concawe review

Volume 11 • Number 1 • April 2002

Photographs: cover and page 11, BP plc
Design and production: Words and Publications, Oxford, United Kingdom • www.words.co.uk

Foreword

The CONCAWE *Review* has now been published for 10 years. While content is what really matters and gets all our attention, we are aware that presentation plays its role, hence the facelift and the 'new look' of our magazine. We hope that you will find the new format attractive, and would be pleased to receive any comments you may have.

Our aim remains of course to inform our readers on a range of subjects to which CONCAWE currently contributes, providing facts, figures and opinions. In this issue we lead with an article on biofuels, a topic which is high on the EU Commission's agenda through the proposed biofuels Directive. This is also a complex and often misunderstood or misrepresented area and we believe that it is essential to establish a clear and non-controversial picture of the potential for such fuels to save fossil energy and avoid greenhouse gas emissions. Through our cooperative 'Well-to-Wheels' study programme with EUCAR and the EU Commission's Joint Research Centre, we hope, during the course of this year, to help shed more light on the potential of biofuels in comparison with both conventional and other alternative fuels.

The next four articles, dealing with emissions from ships, best available techniques for refineries, the contribution of fuel quality to modern diesel engine emissions and potential changes in non-road fuels specifications, all have in common the underlying theme of cost-effectiveness, an essential concept in an era of increasingly complex and far-reaching legislation.

The last article summarizes the encouraging performance of European oil pipeline operators in reducing the number and severity of spillage incidents over the past 30 years.

Jean Castelein
Secretary-General, CONCAWE

Contents

On the basis of published studies, CONCAWE has evaluated the 'field-to-tank' energy and greenhouse gas (GHG) balance for the two most prominent biofuels in Europe, namely rapeseed methylester (RME) and ethanol (from wheat or sugar beet). Although production of these biofuels gives modest net energy and GHG savings, land availability limits the global impact to rather small numbers. Judicious use of by-products can improve the efficiency of the process although it remains to be seen whether practicality and economics could support such practices on a large scale. More details will be available in a CONCAWE report to be published soon.

Enquiries to: Jean-François Larivé

Within the context of the 'Community Strategy on Air Pollution from Seagoing Ships', the EU Commission is studying the merits of seeking the SO_x Control Area status for the Mediterranean and Europe's Atlantic approaches. SO_2 deposition data from work associated to the National Emission Ceiling Directive shows that such a move would have minimum impact on acidification and other issues and would not be justifiable from either an environmental or a cost-effectiveness point of view.

Enquiries to: Peter Goodsell

Within the framework of the Integrated Pollution Prevention and Control (IPPC) Directive, the refinery 'BREF' (Best Available Technique reference document) has recently been completed, with the significant involvement of CONCAWE. This article reviews the process that was followed to generate this document and the difficulties that arose along the way. It also highlights the main points of concern to CONCAWE and particularly the potential misuse of the emission levels mentioned in this important document.

Enquiries to: Eric Martin and Peter Goodsell

Biofuels

What are the real savings?

Biofuels can, in principle, provide a renewable source of energy and, by displacing fossil fuels, reduce greenhouse gas (GHG) emissions to the atmosphere. However, the biofuels production process itself consumes energy and emits greenhouse gases. To identify what the real savings are in terms of energy and GHG emissions, a careful evaluation of the entire 'field-to-tank' process is needed. In 1995, CONCAWE published a report (02/95) on alternative fuels, based on an extensive literature review. A new report to be published in due course updates the earlier report, including results from recent studies on the two main biofuels under consideration in Europe—ethanol from either wheat or sugar beet and rapeseed methyl ester (RME).

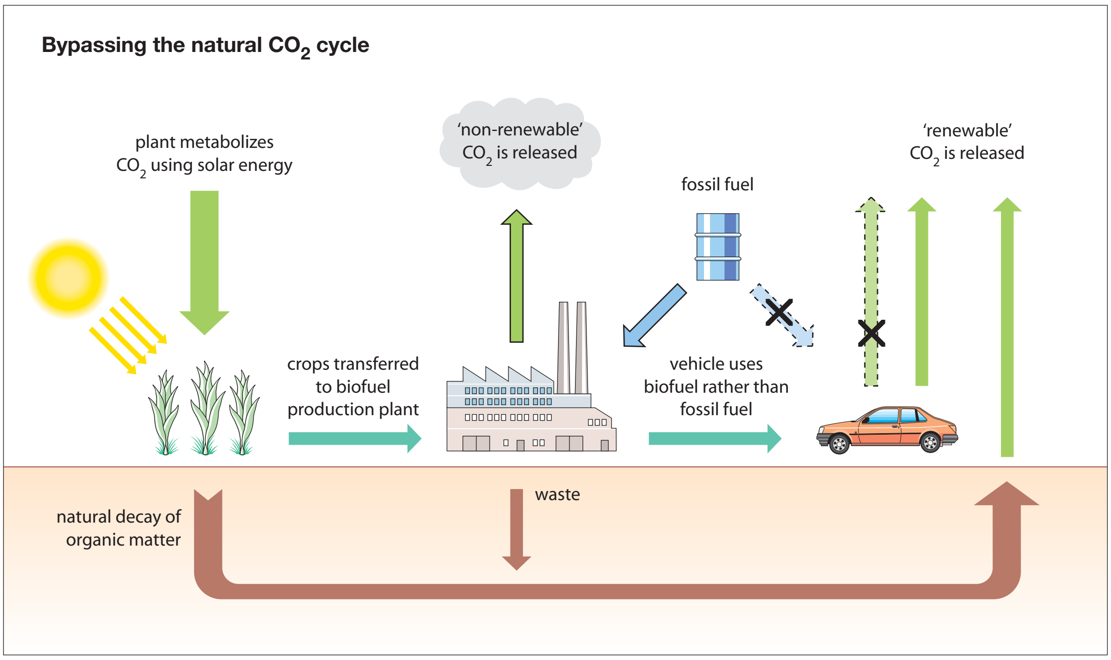
The biofuel production process is generally energy-intensive and the energy balance as well as the CO_2 balance can only become attractive with optimum use of by-products. Although technologies to that effect are being developed it remains to be seen whether practical and economic considerations would allow this to happen on a large scale. The real impact of field emissions of nitrous oxide and carbon sequestration in soil on the GHG balance is still largely unresolved, but both issues have the potential to negate most of the CO_2 gains.

The plant carbon cycle

Plants use solar energy to turn atmospheric CO_2 and water into organic carbon and hydrogen, thereby storing energy. In the natural cycle, the organic molecules are broken down as the plant decays and the carbon is returned to the atmosphere as CO_2. In this case and in food-based agriculture the energy is used to support other forms of life.

When growing a crop for fuel, part of the biomass produced by the plant is used directly to produce energy.

Figure 1
Biofuels potentially save fossil CO_2



The CO_2 originally metabolized by the plant is returned to the atmosphere during the combustion process. This CO_2 is therefore 'renewable' as it is simply a portion of the total amount involved in the natural cycle. In order to produce the biofuel, however, a certain amount of energy is required. In the case of biofuels for vehicle use, the production process is sophisticated and significant energy is required for growing, harvesting and processing of the biomass. Typically, most, if not all, of this production energy is of fossil origin. Its use generates CO_2 that is additional to the natural cycle and is not 'renewable'.

The energy balance

A certain amount of energy is embodied in a biofuel as measured by its heating value. From this must be subtracted the energy used during all stages of the production process, including such things as the production (and transport) of fertilizer, drying, fermenting, distillation etc. On the other hand, the biofuel will be used in place of an amount of conventional fuel which will no longer need to be produced. The energy required for producing this amount of conventional fuel is considered to be an additional 'saved energy' and is therefore a credit to the biofuel. The general consensus is that biofuels (at least those considered in this work) will be used mainly in blends with conventional fuels and will not affect positively or negatively the efficiency of the vehicles. The substitution can therefore be considered to occur on a pure energy content basis.

The production of biofuels leaves a large amount of unused biomass in the form of a number of by-products that can be broadly put into two groups. The first group concerns the protein-rich products such as the 'cake' left after pressing rapeseeds, or the residue of ethanol fermentation. Generally these products have the potential to be used as animal feed. As such they would substitute an equivalent amount of, for example, soy-meal that would not need to be produced and transported. The energy involved in such activities can then be saved and represents an additional potential credit for the biofuel. The second group is made up of waste material such as straw, leaves etc. This biomass has a certain energy content, although it is 'low density' energy because of the large volume and high water content. Nevertheless, some such products (such as wheat straw) could potentially be used as fuel in certain installations that may be either integrated with the biofuel production process or separate from it. The energy potentially generated represents a third source of credit for the biofuel.

