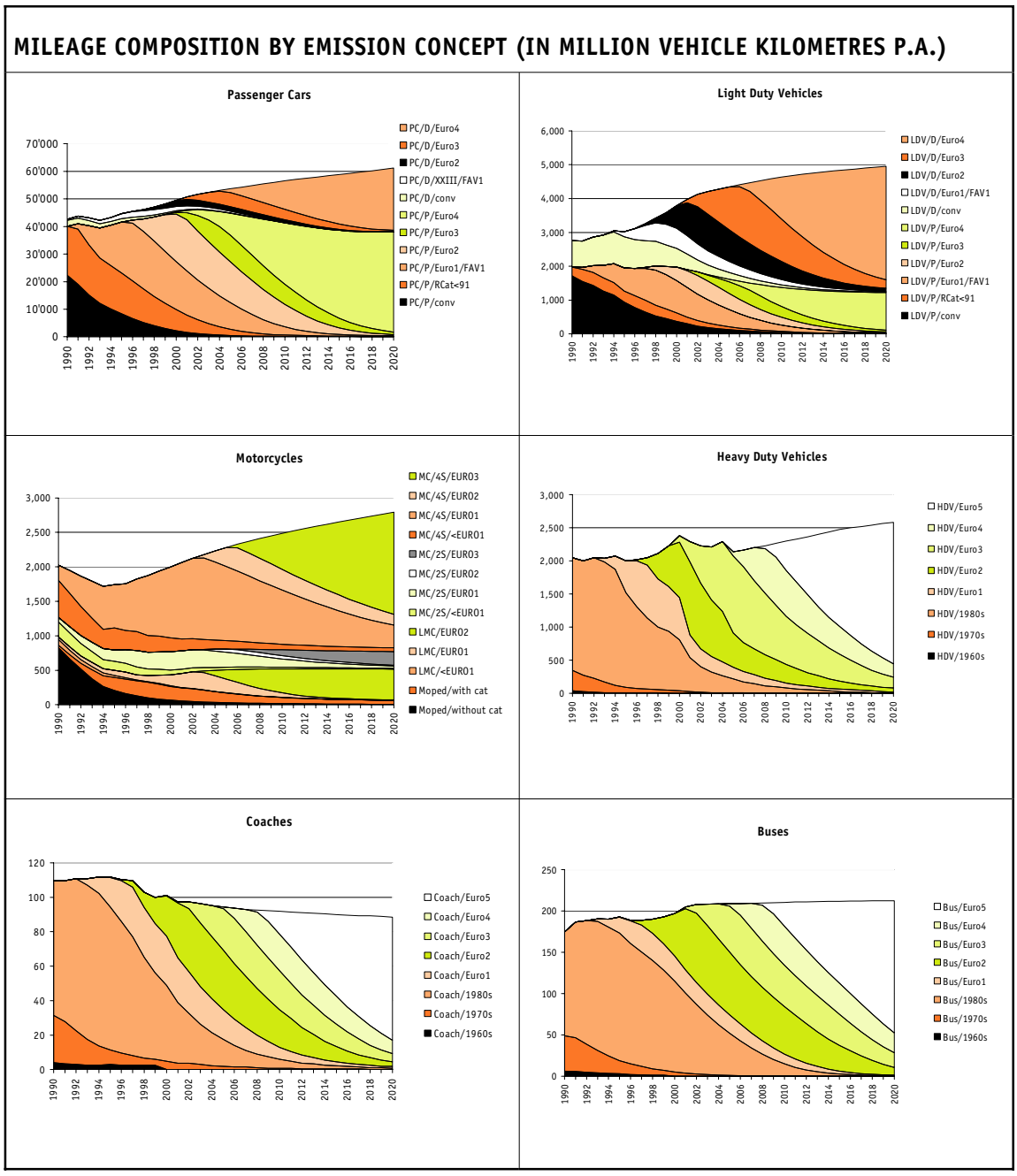


Fig. 10 Continual substitution of older technologies by new ones constantly alters the fleet composition or mileage by emission concepts in all vehicle categories. Figures are reproduced in Annex A3, but are also available in the Handbook of Emission Factors in Road Transport, version 2.1. (INFRAS, 2004a).

4. EMISSIONS TREND, 1980 TO 2030

4.1. BASIC SCENARIO: OVERVIEW

The following illustrations show the findings for selected pollutants. The figures pertaining to the pollutants shown in the illustrations and other calculated pollutants can be found in Annex A5, and the corresponding emission factors are summarised in Annex A6. The illustration depicts the time series 1980-2030; the pre-1980 figures are also reproduced in Annex A5. They have been taken directly from SAEFL Report 255/Supplement (SAEFL 2000) and have not been re-calculated. In the basic scenario all emission levels have been taken into account that are currently binding, including the future EURO 4 and EURO 5 (for heavy motor vehicles). For motorcycles, an emission level "EURO 3" has been taken as a basis (with effect from 2006). In addition, the findings from two sensitivity assessments have been depicted: on the one hand the influence of air-conditioning systems and particle filters on emissions is considered, and on the other hand the way in which the reduction of specific fuel consumption influences the trend with respect to CO_2 emissions is studied.

Fig. 11 shows the emissions trend by vehicle categories for the period from 1980 to 2030. The curves confirm the general trends that were already stated in Report 255/Supplement: the "major" reductions have already taken place. The emission level will decline further, but the extent of the reduction will lessen. The reductions in CO and HC, of which passenger cars are the main sources, were especially pronounced. SO_2 and lead are not shown in Fig. 11, but the data in Annex A5 document the direct impacts of improvements in fuel quality. With respect to HC emissions it is clear that motorcycles meanwhile account for a proportion that should not be overlooked; here, the level will soon be as high as that of all passenger cars. The reductions in NO_x emissions are also clearly visible, even though emissions from HDVs in the period from 1995 to 2000 did not decrease, but actually increased (cf. chapter 4.3.1). With respect to particle emissions it should be noted that Fig. 11 also includes estimates of particles in exhaust emissions; however, non-exhaust particles are not included – these are dealt with in chapter 4.3.2.

While we can anticipate a noticeable reduction of pollutants despite traffic growth since technical measures have not yet been exhausted and EURO 4 and EURO 5 should give rise to further reductions, this does not apply to fuel consumption. The depicted CO_2 trend shows that traffic growth practically cancels out the specific reduction among new vehicles. In line with the recently updated assessment by SAEFL (Prognos 2004) in connection with the CO_2 Act, an annual reduction rate of 2 percent was estimated (which is certainly not pessimistic).

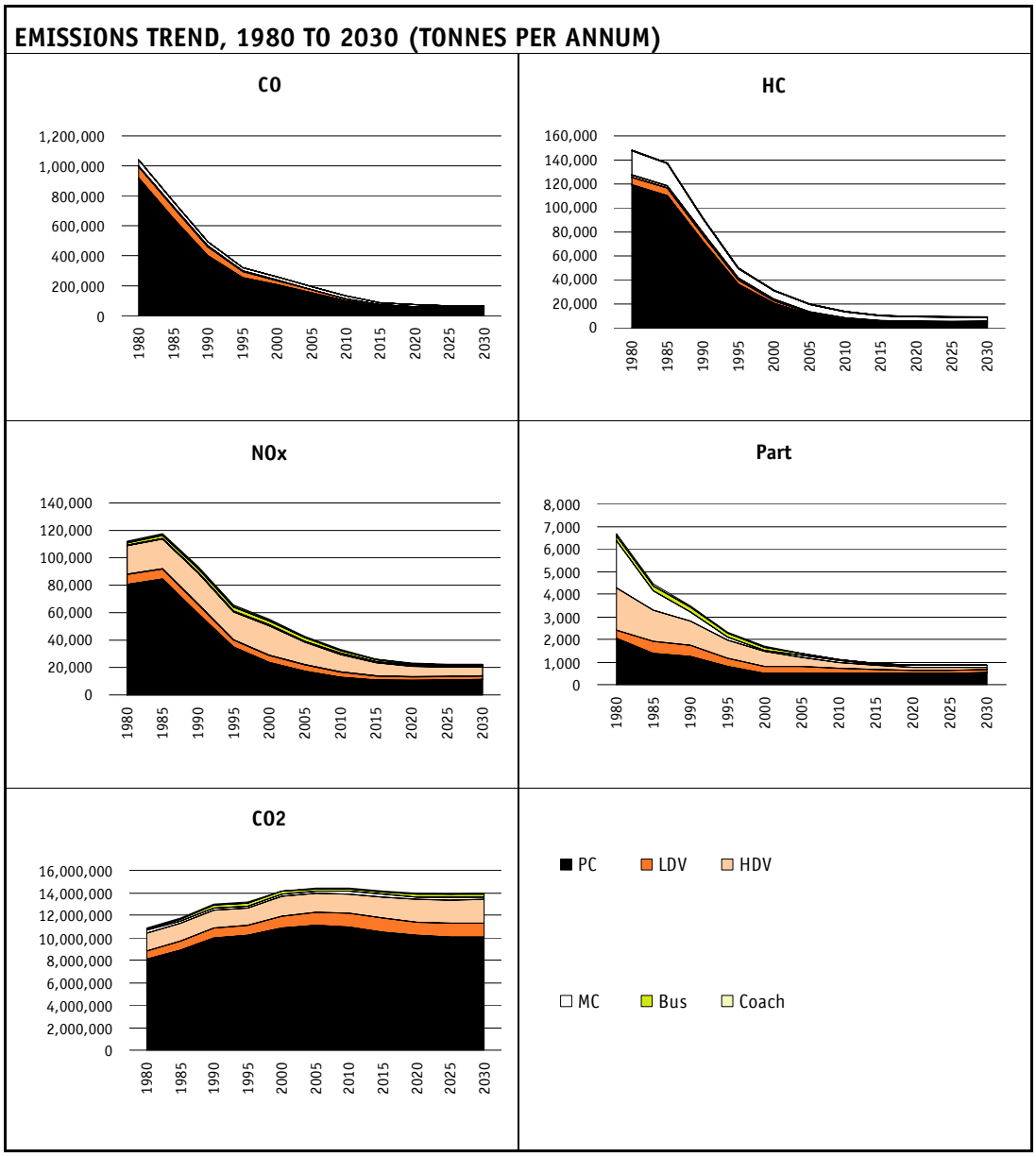


Fig. 11 Emissions trend by vehicle categories.

In the past few years, the fleet-weighted reduction was in the region of 1.5 percent per annum. The agreement between "auto-schweiz" and DETEC targets a reduction rate of 3 percent (cf. chapter 4.4.3). The declared objective of reducing CO_2 missions to 8 percent below the 1990 level by 2010, as postulated by the CO_2 Act, is therefore likely to be missed by a considerable margin. (To be more precise, this target refers to CO_2 emissions in accordance with the "sales" principle – see below).

CO2 emissions by territorial and sales principle

In this report, CO_2 emissions have been recorded on the basis of the territorial principle. In other words, the data refer to emissions resulting from vehicles travelling on Switzerland's road network. But for the CO_2 Act, as well as for the greenhouse gas inventory in accordance with the Kyoto Protocol, emissions have to be recorded on the basis of the "sales" principle. Here the volume has to be indicated that has been sold in Switzerland within each year. This is a clearly verifiable figure. The corresponding energy volumes are reported in the overall statistics of the Swiss Federal Office of Energy. Diesel sales were reduced by off-road data in order to record the sales of diesel for use on the road network.

The fact that prices of motor fuels differ considerably between Switzerland and its neighbouring countries gives rise to the practice of fuel tourism. This means that motorists buy fuel in the country in which it is cheaper, but actually consume it abroad. Thus a certain proportion of petrol sold in Switzerland is in fact consumed abroad, and in the case of diesel the situation is reversed. The proportion of petrol tourism is greater than that of diesel tourism, and this means that CO_2 emissions recorded on the basis of the sales principle are higher than those recorded on the basis of the territorial principle. The table below presents a comparison between the two sets of figures.

The following web sites provide detailed information concerning the status and trend of CO_2 emissions on the basis of the sales principle:

› CO_2 statistics:
http://www.umwelt-schweiz.ch/buwal/en/fachgebiete/fg_kLDVma/daten/co2-stat/index.html

› Greenhouse gas inventory:
http://www.umwelt-schweiz.ch/buwal/en/fachgebiete/fg_kLDVma/daten/thg-inv/index.html

› CO_2 assessment with future CO_2 trend:
http://www.umwelt-schweiz.ch/imperia/md/content/oekonomie/kLDVma/fakten/33.pdf

CO_2 EMISSIONS FROM ROAD TRANSPORT IN SWITZERLAND (IN MILLION TONNES)

	Territorial principle (applies to this report)	Sales principle (relevant for the CO2 Act and Kyoto Protocol)
1990	12.97	13.76
1995	13.15	13.48
2000	14.18	15.25

Table 1 CO_2 emissions from road transport in Switzerland

4.2. COMPARISON WITH THE SUPPLEMENT TO REPORT 255

4.2.1. EMISSIONS TREND

The updated emissions trends only deviate slightly from the previously published calculations (cf. **Fig. 12**). The most striking change concerns particles, especially during the 1980s.

This difference is mainly attributable to the fact that estimates concerning particle emissions from petrol-fuelled vehicles were incorporated into the updated figures for the first time[8].

Furthermore, it is apparent that in the period from 1995 to approx. 2010, the reduction in pollutants is taking place at a slower pace than had been assumed a few years ago. This especially applies to NO_x emissions, the reduction rate of which was considerably slower than anticipated. The estimated 2010 level has therefore been adjusted to approximately one-third higher than in the report published in 2000 (2010 NO_x emissions according to Report 255/Supplement: 24,500 tonnes per annum; revised estimate: 33,000 tonnes per annum). The differences with respect to HC emissions are only slight, even though evaporation emissions from motorcycles have been additionally taken into account.

4.2.2. TREND IN EMISSION FACTORS

The differences in estimates of the emissions trend are partly attributable to the fact that the traffic volumes have been updated or their future trends have been re-assessed. A major factor here is that the growth in the passenger car volume was slightly higher in the period from 1995 to 2002 than was assumed in Report 255/Supplement, and this trend is expected to continue in the future. With respect to HDVs, the present-day level was adjusted downwards, and the pace of development has been assessed more cautiously. As a result, the projected mileage figures for HDVs (for example in 2010) are around 20 percent lower (cf. chapter 3.2 and Fig. 4).

The comparison of specific emissions in **Fig. 13** shows that notable differences only occur in certain cases:

› NO_x emissions from HDVs in 1990 are at a roughly similar level (around 11 g/km), but they then fall significantly more slowly, with the result that in 2005 the mean emission factor is only around 8 g/km instead of 6 g/km as previously anticipated.

8 These figures are not included in the Handbook of Emission Factors (HEBFA 2.1). The corresponding assumptions concerning particulate matter emissions from petrol-driven vehicles have therefore been reproduced in Annex A4.

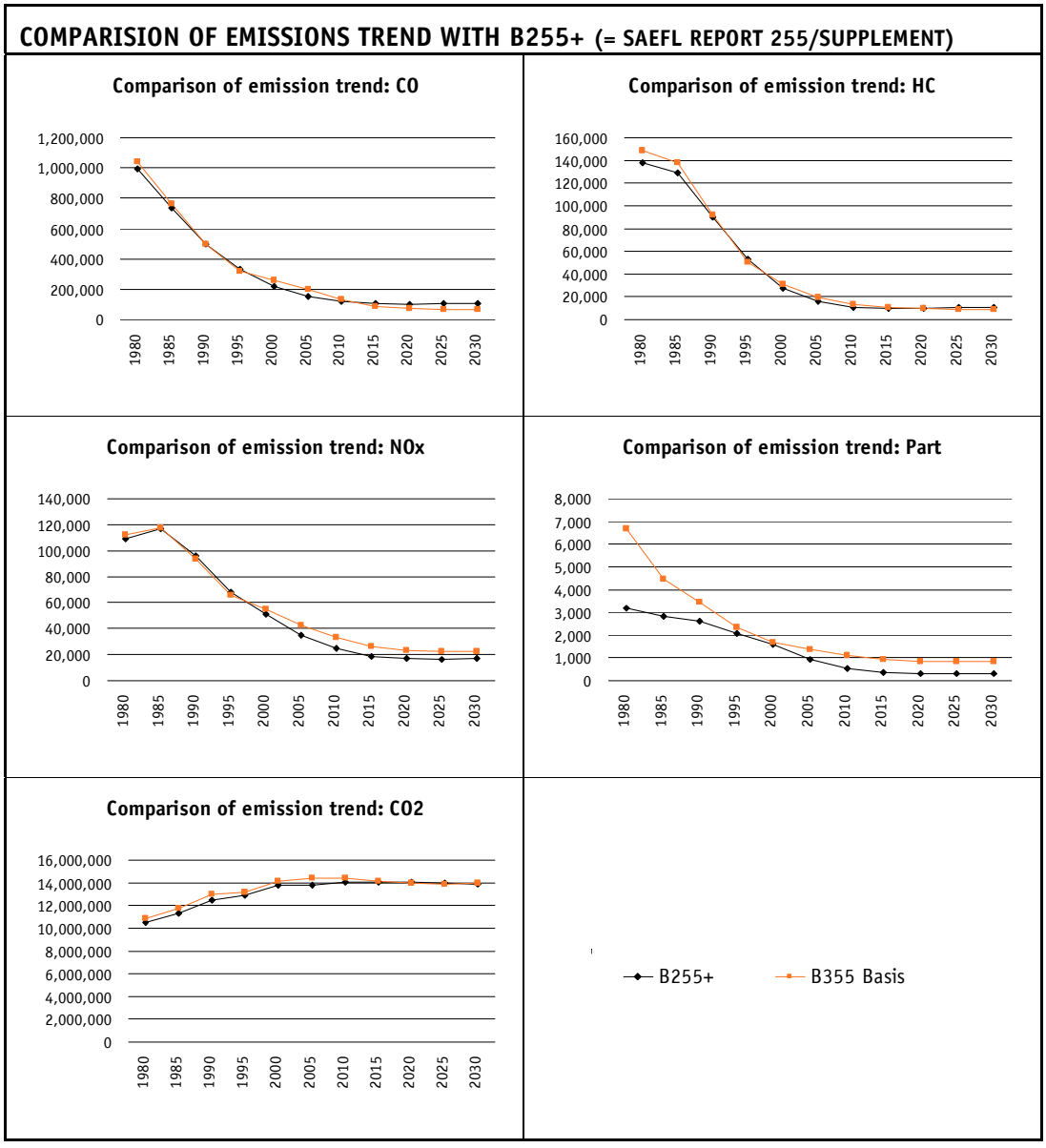
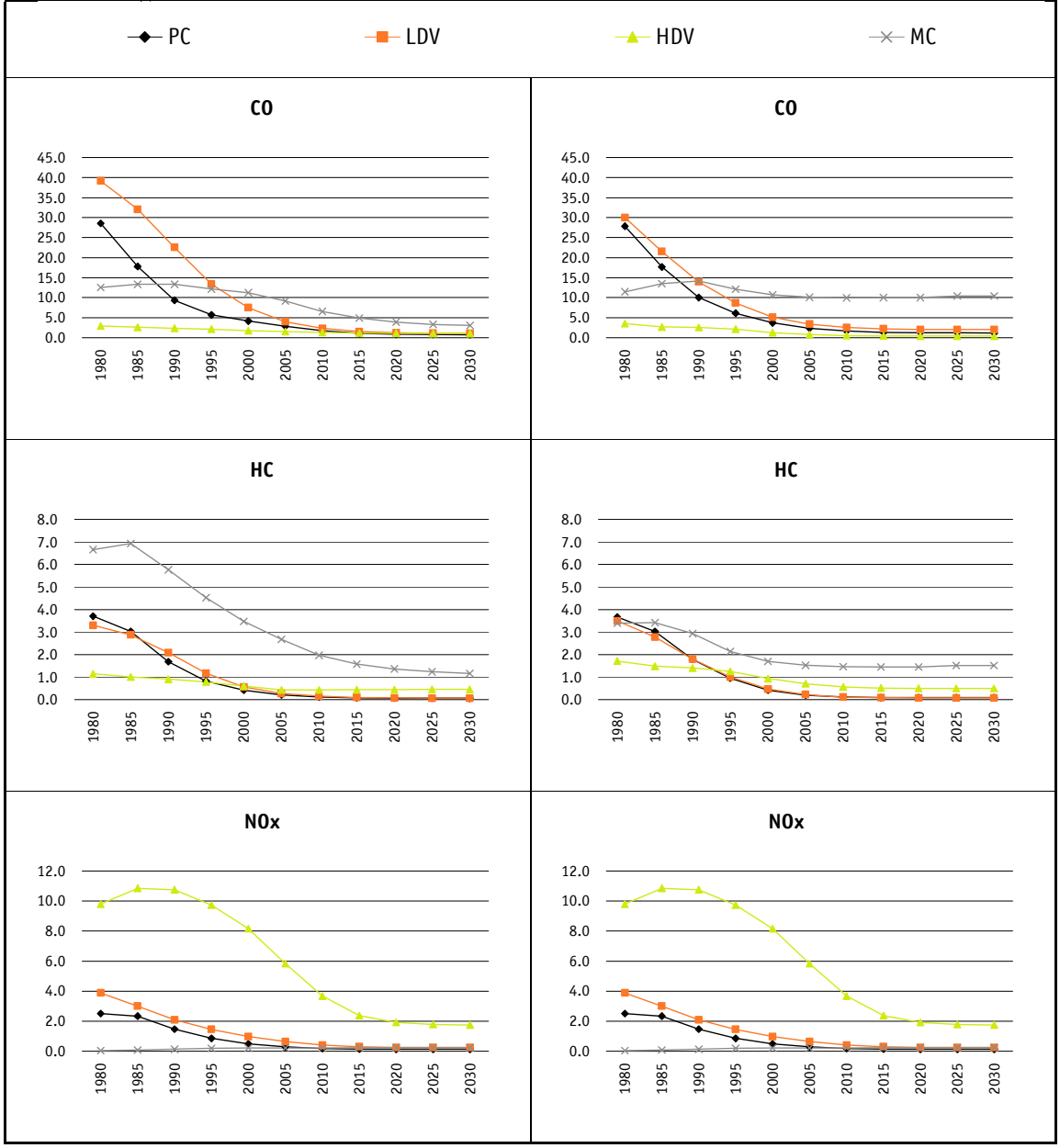


Fig. 12 Comparison of updated emissions trend (B355) with the findings of SAEFL Report 255/Supplement (B255+).

COMPARISON OF EMISSION FACTORS IN B355 AND B255 (IN G/KM)

B355	B255 (Supplement)



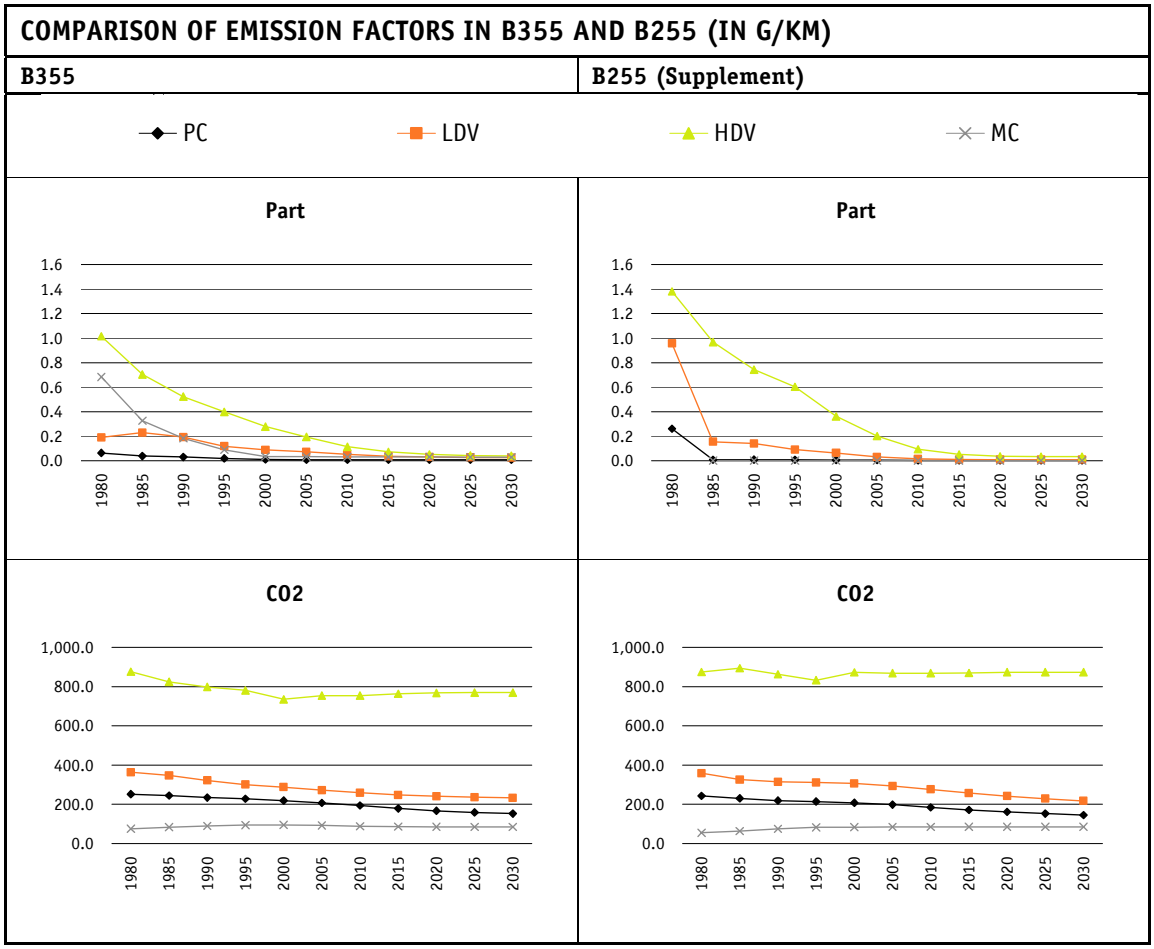


Fig. 13 Comparison of emission factors between the updated report (B355) and SAEFL Report 255/Supplement (B255+).

› With respect to HC emissions, the estimates for motorcycles have been adjusted sharply upwards, e.g. almost doubled for 2005 (3 g/km versus the previous estimate of 1.6 g/km), but this is only partially attributable to the inclusion of evaporation emissions in the calculations. At the same time, they indicate a significantly higher level versus passenger cars: motorcycles 2005: 2.67 g/km versus passenger cars 2005: 0.21 g/km.

› For light duty vehicles, the emission levels for NO_x and CO, at least those of older models, have to be adjusted upwards. This is partly because the proportion of diesel vehicles is now higher, but also in order to more realistically reflect the load rate.

› Estimates concerning particle emission factors for heavy duty vehicles have been adjusted slightly downwards. At the same time, PM 10 emissions of motorcycles were added, though these are based solely on estimates (cf. Annex A4)

› For CO_2, estimates concerning the emission level for passenger cars have been generally adjusted upwards versus Report 255/Supplement. In this way the fuel balance (i.e. comparison between overall consumption and sales) can be presented more plausibly. Furthermore, the periodical release of findings from surveys conducted by "auto-schweiz" since 1995 concerning fleet-weighted consumption by new vehicles indicate that the mean consumption level was underestimated until now.
› For HDVs, the estimates concerning energy consumption (or specific CO_2 emissions) have now been adjusted slightly downwards.

4.3. DETAILED ANALYSES AND INTERPRETATIONS

Generally speaking, the emissions trend (i.e. changes versus previous findings) is attributable to a variety of causes. We would like to illustrate this here on the basis of two examples: the trends with respect to nitric oxides and particle emissions.

4.3.1. NITRIC OXIDE EMISSIONS FROM HEAVY DUTY VEHICLES

In Fig. 11 we can observe the special trend for nitric oxide emissions: while emissions from light motor vehicles have fallen constantly, this is not the case with heavy-duty vehicles. As already described above, there are various causes at play here, some of which are conflicting: on the one hand, the level of specific emissions from HMVs (NOx) is higher than previously assumed, and at the same time the reduction is taking place at a slower pace than expected. And on the other hand, estimates concerning both the present-day traffic volume and traffic growth have been adjusted downwards. Thus these two contradicting trends tend to balance one another out (cf. **Fig. 14**).

However, the situation was exceptional in the period from 1995 to 2000: here, emissions actually increased, viewed in absolute terms. The volume of HDV traffic apparently fell during this period. At the same time, specific NOx emissions from HDVs barely declined at all, even though EURO 2 was introduced in 1996, which stipulates lower limits than EURO 1 (7 instead of 9 g/km; cf. Annex A1). But new measurements have revealed that emissions from EURO 1 motors were already close to the EURO 2 standard. Higher NOx emissions in the uncontrolled range, i.e. outside the area controlled by the R 49 cycle, resulted in a situation in which EURO 2 motors under real operating conditions indicated a higher emission level than EURO 1 vehicles. Only EURO 3 reduces the level to below that of EURO 1, though the difference is considerably less pronounced than a comparison of emission limits would

suggest. The updated curve for emission factors therefore is not as steep as previously assumed.

