4. Further research needs

This chapter contains a list of future needs in areas where there are substantial gaps in knowledge.

It should be the aim of the future research activities to create better insight and empirical data, in such a way that both national and European needs are met. This will require, in particular, standardisation of the approaches, methods of measurement, and models to be applied and developed.

The list presented below gives the level of priority (◆ = lower priority; ◆◆ = higher priority), and indicates where it will only be possible to conduct the research on a European level (E). It should be noted that the word "emissions", in this context, always relates to "emissions and energy consumption".

4.1. Emission factors and functions for road transport

◆◆E **Analysis of the large differences between laboratories** (car manufacturers and research organisations) concerning emission levels. As all co-operative work has shown, large discrepancies tens to be observed between measurements conducted at different laboratories: the differences can arise from measurement accuracy (sampling accuracy, analyser accuracy), vehicle sample factors, or environmental conditions (ambient temperature, pressure, and humidity). In addition, these laboratory effects should be compared to the effects of well-known parameters such as average speed, vehicle technology, etc.

◆◆ The amount of emission data available for heavy-duty traffic is much smaller than that available for cars. Heavy-duty traffic is responsible for approximately 50 % of total NOx emissions, and therefore in this case the amount of data available should be proportional to the size of the problem in order to achieve comparable accuracy and reliability. **New emission measurements of heavy duty vehicles** must be therefore performed: either with engine emission maps and vehicle models including the driving resistance (driving resistance is probably less well understood than engine emissions), or by direct measurement of vehicle emissions either on a dynamometer or using an on-board system.

◆◆ Measurement of emissions of the numerous **non-regulated pollutants** (including particle size, heavy metals for the health effects, hydrocarbon speciation and NO/NO_2 for photochemical pollution, greenhouse gases, etc.) : knowledge of these is becoming more and more important, but the amount of data is often too low, and in some cases it is non-existent.

◆◆ New steps in the measurement and modelling of **evaporative emissions**. The amount of data is insufficient at present, and does not allow accurate assessments to be made; more detailed research is required.

◆◆ Influence of the **auxiliaries** on emissions. Air conditioning in particular is known to have a strong effect on emissions.

◆◆ The **cold start effect** at ambient and engine temperatures below 10 degrees, the cold start effect for the latest engines and catalysts, and the cold start effect for engine temperatures that are intermediate between the ambient temperature and the hot' temperature.

◆ **Producing a large number of emissions engine maps** for passenger cars, and in particular duty vehicles. Agreement on a **vehicle model** which allows these engine emissions to be transformed into vehicle emissions.

◆ **Effects of driving conditions** on emissions, in order to assess the impact of small changes in driving behaviour on emissions on the urban scale.

◆ **Effects of fuel** quality, alternative fuels, and alternative technologies on the emissions from passenger cars and duty vehicles, including energy use.

◆ Emissions from **2-wheelers**, especially VOCs which are increasingly important, especially in southern countries.

◆ Updating the emission database for the **latest vehicles**.

4.2 Road traffic characteristics

◆◆ Precise modelling of the **future composition of the vehicle fleets** and usages, combining the present knowledge of the technological structure of the fleets and traffic with the socio-economic approaches to the evolution of registration and use of the vehicles based on human demographic parameters.

◆◆ Analysis of the **driving behaviour of heavy-duty vehicles**, with extensive measurement campaigns of all vehicle types and usages, especially engine and vehicle speed, vehicle and engine load.

◆◆ Analysis of the **driving behaviour according to the infrastructure** type and the traffic management strategies for the passenger cars, and then the duty vehicles: localisation of the traffic characteristics.

◆◆ Modelling of microscopic driving behaviour by **traffic models**.

◆◆E Collection and processing at the **European** level of the **traffic characteristics** necessary for the emission calculations, from existing statistics.

◆◆E Measurement of **driving behaviour in different countries**, especially for passenger cars - driving cycles, parking time, air conditioning use, etc., in order to have a good geographical representativity of driving behaviour.

4.3 Inventorying tools for road transport emissions

◆◆E **Verification of inventorying models** by independent measurements. Emission models combine different submodels dealing with emission factors and traffic characteristics, but the final model is never tested. It is nevertheless necessary for assessing the accuracy of the models. A large measurement campaign

should be undertaken, for instance over a whole city, and under specific meteorological conditions.

- Building reliable vehicle or **disaggregated models** which allow us to assess the longitudinal evolution of emissions along a street, to evaluate the influence of even small changes in driving behaviour, or to produce average emission factors.
- Building of **intelligent modelling of the future emission** inventory, combining the technological knowledge of the future emission factors, the forecast of the fleets and traffic based on the human demography, the most known future parameter.

4.4 Rail transport

- ◆◆ Better and more complete **driving resistance and energy consumption** data for freight trains. The cars have varying shapes, and the trains are put together in random order, which makes it difficult to estimate aerodynamic drag. The is not the case for passenger trains, where the shapes are quite similar. This data can be obtained by better contact with technical divisions of railway companies, who should be in possession of fuel and energy consumptions statistics for freight trains. Manufacturers of railway wagons may also have data that can be used.
- Better **statistics on the driving patterns of freight trains**. Passenger train characteristics can be evaluated from publicly available timetable data. Freight train statistics and scheduling are not generally available to the public and must be obtained from railway agencies. As a last resort, studies could be made by observation, but this appears to be very difficult, time consuming, and expensive.
- A more complete **statistical compilation of the types of tracks** and power units used throughout Europe would be useful in order to split emissions between diesel and electric units. Some statistics have been collected, but this data base should be improved and expanded.

4.5. Ship transport

- ◆◆ A better **identification of inland shipping**, in terms of sizes, engine sizes and engine maps for emissions, and amount of traffic.
- ◆◆ The evaluation of **emissions arising from the activity of maritime traffic** in port, and with maintenance procedures. In port the emissions come from all land-based activity (fuel tanks, load and unload of oil product, loading and unloading of road vehicles, electric power generation, etc.). The emissions arising from maintenance procedures, such as paint application and other repair operations, must be taken into account. All these emissions must be taken into account to evaluate the impact of inter-modal networks in the different countries.

4.6. Air transport

◆◆E **Comparison and verification of the emission factors** from different inventories/models. The COST 319 D2 subgroup has agreed on a scheme to make emission factors and emission simulation results comparable. This scheme has to filled in with individual results and differences which are likely to exist have to be explained (hidden model assumptions).

◆◆ Influence of the **in-flight situation** on emissions: at the moment all the calculations and emission simulations are also based on the ICAO certification data (for standard ground environmental conditions) using correction factors for the in-flight situation.

◆◆ Emissions from **ground operation**: evaporative emissions, refuelling emissions, operation of auxiliary power units, engine start up: these emissions are not covered at the moment but have a great influence on local VOC emissions.

◆ **Influence of maintenance and ageing** on the emissions: at the moment only ICAO certification data from new engines are used.

◆ Improvement of **database for VFR** (general aviation) and military: ANCAT has carried out a substantial amount of work in this area, but this work only covers NOx and fuel consumption (and then CO_2 and H_2O). No information on HC and CO emissions is available.

5. Conclusion

The results of the COST 319 Action "Estimation of pollutant emissions from transport" are threefold: the determination of the state of the art, identification of gaps in the scientific knowledge gaps, and the implementation of a European network of co-operation.

An understanding of the current state of the art has enabled us to structure the scientific field, to organise it clearly, and to improve its presentation. Secondly, the current state of the art - which is the subject of Section 3 in this report - corresponds to a substantial qualitative progression from the previous state of the art defined at European level (CORINAIR). At the time this was based on the knowledge acquired by just five or six specialists from various laboratories. The active participation of many more specialised researchers in the COST 319 action ensured that the most of the recorded data and acquired knowledge at the European level were taken into account, and that a consensus was reached. However, this was only achieved after lengthy and complex discussion, especially where the views of the various experts involved differed significantly. The widespread participation of users of inventory methods, and the determination of their needs through surveys, enabled us to consider and develop methods corresponding to actual user needs, even if in some circumstances such needs could not immediately be satisfied owing to a lack of knowledge.

By considering the user needs, the opinions of experts in the pollutant emissions field, and further developments in vehicle and transport systems, we were able to establish future research needs. These include, in particular, the development of tools which integrate the COST / MEET methods for different applications, measurement methods for emission factors, heavy vehicles, unregulated pollutants, evaporative emissions and the effects of using auxiliaries, the further development of vehicle fleets, the geographical analysis of the driving patterns throughout Europe, the features of goods trains and river transport, aircraft emission factors under real-world condition and, eventually, the checking of inventory models. This list may seem very long, but only a comparatively small number of items have been mentioned. The lack of relevant data contributes to the significant inaccuracies in current emission evaluations. Although predictions have improved since the first CORINAIR/COPERT project, the inaccuracies remain significant. Emission inventories developed for use on the micro scale, air quality models set up on the city scale, or national emission factors (which are the subject of specific measures on the international scale) need to be more accurate.

The data which has been synthesised during this action has been acquired mainly through national research programmes, including large measurement campaigns. This synthesis, even if very important from a scientific standpoint, only corresponds to a small part of the global effort being made. In addition, further research into transport-related emissions should be based mainly on costly measurement campaigns involving heavy-duty test equipment (amounting to several million Euros). But synthesising the recorded data, determining a new state of the art, and developing software programmes, although very important aspects, can only be performed in a second step.

The third action resulted in the setting up of an extensive network of European researchers and users in the field of transport-related emission inventory methods. This multi-disciplinary, pluri-modal field includes the majority of European specialists (over 200 members) from various laboratories and engineering departments. The long-term research work carried out jointly by several tens of experts, and the information supplied to less active members, provides this network with a real efficiency. The results presented here are a first product of it, and future co-operation will undoubtedly produce more.

What is the future for the COST 319 action?

Mutual knowledge, and the contacts developed between specialists, should lead to the setting up of consortia or working groups studying specific research items. The objective is to draw up proposals in the context of the 5th framework programme for Research and Development in Europe, to develop multinational initiatives linking the most involved researchers and in some circumstances their national sponsors, and to launch co-ordinated national programmes and even European projects.

These consortia and co-operation groups will be, in a way, the secondary fruit of the COST 319 network. Nevertheless, we would like to maintain the whole network since various points of view must be presented, to co-ordinate various research projects, and to improve the state of the art step by step. The structure and the means required for such a network are not well defined at present.

The network should open up to traffic engineers who are increasingly concerned about environmental issues, to transport economists and their models, and to specialists of non-road transport modes since the inter-modal issue is of prime interest. The balanced appraisal of all the scientific fields involved in calculating transport-related emissions, and coverage of highly diversified applications, will guarantee action efficiency.

From a geographical standpoint the network covers nearly the whole of Europe. Specific attention should nevertheless be paid to the active participation of our colleagues from Eastern Europe, who are under-represented in the present network for a number of reasons. The acute problems generated by transport-related pollutant emissions in these countries, the specificity of the vehicle fleets and transport systems, and the likely developments in the transport field clearly justify such attention.

Finally, most of the European method to be used for calculating transport-related emissions is based on the state of the art presented in this report. This method will be used by most of the European users, but also by a great number of developing countries. This can be explained by their specific relations with Europe, their vehicle fleets and transport systems coming from Europe, or by the very interest of the method. If the method itself is to be easily exported, the associated database must be adapted to local conditions where they differ significantly from European ones. Such a situation will involve the opening of the network to developing countries, and may require specific measures to be taken, as is usually the case for such co-operation programmes.

Annex 1: International activities on reporting of national air emission inventories

The main objective of the European Environment Agency (EEA) and it's European topic centre on air emissions (ETC/AE) is to establish the annual European inventory of air emissions, based on the official national inventories, including total emissions and emissions by source sector, that have to be submitted to the European Commission (Monitoring mechanism for CO_2 and other greenhouse gas emissions), the UNECE convention on long range transboundary air pollution (CLRTAP), assisted by EMEP (the co-operative programme for monitoring and evaluation of the long range transmission of air pollutants in Europe) and the United Nations framework convention on climate change (UNFCCC), assisted by the intergovernmental panel on climate change (IPCC). This European inventory is the core European inventory of air emissions (CORINAIR).

ETC/AE assists participating countries to report their national emission inventories to the various international obligations in a consistent, transparent, complete and timely way. For this purpose it makes available a software package. In addition specifically for road transport it continued the further development of COPERT, resulting in COPERT 2 that was made available to participating countries in 1997. COPERT 2 makes use of intermediate results from COST 319 and MEET.

In the work programme of ETC/AE is included the updating of COPERT 2 based on the main results of this report for road transport. It is intended to exchange further information between different projects and to improve the understanding of user needs. Therefore COPERT 3 is expected to be finalised in 1999.

UNECE/CLRTAP and encourages and recommends countries to report by using the joint atmospheric emission inventory guidebook, according to the IPCC source sector split. After a first edition [EEA, 1996], a revised edition [EEA, 1998], the second edition of the guidebook will be published by the European Environment Agency in 1999, including the latest COST 319 and MEET results.

UNFCCC encourages parties to report their national emission inventories using the IPCC guidelines for national greenhouse gas inventories [IPCC/OECD/IEA, 1997]. In these guidelines experiences from several European experts and organisations have been included. Possibly these guidelines will be revised in the future and might then include results from COST 319 and MEET.

It should be noted that for both conventions countries can report also using their own more detailed methods, provided these methods, as well as the differences with the "standard/reference" approaches in the guidebook and/or guidelines, are well documented.

More information is provided in EEA and OECD internet sites: http://www.eea.eu.int and http://www.oecd.org/env/cc/tocinv.htm.

Annex 2: Memorandum of understanding (M.O.U.)

The Signatories to this Memorandum of Understanding, declaring their common intention to participate in a European project in the field of estimation of pollutant emissions from transport, have reached the following understanding:

Section 1

1. The Signatories intend to co-operate in a project to promote research in the field of estimation of pollutant emissions from transport (hereinafter **referred to** as the "project").
2. The main objective of the project is to develop harmonised methods and models to be applied in different estimation cases of pollutant emissions.
3. The Signatories hereby declare their intention of carrying out the project jointly, in accordance with the general description given in Annex II, adhering as far as possible to a timetable to be decided by the Management Committee referred to in Annex I.
4. The project will be carried out through concerted action, in accordance with the provisions of Annex I.
5. The overall value of the activities of the Signatories under the Project is estimated at ECU 1 000 000 at 1992 prices.
6. The Signatories will make every effort to ensure that the necessary funds are made available under their internal financing procedures.

Section 2

The Signatories intend to take part in the Project in one or several of the following ways:

(a) by carrying out studies and research in their technical services or public research establishments (hereinafter referred to as "public research establishments");

(b) by concluding contracts for studies and research with other organisations (hereinafter referred to as "research contractors?");

(c) **by contributing** to the provision of a Secretariat and/or other co-ordinatory services or activities necessary for the aims of the project to be achieved;

(d) by making information on existing relevant research, including all necessary basic data, available to other Signatories;

(e) by arranging for inter-laboratory visits and by co-operating in a small-scale exchange of staff in the later stages.

Section 3

1. This Memorandum of Understanding will take effect for four years upon signature by at least five Signatories. This Memorandum of Understanding may expire on the entry into force of an agreement between the European **Communities** and the non-Community COST member countries having the same aim as that of the present Memorandum of Understanding. This change in the rules governing the project is subject to the prior agreement of the Management Committee referred **to in Annex I.**

2. This Memorandum of Understanding may be amended in writing at any time by arrangement between the Signatories.

3. A Signatory which intends, for any reason whatsoever, to terminate its participation in the Project will notify the Secretary-General of the Council of the European Communities of its intention as soon as possible, preferably not later than three months beforehand.

4. If at any time the number of Signatories falls below four. the Management Committee referred to in Annex I will examine the situation which has arisen and consider whether or not this Memorandum of Understanding should be terminated by decision of the Signatories.

Section 4

1. This Memorandum of Understanding will, for a period of six months from the date of the first signing, remain open for signing, by the Governments of the countries which are members of the COST framework and also by the European Communities.

2. The Governments referred to in the first subparagraph and the European Communities may take part in the Project on a provisional basis during the abovementioned period, even though they may not have signed this Memorandum of Understanding.

3. After this period of six months has elapsed, application to sign this Memorandum of Understanding from the Governments referred to in paragraph 1 or **from the European** Communities will be decided upon by the Management Committee referred to in Annex I, which may attach special conditions thereto.

4. Any Signatory may designate one or more competent public authorities or bodies to act on its behalf, in respect of the implementation of the Project.

Section 5

This Memorandum of Understanding is of an exclusively recommendatory nature. It will not create any binding legal effect in public international law.

