TECHNICAL ANNEX
ASSESSMENT AND FURTHER DEVELOPMENT OF THE TREMOVE MODEL

1. BACKGROUND

TREMOVE model was developed as an analytical underpinning for the second European Auto-Oil Programme (AOPII). It is an integrated simulation model developed for the strategic analysis of costs and effects of a wide range of policy instruments applicable to local, regional and European surface transport markets. The current version of the model includes nine Member States.

TREMOVE is a partial equilibrium model, built in GAMS, that allows to simulate consumer behavior with regard to the choice of transport modes and vehicle types (i.e. size and technologies), to assess how these choices are affected by the introduction of policy measures, and to estimate what effect these policy measures will have on pollutant emissions and what will be the welfare effect ("cost to society"). The model takes into account a large number of transport modes, and determines the demand for each mode and emissions from road transport by taking into account the many interactions between the various transport modes.

The European Commission services are considering the further development of TREMOVE model. Therefore, it is important to first assess how well the current version of TREMOVE suits to the analytical needs of the Commission and how it should be further developed to cover future needs. These terms of reference are based on the experience of using TREMOVE in the AOP II as well as the recommendations for future work of TREMOVE Model 1.3 (Draft Final report August 1999, see Annex 1).

As a backdrop to this assessment exercise, it should be noted that the transport module of the PRIMES energy systems model (developed by the National Technical University of Athens, NTUA) is being updated (by University of Leuven, KUL) in the short term and that update will use part of the TREMOVE output and inputs. Further, STEEDS transport model (developed by AEA Technology), has components that use TREMOVE model results as its input data. There may be synergies between STEEDS and TREMOVE and one option would be to merge the feature of these models in a new version of TREMOVE.

It has to be noted that TREMOVE model does not have a representation of the transport networks, such STREAMS and its follow-up SCENES (developed by Marcial Echenique & Partners) being financed under the 4th and 5th Research Framework Programme. The latter is now also being linked to a macro-economic model E3ME (developed by Cambridge Econometrics). As there are different developments of transport modelling at the EU level, the further possible development of TREMOVE needs to be clearly positioned among other model developments.

2. OBJECTIVE

The objective of the assignment is to have a well-specified development plan for the TREMOVE model, including the required specifications for an updated version of TREMOVE. This development plan needs to also specify what the role of the TREMOVE model would be among other similar models in the EU.
3. TASKS

In order to fulfil the objective, the consultant should undertake the following tasks. However, when justified, the consultant may suggest slight modifications to ensure a satisfactory completion of the assignment.

(1) Review the structure and databases of TREMOVE Model 1.3

(2) Based on the requirements of the Commission (see Annex 2), make a gap analysis to define the most effective way to develop TREMOVE further. The link with the existing network based models will have to be studied.

(3) Based on the review recommend a possible plan of action.

3.1. Review the structure and databases of TREMOVE Model 1.3

3.1.1. Review of TREMOVE model

Assessment of the key features of TREMOVE. Specifically the following questions need to be answered:

• how well the model works technically?
• how user friendly it is?
• how easy it is to update in terms of data?
• how easy is it to develop the model further?
• what are the specific strengths and weaknesses of the model?
• which policy measures can be assessed directly by the model and which require additional information?
• how well has the model been able to forecast year 2000?

3.1.2. Review of software structure

Review of the coding and the software structure should take into account the issues identified in the tasks identified above. The review consists of the following tasks:

• Definition of possible improvements and simplifications. This task should be undertaken i.a. by interviewing the experts that have either prepared the GAMS code or reviewed it.

• Feasibility of a user-friendly interface for scenario building and results interpretations. In particular, the consultant should look into the possibility of changing the model structure so that it would allow running the model “in one go” solving the model for each Member State and then for the EU as a whole.
3.1.3. Review of data used for TREMOVE

Review of the quality of current data, both in terms of historic data and projections, in particular:

- Is the data detailed enough to form a basis for a meaningful understanding of the differences between countries?

- Does the choice of cities in the model give a good coverage of the issues, in other words are the cities representative of all urban areas in each Member State?

- What are the data sources for the different elasticities and parameters used in the model? Are they empirically valid in different countries, cities and transport sub-markets?

- Can the data be easily updated? How could the Commission services (including Eurostat) be better placed to receive promptly relevant data? This should include a recommendation for carrying out such work. In particular, the consistency of the projections with, for example, macro-economic forecasting and transport flow forecasting is an issue to be addressed.

- What would be the data needs for the extension to EU Member States, Accession and other countries that are not part of the current version of TREMOVE?

This review of the model, data and software structure should be based on existing material (see Annex 3 for relevant documents) as well as discussions with experts involved in the development of TREMOVE and other transport models. As a by-product, the contractor is expected to prepare a short inventory of EU-wide models that are or can be used to analyze transport issues.