If the credit for substituted fuel production is not in doubt, whether and to what extent the by-products will be used in real life is a matter of debate. The animal feed products are relatively low-volume materials, present in the fuel processing plant and which have to be disposed of in some way. The steps to use them as animal feed are simple and inexpensive and, at the right price, they are likely to find a ready market, possibly even in the immediate neighbourhood of a plant. For these reasons, we believe that it is realistic to associate an energy credit to such products.

Turning waste biomass products into fuel requires technologies that do exist and have been implemented in a small number of demonstration plants. They tend, however, to be complicated and costly. Because of the logistics involved in transporting the crops, biofuel production plants are likely to remain small to medium in size, so economies of scale will be limited. Biofuel plants will be built with a view to minimizing cost rather than saving energy or minimizing CO_2 emissions. Consequently, the maximum use of waste is unlikely to be a top priority in all but a fraction of the cases.

In the context of a complete 'life cycle analysis', other aspects would also need to be considered, such as the energy embodied in the additional farm machinery or process plants required. These are not systematically taken into account in all studies. Although it is useful to keep them in mind for a 'health check' of the conclusions, we believe that, generally, they are of a second order of magnitude compared to the main factors described above.

The overall energy balance figures reported in the studies considered in the survey are summarized in Figure 2. The columns represent the arithmetic average while the 'error bars' show the spread of the data. The

Biofuels

What are the real savings?

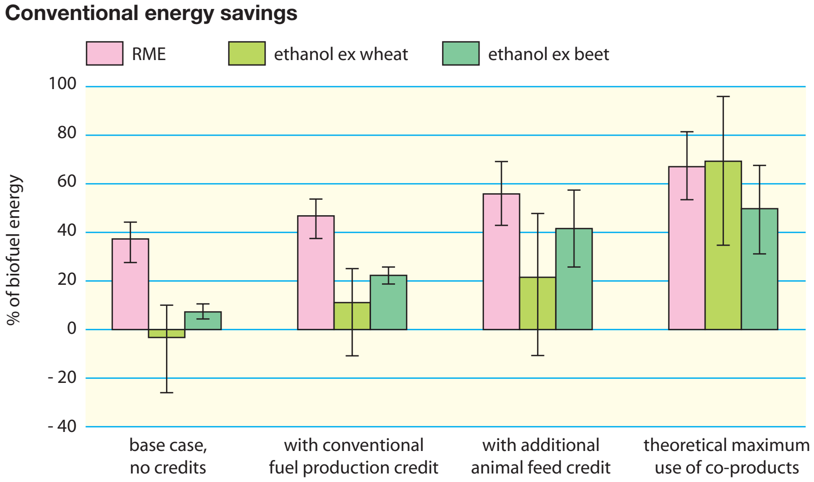
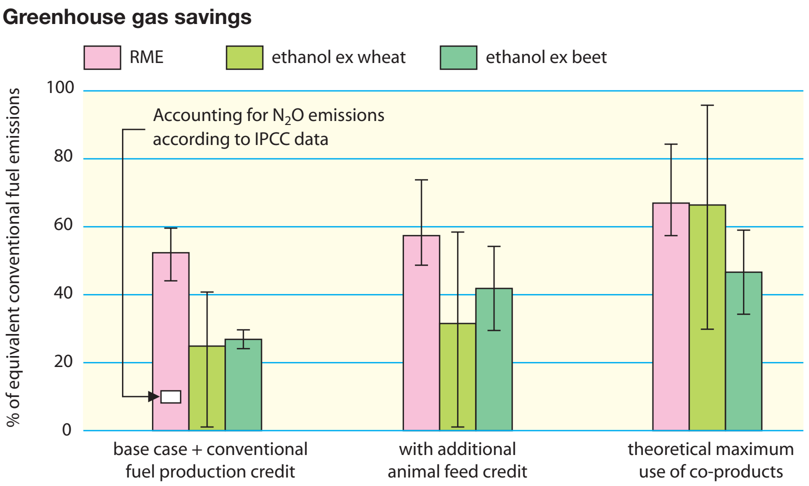


Figure 2
Ethanol shows a relatively poor energy balance compared to RME which gives the most favourable results overall.

first group represents the base case in which the energy balance is calculated without credits. In the next groups the credits are added stepwise, starting from production of the substituted conventional fuel and finishing with the waste biomass.

RME generally gives more favourable results than ethanol, reaching some 56% 'renewability' when the animal feed credit is included. Ethanol from wheat shows a particularly poor energy balance, only matching the other options when a waste biomass credit is included, which, as discussed above, we consider an unrealistic scenario on a large scale.

Figure 3
The CO_2 balance closely matches the energy balance; but N_2O emissions can affect the GHG balance.



The CO_2 and greenhouse gases balance

The CO_2 balance follows the same logic as the energy, with the additional complication of assessing from which fuel the energy required for each step is likely to come. This requires a number of assumptions and is a source of divergence between studies. Figure 3 summarizes the findings based on figures published in the reviewed studies. It must be noted that not all studies included GHG calculations and, in some cases, we made our own calculations based on the reported energy consumptions.

Predictably the general trend closely follows the energy balance, RME still coming out better than ethanol.

Although CO_2 is the main greenhouse gas in terms of volumes, others have to be considered. In the field of agriculture, the main culprit is nitrous oxide (N_2O), significant quantities of which are released from cultivated fields, particularly with intensive use of fertilizers. N_2O is more than 300 times more potent than CO_2 as a greenhouse gas, so that even modest volumes can turn out to have a non-negligible impact on the overall balance. One study by IFEU (Germany) takes into account N_2O emissions according to the IPCC[1] data, and suggests a dramatic effect on the GHG balance; from an average of more than 50% in the other studies, the CO_2-equivalent saving falls to about 10%. The exact effect of N_2O field emissions is still a matter of debate but this goes to show that more study is required to clarify an issue with such potentially dramatic impact.

Land use and potential biofuel production

Growing crops for biofuels requires agricultural land. In the context of large-scale production, set-aside land could be used rather than displacing existing food crops. The entire EU-15 set-aside area is estimated by the EU Commission at 5.6 Mha. On this basis and with the yields indicated in the literature, we have estimated the

[1] *Intergovernmental Panel on Climate Change*

maximum potential for biofuels in terms of production, net substitution on an energy basis and absolute GHG emissions reduction. Figure 4 summarizes the results assuming a 50/25/25 split between rape, wheat and sugar beet.

The first observation is that, even on a gross basis, set-aside land is not likely to be enough to meet the Commission's expressed target of 5.75% biofuels by 2010. The total biofuel energy that can be produced from the set-aside land is 8.9 Mtoe/a, or 3.3% of road transport needs. However once the energy input is factored in, this figure falls to 3.8 Mtoe/a, only 1.4% of road fuel consumption. The net CO_2 avoided is similarly around 1.5% of road transport emissions. It must also be realized that a large part of the set-aside land may not be suitable for growing such crops, or only with lower yields, so that this estimate may be optimistic. Also the more pessimistic estimates for N_2O emissions have not been included, and these would further reduce the GHG benefits.

With regard to CO_2 avoidance, another contentious issue is carbon sequestration in soil. Changing land use results in slow changes in the carbon content of the soil. Whereas soil bearing natural vegetation tends to have a high carbon content, regularly cultivated and ploughed land retains very little. The figures quoted by some sources are so large that using currently fallow land for biofuels could release enough carbon to negate the whole benefit of such endeavours for a number of decades.

Conclusions: biofuels versus bio-energy

Production of RME and bio-ethanol gives modest net gains in terms of overall energy balance. The entire EU-15 set aside area would account for about 1.5% of road fuels on an energy basis. The GHG balance is more uncertain in view of largely unresolved debates regarding N_2O emissions and carbon sequestration in soil. Judicious use of by-products such as protein-rich residues for animal feed and wheat straw as an energy source can improve the efficiency of the process. However, the real energy and GHG savings from animal feed are unclear, and it remains to be seen whether practicality and economics will support the use of straw or other biomass energy.

Potential of biofuels based on entire EU-15 set-aside area

'renewability' of biofuels (42% average) — average yield 2.3 t/h — EU-15 set-aside land area (5.6 Mha)

	biofuels production	oil equivalent		net CO_2 avoidance
		gross	net	
Mt/a	12.8			12.6
Mtoe/a		8.9	3.8	
% of road fuels		3.3	1.4	
% of crude energy			0.6	
% of total EU-15 emissions				0.3
% of road fuels emissions				1.5

Figure 4
Even on a gross basis, set-aside land is not likely to be enough to meet the Commission's expressed target of 5.75% biofuels by 2010.