Section 6

1. The Secretary-General of the Council of the European Communities will inform all Signatories of the signing dates and the date of entry into effect of this Memorandum of Understanding, and will forward to them all notices which he has received under this Memorandum of Understanding.

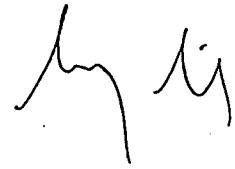
2. This Memorandum of Understanding will be deposited with the General Secretariat of the Council of the European Communities. The Secretary-General will transmit a certified copy to each of the Signatories.

Geschehen zu Brüssel am neunundzwanzigsten April neunzehnhundertdreiundneunzig.

Done at Brussels on the twenty-ninth day of April in the year one thousand nine hundred and ninety-three.

Fait à Bruxelles, le vingt-neul avril mil neuf cent quatre-vingt-treize.

For the Government of the Republic of Greece



For the Government of the Republic of Finland

Für die Regierung der Schweizerischen Eidgenossenschaft
Pour le Gouvemement de la Confédération suisse
Per il Governo della Confederazione svizzera

For the Government of the Republic of Slovak Republic

For the Government of the United Kingdom of Great Britain and Northern Ireland

Annex 1 of the M.O.U.: Co-ordination of the project

Chapter I

1. A **Management Committee (hereinafter** referred to as "the Committee") will be set up, composed of not more than two representatives of each Signatory. Each representative may be accompanied by such experts or advisers as he or she may need.

   The Governments of the countries which are members of the COST framework and the European Communities may, in accordance with the second subparagraph of Section 4(1) of the Memorandum of Understanding, participate in the work of the Committee before becoming Signatories to the Memorandum, without, however, having the right to vote.

   When the European Communities are not a Signatory to the Memorandum of Understanding, a representative of the Commission of the European Communities may attend Committee meetings as an observer.

2. The Committee will be responsible for co-ordinating the Project and in particular for making the necessary arrangements for:
   (a) the choice of research topics on the basis of those provided for in Annex II including any modifications submitted to Signatories by the competent public authorities or bodies; any proposed changes to the Project framework will be referred for an opinion to the COST Technical Committee on Transport;
   (b) advising on the direction which work should take;
   (c) drawing up detailed plans and defining methods for the different phases of execution of the Project;
   (d) co-ordinating the contributions referred on in subparagraph (c) of Section 2 of the Memorandum of Understanding;
   (e) keeping abreast of the research being done in the territory of the Signatories and in other countries;
   (f) liasing with appropriate international bodies;
   (g) exchanging research results amongst the Signatories to the extent compatible with adequate safeguards for the interests of Signatories, **their competent public authorities** or bodies and research contractors in respect of industrial property rights and commercially confidential material;
   (h) drawing up the annual interim reports and the final report to be submitted to the Signatories and circulated as appropriate;
   (i) dealing with any problem which may arise out of the execution of the Project, including those relating to possible special conditions to be attached to accession to the Memorandum of Understanding in the case of applications submitted more than six months after the date of the first signing.

3. The Committee will establish its rules of procedure.

4. The Secretariat of the Committee will be provided at the invitation of the Signatories by either the Commission of the European Communities or one of the Signatory States.

Chapter II

1. Signatories will invite public research establishments or research **contractors in their** territories to submit proposals for research work to their respective competent public authorities or bodies. Proposals accepted under this procedure will be submitted to the Committee.

2. Signatories will request public research establishments or research contractors, before the Committee takes any decision on a proposal. to submit to the public authorities or bodies referred to in paragraph 1 notification of previous commitments and industrial property rights which they consider might preclude or hinder the execution of the Projects of the Signatories.

Chapter III

1. Signatories will request their public research establishments or research contractors to submit periodical progress reports and a final report.

2. The progress reports will be distributed to the Signatories only, through their representatives on the Committee. The Signatories will treat these progress reports as **confidential and will not use them for purposes other** than research work. In order to assess better the final data on the action, the Signatory States are invited, for the preparation of the final report. to state the approximate level of spending at national level arising from their involvement in the said action. The final report on the results obtained will have much wider circulation, covering at least the Signatories' public research establishments or research contractors concerned.

Chapter IV

1. In order to facilitate the exchange of results referred to in Chapter I, paragraph 2(g), and subject to **national law, Signatories intend to** ensure, through the inclusion of appropriate terms in research contracts, that the owners of industrial property rights and technical information resulting from work carried out in implementation of that part of the Action assigned to them under Annex II (hereinafter referred to as "the research results") will be under an obligation. if so requested by another Signatory (hereinafter referred to as the "applicant Signatory"), to supply the research results and to grant to the applicant Signatory or to a third party nominated by the applicant Signatory a licence to use the research results and such technical know-how incorporated therein as is necessary for such use if the applicant Signatory requires the granting of a licence for the execution of work in respect of the Action.

   Such licences will be granted on fair and reasonable terms, having regard to commercial usage.

2. Signatories will, by including appropriate clauses in contracts placed with research contractors, provide for the licence referred to in paragraph 1 to be

extended on fair and reasonable terms, having regard to commercial usage, to previous industrial property rights and to prior technical know-how acquired by the research contractor insofar as the research results could not otherwise be used for the purpose referred to in paragraph 1.

Where a research contractor is unable or unwilling to agree to such extension, the Signatory will submit the case to the Committee. before the contract is concluded; thereafter the Committee will state its position on the case, if possible after having consulted the interested parties.

3. Signatories will take any steps necessary to ensure that the fulfilment of the conditions laid down in this Chapter will not be affected by any subsequent transfer of rights to ownership of the research results. Any **such transfer will be notified** to the Committee.

4. If a Signatory terminates its participation in the Project, any rights of use which it has granted, or is obliged to grant to, or has obtained from. other Signatories in application of the Memorandum of Understanding and **concerning work** carried out up to the date on which the said Signatory terminates its participation will continue thereafter.

5. The provisions of paragraphs 1 to 4 will continue to apply after the period of operation of the Memorandum of Understanding has expired and will apply to industrial property rights as long as these remain valid, and to unprotected inventions and technical know-how until such time as they pass into the public domain other than through disclosure by the licensee.

Annex II of the M.O.U.: General description of the project

1. Background

It has long been recognised that transport, and in particular road traffic, is an important source of pollution in Europe. As an example, the recently published results of the CORINAIR programme show that the contribution of road traffic to total man-made NOx emissions was estimated to be about 55%. while the contribution to total VOC emissions was about 54% in 1985 in the European Community. Additionally, transport has also been identified as the third important source of greenhouse gas emissions, emitting approximately 25% of total $C0_2$ emissions in the EC, more than three quarters of which are allocated to road traffic. Obviously, the **contribution of these emissions** varies significantly from one country to another (according to particular vehicle fleet and fuel characteristics) and between urban agglomerations and rural areas (due to the different vehicle usage patterns and actual vehicle density). Moreover, seasonal variations and geographical features strongly influence the local patterns of the emissions.

At present, the research carried out in Europe in the field of transport emissions is aimed mainly at improving the knowledge on the actual emissions (through measurements of unit vehicle emissions and driving behaviour, as well as assessment of vehicle fleet characteristics), but it is also directed towards studying the potential solutions of air pollution related to transport (via both technological and socio-economic measures).

The main part of these research activities is conducted at local or national level, while an increasing number of research teams is producing an equally increasing number of different approaches. The actual co-ordination of these activities is very limited: it is allocated either to exchange of ideas and information in conferences or to first level evaluations in **working groups (e.g. the** CORINAIR working group on emissions from road **traffic).**

Moreover, common research projects are as yet very rare in this field (e.g. DRIVE-MODEM or German-Swiss-Austrian co-operation) and mainly aimed at improving knowledge on vehicle unit emissions. The considerable amount of partial solutions tested at local level needs to be co-ordinated and analysed on a commonly accepted base; knowledge accumulated on emissions throughout Europe has to be pooled to form a basis for common tools.

It should be mentioned that the estimation of emissions from transport might be, more than in the case of other source categories. a permanent task. This is due to the relatively great changes in this sector e.g. the turnover of the fleets is rather short, legislation requirements change quickly, the number of vehicles and mobility increase steadily. These changes require not only continuation of the work but also a constant adaptation and up-dating of the methods applied.

The scientists and research laboratories in the field of transport emissions and the economy of this sector express in this context the need for a wider collaboration and co-ordination of the related research activities.

2. Objectives

It should be recalled that various approaches have been developed so far **for the** estimation of transport emissions, based on the available statistical and laboratory data. A characteristic basic to all these approaches is the formula:

d(Emissions) [g] = Unit Emission [g/activity unit] Mactivity) [activity unit]

where activity unit = distance [m] or quantity of fuel fkg] or time of operation [h].

Depending on the available data and on the level of detail imposed by the aim of the calculations, the application of the above equation is in principle possible either in a differentiated or an integrated form. e.g.

- using yearly averages of emission factors for a broad calculation of annual emissions over a large territorial unit,
- introducing statistical dependencies for the emission factors (e.g. speed, age, cylinder capacity) for a first level split of the emissions,
- combining emission maps with vehicle characteristics and driving patterns, for the detailed calculation of the emissions on a local (e.g. street) level.

COST Project 319, the main objectives of which are:

1) to assess the current situation and
2) to propose and evaluate solutions for the future

is designed to:

(a) analyse the methods and the results of research,
(b) carry out synthesis of the available data and develop appropriate tools,
(c) co-ordinate research

on direct or indirect emissions of regulated and unregulated pollutants as well as fuel consumption or energy use by transport.

As regards aim (a), it has to be stressed that due to the differences in the applied methods, as well as in the statistical but - predominantly -experimental data, major inconsistencies in the calculated emission levels have been identified so far among the research results reported by different institutions. The need for harmonisation, transparency and comparability of data has already been identified and requested by all investigators in the field.

In this context, the first major task of COST Project 319 should be data collection on :

- emission factors and functions of the different vehicle and engine categories and transport modes. Data collected should cover not only existing vehicles, but also future ones. Moreover, an effort has to be made in order to collect emission data covering all possible detail of expression, i.e. from surrogate emission factors to engine emission maps;
- driving behaviour. This is of particular interest for road traffic , as it has a major effect on emission levels, specifically in urban areas;
- passenger and freight transport vehicle use. Vehicle usage (e.g. annual mileage, split into different road categories, occupancy rates, actual carrying capacity, etc) is of high importance, as it influences total emissions via the second term of the basic equation. At this point it should be recalled that technical policy plans and socio-economic measures are already underway to influence the general usage of the vehicles, in order to comply with targets such as CO_2 stabilisation and reduction;
- statistics of different vehicle fleets, referring both to road traffic (e.g. number of passenger cars - gasoline and diesel -, light duty vehicles, heavy goods vehicles, two-wheeled vehicles. lifetime functions. age - capacity -weight distribution etc.), as well as to other modes of transport (trains, aircraft etc).

Knowledge already collated on the abovementioned topics, together **with that to be acquired in the** future, will facilitate the analysis of the methods developed and applied so far, in order to determine the extent of application, **to identify the** limitations and to produce recommendations as to how these methods should be applied.

As regards aim (b), a synthesis of the baseline data will be conducted (both in terms of raw data and of available methodologies), in order initially to evaluate existing procedures and subsequently to produce and propose harmonised methodological approaches to be applied in different estimation cases. Such methods have to take into account the peculiarities of each specific application, in an attempt to develop also the

necessary interfaces between applications of different local and temporal resolution. Nevertheless, it is necessary to categorise the different application levels, in order to optimise in terms of efforts and accuracy.

In this context, it is envisaged that work will focus on the development of a number of tools, in particular:

- Creation and maintenance of a data base on vehicle unit emissions. This may be envisaged as a priority task, as it will attempt to incorporate in an intelligent way the major portion of existing knowledge on vehicle unit emissions and to afford the possibility of usage for different purposes and by different users;
- simulation of the emissions, e.g. from steady-state and transient emission **maps, coupled** to vehicle characteristics and fed with traffic conditions. In this activity it is planned to take advantage of the experience gained with existing models for traffic engineering applications;
- emission inventorying methodologies, taking into account different **approaches for the** local, national and international scale;
- emission trends analysis and forecast models for the evaluation of transport policies. traffic management and efficiency of technological developments. Economic research techniques for studying the evolution of mobility and its determinants are highly important in this context.

As far as aim (c) is concerned, the identification of the gaps in the knowledge of the emission behaviour of the different transport sub-groups will be a major outcome of the previous activities. COST project 319 should also be aimed at co-ordinating and supporting the research activities in the identified fields. Engineering topics such as emissions of heavy duty vehicles. emissions of two-wheeled vehicles. emissions from two-stroke engines, evaporation losses, cold start emissions, unregulated pollutants, emissions of aircraft, trains and ships can already be mentioned as examples which will require particular attention. Additionally, factors that influence vehicle operation, such as traffic management techniques, and social and economic policies that influence transport activity should be given attention.

3. Work method and group management

Clearly, the objectives stated above relate both to scientific fields (e.g. unit emissions, vehicle usage patterns) and to fundamental synthetical requirements, such as the knowledge of actual emission situations (e.g. inventories) and the evaluation of potential solutions (e.g. traffic **management, vehicle** use etc.). In this respect the researchers potentially interested in these activities are of different specialities (engine specialists, economists, planners etc): it is therefore necessary to envisage both inter-disciplinarity and exchange of expertise.

COST Project 319 will thus have to operate fundamentally as one group. in order to ensure its cohesion, and in sub-groups in order to ensure its scientific efficiency. Hence the following scheme may be envisaged:

- in the beginning: plenary sessions in order precisely to define the objectives of the group, more enlarged than its initial composition. With this in mind, wide publicity is required in order to attract the interest of experts in the field.

- as a second stage: definition of sub-groups
- finally: work in subgroups and periodic plenary meetings.

As a first approach, the proposal is to form three main sub-groups. in order to deal with three different levels of emission estimation from transport:

- Sub-group A: Emission Factors and Functions

  It is proposed that Sub-Group A concentrate mainly on the field of emission factors, dealing with actual emissions. technology (engine and **fuel) related alternatives, driving** patterns dependencies, covering both **regulated and unregulated emissions.**

- Sub-group B: Traffic Characteristics

  The tasks of Sub-group B will include traffic management, driving behaviour, fleet statistics, mobility analysis, cost-price impacts etc.

- Sub-group C: Tool Harmonisation and Development

  The tasks that could be envisaged by Sub-Group C may include development of methods and techniques for the estimation of transport emissions (to be used in inventories, forecasts etc), preparation of relevant guidelines (with, possibly, appropriate publications) and development of relevant software tools (e.g. engine and vehicle models). In this framework, the creation and maintenance of a database on emission factors from the different transport modes could, for example, be contemplated.

It is evident that each group will have to take into account the existing methodologies developed so far in different countries and that the different sub-group activities and targets will have to be clearly linked to the main objectives of the work.

Collaboration and co-ordination of COST Project 319 with ongoing activities at international level are absolutely necessary. Thus, for example, CORINAIR (European Environmental Agency - Task Force), UN ECE inventory work, as well as other relevant COST activities (in particular CITAIR) will have to be closely followed. In this respect COST Project 319 may play an **important** role in linking the research on transport emissions.

Finally, the dissemination of the information produced within the framework of the project is also of importance, as it may provide a significant feedback to both the quality of the data and the methodologies developed.

4. Duration

The duration of the project is four years (1993-1996).

As a first step, it is anticipated that periodic meetings (one every six months) of each working sub-group and one seminar (geared to a meeting of the technical committee) will be necessary.

5. Participants

Initially the working group will consist of scientists from Austria. Belgium, Finland, France, Germany, Greece, Italy, Sweden and the United Kingdom. However, the project

still needs to be widely advertised in order to attract the interest of scientists in all European countries, as well as from industry.

6. Estimated cost

The COST of direct participation in this activity by the nine initial members is estimated to be ECU 1 000 000.

In addition there is extensive research in progress nationally, which is estimated to be in the order of ECU 70 000 000.