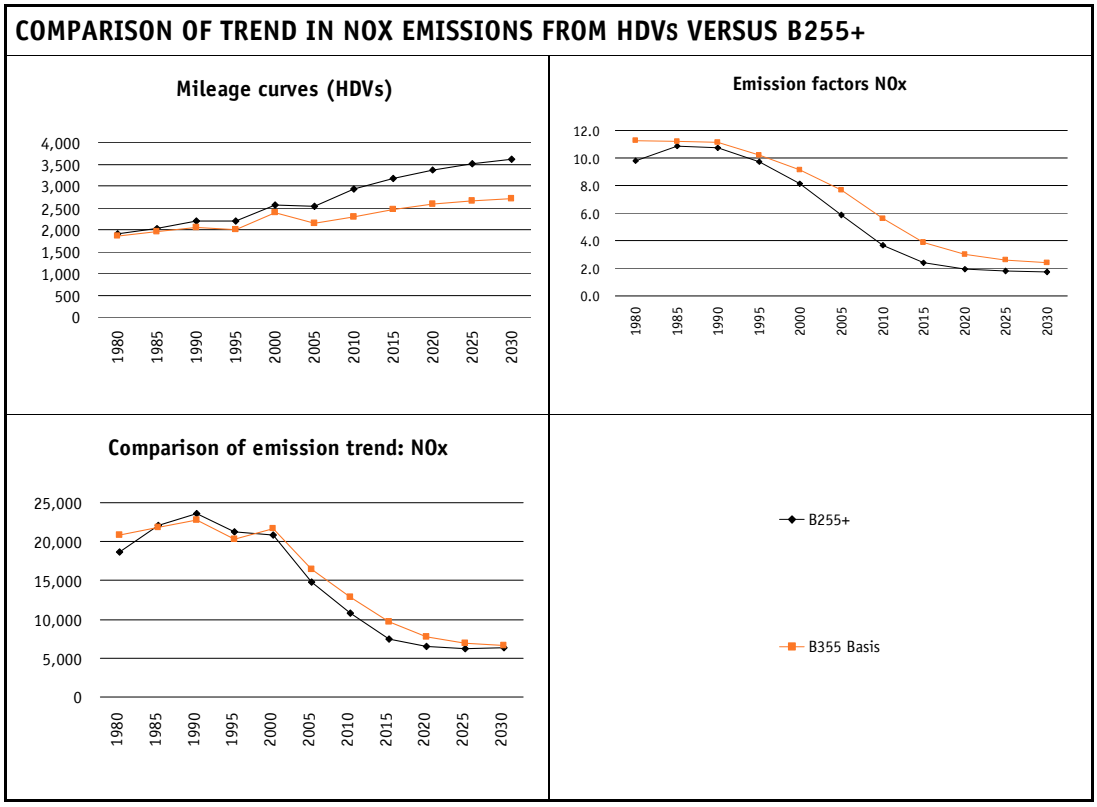


Fig. 14 Trend in mileage (million vehicle km p.a.), NOx emission factor (g/km) and NOx emissions (tonnes p.a.) from HDVs. Updated figures and comparison with SAEFL Report 255/Supplement.

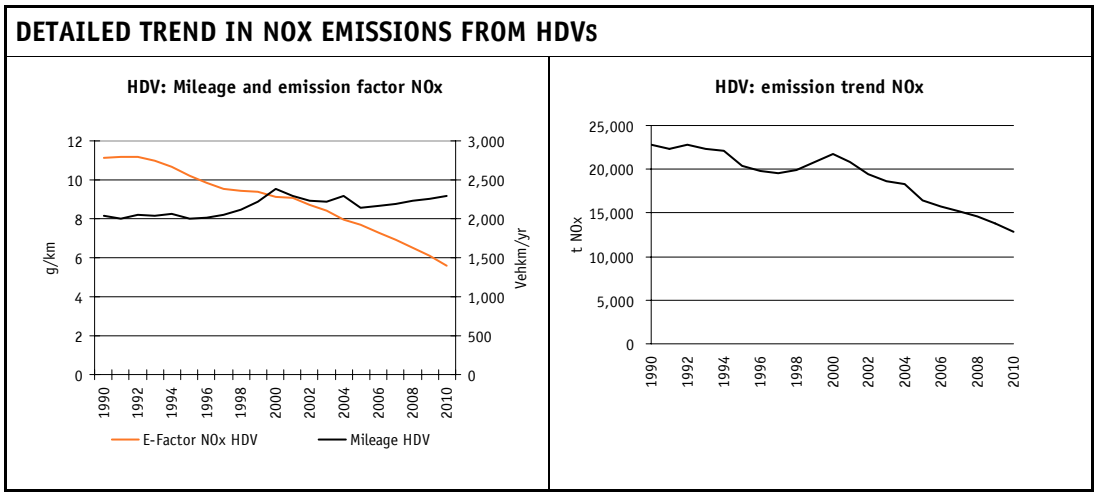


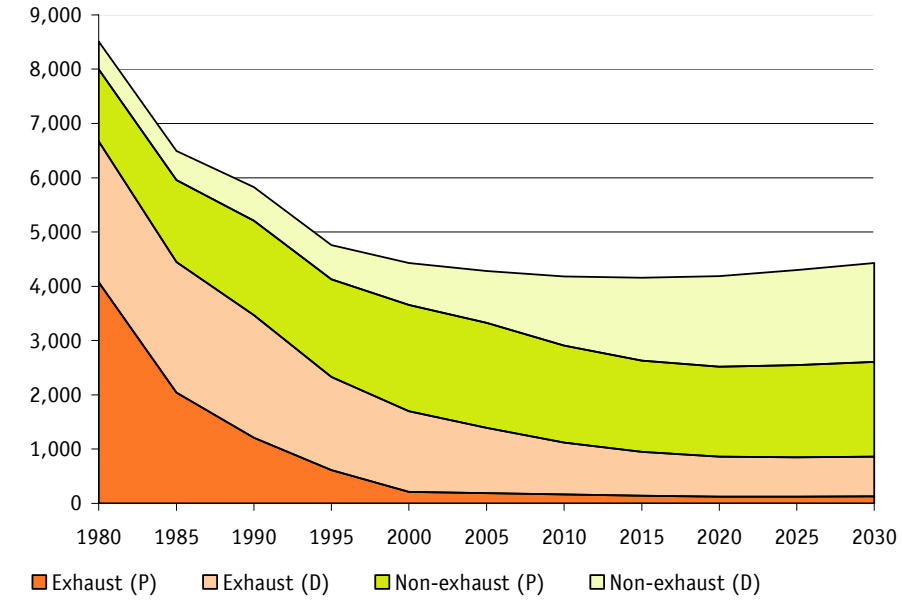
Fig. 15 Details concerning the trend in mileage, NOx emission factor and NOx emissions for HDVs.

The picture with respect to particle emissions was more consistent, i.e. clear reductions were identified between “pre-EURO 1”, EURO 1 and EURO 2, though the trend from EURO 2 to EURO 3 is not so readily apparent (reductions as well as increases were identified, depending on the vehicle category).

4.3.2. PARTICLE EMISSIONS

The previously cited particle figures encompassed exhaust emissions (though they now include estimates regarding the contribution from petrol-driven vehicles). **Fig. 16** shows the overall particle emission volume if emissions caused by abrasion and resuspension are additionally taken into account (the applied emission factors are summarised in Annex A4). The illustration shows that non-exhaust emissions already account for around one-third of overall PM10 emissions today, and approximately two-thirds in 2010. It also shows the various sources, differentiated by vehicle category (lower section).

PARTICLE EMISSIONS BY SOURCE: EXHAUST/NON-EXHAUST FROM PETROL / DIESEL VEHICLES (IN TONNES PER ANNUM)



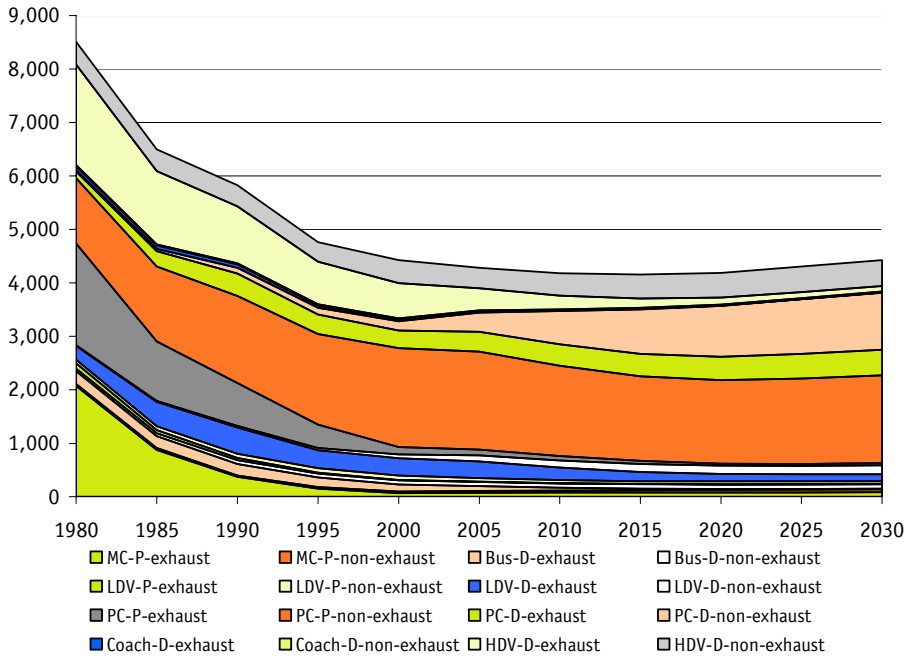


Fig. 16 Composition and development of the various types of PM10 emissions (refer to Annex A4 for figures; emission factors for abrasion/resuspension based on SAEFL 2003).

4.4. SENSITIVITIES

4.4.1. INFLUENCE OF AIR-CONDITIONING SYSTEMS

Air conditioners (A/C) give rise to increased fuel consumption as well as higher pollutant emissions, and these effects were not taken into account in the past. Today, a large proportion of new vehicles is equipped with air conditioners. It is therefore important to calculate the resulting additional emissions. In the new version of the Handbook of Emission Factors (HBEFA 2.1) an attempt was made to estimate the approximate extent of this effect. However, the volume of available measurements is limited, and little reliable material is available with respect to the frequency with which air conditioners are used. This estimate is therefore merely indicative and more intensive studies need to be carried out.

For estimating the impacts on pollutant emissions and fuel consumption, reference was made to a method that was developed for the US emission model, MOBILE6 (for further details, please refer to INFRAS 2004a). This method was then extended and adapted to central European conditions. It is based on measurements on vehicles in which the additional emissions are normally measured when the air conditioner is operating at full power. In order to estimate the length of time air conditioners are in use, reference is made to a heat index that comprises outside temperature and relative humidity. The second sensitive factor is the proportion of vehicles that are equipped with air conditioners. **Fig. 17** shows the assumptions on which estimates were made, and **Fig. 18** shows the results. These indicate that the effect is most noticeable with respect to CO emissions, and significantly less pronounced for HC and NOx emissions. As far as particles are concerned there were not enough figures available for us to include any comments here. For CO_2, findings are based on studies such as TNO (2002), according to which the additional fuel consumption of a vehicle equipped with an air conditioner in Europe is 0.3 litres per 100 km. This corresponds to the figure obtained on the assumption that an air conditioner is in operation 19 percent of the time.

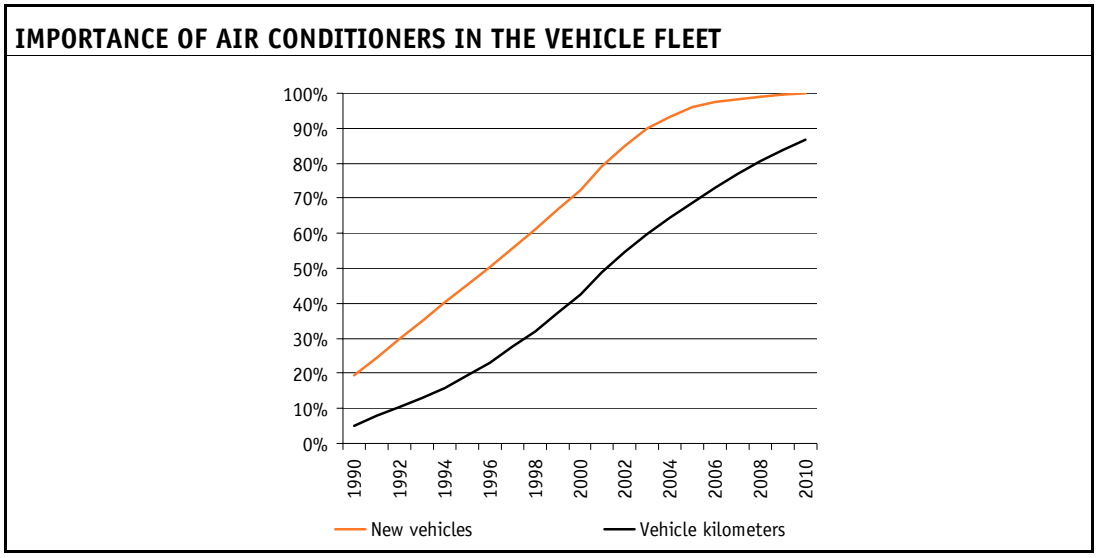


Fig. 17 Proportion of new vehicles equipped with air conditioners, and proportion of mileage covered by vehicles equipped with air conditioners.

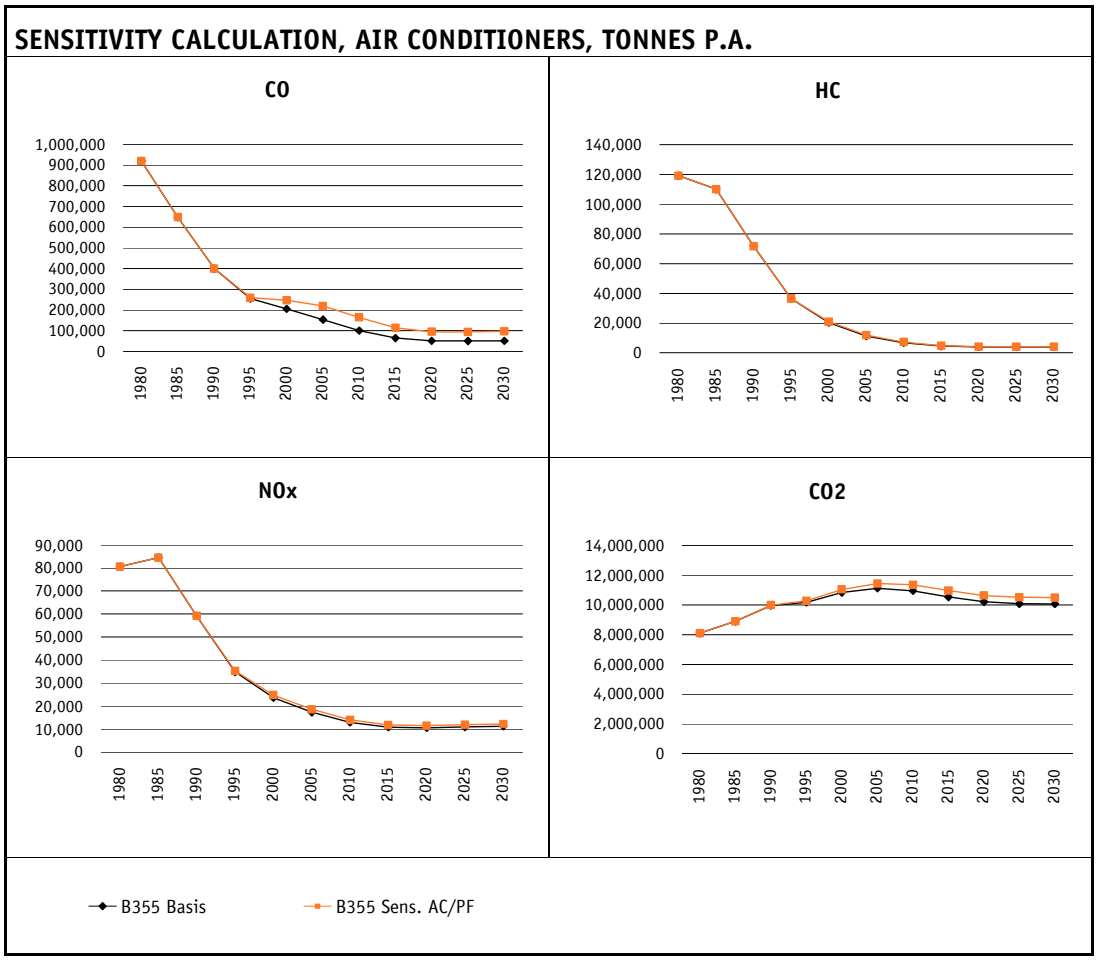


Fig. 18 Emissions trend without (B355 basis) and with (B355 Sens AC/PF) air conditioners in cars.

4.4.2. PARTICLE FILTERS

Particle filters (PF) are able to greatly reduce emissions. Measurements show that they are capable of holding back around 90 percent of particle emissions. This applies to both light and heavy motor vehicles. However, they also give rise to a slight increase in fuel consumption: for light motor vehicles, 1 percent and for heavy motor vehicles, 3 percent[9]. By contrast with air conditioners, the assumption here is primarily based on how large the proportion of vehicles will be that are equipped with particle filters in the future. This in turn greatly depends on the future development of exhaust limits. Annex A7 provides background information about the assumptions that are made in the handbook to serve as examples.

4.4.3. CO2 SENSITIVITY

How CO2 emissions from road transport will develop in the future depends partly on traffic growth, and partly on technological progress, i.e. how efficient motor vehicles will be in the future. For passenger cars, which accounted for around three-quarters of CO2 emissions in 2000 (10.8 of 14.2 million tonnes), the already mentioned target agreement between "auto-schweiz" and the Federal Department of the Environment, Transport, Energy and Communications calls for a reduction in the specific fuel consumption of new motor vehicles by 3 percent p.a., or a reduction from 8.4 litres per 100 kilometres in 2000 to 6.4 litres in 2008. In the past, the reduction has usually averaged around 1.5 percent p.a. For the basic calculation, a reduction of 2 percent has been assumed here. From **Fig. 19** we can see how sensitive this assumption is: if the reduction remains on the present course, the CO2 trend will have been underestimated. If the target agreement were to be met, the level of CO2 emissions in 2010 would be around 0.3 million tonnes lower than shown in the basis calculation. If no efficiency gains were to be realised at all, or if the technological efficiency gains were to be primarily invested in more powerful and heavier vehicles, the emissions level in the future would be much higher than assumed here: in the medium term (2010) by around 0.5 tonnes, in the long term (2020) by approx. 2 million tonnes[10].

9 The Handbook of Emission Factors assumes these levels if option "PF" (particle filter) is selected.

10 By way of comparison: from the present-day perspective the target gap is approx. 2.4 million tonnes of CO_2, cf. chapter 4.1.

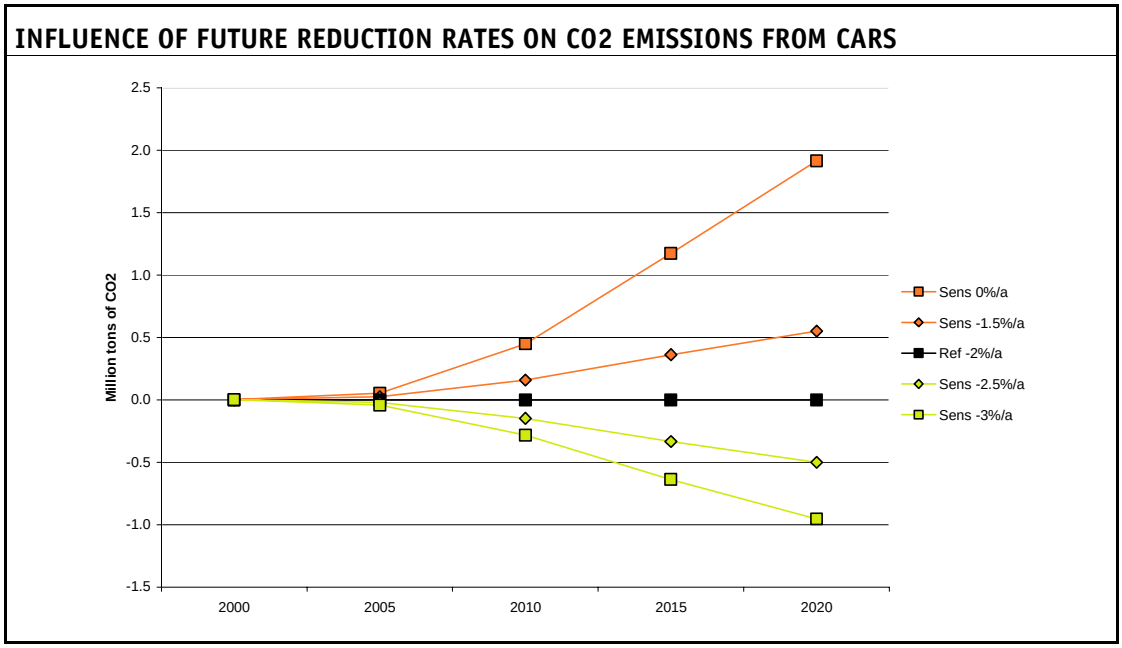


Fig. 19 The assumptions concerning efficiency gains from future vehicles have a considerable influence on the CO_2 emissions trend.

4.5. COMPARISON WITH THE IMMISSIONS TREND

The emission calculations have to be based on models that in their turn are based on measurements (namely of the emission behaviour of the vehicles on laboratory testing tables), but also on other source data (e.g. traffic volumes) and a variety of additional assumptions of an empirical nature. The question nonetheless arises as to how reliable the results are. We can obtain an indicative validation by comparing the trends of emissions and immissions over extensive time frames. Shorter periods cannot be used for such a comparison because weather conditions fluctuate considerably from year to year and thus have an influence on immission limits. **Fig. 20** shows the reductions of immissions and overall emissions of nitric oxides in Switzerland from 1991 (the year in which the expanded immissions measurement network was put into operation) to 2003. For immissions, the figures represent the average for all stations on the National Air Pollution Monitoring Network (NABEL) except Berne, the location of which had to be changed twice. 1991 has been designated as 100 percent. As we can see, the two curves are very similar. If the 12-year period is evaluated by means of linear regression, this results in a reduction of NOx immissions by 37 percent. And in the same period, the figure for NOx emissions reduction is minus 36 percent.

TREND OF NOX EMISSIONS AND IMMISSIONS RELATIVE TO 1991

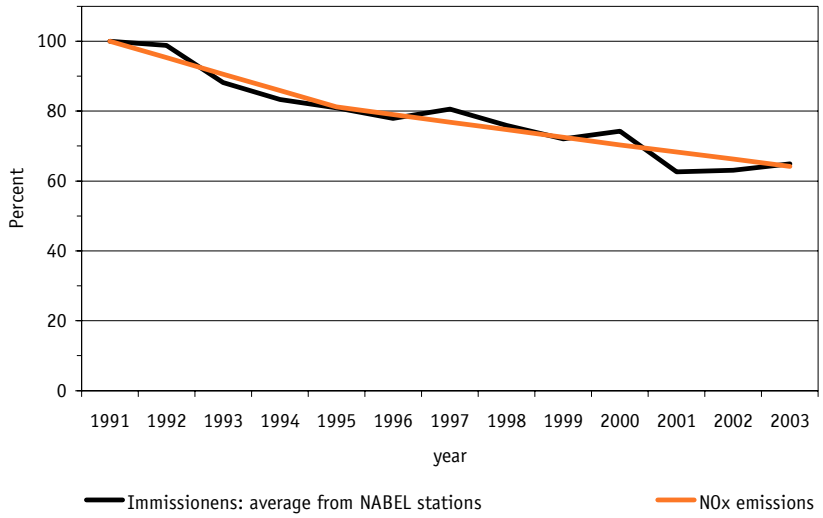


Fig. 20 Comparison between the NOx emissions and immissions trends (mean readings from all NABEL stations except Berne).

With a share of around 50 percent, road traffic remains one of the principal sources of NOx emissions. Nitric oxides give rise to a variety of environmental problems: they can cause the nitrogen dioxide limit to be exceeded and are major contributors towards excessive ozone immissions and acid and nitrogen deposition. The exhaust regulations and measures relating to other sources have led to a significant reduction in emissions, but these are still not sufficient to maintain immission limits at the prescribed level to prevent damage to health and the environment, and comply with internationally defined critical loads for sensitive ecological systems. **Fig. 21** shows the range within which overall emissions of NOx need to lie in accordance with the present-day status of knowledge in order to comply with the immission limits (as per the Clean-Air Ordinance) for nitrogen dioxide, and the critical loads for acids and nitrogen. It also depicts the trend with respect to NOx emissions, which still need to be reduced by around 50 percent versus the present-day level. Future EURO standards and the measures introduced to reduce other NOx emissions will only begin to take effect in the course of the next few years. However, they will still not suffice, even up to 2020, to allow us to achieve the declared objectives. Further-reaching measures aimed at reducing emissions are therefore unavoidable (SAEFL report: in preparation).

In the area of road transport, more stringent exhaust regulations are required for diesel vehicles in particular, which not only give rise to high levels of NOx emissions, but also produce carcinogenic particulate matter.

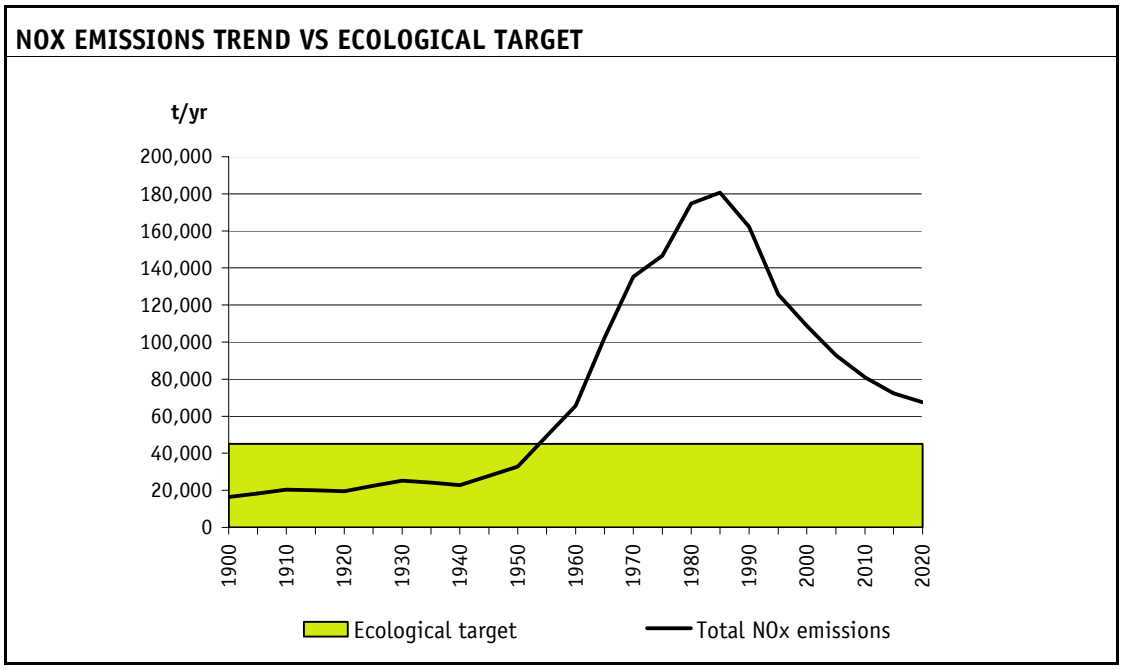


Fig. 21 Overall NOx emissions would have to be reduced by around 50 percent versus the present-day level if we are to achieve the ecological objective and comply with the immission limits (as per the Clean-Air Ordinance) for nitrogen dioxide and ozone, and the critical loads for acids and nitrogen (source: SAEFL report in preparation).

ANNEX
ANNEX A1: EMISSION LIMITS

Emission calculations are based on measurements carried out on vehicles, and not on emission limits. Although the measurements were carried out on chassis dynamometers, they were obtained on the basis of realistic driving patterns (and not type approval cycles). However, emission limits nonetheless provide an indicator of the emissions trend. The tables below depict the trends in emission limits for the various vehicle categories.

Emission limits: passenger cars (petrol engine)

Standard	Stage	Entry into Effect	Measurement cycle	Emission limits (g/km)				
				CO	HC	NO_x	HC+NO_x	Part.
ECE 15	ECE 15.00	1.01.1974	ECE 15	30 - 65	5.1 - 8.2	-	-	-
	ECE 15.01	1.09.1975	ECE 15	24 - 52	4.3 - 7.0	-	-	-
	ECE 15.02	1.10.1977	ECE 15	24 - 52	4.3 - 7.0	3.0 - 4.7	-	-
	ECE 15.03	1.10.1980	ECE 15	19 - 42	3.8 - 6.2	2.5 - 4.0	-	-
AGV	AGV 82	1.10.1982	FTP 72	24.20	2.10	1.90	-	-
	AGV 86	1.10.1986	FTP 72	9.30	0.90	1.20	-	-
FAV 1	FAV 1-1	1.10.1987	FTP 75	2.10	0.25	0.62	-	-
91/441/EwG	*Euro-1 *)*		*NEFZ*	*3.16*			*1.13*	
TAFV 1	Euro-2	1.10.1996	NEFZ **)	2.20	-	-	0.50	-
94/12/EG	Euro-3	1.01.2001	NEFZm ***)	2.30	0.20	0.15	-	-
	Euro-4	1.01.2006	NEFZm	1.00	0.10	0.08	-	-

*) Not relevant for Switzerland.

**) NEFZ: drive cycle for light motor vehicles (new European drive cycle, equivalent to ECE 15, but extended by an additional city cycle – referred to as EUDC).

***) NEFZm: also referred to as "EURO -3" cycle. Corresponds to "NEFZ" cycle, except that the warm-up phase of 40 seconds (motor idle, without emission measurement) prior to commencement of the cycle is excluded.

Emission limits: passenger cars (diesel engine)

Standard	Stage	Entry into effect	Measurement cycle	Emission limits (g/km)				
				CO	HC	NO_x	HC+NO_x	Part.
FAV 1	FAV 1-1	1.10.1987	FTP 75	2.10	0.25	0.62	-	0.370
	FAV 1-2	1.10.1988	FTP 75	2.10	0.25	0.62	-	0.124
91/441/EWG	*Euro-1 *)*		*NEFZ*	*3.16*	-	-	*1.13*	*0.18*
TAFV 1	Euro-2	1.10.1996	NEFZ	1.00	-	-	0.70/0.9	0.08/0.1
94/12/EG	Euro-3	1.01.2001	NEFZm	0.64	-	0.50	0.56	0.050
	Euro-4	1.01.2006	NEFZm	0.50	-	0.25	0.30	0.025

Emission limits: light duty vehicles (petrol engine)

Standard	Stage	Entry into effect	Measurement cycle	Emission limits (g/km)				
				CO	HC	NO_x	$HC+NO_x$	Part.
ECE 15	ECE 15.00	1.01.1974	ECE 15	30 – 65	5.1 - 8.2	-	-	-
	ECE 15.01	1.09.1975	ECE 15	24 – 52	4.3 - 7.0	-	-	-
	ECE 15.02	1.10.1977	ECE 15	24 – 52	4.3 - 7.0	3.8 - 5.9	-	-
	ECE 15.03	1.10.1980	ECE 15	19 – 42	3.8 - 6.2	3.8 - 5.9	-	-
AGV	AGV 82	1.10.1982	FTP 72	24.20	2.10	1.90	-	-
	AGV 86	1.10.1986	FTP 72	9.30	0.90	1.20	-	-
FAV 1 *)								
Group I	FAV 1-1	1.10.1987	FTP 75	2.10	0.25	0.62	-	-
Group II	FAV 1-1	1.10.1988	FTP 75	6.20	0.50	1.40	-	-
	FAV 1-2	1.10.1990	FTP 75	6.20	0.50	1.10	-	-
TAFV 1 *)								
Class 1	Euro-2	1.10.1997	NEFZ	2.20	-	-	0.50	-
Class 2	Euro-2	1.10.1998	NEFZ	4.00	-	-	0.60	-
Class 3	Euro-2	1.10.1998	NEFZ	5.00	-	-	0.70	-
Class 1	Euro-3	1.01.2001	NEFZm	2.30	0.20	0.15	-	-
Class 2	Euro-3	1.01.2002	NEFZm	4.17	0.25	0.18	-	-
Class 3	Euro-3	1.01.2002	NEFZm	5.22	0.29	0.21	-	-
Class 1	Euro-4	1.01.2006	NEFZm	1.00	0.10	0.08		
Class 2	Euro-4	1.01.2007	NEFZm	1.81	0.13	0.10	-	-
Class 3	Euro-4	1.01.2007	NEFZm	2.27	0.16	0.11	-	-

*) Definition of classes, see end of Annex A1.

