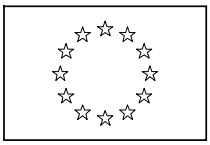


COMMISSION OF THE EUROPEAN COMMUNITIES

Brussels, 05.10.2000
COM(2000) 626 final

COMMUNICATION FROM THE COMMISSION

A Review of the Auto-Oil II Programme

COMMUNICATION FROM THE COMMISSION

A Review of the Auto-Oil II Programme

EXECUTIVE SUMMARY

This Communication reviews the approach taken and the work carried out within Auto-Oil II programme, and reports on the key results in terms of

- emissions and air quality predictions,
- development of modelling tools for assessing policy options
- conclusions on the cost-effectiveness of the policy options studied.

The first auto-oil programme marked a new departure in the development of Community environmental policy by involving stakeholders in a technical programme to identify the most cost-effective ways of meeting certain agreed air quality targets. It resulted in two proposed directives setting fuel quality and vehicle emission standards to apply from 2000.

Auto-Oil II was originally designed to provide the analytical foundation for a similar package of measures to apply from 2005. Since the conciliation agreement between Council and Parliament on the "auto-oil I directives" in fact settled many of 2005 standards, the programme was radically reshaped. The resulting revised objectives were

(1) to complete the work being done to assess future air quality and establish a consistent framework within which different policy options to reduce emissions can be assessed using the principles of cost-effectiveness, sound science and transparency;

(2) to provide the analytical foundation and input for a limited remaining set of Community measures to take effect from around 2005;

(3) to provide the foundation, in terms of data and modelling tools, for the transition towards longer-term air quality studies covering all emission sources.

Like its predecessor, Auto-Oil II has been based on the principles of cost-effectiveness, sound science and transparency; it has also been characterised by the involvement of a wider range of stakeholders than was the case in Auto-Oil I. The cost-effectiveness of measures has been assessed against agreed air quality targets taken from adopted or proposed Community legislation. Separate working groups were set up to identify policy options relating to vehicle technology, fuel quality, inspection and maintenance, non-technical measures and fiscal instruments. Many of the potential measures identified in these working groups have been analysed using the TREMOVE model, an integrated transport sector model that analyses the costs and effects of technical and non-technical measures relating to road transport.

Projected emissions from road transport have been estimated using a base case scenario developed within Auto-Oil II. The results suggest that emissions of the traditionally regulated pollutants will fall to less than 20% of their 1995 levels by 2020, whereas CO2 emissions will continue to rise at least until 2005. Comparison with existing emission scenarios for other sources suggests that the share of overall (non-CO2) emissions attributable to road transport will have fallen substantially between 1990 and 2010 and the relative importance of other sectors will have correspondingly risen.

The implications of these emission projections for future air quality have been assessed using two complementary modelling approaches. Both sets of results predict a large improvement in urban air quality by 2010, although several environmental objectives will still not be met. Among the pollutants studied, the most important remaining challenges concern particulate matter, regional tropospheric ozone levels and some localised exceedances of nitrogen dioxide targets.

The assessment of policy options carried out within Auto-Oil II has led to the identification of cost-effective options for reducing emissions from 2- and 3-wheeled vehicles resulting in the recent adoption of a Commission proposal. In the area of fuel quality the effect of modifying specifications for petrol and diesel fuels have been studied, although it should be noted that the effect of reducing the sulphur specifications below 50 parts per million has not been assessed. Preliminary data relating to special fuel requirements for captive fleets suggest that these could potentially contribute to solving local pollution problems. Analysis of non-technical measures in representative cities has demonstrated their considerable potential for simultaneously reducing emissions and cutting costs, provided that they combined in an optimal way to avoid possible adverse effects. Fiscal measures have also been shown to provide a win-win solution for both the environment and the economy.

Existing legislation relating to fuel quality and emissions from light-duty vehicles, heavy-duty vehicles and two- and three-wheeled vehicles contains a number of review clauses for which work within the Commission is ongoing. Section 5 provides a status report on each of these areas. A proposal for a directive tightening the emission standards for two- and three-wheeled vehicles on the basis of work carried out within the context of Auto-Oil II has already been adopted by the Commission. Technical updates concerning light-duty and heavy-duty vehicles are likely to be proposed by the Commission during the course of the coming year. Amendment of the fuel quality directive 98/70/EC will depend on the outcome of an ongoing consultation exercise concerning sulphur levels in petrol and diesel.

Although much was achieved through the Auto-Oil II Programme, certain shortcomings in the process provide an important opportunity to draw conclusions on how similar programmes should be conducted in future. These lessons are discussed in the final section.

A list of acronyms used within this Communication is provided in the annex.

1. INTRODUCTION

The Auto-Oil II Programme has recently been finalised. Auto-Oil II was a technical programme of work undertaken jointly by several Commission services and a wide

range of stakeholders, in order to assess policy options for achieving air quality objectives with a particular focus on reducing road transport emissions. Auto-Oil II was based on the principles of cost-effectiveness, sound science and transparency.

The results of Auto-Oil II are reported in a series of working group and consultants reports, as well as an overview report from the services of the European Commission available on the Internet. The purpose of this Communication is to explain the approach taken and the main outcomes of the Programme, to report progress on a number of related legislative proposals in the pipeline, and to make some suggestions concerning the way forward.

2. BACKGROUND

2.1. The first Auto-Oil Programme

An overview of the auto-oil principles and methodology is provided in the boxed text. The first Auto-Oil Programme was set up in 1992 to provide the analytical foundation for the setting of vehicle emission and fuel quality standards for the year 2000 and beyond. There was a need for an objective assessment of the most cost-effective ways to reduce emissions from the road transport sector in order to achieve the new air quality standards that were then under development. The Commission therefore invited the European automobile and oil refining industries to participate in a technical work programme with this aim.

The Programme included the following elements:

- studies on the expected development of vehicle emissions on the basis of current trends;
- modelling to predict the resulting air quality for a range of pollutants;
- research on the interaction between vehicle emissions and fuel quality;
- cost-effectiveness studies to help identify promising packages of measures to meet the air quality standards.

The Programme was concluded in 1996 and was closely followed by the adoption of a Commission Communication presenting a future strategy for the control of emissions from road transport (COM(96) 248). This was accompanied by proposals which eventually led to the adoption of Directives 98/69/EC on emission from light-duty vehicles and 98/70/EC on fuel quality. These were joined subsequently by further proposals concerning emissions from other types of vehicles and improved procedures for inspection and maintenance.