Annex 3: Structure of the action: working groups

Chairman: R. Joumard (F) Vice-chairmen: J. Hickman (UK), O.H. Koskinen (FIN), Z. Samaras (GR) Secretary: R. Mayet (CEC)

A : Emission Factors and Functions O.H. Koskinen (FIN)												B : Traffic Characteristics J. Hickman (UK)				C : Inventorying Tools Z. Samaras (GR)		D : Non-Road Transport S. Sorenson (DK)		
A1	A2	A3							A4			B1	B2		B3	B4	C1	C2	D1	D2	D3
Engine Maps	Instant Veh. Emis.	Average Vehicle Emissions							Future Vehicle & Life Cycle Emissions			Traffic Management	Driving Behaviour		Traffic Composition	Mobility	Bottom-up Appr.	Top-down Appr.	Rail Transport	Air Transport	Waterborne Transp
O.H. Koskinen (FIN)	P. Sturm (A)	R.C. Rijkeboer (NL)							L. Donovan (IRL)			J. Perez-Cerezo (E)	U. Hammarström (S)		N. Kyriakis (GR)	W. Hecq (B)	E. Negrenti (I)	M. Keller (CH)	S. Sorenson (DK)	M. Kaliwoda (A)	C. Trozzi (I)
		A3A	A3B	A3C	A3D	A3E	A3F	A3G	A4A	A4B	A4C		B2A	B2B							
		Hot Emis. Fact. / PC	Cold Start Emis.	Evapo-rative Emis.	Gradient Infl.	Light Duty Veh.	Heavy Duty Veh.	Motorcycles	Alternative Fuels	New Vehic. Tech.	Life Cycle Emis.		Simulation Models	Measures & Meas. Meth.							
		Z. Samaras (GR)	R. Joumard (F)	R.C. Rijkeboer (NL)	D. Hassel (D)	Z. Samaras (GR)	J. Hickman (UK)	R.C. Rijkeboer (NL)	L. Donovan (IRL)	S. Sorenson (DK)	A. Lewis (UK)		U. Hammarström (S)	M. André (F)							

Annex 4: Working group meetings

Sub-group (see annex 3)	date	location	participants
A+B+C+D	8-9 Nov. 1994	Brussels	30
D	30 Jan. 1995	Vienna	6
A2	2 Feb. 1995	Graz (A)	14
A4	11 Feb. 1995	Birmingham (UK)	5
A3	27 March 1995	Delft (NL)	8
A1	16 May 1995	Helsinki	12
B	June 1995	Madrid	8
A+B+C+D	27-28 Nov. 1995	Brussels	35
A3F	7 May 1996	Cologne (D)	8
A+B+C+D	30 May 1996	Bron (F)	25
A2 + C	10 June 1996	Thessaloniki (GR)	15
B2	19-20 Sept. 1996	Linköping (S)	16
A1 + A4	21 Oct. 1996	Nuneaton (UK)	6
A1 + A3F	29 Oct. 1996	Graz (A)	11
B2 + B3	25 April 1997	Zürich (CH)	6
A4 + COST 616	12-13 May 97	Naples (I)	125
A1 + A3F	6 June 1997	Delft (NL)	9
D2	29 August 1997	Vienna	5
French participants	4 Sept. 1997	Arcueil (F)	17
C	29 Sept. 1997	Prague	26
A4	14 Nov. 1997	Paris	10
D2	9 Dec. 1997	Brussels	6
A2	4 Feb. 1998	Thessaloniki (GR)	9
A3A + A3E	5 Feb. 1998	Thessaloniki (GR)	14
D2	20 April 1998	Copenhagen	7
C	4 May 1998	Rome	18
French participants	11 June 1998	Paris	24
A2	18 June 1998	Graz (A)	8

In addition 12 management committee meetings were held every 6 months with 20 to 30 participants each, where technical discussions took place also: In Brussels (EC, May and October 1993, 28 November 1994, 7 April 1997), Avignon (F, INRETS, 10 June 1994), Helsinki (Min. Transport, 15 May 1995), Brussels (ULB, 28 November 1995), Bron (F, INRETS, 31 May 1996), Barcelona (E, UPC, 7 October 1996), Prague (CUAP, 30 September 1997), Rome (ENEA, 5-6 May 1997) and finally Budapest (KTI, 1-2 October 1998).

Annex 5: List of the active members per domain

See annex 3 for the meaning of the working group numbers (A1, A2 ... D3).

w : **member** of the working group * : specialist			Emission Factors				Traffic				Tools		Non-Road		
			A1	A2	A3	A4	B1	B2	B3	B4	C1	C2	D1	D2	D3
Faiz Asif	World Bank	Argentina			*		*		*	*				.	
Hausberger Stefan	Technical Univ. Graz	Austria		w	w										
Kalivoda Manfred	Consultant	Austria											w	w	
Medinger Walter	Municipality Linz	Austria									*	*			
Pischinger Rudolf	Technical Univ. Graz	Austria	*	w	*	*		*			*	*			
Reiter Christoph	Technical Univ. Graz	Austria		w	*						*	*			
Sammer Gerd	Univ. Bodenkultur Vienna	Austria					*			*					
Schinagl Gerhid	Technical Univ. Graz	Austria		w											
Sturm Peter	Technical Univ. Graz	Austria	w	w	w			w	w		w	w			
De Vlieger Ina	VITO	Belgium	w	w	*										
Dunker Reiner	CEC-DG XII.C.3.	Belgium				*								*	
Favrel Vincent	CEESE	Belgium								w					
Gilson Benoit	CEESE	Belgium								w					
Hecq Walter	CEESE - ULB	Belgium			*	*			*	w		*	*	*	*
Mahieu Vincent	ULB	Belgium			w										
Toussaint Yves	Univ. Liège	Belgium	*	*	*			*							
Vandenberghe Christian	Eurocontrol	Belgium												w	
Barzev Kiril	Technical Univ. Rousse	Bulgaria	w		w										
Otto Karel	Czech Univ. Agric. Prague	Czech Rep.		*	*										
Volák Vladimir	Motor Vehicle Research Institute	Czech Rep.	*	*	*	*							*		
Bendtsen Hans	Road Directorate	Denmark					*	*	*	*	*				
Coffey Robert	Denmarks Tech. Univ.	Denmark			*	w									
Fenger Jes	Nat. Environmental Research Inst.	Denmark		*							*	*			
Jol André	European Environment Agency	Denmark									w	w			
Michelsen Nic	Civil Aviation Administration SLV	Denmark												w	
Sorenson Spencer C.	Technical Univ. Denmark	Denmark	*	*	w	*						*	w		
Winther Morten	Nat. Environmental Research Inst.	Denmark			*									w	
Juva Ari	Neste Oy	Finland	*		*										
Karhula Mervi	Finnish National Road Adm.	Finland						*	*		*	*			
Koskinen Olavi H.	Ministry Transport & Communication	Finland	w	w	w			*	*		w	w			
Laurikko Juhani	VTT Energia	Finland			w										
Mäkelä Kari	VTT	Finland			w		*	w	*	*	*	*	*		
Otterström Tomas	Ekono Energy Ltd	Finland								*					
André Michel	INRETS	France					w	w	w						
Badin François	INRETS	France				w									
Casalé Eric	Scetauroute - DTTS	France			*			*							

w : **member** of the working group * : specialist			Emission Factors				Traffic				Tools		Non-Road		
			A1	A2	A3	A4	B1	B2	B3	B4	C1	C2	D1	D2	D3
Charbonnier Marc-André	Lucas Varity Diesel Syst.	France	*	*	*	*									
Cotte Hélène	PSA Peugeot-Citroën	France		*	*	w	*	*	*		*	*			
Faudry Daniel	IEPE	France								*					
Fontelle Jean-Pierre	CITEPA	France									*	*			*
Gallet Michel	Eres Transport-Ingetrans	France					*	*	*	*	*		*		
Guillermo René	École des Mines de Douai	France			*						*				
Jaecker Anne	IFP	France									*	*		*	
Joumard Robert	INRETS	France	w	w	w			*	w		w	w			
Nicolas Jean-Pierre	LET	France								*					
Nollet Valérie	Univ. S. T. Lille	France	*	*	*	*					*	*			
Noppe Jane	Ademe	France		*	*	w					w	w			
Parfait Christine	RATP	France		*	*										
Paturel Laurent	Univ. Savoie	France			*										
Pereira Alice	LCPC	France				*									
Pillot Didier	INRETS	France						*	*						
Roumégoux Jean-Pierre	INRETS	France	*	*	*										
Thibaut Gérard	Ville de Paris	France					*	*							
Vantelon Alain	BCEOM	France						*							
Villanova A.	RATP	France	*	*	*	*	*	*	*	*	*	*			
Benz Thomas	Benz Consult Gmbh	Germany	*	*	*			*	*		*	*			
Brannolte Ulrich	PTV Consult Gmbh	Germany					*	*	*	*					
Geier Martin	BMW AG	Germany									w	w			
Gruden Dusan	Porsche AG	Germany	*	*	*	*	*		*						
Hassel Dieter	TÜV Rheinland	Germany	w	w	w						w	w			
Heland Jörg	FhG-IFU	Germany	*	*		*								*	
Hellebrandt Pia	Heusch-Boesefeldt GmbH	Germany					*	*				*			
Höpfner Ulrich	IFEU	Germany			*	*					w	w			
Hotes Andreas	Techn. Univ. Berlin, ILR	Germany												*	
Metz Norbert	BMW AG	Germany		*	*	*			*	*					
Niederau Arnold	Heusch-Boesefeldt Gmbh	Germany					*				*		*	*	
Niederle Werner	Umweltbundesamt	Germany		w	w	*					w	w			
Wacker Manfred	Inst. f. Strassen- & Verkehrswesen	Germany	*	*	*		*	*	*						
Weber Franz-Josef	TÜV Rheinland	Germany		*	w										
Kyriakis Nikos	Aristotle Univ. Thessaloniki	Greece	*		*	*		w	w		*	*			
Ntziachristos Leonidas	Lab. Applied Thermodynamics	Greece		w	w						*				
Samaras Zissis	Lab. Applied Thermodynamics	Greece	*	w	w	*			w		w	w	*		*
Michelberger Pál	Budapesti Műszaki Egyetem	Hungary							*	*		*	*	*	
Pollák Iván	Institute for Transport Sciences (KTI)	Hungary	*	*	*				*	*	w	w			
Donovan Liam	Univ. Limerick	Ireland				w									
Cernuschi Stefano	Politecnico di Milano	Italy		*	w						w	w			
d'Elia Sergio	Univ. della Calabria	Italy			*					*					
Danieli Guido	Univ. della Calabria	Italy	*	*	*	*		*	*						
Negrenti Emanuele	ENEA	Italy		w		*	*	w		*	w	*			
Police Giuseppe	Istituto Motori CNR	Italy		*	*										
Rapone Mario	Istituto Motori CNR	Italy						w			w	w			

w : **member** of the working group * : specialist			Emission Factors				Traffic				Tools		Non-Road		
			A 1	A 2	A 3	A 4	B 1	B 2	B 3	B 4	C 1	C 2	D 1	D 2	D 3
Skouloudis Andreas	CCR/ISPRA	Italy									*	*			
Trozzi Carlo	Techne SRL	Italy									*	*		*	w
Vaccaro Rita	Techne SRL	Italy													w
Milukaite Androné	Institute of Physics	Lithuania			*										
Wane Hamdou Rabby	CERPOD	Mali						*	*		*				
Gong Rose	Industrial Res. Ltd	New Zealand		*											
Larssen Steinar	Norwegian Inst. Air Research	Norway			*						*	*			
Rypdal Kristin	Statistics Norway	Norway									*	*		w	*
Adamski Andrzej	Univ. Mining & Metallurgy	Poland		*	*		*			*					
Bukowy Elzbieta		Poland		*	*	*	*	*	*	*	*	*	*		*
Lukanin Valentin	MADI-TU	Russia		*	w	*		*	*	*					
Nemtchinov Michail	Moscow State Auto. Road Inst.	Russia		*	*		*		*						
Sinyavski Vladimir V.	MADI-TU	Russia		*	*	*									
Krakovsky Pavol		Slovakia	*	*	*			*	*			*	w		
Baldasano José	Univ. Politèc. Catalunya	Spain									w	w			
Laguna J.Pablo	INTA	Spain		*	w										
Pérez-Cerezo Julia	Environment, Transport & Planning	Spain			*	*	w	*		*	*	*	*	*	
Dahlstedt Sven	VTI	Sweden						*							
Egnell Rolf	Aspen Utvecklings AB	Sweden	w		w										
Ericsson Eva	Lund Inst. Traffic Planning Eng.	Sweden						w			w	w			
Erlandsson Lennart	Motortestcenter	Sweden	w		w										
Flodström Eje	MariTerm AB	Sweden													*
Hammarström Ulf	Swedish Road Traffic Res. Inst.	Sweden	w		w		*	w		*	w	w			
Höglund Paul G.	Royal Institute of Technology	Sweden		w	*		*	w	w		w	w			
Johansson Lars	Swedish State Railways	Sweden			*	*									
Larson Lars-Gunnar	FFA	Sweden		*	*						*			w	
Sjöbris Anders	MariTerm AB	Sweden													*
Sjödin Åke	Swedish Environ. Res. Inst.	Sweden		*	*								*	*	*
Wallin Mats	AB Svensk Bilprovning	Sweden	*	*	w										
de Haan Peter	Infras AG	Switzerland		w											
Evéquoz Roger	OFEFP	Switzerland	*	*	*			*	*		w	w	*	*	*
Keller Mario	Infras AG	Switzerland		w	w			w	w		w	w			
Schweizer Thomas	EMPA	Switzerland		w	*										
Brok Paul	National Aerospace Lab. NLR	The Netherlands												w	
Riemersma Iddo	TNO-WT	The Netherlands		*	*						*				
Rijkeboer Rudolf C.	TNO-IW	The Netherlands	w		w	*					w	w			
Göktan Ali	Techn. Univ. Istanbul	Turkey	*		*			*							
Uyumaz Ali	Istanbul Tech. Univ.	Turkey						*							

w : **member** of the working group * : specialist			Emission Factors				Traffic				Tools		Non-Road		
			A1	A2	A3	A4	B1	B2	B3	B4	C1	C2	D1	D2	D3
Boulter Paul G.	TRL	U.K.		w	w										
Charters Derek	MIRA	U.K.			*	w		*			*				
Chiquetto Sergio	TTR	U.K.			*										
Davison Paul	AEA Technology Environment	U.K.				*									
Falk Robert S.	DTI - Dept Trade Industry	U.K.												w	
Hickman John	TRL	U.K.	w	w	w	*	w	w	w		w	w			
Mc Crae Ian	TRL	U.K.		*	*		*		*				*		
Moon David	AEA Technology Environment	U.K.				*									
Namdeo A.K.	Univ. Nottingham	U.K.			*				*						
Newton Peter J.	DTI	U.K.												*	
Noons Richard	MIRA	U.K.				w					w	w			
Swann Jaimie	MIRA	U.K.				w									
Williams Ian	Middlesex Univ.	U.K.		*	*		*				*	*			

Annex 6: Coordinates of the network members

Name : specialist (see annex 5) **Name** : only interested by results	address	phone number *fax number* e.mail	scientific fields
Pr **Adamski** Andrzej	**Univ. Mining & Metallurgy** - Inst. Automatics - - 30-059 Cracow - Poland	+48 12 34 15 68 or 17 28 51 *+48 12 34 15 68* aad@earth.ia.agh.edu.pl	traffic management and control (individual and public transport), transport environmental impacts measurements, modelling and estimation, multicriteria networks optimisation problems (optimal algorithms, tools etc.), applied mathematics (stochastic, AI-tools, rough sets, optimisation)
Mr **Alary** René	**LCPPP** - 39 bis, rue de Dantzig - - 75015 Paris - France	+33 (0)145 31 14 80 *+33 (0)145 31 27 81*	measurement of urban air pollution
Mme **Allemand** Nadine	**CITEPA** - 10, rue du Faubourg Poissonnière - - 75010 Paris - France	+33 (0)144 83 68 83 *+33 (0)140 22 04 83* citepa@compuserve.com	
Mr **Anders** Peter	**Deutsche Automobilgesellschaft mbh** - Julius-Konegen-str. 24 - - 38114 Braunschweig - Germany	+49 531 59 09 363 *+49 531 59 09 310* anders@daug.de	traffic engineering, exhausts, man-machine interaction
Mr **André** Michel	**INRETS** - case 24 - - 69675 Bron cedex - France	+33 (0)472 14 24 73 *+33 (0)472 37 68 37* andre@inrets.fr	driving behaviour, methods of emission and consumption measurements
Mr **Badin** François	**INRETS** - case 24 - - 69675 Bron cedex - France	+33 (0)472 14 24 74 *+33 (0)472 37 68 37* badin@inrets.fr	electric and hybrid vehicle modelling (cars and bus), energy consumption and emissions of passenger cars and buses, fuel consumption and emissions of internal combustion engines
Mr **Baldasano** José	**Univ. Politèc. Catalunya** - ITEMA - Ap. Correus 508 - 08220 Terrassa - Spain	+34 3 739 83 91 *+34 3 739 83 81* baldasano@pe.upc.es	environmental modelling, air pollution modelling, waste management and pollution prevention
Dr **Barzev** Kiril	**Technical Univ. Rousse** - Lab. on Ecological Problems of Engines - 8, Studentska str. - Rousse 7017 - Bulgaria	+359 82 44 47 16 *+359 82 45 10 92*	reduction of emissions of internal combustion engines by means of additional devices and alternative fuels
Ms **Beckestad** Tone	**Norwegian Inst. Air Research** - PB 100 - - 2007 Kjeller - Norway	+47 63 89 80 87 *+47 63 89 80 50* tone@zardoz.nilu.no	air pollution from vehicles, emissions rather dispersion, effects of air pollution
Dr **Beckroege** Wolfgang	**Kommunalverband Ruhrgebiet** - Kronprinzstr. 35 - - 45128 Essen - Germany	+49 201 2069 614 *+49 201 2069 500 to 502*	transport emissions and immissions, climate, air pollution control, air pollution simulation models
Mr **Bendtsen** Hans	**Road Directorate** - Niels Juels Gade 13 - - 1059 Copenhagen - Denmark	+45 33 93 33 38 *+45 33 93 07 12* hbe@tmvd.dk	road noise, traffic characteristics, road traffic and air pollution, alternative transportation systems, traffic calming
Mr **Benkhelifa** F.	**Explicit** - 69 rue de Rochechouart - - 75009 Paris - France	+33 (0)148 74 36 20 *+33 (0)148 74 36 25* explicit@worldnet.fr	energy, environment