Emission limits: light duty vehicles (diesel engine)

Standard	Stage	Entry into effect	Measurement cycle	Emission limits (g/km)				
				CO	HC	NO_x	$HC+NO_x$	Part.
FAV 1								
Group I	FAV 1-1	1.10.1987	FTP 75	2.10	0.25	0.62	-	0.370
Group I	FAV 1-2	1.10.1988	FTP 75	2.10	0.25	0.62	-	0.124
Group II	FAV 1-1	1.10.1988	FTP 75	6.20	0.50	1.40	-	0.370
Group II	FAV 1-2	1.10.1990	FTP 75	6.20	0.50	1.10		0.370
Group II	FAV 1-3	1.10.1992	FTP 75	6.20	0.50	1.10	-	0.162
TAFV 1 *)								
Class 1	Euro-2	1.10.1997	NEFZ	1.00	-	-	0.70	0.080
Class 2	Euro-2	1.10.1998	NEFZ	1.25	-	-	1.00	0.120
Class 3	Euro-2	1.10.1998	NEFZ	1.50	-	-	1.20	0.170
Class 1	Euro-3	1.01.2001	NEFZm	0.64	-	0.50	0.56	0.050
Class 2	Euro-3	1.01.2002	NEFZm	0.80	-	0.65	0.72	0.070
Class 3	Euro-3	1.01.2002	NEFZm	0.95	-	0.78	0.86	0.100
Class 1	Euro-4	1.01.2006	NEFZm	0.50	-	0.25	0.30	0.025
Class 2	Euro-4	1.01.2007	NEFZm	0.63	-	0.33	0.39	0.040
Class 3	Euro-4	1.01.2007	NEFZm	0.74	-	0.39	0.46	0.060

*) Definition of classes 1 to 3, see end of Annex A1.

Emission limits: heavy duty vehicles (diesel engine)

Standard	Stage	Entry into effect	Measurement cycle	Emission limits (g/kWh)				
				CO	HC	NO_x	$HC+NO_x$	Part.
FAV 2	FAV 2-1	1.10.1987	ECE 49	8.40	2.10	14.4	-	-
	FAV 2-2	1.10.1991	ECE 49	4.90	1.23	9.0	-	0.70
	FAV 2-3	1.10.1993	ECE 49	4.90	1.23	9.0	-	0.40
TAFV 1	Euro-2	1.10.1996	ECE 49	4.00	1.10	7.0	-	0.15
In accordance with resolution of EU Parliament dated 16 November 1990*):								
	Euro-3	from 2000/1	ESC	2.10	0.66	5.0	-	0.10
	Euro-3	from 2000/1	ETC	5.45	0.78	5.0	-	0.16
	Euro-4	from 2005/6	ESC	1.50	0.46	3.5	-	0.02
	Euro-4	from 2005/6	ETC	4.00	0.55	3.5	-	0.03
	Euro-5	from 2008/9	ESC	1.50	0.46	2.0	-	0.02
	Euro-5	from 2008/9	ETC	4.00	0.55	2.0	-	0.03
European levels (not relevant for Switzerland)								
88/77/EWG	*"Euro-0"*	*Before 1992*	*ECE 49*	*12.3*	*2.6*	*15.8*		*-*
91/542/EG	*Euro-1*	*From 1992/3*	*ECE 49*	*4.9*	*1.23*	*9.0*		*0.4*

*) For type approval purposes it is the first year that is relevant (registration date 1 October), while for sale and entry into circulation it is the following year (as of 1 October).

Emission limits: motorcycles

Standard	Stage	Entry into effect	Measurement cycle	Engine	Emission limits (g/km)				
					CO	HC	NO_x	$HC+NO_x$	Part.
ECE 40	ECE 40	1.10.1983	ECE 40	2S	20 - 50	13 - 21	-	-	-
	ECE 40	1.10.1983	ECE 40	4S	30 - 60	10 - 14	-	-	-
FAV 3	FAV 3-1	1.10.1987	ECE 40	2S	8.0	7.5	0.10	-	-
	FAV 3-1	1.10.1987	ECE 40	4S	13.0	3.0	0.30	-	-
	FAV 3-2	1.10.1990	ECE 40	2S	8.0	3.0	0.10	-	-
	FAV 3-2	1.10.1990	ECE 40	4S	13.0	3.0	0.30	-	-
TAFV 3 Motorcycles	Euro-1	1.10.1999	ECE 40	2S	8.0	4.0	0.10	-	-
	Euro-1	1.10.1999	ECE 40	4S	13.0	3.0	0.30	-	-
	Euro-2	1.04.2003	ECE 40m**)	2S / 4S	5.5	1.0	0.30	-	-
	Euro-3	1.01.2006	NEFZ+	2S / 4S	2.0	0.3	0.15	-	-
Light motor cycles*	"Euro-1"	1.10.1999	ECE 40	2S / 4S	6.0	-	-	3.0	-
	"Euro-2"	1.10.2002	ECE 40	2S / 4S	1.0	-	-	1.2	-
In discussion	"Euro-3"	From 2006?	NEFZ	2S / 4S	3.0	1.0	0.3		

*) light motorcycles = capacity up to 50 cc (the structure-based maximum speed of 45 km/h has meanwhile been done away with following the introduction of Directive 2002/51/EC)

**) ECE 40m: performed without 40-second idling prior to cycle.

Emission limits: mopeds

Standard	Stage	Entry into Effect	Measurement cycle	Engine	Emission limits (g/km)				
					CO	HC	NO_x	$HC+NO_x$	Part.
ECE 47	ECE 47	1.10.1983	ECE 47	2S	9.6	6.5	-	-	-
FAV 4	FAV 4	1.10.1988	ECE 47	2S	0.5	0.5	0.10	-	-

Classification of light motor vehicles in accordance with FAV 1 (prior to 1996)

Article 1.3, Ordinance on Exhaust Emissions from Light Motor Vehicles (FAV 1) dated 22 October 1986 (status, 4 August 1998):

› Group I

a. Vehicles for carrying passengers. Maximum no. of seats, 9 (including driver); maximum load, 760 kilograms

b. Vehicles for carrying goods, maximum load 760 kilograms

c. Vehicles as per a. and b., for the transport of both passengers and goods

› Group II

a. Vehicles for passenger transport with a load of more than 760 kilograms, and those with more than nine seats (including the driver)

b. Vehicles for carrying goods, with a capacity of more than 760 kilograms

c. Vehicles for carrying passengers, with a maximum of nine seats (including driver) and a maximum load of 760 kilograms, clearly differentiable from vehicles in a. and b. above

d. Group I vehicles that are designed for use off-road

Classification of motor vehicles in accordance with TAFV 1 (with effect from 1996)

Ordinance on the technical requirements of transport motor vehicles and their trailers (TAFV) dated 19 June 1995 (status, 15 October 2002)

Classification of vehicles

› Class M: motor vehicles intended for passenger transport, with at least four wheels:
  › Class M1: vehicles with a maximum of nine seats (including driver)
  › Class M2: vehicles with more than nine seats (including driver) and with a certified maximum weight of 5 tonnes
  › Class M3: vehicles with more than nine seats (including driver) and with a certified weight of more than 5 tonnes

› Class N: motor vehicles intended for goods transport, with at least four wheels:
  › Class N1: vehicles with a certified maximum weight of 3.5 tonnes
  › Class N2: vehicles with a certified weight of more than 3.5 tonnes, up to a maximum of 12 tonnes
  › Class N3: vehicles with a certified weight of more than 12 tonnes

› Class O: trailers (including semi-trailers and central axle trailers)

Classification of light duty vehicles (classes M and N1):

Class M: vehicles for passenger transport, with a total weight of < 2.5 tonnes and a maximum of 6 seats

Class N1: vehicles with a total weight > 2.5 tonnes or > 6 seats. These are sub-divided into 3 unladen weight categories (defined as vehicle + full tank + 75 kilograms for driver):

› Euro-1/2: unladen weight N1-I < 1,250 kg, N1-II 1,250-1,700 kg, N1-III > 1,700 kg

› Euro-3: unladen weight N1-I < 1,305 kg, N1-II 1,305-1,760 kg, N1-III > 1,760 kg

ANNEX A2: KEY DATA CONCERNING TRAFFIC TREND

MILEAGE [MILLION VEHICLE KILOMETRES PER ANNUM]						
Year	Passenger cars	light duty vehicles	heavy duty vehicles	Coaches	Buses	Motorcycles
1980	32,196	1,915	1,853	79	113	3,034
1985	36,432	2,245	1,948	87	136	2,684
1990	42,648	2,758	2,044	110	175	2,025
1995	44,638	3,025	1,996	112	193	1,744
2000	49,552	3,792	2,385	101	197	1,998
2005	53,689	4,343	2,138	94	209	2,282
2010	56,537	4,635	2,296	92	210	2,485
2015	58,828	4,816	2,474	90	212	2,649
2020	61,194	4,956	2,583	89	212	2,793
2025	63,698	5,108	2,655	88	213	2,928
2030	65,968	5,281	2,711	88	213	3,055

Table 2 Mileage data, 1980 to 2030

FLEETS AND START PROCEDURES									
	Passenger cars			light duty vehicles			Motorcycles		
Year	No. of vehicles	Starts per vehicle & day	Million starts p.a.	No. of vehicles	Starts per vehicle & day	Million starts p.a.	No. of vehicles	Starts per vehicle & day	Million starts p.a.
1980	2,246,745	3.07	2,518	134,670	1.95	96	808,894	1.67	493
1985	2,617,156	2.99	2,856	170,647	1.98	123	862,149	1.63	513
1990	2,985,390	2.91	3,171	220,923	1.97	159	763,873	1.59	443
1995	3,229,165	2.83	3,336	238,363	1.97	171	704,053	1.54	396
2000	3,545,253	2.75	3,559	260,052	1.96	186	731,430	1.50	400
2005	3,846,086	2.68	3,762	278,533	1.96	199	752,304	1.54	423
2010	4,054,359	2.63	3,892	287,124	1.96	205	767,619	1.57	440
2015	4,222,932	2.61	4,023	293,781	1.96	210	788,045	1.58	454
2020	4,397,624	2.60	4,173	300,448	1.96	215	810,766	1.59	471
2025	4,577,448	2.60	4,344	308,688	1.96	221	835,232	1.59	485
2030	4,745,859	2.60	4,504	318,412	1.96	228	859,755	1.59	499

Table 3 Trend in passenger car, light duty vehicle and motorcycle fleets, and estimated start procedures for each category (required for estimating cold-start excess). The number of stop procedures is required for calculating evaporation emissions after the engine has been turned off. These are equated with the number of start procedures.

NO. OF HEAVY MOTOR VEHICLES			
Year	**HDVs**	**Coaches**	**Buses**
1980	49,960	1,797	3,449
1985	48,967	2,043	3,702
1990	55,919	2,341	4,133
1995	53,843	2,382	4,263
2000	52,178	2,229	4,228
2005	50,240	2,090	4,412
2010	52,614	2,030	4,412
2015	55,415	1,989	4,414
2020	56,704	1,956	4,418
2025	57,247	1,942	4,421
2030	57,481	1,937	4,422

Table 4 Trend in fleet of heavy-motor vehicles (trucks + semi-trailers, coaches and buses).
These fleet data are not required for emission calculations, but form the basis for processing traffic quantity data.

ANNEX A3: MILEAGE-WEIGHTED FLEET COMPOSITIONS

FLEET COMPOSITION BY EMISSION LEVELS (MILEAGE-WEIGHTED)												
Vehicle cat.	**Emissions level**	**1980**	**1985**	**1990**	**1995**	**2000**	**2005**	**2010**	**2015**	**2020**	**2025**	**2030**
PC	PC/P/conv	98%	96%	52%	19%	4%	1%	0%	0%	0%	0%	0%
PC	PC/P/RCat<91		0%	41%	33%	15%	4%	1%	0%	0%	0%	0%
PC	PC/P/Euro1/FAV1				41%	35%	18%	5%	1%	0%	0%	0%
PC	PC/P/Euro2					35%	28%	14%	4%	1%	0%	0%
PC	PC/P/Euro3					1%	18%	13%	6%	1%	0%	0%
PC	PC/P/Euro4					0%	15%	39%	54%	59%	60%	60%
PC	PC/D/conv	2%	3%	5%	3%	1%	0%	0%	0%	0%	0%	0%
PC	PC/D/XXIII/FAV1			1%	4%	3%	1%	0%	0%	0%	0%	0%
PC	PC/D/Euro2				0%	4%	3%	2%	1%	0%	0%	0%
PC	PC/D/Euro3					0%	10%	7%	3%	1%	0%	0%
PC	PC/D/Euro4						3%	18%	31%	37%	39%	39%
LDV	LDV/P/conv	87%	82%	62%	31%	10%	3%	1%	0%	0%	0%	0%
LDV	LDV/P/RCat<91		0%	10%	11%	7%	2%	1%	0%	0%	0%	0%
LDV	LDV/P/Euro1/FAV1				23%	25%	12%	4%	1%	0%	0%	0%
LDV	LDV/P/Euro2					10%	11%	5%	2%	1%	0%	0%
LDV	LDV/P/Euro3					0%	8%	7%	3%	1%	0%	0%
LDV	LDV/P/Euro4						2%	12%	20%	23%	23%	23%
LDV	LDV/D/conv	13%	18%	28%	30%	14%	5%	2%	1%	0%	0%	0%
LDV	LDV/D/Euro1/FAV1				5%	16%	8%	3%	1%	0%	0%	0%
LDV	LDV/D/Euro2					18%	22%	12%	5%	2%	1%	0%
LDV	LDV/D/Euro3					0%	29%	27%	14%	5%	2%	1%
LDV	LDV/D/Euro4							27%	54%	68%	73%	75%
Coach	Coach/1950s	4%	2%									
Coach	Coach/1960s	25%	7%	4%	3%							
Coach	Coach/1970s	68%	53%	25%	8%	5%	2%	1%	0%	0%	0%	0%
Coach	Coach/1980s	3%	38%	71%	74%	44%	16%	6%	2%	1%	0%	0%
Coach	Coach/Euro1				15%	28%	18%	8%	3%	1%	0%	0%
Coach	Coach/Euro2				0%	23%	37%	24%	10%	3%	1%	0%
Coach	Coach/Euro3					0%	25%	25%	15%	5%	2%	1%
Coach	Coach/Euro4						1%	23%	18%	9%	3%	1%
Coach	Coach/Euro5							14%	53%	81%	93%	98%
Bus	Bus/1950s	4%	2%									
Bus	Bus/1960s	27%	9%	4%	1%							
Bus	Bus/1970	66%	51%	24%	8%	3%	0%	0%	0%	0%	0%	0%
Bus	Bus/1980s	3%	37%	72%	80%	56%	24%	7%	1%	0%	0%	0%
Bus	Bus/Euro1				10%	16%	11%	6%	2%	0%	0%	0%
Bus	Bus/Euro2				0%	26%	36%	27%	15%	4%	1%	0%
Bus	Bus/Euro3					0%	27%	24%	18%	8%	2%	0%
Bus	Bus/Euro4						1%	23%	18%	11%	5%	1%

FLEET COMPOSITION BY EMISSION LEVELS (MILEAGE-WEIGHTED)												
Vehicle cat.	**Emissions level**	**1980**	**1985**	**1990**	**1995**	**2000**	**2005**	**2010**	**2015**	**2020**	**2025**	**2030**
Bus	Bus/Euro5							14%	47%	75%	93%	99%
HDV	HDV/1950s	2%	0%									
HDV	HDV/1960s	16%	5%	2%	0%							
HDV	HDV/1970s	79%	45%	15%	4%	2%	0%	0%	0%	0%	0%	0%
HDV	HDV/1980s	3%	50%	83%	71%	32%	10%	3%	1%	0%	0%	0%
HDV	HDV/Euro1				24%	27%	8%	3%	1%	1%	0%	0%
HDV	HDV/Euro2					35%	24%	12%	5%	2%	1%	0%
HDV	HDV/Euro3					4%	54%	32%	16%	6%	2%	1%
HDV	HDV/Euro4						3%	30%	17%	8%	3%	1%
HDV	HDV/Euro5							19%	59%	83%	93%	98%
MC	MP/ without cat	78%	63%	41%	12%	3%	1%	1%	0%	0%	0%	0%
MC	MP/ with cat			2%	11%	10%	6%	4%	2%	2%	2%	1%
MC	LMC/<Euro-1	6%	7%	4%	2%	0%	0%	0%	0%	0%	0%	0%
MC	LMC/Euro-1			2%	4%	8%	9%	3%	1%	0%	0%	0%
MC	LMC/Euro-2						6%	14%	16%	16%	16%	15%
MC	MC/2S/<Euro-1	10%	14%	11%	8%	4%	2%	1%	1%	0%	0%	0%
MC	MC/2S/Euro-1			3%	10%	13%	10%	5%	2%	1%	1%	0%
MC	MC/2S/Euro-2						2%	2%	1%	0%	0%	0%
MC	MC/2S/Euro-3							3%	6%	7%	7%	7%
MC	MC/4S/<Euro-1	6%	17%	26%	18%	10%	5%	3%	2%	2%	2%	1%
MC	MC/4S/Euro-1			11%	36%	51%	47%	32%	20%	12%	8%	6%
MC	MC/4S/Euro-2						12%	12%	9%	6%	3%	2%
MC	MC/4S/Euro-3							21%	40%	53%	61%	66%

Table 5 These figures show the proportions of the various emission concepts to the mileage per vehicle category and reference year.

ANNEX A4: PM10

A4.1 PM10 emission factors for petrol vehicles (exhaust)

PM10 EMISSION FACTORS FOR PETROL VEHICLES [G/VEHKM] (SOURCE: SAEFL)

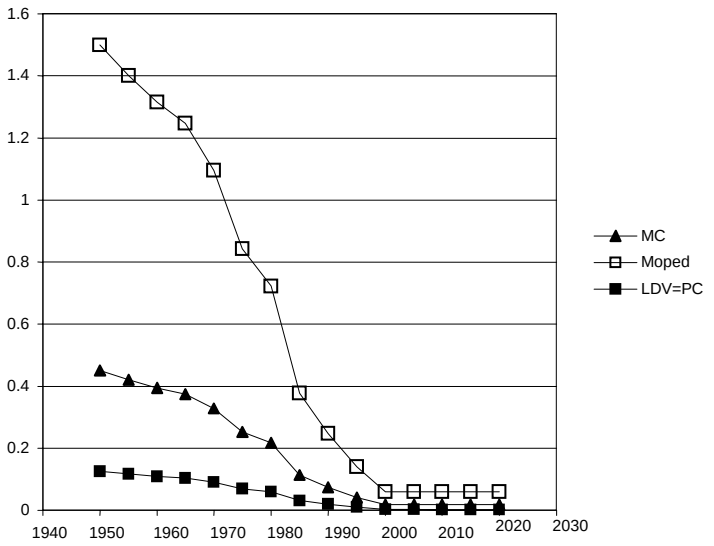


Fig. 22 These emission factors are based on SAEFL 2001, Annex 1, Table 9. The data for cars/LDVs for the period after 1990 have been adjusted slightly downwards on the basis of figures from ACEA and CONCAVE: 1990: 0.02, 1995: 0.01; 2000: 0.003; 2005: 0.0025; 2010: 0.002; 2015ff: 0.001 g/km.

A4.2 PM10 emission factors for abrasion and resuspension

PM10 EMISSION FACTORS FOR FRICTION AND AIR MOVEMENT [G/VEHKM]

	Mot	Rur	Urb
LMV	0.047	0.022	0.054
HMV	0.074	0.144	0.54
MC 4S	0.0235	0.011	0.027
MC 2S	0.01175	0.0055	0.0135

Table 6 PM10 emission factors (abrasion and esuspension) based on SAEFL 2003 (summary pp. 33/34; adapted).

A4.3 PM10 emission data

PM10 EMISSIONS BY VEHICLE CATEGORY, FUEL (PETROL/DIESEL), EXHAUST/NON-EXHAUST [TONNES P.A.]													
Vehicle cat.	Fuel	Type	1980	1985	1990	1995	2000	2005	2010	2015	2020	2025	2030
MC	P	Exhaust	2,074	873	370	153	67	73	77	79	81	83	85
MC	P	Non-exhaust	36	34	29	27	32	37	41	44	47	50	52
Bus	D	Exhaust	243	225	216	177	130	85	48	29	18	14	13
Bus	D	Non-exhaust	46	55	70	77	79	83	84	85	85	85	85
LDV	P	Exhaust	100	58	40	21	6	4	2	2	1	1	1
LDV	P	Non-exhaust	65	74	81	81	82	68	58	53	52	52	53
LDV	D	Exhaust	261	456	489	334	327	310	237	173	142	132	132
LDV	D	Non-exhaust	9	16	31	43	73	111	134	146	153	160	166
PC	P	Exhaust	1,900	1,112	801	437	136	112	83	58	38	39	40
PC	P	Non-exhaust	1,224	1,407	1,626	1,692	1,846	1,829	1,690	1,584	1,560	1,595	1,641
PC	D	Exhaust	130	282	425	366	332	370	397	422	440	461	480
PC	D	Non-exhaust	20	45	106	124	173	364	625	832	953	1,021	1,069
Coach	D	Exhaust	80	65	62	47	33	21	13	8	5	4	4
Coach	D	Non-exhaust	18	18	21	21	19	18	17	17	17	16	16
HDV	D	Exhaust	1,881	1,371	1,068	794	663	413	259	177	131	112	105
HDV	D	Non-exhaust	424	405	392	366	429	384	415	447	465	476	484
Total	P	Exhaust	4,074	2,043	1,210	610	209	189	161	138	120	123	126
Total	P	Non-exhaust	1,325	1,515	1,736	1,799	1,960	1,933	1,788	1,681	1,659	1,697	1,746
Total	D	Exhaust	2,595	2,399	2,259	1,718	1,484	1,199	954	808	736	724	734
Total	D	Non-exhaust	518	538	620	631	773	960	1,274	1,527	1,673	1,758	1,820
Total	P		5,399	3,558	2,946	2,409	2,169	2,122	1,950	1,819	1,779	1,820	1,872
Total	D		3,112	2,937	2,880	2,349	2,257	2,159	2,228	2,335	2,409	2,482	2,554
Total		Exhaust	6,669	4,442	3,470	2,329	1,693	1,388	1,115	946	856	846	860
Total		Non-exhaust	1,843	2,053	2,356	2,430	2,733	2,893	3,063	3,208	3,332	3,455	3,565
Total	P/D	total	8,511	6,495	5,826	4,758	4,426	4,282	4,178	4,154	4,188	4,302	4,426

Table 7 PM10 emissions by vehicle category, fuel (petrol/diesel) and type of emission (exhaust/non-exhaust).

ANNEX A5: BASIC EMISSIONS SCENARIO

A5.1 EMISSIONS PER VEHICLE CATEGORY

In tonnes per annum

Note: figures for the period prior to 1980 have been taken from SAEFL Report 255/Supplement (SAEFL 2000) and are printed in italics; inconsistencies in the time-series cannot be ruled out.

Emission	Year	PCs	LDVs	HDVs	Coaches	Buses	MCs	Total
Benzene	1980	4,089	229	35	1	5	936	5,296
Benzene	1985	3,610	223	33	1	6	850	4,722
Benzene	1990	2,692	199	31	1	7	511	3,441
Benzene	1995	1,716	147	26	1	7	327	2,225
Benzene	2000	1,230	118	24	1	5	277	1,654
Benzene	2005	708	73	15	1	3	238	1,038
Benzene	2010	381	41	16	1	2	183	625
Benzene	2015	209	26	18	1	2	151	407
Benzene	2020	159	20	19	1	2	135	336
Benzene	2025	153	18	20	1	2	126	320
Benzene	2030	153	18	20	1	2	122	316
CH4	*1950*	*546*	*44*	*59*	*2*	*2*	*97*	*749*
CH4	*1955*	*979*	*59*	*85*	*2*	*3*	*307*	*1,434*
CH4	*1960*	*1,838*	*90*	*101*	*3*	*4*	*414*	*2,450*
CH4	*1965*	*3,226*	*155*	*114*	*3*	*4*	*459*	*3,961*
CH4	*1970*	*4,505*	*217*	*115*	*4*	*5*	*484*	*5,329*
CH4	*1975*	*4,777*	*219*	*108*	*3*	*6*	*482*	*5,596*
CH4	1980	5,334	225	51	1	8	1,285	6,903
CH4	1985	4,677	224	47	1	9	1,155	6,112
CH4	1990	3,046	197	44	2	10	674	3,973
CH4	1995	1,624	132	37	2	10	414	2,219
CH4	2000	986	94	34	1	7	337	1,460
CH4	2005	540	56	22	1	5	318	942
CH4	2010	294	32	23	1	3	300	654
CH4	2015	167	20	26	1	3	280	497
CH4	2020	130	15	27	1	3	266	443
CH4	2025	126	14	28	1	3	257	430
CH4	2030	126	14	29	1	3	253	426
CO	*1950*	*91,032*	*7,161*	*10,284*	*85*	*253*	*9,052*	*117,867*
CO	*1955*	*162,866*	*9,643*	*13,613*	*114*	*307*	*23,949*	*210,492*
CO	*1960*	*306,555*	*15,259*	*14,078*	*171*	*382*	*28,708*	*365,154*
CO	*1965*	*547,640*	*27,259*	*12,251*	*193*	*443*	*29,228*	*617,014*
CO	*1970*	*808,263*	*40,494*	*10,164*	*221*	*542*	*30,569*	*890,254*
CO	*1975*	*988,118*	*42,477*	*8,941*	*175*	*641*	*31,066*	*1,071,418*
CO	1980	918,723	75,011	5,444	179	720	38,090	1,038,167
CO	1985	647,804	72,002	5,079	178	827	35,813	761,703
CO	1990	399,163	62,260	4,870	212	1,022	26,980	494,508
CO	1995	254,010	40,461	4,255	204	1,049	21,160	321,139
CO	2000	205,677	28,431	4,093	166	863	22,422	261,651
CO	2005	153,250	17,358	3,288	136	671	20,928	195,631
CO	2010	100,589	10,850	2,958	117	505	16,301	131,320
CO	2015	63,441	7,340	2,877	104	429	12,941	87,132

Emission	Year	PCs	LDVs	HDVs	Coaches	Buses	MCs	Total
CO	2020	50,699	6,022	2,834	97	390	10,857	70,899
CO	2025	49,483	5,629	2,844	94	373	9,699	68,121
CO	2030	50,157	5,583	2,866	93	369	9,228	68,297
CO2	*1950*	*703,631*	*77,276*	*294,460*	*22,385*	*40,653*	*33,848*	*1,172,254*
CO2	*1955*	*1,244,200*	*107,196*	*511,062*	*29,835*	*49,131*	*93,611*	*2,035,035*
CO2	*1960*	*2,343,180*	*174,155*	*769,955*	*45,012*	*60,891*	*116,775*	*3,509,968*
CO2	*1965*	*4,158,348*	*319,386*	*1,167,849*	*51,446*	*71,124*	*128,464*	*5,896,618*
CO2	*1970*	*5,985,371*	*474,215*	*1,451,998*	*60,226*	*87,053*	*141,824*	*8,200,687*
CO2	*1975*	*7,146,344*	*501,283*	*1,498,431*	*50,141*	*105,848*	*148,688*	*9,450,736*
CO2	1980	8,097,868	695,727	1,623,858	77,476	143,766	229,145	10,867,840
CO2	1985	8,897,300	778,246	1,607,312	80,892	167,065	223,648	11,754,464
CO2	1990	9,964,461	887,730	1,632,049	98,816	207,945	180,614	12,971,616
CO2	1995	10,188,069	910,640	1,559,136	97,507	226,457	163,756	13,145,566
CO2	2000	10,837,418	1,089,444	1,754,451	83,685	223,513	188,573	14,177,084
CO2	2005	11,119,218	1,180,169	1,612,285	75,206	230,073	209,677	14,426,629
CO2	2010	10,949,441	1,200,828	1,732,958	73,631	231,227	218,449	14,406,534
CO2	2015	10,529,990	1,196,036	1,887,919	74,135	236,633	227,195	14,151,908
CO2	2020	10,210,845	1,193,703	1,983,469	74,027	241,015	236,809	13,939,868
CO2	2025	10,084,001	1,204,962	2,043,720	73,992	243,128	247,365	13,897,168
CO2	2030	10,073,152	1,225,573	2,086,999	74,014	243,776	258,342	13,961,855
HC	*1950*	*12,701*	*1,028*	*1,369*	*50*	*79*	*1,926*	*17,153*
HC	*1955*	*22,905*	*1,366*	*2,075*	*67*	*96*	*6,128*	*32,638*
HC	*1960*	*42,802*	*2,093*	*2,641*	*100*	*120*	*8,273*	*56,029*
HC	*1965*	*75,221*	*3,597*	*3,305*	*113*	*140*	*9,184*	*91,560*
HC	*1970*	*105,954*	*5,051*	*3,525*	*129*	*171*	*9,675*	*124,504*
HC	*1975*	*115,728*	*5,162*	*3,390*	*102*	*202*	*9,637*	*134,222*
HC	1980	119,140	6,317	2,117	60	313	20,216	148,164
HC	1985	110,103	6,450	1,955	61	355	18,605	137,529
HC	1990	71,793	5,736	1,844	73	432	11,667	91,544
HC	1995	36,481	3,546	1,562	70	410	7,889	49,959
HC	2000	20,452	2,132	1,434	58	308	6,939	31,324
HC	2005	11,342	1,185	918	43	196	6,097	19,780
HC	2010	6,828	676	976	40	145	4,880	13,546
HC	2015	4,559	437	1,074	41	131	4,162	10,404
HC	2020	3,937	350	1,142	41	132	3,793	9,395
HC	2025	3,892	321	1,183	41	134	3,611	9,183
HC	2030	3,905	315	1,211	41	135	3,540	9,147
N2O	*1950*	*30*	*3*	*9*	*1*	*1*	*4*	*48*
N2O	*1955*	*52*	*4*	*15*	*1*	*1*	*13*	*87*
N2O	*1960*	*98*	*7*	*22*	*1*	*2*	*18*	*148*
N2O	*1965*	*175*	*13*	*31*	*1*	*2*	*16*	*237*
N2O	*1970*	*251*	*19*	*38*	*2*	*2*	*13*	*325*
N2O	*1975*	*300*	*20*	*39*	*1*	*3*	*11*	*374*
N2O	1980	0	0	24	1	2	3	30
N2O	1985	2	0	24	1	2	3	33
N2O	1990	248	4	25	1	3	2	283
N2O	1995	465	15	24	1	3	2	510
N2O	2000	471	25	27	1	3	2	530
N2O	2005	336	25	19	1	3	2	386
N2O	2010	226	23	18	1	2	2	273
N2O	2015	184	22	18	1	2	3	230
N2O	2020	182	22	18	1	2	3	228
N2O	2025	189	23	18	1	2	3	235
N2O	2030	196	24	19	1	2	3	243