The current focus is very much on the use of available land for the production of motor fuels. An alternative might be to use that land to produce biomass as a fuel for generating electricity (the demand for which is in constant increase). The process to produce biofuels is energy intensive and the crops are selected to produce suitable compounds rather than for their potential to metabolize CO_2 and produce maximum biomass. Limited data on experimental schemes for short rotation coppicing or growing of selected grass varieties suggest that net CO_2 avoidance figures could be 4 to 8 times more favourable than for traditional biofuels.

SO_2 emissions from ships in Europe

Can restrictions in the Mediterranean and the Atlantic be environmentally justified?

In response to concerns over the contribution of international shipping to air pollution, during the 1990s, the International Maritime Organization of the United Nations developed an annex to the MARPOL Convention covering air pollution from ships (Annex VI). This Annex incorporates the concept of SO_x Emission Control Areas or SECAs. Under its provisions, when ships operate in, or pass through such areas, they are required to use a fuel with a sulphur content of 1.5% m/m or less. Outside SECAs the sulphur content is limited to 4.5% m/m. For a sea area to be designated as a SECA, an application has to be made to the IMO, including a detailed environmental and cost-effectiveness justification in accordance with specific criteria laid down in Annex VI. To date the Baltic and North Seas are designated SECAs but the requirements will not be binding until Annex VI, signed by parties to the MARPOL Convention in September 1999, has been ratified.

In January this year, as a follow-up to their acidification strategy and in preparation for their planned revision to the sulphur-in-liquid-fuels Directive (SLFD), the Environment Directorate of the European Commission (DG Environment) launched their 'Community Strategy on Air Pollution from Seagoing Ships'. In support of this strategy, consultants engaged by DG Environment will study the implications for the EU of entry into force of SECA status of the Baltic and North Seas. In addition, they will examine the implications of extending the SECA requirements to further sea areas, e.g. the Atlantic approaches to Europe and the Mediterranean. They will also assess the implications of lower sulphur requirements than those contained in Annex VI for SECAs, e.g. 1% m/m.

CONCAWE believes that any measure to limit ship emissions must include a thorough assessment of the environmental justification and cost-effectiveness. This applies to any extension of restrictions on SO_2 emissions from ships beyond the North and Baltic Seas. This is in line with the requirements of Annex VI to MARPOL and would ensure consistency between this strategy and the development of the National Emission Ceilings Directive (NECD), a major building block in the Commission's strategy to combat acidification in the EU. To 'share the burden' between Member States and arrive at individual national emission ceilings Integrated Assessment Modelling techniques were used with a view to minimizing the overall cost to the EU to attain its environmental targets. In this article we use the extensive data sources used by DG Environment in the development of the NECD to explore the possible environmental justification of restrictions of SO_2 emissions in the Mediterranean and the Atlantic approaches.

In examining this question we need to clear up a potential misunderstanding. If we are developing a cost-effective strategy to deliver defined environmental targets (as for the NECD), then focusing on emissions *per se* is not appropriate. What we need to understand is the relationship between emission sources and their contribution to environmental loads. If a given emission source does not contribute to the exceedance of any environmental target, then it is environmentally benign. Any expenditure towards controlling such a source would be a waste of societal resources, at least on environmental grounds.

Figure 1 shows the SO_2 emissions from EU/EEA countries, a selection of accession countries and the four sea areas which border the EU. These data are forecasts for 2010 and reflect the obligations under either the NECD or the UN-ECE[1] Gothenburg Protocol but not the implications of the entry into force of Annex VI to the IMO MARPOL convention.

[1] *United Nations Economic Council for Europe*

SO_2 emissions from ships in Europe

Can restrictions in the Mediterranean and the Atlantic be environmentally justified?

Figure 1, taken in isolation, would suggest that the Mediterranean and Atlantic are important sources to control in a '2010 EU'. Indeed the emissions from these two areas are much higher than those from the Baltic and North Seas which have already been accepted as SECAs by the IMO.

The relevance of these numbers must, however, be considered in the context of their environmental impact. Figure 2 shows the result of some of the Integrated Assessment Modelling carried out in connection with the NECD[2]. The percentage of ecosystems that are still expected to exceed their acid critical loads by 2010 is shown for each EMEP[3] grid square (assuming already agreed emission reduction measures are implemented). A blank denotes no exceedance.

Separate work of the Norwegian Meteorological Institute (NMI)[4], also under the UN-ECE EMEP programme, provides extensive data on the contribution of a given country or sea area to deposition in each of the EMEP grids. We have utilized the NMI database to illustrate the importance of the difference between an 'emission' focus and a 'deposition' focus. This allows the all important determination of what percentage of a given emission source deposits on the EU 'exceedance grid squares' i.e. the 'non-blank' EU squares in Figure 2.

The results of this analysis are plotted as Figure 3, providing a very different perspective from Figure 1. Although SO_2 emissions from ships in the Mediterranean and Atlantic are the second and third highest emission sources in a '2010 Europe', less than 1% and 4% respectively of these emissions deposit on the EU 'exceedance squares'.

This is very different to the situation for the North and Baltic Seas. These areas deposit some 30% of their emissions on to the exceedance squares. To achieve a 1-kilotonne reduction in sulphur deposition over the 'exceedance grid squares' would require SO_2 emissions reductions of 200 kt from ships in the Mediterranean, 50 kt SO_2 for the Atlantic and only 6 kt for the North or Baltic Seas. As a result, any cost-effectiveness justification valid for the North and Baltic Seas is not applicable to the Mediterranean or Atlantic since, assuming similar unit costs, the costs to achieve the same environmental benefit are at least an order of magnitude higher.

SO_2 emissions from ships (2010 NECD case* for EU/EEA countries, a selection of accession countries, and the four sea areas bordering the EU)

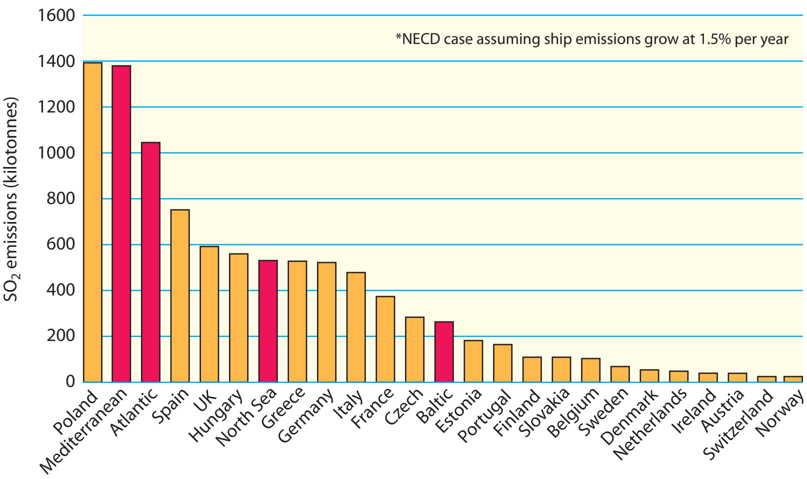


Figure 1
SO_2 emissions from the Mediterranean and Atlantic are much higher than those from the Baltic and North Sea which are already designated control areas, but …

Percentage ecosystems exceeding critical load, 2010[2]

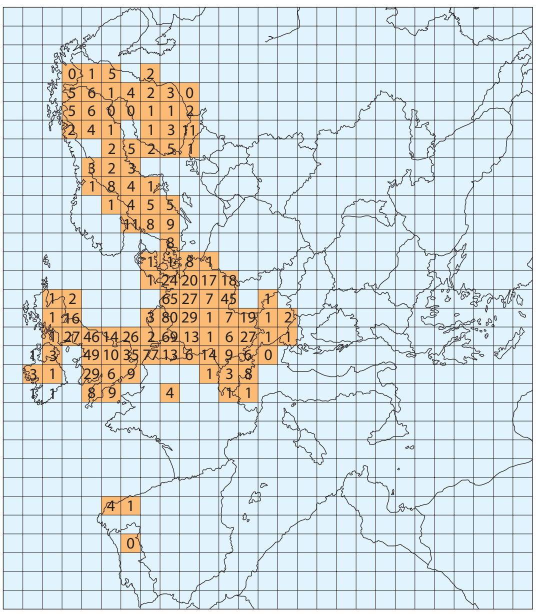


Figure 2
… virtually all critical load exceedances are in northern Europe.

[2] *IIASA 7th Interim Report for the NECD*
[3] *UN-ECE EMEP programme:*
[4] *EMEP 1998 deposition data by individual country or sea area from Norwegian Meteorological Institute web site adjusted for NECD emissions ceilings in 2010*

SO_2 emissions from ships in Europe

Can restrictions in the Mediterranean and the Atlantic be environmentally justified?