Name : specialist (see annex 5) **Name** : only interested by results	address	phone number *fax number* e.mail	scientific fields
Dr **Benz** Thomas	**Benz Consult Gmbh** - Kaiserstr. 23 - - 76131 Karlsruhe - Germany	+49 721 3 45 80 *+49 721 3 34 81* benzconsult@t-online.de	emission, dispersion, air quality, traffic flow, software development
Pr **Bernhardt** Maciej	**Univ. Technique Varsovie** - faculté SIMR - rue Narbutta 84 - 02-524 Varsovie - Poland	+48 22 49 03 03 or 14 *+48 22 49 03 06*	air pollution from motor vehicles
Mr **Blaison** Jean Claude	**Ministère de l'Environnement** - DPPR - 20, av. de Ségur - 75302 Paris 07SP - France	+33 (0)142 19 14 96 *+33 (0)142 19 14 71*	
Mr **Boch** Wolfgang	**CEC-DGXIII** - Beaulieu 29 - 200, rue de la Loi - 1049 Brussels - Belgium	+32 2 296 35 91 *+32 2 296 23 91*	co-ordination of the environment telematics research activities
Dr **Boschetti** Paola	**IPLA** - Corso Casale 476 - - 101 Torino - Italy	+39 011 899 89 33 *+39 011 898 93 33*	bioenergy (composting, use of organic wastes in agriculture, etc.), road traffic pollution and its environmental impact (on air, soil, vegetation, surface water and man)
Mr **Boughedaoui** Menouer	**Univ. Blida** - BP 270 - - 09000 Blida - Algeria	+213 349 09 13 *+213 349 09 13* boughedaoui@ist.cerist.dz	air pollution, car pollution
Mr **Boulter** Paul G.	**TRL** - Old Wokingham road - - RG45 6AU Crowthorne - United Kingdom	*+44 1344 77 00 28*	
Mr **Bowsher** Jason	**Consultants Environmental Sciences Ltd** - Maunsell House, 160 Croydon rd - Beckenham Kent - BR3 4DE London - United Kingdom	+44 181 663 6730 *+44 181 663 6731* jpb@beck-ces.demon.co.uk	air pollution, noise, water pollution
Dr **Brannolte** Ulrich	**PTV Consult Gmbh** - Beratende Verkehrsingenieure - Gerwigstr. 53 - 76131 Karlsruhe - Germany	+49 721 62 88 80 *+49 721 62 88 88*	traffic management, transport operations, transport economics, emissions, air quality, simulation, modelling, traffic safety
Mr **Breziansky** Ivan	**Transport Research Institute** - Velky Diel - P.P. B-49 - 01139 Zilina - Slovakia	+42 89 41 756 *+42 89 65 28 83* breziansky@vud.sk	evaluation methods of transport impacts upon the environment, emission factors
Mr **Brok** Paul	**National Aerospace Lab. NLR** - Anthony Fokkerweg 2 - - 1059 CM Amsterdam - The Netherlands	+31 20 511 34 79 *+31 20 511 32 10* brok@nlr.nl	aircraft emissions tools, aircraft noise tools, air transport policy analysis, aircraft operational procedures
Mme **Bukowy** Elzbieta	- ul. Zubrzyckiego 42/4 - - 41-606 Swietochlowice - Poland	+48 32 455 483 *+48 32 455 483*	sustainable development, environmental impact assessment for transport and industry, industry and transport emission factors, transport studies and projects
Mrs **Canale** Sascia	- Viale B. Buozzi 47 - - 00197 Roma - Italy	+39 06 808 46 20 *+39 06 807 68 06*	air pollution from transport
Dr **Casado** H.	**Univ. del Pais Vasco** - Faculdad de Farmacia - - 01007 Vitoria - Spain	+34 945 13 16 66 *+34 945 13 07 56 ?* wdpcahoh@vc.ehu.es	acid deposition : dry, wet and total

Name : specialist (see annex 5) **Name** : only interested by results	address	phone number *fax number* e.mail	scientific fields
Dr **Casalé** Eric	**Scetauroute - DTTS** - Les Pleïades n°35 - Parc nord Annecy - La Bouvarde - 74373 Pringy - France	+33 (0)450 27 39 76 *+33 (0)450 27 39 40* e.casale@scetauroute.fr	pollution control in tunnels, environment, fires in tunnels
Mr **Cecchi** Maurizio	**Italtel / Tecnitel** - - via Abruzzi 3 - Roma - Italy	+39 06 47 80 82 12 *+39 06 47 80 82 44*	dispersion, emissions models, especially in urban areas
Mr **Cernuschi** Stefano	**Politecnico di Milano** - DIIAR - Sez. Ambientale - P.za L. da Vinci, 32 - 20133 Milano - Italy	+39 02 23 99 64 11 *+39 02 23 99 64 99* cernushi@amb1.amb.polimi.it	air pollution, emissions treatment
Dr **Charbonnier** Marc-André	**Lucas Varity Diesel Syst.** - Direction Technique - 9, Bd de l'Industrie - 41000 Blois - France	+33 (0)254 55 59 51 *+33 (0)254 55 39 90*	vehicle emissions, car pollution, exhaust emission reduction, emission measurements, driving cycles, emission database, energy saving
Mr **Charters** Derek	**MIRA** - Watling street - Warks - CV10 0TU Nuneaton - United Kingdom	+44 (0)12 03 35 53 57 *+44 (0)12 03 35 53 55* derek.charters@mira.co.uk	
Mme **Chene** Anne	**Ademe** - 27 rue Vicat - - 75015 Paris - France	+33 (0)147 65 24 35 *+33 (0)147 36 48 83* chene@ademe.fr	
Dr **Chiquetto** Sergio	**TTR** - 16 Bore Street - Lichfield - Staffordshire WS13 6LL - United Kingdom	+44 15 43 41 64 16 *+44 15 43 41 66 81* 100664.427@compuserve.com	emission and dispersion of pollutants, effects of transport policies on air quality, global emissions
Mr **Coffey** Robert	**Denmarks Tech. Univ.** - Department of Energy Technology - Building 403 - 2800 Lyngby - Denmark	+45 45 25 41 66 *+45 45 93 06 63* robert@et.dtu.dk	road vehicle emissions, transport, air pollution and emission factors
Mme **Cotte** Hélène	**PSA Peugeot-Citroën** - DETA/MXT/CED - 18 rue des Fauvelles - 92250 La Garenne-Colombes - France	+33 (0)147 69 39 73 *+33 (0)147 69 87 70*	automobile pollution, emission inventories, emission factors, traffic influence, chemistry of the atmospheric pollution, anthropogenic emissions
Mr **d'Elia** Sergio	**Univ. della Calabria** - Dip.Pianificazione Territoriale - - 87030 Rende (CS) - Italy	+39 09 84 44 68 06 *+39 09 84 44 68 07*	traffic characteristics, pollutant production in traffic
Mr **Dahlstedt** Sven	**VTI** - - - 58195 Linköping - Sweden	+46 13 20 40 66 *+46 13 14 14 36*	road user behaviour
Mr **Danieli** Guido	**Univ. della Calabria** - Dip. di Meccanica - - 87030 Rende (CS) - Italy	+39 09 84 49 48 24 *+39 09 84 83 71 55* g.danieli@unical.it	combustion in engines, biomechanics, pollutant production in urban traffic, electronic measuring equipment
Mr **Darbéra** Richard	**CNRS - LATTS** - ENPC - Cité Descartes - 77455 Marne la Vallée cedex 2 - France	+33 (0)1 64 15 38 34 *+33 (0)1 64 15 38 47* darbera@enpc.fr	
Mr **Davison** Paul	**AEA Technology Environment** - D5 Culham - - Abingdon OX14 3DB - United Kingdom	+44 12 35 46 39 10 *+44 12 35 46 35 74* paul.davison@aeat.co.uk	alternative transport technologies and fuels
Mr **de Haan** Peter	**Infras AG** - Mühlemattstrasse 45 - - 3007 Bern - Switzerland	+41 31 370 19 19 *+41 31 370 19 10* pdehaan@infras.ch	emission factors, air pollution modelling, particulates

Name : specialist (see annex 5) **Name** : only interested by results	address	phone number *fax number* e.mail	scientific fields
Ms **De Vlieger** Ina	**VITO** - Boeretang 200 - - 2400 Mol - Belgium	+32 14 33 58 31 *+32 14 32 11 85* dvliegeri@vito.be	inventory of Belgian road transport (e.g. activities), technical-scientific support to the Flemish demonstration programs on alternative motor fuels, determination of emission values in real traffic situations based on "on-the-road" emission measurements
Mr **de Winne** Etienne	**Min. Flemish Community** - WTC 3 - Simon Bolivarlaan, 30 - 1210 Brussel - Belgium	+32 2 208 48 25 *+32 2 208 48 00*	traffic engineering, planning for traffic road safety
Mr **Deroyer** Sylvain	**OPET-CS** - - Av. r. Vandendrisshe, 18 - 1150 Bruxelles - Belgium	+32 2 771 53 70 *+32 2 771 56 11*	
Mr **Diebold** François	**INRS** - BP 27 - - 54501 Vandoeuvre cedex - France	+33 (0)383 50 20 00 *+33 (0)383 50 20 60* boulet@inrs.fr	industrial hygiene, pollutant measurements (gas, particulates)
Mr **Donovan** Liam	**Univ. Limerick** - National Technological Park - Plassey - Limerick - Ireland	+353 61 20 28 83 *+353 61 20 29 44* liam.donovan@ul.ie	evaluation and optimisation of performance characteristics of natural gas fuelled vehicles, with special emphasis on exhaust emissions / pollutants, reduction etc.
Mr **Dunker** Reiner	**CEC-DG XII.C.3.** - MO75 3/59 - 200 rue de la Loi - 1049 Bruxelles - Belgium	+32 2 296 16 08 *+32 2 296 67 57*	
Mr **Egnell** Rolf	**Aspen Utvecklings AB** - Hyllegränd 5 - - 22359 Lund - Sweden	+46 46 18 96 20 *+46 46 18 96 25* rolf.egnell@netor.se	emission factors and functions, driving behaviour, inventorying tools
Dr **Ekert** Karol	**Aviation Institute** - Al. Krakowska 110/114 - - 02-256 Warszawa - Poland	+48 22 46 08 01 ext 618 *+48 22 46 44 32*	pollution generated by I.C. engines, combustion processes
Ms **Ericsson** Eva	**Lund Inst. Traffic Planning Eng.** - Lund Univ. - Box 118 - 22100 Lund - Sweden	+46 46 222 91 38 *+46 46 12 32 72* eva.ericsson@tft.lth.se	driving behaviour, traffic modelling
Mr **Erlandsson** Lennart	**Motortestcenter** - Box 223 - - 13623 Haninge - Sweden	+46 8 5006 5612 *+46 8 5002 83 28* lennarte@mtc.se	
Mr **Evéquoz** Roger	**OFEFP** - - - 3003 Berne - Switzerland	+41 31 322 93 40 *+41 31 324 01 37* roger.evequoz@buwal.admin.ch	air pollution due to transport
Dr **Faiz** Asif	**World Bank** - Bouchard 547- Piso 3 - Capital Federal - 1106, Buenos Aires - Argentina	+54 11 43 16 97 00 or 59 *+54 11 43 13 12 33 or 45 86* afaiz@worldbank.org	air pollution control
Mr **Falk** Robert S.	**DTI - Dept Trade Industry** - 151 Buckingham Palace Road - - SW1 W922 London - United Kingdom	+44 171 215 13 92 *+44 171 215 11 80*	
Dr **Faudry** Daniel	**IEPE** - BP 47X - - 38040 Grenoble cedex 09 - France	+33 (0)476 63 57 72 *+33 (0)476 51 45 27*	urban utilities management, environment economics
Mr **Favrel** Vincent	**CEESE** - ULB - 44, av. Jeanne C.P. 124 - 1050 Brussels - Belgium	+32 2 650 33 65 *+32 2 650 46 91* vfavrel@ulb.ac.be	air quality, urban traffic, external costs, air pollution modelling, economic impacts, sustainable mobility

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Dr **Fenger** Jes	**Nat. Environmental Research Inst.** - Frederiksborgvej 399 - P.O. Box 358 - 4000 Roskilde - Denmark	+45 46 30 11 25 *+45 46 30 11 14*	climate change, policy analysis, material damage
Mr **Festa** Demetrio	**Univ. della Calabria** - Dipart. di Pianificazione Territoriale - C. da Santo Stefano - 87030 Rende (CS) - Italy	+39 09 84 44 68 06 *+39 09 84 44 68 07*	Traffic flow analysis, transport demand modelling, evaluation of traffic pollution
Mr **Flodström** Eje	**MariTerm AB** - Box 12037 - - 401 42 Gothenburg - Sweden	+46 31 12 20 30 *+46 31 24 58 56* mariterm@algonet.se	emissions from sea (and rail) transportation
Mr **Fontana** Marco	**Lab. Sanità Pubblica - USL 5** - via Leonardo da Vinci 44 - - 10095 Grugliasco (TO) - Italy	+39 011 401 76 21 *+39 011 411 08 37*	air pollution, industrial hygiene, estimation of transport emissions, strategies of monitoring
Mr **Fontelle** Jean-Pierre	**CITEPA** - 10, rue du Faubourg Poissonnière - - 75010 Paris - France	+33 (0)144 83 68 83 *+33 (0)140 22 04 83* 100706.407@compuserve.com	air pollution emission inventories (all sectors), measurements
Mr **Foray** Jean-Pierre	**Ministère de l'Environnement** - DPPR - 20, av. de Ségur - 75302 Paris 07SP - France	+33 (0)142 19 14 33 *+33 (0)142 19 14 67*	elaboration of national and community standards
Mr **Froelich** Daniel	**ENSAM** - Savoie Technolac - BP 295 - 73375 le Bourget du Lac - France	+33 (0)4 79 25 36 55 *+33 (0)4 79 25 36 70*	eco-conception, environmental management
Dr **Frondaroli** Alberto	**Centro Studi sui Sistemi di Trasporto** - via Sallustiana, 26 - - 00187 Roma - Italy	+39 06 488 17 71 *+39 06 481 83 61* csstrm@mclink.it	traffic and transport planning and management
Mr **Gallet** Michel	**Eres Transport-Ingetrans** - 8, crs Général Giraud - - 69001 Lyon - France	+33 (0)4 78 28 89 12 *+33 (0)4 78 39 28 04* 1013612721@compuserve.com	inter-modal transportation, traffic engineering
Mme **Gallez** Caroline	**INRETS** - 2, av du Général Malleret Joinville - - 94114 Arcueil cedex - France	+33 (0)1 47 40 72 73 *+33 (0)1 45 47 56 06* gallez@inrets.fr	mobility, energy and emissions inventories, long term forecasting, policy assessment
Dr **Gambino** Michele	**Istituto Motori CNR** - via Marconi, 8 - - 80125 Napoli - Italy	+39 081 717 71 40 *+39 081 239 60 97* gambino@motori.im.na.cnr.it	CNG and LPG duty engines, oxygenated additives for fuels, regulated and unregulated emissions, after-treatment of emissions
Mr **Gardner** Roger	**UK DERA** - 170 Bldg, Pyestock - Farnborough - Hants, GU14 OLS - United Kingdom	+44 (0) 1252 37 44 26 *+44 (0) 1252 37 24 77* dhlister@dra.hmg.gb	aircraft emissions certification, international regulation controls, aircraft emissions inventories
Mr **Gaudioso** Domenico	**ENEA - Environment Dpt** - CRE Casaccia - Via Anguillarese 301 - 00060 S. Maria di Galeria - Italy	+39 06 3048 3571 or 3894 *+39 06 3048 4925* gaudioso@casaccia.enea.it	emission inventories, air pollution problems at local and global scale
Mr **Geier** Martin	**BMW AG** - Abt. W-2 - Petuelring 130 - Postfach 40 02 40 - 80788 Munich 40 - Germany	+49 89 38 24 67 87 *+49 89 38 24 57 60* martin.geier@bmw.de	
Dr **Giavazzi** Fulvio	**Euron Spa** - Via Maritano, 26 - - 20097 S. Donato Mil. - Italy	+39 02 520 56 421 *+39 02 520 56 612*	fuel quality and emissions