The Auto-Oil Principles and Methodology

At the time the Auto-Oil I programme was established, legislation regulating vehicle emissions was already in place and it was apparent that the scope for making further improvements in emissions performance was becoming increasingly limited. It was clear that future emission standards would need to be based on a more comprehensive and integrated approach.

The result was a new departure in the way that Community environmental policy in this area is developed. For the first time ever, the industries that would bear the brunt of environmental measures were involved in their development from the beginning. The work programme brought together prediction of trends in emissions and air quality, research on the interaction between vehicle emissions and fuel quality, and studies to identify the costs and effects of different potential measures in order to identify the most cost-effective means of meeting a series of agreed air quality standards. This systematic approach was designed to ensure that the key principles of **cost-effectiveness**, **sound science** and **transparency** were respected.

Auto-Oil I was not without its critics, however. The perception that the auto and oil industries' participation had not been sufficiently balanced by input from other stakeholders is arguably one of the factors that led the Council and Parliament to depart substantially from the original Commission proposals resulting from Auto-Oil I. For this reason, Auto-Oil II has been characterised by a much wider stakeholder involvement with working groups comprising experts from the Member States and environmental NGOs as well as industry representatives. Auto-Oil II has also addressed a wider range of measures, with individual working groups dedicated to non-technical measures and fiscal instruments.

2.2. Development and Aims of the Auto-Oil II Programme

The proposals arising out of Auto-Oil I included mandatory standards to take effect from the year 2000, as well as a limited number of indicative standards relating to vehicle emissions for 2005. At the same time they envisaged that a further programme should provide the technical foundation for completing and confirming or amending the 2005 standards.

Auto-Oil II was thus launched in the spring of 1997 with this aim. During 1998, however, it became clear that Council and Parliament would in fact settle many of the 2005 standards. As a result, the Auto-Oil II Programme was redirected in order to fulfil the following objectives.

(1) To complete the work being done to assess future air quality and establish a consistent framework within which different policy options to reduce emissions can be assessed using the principles of cost-effectiveness, sound science and transparency.

(2) To provide the analytical foundation and input for a limited remaining set of Community measures to take effect from around 2005.

(3) To provide the foundation, in terms of data and modelling tools, for the transition towards longer-term air quality studies covering all emission sources.

The new measures envisaged within the second objective could include:

- environmental specifications for petrol and diesel fuels complementing the mandatory specifications for sulphur and aromatics;
- environmental specifications for two- and three-wheeled vehicles;
- Community provisions for improved roadworthiness testing of vehicles;
- specifications for fuels used by captive fleets;
- environmental specifications for liquid petroleum gas, natural gas and biofuels.

The purpose of this Communication is to summarise the approach taken in Auto-Oil II as well as the key results and conclusions, to report on progress with a number of related legislative proposals in the pipeline, and to make some suggestions concerning the way forward.

3. APPROACH

In order to fulfil the agreed objectives it was necessary to follow many of the same steps carried out within Auto-Oil I, namely:

- prediction of future road transport emissions and air quality and identify where further effort is needed;
- identification of possible packages of measures in the road transport sector that could help to achieve air quality objectives;
- estimation of the costs and effects of these policy scenarios.

At the same time, the experience of Auto-Oil I and the revised aims of Auto-Oil II led to a number of differences in approach.

- One of the lessons of Auto-Oil I was the need to engage a wide community of interests within the programme. As a result, the participation in AOPII working groups was extended to all interested stakeholders including Member States and non-governmental organisations. The European Parliament was also kept fully informed of progress.
- Secondly, in order to prepare for longer air quality studies covering all emissions an effort was made to estimate emissions from sectors other than road transport and to identify possible additional measures in those sectors.
- Thirdly, the development of a consistent framework for assessing a wide range of policy options necessitated the development of tools and databases that could consider technical and non-technical measures on an equal footing.

- Fourthly, it was acknowledged that an integrated approach also necessitated the need to consider other impacts that were not directly targeted. For example, carbon dioxide (CO2) was not treated as a policy driver in this analysis, the focus being on air quality rather than climate change. It was recognised, however, that trends in greenhouse gas emissions needed to be borne in mind when assessing both technical and non-technical measures, in order to avoid counterproductive side-effects. An indication of future trends in CO2 emissions was included along with an assessment of the impact of air quality measures on CO2.

Management of the programme was carried out by an ad hoc inter-service group which reported progress to a "contact group" comprising all relevant stakeholders. Responsibility for carrying out the various activities was delegated to seven expert working groups, each chaired by a Commission service but with wide participation from stakeholders and other experts.

Air quality objectives were set for five key pollutants: benzene (C_6H_6), carbon monoxide (CO), nitrogen dioxide (NO_2), particulate matter (PM10) and ozone (O_3). These were derived mainly from recently proposed or adopted Directives setting limit or target values for air quality to be achieved in 2005 or 2010. The relevant objectives are shown in Table 1.

In order to estimate current and future concentrations of these pollutants, it was necessary to estimate emissions of benzene, CO and PM10 as well as the precursors of ozone: nitrogen oxides (NO_x) and volatile organic compounds (VOCs). Sulphur dioxide (SO_2) emissions were also estimated. The Commission's proposed national emission ceilings for nitrogen oxides and volatile organic compounds were taken as complementary emission reduction targets for "regional" ozone. These are shown in Table 2.

TABLE 1: MAIN AOP-II ENVIRONMENTAL OBJECTIVES

Pollutant	Legal Basis	Target level	Target date
CO (8-hour rolling average)	COM(1998) 591 final	10 (mg/m³)	2005
NO2 (annual average)	Council dir. 1999/30/EC (22/4/99)	40 (µg/m³)	2010
Benzene (annual average)	COM(1998) 591 final	5 (µg/m³)	2010
PM (annual average)	Council dir. 1999/30/EC (22/4/99)	20 (µg/m³)	2010
Ozone (8-hour mean*)	COM(1999) 125	120 (µg/m³)	2010

* The precise target contained in COM(1999) 125 refers to the highest 8-hour mean within one day, not to be exceeded on more than 20 days per calendar year averaged over 3 years.