Ratio of total sulphur deposition* on all EU exceedance grids to emissions from a given country or sea area from ships

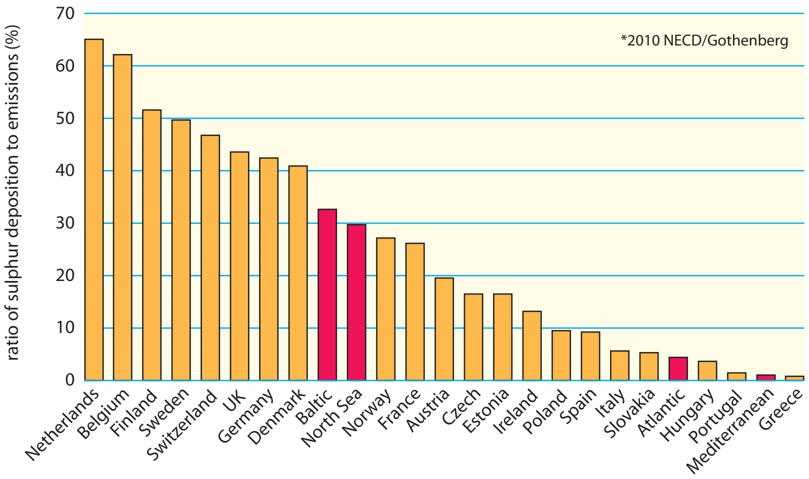


Figure 3

Less than 4% and 1% of the SO_2 emissions from the Atlantic and Mediterranean respectively deposit on EU exceedance squares (see also Figure 2).

When it comes to comparing reductions in emissions from ships in the Mediterranean and Atlantic areas to further reductions in land-based sources, the situation is even clearer. Each of the eight countries which lie to the left of the Baltic Sea in Figure 3 (NL, B, SF, S, CH, UK, D, DK) deposit more than 40% of their 'post NECD/Gothenburg' level emissions on the 'exceedance squares'. This means that a 1-kilotonne reduction in sulphur deposition over the 'exceedance squares' would require a reduction of only 5 kt SO_2.

The cost of a move to 1.5% sulphur bunkers has recently been estimated by consultants to DG Environment to range from 850–1400 EUR/t of SO_2[5]. This is significantly higher than the cost of 450 EUR/t used in the original submission by the EU for recognition of the North Sea as a SECA[6]. However, even if the lower figure of 450 were used, it means that the 1-kilotonne reduction in deposition discussed above would cost some 900,000 EUR/a for ships in the Mediterranean and 220,000 EUR/a for ships in the Atlantic.

To compare these costs to the alternative of further land-based controls in, say, the UK and Germany, we need to access the SO_2 cost curve data used in the Integrated Assessment Modelling for the NECD[7]. At NECD ceilings, the next measures in both countries cost about 1500 EUR/t SO_2, increasing to about 5000 EUR/t toward the higher end of the cost curves. Even using this higher figure, the cost of a 1-kilotonne reduction in deposition achieved through land-based measures in those countries would be only 25 kEUR/year. This is because a much larger proportion of land-based emissions deposits on areas in the vicinity of the emission source and represents a difference of more than an order of magnitude in the cost effectiveness!

This analysis clearly demonstrates that the designation of the Mediterranean and Atlantic Seas as SECAs would not be justified on either environmental or cost grounds. However, it is worth noting that the costs for a similar 1-kilotonne reduction in deposition resulting from emissions from the North or Baltic Seas is some 30,000 kEUR/a, which is comparable to the cost of further land-based controls in Germany and the UK.

Before concluding this article it is worth focusing briefly on other environmental concerns that might drive a requirement for further SO_2 emission reductions. There might firstly be concerns over compliance with the EU first Daughter Directive which sets air quality standards for SO_2. In the case of SO_2 emissions from ships, this is likely to affect operations in some EU ports. CONCAWE has previously studied the contribution of ship emissions to local air quality in the vicinity of EU ports[8]. This indicated that, in large ports like Rotterdam and Antwerp, ship emissions contributed significantly to overall levels of SO_2. However in medium to small ports and for operation outside ports, the contribution was low. These findings indicate that any requirement for low sulphur fuels in-port would need to be based on a case-by-case assessment requiring local action by the port authorities.

[5] *Study on the Economic, Legal, Environmental and Practical Implications of a European Union System to Reduce Ship emissions of SO_x and NO_x, BMT Study 3623, August 2000*

[6] *IIASA Data*

[7] *IIASA RAINS Model SO_2 Cost Curves for Germany and UK*

[8] *CONCAWE Report 2/94*

A further emerging environmental concern associated with SO_2 emissions is the role they play in the formation of secondary particulates. Although the importance of sulphate particulates as a health concern has yet to be confirmed, they do represent a significant contribution to overall levels of fine particulates[9]. Does this mean that reduction of SO_2 emissions from ships in the Mediterranean and the Atlantic may yet be environmentally justified? This question should perhaps best be addressed within the Commission's new 'Clean Air For Europe' programme (CAFE) where all contributions to particulates will be examined. However, the EMEP data used above to demonstrate the lack of justification, from an acidification point of view, for action on ships in these areas, does provide an early insight into the likely answer to this question.

For example, about 25% of the SO_2 emissions from Greece deposit on Greece itself, whereas only 2% of SO_2 emissions from ships in the Mediterranean do so. The NECD ceiling for Greece implies a marginal cost of some 200 EUR/t SO_2. Therefore, the cost of achieving a 1 t/a reduction in secondary particulates derived from SO_2 emissions from ships in the Mediterranean would be more than an order magnitude higher than further land-based SO_2 controls in Greece. This indicates that if concerns over secondary particulates from SO_2 emissions are confirmed and their control becomes a target within CAFE, then the priority should be for significant further reduction measures on southern-European land-based sources rather than reductions in emission from ships in the Mediterranean or the Atlantic.

According to the substantial data underpinning the NECD, we can conclude that the extension of SECAs beyond the North and Baltic Seas is clearly not justified on either environmental or cost-effectiveness grounds.

Available data indicate that the extension of SECAs beyond the North and Baltic Seas is clearly not justified on either environmental or cost-effectiveness grounds

[9] *An Initial Framework to Assess the Control of Fine Particulates in Europe, IIASA, April 2000*

The refinery BAT reference document

An important document with a potential for misuse

The Integrated Pollution Prevention and Control (IPPC) Directive, adopted in September 1996, requires Member States to issue permits for major industrial installations (such as oil refineries) to promote the use of Best Available Techniques (BAT) for reducing emissions of specified pollutants. The Directive is already in force for new installations as well as for significant revamps or upgrades but does not apply to existing installations until 2007. 'Integrated' in the title of the Directive means that the permit must consider emissions to all environmental media as well as the use of raw materials and energy.

Article 16 of the Directive calls for the production of a so-called BREF (Best Available Technique reference document) for each major industrial sector via a process of information exchange between the main stakeholders. The BREFs are intended to give guidance to regulators on an industrial sector and its emissions, what can be considered as BAT, the levels of pollution abatement achievable, the cross-media implications, energy use, etc. The BREFs are publicly available documents.

Although the Directive calls for mandatory application of BAT, what constitutes BAT has to be determined on a case-by-case basis and the BREF only offers guidance in this respect. In particular none of the emission levels quoted are intended to be translated into permit levels. Nevertheless, local regulators will use them as a starting point for discussions with installations such as refineries.

For the purpose of producing the BREFs, the European Commission established the European IPPC Bureau (EIPPCB) based in Seville. For each BREF, a Technical Working Group (TWG) was formed with membership from Member State experts, industry and environmental organizations. Each TWG has its own EIPPCB staff member to manage the process, collate all the information and draft the documents. However TWG members are expected to provide the majority of the information and to actively participate in the development and update of the BREF.

The refinery BREF

CONCAWE has been involved with the refinery BREF from its inception and even before. Work started some two years before the first meeting of the TWG when two CONCAWE Task Forces were established to gather the necessary information, eventually producing CONCAWE Document 99/01. This was tabled at the first meeting of the TWG and has been one of the most important sources of data for the TWG, indeed, almost the only source of information on costs. Participation in the TWG has entailed a massive workload both for the CONCAWE Secretariat and for representatives of Member Companies. A small core group attended all TWG meetings and provided the main input. They have been supported, particularly in providing additional information and reviewing the drafts of the BREF, by a large number of experts in Member Companies and the National Oil Industry Associations (NOIAs).