3.2. Gap analysis based on Commission needs

The gap analysis should answer the following questions. Based on the needs as defined in Annex 1:

- Which of the current components of TREMOVE can remain as they are?

- Which components should be developed further, based on the existing model and data structure?

- Which (new) components need to be developed “from scratch”? Are there other models (e.g. STEEDS) which one could either use concurrently with TREMOVE or develop as an integral part of TREMOVE?

- Which (new) components can / need to be developed in order to link the TREMOVE model to the network based transport models (e.g. STREAMS/SCENES or others)?
3.3. Recommendations for a possible plan of action

Based on a description of other competing or complementary transport related models, the contractor should suggest which features of TREMOVE should be developed and where further development work would simply be a duplication of effort.

- Given the review and the gap analysis, the consultant should first give a “stop or go” recommendation, i.e. recommend to the Commission whether TREMOVE should be developed further to be one of its reference models that it would use when carrying out environmental, economic or other analysis of transport policies.

- If the recommendation for the further development of TREMOVE is positive, the consultant should define a development plan for the further development of TREMOVE. This development plan should include a terms of reference to define the structure needed to ensure the development as well as the maintenance of the model. Also, a set of recommendations is needed on whether to incorporate some of the features of STEEDS to TREMOVE. Finally, recommendations need to be given on how TREMOVE should be developed, taking into account the development work for PRIMES and network models such as STREAMS/SCENES.

- The contractor should also assess the capabilities of organisations/institutions, including the Commission services, to carry out the implementation of the development plan.

- A preliminary budget for the development work should be provided. In addition, the consultant is requested to make recommendations on how the management of this development should be undertaken both within the Commission and amongst stakeholders.

4. EXPERIENCE OF THE CONTRACTOR

The contractor is to have both economic and modelling background. As a transport economist, the contractor needs to have a strong knowledge of the transportation partial equilibrium theoretical model and the data sources. As a modeller, the contractor needs to have knowledge in programming structural equations. If the programming and transport economic skills are not combined in one person, it is possible to have two persons. It would be preferable that the contractor has expertise in transport planning in general. Finally, the contractor should be in a position to give impartial assessment and advice concerning the TREMOVE model.

5. ORGANISATION OF THE WORK

5.1. Ad hoc steering group

The Commission will set up an ad hoc steering group to give support and guidance during the model review. The steering group will consist of representatives of DG Environment, Enterprise, Taxation, Economic and Monetary Affairs as well as
Transport and Energy. The *ad hoc* steering group meets with the contractor as required.

### 5.2. TREMOVE contact group

In addition, the Commission will set up a TREMOVE contact group which will consist of the organisations that have taken an active part in the development of the TREMOVE model. The purpose of the contact group is to facilitate the contractors work by giving the views and suggestions for TREMOVE model development. The contact group will meet two or three times. First, during a kick-off meeting and second, once the draft final report is ready. A third meeting can be scheduled if need for this arises.

### 5.3. Schedule

The study should be completed the within 4 months after the signature of the contract.

Within two weeks of the signing of the contract the contractor has to send the European Commission an inception report, where all relevant questions are raised. This will be the basis for the kick-off meeting, which is to be organised within 2 weeks from the receipt of the inception report. During or after the kick-off meeting the *ad hoc* steering group and the TREMOVE contact group will respond to the questions to the best of their ability.

After the kick-off meeting the contractor is expected to carry out the assignment in 2 months, to prepare the draft final assessment report which will be distributed to the *ad hoc* steering group and the TREMOVE contact group. The second meeting will be held within 2 weeks of the receipt of the report. After the second meeting, unless otherwise agreed, the contractor has 2 weeks to finalise the assessment report.

### 6. DELIVERABLES

The contractor will prepare three reports:

1. Inception report. In this all relevant questions for the assignment are to be highlighted.

2. Draft Final Assessment report. A draft of the assessment report will be commented by the *ad hoc* steering group and the TREMOVE contact group. Based on these comments the draft will be finalised.


All reports should be delivered to the European Commission in both Word, Excel and pdf formats. The assessment report will be made public on DG Environment web-site.
Annex 1: Suggestions for the development of TREMOVE

A number of possible improvements for TREMOVE have already been identified to date (see e.g. the AOP II Cost-effectiveness Study, Part II The TREMOVE Model 1.3, Annex C). These recommendations need to be taken into account in the review work:

**Update and Improvements**

- Most data for constructing the AOPII transport base case were collected until late 1997. **Updating** this data, to include historical figures for 1997 and 1998, would improve the quality of the simulations.

- Data should be **extended** to the remaining 6 Member States, to ALL accession (Candidate) countries and Norway and Switzerland (data permitting). A more detailed investigation into the **classification** of data, in particular traffic, vehicle stock and ²) is recommended.