Emission	Year	PCs	LDVs	HDVs	Coaches	Buses	MCs	Total
NH3	*1950*	*9*	*1*	*28*	*3*	*5*	*0*	*47*
NH3	*1955*	*17*	*2*	*53*	*4*	*6*	*0*	*82*
NH3	*1960*	*32*	*4*	*87*	*6*	*8*	*0*	*137*
NH3	*1965*	*57*	*8*	*141*	*7*	*9*	*1*	*223*
NH3	*1970*	*81*	*11*	*181*	*8*	*11*	*1*	*294*
NH3	*1975*	*98*	*12*	*188*	*6*	*14*	*1*	*320*
NH3	1980	64	4	9	0	1	6	84
NH3	1985	76	4	10	0	1	5	97
NH3	1990	603	13	10	1	1	4	631
NH3	1995	1,067	36	10	1	1	3	1,118
NH3	2000	1,315	53	12	1	1	4	1,385
NH3	2005	1,261	47	11	0	1	5	1,324
NH3	2010	1,084	39	11	0	1	5	1,141
NH3	2015	966	35	12	0	1	5	1,019
NH3	2020	931	33	13	0	1	6	984
NH3	2025	948	33	13	0	1	6	1,001
NH3	2030	974	33	14	0	1	6	1,029
NMHC	*1950*	*12,155*	*984*	*1,310*	*49*	*76*	*1,829*	*16,404*
NMHC	*1955*	*21,926*	*1,307*	*1,990*	*65*	*93*	*5,822*	*31,203*
NMHC	*1960*	*40,963*	*2,003*	*2,540*	*97*	*117*	*7,859*	*53,580*
NMHC	*1965*	*71,996*	*3,443*	*3,191*	*110*	*135*	*8,725*	*87,599*
NMHC	*1970*	*101,449*	*4,834*	*3,410*	*125*	*166*	*9,191*	*119,175*
NMHC	*1975*	*110,951*	*4,942*	*3,282*	*99*	*196*	*9,156*	*128,626*
NMHC	1980	113,806	6,092	2,066	59	306	18,931	141,260
NMHC	1985	105,426	6,227	1,908	59	346	17,450	131,417
NMHC	1990	68,747	5,539	1,799	71	421	10,993	87,571
NMHC	1995	34,858	3,414	1,525	68	400	7,475	47,740
NMHC	2000	19,466	2,039	1,400	57	301	6,602	29,864
NMHC	2005	10,802	1,129	896	42	191	5,778	18,838
NMHC	2010	6,534	644	953	39	142	4,580	12,892
NMHC	2015	4,392	418	1,048	40	128	3,882	9,907
NMHC	2020	3,807	334	1,115	40	129	3,527	8,952
NMHC	2025	3,766	307	1,155	40	131	3,354	8,752
NMHC	2030	3,779	301	1,182	40	132	3,287	8,721
NOx	*1950*	*5,180*	*675*	*2,829*	*219*	*476*		*9,417*
NOx	*1955*	*9,643*	*969*	*4,946*	*292*	*575*		*16,513*
NOx	*1960*	*19,486*	*1,644*	*7,515*	*443*	*716*		*29,896*
NOx	*1965*	*36,107*	*3,114*	*11,861*	*530*	*876*		*52,558*
NOx	*1970*	*54,250*	*4,900*	*14,843*	*629*	*1,087*		*75,776*
NOx	*1975*	*65,420*	*5,350*	*16,072*	*554*	*1,392*		*88,857*
NOx	1980	80,636	7,516	20,894	945	1,862	154	112,007
NOx	1985	84,539	7,555	21,821	1,038	2,282	225	117,460
NOx	1990	59,128	7,109	22,763	1,317	2,974	325	93,616
NOx	1995	34,798	5,423	20,349	1,256	3,181	429	65,436
NOx	2000	23,654	5,226	21,718	1,030	3,003	566	55,198
NOx	2005	17,268	4,818	16,421	824	2,681	665	42,678
NOx	2010	12,884	3,875	12,871	622	2,078	665	32,995
NOx	2015	10,847	3,057	9,639	427	1,524	652	26,145
NOx	2020	10,577	2,690	7,731	311	1,115	645	23,069
NOx	2025	10,911	2,601	6,886	266	902	653	22,218
NOx	2030	11,286	2,631	6,570	251	839	671	22,249
Pb	*1950*	*184*	*20*	*23*			*9*	*235*
Pb	*1955*	*324*	*27*	*29*			*24*	*405*
Pb	*1960*	*609*	*42*	*28*			*30*	*710*

Emission	Year	PCs	LDVs	HDVs	Coaches	Buses	MCs	Total
Pb	*1965*	*1,081*	*76*	*19*			*34*	*1,209*
Pb	*1970*	*1,377*	*99*	*10*			*33*	*1,519*
Pb	*1975*	*1,178*	*75*	*6*			*24*	*1,283*
Pb	1980	1,300	97	0	0	0	37	1,435
Pb	1985	482	34	0	0	0	12	528
Pb	1990	282	18	0	0	0	5	305
Pb	1995	98	6	0	0	0	2	105
Pb	2000	4	0	0	0	0	0	5
Pb	2005	4	0	0	0	0	0	4
Pb	2010	4	0	0	0	0	0	4
Pb	2015	3	0	0	0	0	0	3
Pb	2020	3	0	0	0	0	0	3
Pb	2025	3	0	0	0	0	0	3
Pb	2030	3	0	0	0	0	0	3
PM exh	*1950*	*3*	*6*	*591*	*47*	*105*		*752*
PM exh	*1955*	*6*	*12*	*1,144*	*63*	*127*		*1,352*
PM exh	*1960*	*22*	*28*	*1,862*	*93*	*156*		*2,161*
PM exh	*1965*	*38*	*63*	*2,720*	*95*	*163*		*3,078*
PM exh	*1970*	*38*	*102*	*3,194*	*106*	*192*		*3,632*
PM exh	*1975*	*50*	*124*	*2,797*	*75*	*200*		*3,246*
PM exh	1980	2,030	361	1,881	80	243	2,074	6,669
PM exh	1985	1,394	514	1,371	65	225	873	4,442
PM exh	1990	1,226	528	1,068	62	216	370	3,470
PM exh	1995	802	354	794	47	177	153	2,329
PM exh	2000	468	332	663	33	130	67	1,693
PM exh	2005	482	313	413	21	85	73	1,388
PM exh	2010	479	239	259	13	48	77	1,115
PM exh	2015	480	174	177	8	29	79	946
PM exh	2020	478	143	131	5	18	81	856
PM exh	2025	500	133	112	4	14	83	846
PM exh	2030	520	133	105	4	13	85	860
PM non-exh	1980	1,244	74	424	18	46	36	1,843
PM non-exh	1985	1,451	90	405	18	55	34	2,053
PM non-exh	1990	1,731	113	392	21	70	29	2,356
PM non-exh	1995	1,815	124	366	21	77	27	2,430
PM non-exh	2000	2,020	156	429	19	79	32	2,733
PM non-exh	2005	2,193	179	384	18	83	37	2,893
PM non-exh	2010	2,315	191	415	17	84	41	3,063
PM non-exh	2015	2,416	199	447	17	85	44	3,208
PM non-exh	2020	2,513	205	465	17	85	47	3,332
PM non-exh	2025	2,616	211	476	16	85	50	3,455
PM non-exh	2030	2,709	219	484	16	85	52	3,565
SO2	*1950*	*129*	*27*	*1,201*	*129*	*235*	*5*	*1,727*
SO2	*1955*	*223*	*42*	*1,910*	*142*	*233*	*15*	*2,566*
SO2	*1960*	*444*	*76*	*2,615*	*176*	*238*	*19*	*3,568*
SO2	*1965*	*779*	*152*	*3,944*	*185*	*256*	*21*	*5,336*
SO2	*1970*	*1,036*	*176*	*3,349*	*143*	*207*	*23*	*4,934*
SO2	*1975*	*1,241*	*185*	*3,203*	*109*	*231*	*24*	*4,993*
SO2	1980	1,561	334	3,918	187	347	36	6,384
SO2	1985	1,501	333	2,449	123	255	28	4,690
SO2	1990	1,718	328	1,451	88	185	23	3,792
SO2	1995	1,358	148	338	21	49	21	1,934
SO2	2000	1,051	145	303	14	39	17	1,569
SO2	2005	59	7	10	0	1	1	79

Emission	Year	PCs	LDVs	HDVs	Coaches	Buses	MCs	Total
SO2	2010	59	7	11	0	1	1	80
SO2	2015	58	7	12	0	2	1	80
SO2	2020	57	7	13	0	2	1	80
SO2	2025	56	7	13	0	2	1	80
SO2	2030	56	7	13	0	2	1	80
Toluol	1980	11,104	575	7	0	1	2,283	13,971
Toluol	1985	9,854	558	6	0	1	2,076	12,495
Toluol	1990	6,296	479	6	0	1	1,252	8,035
Toluol	1995	3,157	292	5	0	1	806	4,261
Toluol	2000	1,783	174	5	0	1	684	2,648
Toluol	2005	953	92	3	0	1	575	1,624
Toluol	2010	516	47	3	0	0	427	994
Toluol	2015	286	27	3	0	0	338	655
Toluol	2020	216	19	4	0	0	291	531
Toluol	2025	205	17	4	0	0	265	492
Toluol	2030	201	16	4	0	0	252	474
Xylol	1980	8,983	461	17	0	3	2,043	11,506
Xylol	1985	7,888	445	16	0	3	1,850	10,201
Xylol	1990	5,071	380	15	1	3	1,102	6,572
Xylol	1995	2,597	234	12	1	3	697	3,545
Xylol	2000	1,526	144	11	0	2	583	2,268
Xylol	2005	828	78	7	0	2	484	1,399
Xylol	2010	447	41	8	0	1	350	848
Xylol	2015	245	23	9	0	1	271	549
Xylol	2020	184	17	9	0	1	229	440
Xylol	2025	175	15	9	0	1	206	406
Xylol	2030	172	14	10	0	1	193	391

Table 8 Updated emissions in tonnes p.a. prior to 1980 (in italics) correspond to the data presented in Report 255/Supplement (SAEFL 2000). PM-exhaustemissions also include emissions from petrol driven vehicles.

A5.2 EMISSIONS BY EMISSION TYPE

In tonnes per annum [passenger cars, LDVs, motorcycles)

Emission	Year	Emission type	Cars	LDVs	Motor-cycles
CO	1980	Start	237,925	20,058	
CO	1980	Warm	680,798	54,953	38,090
CO	1985	Start	169,670	19,343	
CO	1985	Warm	478,134	52,659	35,813
CO	1990	Start	120,916	16,581	
CO	1990	Warm	278,247	45,680	26,980
CO	1995	Start	111,999	11,299	
CO	1995	Warm	142,012	29,162	21,160
CO	2000	Start	123,112	8,543	
CO	2000	Warm	82,565	19,887	22,422
CO	2005	Start	101,761	5,645	
CO	2005	Warm	51,489	11,713	20,928
CO	2010	Start	65,577	3,392	
CO	2010	Warm	35,012	7,458	16,301
CO	2015	Start	37,118	1,969	
CO	2015	Warm	26,323	5,371	12,941

Emission	Year	Emission type	Cars	LDVs	Motor-cycles
CO	2020	Start	26,957	1,410	
CO	2020	Warm	23,742	4,612	10,857
CO	2025	Start	25,654	1,220	
CO	2025	Warm	23,829	4,409	9,699
CO	2030	Start	26,051	1,173	
CO	2030	Warm	24,106	4,410	9,228
CO2	1980	Start	712,698	33,809	
CO2	1980	Warm	7,385,170	661,919	229,145
CO2	1985	Start	753,458	40,240	
CO2	1985	Warm	8,143,843	738,006	223,648
CO2	1990	Start	669,865	44,076	
CO2	1990	Warm	9,294,596	843,655	180,614
CO2	1995	Start	541,371	39,365	
CO2	1995	Warm	9,646,698	871,276	163,756
CO2	2000	Start	511,506	37,360	
CO2	2000	Warm	10,325,911	1,052,084	188,573
CO2	2005	Start	520,160	36,444	
CO2	2005	Warm	10,599,059	1,143,726	209,677
CO2	2010	Start	519,187	35,076	
CO2	2010	Warm	10,430,253	1,165,752	218,449
CO2	2015	Start	502,709	34,061	
CO2	2015	Warm	10,027,281	1,161,976	227,195
CO2	2020	Start	488,336	33,698	
CO2	2020	Warm	9,722,509	1,160,005	236,809
CO2	2025	Start	482,625	33,873	
CO2	2025	Warm	9,601,376	1,171,089	247,365
CO2	2030	Start	482,418	34,354	
CO2	2030	Warm	9,590,733	1,191,218	258,342
HC	1980	Start	28,630	682	
HC	1980	Stop/switch-off	17,337	597	992
HC	1980	Tank respiration	7,300	400	760
HC	1980	Hot	65,873	4,639	18,464
HC	1985	Start	25,403	753	
HC	1985	Stop/switch-off	19,334	727	1,032
HC	1985	Tank respiration	8,383	484	810
HC	1985	Hot	56,982	4,486	16,764
HC	1990	Start	18,570	758	
HC	1990	Stop/switch-off	12,563	736	892
HC	1990	Tank respiration	5,945	512	717
HC	1990	Hot	34,716	3,729	10,058
HC	1995	Start	12,362	612	
HC	1995	Stop/switch-off	5,880	430	796
HC	1995	Tank respiration	3,143	360	661
HC	1995	Hot	15,096	2,143	6,432
HC	2000	Start	9,785	541	
HC	2000	Stop/switch-off	2,639	184	806
HC	2000	Tank respiration	1,477	190	687
HC	2000	Hot	6,551	1,218	5,447
HC	2005	Start	6,097	371	
HC	2005	Stop/switch-off	1,403	78	851
HC	2005	Tank respiration	848	93	706
HC	2005	Hot	2,995	643	4,540
HC	2010	Start	3,521	214	

Emission	Year	Emission type	Cars	LDVs	Motor-cycles
HC	2010	Stop/switch-off	913	37	885
HC	2010	Tank respiration	628	54	721
HC	2010	Hot	1,766	372	3,274
HC	2015	Start	2,054	130	
HC	2015	Stop/switch-off	696	21	914
HC	2015	Tank respiration	525	36	740
HC	2015	Hot	1,284	250	2,508
HC	2020	Start	1,630	101	
HC	2020	Stop/switch-off	640	16	947
HC	2020	Tank respiration	480	26	761
HC	2020	Hot	1,187	207	2,085
HC	2025	Start	1,595	91	
HC	2025	Stop/switch-off	641	15	975
HC	2025	Tank respiration	456	20	784
HC	2025	Hot	1,200	195	1,852
HC	2030	Start	1,613	90	
HC	2030	Stop/switch-off	648	15	1,004
HC	2030	Tank respiration	439	16	807
HC	2030	Hot	1,204	195	1,729
NOx	1980	Start	-431	-34	
NOx	1980	Hot	81,066	7,551	154
NOx	1985	Start	-415	-33	
NOx	1985	Hot	84,955	7,588	225
NOx	1990	Start	1,001	7	
NOx	1990	Hot	58,127	7,102	325
NOx	1995	Start	2,458	182	
NOx	1995	Hot	32,339	5,242	429
NOx	2000	Start	3,003	333	
NOx	2000	Hot	20,651	4,893	566
NOx	2005	Start	2,390	310	
NOx	2005	Hot	14,878	4,508	665
NOx	2010	Start	1,490	218	
NOx	2010	Hot	11,394	3,657	665
NOx	2015	Start	875	151	
NOx	2015	Hot	9,972	2,905	652
NOx	2020	Start	689	126	
NOx	2020	Hot	9,888	2,564	645
NOx	2025	Start	675	119	
NOx	2025	Hot	10,235	2,482	653
NOx	2030	Start	694	119	
NOx	2030	Hot	10,593	2,513	671
PM exh	1980	Start	13	16	
PM exh	1980	Hot	2,016	345	2,074
PM exh	1985	Start	29	30	
PM exh	1985	Hot	1,366	484	873
PM exh	1990	Start	38	32	
PM exh	1990	Hot	1,189	496	370
PM exh	1995	Start	31	20	
PM exh	1995	Hot	772	335	153
PM exh	2000	Start	30	9	
PM exh	2000	Hot	438	323	67
PM exh	2005	Start	40	5	
PM exh	2005	Hot	442	308	73

Emission	Year	Emission type	Cars	LDVs	Motor-cycles
PM exh	2010	Start	48	3	
PM exh	2010	Hot	431	236	77
PM exh	2015	Start	54	2	
PM exh	2015	Hot	426	172	79
PM exh	2020	Start	58	2	
PM exh	2020	Hot	420	141	81
PM exh	2025	Start	61	2	
PM exh	2025	Hot	439	132	83
PM exh	2030	Start	63	2	
PM exh	2030	Hot	457	131	85

Table 9 Updated emissions in tonnes p.a. – shown by emission type. This differentiation is only relevant for cars, light duty vehicles and motorcycles, since the other vehicle categories only produce hot emissions.

A5.3 EMISSIONS BY ROAD CATEGORY

In tonnes per annum

Emission	Year	Road type	Cars	LDVs	HDVs	Coaches	Buses	Motor-cycles	Total
CO	1980	Mot	182,646	15,105	1,113	35		2,565	201,464
CO	1980	Rur	235,039	20,076	1,753	58	167	10,437	267,530
CO	1980	Urb	501,038	39,831	2,578	86	553	25,088	569,173
CO	1985	Mot	150,654	21,219	1,362	45		3,982	177,262
CO	1985	Rur	137,370	13,896	1,545	55	195	11,030	164,091
CO	1985	Urb	359,780	36,887	2,172	77	632	20,800	420,350
CO	1990	Mot	99,417	23,661	1,629	64		4,556	129,327
CO	1990	Rur	70,157	9,230	1,300	60	248	9,576	90,570
CO	1990	Urb	229,589	29,369	1,942	88	774	12,848	274,611
CO	1995	Mot	53,953	16,818	1,538	67		4,641	77,017
CO	1995	Rur	34,543	5,359	1,124	56	255	8,452	49,788
CO	1995	Urb	165,513	18,285	1,593	82	794	8,067	194,334
CO	2000	Mot	32,400	11,591	1,533	55		5,694	51,273
CO	2000	Rur	19,745	3,832	1,072	45	209	9,388	34,290
CO	2000	Urb	153,532	13,007	1,488	66	654	7,340	176,088
CO	2005	Mot	21,023	6,686	1,214	45		5,879	34,846
CO	2005	Rur	12,147	2,243	882	38	162	8,879	24,351
CO	2005	Urb	120,081	8,430	1,192	53	509	6,170	136,434
CO	2010	Mot	15,408	4,307	1,096	39		4,726	25,575
CO	2010	Rur	7,951	1,333	799	33	122	6,869	17,107
CO	2010	Urb	77,231	5,211	1,063	45	383	4,706	88,639
CO	2015	Mot	12,830	3,269	1,083	36		3,731	20,948
CO	2015	Rur	5,528	839	770	29	104	5,341	12,610
CO	2015	Urb	45,083	3,233	1,024	40	325	3,869	53,574
CO	2020	Mot	11,946	2,889	1,080	34		2,955	18,903
CO	2020	Rur	4,837	659	751	26	94	4,446	10,814
CO	2020	Urb	33,916	2,474	1,002	37	296	3,457	41,182
CO	2025	Mot	12,024	2,793	1,099	33		2,483	18,432
CO	2025	Rur	4,831	605	747	26	90	3,922	10,221
CO	2025	Urb	32,628	2,231	998	36	283	3,294	39,469
CO	2030	Mot	12,159	2,801	1,124	33		2,274	18,390
CO	2030	Rur	4,873	596	745	25	89	3,698	10,026

Emission	Year	Road type	Cars	LDVs	HDVs	Coaches	Buses	Motor-cycles	Total
CO	2030	Urb	33,125	2,186	998	35	280	3,256	39,880
CO2	1980	Mot	1,718,250	171,695	439,255	23,740		15,561	2,368,503
CO2	1980	Rur	2,604,465	258,248	574,260	25,694	38,761	61,454	3,562,882
CO2	1980	Urb	3,775,153	265,784	610,343	28,042	105,005	152,129	4,936,456
CO2	1985	Mot	2,323,529	248,806	554,582	30,562		24,304	3,181,783
CO2	1985	Rur	2,521,927	232,219	522,988	24,770	45,790	67,342	3,415,036
CO2	1985	Urb	4,051,844	297,221	529,742	25,560	121,275	132,002	5,157,645
CO2	1990	Mot	2,981,836	337,969	686,546	43,035		29,904	4,079,291
CO2	1990	Rur	2,666,161	233,241	457,191	26,784	58,589	63,585	3,505,550
CO2	1990	Urb	4,316,464	316,520	488,312	28,997	149,356	87,125	5,386,775
CO2	1995	Mot	3,212,556	363,147	692,618	44,478		34,323	4,347,122
CO2	1995	Rur	2,757,119	233,782	432,767	25,654	64,108	64,891	3,578,321
CO2	1995	Urb	4,218,394	313,712	433,751	27,376	162,349	64,542	5,220,123
CO2	2000	Mot	3,647,082	455,801	805,896	38,617		44,803	4,992,199
CO2	2000	Rur	2,910,980	275,500	476,034	21,877	63,652	78,041	3,826,084
CO2	2000	Urb	4,279,356	358,143	472,522	23,191	159,860	65,728	5,358,800
CO2	2005	Mot	3,983,665	513,762	739,827	34,938		55,139	5,327,331
CO2	2005	Rur	2,938,361	293,172	439,366	19,763	66,079	88,011	3,844,752
CO2	2005	Urb	4,197,193	373,235	433,092	20,504	163,995	66,527	5,254,546
CO2	2010	Mot	4,132,073	537,682	790,889	34,698		61,060	5,556,402
CO2	2010	Rur	2,830,801	292,288	477,581	19,117	66,801	91,349	3,777,937
CO2	2010	Urb	3,986,567	370,858	464,488	19,816	164,426	66,041	5,072,195
CO2	2015	Mot	4,142,297	547,667	867,680	35,412		66,067	5,659,123
CO2	2015	Rur	2,654,006	285,861	517,037	18,706	68,539	93,593	3,637,742
CO2	2015	Urb	3,733,687	362,509	503,202	20,016	168,094	67,535	4,855,043
CO2	2020	Mot	4,027,239	547,520	918,332	35,527		68,801	5,597,419
CO2	2020	Rur	2,570,600	285,253	539,232	18,647	69,867	97,860	3,581,459
CO2	2020	Urb	3,613,006	360,930	525,905	19,852	171,149	70,147	4,760,990
CO2	2025	Mot	3,978,888	553,009	955,791	35,542		71,351	5,594,581
CO2	2025	Rur	2,536,097	287,854	550,088	18,617	70,494	102,241	3,565,390
CO2	2025	Urb	3,569,016	364,098	537,841	19,834	172,635	73,773	4,737,197
CO2	2030	Mot	3,973,675	562,631	987,872	35,565		74,136	5,633,879
CO2	2030	Rur	2,530,807	292,674	555,163	18,607	70,683	106,774	3,574,708
CO2	2030	Urb	3,568,670	370,268	543,963	19,842	173,093	77,432	4,753,269
HC	1980	Mot	11,355	617	427	14		805	13,219
HC	1980	Rur	25,377	1,608	569	16	64	4578	32,213
HC	1980	Urb	82,408	4,092	1,120	30	249	14,833	102,732
HC	1985	Mot	11,789	789	521	18		849	13,966
HC	1985	Rur	18,953	1,288	499	15	74	4,324	25,153
HC	1985	Urb	79,360	4,374	935	27	281	13,432	98,410
HC	1990	Mot	7,955	813	612	26		594	10,000
HC	1990	Rur	10,398	959	411	17	92	2,715	14,592
HC	1990	Urb	53,440	3,963	821	31	339	8,359	66,952
HC	1995	Mot	3,661	556	570	26		513	5,325
HC	1995	Rur	4,390	526	350	16	88	1,854	7,223
HC	1995	Urb	28,431	2,464	643	28	322	5,523	37,411
HC	2000	Mot	1,746	384	557	22		555	3,265
HC	2000	Rur	1,815	287	315	13	66	1,703	4,199
HC	2000	Urb	16,891	1,461	562	23	242	4,681	23,860
HC	2005	Mot	893	220	362	17		547	2,038
HC	2005	Rur	786	143	201	10	43	1,510	2,693
HC	2005	Urb	9,663	822	356	16	153	4,040	15,050
HC	2010	Mot	560	132	399	16		428	1,535

Emission	Year	Road type	Cars	LDVs	HDVs	Coaches	Buses	Motor-cycles	Total
HC	2010	Rur	445	80	216	9	34	1,087	1,871
HC	2010	Urb	5,823	463	361	15	111	3,365	10,139
HC	2015	Mot	422	92	451	17		327	1,310
HC	2015	Rur	312	52	237	9	31	805	1,446
HC	2015	Urb	3,824	293	386	15	100	3,030	7,648
HC	2020	Mot	387	77	487	17		251	1,219
HC	2020	Rur	286	42	250	9	32	651	1,270
HC	2020	Urb	3,265	230	405	15	100	2,892	6,906
HC	2025	Mot	389	73	512	17		206	1,197
HC	2025	Rur	287	39	257	9	32	561	1,186
HC	2025	Urb	3,216	208	415	15	102	2,844	6,800
HC	2030	Mot	391	73	531	17		184	1,197
HC	2030	Rur	285	39	260	9	33	513	1,140
HC	2030	Urb	3,228	203	420	15	102	2,842	6,810
NOx	1980	Mot	26,035	2,598	5,749	290		43	34,716
NOx	1980	Rur	33,171	3,174	7,779	325	517	49	45,015
NOx	1980	Urb	21,429	1,745	7,366	329	1,345	62	32,276
NOx	1985	Mot	34,400	3,199	7,625	393		80	45,697
NOx	1985	Rur	28,560	2,552	7,461	329	644	86	39,632
NOx	1985	Urb	21,580	1,805	6,735	316	1,638	59	32,131
NOx	1990	Mot	26,009	3,350	9,676	575		127	39,737
NOx	1990	Rur	17,366	2,091	6,704	370	863	143	27,537
NOx	1990	Urb	15,752	1,668	6,383	372	2,112	55	26,342
NOx	1995	Mot	15,125	2,623	9,084	570		171	27,573
NOx	1995	Rur	9,159	1,409	5,909	343	924	201	17,946
NOx	1995	Urb	10,514	1,391	5,355	343	2,257	57	19,917
NOx	2000	Mot	9,995	2,609	9,952	463		228	23,247
NOx	2000	Rur	5,502	1,164	6,047	279	865	265	14,122
NOx	2000	Urb	8,157	1,453	5,720	288	2,138	74	17,829
NOx	2005	Mot	7,067	2,419	7,253	354		284	17,378
NOx	2005	Rur	3,892	1,014	4,584	226	756	303	10,775
NOx	2005	Urb	6,309	1,385	4,583	244	1,925	78	14,525
NOx	2010	Mot	5,197	1,978	5,317	259		302	13,053
NOx	2010	Rur	2,999	796	3,673	169	569	294	8,500
NOx	2010	Urb	4,688	1,101	3,881	194	1,509	70	11,442
NOx	2015	Mot	4,467	1,592	3,840	175		311	10,386
NOx	2015	Rur	2,613	617	2,772	112	408	279	6,801
NOx	2015	Urb	3,767	847	3,027	139	1,116	62	8,958
NOx	2020	Mot	4,364	1,405	2,995	127		313	9,203
NOx	2020	Rur	2,604	543	2,232	81	292	275	6,027
NOx	2020	Urb	3,608	743	2,504	103	823	57	7,838
NOx	2025	Mot	4,498	1,359	2,639	108		318	8,922
NOx	2025	Rur	2,697	524	1,985	69	233	278	5,787
NOx	2025	Urb	3,716	717	2,262	89	669	57	7,509
NOx	2030	Mot	4,647	1,376	2,529	102		327	8,980
NOx	2030	Rur	2,789	530	1,879	65	216	287	5,766
NOx	2030	Urb	3,850	725	2,162	84	623	58	7,503
PM exh	1980	Mot	502	114	407	19		42	1,084
PM exh	1980	Rur	849	124	620	26	53	546	2,218
PM exh	1980	Urb	680	123	854	35	189	1,486	3,367
PM exh	1985	Mot	412	216	388	20		29	1,064
PM exh	1985	Rur	495	125	425	20	50	244	1,358
PM exh	1985	Urb	488	173	558	26	175	600	2,020

Emission	Year	Road type	Cars	LDVs	HDVs	Coaches	Buses	Motor-cycles	Total
PM exh	1990	Mot	406	250	376	22		22	1,077
PM exh	1990	Rur	389	114	289	17	49	111	970
PM exh	1990	Urb	431	164	402	23	166	236	1,423
PM exh	1995	Mot	276	172	300	18		15	780
PM exh	1995	Rur	250	80	209	13	41	51	644
PM exh	1995	Urb	277	103	285	17	136	87	905
PM exh	2000	Mot	171	169	263	13		8	624
PM exh	2000	Rur	135	81	170	9	30	24	448
PM exh	2000	Urb	162	82	231	12	100	35	621
PM exh	2005	Mot	178	163	161	8		10	521
PM exh	2005	Rur	130	77	106	6	20	27	365
PM exh	2005	Urb	174	74	146	7	65	36	502
PM exh	2010	Mot	180	126	99	5		11	422
PM exh	2010	Rur	121	57	67	3	12	28	289
PM exh	2010	Urb	178	56	93	5	37	37	404
PM exh	2015	Mot	184	93	66	3		13	359
PM exh	2015	Rur	115	41	46	2	7	28	240
PM exh	2015	Urb	181	40	65	3	22	38	348
PM exh	2020	Mot	182	76	48	2		13	322
PM exh	2020	Rur	112	34	35	1	4	29	215
PM exh	2020	Urb	183	33	49	2	14	39	319
PM exh	2025	Mot	191	71	40	2		14	318
PM exh	2025	Rur	117	31	30	1	3	30	213
PM exh	2025	Urb	192	31	42	2	11	40	316
PM exh	2030	Mot	199	71	38	1		14	323
PM exh	2030	Rur	122	31	28	1	3	30	215
PM exh	2030	Urb	200	30	40	1	10	40	322

Table 10 Updated emissions in tonnes p.a. – shown by road type (motorway/rural/urban).