The preparation of the BREF was a difficult exercise because of the complexity and diversity of refinery processes as well as different levels of integration of refineries in Europe. Against the advice of both CONCAWE and a number of Member States, who felt that refinery emissions should be tackled using a pollutant/media approach, the EIPPCB opted for a process-by-process approach. This made the whole matter even more fraught with difficulties.

To the end, CONCAWE as well as some other stakeholders considered that the document had many deficiencies. Unfortunately not all issues could be resolved and the document contains many 'split views' where either industry or Member States disagreed with the EIPPCB. Although previous BREFs developed for other sectors also include some split views, their number in the refinery

BREF is much higher than previously experienced. In spite of still strong reservations on some aspects of the document, the oil industry decided to support the publication of the document. In the event, the Commission (DG Environment) approved the document, despite objections from a large number of Member States who wanted a further period of work and an extra meeting of the TWG to try to resolve the differences.

Areas of discussion and concern

One of the main areas of disagreement was the setting of the various emission levels quoted in the document. These fall into three categories: BAT associated levels, achievable emission levels and emission limit values.

BAT associated levels are meant to represent the environmental performance that could be anticipated as a result of the application of the BAT in the sector. In some cases it may be technically possible to achieve better emission or consumption levels but due to the costs involved or cross-media considerations, such schemes are not considered to be appropriate as BAT for the sector as a whole. The definition does include the statement that 'such levels may be considered to be justified in more specific cases where there are special driving forces'.

Achievable emissions values are defined as the level that may be expected to be achieved over a substantial period of time in a well maintained and operated installation or process using the relevant techniques.

It is important to realize that neither of these levels is meant to represent an ***emissions limit value*** (ELV), i.e. a regulatory control value, nor is it intended to be used as such. ELVs are only mentioned in the BREF as examples from Member State legislation.

The BAT Associated Levels and Achievable Emissions Values have been derived from information originating partly from equipment suppliers, but mainly from refineries operating the relevant processes. In most cases, this has resulted in a range of values. The EIPPCB (supported by some Member States) has maintained that only the best performers in this range should be taken to indicate achievable levels. CONCAWE's position has been that 'best' performance may be due to special circumstances such as low throughput, favourable crude type, etc. that do not apply to all refineries. To avoid over-optimistic expectations, the whole range should be taken as the achievable level, except perhaps where the 'poor' end of the range clearly results from bad operational practices.

Cross-media effects and implementation costs

While cross-media effects are noted in the BREF, there is very little information on their scale and relevance. In a number of cases, the choice of what is BAT for a certain pollutant has been made with only a very superficial analysis of the implications for emissions of other pollutants, uses of resources, and energy usage. These implications are mostly site-specific. Energy is of particular relevance in the context of CO_2 emissions.

The BREF also contains only very limited information on costs. Costs are generally very site-specific, as are related issues such as availability of plot space for new equipment. In CONCAWE's opinion, the document does not sufficiently recognize the fact that investments have implications beyond purely financial matters. Capital is mainly spent on new equipment, the construction of which has its own environmental impact, which should be set against benefits from its use using a life cycle analysis approach. Cost is therefore one aspect of cross-media effects.

Structure of the BREF document

The BREF includes a so-called BAT chapter where all BATs are briefly described, in many cases with a single line of text, without any indication of possible limitations. In the refinery BREF this chapter included more than 200 BATs, in sharp contrast with those previously written for other industrial sectors, which included a much smaller number.

Although many of CONCAWE's concerns were accepted, they are often only recorded in separate technical chapters giving details of the candidate BAT processes and

The refinery BAT reference document

An important document with a potential for misuse

not in the all-important BAT chapter. It is therefore essential that the document should be consulted as a whole and the BAT chapter not taken in isolation. CONCAWE objected to a proposal to include the whole BAT chapter in the Summary (the only part of the document to be translated into all EU languages) on the ground that this could lead to Member States' regulators using this section without looking at the whole document. The proposal was abandoned but the Commission decided to exceptionally produce separate translations of the BAT chapter, potentially creating the same situation.

The emission 'bubble concept'

Refinery emissions, particularly those of sulphur compounds, are controlled in many Member States by what is known as the 'bubble concept', in which a limit is set on the emissions of the refinery as a whole rather than imposing limits on individual units/emission sources. The refiner then has the freedom to reduce emissions in the most cost-effective way.

From the start, CONCAWE had proposed that this method should be discussed in the BREF. EIPPCB however insisted that this method was irrelevant to a BAT-driven concept, in which each individual unit must strive to achieve BAT, resulting in minimum emissions for all. In our view this philosophy is inconsistent with the definition of a BAT, which is meant to include costs, local factors and the different environmental needs in different locations. In the real world of integrated refineries, the bubble concept provides a mechanism for forcing down emissions while allowing site-specific factors to be considered for the refinery as a whole.

Under pressure of a number of Member States limited information on the bubble concept together with some benchmarking data has been included, not however as a BAT, but as a useful tool.

Implications for European refineries

Much of the document (particularly the technical chapters) is a useful description of current day practices in Europe and guidance to refineries on measures they should consider when planning to improve their environmental performance. Many of the 200-plus BATs were proposed by CONCAWE, and the majority are relevant provided that they are considered in the light of local circumstances.

There is, however, serious concern that the BREF will be misconstrued as a blue print for all refineries that would have to exclusively use the techniques described and be able to achieve the best of the emissions levels quoted. This is of course in accordance with neither the letter nor the spirit of the IPPC Directive, but Member Companies and refinery management will have to be prepared to respond to such claims.

To assist them in understanding this massive document of more than 500 pages, CONCAWE plans to produce a guidance report. This will cover the IPPC Directive and what it requires refineries to do, the role of the BREF in the permitting process, and the factors that need to be considered to establish which of the techniques described are appropriate in the local circumstances of a particular refinery. In particular, each of the 'split views' will be discussed and the reasons for CONCAWE's reservations explained.

Emissions from modern diesel engines

How important are diesel fuel properties other than sulphur?

The European Commission's proposed update of Fuels Directive 98/70/EC includes the gradual introduction of sulphur-free fuels from 2005 to enable the use of advanced exhaust after-treatment technologies but does not propose further changes to other fuel properties. However, the impact of certain other fuel properties on emissions remains under discussion, especially in connection with advanced engine technologies.

EPEFE[1] provided a thorough basis for understanding the interaction between diesel fuel quality and engine technologies for both the light-duty and heavy-duty diesel fleets. However, EPEFE was carried out almost a decade ago and only included engine technologies up to Euro 2 (1996). Engine technologies continue to be developed in response to emissions legislation (Euro 3 in 2000, Euro 4 in 2005) and CONCAWE decided to quantify these relationships for more advanced, but already available, engine technologies (approaching Euro 3). To this end an extensive test programme was carried out, the complete report from which is expected to be issued in May 2002. This article gives an overview of the objectives and scope of the programme as well as the most important results.

Objectives of the programme

In EPEFE the influence of cetane number, polyaromatics, density and back-end distillation (T95) on emissions was evaluated in detail. Two important questions remained however, namely the difference (if any) between natural and additive-derived cetane and the influence of aromatics composition (mono- versus poly-). The main objective of this programme was therefore to elucidate these relationships with modern hardware operated over the Euro 3 emissions test cycles.

Selection of vehicles, engines and fuels

Three light-duty diesel vehicles and two heavy-duty diesel engines were used in the programme. They were selected to cover a range of technologies which were expected to be widely used to meet Euro 3 emissions standards. For heavy duty, a 1-litre per cylinder and a 2-litre per cylinder engine were tested, one with and one without cooled EGR[2], one with a high-pressure in-line pump and one with unit injectors. Light-duty hardware included engines with common rail injection, unit injectors as well as an advanced rotary pump.

Two fuel matrices were designed to evaluate the possible impact of mono-, poly- and total aromatic content and to allow discrimination between natural and additive-derived cetane number. The matrices were statistically designed to separately identify the effects of the fuel properties under investigation while keeping all other properties as constant as possible and close to the average market fuel quality for

[1] *European Programme on Emissions, Fuels and Engine Technologies*

[2] *Exhaust Gas Recirculation: a technology used to reduce NO_x emissions*

Emissions from modern diesel engines

How important are diesel fuel properties other than sulphur?