- The future structure of TREMOVE would have to take into account the result of completed or ongoing **research** programmes, in particular in the field of elasticities, (due to lack of data the same elasticities are used in all countries, see e.g. the 4FP TRACE project), emission performance of near future vehicle technologies and fuel qualities, traffic management and public transport management policies, the value of time in the transport of passengers (e.g. depending on purpose of trip) and freight (e.g. depending on the value of goods) etc. The time to run the TREMOVE simulation on a PC could be improved by **re-writing some part of the code**, in particular the emission module.

- Given that data is received often, with considerable time lapses, it would be beneficial to have TREMOVE make estimates of the current situation (e.g. based on 1998 data make an estimate for 1999, 2000 and 2001) of relevant data, for instance, the purposes of Transport and Environment Reporting Mechanism (see e.g. http://themes.eea.eu.int/activities/transport).
Annex 2: Needs of the Commission services for a modeling tool in transport

The following needs have been identified by the Commission staff for a modeling tool (like TREMOVE). This list should serve as the basis for a gap-analysis:

- Developing a specific and consistent **traffic forecasting** tool to cover the European Union would help improve the consistency of the traffic forecast. Existing transport models could be used to minimize the cost of such a development. The model will have to deal with the load factor variable (many existing models deal in pkm/ktkm but policy needs are increasingly focussed on vkm - so the tool must be able to apply appropriate load factors to produce vkm results.)

- The model needs to be based on a **user-friendly interface** otherwise the tool will not be used adequately by the Commission staff.

- The treatment of the **taxation and other cost components** should be expanded so that the tool can easily handle all energy and transport related taxes and VAT. In a direct way thus ensuring the possibility for an in-depth policy analysis of taxation, charging and other cost components. Ideally, TREMOVE should be able to model a wide range of environmental tax reforms for the sectors it covers. It should also make it possible to analyse and suggest revenue neutral reforms and new economic instruments (e.g. widespread km-charges/tolling, rail access charging and the various charging instruments applied in other modes (see below)... and their impact. Ideally, the impacts analysed should also include distributional and sectoral impacts.

- Related to the above, the ability of TREMOVE to analyse **behavioural changes** should be further improved. For instance, how would the impact of improved information or education (e.g. better truck and passenger driver training) be modelled in TREMOVE?

- Inclusion of all **greenhouse gases** (specifically HFCs and N2O) in the model so that the greenhouse gas emissions of transport sector is well covered.

- There is a need to **increase the coverage** of the model to additional sub-markets: as policy tries to take a more neutral and horizontal tone, the possible inclusion of all modes of transport should be at least assessed including aviation and maritime transport.

- The analysis of **inter-modality** needs to be developed. The issue of inter-modal terminals could be treated, not as a separate mode but, as a new vehicle/infrastructure/management technology.

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1 TREMOVE uses external traffic data as a reference scenario to analyze variations caused by policies around this reference.

2 Preparing a scenario for TREMOVE and analyzing the results is not a trivial exercise.

3 "Other cost components" includes infrastructure total/fixed/variable/marginal costs (for which the 5FP UNITE project will be an excellent source). The model will have to analyse the interplay of fixed variable and marginal costs.
• There needs to be **interaction between different sub-markets**, for instance the effect of changes in taxation in one freight market into other freight markets. For the moment, TREMOVE works like an "archipelago".

• The coverage of different vehicle types, including future technologies, needs further elaboration.

**Relation with other models**

• It has to be assessed whether TREMOVE should be developed in **cooperation with existing models**, like STEEDS, PRIMES and SCENES as well as the model that Cowiconsult is developing for DG Environment; to analyze the impact of vehicle taxation on CO2. One idea is to include some components of STEEDS and PRIMES as part of TREMOVE, and conversely that some of the core elements of TREMOVE would form a part of STEEDS and PRIMES.

• Also, the review should assess the interaction/data interchange with other models of collaborating institutions like MARKAL and others.

• The assessment of investments in transport infrastructure and policies in specific geographical locations should also be looked at.
Annex 3: Relevant Documentation

The following documentation should be helpful in the review process:


- “Short term expertise in the context of Auto-Oil II programme and the envisaged clean air for Europe programme”. GAMS Software GmbH, December 1999

Documentation of other models


- STEEDS (will be made available to the contractor)

- STREAMS/SCENES model description and other information, some of which is available at [http://fpiv.meap.co.uk/fpiv/streams3.htm](http://fpiv.meap.co.uk/fpiv/streams3.htm) and [http://www.iww.uni-karlsruhe.de/SCENES/](http://www.iww.uni-karlsruhe.de/SCENES/)

- Additional documentation will be made available to the selected contractor.