TABLE 2: NATIONAL EMISSION CEILINGS FOR NOX, AND VOC (THOUSAND TONNES), TO BE ATTAINED BY 2010 (COM (99)125)[1]

	AOPII base case V5 NO_x Kilotonnes	*National emission ceiling NO_x Kilotonnes*	*AOPII base case V5 VOC Kilotonnes*	*National emission ceiling VOC Kilotonnes*
Austria	98	91	196	129
Belgium	161	127	171	102
Denmark	133	127	81	85
Finland	154	152	109	110
France	873	679	1157	932
Germany	1099	1051	1152	924
Greece	368	264	211	173
Ireland	63	59	41	55
Italy	1048	869	1050	962
Luxembourg	10	8	6	6
Netherlands	260	238	217	156
Portugal	130	144	145	102
Spain	832	781	624	662
Sweden	198	152	283	219
UK	1235	1181	1597	964
EC15	6652	5923	7040	5581

4. KEY RESULTS FROM AUTO-OIL II

4.1. Emission and Air Quality Results

The detailed emission and air quality results are presented in the technical reports. The purpose here is to provide a brief summary of those results.

Projected emissions were estimated on the basis of the so-called "Auto-Oil II base case", essentially a business-as-usual scenario, covering the whole of the EU15, the period 1990-2020, and all emission sources. The methodology for constructing the base case clearly distinguished between road transport emissions and other emissions. Whereas considerable effort was devoted to developing a robust model for estimating road transport emissions, data concerning other sources was generally taken from existing emissions estimates undertaken in the context of other air pollution programmes.

[1] The figures quoted here are taken from the original Commission Proposal for a Directive on national emission ceilings for certain atmospheric pollutants and were used as environmental objectives for the purposes of Auto-Oil II. Political agreement has recently been reached in Council on a different set of targets, but the final result will depend on the outcome of the second reading in Parliament and a possible conciliation procedure.

4.1.1. *Emissions from road transport*

The road transport base case took full account of the latest vehicle and fuel regulations. It used national forecasts supplemented by the scenario developed by the Commission for the macro-economic framework up to 2020, together with other traffic forecasts sourced from local, national and international authorities and detailed information regarding vehicle stocks, costs and prices.

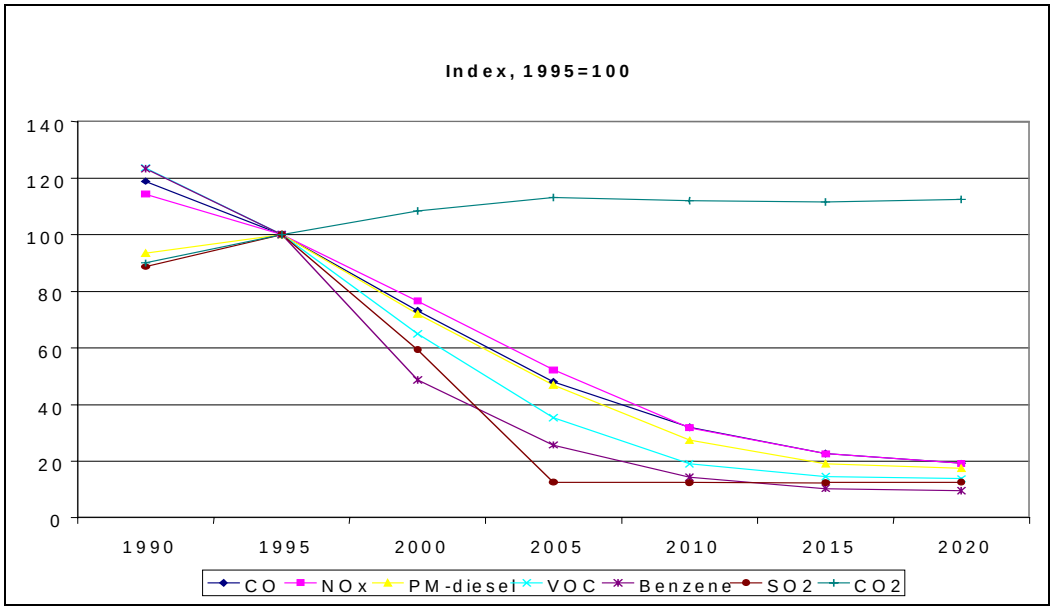
Figure 1 summarises the results from the road transport base case, showing total EU emissions of the each pollutant (including CO2) as a proportion of 1995 levels. It can be seen that emissions of all the pollutants except CO2 are expected to fall to less than 20% of their 1995 levels by 2020, whereas CO2 emissions will continue to rise until 2005 before stabilising (on the assumption that the voluntary commitments of the car manufacturers are met). These emission reductions are expected in spite of the forecast growth in transport demand. SO2 emissions will decrease most rapidly, falling to around 10% of their 1995 levels as early as 2005, while NOx emissions are the slowest of the regulated pollutants to fall, remaining at around 30% of their 1995 levels in 2010.

It should be noted that the results concerning particulate matter (PM) refer only to diesel emissions. It should also be noted that, in addition to these results concerning total EU emissions, the base case results also revealed considerable geographical variations in the projected reductions.

4.1.2. *Emissions from other sources*

Emission scenarios for other sources were taken from IIASA's Regional Air Pollution Information and Simulation (RAINS) model, from a PM10 inventory and forecast carried out by TNO in 1998, or calculated from other existing scenarios using simple methodologies (CO, benzene and CO2).

FIGURE 1: ROAD TRANSPORT EMISSIONS IN EUROPE



Apart from individual source categories such as large combustion plants and waste incinerators, the process of setting mandatory, quantitative emission standards for the six Auto-Oil II pollutants in the road transport sector has not really been paralleled by similar developments in other sectors. While it is reasonable to assume that emission reductions in the other sectors are therefore likely to be generally less impressive than in the road transport sector, these reductions are also generally more difficult to predict. For example, it has not been possible to take into account the potential impact that instruments such as the integrated pollution prevention and control (IPPC) Directive 96/61/EC may have on emissions. Moreover, many of the scenarios used extend only as far as 2010, with emissions being assumed to remain constant thereafter. Comparisons between road transport and other emissions must therefore be treated with caution, particularly as concerns the 2020 projections.

Nevertheless, the results for other than road transport sources presented in the technical report would seem to indicate that, on the basis of current trends and policy, the share of overall emissions attributable to road transport will have fallen substantially between 1990 and 2010 for the six Auto-Oil II pollutants (excluding CO2), and the relative importance of other sectors will have correspondingly risen.