A5.4 EMISSIONS BY FUEL TYPE

In tonnes per annum

Emission	Year	Fuel	Cars	LDVs	HDVs	Coaches	Buses	Motor-cycles	Total
CO	1980	P	918,150	74,393				38,090	1,030,633
CO	1980	D	573	618	5,444	179	720		7,534
CO	1985	P	646,579	70,960				35,813	753,352
CO	1985	D	1,225	1,042	5,079	178	827		8,351
CO	1990	P	397,421	61,039				26,980	485,441
CO	1990	D	1,742	1,221	4,870	212	1,022		9,067
CO	1995	P	252,520	39,493				21,160	313,174
CO	1995	D	1,490	968	4,255	204	1,049		7,966
CO	2000	P	204,041	27,391				22,422	253,854
CO	2000	D	1,636	1,040	4,093	166	863		7,797
CO	2005	P	150,824	16,459				20,928	188,211
CO	2005	D	2,426	899	3,288	136	671		7,421
CO	2010	P	96,914	10,068				16,301	123,284
CO	2010	D	3,675	782	2,958	117	505		8,036
CO	2015	P	58,764	6,645				12,941	78,350
CO	2015	D	4,677	695	2,877	104	429		8,782

Emission	Year	Fuel	Cars	LDVs	HDVs	Coaches	Buses	Motor-cycles	Total
CO	2020	P	45,389	5,359				10,857	61,605
CO	2020	D	5,310	663	2,834	97	390		9,294
CO	2025	P	43,785	4,964				9,699	58,448
CO	2025	D	5,698	665	2,844	94	373		9,674
CO	2030	P	44,173	4,900				9,228	58,300
CO	2030	D	5,985	683	2,866	93	369		9,997
CO2	1980	P	7,975,562	596,331				229,145	8,801,038
CO2	1980	D	122,306	99,397	1,623,858	77,476	143,766		2,066,802
CO2	1985	P	8,633,604	611,001				223,648	9,468,252
CO2	1985	D	263,696	167,246	1,607,312	80,892	167,065		2,286,211
CO2	1990	P	9,375,404	605,096				180,614	10,161,115
CO2	1990	D	589,057	282,634	1,632,049	98,816	207,945		2,810,501
CO2	1995	P	9,508,778	553,068				163,756	10,225,602
CO2	1995	D	679,291	357,572	1,559,136	97,507	226,457		2,919,964
CO2	2000	P	9,933,461	523,579				188,573	10,645,613
CO2	2000	D	903,957	565,865	1,754,451	83,685	223,513		3,531,470
CO2	2005	P	9,433,500	394,233				209,677	10,037,411
CO2	2005	D	1,685,718	785,936	1,612,285	75,206	230,073		4,389,219
CO2	2010	P	8,249,571	306,141				218,449	8,774,161
CO2	2010	D	2,699,870	894,687	1,732,958	73,631	231,227		5,632,374
CO2	2015	P	7,172,497	261,610				227,195	7,661,301
CO2	2015	D	3,357,493	934,426	1,887,919	74,135	236,633		6,490,607
CO2	2020	P	6,587,586	244,602				236,809	7,068,997
CO2	2020	D	3,623,259	949,101	1,983,469	74,027	241,015		6,870,871
CO2	2025	P	6,383,888	239,382				247,365	6,870,635
CO2	2025	D	3,700,113	965,580	2,043,720	73,992	243,128		7,026,533
CO2	2030	P	6,330,904	238,593				258,342	6,827,839
CO2	2030	D	3,742,248	986,980	2,086,999	74,014	243,776		7,134,016
HC	1980	P	118,991	6,088				20,216	145,295
HC	1980	D	149	229	2,117	60	313		2,868
HC	1985	P	109,785	6,065				18,605	134,455
HC	1985	D	318	385	1,955	61	355		3,074
HC	1990	P	71,391	5,357				11,667	88,415
HC	1990	D	402	379	1,844	73	432		3,129
HC	1995	P	36,179	3,325				7,889	47,393
HC	1995	D	303	221	1,562	70	410		2,566
HC	2000	P	20,130	1,952				6,939	29,020
HC	2000	D	322	181	1,434	58	308		2,304
HC	2005	P	10,853	1,020				6,097	17,970
HC	2005	D	489	165	918	43	196		1,811
HC	2010	P	6,083	529				4,880	11,492
HC	2010	D	745	147	976	40	145		2,053
HC	2015	P	3,610	304				4,162	8,077
HC	2015	D	949	133	1,074	41	131		2,327
HC	2020	P	2,859	221				3,793	6,874
HC	2020	D	1,078	128	1,142	41	132		2,521
HC	2025	P	2,735	192				3,611	6,537
HC	2025	D	1,157	129	1,183	41	134		2,645
HC	2030	P	2,688	182				3,540	6,410
HC	2030	D	1,216	133	1,211	41	135		2,736
NOx	1980	P	80,186	7,146				154	87,487
NOx	1980	D	450	370	20,894	945	1,862		24,520
NOx	1985	P	83,572	6,937				225	90,733

Emission	Year	Fuel	Cars	LDVs	HDVs	Coaches	Buses	Motor-cycles	Total
NOx	1985	D	967	619	21,821	1,038	2,282		26,727
NOx	1990	P	57,312	5,972				325	63,609
NOx	1990	D	1,816	1,136	22,763	1,317	2,974		30,007
NOx	1995	P	32,826	3,911				429	37,165
NOx	1995	D	1,972	1,513	20,349	1,256	3,181		28,271
NOx	2000	P	20,936	2,806				566	24,308
NOx	2000	D	2,718	2,420	21,718	1,030	3,003		30,890
NOx	2005	P	12,795	1,759				665	15,219
NOx	2005	D	4,474	3,059	16,421	824	2,681		27,459
NOx	2010	P	6,915	1,046				665	8,626
NOx	2010	D	5,969	2,829	12,871	622	2,078		24,369
NOx	2015	P	3,754	648				652	5,053
NOx	2015	D	7,093	2,409	9,639	427	1,524		21,092
NOx	2020	P	2,822	499				645	3,966
NOx	2020	D	7,754	2,191	7,731	311	1,115		19,102
NOx	2025	P	2,684	454				653	3,791
NOx	2025	D	8,227	2,146	6,886	266	902		18,427
NOx	2030	P	2,682	446				671	3,800
NOx	2030	D	8,604	2,185	6,570	251	839		18,449
PM exh	1980	P	1,900	100				2,074	4,074
PM exh	1980	D	130	261	1,881	80	243		2,595
PM exh	1985	P	1,112	58				873	2,043
PM exh	1985	D	282	456	1,371	65	225		2,399
PM exh	1990	P	801	40				370	1,210
PM exh	1990	D	425	489	1,068	62	216		2,259
PM exh	1995	P	437	21				153	610
PM exh	1995	D	366	334	794	47	177		1,718
PM exh	2000	P	136	6				67	209
PM exh	2000	D	332	327	663	33	130		1,484
PM exh	2005	P	112	4				73	189
PM exh	2005	D	370	310	413	21	85		1,199
PM exh	2010	P	83	2				77	161
PM exh	2010	D	397	237	259	13	48		954
PM exh	2015	P	58	2				79	138
PM exh	2015	D	422	173	177	8	29		808
PM exh	2020	P	38	1				81	120
PM exh	2020	D	440	142	131	5	18		736
PM exh	2025	P	39	1				83	123
PM exh	2025	D	461	132	112	4	14		724
PM exh	2030	P	40	1				85	126
PM exh	2030	D	480	132	105	4	13		734

Table 11 Updated emissions in tonnes p.a. – shown by fuel type (petrol/diesel).

A5.5 EMISSIONS BY EMISSION CONCEPT

In tonnes per annum

Emission	Veh. type	Concept	1985	1990	1995	2000	2005	2010	2015	2020	2025	2030
CO	PC	PC/P/conv	645,588	321,937	113,744	30,376	7,572	3,602	2,091	1,471	1,218	668
CO	PC	PC/P/RCat<91	991	75,484	80,099	47,513	14,622	3,049	998	556	422	299
CO	PC	PC/P/Euro-1/FAV1			58,678	72,148	46,719	15,695	3,290	1,068	583	442
CO	PC	PC/P/Euro-2				53,110	60,699	40,337	13,082	2,831	952	539
CO	PC	PC/P/Euro-3				790	14,722	14,146	7,939	2,193	530	192
CO	PC	PC/P/Euro-4				105	6,490	20,084	31,364	37,271	40,079	42,033
CO	PC	PC/D/conv	1,225	1,529	728	240	43	12	5	4	3	2
CO	PC	PC/D/XXIII/FAV1		212	762	642	257	85	20	6	3	2
CO	PC	PC/D/Euro-2			1	704	499	278	95	22	7	4
CO	PC	PC/D/Euro-3				50	1,311	949	491	142	34	12
CO	PC	PC/D/Euro-4					316	2,351	4,066	5,137	5,652	5,966
CO	LDV	LDV/P/conv	70,948	57,999	28,604	11,052	3,494	1,217	423	161	66	38
CO	LDV	LDV/P/RCat<91	12	3,040	4,739	4,036	1,596	627	196	77	27	11
CO	LDV	LDV/P/Euro-1/FAV1			6,150	9,960	6,017	2,513	914	313	122	46
CO	LDV	LDV/P/Euro-2				2,326	3,539	2,103	829	320	106	44
CO	LDV	LDV/P/Euro-3				17	1,570	1,766	911	341	127	42
CO	LDV	LDV/B/Euro-4					243	1,842	3,372	4,148	4,516	4,718
CO	LDV	LDV/D/conv	1,042	1,221	870	426	146	57	23	9	4	2
CO	LDV	LDV/D/Euro-1/FAV1			98	385	201	95	37	14	5	2
CO	LDV	LDV/D/Euro-2				228	305	176	74	29	10	4
CO	LDV	LDV/D/Euro-3				1	247	247	129	50	20	7
CO	LDV	LDV/D/Euro-4						206	433	562	627	668
CO	HDV	HMV/1950s	36									
CO	HDV	HMV/1960s	306	117	21							
CO	HDV	HMV/1970s	2,417	859	234	99	21	6	2	1	0	0
CO	HDV	HMV/1980s	2,320	3,894	3,186	1,746	487	178	57	18	8	4
CO	HDV	HMV/Euro-1			814	1,034	282	125	55	21	7	2
CO	HDV	HMV/Euro-2				1,044	643	339	149	69	22	6
CO	HDV	HMV/Euro-3				169	1,783	1,106	614	245	99	24
CO	HDV	HMV/Euro-4					74	735	438	213	84	31
CO	HDV	HMV/Euro-5						470	1,560	2,266	2,623	2,798
CO	Coach	HMV/1950s	5									
CO	Coach	HMV/1960s	15	9	6							
CO	Coach	HMV/1970s	97	57	17	10	4	1	1	0	0	0
CO	Coach	HMV/1980s	61	145	153	81	28	10	4	1	0	0
CO	Coach	HMV/Euro-1			28	46	28	11	4	1	0	0
CO	Coach	HMV/Euro-2			0	28	40	25	10	3	1	0
CO	Coach	HMV/Euro-3				0	35	33	19	7	2	1
CO	Coach	HMV/Euro-4					1	22	17	8	3	1
CO	Coach	HMV/Euro-5						14	50	75	87	91
CO	Bus	HMV/1950s	25									
CO	Bus	HMV/1960s	83	42	19							
CO	Bus	HMV/1970s	437	266	100	32	5	1	0	0	0	0
CO	Bus	HMV/1980s	283	714	874	630	285	82	14	2	0	0
CO	Bus	HMV/Euro-1			56	88	63	33	10	2	0	0
CO	Bus	HMV/Euro-2			0	112	165	126	69	20	3	1
CO	Bus	HMV/Euro-3				0	147	132	100	47	11	2
CO	Bus	HMV/Euro-4					5	81	64	41	17	3

Emission	Veh. type	Concept	1985	1990	1995	2000	2005	2010	2015	2020	2025	2030
CO	Bus	HMV/Euro-5						50	172	277	341	363
CO	MC	MP/ without cat	18,948	9,091	2,276	718	312	185	109	60	33	18
CO	MC	MP/ with cat		178	898	958	667	413	309	262	232	207
CO	MC	LMC/<Euro-1	1,853	831	292	91	21	14	11	8	6	4
CO	MC	LMC/Euro-1		159	313	680	836	274	66	30	16	11
CO	MC	LMC/Euro-2					125	325	398	419	430	436
CO	MC	MC/2S/<Euro-1	7,805	4,676	2,767	1,503	828	531	356	236	156	103
CO	MC	MC/2S/Euro-1		1,200	3,076	4,907	4,033	2,252	1,136	608	379	251
CO	MC	MC/2S/Euro-2					679	677	398	193	87	53
CO	MC	MC/2S/Euro-3						683	1,254	1,558	1,690	1,745
CO	MC	MC/4S/<Euro-1	7,207	8,583	5,114	3,407	2,106	1,379	1,078	952	848	752
CO	MC	MC/4S/Euro-1		2,263	6,424	10,158	10,523	7,717	5,203	3,378	2,302	1,851
CO	MC	MC/4S/Euro-2					798	870	658	417	253	158
CO	MC	MC/4S/Euro-3						980	1,964	2,737	3,270	3,637
CO2	PC	PC/P/conv	8,597,023	5,396,989	2,043,505	543,251	121,604	48,183	26,547	18,652	14,392	8,828
CO2	PC	PC/P/RCat<91	36,581	3,978,415	3,343,277	1,736,433	513,184	104,634	33,157	17,839	13,102	9,080
CO2	PC	PC/P/Euro-1/FAV1			4,121,996	3,882,665	2,140,226	663,514	138,489	43,790	23,146	17,032
CO2	PC	PC/P/Euro-2				3,611,887	3,089,053	1,705,111	501,282	103,960	33,643	18,510
CO2	PC	PC/P/Euro-3				129,733	1,964,012	1,484,296	720,511	185,471	43,368	15,172
CO2	PC	PC/P/Euro-4				29,493	1,605,420	4,243,833	5,752,510	6,217,874	6,256,238	6,262,284
CO2	PC	PC/D/conv	263,696	487,139	277,275	99,701	20,600	5,435	2,209	1,441	1,102	678
CO2	PC	PC/D/XXIII/FAV1		101,918	401,629	341,651	147,575	50,026	12,052	3,864	1,950	1,388
CO2	PC	PC/D/Euro-2			387	428,767	324,106	181,778	61,721	13,833	4,462	2,334
CO2	PC	PC/D/Euro-3				33,838	946,958	692,654	359,063	101,287	23,768	8,227
CO2	PC	PC/D/Euro-4					246,480	1,769,977	2,922,448	3,502,833	3,668,830	3,729,620
CO2	LDV	LDV/P/conv	610,702	535,913	281,868	111,223	36,479	12,705	4,424	1,671	678	390
CO2	LDV	LDV/P/RCat<91	299	69,183	86,235	65,466	23,750	8,492	2,534	954	322	134
CO2	LDV	LDV/P/Euro-1/FAV1			184,965	255,429	135,988	50,367	17,024	5,600	2,121	771
CO2	LDV	LDV/P/Euro-2				90,503	108,832	54,212	19,345	7,079	2,304	933
CO2	LDV	LDV/P/Euro-3				959	72,806	67,869	30,709	10,553	3,735	1,236
CO2	LDV	LDV/P/Euro-4					16,378	112,495	187,574	218,747	230,223	235,130
CO2	LDV	LDV/D/conv	167,246	282,634	309,202	177,076	64,504	25,833	10,007	3,884	1,619	684
CO2	LDV	LDV/D/Euro-1/FAV1			48,370	188,502	103,734	49,369	19,352	7,205	2,677	1,201
CO2	LDV	LDV/D/Euro-2				198,657	272,212	156,499	65,735	25,939	8,726	3,684
CO2	LDV	LDV/D/Euro-3				1,629	345,486	342,768	179,069	70,116	27,401	9,381
CO2	LDV	LDV/D/Euro-4						320,218	660,264	841,957	925,156	972,031
CO2	HDV	HMV/1950s	8,718									
CO2	HDV	HMV/1960s	83,500	31,299	5,683							
CO2	HDV	HMV/1970s	736,351	262,080	71,589	29,549	6,228	1,783	674	356	169	58
CO2	HDV	HMV/1980s	778,743	1,338,670	1,127,497	608,583	164,236	60,109	20,015	6,683	3,212	1,710
CO2	HDV	HMV/Euro-1			354,368	454,743	127,885	56,429	25,008	9,537	3,071	1,015
CO2	HDV	HMV/Euro-2				581,958	378,974	198,929	87,639	40,655	12,686	3,753
CO2	HDV	HMV/Euro-3				79,617	881,956	546,455	303,614	121,263	49,218	11,779
CO2	HDV	HMV/Euro-4					53,006	527,053	314,309	153,382	60,766	22,513
CO2	HDV	HMV/Euro-5						342,200	1,136,660	1,651,593	1,914,599	2,046,171
CO2	Coach	HMV/1950s	1,969									
CO2	Coach	HMV/1960s	6,639	4,139	2,872							
CO2	Coach	HMV/1970s	43,925	26,367	8,084	4,629	1,861	665	275	113	47	19
CO2	Coach	HMV/1980s	28,360	68,310	73,272	39,142	13,718	4,690	1,724	607	223	92
CO2	Coach	HMV/Euro-1			13,233	22,031	13,538	5,545	1,840	703	239	83
CO2	Coach	HMV/Euro-2			46	17,752	26,038	16,375	6,635	2,167	846	282
CO2	Coach	HMV/Euro-3				131	19,002	18,009	10,495	3,712	1,163	543
CO2	Coach	HMV/Euro-4					1,049	17,258	13,036	6,463	2,209	691

Emission	Veh. type	Concept	1985	1990	1995	2000	2005	2010	2015	2020	2025	2030
CO2	Coach	HMV/Euro-5						11,089	40,130	60,262	69,265	72,303
CO2	Bus	HMV/1950s	4,909									
CO2	Bus	HMV/1960s	16,317	7,905	3,487							
CO2	Bus	HMV/1970s	87,774	53,174	20,145	6,384	1,114	192	33	6	1	0
CO2	Bus	HMV/1980s	58,066	146,866	182,643	132,487	61,480	17,621	3,107	533	91	16
CO2	Bus	HMV/Euro-1			20,109	31,741	23,335	12,363	3,638	621	106	18
CO2	Bus	HMV/Euro-2			72	52,823	79,995	60,813	33,206	9,905	1,686	290
CO2	Bus	HMV/Euro-3				77	60,894	54,797	41,293	19,644	4,508	770
CO2	Bus	HMV/Euro-4					3,255	52,488	41,539	26,794	10,748	1,974
CO2	Bus	HMV/Euro-5						32,953	113,816	183,512	225,988	240,708
CO2	MC	MP/ without cat	104,455	50,117	12,548	3,934	1,727	1,023	604	331	182	99
CO2	MC	MP/ with cat		1,771	8,949	9,491	6,681	4,137	3,094	2,626	2,320	2,077
CO2	MC	LMC/<Euro-1	14,584	6,541	2,298	710	164	112	84	63	47	35
CO2	MC	LMC/Euro-1		2,463	4,867	10,496	13,040	4,276	1,030	460	247	177
CO2	MC	LMC/Euro-2					7,321	18,958	23,268	24,498	25,112	25,488
CO2	MC	MC/2S/<Euro-1	57,798	34,561	20,371	10,871	5,995	3,837	2,577	1,711	1,135	755
CO2	MC	MC/2S/Euro-1		6,883	17,588	27,603	22,758	12,686	6,407	3,437	2,144	1,425
CO2	MC	MC/2S/Euro-2					4,238	4,216	2,480	1,206	545	334
CO2	MC	MC/2S/Euro-3						6,574	12,092	15,076	16,412	16,993
CO2	MC	MC/4S/<Euro-1	46,811	56,086	33,636	22,610	14,243	9,303	7,260	6,425	5,734	5,101
CO2	MC	MC/4S/Euro-1		22,192	63,499	102,856	108,410	79,744	53,757	34,855	23,849	19,238
CO2	MC	MC/4S/Euro-2					25,101	27,456	21,404	14,359	9,462	5,834
CO2	MC	MC/4S/Euro-3						46,127	93,138	131,761	160,177	180,787
HC	PC	PC/P/conv	109,699	63,021	23,286	6,170	1,609	815	560	450	384	299
HC	PC	PC/P/RCat<91	86	8,370	8,592	4,865	1,467	314	108	63	49	36
HC	PC	PC/P/Euro-1/FAV1			4,301	4,132	2,335	729	155	56	34	27
HC	PC	PC/P/Euro-2				4,905	4,291	2,427	701	143	51	31
HC	PC	PC/P/Euro-3				48	705	554	277	69	17	7
HC	PC	PC/P/Euro-4				9	446	1,244	1,810	2,079	2,201	2,288
HC	PC	PC/D/conv	318	365	169	54	10	3	1	1	1	0
HC	PC	PC/D/XXIII/FAV1		37	133	112	45	15	4	1	1	0
HC	PC	PC/D/Euro-2			0	146	104	58	20	5	2	1
HC	PC	PC/D/Euro-3				10	267	194	101	30	7	2
HC	PC	PC/D/Euro-4					64	476	823	1,041	1,148	1,212
HC	LDV	LDV/P/conv	6,065	5,191	2,745	1,087	378	147	64	32	18	12
HC	LDV	LDV/P/RCat<91	1	165	243	197	76	29	9	4	1	1
HC	LDV	LDV/P/Euro-1/FAV1			337	510	299	121	43	15	6	2
HC	LDV	LDV/P/Euro-2				158	196	102	37	14	5	2
HC	LDV	LDV/P/Euro-3				1	61	60	29	10	4	1
HC	LDV	LDV/P/Euro-4					10	70	122	146	157	164
HC	LDV	LDV/D/conv	385	379	209	86	30	11	5	2	1	0
HC	LDV	LDV/D/Euro-1/FAV1			12	48	25	12	5	2	1	0
HC	LDV	LDV/D/Euro-2				46	61	35	15	6	2	1
HC	LDV	LDV/D/Euro-3				0	48	48	25	10	4	1
HC	LDV	LDV/D/Euro-4						40	84	109	122	130
HC	HDV	HMV/1950s	15									
HC	HDV	HMV/1960s	124	48	9							
HC	HDV	HMV/1970s	941	336	89	38	8	2	1	0	0	0
HC	HDV	HMV/1980s	875	1,460	1,144	628	172	63	20	6	3	1
HC	HDV	HMV/Euro-1			321	406	106	47	21	8	3	1
HC	HDV	HMV/Euro-2				320	188	99	44	20	6	2
HC	HDV	HMV/Euro-3				41	414	257	143	57	23	6
HC	HDV	HMV/Euro-4					31	309	185	90	36	13

Emission	Veh. type	Concept	1985	1990	1995	2000	2005	2010	2015	2020	2025	2030
HC	HDV	HMV/Euro-5						199	661	960	1,113	1,188
HC	Coach	HMV/1950s	2									
HC	Coach	HMV/1960s	5	3	2							
HC	Coach	HMV/1970s	33	20	6	3	1	0	0	0	0	0
HC	Coach	HMV/1980s	21	50	51	27	9	3	1	0	0	0
HC	Coach	HMV/Euro-1			11	19	11	4	1	1	0	0
HC	Coach	HMV/Euro-2			0	9	13	8	3	1	0	0
HC	Coach	HMV/Euro-3				0	9	8	5	2	1	0
HC	Coach	HMV/Euro-4					1	10	7	4	1	0
HC	Coach	HMV/Euro-5						6	22	34	39	40
HC	Bus	HMV/1950s	11									
HC	Bus	HMV/1960s	35	22	9							
HC	Bus	HMV/1970s	187	114	41	13	2	0	0	0	0	0
HC	Bus	HMV/1980s	121	295	341	236	102	30	5	1	0	0
HC	Bus	HMV/Euro-1			18	29	20	11	3	1	0	0
HC	Bus	HMV/Euro-2			0	29	41	31	17	5	1	0
HC	Bus	HMV/Euro-3				0	28	25	19	9	2	0
HC	Bus	HMV/Euro-4					2	30	23	15	6	1
HC	Bus	HMV/Euro-5						18	63	102	125	133
HC	MC	MP/ without cat	9,404	4,779	1,337	455	216	136	88	56	37	25
HC	MC	MP/ with cat		166	905	966	663	404	300	255	226	204
HC	MC	LMC/<Euro-1	914	432	162	52	12	8	6	5	4	3
HC	MC	LMC/Euro-1		148	307	667	825	283	72	32	17	13
HC	MC	LMC/Euro-2					286	735	914	967	992	1,006
HC	MC	MC/2S/<Euro-1	7,637	4,608	2,735	1,442	781	499	337	225	150	100
HC	MC	MC/2S/Euro-1		388	1,013	1,559	1,255	705	362	198	125	84
HC	MC	MC/2S/Euro-2					165	161	96	48	23	14
HC	MC	MC/2S/Euro-3						212	391	492	541	564
HC	MC	MC/4S/<Euro-1	650	838	533	341	204	142	116	104	93	84
HC	MC	MC/4S/Euro-1		308	897	1,458	1,501	1,116	762	508	370	310
HC	MC	MC/4S/Euro-2					189	197	157	108	72	51
HC	MC	MC/4S/Euro-3						281	561	794	961	1,083
NOx	PC	PC/P/conv	83,534	49,950	17,676	4,427	1,003	411	233	164	125	79
NOx	PC	PC/P/RCat<91	38	7,362	8,680	5,280	1,690	374	125	70	53	37
NOx	PC	PC/P/Euro-1/FAV1			6,470	8,480	5,780	2,053	457	150	82	62
NOx	PC	PC/P/Euro-2				2,714	3,351	2,323	779	173	58	33
NOx	PC	PC/P/Euro-3				31	640	667	393	116	29	11
NOx	PC	PC/P/Euro-4				5	331	1,087	1,767	2,150	2,336	2,462
NOx	PC	PC/D/conv	967	1,531	846	296	59	16	7	4	3	2
NOx	PC	PC/D/XXIII/FAV1		285	1,125	964	411	140	33	11	5	4
NOx	PC	PC/D/Euro-2			1	1,369	1,044	589	200	44	14	7
NOx	PC	PC/D/Euro-3				89	2,511	1,842	955	266	62	21
NOx	PC	PC/D/Euro-4					448	3,383	5,899	7,429	8,142	8,569
NOx	LDV	LDV/P/conv	6,936	5,768	2,909	1,114	356	125	44	17	7	4
NOx	LDV	LDV/P/RCat<91	1	205	366	335	137	54	17	6	2	1
NOx	LDV	LDV/P/Euro-1/FAV1			635	1,139	736	312	113	38	15	5
NOx	LDV	LDV/P/Euro-2				218	405	269	112	45	16	7
NOx	LDV	LDV/P/Euro-3				1	110	154	88	35	14	5
NOx	LDV	LDV/P/Euro-4					15	133	273	357	401	425
NOx	LDV	LDV/D/conv	619	1,136	1,301	753	271	110	43	17	7	3
NOx	LDV	LDV/D/Euro-1/FAV1			212	839	458	220	87	32	12	5
NOx	LDV	LDV/D/Euro-2				822	1,153	667	282	111	38	16
NOx	LDV	LDV/D/Euro-3				5	1,177	1,182	621	244	95	33