Aromatics fuel matrix

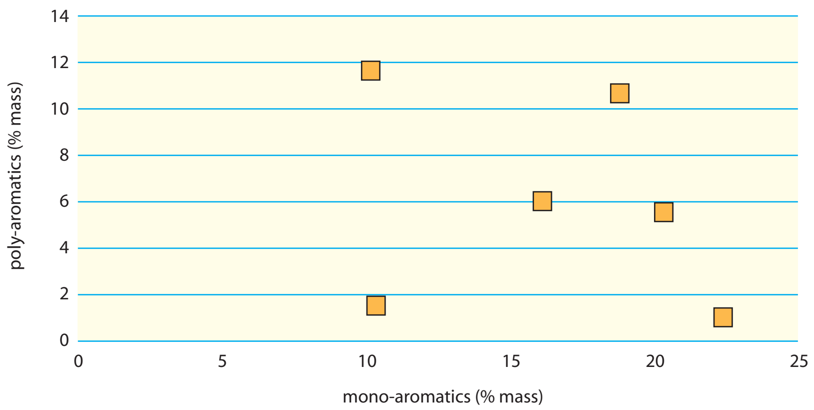


Figure 1
Mono- and poly-aromatics in the aromatics fuel matrix

the year 2000. The aromatics matrix is shown in Figure 1. The cetane matrix covered a final cetane number range from 49.4 to 58.2 with the additive derived cetane contribution from 0 to 4.7.

Test protocol

All tests were based on the legislated test cycles i.e. the year-2000 New European Drive Cycle (NEDC) for passenger cars and the European Steady-State Cycle (ESC) for the heavy-duty engines. A fully randomized block test design was used in order to minimize the risk of fuel effects being biased by unexpected effects such as carry-over or performance drift.

Table 1
Emission levels were up to 40% lower than the EPEFE fleet

Emission results compared with the EPEFE fleet

Heavy-duty, g/kWh	HC	CO	NO_x	PM
Engine 1	0.129	0.427	4.95	0.074
Engine 2	0.198	0.313	4.86	0.096
EPEFE Fleet	0.253	0.610	6.59	0.122
Heavy-duty, g/km	**HC**	**CO**	**NO_x**	**PM**
Vehicle A	0.080	0.474	0.460	0.041
Vehicle B	0.035	0.139	0.537	0.036
Vehicle C	0.052	0.275	0.629	0.065
EPEFE Fleet	0.081	0.405	0.542	0.054

Emissions levels were up to 40% lower than the EPEFE fleet

For all four emission parameters, the average emissions from the two heavy-duty engines tested here were 25–40% lower than those from the EPEFE prototype Euro 2 fleet. The light-duty vehicles tested here averaged 25–30% lower hydrocarbons (HC) and CO emissions and about the same levels of particulate matter (PM) and NO_x emissions (see Table 1).

Fuel effects were small

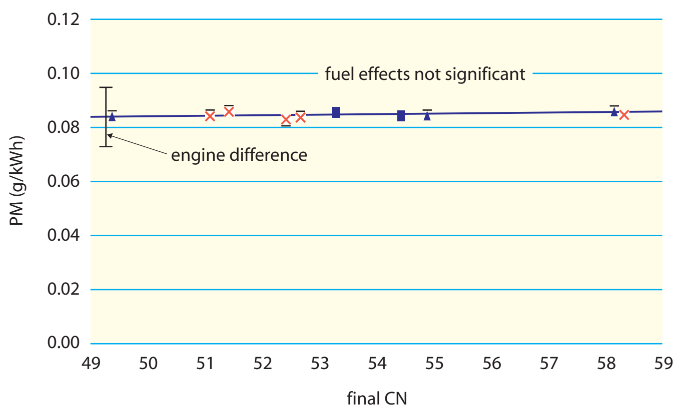
Fuel effects were generally found to be small compared to engine technology effects and test variability. Despite the rigorous test design, statistically significant fuel effects were difficult to identify.

Increasing cetane number had no significant effect on the critical emissions, NO_x and PM, in either the heavy-duty engines or the light-duty vehicles tested. Increasing cetane number directionally reduced HC and CO emissions, though these emissions were well below the Euro 3 limits. In the heavy-duty engines, HC effects were not significant and only one engine showed a significant CO effect. In the light-duty vehicles, statistically significant reductions in HC and CO emissions were seen in all but one case. No emission differences were observed between natural cetane fuels and those where the cetane number was boosted using ignition improver additive.

Aromatic effects were small. In the heavy-duty engines, reducing aromatics reduced HC emissions but had no significant effect on PM, NO_x or CO emissions. In the light-duty vehicles, aromatic effects varied between vehicles. Only one vehicle showed significant effects on NO_x and PM emissions, NO_x emissions decreasing as aromatics were reduced while PM emissions increased. There were no consistent trends in HC emissions, but CO emissions tended to decrease with lower aromatics. As the total aromatic effects were small, it was not possible to separately quantify the relative contributions from mono- versus poly-aromatics.

Figures 2 and 3 are illustrative examples of the trends, showing heavy-duty and light-duty fleet average PM emissions as a function of cetane and total aromatics respectively.

Heavy-duty fleet average PM emissions vs. cetane number



Light-duty fleet average PM emissions vs. aromatics

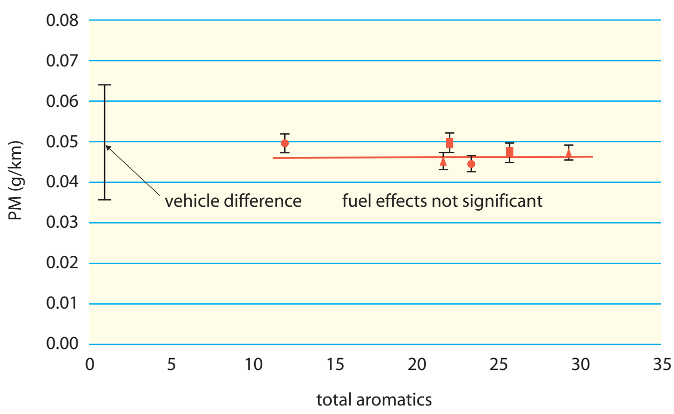


Figure 2 (above left)
In the heavy-duty fleet, increasing cetane number had no significant effect on PM emissions.

Figure 3 (above right)
Average PM emissions (light-duty fleet) as a function of aromatics: aromatic effects varied between vehicles; fleet average effect was not significant.

The report also contains additional light-duty vehicle test data carried out with another fuel matrix also designed to investigate aromatic effects. These data show small but more consistent NO_x effects. On average a 10% reduction in mono- or poly-aromatics reduced NO_x emissions by around 3%. The relative impacts of mono- and poly-aromatics appeared similar. Aromatic effects on PM, HC and CO emissions showed variation between the different vehicles tested.

Outlook

It is clear that the effects of fuel aromatics and cetane on modern diesel engines emissions are small and difficult to differentiate from the experimental 'noise'. Drawing firm conclusions from tests on a few vehicles is risky. Indeed a rigorous protocol is necessary to identify significant trends and testing of a range of engines/vehicles is needed for a meaningful fleet coverage. This reinforces the value of major cooperative programmes such as EPEFE. In the near future, the introduction of Euro 4 and Euro 5 engine technologies, along with sulphur-free fuels, is expected to result in extremely low emissions levels and the remaining fuel effects will be even more difficult to evaluate. Nevertheless CONCAWE plans to investigate such effects as soon as advanced engine technologies become available and believes that a joint programme with our partners from the motor industry would lead to the most valuable data-set.

Non-road diesel

Status and possible developments

The draft 2005 Fuels Directive, proposed by the European Commission in May 2001 (updating 98/70/EC), included a consolidation of the requirements for non-road diesel, but did not impose any more stringent limits on this fuel. Amongst its amendments to the Commission's proposal, the EU Parliament proposed that non-road diesel should meet the same specifications as road diesel from 2005. As we reach the last stages of the legislative process, this debate is still ongoing.

Meanwhile, the European Commission's GEME (Group on Emissions from Non-Road Mobile Machinery Engines) is reviewing the next stage of emissions legislation for engines used in non-road mobile machinery applications, which would amend Directive 97/68/EC. Such legislation (Stage 3) is likely to be implemented towards the end of the decade. Although emission limits have yet to be agreed it is likely that advanced engine and/or exhaust after-treatment technologies will be needed. These advanced technologies may require a reduction in fuel sulphur content to enable the required improvements in emissions to be achieved. GEME therefore established a Task Force on Non-Road Fuels, to investigate the fuel requirements of the various engine technologies that may be required and to identify the potential issues related to the introduction of such fuels.

Against this background, EUROMOT (European Association of Internal Combustion Engine Manufacturers) was asked to prepare a report on the engine and exhaust after-treatment technologies required to achieve various stages of emissions reduction, and to demonstrate the related 'enabling' fuel sulphur levels. Concurrently CONCAWE was asked to prepare a summary of the current European situation with regard to non-road diesel specifications and distribution system issues. The Commission took on the job of clarifying the current position on fuel duty levels and contracted a consultant to report on the refining and cost implications of changing non-road diesel specifications.