4.1.3. Air quality assessments

Two types of air quality assessments were carried out within Auto-Oil II:

(1) urban impact assessment modelling co-ordinated by the Environment Institute of the European Commission Joint Research Centre;

(2) a complementary "generalised empirical approach" undertaken by the European Environment Agency.

The urban impact assessment (UIA) concentrated on a detailed examination of air quality in ten cities across Europe. This examination was carried out using an integrated methodology developed at the Joint Research Centre using several models for establishing and validating a realistic physical and chemical relationship between emissions and air quality concentrations. The cities selected for this analysis were Athens, Berlin, Cologne, Dublin, Helsinki, London, Lyons, Madrid, Milan and Utrecht. In rough terms, the assessment took data on source emissions within a 300kmX300km domain around each city and combined these with the base case emissions data to estimate the evolution of these emissions over the modelling period (1990-2020). Taken together, the domains studied included 1065 settlements containing 46.5% of the EU15 urban population. Air quality projections were then generated on the basis of dispersion and photochemical models using representative meteorological data, and validated against monitoring data.

The generalised empirical approach (GEA) covered around 200 urban agglomerations and used simple, top-down models to estimate the fraction of the European urban population living in cities that are not expected to comply with the air quality objectives in future years unless further action is taken. The approach complements the more detailed UIA modelling. While the simplifications contained therein may obviously introduce uncertainties, the advantage of the approach lies in its consistency and sample size. As with the UIA modelling, the Auto-Oil II base case emissions projections were used as the basis for air quality predictions for the year 2010.

Both sets of results suggest that the projected reduction in emissions will result in a large improvement in urban air quality by 2010. Nevertheless, several environmental objectives will still not be met, in particular as regards PM. The number of inhabitants living in cities where the objectives for four or more pollutants are exceeded simultaneously is expected to fall from more than 40 million in 1995 to less than 4.5 million in 2010. In the case of PM, and subject to the uncertainties mentioned below, only modest reductions in total population living in non-attainment areas are expected, although the severity of the exceedances will be substantially reduced. A final conclusion is that even the total elimination of traffic emissions whilst keeping non-transport sources unaffected would not be enough to remove all exceedances by 2010. Future measures will therefore also need to target sectors other than road transport.

Special remarks must be made in relation to PM and ozone.

The modelling of PM10 was subject to a variety of important uncertainties including the emission inventories, concentration measurements and the lack of detailed modelling of secondary particulates. Despite these limitations, it can nevertheless be assumed with reasonable confidence that PM10 exposure will remain a significant urban air quality problem for the foreseeable future.

Although a key pollutant for future air quality policy, ozone modelling within Auto-Oil II was very limited since the ozone strategy being developed in parallel already provided a full evaluation of predicted ozone levels in 2010 and the Commission had already proposed a set of national emission ceilings to be met by that date.

The UIA modelling also included a calculation, using mass conservation techniques, of the contribution of each emission source category to the concentration of each pollutant in the ten cities. Although there is uncertainty associated with any technique of source apportionment, the results of this analysis suggest that, despite its declining share of total emissions, road transport will still have a major influence on urban air quality in those cases where exceedances are predicted.

4.2. Assessment of policy options: development of modelling tools

As stated in section 3, the development of a consistent framework for assessing all possible policy options to reduce emissions necessitates the development of tools that can consider technical and non-technical measures on an equal footing. In this context, an important contribution of Auto-Oil II has been the development and testing of the TREMOVE model and its databases.

TREMOVE was developed by and on behalf of the Commission services in co-operation with experts from industry, Member States and NGOs. Its purpose was to support the policy assessment process within Auto-Oil II by providing an integrated transport sector model that analyses the costs and effects (in terms of emission reductions) of a wide range of technical and non-technical measures relating to road transport. Within Auto-Oil II the model has been used in the following ways:

- to build a comprehensive reference scenario whilst improving the general understanding of the transport system as a whole;

- to identify the cost-effectiveness of individual measures, taking account of factors such as their technical performance, impact on life-time driving costs and market adaptation;

- to identify cost-effective policy packages;

- to identify possible side-effects (e.g. on noise and accidents) of measures designed to improve air quality.

The purpose of this type of model is not to develop an additional emission calculation methodology but rather to combine existing methodologies in a comprehensive policy simulation tool. The types of input data required include general economic conventions and assumptions, estimations of the costs of different measures (including capital and operating costs), the effect of measures on emissions per kilometre from individual vehicles and information regarding the quality of market fuels. It should be emphasised that the purpose of such models is to provide strategic guidance and that the accuracy of their results depends crucially on these input data.

The results and conclusions presented in the following section are based on analyses performed using TREMOVE, which was generally accepted by stakeholders as a valuable tool for the integrated assessment of policy options relating to road transport emissions. While it would clearly be inappropriate to single out one model as the basis for future analysis, the acceptance of this type of approach represents a significant advance for policy development in this area.

4.3. Assessment of policy options: results and conclusions

For reasons of comparability, all policy measures were assumed to be implemented from 2005 onwards. It is clear, however, that the effectiveness of some measures (such as retrofitting schemes) could be increased by introducing them earlier. In order to allow an analysis of changing costs over time, total costs to society are expressed in present value terms, i.e. the sum of annual costs up to the year 2020 discounted to date.

Policy options studied within Auto-Oil II included measures on vehicle technology, measures on fuel quality, inspection and maintenance, non-technical measures and fiscal instruments.

4.3.1. Vehicle technology measures

In view of the agreement reached between Council and Parliament on mandatory standards applicable from 2005, vehicle technology measures studied within Auto-Oil II were limited to the selected application of advanced after-treatment systems for certain categories of vehicles and to motorcycles. The introduction of advanced after-treatment systems such as PM traps and deNOx catalysts was assumed to form part of the reference scenario after 2005 for passenger cars and light-duty vehicles. In the case of heavy-duty vehicles, it was assumed that PM traps would be introduced in the fleet from 2005 whilst deNOx traps would be fitted from around 2008.

Possible measures relating to motorcycle technology distinguished between the different types and sizes of engines and included engine modifications, oxidation

catalysts, direct injection, secondary air injection and three-way catalysts. The additional costs and reduction in emission factors associated with these measures were taken from a study carried out on behalf of the Commission. The cost-effectiveness of four policy scenarios including different combinations of these measures were studied using TREMOVE. The average cost to society of the scenarios ranged from 800 to 2700 million € and led to important VOC reductions (up to 3% of total EU road transport emissions), with higher potential in southern Member States and in urban areas with a high motorcycle usage.