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Mr **Gilson** Benoit	**CEESE** - ULB - 44, av. Jeanne C.P. 124 - 1050 Brussels - Belgium	+32 2 650 33 65 *+32 2 650 46 91* gilsonb@ulb.ac.be	mobility models, mobility determinants, sustainable mobility
Pr **Göktan** Ali	**Techn. Univ. Istanbul** - I.T.Ü. Makina Fakültesi - Gümüssuyu - 80191 Istanbul - Turkey	+90 212 285 34 58 *+90 212 285 34 43* goktan@sariyer.cc.itu.edu.tr	vehicle technology, internal combustion engines, combustion and emissions
Ms **Gong** Rose	**Industrial Res. Ltd** - Gracefield rd - P.O. Box 31-310 - Lower Hutt - New Zealand	+64 4 569 05 34 *+64 4 569 04 31* r.gong@irl.cri.nz	vehicle emission technology, remote sensing for diesel and petrol vehicles, energy applications, combustion efficiency, mathematical modelling, coal pile spontaneous combustion
Dr **Gotsias** Apostolos	**Dept Business Administration** - Univ. of the Aegean - Michalon 8 - 82100 Chios - Greece	+30 1 684 73 23 *+30 271 436 40* agotsia@posidon.servicenet.ariadne-t.gr	air transport, efficiency issues in all transport modes, energy models (statistical, econometric), energy management
Mr **Grimaud** Laurent	**Scetauroute - DTTS** - Les Pleéiades n°35 - Parc Nord Annecy - La Bouvarde - 74373 Pringy cedex - France	+33 (0)4 50 27 39 61 *+33 (0)4 50 27 39 40* l.grimaud@scetauroute.fr	ventilation of road and rail tunnels, atmospheric pollution from tunnels, treatment methods of air pollution in tunnels
Dr **Gruden** Dusan	**Porsche AG** - Poeschestr. 42 - - 70435 Stuttgart - Germany	+49 711 827 56 62 *+49 711 827 52 16*	automotive industry and environment exhaust emission
Dr **Guerrassi** Noureddine	**Lucas** - BP 849 - - 41008 Blois cedex - France	+33 (0)254 55 59 52 *+33 (0)254 55 39 07*	diesel engines research and development
Mme **Guieu-Renzi** Patricia	**Airmaraix** - 67/69 av. du Prado - - 13286 Marseille cedex 6 - France	+33 (0)491 83 63 90 *+33 (0)491 83 64 43* p-guieu@airmaraix.com	traffic and NO, NO2, NOx air pollution
Pr **Guillermo** René	**École des Mines de Douai** - 941, rue C. Bourseul - - 59508 Douai - France	+33 (0)327 71 26 00 *+33 (0)327 71 25 25* guillermo@ensm-douai.fr	atmospheric environment measurements (SO2, NOx, O3, VOC, particles), study of photochemical reactions in the troposphere, emission factor determination for VOC
Mr **Güller** Peter	**Synergo** - Fraumünsterstr. 23 - C.P. 4925 - 8022 Zurich - Switzerland	+41 1 211 40 12 *+41 1 212 39 07*	regional development, transport policy (urban, national, European), ecology, urbanism
Dr **Hahn** Jürgen	**Fraunhofer Inst. Atm. Umweltforsch.** - Kreuzeckbahnstr. 19 - - 82467 Garmisch-Partenkirchen - Germany	+49 88 21 183 210 *+49 88 21 735 73* hahn@ifu.fhg.de	air pollution chemistry, anthropogenic emissions, temporal trends of trace components in the atmosphere
Mr **Hammarström** Ulf	**Swedish Road Traffic Res. Inst.** - Olaus Magnus väg 37 - - 581 93 Linköping - Sweden	+46 13 20 41 72 *+46 13 20 40 30* ulf.hammarstrom@vti.se	traffic signals, model of vehicle costs, mechanistic and empirical models of exhaust emissions for transport sector,
Mr **Hassel** Dieter	**TÜV Rheinland** - - - 51105 Köln 1 - Germany	+49 221 806 24 79 *+49 221 806 17 56* d-hassel@compuserve.com	emissions and air pollution caused by traffic

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Mr **Hausberger** Stefan	**Technical Univ. Graz** - Inst. Intern. Comb. Eng. & Thermod. - Inffeldgasse 25 - 8010 Graz - Austria	*+43 316 46 21 75*	
Pr **Hecq** Walter	**CEESE - ULB** - av. Jeanne, 44 - CP 124 - 1050 Bruxelles - Belgium	+32 2 650 33 77 & 78 *+32 2 650 46 91* whecq@ulb.ac.be	COST assessment of pollution control, externalities, environmental impact, emission inventories, economic optimisation of pollution control
Mr **Heich** Hermann-Joseph	**TÜV Rheinland Sicherheit und Umwelschentz GmbH** - - Konstantin-Wille Strasse, 1 - 51108 Köln - Germany	+49 221 806 20 18 *+49 221 806 17 56*	
Mr **Heland** Jörg	**FhG-IFU** - Kreuzeckbahnstr. 19 - - 82467 Garmisch-Partenkirchen - Germany	+49 88 21 1 83 0 *+49 88 21 7 35 73* schaefer@ifu.fhg.de	remote sensing measurements, FTIR-absorption and emission spectroscopy, combustion chemistry, atmospheric chemistry, aircraft engine emissions
Mrs **Hellebrandt** Pia	**Heusch-Boesefeldt GmbH** - Liebigstr. 20 - - 52070 Aachen - Germany	+49 241 96 69 126 *+49 241 96 69 155*	traffic related environmental planning, emission / immission calculation, environmental impact studies
Mr **Henriet** Alain	**PSA Peugeot Citroën** - DRAS - route de Gisy - 78140 Vélizy - France	+33 (0)141 36 29 30 *+33 (0)141 36 33 78*	automobile pollution, traffic
Mr **Hickman** John	**TRL** - Old Wokingham road - - RG45 6AU Crowthorne - United Kingdom	+44 1344 770 351 *+44 1344 77 00 28* ahickman@trl.co.uk	exhaust emissions, air pollution, energy consumption
Dr **Hitchcock** Guy	**ETSU** - B156 Harwell Didcot - - OX11 0RA - United Kingdom	+44 12 35 43 68 35 *+44 12 35 43 26 62* guy.hitchcock@aeat.co.uk	
Mr **Hivert** Laurent	**INRETS** - 2, av du Général Malleret Joinville - - 94114 Arcueil cedex - France	+33 (0)1 47 40 72 66 *+33 (0)1 45 47 56 06* hivert@inrets.fr	
Dr **Höglund** Paul G.	**Royal Institute of Technology** - Dept Traffic and Transport Planning - - 10044 Stockholm - Sweden	+46 8-790 79 36 or 91 20 or 80 11 *+46 8 21 28 99* phoglund@ce.kth.se	traffic : field measurements, analysis and systems' development, control and intersection design, flow and environment; micro analysis of traffic flow, emission models, traffic behaviour, driving patterns
Dr **Höpfner** Ulrich	**IFEU** - Wilckenstr. 3 - - 69120 Heidelberg - Germany	+49 62 21 47 670 *+49 62 21 47 67 19* 100564.632@compuserve.com	estimation models
Mr **Hotes** Andreas	**Techn. Univ. Berlin, ILR** - Sekr. F3 - Marchstr. 14 - 10587 Berlin - Germany	+49 30 314 26 569 *+49 30 315 90 414* hotti@ilrserv.fb12.tu-berlin.de	air pollution from civil aircraft in the direct vicinity of airports, optimisation of flight routing (North-Atlantic), "ecological" flight routing, usage of APU during ground handling of aircraft
Mr **Hvid** Erling	**Cowi** - Parallelvej 15 - - 2800 Lyngby - Denmark	+45 45 97 22 11 *+45 45 97 22 12*	relations between emission and traffic management, traffic management as a tool for reducing the total environmental load in urban areas (air pollution, noise, traffic accidents ...), specific emissions from vehicles

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Dr **Jaecker** Anne	**IFP** - 1 & 4 av. de Bois Préau - - 92852 Rueil malmaison - France	33-1 47 52 73 25 *33-1 47 52 66 85* anne.jaecker@ifp.fr	air quality modelling, tropospheric chemistry, mission factors, emission inventory
Mr **Janssen van de Laak** Willem H.	**RWS - DWW** - Postbox 5044 - - 2600 GA Delft - The Netherlands	+31 15 699 465 *+31 15 611 361*	soil and air pollution
Dr **Jez** Marian	**Aviation Institute** - Al. Krakowska 110/114 - - 02-256 Warszawa - Poland	+48 22 46 08 01 ext 616 *+48 22 46 44 32*	aviation-generated pollution, dynamics of internal combustion engines, diesel engine pollution
Mr **Jimenez** Jose-Luis	**M.I.T.** - 66-060 - - 02139 Cambridge, MA - USA	+1 617 253 5973 *+1 617 258 0546* jljimene@mit.edu	combustion-generated air pollution, atmospheric chemistry and dispersion, measurement techniques, uncertainty analysis
Dr **Johansson** Lars	**Swedish State Railways** - SJ-HK - Stab Information - 10 550 Stockholm - Sweden	+46 8 762 31 91 *+46 8 411 12 16*	transport & ecology, & health effects, & society planning
Mr **Jol** André	**European Environment Agency** - Kongens Nytorv 6 - - 1050 Copenhagen K - Denmark	+45 33 36 71 44 *+45 33 36 71 99* andre.jol@eea.eu.int	atmospheric emissions (all modes), national inventories and projections, emission reduction measures, air quality, ozone, acidification
Dr **Joumard** Robert	**INRETS** - case 24 - - 69675 Bron cedex - France	+33 (0)472 14 24 77 *+33 (0)472 37 68 37* joumard@inrets.fr	transport and air pollution, emission factors, emission inventory, control and reduction of air pollution
Dr **Jung** Hans Josef	**IABGmbH** - TAF - Einsteinstr. 20 - 85521 Ottobrunn - Germany	+49 89 60 88 34 78 *+49 89 60 88 33 99* jung@iabg.de	atmospheric dispersion of pollutants, photochemical reactions, climate modelling
Mr **Juva** Ari	**Neste Oy** - - Box 310 - 06101 Porvoo - Finland	+358 15 187 3469 *+358 15 187 7636*	low emission traffic fuels, traffic emissions
Dr **Kalivoda** Manfred	**Consultant** - - Aspettengasse 24 - 2380 Perchtoldsdorf - Austria	+43 1 865 67 55 *+43 1 865 67 55* psia-consult@eunet.at	noise control, psycho-acoustics, traffic emissions, traffic planning
Mrs **Karhula** Mervi	**Finnish National Road Adm.** - Traffic and Road Engineering - P.O.B 33 - 00521 Helsinki - Finland	+358 20 444 2342 *358 20 444 2395* mervi.karhula@fieh.fi	driving cycles, emission models
Mr **Keen** Keith	**European Commission-DGVII E2** - Beaulieu 31 5/40 - 200, rue de la Loi - 1049 Brussels - Belgium	+32 2 296 34 69 *+32 2 295 43 49*	transport strategies
Mr **Keller** Mario	**Infras AG** - Mühlemattstrasse 45 - - 3007 Bern - Switzerland	+41 31 370 19 19 *+41 31 370 19 10* mario.keller@infras.ch	economy, environment, transport
Mr **Kerbachi** Rabah	**École Nationale Polytechnique** - 10 av. Hacène Badi - El-Harrach - 16200 Alger - Algeria	+213 2 76 53 01 *+213 2 76 09 66* kerbachi@ist.cerist.dz	atmospheric pollution
Dr **Kettrup** Antonius	**GSF** - Inst. Ökologische Chemie - Ingolstädter Landstr.1 - 91465 Neuherberg - Germany	+49 89 3187 4048 *+49 89 3187 3371*	indoor pollution, outdoor pollution, aerosol analysis, PCDD/PIDF, PAH, hydrocarbons
Mr **Kölar** Drahoslav	**Centrum dopravniho vyzkume Parno** - - Botanickà 68a - 66312 Brno - Czech Rep.	+42 5 41 21 32 95 *+42 5 41 21 15 26*	
Mr **Koskentalo** Tarja	**Helsinki Metropolitan Area Council** - Opastinsilta 6 A - - 00520 Helsinki - Finland	+358 9 156 13 58 *+358 9 156 13 34*	Air quality, especially the impact of traffic on air quality

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Mr **Koskinen** Olavi H.	**Ministry Transport & Communication** - Road Administration - Box 33 - 00521 Helsinki - Finland	+358 20 444 25 02 *+358 20 444 23 95* olavi.koskinen@tieh.fi	engine maps of fuel consumption and emissions, driving cycles
Mr **Krakovsky** Pavol	- Osikovà 17/54 - - 010 01 Zilina - Slovakia		car and engine diagnostic methods without dismantling, service life, reliability, fuel consumption, exhaust gas emissions
Mr **Kröbl** Ladislav	**Ustav pro vyzkum motorovych vozidel** - - Lihovarskà 12 - 180 68 Prague 9 - Czech Rep.	+42 2 684 51 28 *+42 2 66 31 03 43*	
Dr **Kyriakis** Nikos	**Aristotle Univ. Thessaloniki** - Lab. Applied Thermodynamics - - 54006 Thessaloniki - Greece	+30 31 99 60 83 *+30 31 99 60 19* nkyr@eng.auth.gr	internal combustion engines, engine emissions, emission modelling, driving pattern development, fleet statistics
Mr **Labrousse** Michel	**Explicit** - 69 rue de Rochechouart - - 75009 Paris - France	+33 (0)148 74 36 20 *+33 (0)148 74 36 25* explicit@worldnet.fr	energy, environment
Mr **Laguna** J.Pablo	**INTA** - Centro Experimentación Homologación Vehículos - Carretera de Ajalvir km. 4 - 28850 Torrejón de Ardoz - Madrid - Spain	+34 1 520 17 23 *+34 1 520 13 19*	motor vehicle emissions
Mrs **Lahtinen** Tarja	**Min. Environment** - Environment Protection Dept - PO Box 399 - 00121 Helsinki - Finland	+358 9 1991 97 04 *+358 9 1991 97 16*	air pollution abatement and traffic
Mr **Lamberts** F.	**CEC-DGXI** - T174 - 1/54c - 200 rue de la Loi - 1049 Bruxelles - Belgium	+32 2 236 87 10 *+32 2 296 95 54* Frank.Lamberts@dg11.cec.be	emissions from all mobile sources
Mr **Larson** Lars-Gunnar	**FFA** - Aeronautical Res. Inst. Sweden - - 161 11 Bromma - Sweden	+46 8 634 13 40 *+46 8 25 34 81* lgl@ffa.se	environmental impacts of air traffic, flight and air traffic simulation
Mr **Larssen** Steinar	**Norwegian Inst. Air Research** - P.O. Box 130 - - 2001 Lilleström - Norway	+47 6 381 41 70 *+47 6 381 92 47*	air pollution problems relating to car exhaust in general, dispersion modelling of car exhaust emissions, emission factors
Mr **Laurikko** Juhani	**VTT Energia** - Moottoritekniikka - PL 1601 - 02044 VTT - Finland	+358 9 456 54 63 *+358 9 460 493* juhani.laurikko@vtt.fi	
Dr **Lehnhart** Lutz	**IER** - Stuttgart University - Hessbrühlstr. 49a - 70565 Stuttgart - Germany	+49 711 780 61 37 *+49 711 780 39 53* ll@iersv1.energietechnik.uni-stuttgart.de	calculation of emission data in Europe with high spatial and temporal resolution
Mrs **Loran** Gisela	**Taller d'Enginyeries SA** - c/ Frederic Mompou, 6, 1er - - 08005 Barcelona - Spain	+34 3 221 10 63 *+34 3 221 62 99* taller_enginyeries@bcn.servicom.es	environmental impact assessment
Pr **Lukanin** Valentin	**MADI-TU** - 64, Leningradskyi prospect - - 125829 Moscow - Russia	+7 095 151 64 12 or 155 03 70 *+7 095 151 03 31 or 151 89 65* lukanin@madi.msk.su	motor vehicle internal combustion engines, ecological problems of engines, design of ecologically sound engines