EUROMOT suggested fuel requirements for various engine technologies

Although Stage 3 emissions limits have yet to be agreed, it is likely that reductions in both PM and NO_x emissions will be specified. The engine and machinery manufacturers submitted a Joint European Industry Proposal on Stage 3 emissions limits in December 2000, suggesting that Stage 3 should be implemented at least seven years after Stage 2. They highlighted the implications of applying exhaust after-treatment technologies in this sector. More recently, EUROMOT submitted a report on the engine technologies needed to achieve various levels of emissions improvement beyond Stage 2. They identified the likely technological steps involved, which would have increasing impact on fuel requirements, viz.

Engine technology required	Suggested max. fuel sulphur content
Engine design improvements without EGR[1]	500 ppm (1000 ppm if only NO_x reduction needed)
Engine design improvements, including EGR	350 ppm
Exhaust after-treatment for 90% PM and/or NO_x reduction	10 ppm

The requirement expressed by EUROMOT for 350 ppm sulphur for systems with EGR is only supported by limited technical data and remains a point of debate. EUROMOT also suggested changes to fuel properties other than sulphur. However, the Task Force concluded that sulphur was the primary fuel factor and the single potential technology enabling fuel property.

[1] *Exhaust gas recirculation: a technology to reduce NO_x emissions*

CONCAWE summarized the current status on non-road fuel specifications

CONCAWE reviewed the current European position on specifications, market volumes and distribution system issues for non-road diesel and other gasoils. The situation differs considerably across the EU Member States and any change to fuel specifications has potentially a significant impact on the refining and distribution systems, as well as raising questions with regard to the fuel duty regimes. If changes to fuel sulphur content are judged necessary to enable future non-road engines to achieve Stage 3 emissions standards, further analysis will be required to identify the optimum solution in each Member State.

Market volumes for the non-road sector are difficult to estimate precisely, since the figures available in published statistics such as the IEA's[2] do not discriminate between the volumes used in non-road mobile machinery and those used in heating systems (e.g. in agriculture). With a number of reasonable assumptions, we were able to use the IEA figures to obtain the overview shown in Figure 1. For the whole of the EU-15 (plus Norway) the total gasoil market distribution in 1998 was 53% road diesel, 9% non-road diesel, 36% heating oil and 2% for inland waterways.

The EN 590 European standard provides a harmonized minimum quality for road diesel in the whole of EU-15. Some countries such as the UK, Sweden, Finland and Denmark, have introduced tax incentives for special qualities exceeding the requirements of EN 590. A single grade of road diesel is generally marketed in each country. For heating oil and non-road diesel, there is no such European standard. Sulphur is limited by the Sulphur in Liquid Fuels Directive which specifies a maximum sulphur content of 2000 ppm max, to be reduced to 1000 ppm by 2008. Some Member States have national standards for heating oil, which may also include non-road diesel. Others have no national standards and the quality is controlled either by individual oil companies or on the basis of local oil industry standards.

The countries grouped to the left of Figure 1 operate substantially similar 2-grade distribution systems with an EN 590 road diesel grade and a separate gasoil grade, with dye/marker and commanding a lower duty rate, for non-road and heating oil use. Spain and Norway have a specific separate non-road gasoil grade. In the countries grouped in the centre of the chart EN 590 road diesel is supplied to part or all of the non-road diesel market, different mechanisms being used to apply the relevant duty rates. In view of its very small heating oil market, Portugal uses road diesel for all applications, albeit with a dye for heating oil and non-road. Sweden and Denmark already have lower sulphur content for all grades. The CONCAWE report provided a detailed summary of the specifications currently used and the potential distribution issues likely to be associated with any changes.

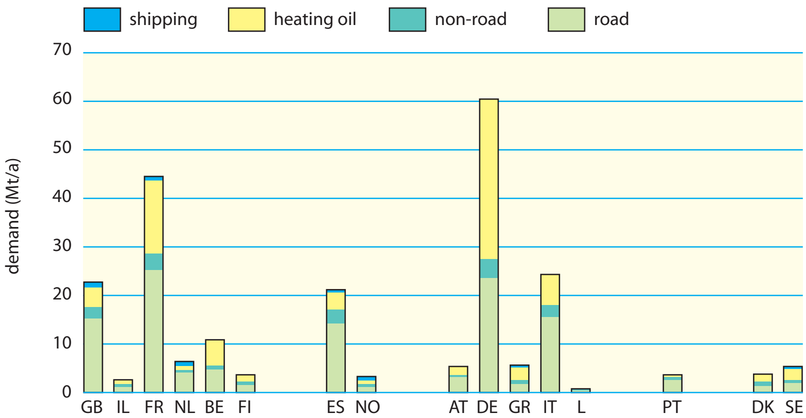
Outlook/next steps

The initial work of the Non-Road Fuels Task Force has now been completed. The European Commission has now to put forward its proposal on Stage 3 emissions legislation, including any related proposals on fuel quality. CONCAWE has pointed out that these proposals should be based on demonstrated air quality benefit, cost-effectiveness and understanding of other implications of proposed changes such as potential increases of CO_2 emissions.

In this regard, it is worth noting that the Auto/Oil II emissions inventory showed that the relative contribution of the non-road sector to total emissions is very small and

Figure 1
This overview of European diesel/gasoil demand by country was based on IEA data, with some additional assumptions regarding the volumes used in non-road mobile machinery and those in heating systems.

European diesel/gasoil demand by country



[2] *International Energy Agency*

Non-road diesel

Status and possible developments

EU-15 PM emissions inventory, 1990–2020 (European Commission data)

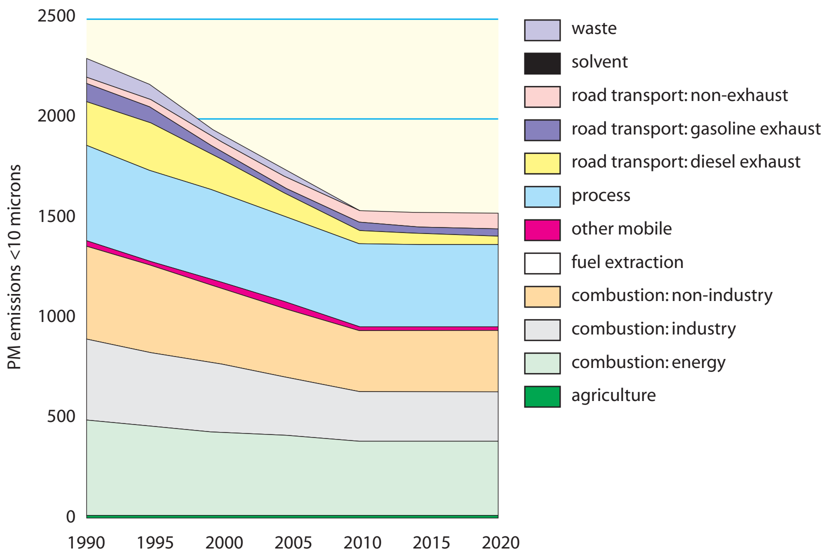


Figure 2
Reducing the relatively small contribution of non-road mobile sources to total PM emissions is unlikely to deliver substantial improvements in overall air quality.

will remain so even when contributions from e.g. the road sector have decreased. Figure 2 illustrates this point for PM (non-diesel road emissions are included in 'other mobile'). Hence reducing emissions from the non-road mobile sources is unlikely to deliver substantial improvements in overall air quality.

If a reduction in the sulphur content of non-road diesel is deemed necessary after the air quality impact assessment, there appear to be three potential options, to be jointly considered by the oil industry and authorities:

- supply the non-road diesel market with road diesel quality, but at a lower tax rate;
- introduce a specific non-road diesel grade with the required sulphur content;
- reduce sulphur content across the whole gasoil pool, including heating oil.

All of these options raise significant refining, distribution, consumer and/or taxation issues. There are significant differences in the markets, specifications, distribution systems, duty regimes and duty points across the Member States. Given these differences, if change to fuel sulphur content for non-road diesel is deemed necessary, the optimal solution is likely to be different in each country. A flexible approach, specifying the maximum sulphur content for European non-road diesel based on demonstrated technical needs in relation to air quality objectives, but leaving implementation to the Member States, would be likely to produce the most cost-effective overall solution.

Western European oil pipelines

30 years of spillage performance monitoring

The integrity and reliability of cross-country oil pipelines is vital to the European economy. One quarter of Europe's refineries are situated inland and depend entirely on pipelines for their crude oil feed-stocks. Major oil fields in Russia and the North Sea use cross-country pipelines to export their productions. Currently, European pipelines transport some 350 Mt/a of crude oil (more than 50% of the EU-15 consumption) and 180 Mt/a of oil products (one-third of the EU-15 demand and a majority of the long distance transportation requirement) over an average distance of 250 km and 200 km respectively.