Analysis related to the targeted application of advanced vehicle technology systems suggested that their implementation, in particular related to captive fleet vehicles which have relatively long lifetimes, could generate important reductions in emissions at the local level and could provide cost-effective solutions for meeting air quality standards in polluted areas. Whereas the simulated effects often exceeded the potential of EU-wide measures, impacts and costs very much depend on the scope of the application and the situation of the local network and fleet.

4.3.2. Fuels quality measures

On the fuels side, scenarios relating to petrol, diesel, city fuels and alternative fuels were studied. In view of the air quality predictions for 2010 these were focused primarily on reducing PM and VOC emissions. Four petrol scenarios aiming at VOC reductions were considered along with five diesel scenarios aiming at PM reductions. It is important to note that, since the 2005 standard for the sulphur content of both fuels had already been set at 50ppm in Directive 98/70/EC, none of these scenarios included further reductions in the sulphur content. It is also important to note that emission impacts of the scenarios studied were calculated on the basis of a set of assumptions developed during Auto-Oil I concerning the relation between emissions and fuel parameters. These assumptions were developed on the basis of the vehicle technology that was available at that time. As new vehicles replace older ones in the vehicle park the technical relevance of these assumptions is likely to diminish.

Total costs for the refining industry were estimated at 300 to 700 million € per year for the petrol scenarios and 400 to 1000 million € per year for the diesel scenarios, although significant differences could be expected between Member States. The impact of these costs on fuel prices would be very limited, and would not lead to significant changes in modal choices (such as switches between petrol- and diesel-driven vehicles or between private and public transport). The average cost to society of these scenarios ranged from 1700 to 4300 million € for gasoline scenarios and from 2200 to 6200 million € for diesel scenarios. The impact of the petrol scenarios on VOCs was estimated at around 1-3% of total road transport emissions, but it was also estimated that they would increase NOx emissions by around 1-2%. They might also necessitate the increased use of oxygenate additives. The diesel scenarios were estimated to reduce PM emissions by around 5-7% of total road transport in 2010.

More stringent fuel quality specifications were studied for so-called “city fuels”, i.e. fuels used by captive vehicle fleets in and around urban areas. Fuel formulations involving further changes in density, polyaromatics and T95 can deliver PM emission reductions of up to 20%. Alternative fuels studied within Auto-Oil II included gaseous fuels (compressed natural gas, liquid petroleum gas and dimethyl ether), biofuels (biodiesel and bioethanol), and water-diesel emulsions. The potential of such fuels to achieve reductions in polluting and CO2 emissions is recorded in the

technical report, together with their estimated costs. These preliminary data suggests that such fuels may provide a potential solution to certain local problems. Of course, much recent research into alternative and reformulated fuels is taking place outside the Auto-Oil context. A key challenge in the future will be to ensure that as much relevant research as possible is taken into account when formulating policy.

4.3.3. Inspection and maintenance

The emission reductions predicted in the base case take account of the expected general deterioration over time of the emissions performance of individual vehicles. They do not, however, take account of the risk of complete failure of the abatement technology. The existence of properly operating inspection and maintenance (I&M) regimes is therefore of crucial importance in ensuring that the expected emission reductions are realised.

Measures relating to inspection and maintenance focused mainly on the roadworthiness testing of catalyst-equipped cars built to the Euro 1 standard, i.e. in conformity with Directive 91/441/EEC. The study evaluated tests in terms of their ability to identify cars emitting more than 50% above the relevant emission standards. The possibility of using remote sensing techniques was also investigated. The study found that the currently regulated short test identified only 15% of high polluters amongst catalyst-equipped vehicles. A properly operating I&M programme could have the potential to bring about considerable reductions in emissions at the time of introduction. The development of on-board diagnostic (OBD) systems is also seen as a promising avenue for future roadworthiness testing schemes.

4.3.4. Non-technical measures

A wide range of non-technical measures in the areas of transport policy and demand management was studied, including traffic management, public transport and intermodality, pricing measures and modernisation of the vehicle fleet. Information on practices at urban level and data needed for a cost-effectiveness analysis was gathered by means of a questionnaire distributed to city authorities, research organisations, consultants, pressure groups and public transport operators. The replies indicated that present policy is generally concentrated on traffic management, public transport and road pricing, but there was little quantitative information on the costs and impacts of these measures.

A number of measures applicable to Athens and Lyon were assessed using TREMOVE. Some individual non-technical measures, such as parking charges and time-differentiated road pricing, were found to have a significant potential impact on total emissions in those areas. Most of them were also accompanied by cost savings and can therefore be seen as "win-win" solutions.

Possible adverse effects of certain measures were nevertheless identified, such as the following.

- Measures designed to reduce congestion tend to encourage additional traffic;
- Traffic restrictions to central urban areas leading to development of activities in suburban belts, generating additional traffic flows that are much more difficult to bundle;

- The emission impact of measures designed to increase the attractiveness of bus transport depends crucially on assumed load factors and emission rates.

It should be possible to avoid such adverse effects by combining physical, pricing and organisational measures in a "push and pull" approach towards motorised road transport. Indeed, such combined approaches generally tend to be more effective than single measures addressing only one aspect of the transport system, and provide the best possibilities for sustainable and cost-effective solutions.

4.3.5. Fiscal measures

Fiscal measures studied within Auto-Oil II were divided into stand-alone measures not linked to specific technical standards and measures designed to help promote specific vehicle technology or fuel quality standards. Specific fiscal scenarios assessed using TREMOVE included increases in the minimum fuel duty at Community level, replacing registration taxes with increased fuel duties, replacing circulation taxes with fuel duties.

The results suggested that overall, undifferentiated increases in excise duties led to modest emission reductions (around 2%) but would have other societal benefits assuming that the increased revenues are used to reduce labour tax. Changes in the levels of circulation and registration tax levels were found to have a higher potential to reduce emissions, although this varies considerably between Member States owing to substantial differences in their current tax structure. Considerable analytical effort would be needed to ensure budget neutrality.

4.3.6. Integrated assessment

It was generally accepted that the method used in Auto-Oil II had led to important progress in integrated policy assessment. Stakeholders particularly welcomed the simultaneous analysis of several air quality objectives and the consideration of the performance of the transport sector as a whole, rather than assessing individual technical and non-technical solutions in isolation. The advantages of studying vehicle technologies and fuel issues simultaneously, as introduced in Auto-Oil I, were again demonstrated. The geographical differentiation and the close link between emission forecasts and air quality projections also allowed a better assessment of possible solutions while accounting for specific Member State characteristics where relevant.