Name : specialist (see annex 5) **Name** : only interested by results	address	phone number *fax number* e.mail	scientific fields
Mr **Mahalec** Ivan	**Fac. Mechanical Eng. Naval Arch.** - Univ. Zagreb - Ivana Lucica 5 - 41000 Zagreb - Croatia	+38 1 61 68 159 or 444 *+38 1 61 56 940* ivan.mahalec@fsb.hr	internal combustion engines
Mr **Mahieu** Vincent	**ULB** - SMA CP165 - 50 av. Roosevelt - 1050 Brussels - Belgium	+32 2 650 26 71 *+32 2 650 27 10*	engines : air and fuel management systems
Mr **Mäkelä** Kari	**VTT** - Communities & Infrastructure - P.O. Box 1902 - 02044 VTT - Finland	+358 9 456 45 86 *+358 9 464 850* kari.s.makela@vtt.fi	air pollution emissions (all sectors), modelling, road noise, fuel consumption, traffic characteristics
Mr **Mayet** Rémi	**CEC-DG VII** - BU31-4/76 - 200 rue de la Loi - 1049 Bruxelles - Belgium	+32 2 296 46 77 *+32 2 295 43 49* remi.mayet@dg7.cec.be	Environmental assessment, emissions from new transport technologies, external costs, mobility analysis
Mr **Mc Crae** Ian	**TRL** - Old Wokingham road - - RG45 6AU Crowthorne - United Kingdom	+44 1344 77 02 71 *+44 1344 77 00 28* imccrae@trl.co.uk	emission modelling, air pollution modelling
Dr **Medinger** Walter	**Municipality Linz** - Env. Dept - Neues Rathaus - Hauptstr. 1-5 - 4041 Linz - Austria	+43 732 70 70 26 90 *+43 732 70 70 26 99*	air quality management, environmental assessment
Dr **Merétei** Tamás	**Institute for Transport Sciences (KTI)** - XI. Thán Károly u. 3-5 - - 1119 Budapest - Hungary	+36 1 1666 945 *+36 1 1666 945*	exhaust emission technology, control of exhaust emissions by catalytic converters, emission inventory, emission factors for several traffic circumstances
Dr **Metz** Norbert	**BMW AG** - Abt. W-2 - Petuelring 130 - Postfach 40 02 40 - 80788 Munich 40 - Germany	+49 89 38 24 65 40 *+49 89 38 24 57 60* norbert.metz@bmw.de	estimation of exhaust emissions including forecast, development of catalyst in the European fleet, CO2 and greenhouse gases, carcinogenic substances, ozone, forest decline, fuel consumption
Mr **Mezghani** Mohamed	**BCEOM** - Place des Frères Mongolfier - - 78286 Guyancourt cedex - France	+33 (0)130 12 48 01 *+33 (0)130 12 10 95* bceom10@calvanet.calvacom.fr	energy saving and environmental impact in the transport sector, traffic management, urban public transport, transport policies
Pr **Michelberger** Pál	**Budapesti Múszaki Egyetem** - Technical Univ. Budapest - Budapest Múegyetem rkp. 3 - Pf 91.1521 Budapest - Hungary	+361 463 17 28 *+361 463 17 83*	vehicles dynamics
Mr **Michelsen** Nic	**Civil Aviation Administration SLV** - Box 744 - 50 Ellebjergvej - 2450 Copenhagen SV - Denmark	+45 36 44 48 48 *+45 36 44 03 03* nimi@slv.dk	aviation
Mme **Mietlicki** Fanny	**Airparif** - 10, rue Crillon - - 75100 Paris cedex 04 - France	+33 (0)1 44 59 40 92 *+33 (0)1 44 59 47 67* fmietlicki@airparif.asso.fr	air quality monitoring and modelling
Dr **Milukaite** Androné	**Institute of Physics** - Gostauto 12 - - 2001 Vilnius - Lithuania	+370 2 64 18 54 *+370 2 61 70 70*	investigation of exhaust emissions, impact of emission on environment, modelling of dispersion from vehicle exhaust

Name : specialist (see annex 5) **Name** : only interested by results	address	phone number *fax number* e.mail	scientific fields
Ms **Miranda** Ana	**Univ. Aveiro** - Dept of Environment - - 3800 Aveiro - Portugal	+351 34 250 85 *+351 34 292 90* aicm@ci.ua.pt	air quality, air pollution modelling, local scale environmental impact assessment, mesoscale photochemical phenomena and sea-breeze circulations, environmental impact of forest fires
Dr **Moon** David	**AEA Technology Environment** - D5 Culham - - Abingdon OX14 3DB - United Kingdom	+44 12 35 46 35 39 *+44 12 35 46 35 74* david.moon@aeat.co.uk	energy, environment & transport, modelling, environmental impact assessment, emission assessment
Pr **Moussiopoulos** Nicolas	**Aristotle Univ. Thessaloniki** - Box 483 - University Campus - 54006 Thessaloniki - Greece	+30 31 99 60 11 *+30 31 99 60 12* moussio@vergina.eng.auth.gr	environmental engineering, air pollution modelling
Dr **Namdeo** A.K.	**Univ. Nottingham** - Sutton Bonnington Campus - Loughborough - LE12 5RD Loughborough - United Kingdom	+44 115 951 51 51 ext 8719 *+44 115 951 62 61* Anil.Namdeo@nottingham.ac.uk	air pollution monitoring and modelling, vehicle emission rates, airborne particulate pollution, traffic composition
Dr **Negrenti** Emanuele	**ENEA** - ERG-SIRE - C.R.E. Casaccia - 00060 Roma - Italy	+39 06 30 48 41 12 *+39 06 30 48 66 11* negrenti@casaccia.enea.it	modelling of consumptions, emissions and pollutants diffusion from vehicular traffic
Pr **Nemtchinov** Michail	**Moscow State Auto. Road Inst.** - Leningradsky prospect, 64 - - 125829 Moscow - Russia	+7 095 155 07 45 *+7 095 151 03 31 or 89 65* info@madi.msk.su	emission, toxicity, traffic and road characteristics, air, soil, water pollution from roads and streets
Mr **Newton** Peter J.	**DTI** - 151 Buckingham Palace rd - - London SW1W 9SS - United Kingdom	+44 171 215 11 17 *+44 171 215 29 09* peter.newton@air.dti.gov.uk	emissions inventories, aircraft emissions, long term trends, forecasting
Dr **Nicolas** Jean-Pierre	**LET** - ENTPE - rue Maurice Audin - 69518 Vaulx en Velin cedex - France	+33 (0)4 72 04 85 17 *+33 (0)4 72 04 70 92* jean-pierre.nicolas@entpe.fr	socio-economic evaluation of transport policies
Mr **Niederau** Arnold	**Heusch-Boesefeldt Gmbh** - Liebigstr. 20 - - 52070 Aachen - Germany	+49 241 16 805 17 *+49 241 16 805 55*	traffic and environment planning
Mr **Niederle** Werner	**Umweltbundesamt** - Bismarckplatz 1 - - 14191 Berlin - Germany	+49 30 89 03 25 13 *+49 30 89 03 22 85* werner.niederle@uba.de	reduction of impact of traffic by means of traffic calming, traffic management and technical means
Mme **Nollet** Valérie	**Univ. S. T. Lille** - LC3 - bat. C11 - 59655 Villeneuve d'Ascq - France	+33 (0)320 43 67 22 *+33 (0)320 43 69 77* valerie.nollet@univ-lille1.fr	measurement and modelling of photochemical oxidants formation in the troposphere
Mr **Noons** Richard	**MIRA** - Watling street - Nuneaton - Warwickhire CV10 OTU - United Kingdom	+44 (0) 1203 355 000 & 170 *+44 (0) 1203 355 355* richard.noons@mira.co.uk	advanced powertrains, vehicle modelling and simulation
Mme **Noppe** Jane	**Ademe** - 27 rue Vicat - - 75015 Paris - France	+33 (0)147 65 24 77 *+33 (0)147 36 48 83* noppe@ademe.fr	road transport emissions, evaluation methodology and unit emissions, dispersion models

Name : specialist (see annex 5) **Name** : only interested by results	address	phone number *fax number* e.mail	scientific fields
Dr **Nowak** Barbara	**Silesian Univ. Medicine** - Dept Toxicology - ul. Jagiellonska 4 - 41-200 Sosnowiec - Poland	48-22 66 96 11 p164 *48-22 66 89 68* tokswi@informed.slam.katowice.pl	heavy metal emission along roads, trace element content in environment, emission sources, metal concentration function of traffic and road distance
Mr **Ntziachristos** Leonidas	**Lab. Applied Thermodynamics** - Aristotle Univ. Thessaloniki - - 54006 Thessaloniki - Greece	+30 31 99 60 61 *+30 31 99 60 19* leon@eng.auth.gr	average emission functions, particle measurement in exhaust emissions, inventories software development
Mr **O'Grady** Rory	**Bord Gais** - D'Olier Street - - Dublin 2 - Ireland	+353 1602 12 84 *+353 1 602 11 10*	impact of emissions from road transport in urban fleet applications, potential emission reductions with alternative transport fuels e.g. natural gas
Dr **Orfeuil** Jean Pierre	**INRETS** - - - 94114 Arcueil cedex - France	+33 (0)147 40 72 57 *+33 (0)145 47 56 06* orfeuil@inrets.fr	mobility analysis, energy environment assessment
Mr **Otterström** Tomas	**Ekono Energy Ltd** - Tekniiknantie 4A, Otaniemi - P.O. Box 27 - 00131 Helsinki - Finland	+358 9 469 13 29 *+358 9 469 19 81 or 12 75* nto@poyry.fi	energy and environmental economics, environmental impacts of transport and energy systems, life-cycle analysis
Mr **Otto** Karel	**Czech Univ. Agric. Prague** - Suchdol - - 165 21 Praha 6 - Czech Rep.	+420 224 38 21 86 or 87 *+420 220 92 13 63* otto@itsz.czu.cz	
Dr **Pagowski** Zbigniew	**Institute of Aviation** - Al. Krakowska 110/114 - - 02 256 Warszawa - Poland	+48 22 46 44 95 *+48 22 46 44 32*	emission, toxicity, fuel equipment, diesel engines, biofuels
Dr **Pankrath** Jürgen	**Umweltbundesamt** - Postfach 33 00 22 - - 14191 Berlin - Germany	+49 30 23 145 782 *+49 30 23 15 638*	dispersion and chemical reactions of air pollutants, international environmental affairs
Mme **Parfait** Christine	**RATP** - 13 rue Jules Vallès - - 75011 Paris - France	+33 (0)144 36 38 80 *+33 (0)148 04 16 26*	pollution and air quality for public transportation network
Mr **Paturel** Laurent	**Univ. Savoie** - ESIGEC - - 73376 Le Bourget du Lac - France	+33 (0)479 75 88 40 *+33 (0)479 75 88 43*	analyse, metrology in the environment (PAH)
Dr **Pereira** Alice	**LCPC** - 58, bd Lefebvre - - 75732 Paris cedex 15 - France	+33 (0)1 40 43 53 11 *+33 (0)1 40 43 54 94* pereira@lcpc.fr	life cycle analysis of transport infrastructures, environmental impact, assessment methodologies, global emission inventory, air pollution effects on environment
Ms **Pérez-Cerezo** Julia	**Environment, Transport & Planning** - General Pardiñas 112 bis, 1°A - - 28006 Madrid - Spain	+34 1 411 23 11 *+34 1 563 27 99* environment@servicom.es	environment, transport and environment
Mr **Person** Alain	**LHVP** - 11, rue G. Eastman - - 75013 Paris - France	+33 (0)144 97 87 87 *+33 (0)144 97 87 55*	air quality, urban environment, indoor / outdoor air
Mr **Petit** Alain	**Renault** - Direction de la Mécanique - 1, allée Cornuel - 91510 Lardy - France	+33 (0)1 69 27 85 33 *+33 (0)1 69 27 81 40*	
Dr **Pilat** Günter	**Steyr-Daimler-Puch AG** - Technologie Zentrum - Schönauerstr. 5 - 4400 Steyr - Austria	+43 72 52 580 23 34 *+43 72 52 45 112*	engine, transmission and vehicle engineering, fatigue analysis, driving simulation of vehicles for fuel consumption and emissions prediction

Name : specialist (see annex 5) **Name** : only interested by results	address	phone number *fax number* e.mail	scientific fields
Mr **Pillot** Didier	**INRETS** - case 24 - - 69675 Bron cedex - France	+33 (0)472 14 24 86 *+33 (0)472 37 68 37* pillot@inrets.fr	pollutant emissions of commercial vehicles
Pr **Pischinger** Rudolf	**Technical Univ. Graz** - Inst. Internal Combustion Engines & Thermodynamics - Kopernikusgasse 24 - 8010 Graz - Austria	+43 316 873 72 00 *+43 316 82 14 90* baumann@vkma.tu.graz.ac.at	emission factors (cold start, gradient,...), road resistance of vehicles, traffic emissions
Mr **Police** Giuseppe	**Istituto Motori CNR** - Viale Marconi 8 - - 80125 Napoli - Italy	+39 081 71 77 112 and 111 *+39 081 239 60 97*	Engine optimisation for emissions control
Mr **Pollák** Iván	**Institute for Transport Sciences (KTI)** - Thán K. u. 3-5 - - 1119 Budapest - Hungary	+36 1 205 58 75 or 97 *+36 1 205 58 97 or 59 51*	exhaust emission technology, control of exhaust emissions by catalytic converters, emission inventory, emission factors for several traffic circumstances
Dr **Rapone** Mario	**Istituto Motori CNR** - Viale Marconi 8 - - 80125 Napoli - Italy	+39 081 71 77 114 *+39 081 239 60 97* mrap@motori.im.na.cnr.it	reliability and standards development, emission modelling
Mr **Reiter** Christoph	**Technical Univ. Graz** - Inst. Intern. Comb. Eng. & Thermod. - Inffeldgasse 25 - 8010 Graz - Austria	+43 316 873 75 84 *+43 316 46 21 75* reiter@vkmb.tu-graz.ac.at	emission modelling
Mr **Riemersma** Iddo	**TNO-WT** - Schoemakerstraat 97 - PO Box 6033 - 2600 JA Delft - The Netherlands	+31 15 269 67 45 *+31 15 269 68 74* riemersma@wt.tno.nl	hybrid- and electrical vehicles, heavy duty emissions
Mr **Rijkeboer** Rudolf C.	**TNO-IW** - P.O. Box 6033 - - 2600 JA Delft - The Netherlands	+31 15 269 63 60 *+31 15 269 68 74* rijkeboer@wt.tno.nl	emissions and fuel consumption of road vehicles
Dr **Rombout** Peter	**RIVM** - Lab. for Toxicology - PO Box 1 - 3720 BA Bilthoven - The Netherlands	+31 30 274 29 36 or 22 38 *+31 30 274 44 48* toxpr@rivm.nl	health risk assessment of air pollution (urban smog, traffic related air pollution, emission, air quality, exposure)
Dr **Roumégoux** Jean-Pierre	**INRETS** - Lab. Energie Nuisances - case 24 - 69675 Bron cedex - France	+33 (0)472 14 23 00 *+33 (0)472 37 68 37* roumegoux@inrets.fr	vehicle modelling, pollutant emissions, fuel consumption, computer simulation
Ms **Rypdal** Kristin	**Statistics Norway** - P.O.B. 8131 Dep - - 0033 Oslo - Norway	+47 22 86 49 49 *+47 22 86 49 98* krr@ssb.no	emission inventories, substance flow analysis
Ms **Sakellariadou** Fani	**Univ. Piraeus** - Dept Maritime studies - 40 Karaoli and Dimitriou st. - 185 32 Piraeus - Greece	+30 1 41 73 742, 41 20 751 ext 217, or 89 53 397 *+30 1 41 25 808* fsakelar@unipi.gr	maritime geochemistry, oceanography, air pollution and sea pollution
Dr **Samaras** Zissis	**Lab. Applied Thermodynamics** - Aristotle Univ. Thessaloniki - - 54006 Thessaloniki - Greece	+30 31 99 60 14 *+30 31 99 60 19* zisis@eng.auth.gr	internal combustion engines, applied thermodynamics, air pollution from road & non-road transportation
Pr **Sammer** Gerd	**Univ. Bodenkultur Vienna** - Inst. Transportation Studies - Gregor Mendel Str. 33 - 1180 Vienna - Austria	+43 1 476 54 53 01 *+43 1 476 54 53 44* verkehr@mail.boku.ac.at	transportation planning