Emission	Veh. type	Concept	1985	1990	1995	2000	2005	2010	2015	2020	2025	2030
NOx	LDV	LDV/D/Euro-4						651	1,377	1,787	1,994	2,128
NOx	HDV	HMV/1950s	101									
NOx	HDV	HMV/1960s	1,025	387	69							
NOx	HDV	HMV/1970s	9,656	3,442	924	384	80	23	9	5	2	1
NOx	HDV	HMV/1980s	11,039	18,934	15,624	8,466	2,280	835	276	91	43	23
NOx	HDV	HMV/Euro-1			3,731	4,784	1,324	584	259	99	32	11
NOx	HDV	HMV/Euro-2				7,371	4,680	2,458	1,083	502	157	46
NOx	HDV	HMV/Euro-3				713	7,743	4,799	2,665	1,064	432	103
NOx	HDV	HMV/Euro-4					314	3,120	1,857	905	358	132
NOx	HDV	HMV/Euro-5						1,052	3,490	5,065	5,862	6,254
NOx	Coach	HMV/1950s	21									
NOx	Coach	HMV/1960s	76	47	32							
NOx	Coach	HMV/1970s	550	330	99	57	22	8	3	1	1	0
NOx	Coach	HMV/1980s	391	940	988	527	181	62	23	8	3	1
NOx	Coach	HMV/Euro-1			136	226	136	56	19	7	2	1
NOx	Coach	HMV/Euro-2			1	219	316	199	81	26	10	3
NOx	Coach	HMV/Euro-3				1	162	153	89	32	10	5
NOx	Coach	HMV/Euro-4					7	108	82	41	14	4
NOx	Coach	HMV/Euro-5						36	131	196	226	236
NOx	Bus	HMV/1950s	55									
NOx	Bus	HMV/1960s	200	90	39							
NOx	Bus	HMV/1970s	1,173	709	263	82	14	2	0	0	0	0
NOx	Bus	HMV/1980s	853	2,175	2,667	1,946	888	254	45	8	1	0
NOx	Bus	HMV/Euro-1			212	335	242	128	38	6	1	0
NOx	Bus	HMV/Euro-2			1	639	947	720	393	117	20	3
NOx	Bus	HMV/Euro-3				1	568	511	385	183	42	7
NOx	Bus	HMV/Euro-4					22	351	277	179	72	13
NOx	Bus	HMV/Euro-5						112	386	622	765	815
NOx	MC	MP/ without cat	41	20	5	1	1	0	0	0	0	0
NOx	MC	MP/ with cat		1	4	4	3	2	1	1	1	1
NOx	MC	LMC/<Euro-1	6	3	1	0	0	0	0	0	0	0
NOx	MC	LMC/Euro-1		1	2	5	6	2	0	0	0	0
NOx	MC	LMC/Euro-2					2	6	8	8	8	8
NOx	MC	MC/2S/<Euro-1	30	18	11	6	3	2	1	1	1	0
NOx	MC	MC/2S/Euro-1		4	11	18	15	8	4	2	1	1
NOx	MC	MC/2S/Euro-2					7	7	4	2	1	1
NOx	MC	MC/2S/Euro-3						7	13	16	17	17
NOx	MC	MC/4S/<Euro-1	147	174	103	69	43	29	22	20	17	15
NOx	MC	MC/4S/Euro-1		104	291	463	490	360	239	152	103	83
NOx	MC	MC/4S/Euro-2					94	103	80	53	35	21
NOx	MC	MC/4S/Euro-3						138	278	389	468	523
PM exh	PC	PC/P/conv	1,107	447	88	7	1	0	0	0	0	0
PM exh	PC	PC/P/RCat<91	5	354	156	23	6	1	0	0	0	0
PM exh	PC	PC/P/Euro-1/FAV1			193	52	24	6	1	0	0	0
PM exh	PC	PC/P/Euro-2				52	37	16	4	0	0	0
PM exh	PC	PC/P/Euro-3				2	24	15	5	1	0	0
PM exh	PC	PC/P/Euro-4				0	20	44	48	36	38	40
PM exh	PC	PC/D/conv	282	379	194	66	13	4	2	1	1	0
PM exh	PC	PC/D/XXIII/FAV1		46	172	147	63	21	5	2	1	1
PM exh	PC	PC/D/Euro-2			0	113	86	48	16	4	1	1
PM exh	PC	PC/D/Euro-3				6	184	134	70	19	4	2
PM exh	PC	PC/D/Euro-4					25	189	329	414	454	477
PM exh	LDV	LDV/P/conv	58	34	10	1	0	0	0	0	0	0

Emission	Veh. type	Concept	1985	1990	1995	2000	2005	2010	2015	2020	2025	2030
PM exh	LDV	LDV/P/RCat<91	0	5	3	1	0	0	0	0	0	0
PM exh	LDV	LDV/P/Euro-1/FAV1			7	3	1	0	0	0	0	0
PM exh	LDV	LDV/P/Euro-2				1	1	0	0	0	0	0
PM exh	LDV	LDV/P/Euro-3				0	1	1	0	0	0	0
PM exh	LDV	LDV/P/Euro-4					0	1	1	1	1	1
PM exh	LDV	LDV/D/conv	456	489	310	138	49	19	8	3	1	1
PM exh	LDV	LDV/D/Euro-1/FAV1			24	95	52	25	10	4	1	1
PM exh	LDV	LDV/D/Euro-2				93	130	75	32	12	4	2
PM exh	LDV	LDV/D/Euro-3				0	79	79	41	16	6	2
PM exh	LDV	LDV/D/Euro-4						39	82	107	119	127
PM exh	HDV	HMV/1950s	17									
PM exh	HDV	HMV/1960s	127	47	8							
PM exh	HDV	HMV/1970s	783	275	68	28	6	2	1	0	0	0
PM exh	HDV	HMV/1980s	444	746	567	305	81	30	10	3	1	1
PM exh	HDV	HMV/Euro-1			151	192	52	23	10	4	1	0
PM exh	HDV	HMV/Euro-2				118	73	38	17	8	2	1
PM exh	HDV	HMV/Euro-3				19	199	124	69	27	11	3
PM exh	HDV	HMV/Euro-4					3	26	16	8	3	1
PM exh	HDV	HMV/Euro-5						17	55	80	93	99
PM exh	Coach	HMV/1950s	3									
PM exh	Coach	HMV/1960s	8	5	3							
PM exh	Coach	HMV/1970s	40	23	6	4	1	1	0	0	0	0
PM exh	Coach	HMV/1980s	14	33	32	17	6	2	1	0	0	0
PM exh	Coach	HMV/Euro-1			5	9	5	2	1	0	0	0
PM exh	Coach	HMV/Euro-2			0	3	5	3	1	0	0	0
PM exh	Coach	HMV/Euro-3				0	4	4	2	1	0	0
PM exh	Coach	HMV/Euro-4					0	1	1	0	0	0
PM exh	Coach	HMV/Euro-5						1	2	3	3	4
PM exh	Bus	HMV/1950s	12									
PM exh	Bus	HMV/1960s	34	18	8							
PM exh	Bus	HMV/1970s	131	79	27	9	2	0	0	0	0	0
PM exh	Bus	HMV/1980s	48	118	132	94	42	12	2	0	0	0
PM exh	Bus	HMV/Euro-1			10	16	11	6	2	0	0	0
PM exh	Bus	HMV/Euro-2			0	11	17	13	7	2	0	0
PM exh	Bus	HMV/Euro-3				0	14	13	10	5	1	0
PM exh	Bus	HMV/Euro-4					0	3	2	1	1	0
PM exh	Bus	HMV/Euro-5						2	6	10	12	13
PM exh	MC	MP/ without cat	619	201	29	4	2	1	1	0	0	0
PM exh	MC	MP/ with cat		9	26	11	8	5	4	3	3	3
M exh	MC	LMC/<Euro-1	67	20	4	1	0	0	0	0	0	0
PM exh	MC	LMC/Euro-1		9	10	9	11	4	1	0	0	0
PM exh	MC	LMC/Euro-2					8	20	24	25	26	26
PM exh	MC	MC/2S/<Euro-1	136	55	19	4	2	1	1	1	0	0
PM exh	MC	MC/2S/Euro-1		16	24	16	13	7	4	2	1	1
PM exh	MC	MC/2S/Euro-2					3	3	2	1	0	0
PM exh	MC	MC/2S/Euro-3						5	9	12	13	13
PM exh	MC	MC/4S/<Euro-1	51	41	14	4	2	1	1	1	1	1
PM exh	MC	MC/4S/Euro-1		17	28	19	20	14	9	6	4	3
PM exh	MC	MC/4S/Euro-2					5	6	4	3	2	1
PM exh	MC	MC/4S/Euro-3						9	19	27	32	36

Table 12 Updated emissions in tonnes p.a. – shown by vehicle emission concepts.

ANNEX A6: EMISSION FACTORS

A6.1 EMISSION FACTORS PER VEHICLE CATEGORY

In g/km – including cold starts and evaporation

Emission	Year	PCs	LDVs	HDVs	Coaches	Buses	MCs
Benzene	1980	0.127	0.120	0.019	0.013	0.046	0.308
Benzene	1985	0.099	0.099	0.017	0.012	0.044	0.317
Benzene	1990	0.063	0.072	0.015	0.011	0.041	0.252
Benzene	1995	0.038	0.049	0.013	0.010	0.036	0.188
Benzene	2000	0.025	0.031	0.010	0.010	0.026	0.138
Benzene	2005	0.013	0.017	0.007	0.008	0.016	0.104
Benzene	2010	0.007	0.009	0.007	0.007	0.012	0.074
Benzene	2015	0.004	0.005	0.007	0.008	0.010	0.057
Benzene	2020	0.003	0.004	0.007	0.008	0.010	0.048
Benzene	2025	0.002	0.004	0.007	0.008	0.011	0.043
Benzene	2030	0.002	0.003	0.007	0.008	0.011	0.040
CH4	1980	0.166	0.118	0.027	0.018	0.067	0.423
CH4	1985	0.128	0.100	0.024	0.017	0.063	0.430
CH4	1990	0.071	0.071	0.022	0.016	0.059	0.333
CH4	1995	0.036	0.044	0.019	0.015	0.051	0.238
CH4	2000	0.020	0.025	0.014	0.014	0.038	0.169
CH4	2005	0.010	0.013	0.010	0.011	0.023	0.139
CH4	2010	0.005	0.007	0.010	0.010	0.017	0.121
CH4	2015	0.003	0.004	0.010	0.011	0.015	0.106
CH4	2020	0.002	0.003	0.011	0.011	0.015	0.095
CH4	2025	0.002	0.003	0.011	0.011	0.015	0.088
CH4	2030	0.002	0.003	0.011	0.011	0.015	0.083
CO	1980	28.54	39.17	2.94	2.27	6.37	12.55
CO	1985	17.78	32.07	2.61	2.05	6.08	13.34
CO	1990	9.36	22.57	2.38	1.93	5.85	13.33
CO	1995	5.69	13.38	2.13	1.82	5.44	12.13
CO	2000	4.15	7.50	1.72	1.64	4.38	11.22
CO	2005	2.85	4.00	1.54	1.44	3.21	9.17
CO	2010	1.78	2.34	1.29	1.27	2.40	6.56
CO	2015	1.08	1.52	1.16	1.16	2.02	4.89
CO	2020	0.83	1.22	1.10	1.09	1.84	3.89
CO	2025	0.78	1.10	1.07	1.07	1.75	3.31
CO	2030	0.76	1.06	1.06	1.06	1.73	3.02
CO2	1980	252	363	876	981	1,272	76
CO2	1985	244	347	825	930	1,228	83
CO2	1990	234	322	798	901	1,190	89
CO2	1995	228	301	781	873	1,175	94
CO2	2000	219	287	736	829	1,135	94
CO2	2005	207	272	754	796	1,102	92
CO2	2010	194	259	755	802	1,099	88
CO2	2015	179	248	763	823	1,117	86
CO2	2020	167	241	768	835	1,134	85
CO2	2025	158	236	770	841	1,143	84
CO2	2030	153	232	770	843	1,146	85
HC	1980	3.70	3.30	1.14	0.76	2.77	6.66
HC	1985	3.02	2.87	1.00	0.70	2.61	6.93
HC	1990	1.68	2.08	0.90	0.66	2.47	5.76

Emission	Year	PCs	LDVs	HDVs	Coaches	Buses	MCs
HC	1995	0.82	1.17	0.78	0.63	2.13	4.52
HC	2000	0.41	0.56	0.60	0.58	1.57	3.47
HC	2005	0.21	0.27	0.43	0.45	0.94	2.67
HC	2010	0.12	0.15	0.43	0.43	0.69	1.96
HC	2015	0.08	0.09	0.43	0.45	0.62	1.57
HC	2020	0.06	0.07	0.44	0.46	0.62	1.36
HC	2025	0.06	0.06	0.45	0.47	0.63	1.23
HC	2030	0.06	0.06	0.45	0.47	0.63	1.16
N2O	1980	0.0000	0.0000	0.0130	0.0129	0.0153	0.0010
N2O	1985	0.0001	0.0000	0.0125	0.0125	0.0153	0.0010
N2O	1990	0.0058	0.0013	0.0121	0.0122	0.0153	0.0010
N2O	1995	0.0104	0.0048	0.0120	0.0121	0.0153	0.0010
N2O	2000	0.0095	0.0066	0.0115	0.0120	0.0152	0.0010
N2O	2005	0.0063	0.0059	0.0089	0.0106	0.0132	0.0010
N2O	2010	0.0040	0.0050	0.0078	0.0088	0.0110	0.0010
N2O	2015	0.0031	0.0046	0.0073	0.0077	0.0094	0.0010
N2O	2020	0.0030	0.0045	0.0071	0.0072	0.0085	0.0010
N2O	2025	0.0030	0.0045	0.0070	0.0071	0.0082	0.0010
N2O	2030	0.0030	0.0045	0.0069	0.0070	0.0082	0.0010
NH3	1980	0.0020	0.0019	0.0050	0.0050	0.0050	0.0020
NH3	1985	0.0021	0.0018	0.0050	0.0050	0.0050	0.0020
NH3	1990	0.0141	0.0046	0.0050	0.0050	0.0050	0.0020
NH3	1995	0.0239	0.0117	0.0050	0.0050	0.0050	0.0020
NH3	2000	0.0265	0.0139	0.0050	0.0050	0.0050	0.0020
NH3	2005	0.0235	0.0108	0.0050	0.0050	0.0050	0.0020
NH3	2010	0.0192	0.0084	0.0050	0.0050	0.0050	0.0020
NH3	2015	0.0164	0.0072	0.0050	0.0050	0.0050	0.0020
NH3	2020	0.0152	0.0067	0.0050	0.0050	0.0050	0.0020
NH3	2025	0.0149	0.0065	0.0050	0.0050	0.0050	0.0020
NH3	2030	0.0148	0.0063	0.0050	0.0050	0.0050	0.0020
NMHC	1980	3.53	3.18	1.11	0.75	2.70	6.24
NMHC	1985	2.89	2.77	0.98	0.68	2.55	6.50
NMHC	1990	1.61	2.01	0.88	0.65	2.41	5.43
NMHC	1995	0.78	1.13	0.76	0.61	2.08	4.29
NMHC	2000	0.39	0.54	0.59	0.56	1.53	3.30
NMHC	2005	0.20	0.26	0.42	0.44	0.92	2.53
NMHC	2010	0.12	0.14	0.42	0.42	0.67	1.84
NMHC	2015	0.07	0.09	0.42	0.44	0.60	1.47
NMHC	2020	0.06	0.07	0.43	0.45	0.61	1.26
NMHC	2025	0.06	0.06	0.43	0.46	0.62	1.15
NMHC	2030	0.06	0.06	0.44	0.46	0.62	1.08
NOx	1980	2.50	3.93	11.28	11.96	16.47	0.05
NOx	1985	2.32	3.37	11.20	11.93	16.77	0.08
NOx	1990	1.39	2.58	11.14	12.01	17.02	0.16
NOx	1995	0.78	1.79	10.19	11.24	16.51	0.25
NOx	2000	0.48	1.38	9.11	10.20	15.25	0.28
NOx	2005	0.32	1.11	7.68	8.73	12.84	0.29
NOx	2010	0.23	0.84	5.61	6.78	9.87	0.27
NOx	2015	0.18	0.63	3.90	4.74	7.19	0.25
NOx	2020	0.17	0.54	2.99	3.51	5.25	0.23
NOx	2025	0.17	0.51	2.59	3.02	4.24	0.22
NOx	2030	0.17	0.50	2.42	2.85	3.95	0.22
Pb	1980	0.040	0.051	0.000	0.000	0.000	0.012
Pb	1985	0.013	0.015	0.000	0.000	0.000	0.005

Emission	Year	PCs	LDVs	HDVs	Coaches	Buses	MCs
Pb	1990	0.007	0.007	0.000	0.000	0.000	0.003
Pb	1995	0.002	0.002	0.000	0.000	0.000	0.001
Pb	2000	0.000	0.000	0.000	0.000	0.000	0.000
Pb	2005	0.000	0.000	0.000	0.000	0.000	0.000
Pb	2010	0.000	0.000	0.000	0.000	0.000	0.000
Pb	2015	0.000	0.000	0.000	0.000		0.000
Pb	2020	0.000	0.000	0.000	0.000		0.000
Pb	2025	0.000	0.000	0.000	0.000		0.000
Pb	2030	0.000	0.000	0.000	0.000		0.000
PM exh	1980	0.063	0.189	1.015	1.017	2.147	0.683
PM exh	1985	0.038	0.229	0.703	0.751	1.653	0.325
PM exh	1990	0.029	0.192	0.522	0.564	1.235	0.183
PM exh	1995	0.018	0.117	0.398	0.424	0.919	0.088
PM exh	2000	0.009	0.088	0.278	0.328	0.659	0.034
PM exh	2005	0.009	0.072	0.193	0.225	0.409	0.032
PM exh	2010	0.008	0.052	0.113	0.140	0.229	0.031
PM exh	2015	0.008	0.036	0.072	0.086	0.135	0.030
PM exh	2020	0.008	0.029	0.051	0.058	0.086	0.029
PM exh	2025	0.008	0.026	0.042	0.048	0.065	0.028
PM exh	2030	0.008	0.025	0.039	0.045	0.061	0.028
PM non-exh	1980	0.039	0.039	0.229	0.228	0.406	0.012
PM non-exh	1985	0.040	0.040	0.208	0.208	0.403	0.013
PM non-exh	1990	0.041	0.041	0.192	0.196	0.400	0.014
PM non-exh	1995	0.041	0.041	0.183	0.190	0.399	0.015
PM non-exh	2000	0.041	0.041	0.180	0.189	0.399	0.016
PM non-exh	2005	0.041	0.041	0.180	0.188	0.399	0.016
PM non-exh	2010	0.041	0.041	0.181	0.187	0.399	0.016
PM non-exh	2015	0.041	0.041	0.181	0.188	0.399	0.017
PM non-exh	2020	0.041	0.041	0.180	0.187	0.399	0.017
PM non-exh	2025	0.041	0.041	0.179	0.187	0.399	0.017
PM non-exh	2030	0.041	0.041	0.178	0.187	0.399	0.017
SO2	1980	0.048	0.175	2.114	2.366	3.069	0.012
SO2	1985	0.041	0.148	1.257	1.417	1.871	0.011
SO2	1990	0.040	0.119	0.710	0.801	1.058	0.011
SO2	1995	0.030	0.049	0.169	0.189	0.254	0.012
SO2	2000	0.021	0.038	0.127	0.143	0.196	0.009
SO2	2005	0.001	0.002	0.005	0.005	0.007	0.000
SO2	2010	0.001	0.002	0.005	0.005	0.007	0.000
SO2	2015	0.001	0.002	0.005	0.005	0.007	0.000
SO2	2020	0.001	0.001	0.005	0.005	0.007	0.000
SO2	2025	0.001	0.001	0.005	0.005	0.007	0.000
SO2	2030	0.001	0.001	0.005	0.005	0.007	0.000
Toluol	1980	0.345	0.300	0.004	0.002	0.009	0.753
Toluol	1985	0.270	0.249	0.003	0.002	0.008	0.773
Toluol	1990	0.148	0.174	0.003	0.002	0.008	0.618
Toluol	1995	0.071	0.097	0.003	0.002	0.007	0.462
Toluol	2000	0.036	0.046	0.002	0.002	0.005	0.342
Toluol	2005	0.018	0.021	0.001	0.001	0.003	0.252
Toluol	2010	0.009	0.010	0.001	0.001	0.002	0.172
Toluol	2015	0.005	0.006	0.001	0.001	0.002	0.128
Toluol	2020	0.004	0.004	0.001	0.001	0.002	0.104
Toluol	2025	0.003	0.003	0.001	0.001	0.002	0.090
Toluol	2030	0.003	0.003	0.001	0.002	0.002	0.082
Xylol	1980	0.279	0.240	0.009	0.006	0.022	0.673

Emission	Year	PCs	LDVs	HDVs	Coaches	Buses	MCs
Xylol	1985	0.217	0.198	0.008	0.006	0.021	0.689
Xylol	1990	0.119	0.138	0.007	0.005	0.020	0.544
Xylol	1995	0.058	0.077	0.006	0.005	0.017	0.400
Xylol	2000	0.031	0.038	0.005	0.005	0.013	0.292
Xylol	2005	0.015	0.018	0.003	0.004	0.008	0.212
Xylol	2010	0.008	0.009	0.003	0.003	0.006	0.141
Xylol	2015	0.004	0.005	0.003	0.004	0.005	0.102
Xylol	2020	0.003	0.003	0.004	0.004	0.005	0.082
Xylol	2025	0.003	0.003	0.004	0.004	0.005	0.070
Xylol	2030	0.003	0.003	0.004	0.004	0.005	0.063

Table 13 Updated emission factors in g/km including cold starts and evaporation.

A6.2 EMISSION FACTORS BY EMISSION TYPE

In g/km or g/start [PCs, LDVs, motorcycles/scooters]

Emission	Year	Emission type	PCs	LDVs	Motor-cycles
CO	1980	Start	94.51	209.26	
CO	1980	Hot	21.15	28.70	12.55
CO	1985	Start	59.40	156.84	
CO	1985	Hot	13.12	23.46	13.34
CO	1990	Start	38.13	104.38	
CO	1990	Hot	6.52	16.56	13.33
CO	1995	Start	33.58	65.93	
CO	1995	Hot	3.18	9.64	12.13
CO	2000	Start	34.60	45.92	
CO	2000	Hot	1.67	5.24	11.22
CO	2005	Start	27.05	28.33	
CO	2005	Hot	0.96	2.70	9.17
CO	2010	Start	16.85	16.51	
CO	2010	Hot	0.62	1.61	6.56
CO	2015	Start	9.23	9.37	
CO	2015	Hot	0.45	1.12	4.89
CO	2020	Start	6.46	6.56	
CO	2020	Hot	0.39	0.93	3.89
CO	2025	Start	5.91	5.52	
CO	2025	Hot	0.37	0.86	3.31
CO	2030	Start	5.78	5.15	
CO	2030	Hot	0.37	0.84	3.02
CO2	1980	Start	283	353	
CO2	1980	Hot	229	346	76
CO2	1985	Start	264	326	
CO2	1985	Hot	224	329	83
CO2	1990	Start	211	277	
CO2	1990	Hot	218	306	89
CO2	1995	Start	162	230	
CO2	1995	Hot	216	288	94
CO2	2000	Start	144	201	
CO2	2000	Hot	208	277	94
CO2	2005	Start	138	183	
CO2	2005	Hot	197	263	92

Emission	Year	Emission type	PCs	LDVs	Motor-cycles
CO2	2010	Start	133	171	
CO2	2010	Hot	184	252	88
CO2	2015	Start	125	162	
CO2	2015	Hot	170	241	86
CO2	2020	Start	117	157	
CO2	2020	Hot	159	234	85
CO2	2025	Start	111	153	
CO2	2025	Hot	151	229	84
CO2	2030	Start	107	151	
CO2	2030	Hot	145	226	85
HC	1980	Start	11.37	7.11	
HC	1980	Stop/switch-off	6.89	6.23	2.01
HC	1980	Tank respiration	8.90	8.13	2.57
HC	1980	Hot	2.05	2.42	6.09
HC	1985	Start	8.89	6.11	
HC	1985	Stop/switch-off	6.77	5.90	2.01
HC	1985	Tank respiration	8.78	7.77	2.57
HC	1985	Hot	1.56	2.00	6.25
HC	1990	Start	5.86	4.77	
HC	1990	Stop/switch-off	3.96	4.63	2.01
HC	1990	Tank respiration	5.46	6.35	2.57
HC	1990	Hot	0.81	1.35	4.97
HC	1995	Start	3.71	3.57	
HC	1995	Stop/switch-off	1.76	2.51	2.01
HC	1995	Tank respiration	2.67	4.14	2.57
HC	1995	Hot	0.34	0.71	3.69
HC	2000	Start	2.75	2.91	
HC	2000	Stop/switch-off	0.74	0.99	2.01
HC	2000	Tank respiration	1.14	2.00	2.57
HC	2000	Hot	0.13	0.32	2.73
HC	2005	Start	1.62	1.86	
HC	2005	Stop/switch-off	0.37	0.39	2.01
HC	2005	Tank respiration	0.60	0.91	2.57
HC	2005	Hot	0.06	0.15	1.99
HC	2010	Start	0.90	1.04	
HC	2010	Stop/switch-off	0.23	0.18	2.01
HC	2010	Tank respiration	0.42	0.51	2.57
HC	2010	Hot	0.03	0.08	1.32
HC	2015	Start	0.51	0.62	
HC	2015	Stop/switch-off	0.17	0.10	2.01
HC	2015	Tank respiration	0.34	0.33	2.57
HC	2015	Hot	0.02	0.05	0.95
HC	2020	Start	0.39	0.47	
HC	2020	Stop/switch-off	0.15	0.08	2.01
HC	2020	Tank respiration	0.30	0.24	2.57
HC	2020	Hot	0.02	0.04	0.75
HC	2025	Start	0.37	0.41	
HC	2025	Stop/switch-off	0.15	0.07	2.01
HC	2025	Tank respiration	0.27	0.18	2.57
HC	2025	Hot	0.02	0.04	0.63
HC	2030	Start	0.36	0.39	
HC	2030	Stop/switch-off	0.14	0.06	2.01
HC	2030	Tank respiration	0.25	0.14	2.57

Emission	Year	Emission type	PCs	LDVs	Motor-cycles
HC	2030	Hot	0.02	0.04	0.57
NOx	1980	Start	-0.17	-0.36	
NOx	1980	Hot	2.52	3.94	0.05
NOx	1985	Start	-0.15	-0.26	
NOx	1985	Hot	2.33	3.38	0.08
NOx	1990	Start	0.32	0.04	
NOx	1990	Hot	1.36	2.58	0.16
NOx	1995	Start	0.74	1.06	
NOx	1995	Hot	0.72	1.73	0.25
NOx	2000	Start	0.84	1.79	
NOx	2000	Hot	0.42	1.29	0.28
NOx	2005	Start	0.64	1.56	
NOx	2005	Hot	0.28	1.04	0.29
NOx	2010	Start	0.38	1.06	
NOx	2010	Hot	0.20	0.79	0.27
NOx	2015	Start	0.22	0.72	
NOx	2015	Hot	0.17	0.60	0.25
NOx	2020	Start	0.16	0.59	
NOx	2020	Hot	0.16	0.52	0.23
NOx	2025	Start	0.16	0.54	
NOx	2025	Hot	0.16	0.49	0.22
NOx	2030	Start	0.15	0.52	
NOx	2030	Hot	0.16	0.48	0.22
PM exh	1980	Start	0.005	0.172	
PM exh	1980	Hot	0.063	0.180	0.683
PM exh	1985	Start	0.010	0.246	
PM exh	1985	Hot	0.037	0.215	0.325
PM exh	1990	Start	0.012	0.204	
PM exh	1990	Hot	0.028	0.180	0.183
PM exh	1995	Start	0.009	0.115	
PM exh	1995	Hot	0.017	0.111	0.088
PM exh	2000	Start	0.008	0.051	
PM exh	2000	Hot	0.009	0.085	0.034
PM exh	2005	Start	0.011	0.025	
PM exh	2005	Hot	0.008	0.071	0.032
PM exh	2010	Start	0.012	0.015	
PM exh	2010	Hot	0.008	0.051	0.031
PM exh	2015	Start	0.013	0.010	
PM exh	2015	Hot	0.007	0.036	0.030
PM exh	2020	Start	0.014	0.008	
PM exh	2020	Hot	0.007	0.028	0.029
PM exh	2025	Start	0.014	0.007	
PM exh	2025	Hot	0.007	0.026	0.028
PM exh	2030	Start	0.014	0.007	
PM exh	2030	Hot	0.007	0.025	0.028

Table 14 Updated emission factors in g/km (hot) or g/start or g/stop (evaporation after stop/switch-off) or g/vehicle and day (tank respiration).