Based on the outcome of the air quality predictions and scenario results described above, it seems that local measures will contribute to a cost-effective solution to the remaining air quality problems related to CO, benzene and NO2. It is nevertheless important to monitor future trends in the transport sector closely. This will ensure that the positive outlook is realised in practice and will enable timely action if this turns out not to be the case.

5. RELATED LEGISLATIVE PROPOSALS

The technical requirements contained in Community legislation aimed at reducing emissions from road transport fall into four groups.

(1) Specifications relating to the quality of petrol and diesel fuels are laid down in Directive 98/70/EC.

(2) Vehicle emission standards relating to light-duty vehicles (international categories M1 and N1) are laid down in Directive 70/220/EEC, as last amended by Directive 98/69/EC (and subsequently by Directive 1999/102/EC).

(3) Vehicle emission standards relating to heavy-duty vehicles (other categories) are laid down in Directive 88/77/EEC, as last amended by Directive 1999/96/EC.

(4) Vehicle emission standards relating to two- or three-wheeled vehicles are laid down in Directive 97/24/EC.

Directives 98/69/EC, 98/70/EC and 1999/96/EC all contain provisions relating to the updating and completion of these technical requirements. The purpose of this section is to report on progress with some of these updates, as well as parallel developments related to non-road mobile machinery.

For the reasons explained in section 2.2, the link between the Auto-Oil II Programme and these legislative updates is not as strong as originally envisaged. In particular, the fact that many of the mandatory standards to apply from 2005 were set in Directives 98/69/EC and 98/70/EC caused a redirection of the work to focus less on filling legislative gaps and more on providing a foundation for longer-term air quality studies. Nevertheless, some of the Auto-Oil II results have contributed or will contribute more or less directly to the development of legislation described in this section. A particular example is the proposal setting new standards for two- and three-wheeled vehicles, which are based on cost-effectiveness studies carried out within Auto-Oil II and referred to in section 4.

5.1. Fuel quality specifications

Directive 98/70/EC forms part of the Auto-Oil I package of measures envisaged in the future strategy for the control of emissions from road transport outlined in the Commission Communication COM(96) 248. As explained above, whereas the original proposal accompanying the Communication envisaged setting mandatory standards for 2000 only, the Council and European Parliament decided also to include mandatory standards for 2005 in this Directive.

The 2005 standards are laid down in Annexes III and IV of the Directive. These Annexes are, however, incomplete, and include only the following specifications:

- for petrol, a minimum research octane number of 95, a minimum motor octane number of 85, a maximum aromatic content of 35% by volume, and a maximum sulphur content of 50 parts per million;

- for diesel, only a maximum sulphur content of 50 parts per million.

For this reason, Article 9 of the Directive envisages a revision of the Directive, which should form an integral part of the Community's strategy for meeting the requirements of Community air quality standards and related objectives. Completion of the mandatory 2005 specifications was therefore one of the measures for which Auto-Oil II was to provide a technical foundation. It was not envisaged, however,

that such a revision would alter the limits on sulphur content of either petrol and diesel, since these had already been set in the Directive.

Since the adoption of Directive 98/70/EC, a number of technological, political and market developments have led to a reopening of the question of whether the maximum sulphur content of petrol and diesel should be lowered some time after 2005. Since the Auto-Oil II Programme had not addressed this question, the Commission launched in May 2000 an open call for evidence on this issue. The contributions submitted in the context of this call for evidence will be synthesised and reviewed by a panel of independent experts. The Commission will draw on the findings of this exercise when deciding whether any further provisions relating to the sulphur content of petrol and diesel should be included in the revised Directive.

It is hoped that a Proposal to amend Directive 98/70/EC can be adopted at the beginning of 2001.

5.2. Light-duty vehicles

The Commission Proposal leading to the adoption of Directive 98/69/EC was another part of the "Auto-Oil I package" accompanying Commission Communication (96)248. Like Directive 98/70/EC, Directive 98/69/EC went further than originally envisaged in the Commission Proposal in setting many of the technical standards to apply from 2005. Nevertheless, Article 3 (1) of the Directive envisages the following further measures to be proposed by the Commission and taking effect from 1 January 2005:

- Category N1 Classes II and III limit values for cold start in low temperature ambient air (266 K or –7° C);
- Community provisions for improved roadworthiness testing;
- the threshold limit values for on-board diagnostics (OBD) for 2005/6 for M1 and N1 vehicles;
- examination of Type V testing, including the possibility of abolishing it.

In contrast to the strategic analysis that was the task of Auto-Oil II, detailed technical discussion and preparation of these measures takes place in the Commission's Motor Vehicle Emission Group (MVEG). Comments concerning the environmental importance and progress made on each of these measures, as well as the related issues of reference fuels and enhanced durability testing, is given below.

5.2.1. Cold start emissions from N1 Class II and III vehicles

"Cold start emissions" refers to the emissions performance of a vehicle starting and running under cold temperature conditions. It is of relevance also at the beginning of a journey at normal temperatures, before the engine and exhaust systems have reached their operational temperature. Since many journeys in urban areas are of short duration, cold start emissions can be a predominant factor in total trip emissions. While these measures target vehicles with petrol engines, many N1 Class II and III vehicles have diesel engines, whose emissions performance is less

dependent on temperature conditions. This issue is therefore not of high importance from an environmental point of view.

The proposal has nevertheless been discussed and agreed in principle within MVEG. It is expected to be adopted by the Commission during the coming weeks.

5.2.2. Improved roadworthiness testing

As emission limit values become stricter, a comparatively small proportion of vehicles failing to comply with them can potentially account for an increasing share of total vehicle emissions. For this reason a comprehensive roadworthiness programme ensuring that vehicles are properly maintained may be of key importance in ensuring that the expected reductions in emissions from road transport are actually achieved.

On the other hand it is expected that newer vehicles will have more stable emissions performance than older ones. Since the development of on-board diagnostic (OBD) systems is seen as a promising avenue for the future, effort within the Commission has so far been channelled towards the further development of OBD as an I&M tool to aid roadworthiness testing rather than improving roadworthiness emission testing procedures.