Name : specialist (see annex 5) **Name** : only interested by results	address	phone number *fax number* e.mail	scientific fields
Ms **Schinagl** Gerhid	**Technical Univ. Graz** - Inst. Intern. Comb. Eng. & Thermod. - Inffeldgasse 25 - 8010 Graz - Austria	+43 316 873 75 84 *+43 316 46 21 75*	emission modelling
Mr. **Schweizer** Thomas	**EMPA** - - †berlandstrasse 129 - 8600 Dübendorf - Switzerland	+41 1 823 46 79 *+41 1 823 40 12* thomas.schweizer@empa.ch	emission factors, measuring technologies, driving cycles, special emission examination
Mr **Sieminski** Andrzej	**Min. Environment** - Dept of Air Land Protection - - 00-922 Warsaw - Poland	+48 22 258 973 *+48 22 25 20 03*	environmental pollution from vehicle and engines, with roads and fuel aspect
Pr **Silyanov** Valentin	**MADI-TU** - 64, Leningradski prospekt - - 125829 Moscow - Russia	+7 095 151 05 81 *+7 095 151 03 31* vvs@madi.msk.su	traffic simulation and control
Dr **Sinyavski** Vladimir V.	**MADI-TU** - Leningradskiy prospekt, 64 - - 125829 Moscow - Russia	+7 095 155 08 80 *+7 095 151 89 65 or 09 31* dvs@madi.msk.su	Sophistication of diesel engine working process, i.e. heat losses reduction, conversion of diesel engine to work on CNG, turbo-charged engines, reduction of emissions of all these engines and vehicles on which they are installed
Mr **Sjöbris** Anders	**MariTerm AB** - Box 12037 - - 401 42 Gothenburg - Sweden	+46 31 12 20 30 *+46 31 24 58 56* mariterm@algonet.se	emissions from sea and rail transportation
Mr **Sjödin** Äke	**Swedish Environ. Res. Inst.** - P.O.Box 47086 - - 40258 Göteborg - Sweden	+46 31 46 00 80 *+46 31 48 21 80* ake.sjodin@ivl.se	local air quality, atmospheric chemistry, monitoring of real-world emissions from transport, real-world emission factors for road veh., ships and aircrafts
Mr **Skouloudis** Andreas	**CCR/ISPRA** - Environment Institute - - 21020 Varenne - Italy	+39 03 32 78 91 86 *+39 03 32 78 96 76 or 78 91 86* andreas.skouloudis@cen.jrc.it	emissions from traffic and transport, air quality, scenarios impacts
Mr **Smokers** Richard T.M.	**TNO Road Vehicles Res. Inst.** - P.O. Box 6033 - - 2600 JA Delft - The Netherlands	+31 15 269 75 11 *+31 15 269 68 74* smokers@wt.tno.nl	electric and hybrid vehicles, emission factors, energy and environmental impact analysis
Mr **Sorenson** Spencer C.	**Technical Univ. Denmark** - Dept of Energy Engineering - Bldg 403 - 2800 Lyngby - Denmark	+45 45 25 41 70 *+45 45 93 06 63* Spencer.Sorenson@et.dtu.dk	air pollution from engines and vehicles, internal combustion engines : combustion, fuels, emissions
Dr **Stathopoulos** Antony	**National Techn. Univ. of Athens** - Civil Eng./ Transportation - 5, Iroon Polytechniou st. - 157 73 Athens - Greece	+30 1 772 12 88 *+30 1 772 13 27* 72644.1752@compuserve.com	environmental traffic control, transportation planning & management, parking management, information systems
Mr **Steinemann** Urs	**Ingenieurbüro US** - Schwalbenbodenstr. 15 - - 8832 Wollerau - Switzerland	+41 1 784 53 65 *+41 1 784 53 66*	HVAC-systems, tunnel ventilation, indoor and outdoor air quality, emissions from all the sources, air pollution analysis
Dr **Sturm** Peter	**Technical Univ. Graz** - Inst. Intern. Comb. Eng. & Thermod. - Inffeldgasse 25 - 8010 Graz - Austria	+43 316 873 75 84 *+43 316 46 21 75* sturm@vkmb.tu-graz.ac.at	emission modelling, air quality and/or dispersion modelling

Name : specialist (see annex 5) **Name** : only interested by results	address	phone number *fax number* e.mail	scientific fields
Mr **Swann** Jaimie	**MIRA** - Watling street - Warks - CV10 0TU Nuneaton - United Kingdom	+44 (0)12 03 355 329 *+44 (0)12 03 355 355* jaimie.swann@mira.co.uk	vehicle modelling and simulation, advanced powertrains, fuel cell technology
Mr **Thibaut** Gérard	**Ville de Paris** - Dir. Protection Environnement - 7, rue Maleville - 75008 Paris - France	+33 (0)145 61 54 70 *+33 (0)145 61 54 90* spaas_mairie_paris@compuserve.com	urban atmospheric pollution : emissions and air quality, policy and actions about traffic and its consequences
Ms **Torp** Charlotte	**Norwegian Soc. Conservation Nature** - PB 2113 - Grunerloekka - 0505 Oslo - Norway	+47 22 04 46 61 *+47 22 71 56 40*	air pollution from vehicles, emissions rather dispersion, effects of air pollution
Mr **Toussaint** Yves	**Univ. Liège** - Mécanique du Transport - 21, rue E. Solney - 4000 Liège - Belgium	+32 41 66 91 72 *+32 41 53 25 81*	hybrid propulsion, combustion phenomenon in internal combustion engines, cold start and transient regime, driving behaviour in urban conditions
Mr **Trozzi** Carlo	**Techne SRL** - Via Nicola Zabaglia, 3 - - 00153 Roma - Italy	+39 06 57 79 173 or 57 48 348 *+39 06 57 41 801* technerm@mclink.it	air pollutant emissions, air quality management plans
Dr **Turunen** Raimo	**Helsinki Univ. Technology** - Internal Combustion Engine Lab. - Puumiehenkuja 5 - 02150 Espoo - Finland	+358 9 451 34 55 *+358 9 451 34 54* raimo.turunen@hut.fi	engine emissions, instantaneous vehicle emissions
Dr **Ulevicius** Vidmantas	**Institute of Physics** - A. Gostauto 12 - - 2600 Vilnius - Lithuania	+37 02 64 18 72 *+37 02 61 70 70* arvisj@ktl.mii.lt	dispersion modelling from motor vehicles exhaust, aerosol measurements and analysers
Dr **Uyumaz** Ali	**Istanbul Tech. Univ.** - Dept Civil Engrg - - 80626 Istanbul - Turkey	+90 212 285 37 18 *+90 212 285 65 87*	Highway storm drainage with curb-opening inlets
Ms **Vaccaro** Rita	**Techne SRL** - Via Nicola Zabaglia, 3 - - 00153 Roma - Italy	+39 06 57 79 173 or 57 48 348 *+39 06 57 41 801* MD3539@mclink.it	energy and environment, data collection, estimations estimates from transport modes, computer models
Mr **Vandenberghe** Christian	**Eurocontrol** - DED 4 - Section Air Traffic Statistics & Forecasts - rue de la Fusée, 96 - 1130 Brussels - Belgium	+32 2 729 32 65 *+32 2 729 90 03* christian.vandenberghe@eurocontrol.be	air traffic statistics and medium/long term forecasts of number of flights
Mr **Vantelon** Alain	**BCEOM** - Place des Frères Mongolfier - - 78286 Guyancourt cedex - France	+33 (0)130 12 48 06 *+33 (0)130 12 10 95* sei@bceom.fr	energy saving in transport
Mr **Veillat** Pierre	**Mairie de Paris** - DPJEV Mission Environnement - 3, av. de la Porte d'Auteuil - 75016 Paris - France	+33 (0)143 42 07 01 *+33 (0)143 42 01 54*	
Mr **Villanova** A.	**RATP** - 13 rue Jules Vallès - - 75011 Paris - France	+33 (0)148 04 14 87 *+33 (0)148 04 16 26* jean-pierre.hamon@ratp.fr	
Mr **Vinot** Jean-Pierre	**Certu** - 9, rue Juliette Récamier - - 69456 Lyon cedex 06 - France	+33 (0)472 74 59 14 *+33 (0)472 74 59 50*	all problems dealing with air pollution from transport

Name : specialist (see annex 5) **Name** : only interested by results	address	phone number *fax number* e.mail	scientific fields
Mr **Volák** Vladimir	**Motor Vehicle Research Institute** - Lihovarská 12 - - 18068 Prague - Czech Rep.	+42 2 684 42 44 *+42 2 663 10 343* uvmv@uvmv-c.anet.cz	exhaust emissions, motor vehicle construction, power trains
Mr **Wacker** Manfred	**Inst. f. Strassen- & Verkehrswesen** - Univ. Stuttgart - Pfaffenwaldring 7 - 70569 Stuttgart - Germany	+49 711 685 6443 *+49 711 685 6966* wacker@isvs.bauingenieure.uni-stuttgart.de	traffic flow, air pollution, planning models, city and traffic planning, traffic and ecological systems
Mr **Wallin** Mats	**AB Svensk Bilprovning** - MTC - Box 223 - 13623 Haninge - Sweden	+46 8 500 65 600 *+46 8 500 28 328* matsw@mtc.se	motortestcenter, vehicle certification
Mr **Walter** Ch.	**PSA Peugeot-Citroën** - DETA/MXT/CED - 18 rue des Fauvelles - 92250 La Garenne-Colombes - France	+33 (0)1 47 69 39 73 *+33 (0)1 47 69 87 70*	
Mr **Wane** Hamdou Rabby	**CERPOD** - Inst. du Sahel - CILSS - B.P. - - 1530 Bamako - Mali	+223 22 30 43 or 22 80 86 *+223 22 78 31* hwane@cerpod.insah.ml	air pollution and health in urban situation, air pollution economy in urban situation, applications of geographic information systems and modelling
Mr **Weber** Franz-Josef	**TÜV Rheinland** - - - 51105 Köln 1 - Germany	+49 221 806 24 84 *+49 221 806 17 56* weberfj@compuserve.com	
Dr **Westerholm** Roger	**Stockholm Univ.** - dept Analytical Chemistry - - 10691 Stockholm - Sweden	+46 8 16 24 40 *+46 8 15 63 91* rwesterholm@anchem.su.se	chemical characterisation of exhaust emissions from mobile sources, fuel dependant exhaust emissions
Dr **Williams** Ian	**Middlesex Univ.** - Bounds Green rd - Bounds Green - N11 2NQ London - United Kingdom	+44 181 362 5000 ext 7334 *+44 181 361 17 26* i.williams@mdx.ac.uk	air pollution monitoring, public attitudes to environmental pollution
Mr **Winther** Morten	**Nat. Environmental Research Inst.** - Frederiksborgvej 399 - P.O. Box 358 - 4000 Roskilde - Denmark	+45 46 30 12 97 *+45 46 30 11 14* symwi@dmu.dk	emission factors and total emissions from transport (on road and off road)
Dr **Zierock** K.H.	**EnviCon** - Wiesbadener Strasse 13 - - 12161 Berlin 41 - Germany	+49 30 822 21 11 *+49 30 822 22 30*	tool harmonisation and development

Annex 7: Road vehicle emission data exchange: parameter list

The objective of this proposal is to facilitate the exchange of vehicle emission data, listing all the necessary parameters, and their unit. The main parameters are underlined.

In any case when a parameter is missing, please do not use a blank, but only a negative figure (-1 for instance, but -99 for temperatures and other parameters which can be negative).

At the begin of the file, or on a separate sheet, please indicate the order of the parameters (and if necessary the writing format), in order to avoid any reading error.

The format should be ASCII with a given separator, or can be a spread sheet (Microsoft Excel...), or a fixed format. It is better to separate the variables by a comma and to write the alphanumeric data (names, comments ...) between two ' (for instance a vehicle model can be written 'Golf GTX 16v').

Only measured parameters should be provided (especially for CO_2 and F.C.). If a calculated parameter is provided, indicate it in comments.

The descriptive parameters which are not basically numeric (for instance the gearbox type) should be either alphanumeric parameters (with a clear description, for instance 'manual gearbox'), or transformed into a number (for instance 1 for the manual gearbox), but in this case the correspondence, i.e. the meaning of the numeric figures, must be clearly indicated in comments.

Vehicle data

laboratory, laboratory internal identification of the vehicle, make (for instance Peugeot), model (for instance 405-GTL), national vehicle type number,

vehicle mass (empty vehicle, kg), max. power (kW), engine capacity (cm^3), number of speeds, gearbox type (manual, automatic...),

first driving day, month, year, local name of the emission standard, normal fuel type (petrol, diesel, LPG, GNV...), fuel H/C ratio,

production emission standards (g/test, or g/km only for directive 91/441 and further) for CO, HC+NOx, NOx, HC (expressed as in the standard, i.e. measured by NDIR for 1500 to 1503), particulates, certification results of the type of vehicle (for the same pollutants),

aftertreatment (without catalyst, uncontrolled or oxidation catalyst, 3-way catalyst...), engine technology (carburettor, electronic carburettor, single point injection, multi-point injection, with EGR, without or with air pump, turbo, comprex, mechanical charging system...),

mileage (km), type of vehicle provenance (private owner, rental company, company vehicle, garage...), type of the choice of the vehicle (random choice, chosen as low emitter, chosen as high emitter...),

size of tyres, tyre pressure at the test (bar),

number of cycles performed, for each pollutant: pollutant name, complete emission unit (if possible g/km, for HC precise the equivalent unit of HC emission (g equivalent $CH_{1.85}$ / km, or CH_4, ...), for NOx precise if a humidity correction is applied or not (and give the correction formulae in comment) - pollutant order : CO, CO_2, HC, NOx, part., F.C., ...)

For each driving cycle

laboratory, laboratory internal identification of the vehicle, day, month, year, hour, minute, second of the test, maintenance (before maintenance, after maintenance), preconditioning cycle (not or yes), cold/hot cycle (cold, intermediate, hot), engine temperature at the begin of the test (°C - indicate in the comments if it is water or oil temperature), engine temperature at the end of the test (°C), catalyst temperature at the begin of the test (°C), inertia weight (kg), power setting at specific speeds,

pressure during the test (mbar or hPa), ambient temperature (°C), humidity (%), cycle name, theoretical duration (sec), theoretical driving distance (m), actual driving duration (sec), actual driving distance (m), speed standard deviation (m/s),

for each pollutant: emission

Additional comments

specification of the dynamometer setting,

description of the driving cycles, ...

Annex 8: Annual mileage of passenger cars

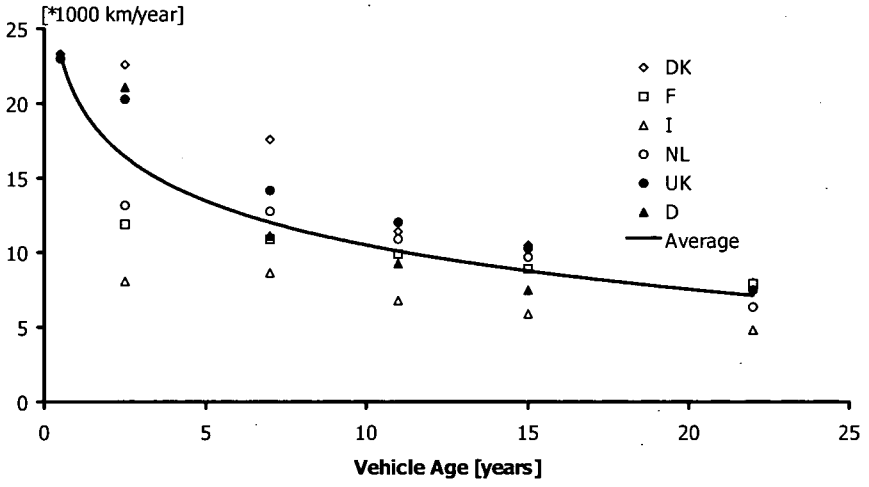


Figure A8-1: Annual mileage as a function of the passenger car age (1990 data).