A6.3 EMISSION FACTORS BY ROAD CATEGORY

In g/km – including cold starts and evaporation

Emission	Year	Road type	PCs	LDVs	HDVs	Coaches	Buses	MCs
CO	1980	Mot	23.06	33.71	1.89	1.35	0.00	23.49
CO	1980	Rur	17.14	24.27	2.30	1.87	4.36	12.69
CO	1980	Urb	47.45	62.27	5.13	3.99	7.40	11.93
CO	1985	Mot	14.21	31.30	1.76	1.28	0.00	21.82
CO	1985	Rur	9.95	16.96	2.14	1.77	4.16	13.65
CO	1985	Urb	29.93	49.34	4.82	3.82	7.10	12.28
CO	1990	Mot	7.31	24.37	1.67	1.25	0.00	18.60
CO	1990	Rur	4.71	9.99	2.01	1.70	4.01	13.51
CO	1990	Urb	16.21	34.02	4.62	3.76	6.86	12.00
CO	1995	Mot	3.70	15.53	1.53	1.22	0.00	15.84
CO	1995	Rur	2.24	5.35	1.83	1.61	3.72	12.20
CO	1995	Urb	11.30	19.44	4.24	3.60	6.39	10.63
CO	2000	Mot	1.94	8.37	1.23	1.11	0.00	14.69
CO	2000	Rur	1.17	3.11	1.53	1.45	2.98	11.32
CO	2000	Urb	9.59	11.07	3.41	3.24	5.15	9.40
CO	2005	Mot	1.12	4.14	1.08	0.95	0.00	11.93
CO	2005	Rur	0.68	1.61	1.41	1.33	2.19	9.20
CO	2005	Urb	7.08	6.30	3.05	2.84	3.78	7.49
CO	2010	Mot	0.75	2.45	0.92	0.84	0.00	8.20
CO	2010	Rur	0.43	0.92	1.18	1.18	1.64	6.55
CO	2010	Urb	4.42	3.66	2.51	2.48	2.82	5.47
CO	2015	Mot	0.58	1.75	0.84	0.78	0.00	5.77
CO	2015	Rur	0.29	0.56	1.06	1.08	1.38	4.85
CO	2015	Urb	2.53	2.21	2.24	2.22	2.38	4.30
CO	2020	Mot	0.52	1.51	0.80	0.75	0.00	4.30
CO	2020	Rur	0.25	0.43	1.00	1.01	1.25	3.82
CO	2020	Urb	1.83	1.64	2.11	2.08	2.16	3.67
CO	2025	Mot	0.50	1.41	0.78	0.74	0.00	3.45
CO	2025	Rur	0.24	0.38	0.97	0.98	1.19	3.21
CO	2025	Urb	1.69	1.44	2.06	2.03	2.06	3.34
CO	2030	Mot	0.49	1.37	0.78	0.74	0.00	3.03
CO	2030	Rur	0.23	0.37	0.96	0.98	1.18	2.90
CO	2030	Urb	1.66	1.36	2.03	2.02	2.04	3.16
CO2	1980	Mot	217	383	746	902	0	142
CO2	1980	Rur	190	312	753	823	1,012	75
CO2	1980	Urb	357	416	1,215	1,305	1,406	72
CO2	1985	Mot	219	367	716	865	0	133
CO2	1985	Rur	183	283	723	789	976	83
CO2	1985	Urb	337	398	1,176	1,261	1,361	78
CO2	1990	Mot	219	348	702	840	0	122
CO2	1990	Rur	179	252	708	763	947	90
CO2	1990	Urb	305	367	1,163	1,241	1,323	81
CO2	1995	Mot	220	335	688	816	0	117
CO2	1995	Rur	179	233	706	743	937	94
CO2	1995	Urb	288	333	1,155	1,207	1,306	85
CO2	2000	Mot	218	329	646	774	0	116
CO2	2000	Rur	173	224	678	710	911	94
CO2	2000	Urb	267	305	1,084	1,142	1,259	84

Emission	Year	Road type	PCs	LDVs	HDVs	Coaches	Buses	MCs
CO2	2005	Mot	213	318	660	746	0	112
CO2	2005	Rur	163	211	702	686	892	91
CO2	2005	Urb	247	279	1,108	1,091	1,218	81
CO2	2010	Mot	202	306	663	756	0	106
CO2	2010	Rur	152	201	703	689	894	87
CO2	2010	Urb	228	261	1,095	1,090	1,211	77
CO2	2015	Mot	188	294	673	778	0	102
CO2	2015	Rur	140	192	710	704	912	85
CO2	2015	Urb	209	248	1,102	1,111	1,231	75
CO2	2020	Mot	175	285	679	792	0	100
CO2	2020	Rur	130	186	715	713	926	84
CO2	2020	Urb	195	240	1,107	1,125	1,249	75
CO2	2025	Mot	167	280	682	798	0	99
CO2	2025	Rur	124	182	716	717	934	84
CO2	2025	Urb	185	234	1,109	1,132	1,258	75
CO2	2030	Mot	161	275	684	800	0	99
CO2	2030	Rur	119	179	716	718	936	84
CO2	2030	Urb	179	231	1,109	1,135	1,261	75
HC	1980	Mot	1.43	1.38	0.73	0.54	0.00	7.37
HC	1980	Rur	1.85	1.94	0.75	0.52	1.68	5.57
HC	1980	Urb	7.80	6.40	2.23	1.40	3.33	7.05
HC	1985	Mot	1.11	1.16	0.67	0.51	0.00	4.65
HC	1985	Rur	1.37	1.57	0.69	0.49	1.57	5.35
HC	1985	Urb	6.60	5.85	2.08	1.34	3.15	7.93
HC	1990	Mot	0.58	0.84	0.63	0.50	0.00	2.43
HC	1990	Rur	0.70	1.04	0.64	0.47	1.49	3.83
HC	1990	Urb	3.77	4.59	1.95	1.31	3.01	7.80
HC	1995	Mot	0.25	0.51	0.57	0.48	0.00	1.75
HC	1995	Rur	0.29	0.53	0.57	0.45	1.28	2.68
HC	1995	Urb	1.94	2.62	1.71	1.25	2.59	7.28
HC	2000	Mot	0.10	0.28	0.45	0.45	0.00	1.43
HC	2000	Rur	0.11	0.23	0.45	0.42	0.95	2.05
HC	2000	Urb	1.06	1.24	1.29	1.13	1.90	5.99
HC	2005	Mot	0.05	0.14	0.32	0.36	0.00	1.11
HC	2005	Rur	0.04	0.10	0.32	0.33	0.59	1.56
HC	2005	Urb	0.57	0.61	0.91	0.87	1.13	4.90
HC	2010	Mot	0.03	0.08	0.33	0.35	0.00	0.74
HC	2010	Rur	0.02	0.06	0.32	0.32	0.45	1.04
HC	2010	Urb	0.33	0.33	0.85	0.81	0.82	3.91
HC	2015	Mot	0.02	0.05	0.35	0.37	0.00	0.51
HC	2015	Rur	0.02	0.03	0.33	0.34	0.41	0.73
HC	2015	Urb	0.21	0.20	0.85	0.82	0.73	3.36
HC	2020	Mot	0.02	0.04	0.36	0.38	0.00	0.36
HC	2020	Rur	0.01	0.03	0.33	0.35	0.42	0.56
HC	2020	Urb	0.18	0.15	0.85	0.84	0.73	3.07
HC	2025	Mot	0.02	0.04	0.37	0.39	0.00	0.29
HC	2025	Rur	0.01	0.02	0.33	0.35	0.43	0.46
HC	2025	Urb	0.17	0.13	0.86	0.84	0.74	2.88
HC	2030	Mot	0.02	0.04	0.37	0.39	0.00	0.25
HC	2030	Rur	0.01	0.02	0.34	0.35	0.43	0.40
HC	2030	Urb	0.16	0.13	0.86	0.85	0.74	2.76
NOx	1980	Mot	3.29	5.80	9.77	11.04	0.00	0.40
NOx	1980	Rur	2.42	3.84	10.21	10.41	13.50	0.06

Emission	Year	Road type	PCs	LDVs	HDVs	Coaches	Buses	MCs
NOx	1980	Urb	2.03	2.73	14.67	15.33	18.00	0.03
NOx	1985	Mot	3.24	4.72	9.84	11.12	0.00	0.44
NOx	1985	Rur	2.07	3.11	10.32	10.48	13.72	0.11
NOx	1985	Urb	1.79	2.41	14.95	15.57	18.38	0.03
NOx	1990	Mot	1.91	3.45	9.89	11.22	0.00	0.52
NOx	1990	Rur	1.17	2.26	10.38	10.55	13.94	0.20
NOx	1990	Urb	1.11	1.93	15.20	15.92	18.71	0.05
NOx	1995	Mot	1.04	2.42	9.02	10.45	0.00	0.58
NOx	1995	Rur	0.59	1.41	9.63	9.94	13.51	0.29
NOx	1995	Urb	0.72	1.48	14.26	15.12	18.16	0.08
NOx	2000	Mot	0.60	1.88	7.98	9.28	0.00	0.59
NOx	2000	Rur	0.33	0.94	8.61	9.05	12.38	0.32
NOx	2000	Urb	0.51	1.24	13.12	14.19	16.84	0.09
NOx	2005	Mot	0.38	1.50	6.47	7.56	0.00	0.58
NOx	2005	Rur	0.22	0.73	7.33	7.84	10.21	0.31
NOx	2005	Urb	0.37	1.04	11.72	13.00	14.29	0.09
NOx	2010	Mot	0.25	1.13	4.46	5.65	0.00	0.52
NOx	2010	Rur	0.16	0.55	5.41	6.08	7.62	0.28
NOx	2010	Urb	0.27	0.77	9.15	10.69	11.11	0.08
NOx	2015	Mot	0.20	0.85	2.98	3.86	0.00	0.48
NOx	2015	Rur	0.14	0.41	3.81	4.22	5.43	0.25
NOx	2015	Urb	0.21	0.58	6.63	7.74	8.17	0.07
NOx	2020	Mot	0.19	0.73	2.21	2.83	0.00	0.46
NOx	2020	Rur	0.13	0.35	2.96	3.10	3.87	0.24
NOx	2020	Urb	0.19	0.49	5.27	5.86	6.00	0.06
NOx	2025	Mot	0.19	0.69	1.88	2.42	0.00	0.44
NOx	2025	Rur	0.13	0.33	2.58	2.65	3.09	0.23
NOx	2025	Urb	0.19	0.46	4.66	5.08	4.87	0.06
NOx	2030	Mot	0.19	0.67	1.75	2.29	0.00	0.43
NOx	2030	Rur	0.13	0.32	2.42	2.50	2.86	0.23
NOx	2030	Urb	0.19	0.45	4.41	4.83	4.54	0.06
PM exh	1980	Mot	0.063	0.255	0.692	0.721	0.000	0.384
PM exh	1980	Rur	0.062	0.150	0.813	0.842	1.391	0.664
PM exh	1980	Urb	0.064	0.193	1.701	1.635	2.535	0.707
PM exh	1985	Mot	0.039	0.318	0.500	0.553	0.000	0.161
PM exh	1985	Rur	0.036	0.153	0.587	0.643	1.069	0.301
PM exh	1985	Urb	0.041	0.232	1.239	1.263	1.961	0.355
PM exh	1990	Mot	0.030	0.258	0.385	0.425	0.000	0.092
PM exh	1990	Rur	0.026	0.123	0.448	0.488	0.800	0.157
PM exh	1990	Urb	0.030	0.190	0.957	0.982	1.473	0.221
PM exh	1995	Mot	0.019	0.158	0.298	0.326	0.000	0.051
PM exh	1995	Rur	0.016	0.080	0.341	0.365	0.596	0.074
PM exh	1995	Urb	0.019	0.109	0.758	0.750	1.097	0.115
PM exh	2000	Mot	0.010	0.122	0.211	0.257	0.000	0.021
PM exh	2000	Rur	0.008	0.066	0.242	0.278	0.432	0.029
PM exh	2000	Urb	0.010	0.070	0.529	0.576	0.785	0.045
PM exh	2005	Mot	0.010	0.101	0.144	0.177	0.000	0.020
PM exh	2005	Rur	0.007	0.055	0.169	0.192	0.275	0.028
PM exh	2005	Urb	0.010	0.055	0.373	0.395	0.484	0.044
PM exh	2010	Mot	0.009	0.072	0.083	0.109	0.000	0.020
PM exh	2010	Rur	0.007	0.039	0.099	0.121	0.156	0.027
PM exh	2010	Urb	0.010	0.039	0.219	0.248	0.269	0.043
PM exh	2015	Mot	0.008	0.050	0.051	0.066	0.000	0.020

Emission	Year	Road type	PCs	LDVs	HDVs	Coaches	Buses	MCs
PM exh	2015	Rur	0.006	0.028	0.064	0.074	0.093	0.026
PM exh	2015	Urb	0.010	0.027	0.142	0.154	0.158	0.042
PM exh	2020	Mot	0.008	0.040	0.035	0.044	0.000	0.019
PM exh	2020	Rur	0.006	0.022	0.046	0.050	0.059	0.025
PM exh	2020	Urb	0.010	0.022	0.102	0.105	0.101	0.041
PM exh	2025	Mot	0.008	0.036	0.029	0.036	0.000	0.019
PM exh	2025	Rur	0.006	0.020	0.039	0.041	0.044	0.024
PM exh	2025	Urb	0.010	0.020	0.087	0.087	0.077	0.040
PM exh	2030	Mot	0.008	0.035	0.026	0.034	0.000	0.019
PM exh	2030	Rur	0.006	0.019	0.036	0.039	0.041	0.024
PM exh	2030	Urb	0.010	0.019	0.081	0.081	0.072	0.039

Table 15 Updated emission factors in g/km including cold starts and evaporation (both added to urban roads).

A6.4 EMISSION FACTORS BY FUEL TYPE

In g/km – including cold starts and evaporation

Emission	Year	Fuel	PCs	LDVs	HDVs	Coaches	Buses	MCs
CO	1980	P	28.99	44.54				12.55
CO	1980	D	1.09	2.52	2.94	2.27	6.37	
CO	1985	P	18.31	38.61				13.34
CO	1985	D	1.09	2.56	2.61	2.05	6.08	
CO	1990	P	9.93	30.85				13.33
CO	1990	D	0.67	1.57	2.38	1.93	5.85	
CO	1995	P	6.07	20.22				12.13
CO	1995	D	0.49	0.90	2.13	1.82	5.44	
CO	2000	P	4.51	13.85				11.22
CO	2000	D	0.38	0.57	1.72	1.64	4.38	
CO	2005	P	3.37	10.19				9.17
CO	2005	D	0.27	0.33	1.54	1.44	3.21	
CO	2010	P	2.35	7.34				6.56
CO	2010	D	0.24	0.24	1.29	1.27	2.40	
CO	2015	P	1.52	5.29				4.89
CO	2015	D	0.23	0.20	1.16	1.16	2.02	
CO	2020	P	1.19	4.38				3.89
CO	2020	D	0.23	0.18	1.10	1.09	1.84	
CO	2025	P	1.13	4.05				3.31
CO	2025	D	0.23	0.17	1.07	1.07	1.75	
CO	2030	P	1.11	3.94				3.02
CO	2030	D	0.23	0.17	1.06	1.06	1.73	
CO2	1980	P	251.82	357.07				75.53
CO2	1980	D	233.09	405.86	876.34	980.74	1,271.99	
CO2	1985	P	244.54	332.46				83.33
CO2	1985	D	234.19	410.74	824.91	929.83	1,228.11	
CO2	1990	P	234.17	305.87				89.21
CO2	1990	D	225.48	362.49	798.47	900.89	1,189.96	
CO2	1995	P	228.64	283.15				93.88
CO2	1995	D	222.85	333.64	781.01	873.03	1,175.35	
CO2	2000	P	219.36	264.71				94.38

Emission	Year	Fuel	PCs	LDVs	HDVs	Coaches	Buses	MCs
CO2	2000	D	211.82	311.93	735.73	828.62	1,135.25	
CO2	2005	P	210.66	244.08				91.87
CO2	2005	D	189.22	288.11	754.27	796.29	1,101.98	
CO2	2010	P	199.85	223.12				87.89
CO2	2010	D	176.95	274.21	754.90	801.83	1,098.59	
CO2	2015	P	185.96	208.22				85.77
CO2	2015	D	165.73	262.48	763.09	822.90	1,117.33	
CO2	2020	P	173.37	199.93				84.78
CO2	2020	D	156.19	254.27	767.97	835.08	1,134.46	
CO2	2025	P	164.36	195.19				84.48
CO2	2025	D	148.86	248.74	769.74	840.53	1,143.12	
CO2	2030	P	158.47	191.79				84.57
CO2	2030	D	143.83	244.49	769.73	842.85	1,145.79	
HC	1980	P	3.76	3.65				6.66
HC	1980	D	0.28	0.94	1.14	0.76	2.77	
HC	1985	P	3.11	3.30				6.93
HC	1985	D	0.28	0.95	1.00	0.70	2.61	
HC	1990	P	1.78	2.71				5.76
HC	1990	D	0.15	0.49	0.90	0.66	2.47	
HC	1995	P	0.87	1.70				4.52
HC	1995	D	0.10	0.21	0.78	0.63	2.13	
HC	2000	P	0.44	0.99				3.47
HC	2000	D	0.08	0.10	0.60	0.58	1.57	
HC	2005	P	0.24	0.63				2.67
HC	2005	D	0.05	0.06	0.43	0.45	0.94	
HC	2010	P	0.15	0.39				1.96
HC	2010	D	0.05	0.05	0.43	0.43	0.69	
HC	2015	P	0.09	0.24				1.57
HC	2015	D	0.05	0.04	0.43	0.45	0.62	
HC	2020	P	0.08	0.18				1.36
HC	2020	D	0.05	0.03	0.44	0.46	0.62	
HC	2025	P	0.07	0.16				1.23
HC	2025	D	0.05	0.03	0.45	0.47	0.63	
HC	2030	P	0.07	0.15				1.16
HC	2030	D	0.05	0.03	0.45	0.47	0.63	
NOx	1980	P	2.53	4.28				0.05
NOx	1980	D	0.86	1.51	11.28	11.96	16.47	
NOx	1985	P	2.37	3.77				0.08
NOx	1985	D	0.86	1.52	11.20	11.93	16.77	
NOx	1990	P	1.43	3.02				0.16
NOx	1990	D	0.70	1.46	11.14	12.01	17.02	
NOx	1995	P	0.79	2.00				0.25
NOx	1995	D	0.65	1.41	10.19	11.24	16.51	
NOx	2000	P	0.46	1.42				0.28
NOx	2000	D	0.64	1.33	9.11	10.20	15.25	
NOx	2005	P	0.29	1.09				0.29
NOx	2005	D	0.50	1.12	7.68	8.73	12.84	
NOx	2010	P	0.17	0.76				0.27
NOx	2010	D	0.39	0.87	5.61	6.78	9.87	
NOx	2015	P	0.10	0.52				0.25
NOx	2015	D	0.35	0.68	3.90	4.74	7.19	
NOx	2020	P	0.07	0.41				0.23
NOx	2020	D	0.33	0.59	2.99	3.51	5.25	
NOx	2025	P	0.07	0.37				0.22

Emission	Year	Fuel	PCs	LDVs	HDVs	Coaches	Buses	MCs
NOx	2025	D	0.33	0.55	2.59	3.02	4.24	
NOx	2030	P	0.07	0.36				0.22
NOx	2030	D	0.33	0.54	2.42	2.85	3.95	
PM exh	1980	P	0.060	0.060				0.683
PM exh	1980	D	0.247	1.067	1.015	1.017	2.147	
PM exh	1985	P	0.031	0.032				0.325
PM exh	1985	D	0.251	1.120	0.703	0.751	1.653	
PM exh	1990	P	0.020	0.020				0.183
PM exh	1990	D	0.163	0.627	0.522	0.564	1.235	
PM exh	1995	P	0.010	0.011				0.088
PM exh	1995	D	0.120	0.312	0.398	0.424	0.919	
PM exh	2000	P	0.003	0.003				0.034
PM exh	2000	D	0.078	0.180	0.278	0.328	0.659	
PM exh	2005	P	0.002	0.002				0.032
PM exh	2005	D	0.042	0.114	0.193	0.225	0.409	
PM exh	2010	P	0.002	0.002				0.031
PM exh	2010	D	0.026	0.073	0.113	0.140	0.229	
PM exh	2015	P	0.001	0.001				0.030
PM exh	2015	D	0.021	0.049	0.072	0.086	0.135	
PM exh	2020	P	0.001	0.001				0.029
PM exh	2020	D	0.019	0.038	0.051	0.058	0.086	
PM exh	2025	P	0.001	0.001				0.028
PM exh	2025	D	0.019	0.034	0.042	0.048	0.065	
PM exh	2030	P	0.001	0.001				0.028
PM exh	2030	D	0.018	0.033	0.039	0.045	0.061	

Table 16 Updated emission factors by fuel type, in g/km including cold starts and evaporation.

A6.5 EMISSION FACTORS BY EMISSION CONCEPTS

In g/km – including cold starts and evaporation

Emission	Veh. type	Concept	1985	1990	1995	2000	2005	2010	2015	2020	2025	2030
CO	PC	PC/P/conv	18.37	14.41	13.60	13.88	15.84	19.26	20.30	20.24	21.76	19.27
CO	PC	PC/P/RCat<91	6.19	4.27	5.40	6.19	6.54	6.84	7.07	7.29	7.50	7.63
CO	PC	PC/P/Euro-1/FAV1			3.19	4.14	4.86	5.33	5.49	5.65	5.81	5.97
CO	PC	PC/P/Euro-2				3.08	4.10	4.94	5.56	5.98	6.23	6.38
CO	PC	PC/P/Euro-3				1.26	1.52	1.93	2.24	2.47	2.63	2.72
CO	PC	PC/P/Euro-4				0.73	0.81	0.90	0.99	1.03	1.05	1.06
CO	PC	PC/D/conv	1.09	0.71	0.60	0.55	0.49	0.51	0.56	0.58	0.58	0.59
CO	PC	PC/D/XXIII/FAV1		0.46	0.42	0.41	0.38	0.38	0.37	0.37	0.37	0.38
CO	PC	PC/D/Euro-2			0.34	0.34	0.31	0.31	0.31	0.33	0.33	0.33
CO	PC	PC/D/Euro-3				0.28	0.25	0.25	0.25	0.26	0.27	0.27
CO	PC	PC/D/Euro-4					0.23	0.23	0.23	0.23	0.23	0.23
CO	LDV	LDV/P/conv	38.63	33.84	30.51	29.60	28.03	27.97	27.64	27.98	28.40	28.96
CO	LDV	LDV/P/RCat<91	9.99	11.51	14.55	16.37	17.98	19.92	20.82	21.69	22.57	23.21
CO	LDV	LDV/P/Euro-1/FAV1			8.91	10.40	11.87	13.53	14.67	15.23	15.74	16.26
CO	LDV	LDV/P/Euro-2				5.87	7.44	9.02	10.12	10.74	10.89	11.16
CO	LDV	LDV/P/Euro-3				3.94	4.61	5.52	6.38	7.04	7.44	7.44
CO	LDV	LDV/P/Euro-4					3.10	3.30	3.57	3.72	3.80	3.84

Emission	Veh. type	Concept	1985	1990	1995	2000	2005	2010	2015	2020	2025	2030
CO	LDV	LDV/D/conv	2.56	1.57	0.94	0.78	0.73	0.73	0.75	0.75	0.80	0.88
CO	LDV	LDV/D/Euro-1/FAV1			0.66	0.65	0.61	0.62	0.62	0.62	0.62	0.62
CO	LDV	LDV/D/Euro-2				0.34	0.33	0.33	0.33	0.33	0.33	0.33
CO	LDV	LDV/D/Euro-3				0.21	0.20	0.20	0.20	0.20	0.20	0.20
CO	LDV	LDV/D/Euro-4						0.17	0.17	0.17	0.17	0.17
CO	HDV	HMV/1950s	3.80									
CO	HDV	HMV/1960s	3.28	3.26	3.27							
CO	HDV	HMV/1970s	2.78	2.74	2.73	2.76	2.79	2.79	2.76	2.68	2.54	2.48
CO	HDV	HMV/1980s	2.37	2.30	2.24	2.26	2.33	2.32	2.27	2.21	2.14	2.10
CO	HDV	HMV/Euro-1			1.69	1.63	1.58	1.56	1.57	1.59	1.63	1.65
CO	HDV	HMV/Euro-2				1.25	1.24	1.23	1.22	1.22	1.23	1.24
CO	HDV	HMV/Euro-3				1.58	1.54	1.52	1.51	1.51	1.50	1.50
CO	HDV	HMV/Euro-4					1.07	1.06	1.05	1.04	1.04	1.04
CO	HDV	HMV/Euro-5						1.07	1.06	1.06	1.06	1.05
CO	Coach	HMV/1950s	2.58									
CO	Coach	HMV/1960s	2.34	2.32	2.20							
CO	Coach	HMV/1970s	2.11	2.09	1.98	1.98	1.93	1.93	1.95	1.95	1.95	1.95
CO	Coach	HMV/1980s	1.88	1.85	1.83	1.85	1.82	1.82	1.83	1.83	1.83	1.84
CO	Coach	HMV/Euro-1			1.63	1.62	1.59	1.59	1.60	1.60	1.61	1.61
CO	Coach	HMV/Euro-2			1.18	1.20	1.17	1.17	1.18	1.18	1.18	1.19
CO	Coach	HMV/Euro-3				1.52	1.47	1.47	1.48	1.48	1.48	1.48
CO	Coach	HMV/Euro-4					1.03	1.03	1.03	1.03	1.04	1.04
CO	Coach	HMV/Euro-5						1.05	1.05	1.05	1.05	1.06
CO	Bus	HMV/1950s	7.64									
CO	Bus	HMV/1960s	6.94	6.83	6.82							
CO	Bus	HMV/1970s	6.25	6.25	6.26	6.45	6.24	6.25	6.26	6.26	6.27	6.27
CO	Bus	HMV/1980s	5.55	5.67	5.66	5.73	5.59	5.58	5.59	5.59	5.60	5.60
CO	Bus	HMV/Euro-1			2.89	2.88	2.81	2.82	2.82	2.83	2.83	2.83
CO	Bus	HMV/Euro-2			2.24	2.19	2.18	2.18	2.19	2.21	2.21	2.21
CO	Bus	HMV/Euro-3				2.78	2.64	2.65	2.65	2.65	2.65	2.65
CO	Bus	HMV/Euro-4					1.71	1.71	1.72	1.72	1.72	1.72
CO	Bus	HMV/Euro-5						1.72	1.73	1.73	1.73	1.73
CO	MC	MP/ without cat	11.28	11.20	11.17	11.19	11.03	11.01	11.00	11.01	11.02	11.03
CO	MC	MP/ with cat		4.92	4.91	4.92	4.84	4.83	4.83	4.84	4.84	4.84
CO	MC	LMC/<Euro-1	10.23	10.16	10.13	10.15	10.00	9.98	9.97	9.98	10.00	10.00
CO	MC	LMC/Euro-1		4.39	4.37	4.38	4.32	4.31	4.31	4.31	4.32	4.32
CO	MC	LMC/Euro-2					0.97	0.97	0.97	0.97	0.97	0.97
CO	MC	MC/2S/<Euro-1	21.33	21.24	21.27	21.52	21.57	21.66	21.60	21.46	21.34	21.24
CO	MC	MC/2S/Euro-1		18.51	18.49	18.81	18.83	18.86	18.80	18.70	18.63	18.57
CO	MC	MC/2S/Euro-2					14.68	14.73	14.69	14.61	14.51	14.53
CO	MC	MC/2S/Euro-3						8.13	8.11	8.06	8.02	7.99
CO	MC	MC/4S/<Euro-1	15.74	15.66	15.85	16.44	16.88	16.95	16.99	16.98	16.98	16.98
CO	MC	MC/4S/Euro-1		10.02	10.07	9.80	9.67	9.72	9.89	10.09	10.06	10.01
CO	MC	MC/4S/Euro-2					2.86	2.85	2.79	2.67	2.51	2.55
CO	MC	MC/4S/Euro-3						1.86	1.85	1.83	1.81	1.80
CO2	PC	PC/P/conv	245	242	244	248	254	258	258	257	257	255
CO2	PC	PC/P/RCat<91	229	225	226	226	230	235	235	234	233	232
CO2	PC	PC/P/Euro-1/FAV1			224	223	223	225	231	232	231	230
CO2	PC	PC/P/Euro-2				210	209	209	213	220	220	219
CO2	PC	PC/P/Euro-3				207	203	203	203	209	215	215
CO2	PC	PC/P/Euro-4				206	201	191	181	171	163	158
CO2	PC	PC/D/conv	234	227	228	230	235	238	238	236	234	233
CO2	PC	PC/D/XXIII/FAV1		220	219	219	219	221	226	228	228	226

Emission	Veh. type	Concept	1985	1990	1995	2000	2005	2010	2015	2020	2025	2030
CO2	PC	PC/D/Euro-2			219	205	200	200	202	208	210	210
CO2	PC	PC/D/Euro-3				189	184	183	184	188	192	192
CO2	PC	PC/D/Euro-4					180	171	163	155	149	144
CO2	LDV	LDV/P/conv	333	313	301	298	293	292	289	290	291	294
CO2	LDV	LDV/P/RCat<91	259	262	265	266	267	270	270	270	272	273
CO2	LDV	LDV/P/Euro-1/FAV1			268	267	268	271	273	273	273	274
CO2	LDV	LDV/P/Euro-2				228	229	232	236	238	236	237
CO2	LDV	LDV/P/Euro-3				219	214	212	215	218	219	217
CO2	LDV	LDV/P/Euro-4					209	201	199	196	194	191
CO2	LDV	LDV/D/conv	411	362	335	324	324	328	332	334	339	345
CO2	LDV	LDV/D/Euro-1/FAV1			324	316	316	319	322	322	324	325
CO2	LDV	LDV/D/Euro-2				298	290	292	293	295	295	296
CO2	LDV	LDV/D/Euro-3				283	274	272	274	275	276	276
CO2	LDV	LDV/D/Euro-4						259	255	251	247	244
CO2	HDV	HMV/1950s	927									
CO2	HDV	HMV/1960s	893	870	868							
CO2	HDV	HMV/1970s	848	838	836	825	828	821	824	843	891	912
CO2	HDV	HMV/1980s	797	790	792	788	786	783	795	818	844	856
CO2	HDV	HMV/Euro-1			737	717	718	708	710	722	738	747
CO2	HDV	HMV/Euro-2				696	731	720	716	718	723	726
CO2	HDV	HMV/Euro-3				748	763	752	747	745	744	744
CO2	HDV	HMV/Euro-4					768	757	752	750	749	747
CO2	HDV	HMV/Euro-5						781	775	773	771	770
CO2	Coach	HMV/1950s	1,126									
CO2	Coach	HMV/1960s	1,039	1,047	1,018							
CO2	Coach	HMV/1970s	953	960	936	936	936	937	941	941	942	942
CO2	Coach	HMV/1980s	866	873	881	890	894	895	898	899	899	900
CO2	Coach	HMV/Euro-1			777	775	776	776	779	780	780	781
CO2	Coach	HMV/Euro-2			739	755	755	756	759	760	760	761
CO2	Coach	HMV/Euro-3				801	796	797	800	801	801	802
CO2	Coach	HMV/Euro-4					810	811	814	815	815	816
CO2	Coach	HMV/Euro-5						839	842	842	843	844
CO2	Bus	HMV/1950s	1,483									
CO2	Bus	HMV/1960s	1,369	1,273	1,276							
CO2	Bus	HMV/1970s	1,255	1,250	1,263	1,288	1,264	1,266	1,269	1,271	1,272	1,273
CO2	Bus	HMV/1980s	1,141	1,166	1,182	1,204	1,206	1,203	1,205	1,206	1,206	1,207
CO2	Bus	HMV/Euro-1			1,040	1,039	1,039	1,040	1,043	1,043	1,044	1,044
CO2	Bus	HMV/Euro-2			1,055	1,030	1,053	1,057	1,062	1,070	1,070	1,070
CO2	Bus	HMV/Euro-3				1,135	1,096	1,098	1,100	1,101	1,101	1,101
CO2	Bus	HMV/Euro-4					1,104	1,106	1,108	1,109	1,109	1,109
CO2	Bus	HMV/Euro-5						1,143	1,145	1,146	1,146	1,146
CO2	MC	MP/ without cat	62	62	62	61	61	61	61	61	61	61
CO2	MC	MP/ with cat		49	49	49	49	48	48	48	48	49
CO2	MC	LMC/<Euro-1	81	80	80	79	79	79	79	79	79	79
CO2	MC	LMC/Euro-1		68	68	68	67	67	67	67	67	67
CO2	MC	LMC/Euro-2					57	56	56	56	57	57
CO2	MC	MC/2S/<Euro-1	158	157	157	156	156	156	156	156	155	155
CO2	MC	MC/2S/Euro-1		106	106	106	106	106	106	106	106	105
CO2	MC	MC/2S/Euro-2					92	92	92	91	91	91
CO2	MC	MC/2S/Euro-3						78	78	78	78	78
CO2	MC	MC/4S/<Euro-1	102	102	104	109	114	114	114	115	115	115
CO2	MC	MC/4S/Euro-1		98	100	99	100	100	102	104	104	104
CO2	MC	MC/4S/Euro-2					90	90	91	92	94	94