5.2.3. OBD thresholds for 2005/6

On-board diagnostic (OBD) systems are designed to alert drivers when there are any failures in the performance of pollution abatement systems. It is also a valuable aid to the diagnosis and repair of problems and failures in vehicle emission control systems. A technically well-developed OBD is thus an important tool in keeping emissions low during real-life driving, and such systems will therefore play a key role in future I&M programmes. Directive 98/69/EC provides for the introduction of the first stage of OBD requirements for petrol vehicles from 2000/1 and for diesel M1 vehicles from 2003/4. These will need to be brought into line with technical developments, and in particular new OBD thresholds may need to be defined for petrol vehicles in conjunction with the 2005 emission standards. For the reasons given above, the improvement of OBD requirements is of great value from an environmental point of view.

A technical study on behalf of the Commission is currently ongoing, and the Commission expects to adopt any necessary proposal on this issue during the first half of 2001.

5.2.4. Examination of the Type V test and the in-service conformity check

The so-called “type V” test is an ageing test designed to verify the durability of anti-pollution devices. This issue is linked with the in-service conformity check that was introduced by Directive 98/69/EC. Once a fully effective in-service conformity check is in place it may no longer be necessary also to test the durability of anti-pollution devices on prototype vehicles at the time of type-approval. However, there is as yet no experience on the effectiveness of the in-service conformity check system. It would seem necessary to wait for such experience to be gained before taking a decision on the future role of the type V test.

5.2.5. Reference fuels

When testing the emissions performance of new vehicles during the type approval process, manufacturers are required to use reference fuels complying with certain specifications laid down in Directive 98/69/EC. These reference fuels provide a standard basis for laboratory tests. However, some reference fuel specifications may not be representative of the fuels that are actually sold in the marketplace and can, in some cases, give emission results during laboratory tests that do not necessarily reflect the emissions performance of in-use vehicles. The adaptation of some of these reference fuel specifications is among the review obligations of Directive 98/69/EC. In particular, the specifications relating to the sulphur content of petrol and diesel and the aromatics and oxygen content of petrol are to be modified for the reference fuels used to test vehicles complying with the 2005 standards. These revised reference fuel specifications will ensure that the fuels used for type-approval are representative of the fuels that are actually sold in the marketplace.

This issue is closely linked with the revision of Directive 98/70/EC, and in particular the question of whether further provisions relating to sulphur content will be set therein. A proposal is expected at the beginning of 2001, at the same time as the amendment of Directive 98/70/EC.

5.2.6. Enhanced durability testing

In addition to the measures listed in Directive 98/69/EC Article 3 (1) to take effect from 1 January 2005, the Directive also contains a list of measures that could be contained in legislation to come into force after 2005. One of these is the modification of the durability requirements, including an extension of the existing durability test.

An extension in both time and distance of the durability requirements could constitute an important part of future environmental improvements.

5.3. Heavy duty vehicles

The Auto-Oil I proposals relating to fuel quality and emissions from light vehicles were subsequently followed by a further proposal relating to emissions from heavy-duty vehicles. This led to the adoption of Directive 1999/96/EC, which sets emission limit values for heavy duty vehicles to take effect from 2000 and 2005, as well as more stringent limits on NOx emissions to take effect from 2008.

Like Directive 98/69/EC, Directive 1999/96/EC envisages the adoption of a number of further measures to take effect from 2005/6. These are:

- provisions relating to the development of on-board diagnostic (OBD) and on-board measurement (OBM) systems to monitor in-service exhaust emissions;
- durability requirements and in-service control;
- appropriate limits for currently non-regulated pollutants that may become important as a result of the widespread introduction of new alternative fuels.

The Commission views all these issues as having a high priority from an environmental point of view, and intends to submit relevant proposals during the first half of 2001.

In addition to the above, Directive 1999/96/EC also requests the Commission to report by 31 December 2002 on the current status of technology needed to meet the mandatory NOx standard for 2008. The Commission will start work on this in the near future, in order to give appropriate positive signals to the industry concerning the prompt implementation of this standard.

5.4. Two- and three-wheeled vehicles

Current emission limits for motorcycles and mopeds are defined in Directive 97/24/EC and have been mandatory for new EU type approvals since 17 June 1999. In Article 5 of Directive 97/24/EC, the Commission is requested to put forward proposals for a further tightening of the emission limits for motorcycles on the basis of the investigation of the emission reduction potential of technology and an assessment of the costs and benefits deriving from the application of more stringent limit values. This provision does not include mopeds, as a second stage to be applicable from 2002 has already been introduced in Directive 97/24/EC.

After a technical feasibility study, the Commission has further assessed the cost-effectiveness of four policy scenarios comprising different combinations of technological emission control measures for motorcycles. On the basis of this analysis, the Commission has recently adopted Proposal COM(2000) 314 final to amend Directive 97/24/EC.

The proposal determines a unique set of emission limits (both for 2-stroke and 4-stroke motorcycles) for carbon monoxide (CO), hydrocarbons (HC) and oxides of nitrogen (NO_x) to be applied for type approval of motorcycles from 1 January 2003 for new vehicle types, and from 1 January 2004 for all new vehicles. The new limits represent important reductions with respect to present-day limits for HC and CO. New limit values for tricycles and quadricycles are also introduced.

Furthermore, the proposal sets out permissive limit values to be applied in order to provide an option for Member States that would like to stimulate more advanced environmental technology through the granting of fiscal incentives. The proposal envisages a second stage of emission limits to further reduce motorcycle emissions from the year 2006. Such limit values can only be developed in detail when the test cycle has been revised. A fundamental review of the test cycle is currently under development at the level of the UN-ECE Working Group on Pollution and Energy (GRPE – a sub-group of WP29). In line with the timetable of this task, it is considered feasible to bring forward a new proposal before the end of 2002, introducing the new test cycle, as well as mandatory emission limits to be applied from 2006.

5.5. Non-road mobile machinery

From a technical point of view, the emissions from non-road mobile machinery are closely related to vehicle emissions. They are currently regulated by Directive 97/68/EC, which covers compression ignition engines with a power output between

18 kW and 560 kW. Recital 5 of the Directive envisages that the scope of the Directive should eventually be extended to include petrol (spark ignition) engines.

Consultations with Member States on a possible extension of the scope have been carried out, and the Commission intends to come forward with a proposal before the end of the year.

6. CONCLUSIONS

6.1. Lessons learnt from Auto-Oil II

Both Auto-Oil programmes have made an important contribution towards a more open, rational and systematic approach to environmental policy making. Auto-Oil II has been especially innovative in a number of ways.