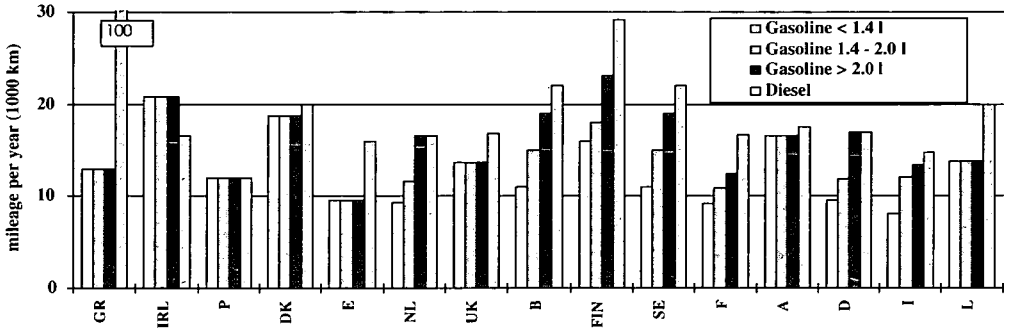
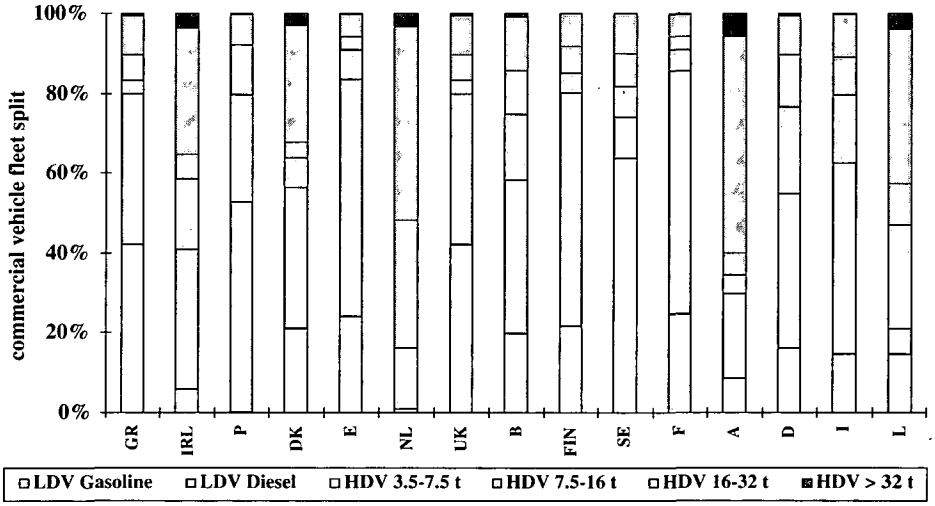


Figure A8-2: Engine type and size effect on annual mileage of passenger cars in the European Union (1995 data).

Annex 9: Commercial vehicle fleet split



Annex 10: Review of emission models

A large number of emission models have been considered by collecting information through COST 319 action partners and parallel initiatives financed by the European Commission (e.g. DRIVE II KITE project and DG VII COMMUTE project). These models allow the assembly of a real 'puzzle' of different approaches, tools, applications representing the substantial value of the review effort. The essential information about these models was put in a synthetic form by means of tables [Negrenti, 1998] which on one hand might limit the completeness of information but on the other hand certainly allow a clear comparison and an easy search of the wished details.

In this annex the detailed contents used in these summarising tables adopted for reporting the information on the 39 reviewed emission models are described (see the list of models in Table 19). The most relevant items to be looked at (for the purpose of a model classification) are the spatial and time scales (that basically differentiate micro-models from macro-models) and the fleet composition (putting into evidence the consideration of a real fleet or of a single vehicle). These pieces of information, together with many others considered relevant for an adequate model comprehension, are described below and reported in the summarising tables included in [Negrenti, 1998].

Table 19: List of reviewed emission models.

Table number in [Negrenti, 1998]	models names			
1	TEEM	MODEM	TAPEM	PREMIT
2	PREDCO	ROADAIR	AAQUIRE	AIRVIRO
3	BENZ	EMIL	KOSKINEN	COLDSTART
4	EVA	VETO	EM94	HEF
5	NETSIM	AEA	VISSIM	VISUM
6	NEMIS	EMISMOB	LIISA	CAREMIS
7	TEE	ASHDOWN	DGV	KEMIS
8	SCRAP	TEE-TURBAN	VERSIT	ROADFAC
9	VEMI	MADI-EM	EMOD	COPERT
10	TEDMAN	TREMOD	CITAIR	

The first two items in these tables concern the *Model Owners* (or developers) and the *type* of model. Two types of classifications are here proposed (see section 3.3.2): one based on the space-time scale and the other based on the aggregation level of emission factors.

Spatial Scale is a critical information for both the description of the model and the model selection process. Actions impacting transport systems often have an inherent spatial scale, so the capability of the emission model to treat that specific level of description is essential. This parameter can be regarded as a key-parameter for models classification.

Time Scale is also a relevant parameter for the selection of models for any impact evaluation. Often actions on transport systems have an inherent time resolution (either short or long) and the capability of models to treat the different possibilities of time

extension is therefore a fundamental information. It must be noted that many emission models do not have a specific time dimension (i.e. their core formulas are related to traffic variables, like average speed and mileage, that can be referred to any time scale), but this is not the general case and reporting such a characteristic of the model looks appropriate.

Traffic Input is meant to identify in which way the traffic amount is described in the input to the emission model (either vehicle flow rates or miles travelled or any other quantification of traffic volume). Such information is also essential for the selection of an emission model. All transport policies and actions are generally expected to impact the amount of traffic, due to modal shift and-or improvements of flow conditions. It is therefore critical to know how the emission model takes into account the traffic quantity. Particular evidence was given in the tables to the emission parameters which belong to the area of traffic input: the vehicle*kilometers run by the vehicle, the number of vehicles (traffic volumes or densities), and the trip length.

The indication of the modelled *Pollutants* is a basic information for the description of an emission model, and for the selection process related to any environmental evaluation. The importance of the modelling of specific pollutants will be in general a function of local city or regional needs and problems.

The availability of a *Traffic Model included* in the emission software can in principle be an advantage for the building up of a complete suite of models for any inventory or impacts analysis. The analyst will anyway have to check if this integration doesn't involve any unacceptable degree of simplification in the emissions modelling. For several reasons, in the past, traffic and emission models (and dispersion models as well) were developed along different paths and with different purposes. This means that efforts on the model accuracy have been done in different directions, and it is possible that integrated packages whose development started from a traffic model show poor treatment of emission problems. In practice the availability of an integrated traffic software can have pros and cons to be carefully evaluated.

Most of current policies in the transport sector, are supposed to cause modal shift due to more favourable conditions for the use of public transport. Moreover when considering future inventories of consumption and emissions it is necessary to represent changes in national or local fleets. From the modelling point of view this means that the emission model must be capable of adequately representing changes of *Fleet Composition*, either at street, area, or city level (this will depend on the spatial resolution of the expected impacts). The presented tables give evidence to this for those models that (at least in a rough form) show capability to simulate fleet changes.

The description of the *Vehicle Kinematics* is probably one of the most crucial elements in the modelling of any environmental impact deriving from changes in the transport system. The analysis of the anticipated impacts of many policies and actions on traffic can lead to the synthetic conclusion that the kinematics impact can have two different forms :

- a change in the overall average speed of the vehicles
- a change of the more detailed speed and acceleration profile (idling, cruise, acceleration and slowing down).

The capability of emission models to treat such information is a key point in the selection of the right model for a certain transport system to be evaluated. In general it would be preferable to use models capable of using information on speed and acceleration variability, but this obviously implies to have real data on speed changes in time, and this can be very costly. Moreover instantaneous emission functions have recently shown not negligible difficulties in accurately predicting emissions over specific speed profiles. On the other hand, experimental or calculated data on average speed of vehicles are more easily available, but it is evident that the inherent approximation of the kinematics information can lead to wrong conclusions, especially in the case of pollutants which show remarkable sensitivity to speed variability around the average value.

Pollutants emission is affected by several *Other Parameters* beyond kinematics. Among these we can here mention: vehicle load, vehicle maintenance, vehicle age, and road gradient. Cities and countries implementing actions recognised to have a potential impact on these parameters should take care of emission models capabilities to treat related data. Only vehicle load and vehicles maintenance appear likely to be impacted by policies in general. Modal shift towards public transport should bring in principle to a slight increase in the average loading of buses. Similarly, improved freight management is allowing an increase in the average loading of light and heavy duty vehicles. Maintenance policies for limiting high emissions from old or poorly maintained vehicles are also in the agenda of several governments.

Details on the *Output* of the models can be of help in understanding how well the model fits the specific needs of analysis. The output data of emission models are also of importance when a dispersion model will be used. In this case calculated emissions are input data for the dispersion calculation and have to be in a format which can be used by the dispersion model.

The provided tables show also information on the activities of *Model Assessment* (assessed model sections, sources of data for the assessment, criteria of assessment). This set of data can be important in the choice of the right tool, since well assessed models generally should be more reliable as compared to models without any testing certification.

The field dedicated to the *Experimental Data Sources* covers fundamental data for the development of a model core (e. g. emissions correlations). This information is also crucial for the evaluation of model reliability and accuracy. Most emission models depend on experimental measurements of vehicle emissions under a range of operating conditions. The data available are by no means complete. Sufficiently reliable measurements of emissions are usually not available for e.g.: operation at altitude, cold starts, accelerating vehicles, effects of vehicle maintenance, and effects of vehicle loading.

In some applications, the use of "off-the-shelf" emission factor models looking at relative emission levels can be acceptable. However, in applications where absolute emission levels are important, it is recommended that the experimental emission data used as the basis for emission models are reviewed with model developers.

Information on *Computer Requirements, Language and Model Availability,* although not strictly needed from the point of view of modelling quality and evaluation capabilities, is nevertheless included in the tables in order to provide practical data in view of a potential selection. Information on *Anticipated Applications and Users* have also been included in order to give an idea on the normal scenario of use of the models, and therefore to draw conclusions (even draft) on the appropriateness of the model.

Finally, information on *References and Descriptive Papers* concludes the information summary.

Annex 11: Publication data form of the final MEET report

1. Unit of the 1st author	2. Project n°	3. TRL report n°
Transport Research Laboratory		SE/491/98
4. Title		
Methodology for calculating transport emissions and energy consumption		
5. Subtitle		6. Language: English
7. Author(s) J. Hickman, D. Hassel, R. Joumard, Z. Samaras, S. Sorenson		8. Affiliation TRL (UK) TÜV Rheinland (D) INRETS (F) LAT-AUTh (GR) DTU (DK)
9 Sponsor, co-editor, name and address European Commission/DG VII Rue de la Loi 200, 1049 Brussels, Belgium		10. Contract ST-96-SC.204 11. Publication date 1999
12. Notes		
13. Summary This report is a summary of all the individual methodologies and corresponding emission factors and functions produced in the MEET project, for use in estimating pollutant emissions and energy consumption from transport. It covers all current vehicle technologies for all different types or classes of road vehicles, as well as rail, shipping and air transport. For road transport, cold start extra emissions, evaporative losses, road gradient and vehicle load effects are addressed. In addition, guidance is given regarding the emissions behaviour of future vehicles and fuels. The methodologies and emission data are complemented with statistical input as regards the necessary transport activity data. Data are also provided on the pollutant emissions associated with energy production. Examples of the use of the methodologies are included in two ways: for road and rail transport, a variety of aggregated emission factors have been calculated, and comparisons have been made for passenger and freight journeys using different modes of transport.		
14. Key Words Emission factors and functions, energy consumption, statistical data, cold start, evaporation, air traffic emissions, road emissions, rail emissions, ship emissions		15. Distribution statement Not classified
16. Nb of pages 350	17. Price	18. Declassification date	19. Bibliography Yes

Transport Research Laboratory
Old Wokingham road
Crowthorne
RG45 6AU
United Kingdom

Telephone: +44 1344 770 351
Fax: +44 1344 770 028
E-mail: ahickman@trl.co.uk

List of illustrations

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COST Transport Overview

COST Transport is one of 17 domains existing in COST at the present time.

It was to be one of the seven areas seen as best suited for this new form of collaboration, which was officially set up by a Conference in November 1971.

The Transport area lends itself particularly well to the COST framework, both because it combines aspects from a number of disciplines, and because of the need for harmonization at European level. Liaison with the Transport Ministries and Administrations in the various countries is a key element of these COST Actions.

The COST Transport Secretariat is located within the Directorate General for Transport of the European Commission. The with the staff managing the Fourth Framework Transport RTD Programme, as well as the proximity with the Common Transport Policy Directorates, enables close collaboration between Transport Research activities and serves as a basis for further political action.

COST Transport Actions are authorised and supervised by the COST Technical Committee on Transport (TCT) which, in turn, reports to the COST Committee of Senior Officials (CSO). Both of these decision making bodies comprise representatives of the national governments of the COST countries.

Actions Underway

COST 323:	Weigh in Motion of Road Vehicles
COST 327:	Motorcycle Safety Helmets
COST 329:	Models for Traffic and Safety Development and Interventions
COST 331:	Requirements for Horizontal Road Marking
COST 332:	Transport and Land-Use Policies
COST 333:	Development of New Bituminous Pavement Design Method
COST 334:	Effects of Wide Single Tyres and Dual Tyres
COST 335:	Passengers' Accessibility of Heavy Rail Systems
COST 336:	Use of Falling Weight Deflectometers in Pavement Evaluation
COST 337:	Unbound Granular Materials for Road Pavements
COST 339:	Small Containers
COST 341:	Habitat Fragmentation due to Transportation Infrastructure

Actions in preparation

COST 338:	Drivers' Visual Information Overload
COST 340:	Towards a European Intermodal Transport Network: Lessons from History
COST 342:	Parking Policy: Effects on Mobility and the Local Economy
COST 343:	Reduction in Road Closures by Improved Maintenance Procedures
COST 344:	Improvements to Snow and Ice Control on European Roads and Bridges
COST 345:	Procedures Required for Assessing Highway Structures
COST 346:	Instantaneous Energy Consumption and Emissions of Road Vehicles, especially of Heavy Duty Vehicles

Completed Actions

COST 30:	Electronic Traffic Aids on Major Roads
COST 30 bis:	Electronic Traffic Aids on Major Roads: Demonstration Project and Further Research
COST 33:	Forward Study of Passenger Transport Requirements between Major European Conurbations
COST 301:	Shore Based Marine Navigation Systems
COST 302:	Technical and Economic Conditions of the Utilization of Electric Road Vehicles in Europe
COST 303:	Technical and Economic Evaluation of National Dual-mode Trolleybus Programmes
COST 304:	Alternative Fuels in Road Vehicles
COST 305:	Data System for the Study of Demand for Interregional Passenger Transport
COST 306:	Automatic Transmission of Data Relating to Transport
COST 307:	Rational Use of Energy in Interregional Transport
COST 308:	Maintenance of Ships
COST 309:	Road Weather Conditions
COST 310:	Freight Transport Logistics
COST 311:	Simulation of Maritime Traffic
COST 312:	Evaluation of the Effects of the Channel Tunnel on Traffic Flows
COST 313:	Socio-economic Cost of Road Accidents
COST 314:	Express Delivery Services
COST 315:	Large Containers
COST 317:	Socio-economic Effects of the Channel Tunnel
COST 318:	Interactions between High-speed Rail and Air Passenger Transport
COST 319:	Estimation of Pollutant Emissions from Transport
COST 320:	The Impact of E.D.I. on Transport
COST 321:	Urban Goods Transport
COST 322:	Low Floor Buses
COST 324:	Long Term Performance of Road Pavements
COST 325:	New Pavement Monitoring Equipment and Methods
COST 326:	Electronic Charts for Navigation
COST 328:	Integrated Strategic Transport Infrastructure Networks in Europe
COST 330:	Teleinformatics Links between Ports and their Partners

Up to date information on COST Transport can be found on the World Wide Web, at the following address: http//www.cordis.lu/COST-Transport/home.html

European Commission

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The COST 319 Action "Estimation of pollutant emissions from transport" involved co-operation between about a hundred European researchers between 1993 and 1998. This report presents the results of the action in terms of network development, inventory methods, and future research needs.

The complete Action network had over 200 members. Half of these played an active role in the various working groups. The network included most of the European specialists in the field of transport-related emission inventories. The addresse, phone numbers, and subject areas of the network members, whether they be researchers or users, are included in this report.

State-of-the-art European inventorying tools are presented in the report. A distinction has been made, according to the type of application, between disaggregated, central, or aggregated models. The four transport modes - road, rail, sea and air - are addressed using a set of sub-models and databases relating to various emission factors and traffic characteristics. The data used in the models, the assumptions that are made, and the model output are all analysed. The implications for emission modelling are reported.

In addition, an assessment was made of the research that would be required in the future to develop sufficiently precise and homogeneous inventorying models for transport-related emissions which could be used in various applications.