Emission	Veh. type	Concept	1985	1990	1995	2000	2005	2010	2015	2020	2025	2030
CO2	MC	MC/4S/Euro-3						87	88	88	89	89
HC	PC	PC/P/conv	3.12	2.82	2.79	2.82	3.37	4.36	5.43	6.19	6.85	8.62
HC	PC	PC/P/RCat<91	0.54	0.47	0.58	0.63	0.66	0.70	0.76	0.83	0.87	0.92
HC	PC	PC/P/Euro-1/FAV1			0.23	0.24	0.24	0.25	0.26	0.30	0.34	0.37
HC	PC	PC/P/Euro-2				0.28	0.29	0.30	0.30	0.30	0.33	0.37
HC	PC	PC/P/Euro-3				0.08	0.07	0.08	0.08	0.08	0.08	0.10
HC	PC	PC/P/Euro-4				0.06	0.06	0.06	0.06	0.06	0.06	0.06
HC	PC	PC/D/conv	0.28	0.17	0.14	0.13	0.11	0.11	0.12	0.13	0.13	0.13
HC	PC	PC/D/XXIII/FAV1		0.08	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07
HC	PC	PC/D/Euro-2			0.07	0.07	0.06	0.06	0.07	0.07	0.07	0.07
HC	PC	PC/D/Euro-3				0.06	0.05	0.05	0.05	0.05	0.06	0.06
HC	PC	PC/D/Euro-4					0.05	0.05	0.05	0.05	0.05	0.05
HC	LDV	LDV/P/conv	3.30	3.03	2.93	2.91	3.03	3.39	4.18	5.63	7.93	9.15
HC	LDV	LDV/P/RCat<91	0.57	0.63	0.75	0.80	0.86	0.92	0.96	1.00	1.09	1.19
HC	LDV	LDV/P/Euro-1/FAV1			0.49	0.53	0.59	0.65	0.69	0.71	0.75	0.82
HC	LDV	LDV/P/Euro-2				0.40	0.41	0.44	0.46	0.47	0.49	0.51
HC	LDV	LDV/P/Euro-3				0.18	0.18	0.19	0.20	0.21	0.22	0.22
HC	LDV	LDV/P/Euro-4					0.12	0.13	0.13	0.13	0.13	0.13
HC	LDV	LDV/D/conv	0.95	0.49	0.23	0.16	0.15	0.15	0.16	0.15	0.18	0.21
HC	LDV	LDV/D/Euro-1/FAV1			0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08
HC	LDV	LDV/D/Euro-2				0.07	0.07	0.07	0.07	0.07	0.07	0.07
HC	LDV	LDV/D/Euro-3				0.04	0.04	0.04	0.04	0.04	0.04	0.04
HC	LDV	LDV/D/Euro-4						0.03	0.03	0.03	0.03	0.03
HC	HDV	HMV/1950s	1.59									
HC	HDV	HMV/1960s	1.33	1.33	1.30							
HC	HDV	HMV/1970s	1.08	1.07	1.04	1.06	1.03	1.03	1.02	0.97	0.87	0.83
HC	HDV	HMV/1980s	0.90	0.86	0.80	0.81	0.82	0.82	0.79	0.74	0.70	0.67
HC	HDV	HMV/Euro-1			0.67	0.64	0.59	0.59	0.59	0.60	0.61	0.62
HC	HDV	HMV/Euro-2				0.38	0.36	0.36	0.36	0.36	0.36	0.37
HC	HDV	HMV/Euro-3				0.39	0.36	0.35	0.35	0.35	0.35	0.35
HC	HDV	HMV/Euro-4					0.45	0.44	0.44	0.44	0.44	0.44
HC	HDV	HMV/Euro-5						0.45	0.45	0.45	0.45	0.45
HC	Coach	HMV/1950s	0.88									
HC	Coach	HMV/1960s	0.80	0.80	0.74							
HC	Coach	HMV/1970s	0.72	0.72	0.66	0.66	0.62	0.62	0.63	0.63	0.63	0.63
HC	Coach	HMV/1980s	0.64	0.64	0.61	0.62	0.58	0.58	0.59	0.59	0.59	0.59
HC	Coach	HMV/Euro-1			0.66	0.65	0.61	0.61	0.62	0.62	0.62	0.62
HC	Coach	HMV/Euro-2			0.39	0.39	0.37	0.37	0.37	0.37	0.37	0.37
HC	Coach	HMV/Euro-3				0.38	0.36	0.36	0.36	0.36	0.36	0.37
HC	Coach	HMV/Euro-4					0.45	0.46	0.46	0.46	0.46	0.46
HC	Coach	HMV/Euro-5						0.47	0.47	0.47	0.47	0.47
HC	Bus	HMV/1950s	3.27									
HC	Bus	HMV/1960s	2.98	3.53	3.46							
HC	Bus	HMV/1970s	2.68	2.69	2.60	2.72	2.63	2.63	2.63	2.62	2.62	2.62
HC	Bus	HMV/1980s	2.38	2.34	2.20	2.15	2.01	2.02	2.02	2.01	2.01	2.01
HC	Bus	HMV/Euro-1			0.95	0.95	0.89	0.89	0.89	0.89	0.89	0.89
HC	Bus	HMV/Euro-2			0.58	0.57	0.54	0.54	0.55	0.55	0.55	0.55
HC	Bus	HMV/Euro-3				0.54	0.51	0.51	0.51	0.51	0.51	0.51
HC	Bus	HMV/Euro-4					0.62	0.62	0.62	0.62	0.62	0.62
HC	Bus	HMV/Euro-5						0.63	0.63	0.63	0.63	0.63
HC	MC	MP/ without cat	5.60	5.89	6.56	7.10	7.64	8.10	8.89	10.37	12.44	15.45
HC	MC	MP/ with cat		4.58	4.95	4.95	4.81	4.73	4.69	4.70	4.73	4.77
HC	MC	LMC/<Euro-1	5.04	5.28	5.63	5.87	5.88	5.87	5.89	5.93	5.97	6.02

Emission	Veh. type	Concept	1985	1990	1995	2000	2005	2010	2015	2020	2025	2030
HC	MC	LMC/Euro-1		4.11	4.28	4.30	4.26	4.45	4.67	4.71	4.76	4.80
HC	MC	LMC/Euro-2					2.21	2.19	2.22	2.23	2.23	2.23
HC	MC	MC/2S/<Euro-1	20.87	20.94	21.03	20.64	20.33	20.36	20.41	20.47	20.52	20.57
HC	MC	MC/2S/Euro-1		5.98	6.09	5.98	5.86	5.90	6.00	6.10	6.15	6.18
HC	MC	MC/2S/Euro-2					3.56	3.51	3.56	3.66	3.81	3.85
HC	MC	MC/2S/Euro-3						2.52	2.53	2.55	2.57	2.58
HC	MC	MC/4S/<Euro-1	1.42	1.53	1.65	1.64	1.64	1.75	1.83	1.85	1.87	1.89
HC	MC	MC/4S/Euro-1		1.36	1.41	1.41	1.38	1.40	1.45	1.52	1.62	1.68
HC	MC	MC/4S/Euro-2					0.68	0.65	0.67	0.69	0.71	0.83
HC	MC	MC/4S/Euro-3						0.53	0.53	0.53	0.53	0.53
NOx	PC	PC/P/conv	2.38	2.24	2.11	2.02	2.10	2.19	2.26	2.26	2.24	2.27
NOx	PC	PC/P/RCat<91	0.24	0.42	0.59	0.69	0.76	0.84	0.89	0.92	0.94	0.95
NOx	PC	PC/P/Euro-1/FAV1			0.35	0.49	0.60	0.70	0.76	0.79	0.81	0.83
NOx	PC	PC/P/Euro-2				0.16	0.23	0.28	0.33	0.37	0.38	0.39
NOx	PC	PC/P/Euro-3				0.05	0.07	0.09	0.11	0.13	0.15	0.15
NOx	PC	PC/P/Euro-4				0.03	0.04	0.05	0.06	0.06	0.06	0.06
NOx	PC	PC/D/conv	0.86	0.71	0.70	0.68	0.67	0.69	0.71	0.71	0.71	0.71
NOx	PC	PC/D/XXIII/FAV1		0.61	0.61	0.62	0.61	0.62	0.63	0.63	0.63	0.62
NOx	PC	PC/D/Euro-2			0.65	0.65	0.65	0.65	0.65	0.66	0.66	0.66
NOx	PC	PC/D/Euro-3				0.49	0.49	0.49	0.49	0.49	0.50	0.50
NOx	PC	PC/D/Euro-4					0.33	0.33	0.33	0.33	0.33	0.33
NOx	LDV	LDV/P/conv	3.78	3.36	3.10	2.98	2.85	2.87	2.88	2.93	3.03	3.10
NOx	LDV	LDV/P/RCat<91	0.67	0.78	1.13	1.36	1.55	1.71	1.76	1.79	1.82	1.84
NOx	LDV	LDV/P/Euro-1/FAV1			0.92	1.19	1.45	1.68	1.81	1.86	1.90	1.93
NOx	LDV	LDV/P/Euro-2				0.55	0.85	1.15	1.37	1.53	1.59	1.67
NOx	LDV	LDV/P/Euro-3				0.24	0.32	0.48	0.62	0.73	0.81	0.84
NOx	LDV	LDV/P/Euro-4					0.19	0.24	0.29	0.32	0.34	0.35
NOx	LDV	LDV/D/conv	1.52	1.46	1.41	1.38	1.36	1.39	1.41	1.42	1.44	1.45
NOx	LDV	LDV/D/Euro-1/FAV1			1.42	1.41	1.40	1.42	1.45	1.45	1.46	1.47
NOx	LDV	LDV/D/Euro-2				1.23	1.23	1.24	1.26	1.26	1.27	1.27
NOx	LDV	LDV/D/Euro-3				0.94	0.93	0.94	0.95	0.95	0.96	0.96
NOx	LDV	LDV/D/Euro-4						0.53	0.53	0.53	0.53	0.53
NOx	HDV	HMV/1950s	10.76									
NOx	HDV	HMV/1960s	10.96	10.76	10.57							
NOx	HDV	HMV/1970s	11.12	11.00	10.79	10.70	10.65	10.58	10.59	10.73	11.08	11.23
NOx	HDV	HMV/1980s	11.30	11.17	10.98	10.97	10.91	10.87	10.96	11.14	11.35	11.45
NOx	HDV	HMV/Euro-1			7.76	7.55	7.43	7.33	7.35	7.48	7.65	7.74
NOx	HDV	HMV/Euro-2				8.81	9.02	8.90	8.85	8.87	8.93	8.98
NOx	HDV	HMV/Euro-3				6.71	6.70	6.60	6.56	6.53	6.53	6.52
NOx	HDV	HMV/Euro-4					4.55	4.48	4.44	4.43	4.41	4.39
NOx	HDV	HMV/Euro-5						2.40	2.38	2.37	2.36	2.35
NOx	Coach	HMV/1950s	11.93									
NOx	Coach	HMV/1960s	11.93	12.01	11.44							
NOx	Coach	HMV/1970s	11.93	12.01	11.48	11.46	11.25	11.26	11.30	11.30	11.31	11.32
NOx	Coach	HMV/1980s	11.93	12.01	11.88	11.98	11.82	11.82	11.86	11.87	11.87	11.88
NOx	Coach	HMV/Euro-1			7.98	7.95	7.81	7.81	7.84	7.85	7.85	7.86
NOx	Coach	HMV/Euro-2			9.16	9.34	9.17	9.19	9.22	9.23	9.23	9.24
NOx	Coach	HMV/Euro-3				6.94	6.77	6.78	6.81	6.82	6.82	6.83
NOx	Coach	HMV/Euro-4					5.08	5.09	5.11	5.12	5.12	5.13
NOx	Coach	HMV/Euro-5						2.73	2.74	2.75	2.75	2.75
NOx	Bus	HMV/1950s	16.77									
NOx	Bus	HMV/1960s	16.77	14.49	14.09							
NOx	Bus	HMV/1970s	16.77	16.67	16.47	16.58	15.77	15.80	15.86	15.90	15.92	15.92

Emission	Veh. type	Concept	1985	1990	1995	2000	2005	2010	2015	2020	2025	2030
NOx	Bus	HMV/1980s	16.77	17.26	17.25	17.69	17.43	17.36	17.40	17.42	17.43	17.43
NOx	Bus	HMV/Euro-1			10.98	10.96	10.76	10.77	10.80	10.80	10.81	10.81
NOx	Bus	HMV/Euro-2			12.73	12.46	12.47	12.50	12.56	12.64	12.63	12.63
NOx	Bus	HMV/Euro-3				10.74	10.23	10.24	10.26	10.26	10.27	10.27
NOx	Bus	HMV/Euro-4					7.37	7.38	7.40	7.40	7.40	7.40
NOx	Bus	HMV/Euro-5						3.87	3.88	3.88	3.88	3.88
NOx	MC	MP/ without cat	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
NOx	MC	MP/ with cat		0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
NOx	MC	LMC/<Euro-1	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03
NOx	MC	LMC/Euro-1		0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03
NOx	MC	LMC/Euro-2					0.02	0.02	0.02	0.02	0.02	0.02
NOx	MC	MC/2S/<Euro-1	0.08	0.08	0.08	0.08	0.08	0.09	0.09	0.08	0.08	0.08
NOx	MC	MC/2S/Euro-1		0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07
NOx	MC	MC/2S/Euro-2					0.16	0.16	0.16	0.16	0.15	0.15
NOx	MC	MC/2S/Euro-3						0.09	0.08	0.08	0.08	0.08
NOx	MC	MC/4S/<Euro-1	0.32	0.32	0.32	0.33	0.35	0.35	0.35	0.35	0.35	0.34
NOx	MC	MC/4S/Euro-1		0.46	0.46	0.45	0.45	0.45	0.45	0.45	0.45	0.45
NOx	MC	MC/4S/Euro-2					0.34	0.34	0.34	0.34	0.35	0.34
NOx	MC	MC/4S/Euro-3						0.26	0.26	0.26	0.26	0.26
PM exh	PC	PC/P/conv	0.031	0.020	0.010	0.003	0.002	0.002	0.002	0.001	0.001	0.001
PM exh	PC	PC/P/RCat<91	0.032	0.020	0.010	0.003	0.003	0.002	0.002	0.001	0.001	0.001
PM exh	PC	PC/P/Euro-1/FAV1			0.010	0.003	0.002	0.002	0.002	0.001	0.001	0.001
PM exh	PC	PC/P/Euro-2				0.003	0.002	0.002	0.001	0.001	0.001	0.001
PM exh	PC	PC/P/Euro-3				0.003	0.002	0.002	0.002	0.001	0.001	0.001
PM exh	PC	PC/P/Euro-4				0.003	0.002	0.002	0.001	0.001	0.001	0.001
PM exh	PC	PC/D/conv	0.251	0.177	0.159	0.152	0.149	0.157	0.168	0.172	0.168	0.170
PM exh	PC	PC/D/XXIII/FAV1		0.099	0.094	0.094	0.093	0.094	0.096	0.096	0.096	0.095
PM exh	PC	PC/D/Euro-2			0.054	0.054	0.053	0.053	0.053	0.054	0.054	0.054
PM exh	PC	PC/D/Euro-3				0.036	0.036	0.036	0.036	0.036	0.036	0.036
PM exh	PC	PC/D/Euro-4					0.018	0.018	0.018	0.018	0.018	0.018
PM exh	LDV	LDV/P/conv	0.032	0.020	0.010	0.003	0.002	0.002	0.002	0.001	0.001	0.001
PM exh	LDV	LDV/P/RCat<91	0.032	0.020	0.011	0.003	0.002	0.002	0.002	0.001	0.001	0.001
PM exh	LDV	LDV/P/Euro-1/FAV1			0.011	0.003	0.002	0.002	0.001	0.001	0.001	0.001
PM exh	LDV	LDV/P/Euro-2				0.002	0.002	0.002	0.001	0.001	0.001	0.001
PM exh	LDV	LDV/P/Euro-3				0.002	0.002	0.002	0.001	0.001	0.001	0.001
PM exh	LDV	LDV/P/Euro-4					0.002	0.002	0.001	0.001	0.001	0.001
PM exh	LDV	LDV/D/conv	1.120	0.627	0.336	0.252	0.246	0.245	0.263	0.262	0.294	0.344
PM exh	LDV	LDV/D/Euro-1/FAV1			0.162	0.160	0.158	0.161	0.163	0.163	0.163	0.164
PM exh	LDV	LDV/D/Euro-2				0.140	0.139	0.140	0.141	0.142	0.142	0.142
PM exh	LDV	LDV/D/Euro-3				0.063	0.062	0.063	0.063	0.063	0.064	0.064
PM exh	LDV	LDV/D/Euro-4						0.032	0.032	0.032	0.032	0.032
PM exh	HDV	HMV/1950s	1.795									
PM exh	HDV	HMV/1960s	1.355	1.311	1.195							
PM exh	HDV	HMV/1970s	0.901	0.878	0.799	0.790	0.771	0.766	0.764	0.767	0.779	0.784
PM exh	HDV	HMV/1980s	0.454	0.440	0.398	0.395	0.386	0.385	0.386	0.389	0.393	0.395
PM exh	HDV	HMV/Euro-1			0.315	0.303	0.293	0.290	0.290	0.295	0.301	0.304
PM exh	HDV	HMV/Euro-2				0.141	0.140	0.138	0.137	0.138	0.139	0.139
PM exh	HDV	HMV/Euro-3				0.181	0.172	0.170	0.169	0.169	0.168	0.168
PM exh	HDV	HMV/Euro-4					0.038	0.038	0.038	0.038	0.037	0.037
PM exh	HDV	HMV/Euro-5						0.038	0.038	0.038	0.037	0.037
PM exh	Coach	HMV/1950s	1.729									
PM exh	Coach	HMV/1960s	1.297	1.279	1.122							
PM exh	Coach	HMV/1970s	0.864	0.852	0.750	0.744	0.716	0.717	0.721	0.722	0.722	0.724

Emission	Veh. type	Concept	1985	1990	1995	2000	2005	2010	2015	2020	2025	2030
PM exh	Coach	HMV/1980s	0.432	0.426	0.389	0.391	0.378	0.378	0.380	0.381	0.381	0.381
PM exh	Coach	HMV/Euro-1			0.312	0.309	0.298	0.299	0.301	0.302	0.302	0.303
PM exh	Coach	HMV/Euro-2			0.143	0.145	0.140	0.140	0.141	0.141	0.141	0.141
PM exh	Coach	HMV/Euro-3				0.174	0.166	0.166	0.167	0.167	0.168	0.168
PM exh	Coach	HMV/Euro-4					0.042	0.042	0.042	0.042	0.042	0.042
PM exh	Coach	HMV/Euro-5						0.042	0.042	0.042	0.042	0.042
PM exh	Bus	HMV/1950s	3.753									
PM exh	Bus	HMV/1960s	2.815	2.970	2.757							
PM exh	Bus	HMV/1970s	1.876	1.861	1.719	1.788	1.730	1.732	1.733	1.733	1.732	1.732
PM exh	Bus	HMV/1980s	0.938	0.938	0.854	0.851	0.818	0.818	0.819	0.819	0.818	0.818
PM exh	Bus	HMV/Euro-1			0.521	0.517	0.497	0.498	0.499	0.499	0.499	0.499
PM exh	Bus	HMV/Euro-2			0.232	0.224	0.221	0.221	0.223	0.224	0.224	0.224
PM exh	Bus	HMV/Euro-3				0.270	0.255	0.256	0.256	0.256	0.256	0.256
PM exh	Bus	HMV/Euro-4					0.059	0.059	0.060	0.060	0.060	0.060
PM exh	Bus	HMV/Euro-5						0.060	0.060	0.060	0.060	0.060
PM exh	MC	MP/ without cat	0.369	0.248	0.141	0.059	0.058	0.058	0.058	0.058	0.058	0.058
PM exh	MC	MP/ with cat		0.248	0.141	0.059	0.058	0.058	0.058	0.058	0.058	0.058
PM exh	MC	LMC/<Euro-1	0.369	0.248	0.141	0.059	0.058	0.058	0.058	0.058	0.058	0.058
PM exh	MC	LMC/Euro-1		0.248	0.141	0.059	0.058	0.058	0.058	0.058	0.058	0.058
PM exh	MC	LMC/Euro-2					0.058	0.058	0.058	0.058	0.058	0.058
PM exh	MC	MC/2S/<Euro-1	0.372	0.252	0.144	0.060	0.060	0.060	0.060	0.060	0.060	0.060
PM exh	MC	MC/2S/Euro-1		0.252	0.144	0.060	0.060	0.060	0.060	0.060	0.060	0.060
PM exh	MC	MC/2S/Euro-2					0.060	0.060	0.060	0.060	0.060	0.060
PM exh	MC	MC/2S/Euro-3						0.060	0.060	0.060	0.060	0.060
PM exh	MC	MC/4S/<Euro-1	0.112	0.076	0.043	0.018	0.018	0.018	0.018	0.018	0.018	0.018
PM exh	MC	MC/4S/Euro-1		0.076	0.043	0.018	0.018	0.018	0.018	0.018	0.018	0.018
PM exh	MC	MC/4S/Euro-2					0.018	0.018	0.018	0.018	0.018	0.018
PM exh	MC	MC/4S/Euro-3						0.018	0.018	0.018	0.018	0.018

Table 17 Updated emission factors by emission concepts, in g/km including cold starts and evaporation.

ANNEX A7: SENSITIVITY OF PARTICLE FILTERS

In tonnes per annum

EFFECT OF PARTICLE FILTERS ON PM-EMISSIONS (PASSENGER CARS) [T/A]												
	Base-Scenario (without PF)					**Sensitivity with PF**						**Diff.**
	PM-exhaust			PM-non-exh.	Sum PM		PM-exhaust			PM-non-exh.	Sum PM	PM-exh.
Year	PC (P)	PC (D)	PC (P+D)	PC (P+D)	PC (P+D)	Share %PF	PC (P)	PC (D)	PC (P+D)	PC (P+D)	PC (P+D)	PC (P+D)
1990	801	425	1,226	1,731	2,958	0	801	425	1,226	1,731	2,958	0
1995	437	366	802	1,815	2,618	0	437	366	802	1,815	2,618	0
2000	136	332	468	2,020	2,487	0	136	332	468	2,020	2,487	0
2005	112	370	482	2,193	2,674	4%	112	360	472	2,193	2,664	10
2010	83	397	479	2,315	2,794	20%	83	343	426	2,315	2,740	53
2015	58	422	480	2,416	2,896	31%	58	318	376	2,416	2,792	104
2020	38	440	478	2,513	2,991	36%	38	303	341	2,513	2,854	137

Table 18 Sensitivity of particle filters in passenger cars (diesel). Figures shown in tonnes per annum

EFFECT OF PARTICLE FILTERS ON PM-EMISSIONS (BUSES) [T/A]								
	Base-Scenario (without PF)			**Sensitivity with PF**				**Diff.**
Jahr	PM-exhaust	PM-nonexh.	Sum PM	Share %PF	PM-exhaust	PM-non-exh.	Sum PM	PM-exhaust
1990	216	70	286	0	216	70	286	0
1995	177	77	254	0	177	77	254	0
2000	130	79	208	0	130	79	208	0
2005	85	83	169	23%	75	83	159	10
2010	48	84	132	42%	37	84	121	11
2015	29	85	113	54%	18	85	103	11
2020	18	85	103	61%	9	85	94	9

Table 19 Sensitivity of particle filters in buses. Figures shown in tonnes per annum

GLOSSARY

A/C:	air conditioning
ACEA:	European Automobile Manufacturers Association
AGV:	Exhaust Emissions Ordinance (esp. in the context of AGV82)
ARTEMIS:	Assessment and reliability of transport emission models and inventory systems (EU project within the scope of the 5th Framework Programme)
AT	Articulated Truck
AV	articulated vehicle
CH:	abbreviation for Switzerland
CH_4:	methane
CO:	Carbon monoxide
CO_2:	Carbon dioxide
CONCAWE:	The oil companies, European association for environment, health and safety in refining and distribution
COST:	European Co-operation in the field of Scientific and Technical Research
COST 346:	COST action: "Emissions and fuel consumption of Heavy Duty Vehicles"
D:	diesel
D-A-CH:	Co-operation between Germany, Austria and Switzerland on the preparation of emission data (Handbook of Emission Factors in Road Transport)
DETEC:	Federal Department of the Environment, Transport, Energy and Communications
ECE:	Economic Commission for Europe
EFKO:	Swiss Federal Vehicle Inspection Office
EMPA:	Swiss Federal Materials Testing and Research Laboratories, Dübendorf
EPEFE:	European Programme on Emissions, Fuels and Engine Technologies
ESC:	European Steady State Cycle
ETC:	European Transient Cycle
Euro-1, -2, -3, -4:	European exhaust standards for light and heavy motor vehicles

FAV:	Swiss exhaust regulations 1 = light motor vehicles, 2 = heavy motor vehicles, 3 = motorcycles 4 = mopeds
FOSD:	Swiss Federal Office for Spatial Development
GVF	Service for dealing with general transport issues
HBEFA:	Handbook of Emission Factors in Road Transport
HC:	hydrocarbons
HDV:	heavy duty vehicle (general term for trucks, semi-trailers and articulated vehicles)
HMV:	heavy motor vehicle > 3.5 tonnes total weight; = general term for heavy duty vehicles (HDVs, coaches and buses)
LDV:	light duty vehicle <3.5 tonnes (mini-buses, vans, mobile homes, etc.)
LMV:	light motor vehicle (= general term for cars and light duty vehicles < 3.5 tonnes)
MC:	motorcycle
MOFIS:	Motor vehicle information system (Swiss Federal Vehicle Inspection Office)
Mot:	motorway
MP	moped
LMC:	light motorcycle (< 50 cc),
N_2O:	laughing gas
NABEL:	National Air Pollution Monitoring Network
NEDC:	New European Driving Cycle
NH_3:	ammonia
NMHC:	non-methane hydrocarbons
NMOG:	non-methane organic gases
NO_x:	nitric oxides
P:	petrol
Part.:	particle (= PM)
Pb:	lead
PC	passenger car
PF:	particle filter
PHEM:	Passenger car and Heavy duty vehicle emission Model (TU Graz)
PM exh:	particle exhaust

PM non-exh:	particle non-exhaust (= abrasion / resuspension)
PM:	particulate matter
RCat:	regulated catalytic converter
Rur:	rural (road)
RT	rigid truck
SAEFL:	Swiss Agency for the Environment, Forests and Landscape
SFSO:	Swiss Federal Statistical Office
SO_2:	sulphur dioxide
ST	semi-trailer
TAFV:	Ordinance on the technical requirements of transport motor vehicles and their trailers (SR 741.412)[11].
TT	truck + trailer
TU Graz:	Technical University Graz
TW:	two-wheelers (mopeds, motorcycles)
UBA:	German ministry of the environment, Berlin
Urb:	urban (road)
VDA:	German Automobile Industry Association
VOC:	volatile organic compounds
WMTC:	Worldwide Harmonized Motorcycle Emissions Certification Procedure
2S:	2-stroke engine
4S:	4-stroke engine

11 TAV 1: Ordinance dated 19 June 1995 on the technical requirements of transport motor vehicles and their trailers (SR 741.412). This Ordinance integrates the following standards into Swiss legisaltion:
- "Euro-2" for light (Directive 70/220/EWG – version 94/12/EG and/or 96/69/EG) and heavy motor vehicles (Directive 88/77/EWG – version 91/542/EG);
- "Euro-3" and "Euro-4" (Directive 98/69/EG for light motor vehicles) and "Euro-3/4/5" (Directive 1999/96/EG for heavy motor vehicles).
TAFV 3: Ordinance dated 2 September 1998 on the technical requirements of motorcycles, mopeds, light motorcycles and three-wheelers (SR 741.414); standards "Euro-1" (Directive 97/24/EG) and "Euro-2" and "Euro-3" (Directive 2002/51/EG) are integrated into this Ordinance.

REFERENCES

ARE 2002: Aggregierte Verkehrsprognosen Schweiz und EU, Zusammenstellung vorhandener Prognosen bis 2020, erarbeitet durch ARR (*Aggregated traffic forecasts for Switzerland and the EU, summary of existing forecasts up to 2020*), available from BBL, Publications Office, 3003 Bern, www.bbl.admin.ch/bundespublikationen, order no. 812.016 d, Bern 2002

auto-schweiz 2004: Motorfahrzeug-Markt Schweiz 2003; Pressemitteilung vom 16.1.2004 (*Swiss motor vehicle market, 2003 – press release dated 16 January 2004*): www.vsai.ch

BFS 2001: BFS Aktuell; Güterverkehr auf der Strasse; Fahrzeugkilometer, Tonnen, Tonnenkilometer: Zeitreihen 1985/93-2000; Daten vor Einführung der LSVA; (*SFSO News; freight transport by road; vehicle kilometres; tonnes; tonne kilometres; time-series 1985/93-2000; data prior to introduction of HDV fee*); Neuchâtel 2001

BFS 2002: Actualités OFS: Prestations du transport privé de personnes par la route, Séries chronologiques actualisées de 1995 à 2001 (*SFSO News; statistics on private passenger transport by road, updatred time-series 1995-2001*), http://www.statistik.admin.ch/stat_ch/ber11/strassenverkehr/personenverkehr_2002.pdf, Neuchâtel 2002

SAEFL 1986: Pollutant emissions from private road transport, 1950-2000, Report 55, Bern 1986 (and supplement dated September 1998)

SAEFL 1995: Pollutant emissions from road transport, 1950 – 2010, Report 255, Bern 1995

SAEFL 2000: Pollutant emissions from road transport, 1950 – 2020, *Supplement* to Report 255; Bern 2000

SAEFL 2001: Measures to reduce PM10 emissions, Report 136, prepared by Electrowatt Engineering AG on behalf of SAEFL, Bern 2001

SAEFL 2003: Verification of PM10 emission factors in road transport, Swiss federal Roads Authority research project 2000/415, prepared by EMPA and PSI

GVF 1999: Service for General Transport Issues, Impacts of the bilateral land transport agreements between Switzerland and the European Union on road and rail freight transport, ECOPLAN, GVF Report 2/99; Bern, June 1999

INFRAS 1995: Handbook of Emission Factors in Road Transport, version 1.1; on behalf of SAEFL and the German environment ministry, Bern/Berlin 1995

INFRAS 1999: Handbook of Emission Factors in Road Transport, version 1.2 (CD-ROM); on behalf of SAEFL and the German environment ministry, Bern/Berlin 1999

INFRAS 2004a: Handbook of Emission Factors in Road Transport, version 2.1 (CD-ROM and background report); on behalf of SAEFL, Bern, German environment ministry, Berlin, German ministry of agriculture and forestry, environment and water management, German minsitry of Transport, Innovation and Technology and Austrian ministry of the environment, Bern/Berlin/Vienna, February 2004

INFRAS 2004b: Mileages in road transport in Switzerland; traffic data, 1980-2030 for calculating pollutant emissions from road transport, on behalf of FOSP and SAEFL, working document 34, August 2004

PROGTrans/Infras 2004: Perspectives for freight transport in Switzerland up to 2030 (draft), on behalf of FOSP, Bern, March 2004

TNO 2002: Options to integrate the use of mobile air-conditioning systems and auxiliary heaters into the emission type approval test and the fuel consumption test for passenger PCs (M1 vehicles), Final report, 02.OR.VM.074.1/NG, 23 December 2002