CONCAWE has now compiled data on Western European oil pipeline spillage incidents and their consequences for a full 30-year period. From 14,000 km in 1971, roughly evenly split between crude and products, the pipeline network monitored by CONCAWE has, 30 years on, increased to 31,000 km. The increase exclusively concerns product lines and is largely due to the extension of reporting coverage, the largest single change being the addition of non-commercially owned pipelines in 1988.

Some 40% of the current inventory has been built since 1971 and, over the period, about 18% of the network has been taken out of service. The overall picture shows an ageing inventory, of which only 10% is less than 10 years of age and 80% more than 20 years (from 70% and a few percents respectively in 1971). Remarkably, this has not prevented the continued improvement in the performance of the network. The very oldest pipelines are more than 65 years old and still safe and reliable.

The results for 2000 have recently been published (CONCAWE report 03/01) and show the best ever annual performance on record, with only six spillages totalling 360 m^3. The causes were typical: three were due to third parties accidentally digging or drilling into pipelines while carrying out unrelated ground work; one was the result of previous mechanical damage, done by an unknown third party, which subsequently caused a crack; one was localized external corrosion; and one was from mechanical failure of small bore instrument pipework. Clean-up activities recovered 77% of the spillages and only very localized temporary pollution resulted.

Even though it has always been good in Europe, spillage performance has improved dramatically over the past 30 years. A few major pipeline spillage incidents elsewhere in the world have caused sufficiently severe problems to attract broad media attention and public concern. In Europe, however, the general public is completely unaware of the millions of tonnes of oil being safely and silently transported under their feet, which is exactly as it should be.

The number of spillages per 1000 km of pipeline that occur in successive years gives a good indication of the spillage performance trend. This indicator was 0.2 in 2000 from a peak of 1.5. Thus the moving average taken over the total 30-year period monitored has reduced from around 1.2 spills per 1000 km per annum to 0.65

The age of the European pipeline network

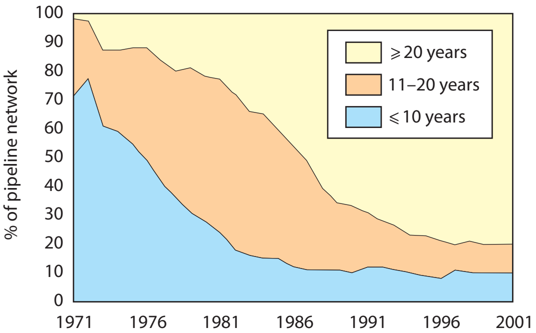


Figure 1

The very oldest pipelines in the European network are more than 65 years old, and still safe and reliable. Even though 80% of the network is more than 20 years old, performance of the network overall continues to improve.

Western European oil pipelines

30 years of spillage performance monitoring

Figure 2
The moving average taken over the period from 1971–2000 shows a reduction in spills from around 1.2 to 0.65 spills per 1000 km per annum. The plot of five-year averages shows about a five-fold improvement from 1.2 to 0.25.

Pipeline spillages, 1971–2000

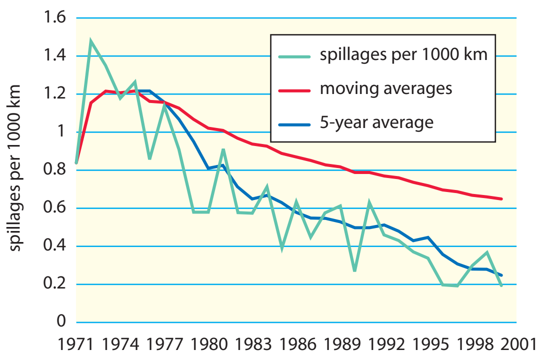
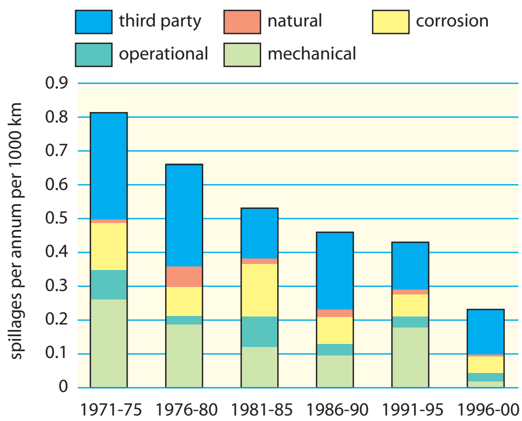


Figure 3
Pipelines carrying heated fuel oil and crude oil (only 5% of the network) typically suffer from corrosion; however, about one-third of these have now been shut down or converted to cold service, contributing significantly to the overall improvement. In the bulk of the network spillages are most frequently caused by third-party activities, often resulting in larger spill sizes.

Causes of cold pipeline spillages, 1971–2000



(see Figure 2). The rate of improvement is illustrated by the plot of the five-year averages, which shows about a five-fold improvement from 1.2 to 0.25.

Pipelines handling heated fuel oil and crude oil have historically suffered excessive external corrosion problems due to the integrity of the heat insulation system in underground conditions. Although these always represented only a very small part of the pipeline network (5%), in 1971–75 for example, they were responsible for some 37% of the spillages. About one-third of them have now shut down or converted to cold service through a combination of business (declining market) and maintenance reasons. This has contributed significantly to the general improvement.

In the bulk of the network, which is in cold service, spillages are most frequently caused by third-party activities, often resulting in a larger spill size.

It can be seen that considerable progress has been made on all fronts and this has required sustained efforts in all aspects of the business. Many issues are directly within the control of the pipeline operator such as internal inspections using intelligence pigs, maintenance policies, control systems and operational procedures. Third-party activities can only be influenced by trying to inform and control. The increase of mechanical failures in the first half of the 1990s initially gave rise to concern that this could be the onset of an adverse trend but the subsequent improvement has proven this to be unfounded.

The detailed analysis of these 30-year statistics has recently been published in a comprehensive CONCAWE report (1/02) and was used to set the scene at the COPEX 2002 seminar for pipeline operating companies held by CONCAWE in April. This seminar, held every two years, provides an opportunity for disseminating information and for discussing best practice in the field of pipeline operation and maintenance.

CONCAWE news

The latest developments inside CONCAWE

We should like to thank all those readers who took the time to complete our reports readership questionnaire at the end of last year. As part of the process of looking at ways to update our CONCAWE website and to improve electronic communications with our contacts, your responses have provided us with some valuable input on your wishes in this area. Additionally, it has been useful to be able to make sure that we have recipients' correct addresses and e-mail details on record.

After four years at the CONCAWE Secretariat as Technical Coordinator for Air Quality, Henk Schipper returned to Shell at the end of February this year and has been replaced by Peter Goodsell from BP. In addition to Peter's wide experience in environmental areas within BP, he has also contributed in recent years to various CONCAWE projects. In particular, he was closely involved in the IPPC Refinery BREF and Storage BREF Task Forces.

We are also pleased to welcome Marleen Eggerickx, who joined the Secretariat recently, replacing Elfriede Geuns who left CONCAWE at the end of 2001.

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CONCAWE publications

Reports published by CONCAWE from 2001 to date

General circulation (yellow cover) reports:	
1/01	Motor vehicle emission regulations and fuel specifications—part 1 summary and annual 1999/2000 update
2/01	Motor vehicle emission regulations and fuel specifications—part 2 detailed information and historic review (1996-2000)
3/01	European downstream oil industry safety performance - statistical summary of reported incidents—2000
4/01	Performance of cross-country oil pipelines in western Europe - statistical summary of reported spillages—2000
1/02	Western European cross-country oil pipelines 30-year performance statistics
2/02	Energy and greenhouse gases balance of biofuels for Europe—an update*
3/02	Motor vehicle emission regulations and fuel specifications—part 1 summary and annual 2000/2001 update*

Special interest (white cover) reports:	
01/51	Measurement of the number and mass weighted size distributions of exhaust particles emitted from European heavy duty engines
01/52	A noise exposure threshold value for hearing conservation
01/53	Classification and labelling of petroleum substances according to the EU dangerous substances directive (CONCAWE recommendations—August 2001)
01/54	Environmental classification of petroleum substances - summary data and rationale
01/56	An assessment of occupational exposure to noise in the European oil industry (1989–1999)

* Available shortly

As announced in the last issue of the CONCAWE Review, from the beginning of 2002 all CONCAWE reports are henceforth published as 'yellow cover' reports.

Up-to-date catalogues of CONCAWE reports are available via the Internet site: www.concawe.be

New reports are generally also published on the website.

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