- Auto-Oil II has been characterised by the involvement of a wide range of stakeholders (including Member States, European Parliament, industry and NGOs) from the earliest stage of policy development.

- Auto-Oil II has been an integrated approach in that it has looked at a wide range of potential measures, both technical and non-technical, in order to meet a number of air quality targets. It has involved an integrated assessment of these measures in order to identify packages that can meet these targets in the most cost-effective way.

- Through the intensive stakeholder dialogue and involvement of dedicated experts, the Auto-Oil II structure has ensured that its findings are based on the best available scientific information. The development and acceptance of models that allow the cost-effectiveness of both technical and non-technical measures to be assessed in a holistic way has been a particularly useful outcome of the programme.

Auto-Oil II has also provided an important learning experience for all involved. One particularly important lesson concerns the way in which the founding principles of cost-effectiveness, sound science and transparency should be applied. Ultimately, the purpose of programmes such as Auto-Oil is to assist policy-making and the development of legislation. If they are to fulfil this purpose it is essential that they are sufficiently flexible to keep up with technological, political and market developments. The high degree of transparency and stakeholder consultation inherent in the Auto-Oil methodology needs to be balanced by the provision by stakeholders of essential data on technology and associated costs: stakeholder involvement must not be allowed to become a one-way street.

Two further lessons relevant for the development of future air quality policy are the following.

- There is a need for improved scientific knowledge on the links between emission targets and air quality requirements.

- A really cost-effective policy package will require an integrated approach across sources, pollutants and measures. One of the key conclusions from Auto-Oil II is

that an exclusive focus on road transport and specific sources does not guarantee a cost-effective outcome. Similarly, the penetration into the road vehicles market of alternatives to the internal combustion engine will also need to be taken into account in the future.

While the advantage of the Auto-Oil approach lies in its systematic, integrated and transparent treatment of policy objectives, the danger of such an approach is that it can be inflexible. But if policy decisions are to be based on the best available scientific information, as the Treaty requires, then the process for gathering such information must fit in with the time-scales imposed by such developments. Efforts in the direction of a transparent and open dialogue with stakeholders must therefore not result in insistence on the application of rigid methodological approaches that are incompatible with sufficient flexibility and political relevance.

6.2. Measures to be taken in the transport sector

As far as the transport sector is concerned, Auto-Oil II has yielded some useful results concerning the cost-effectiveness of a range of technical and non-technical measures. Some of the key conclusions in this respect are listed below. While some of these are relevant for Community action, others are to be taken at national or local level. The Commission invites the Member States to fulfil their role in this respect.

- Cost-effective options for reducing emissions from 2- and 3-wheeled vehicles have been identified.

- In the area of fuel quality a major unresolved issue is the possible further reduction of sulphur levels in petrol and diesel below 50ppm. A consultation exercise on this issue is currently ongoing. The adaptation of other fuel parameters will be considered in the light of the outcome of the sulphur review.

- Special requirements for fuels used by captive vehicle fleets in and around urban areas could potentially contribute to solving local pollution problems.

- On-board diagnostic systems will play a central role in the future development of inspection and maintenance regimes, but will not replace regular controls in the short term.

- Non-technical measures, to be taken primarily at national or local level, provide a particularly attractive opportunity for simultaneously reducing emissions and cutting costs. To be most effective they need to be applied in combination, and care should be taken to avoid a number potential adverse effects.

- Fiscal measures also provide a win-win solution for both environment and the economy. In the case of undifferentiated increases in fuel taxes the main advantage is the provision of a sustainable and relatively undistorting tax resource, while their effectiveness in reducing emissions depends on assumptions regarding the elasticity of transport demand. By contrast, well-targeted differentiated taxes are considered to be an effective tool to influence consumers behaviour, and can therefore confidently be expected to provide an effective means of accelerating improved environmental performance in the transport sector, with a very low or negative societal cost.

6.3. The future of air quality policy

The emissions and air quality projections developed within Auto-oil II suggest that, among the pollutants studied, the key remaining challenges are:

- particulate matter
- localised NO2 exceedances
- ozone (compliance with NOx and VOC emissions ceilings).

In addition to these it will be important to watch out for current or emerging problems associated with non-regulated pollutants such as PAH, and to monitor emission trends to ensure that the positive outlook in relation to CO, benzene and NO2 is realised.

While the analysis has led to some useful results concerning measures to be taken in the transport sector, it also strongly suggests that increased attention will need to be paid to other emission sources if further improvements in air quality are to be achieved. With this in mind, the Commission intends to launch at the beginning of 2001 a new, integrated Clean Air for Europe programme leading to a comprehensive air quality strategy covering all the relevant emission sources by 2004.

Finally, the expected reductions in polluting emissions from road transport are not matched by a similar reduction in CO2 emissions. While the Community strategy relating to CO2 emissions from road transport is beyond the scope of this Communication, it is clear that this is a key issue that needs to be addressed in the framework of our Kyoto obligations and the European Climate Change Programme (ECCP). While the focus of Clean Air for Europe will be on polluting rather than greenhouse emissions, very close links with ECCP will be maintained in order to ensure that the approaches taken are fully co-ordinated.

Annex: List of Acronyms

CO	=	carbon monoxide
CO2	=	carbon dioxide
ECCP	=	European Climate Change Programme
GEA	=	generalised empirical assessment
GRPE	=	Group on Pollution and Energy
HC	=	Hydrocarbons
IIASA	=	International Institute for Applied Systems Analysis
I&M	=	inspection and maintenance
M1	=	international category of vehicles used for the carriage of passengers and comprising no more than eight seats in addition to the driver's seat.
MVEG	=	Motor Vehicle Emissions Group
N1	=	international category of vehicles used for the carriage of goods and having a maximum weight not exceeding 3.75 tonnes
NGO	=	non-governmental organisation
NO2	=	nitrogen dioxide
OBD	=	on-board diagnostics
OBM	=	on-board measurement
PAH	=	polyaromatic hydrocarbon
PM	=	particulate matter
PM10	=	particulate matter with diameter less than 10µm
SO2	=	sulphur dioxide
TNO	=	Nederlandse Organisatie voor Toegepast-Natuurwetenschappelijk Onderzoek
UIA	=	urban impact assessment
UN-ECE	=	United Nations Economic Commission for Europe
VOCs	=	volatile organic compounds