Air quality

CONCAWE's contribution to an area of continued legislative focus

At the start of CONCAWE's life in 1963, air quality was seen mainly as a 'local air' issue and the bulk of legislation in force was based on the prevention of nuisance. How things have changed! Now we have legislation on air-related issues that are regional, continental and even global, such as ozone level depletion and climate change. In Europe, the first EEC Action Programme started in 1973, ten years after CONCAWE's inception. This was followed in 1987 by the Single European Act which confirmed the Community's competence for the environment. In 1993, the European Commission introduced its Fifth Action Programme on the Environment—'Towards Sustainability', and over the past ten years the pace has been maintained.

Since CONCAWE celebrated its 30th anniversary, a significant amount of air quality legislation has been passed at the European level. How has CONCAWE contributed to the various initiatives? It was early in the 1990s that CONCAWE began to encourage a move away from 'technology driven' and towards 'environmental quality driven' approaches to air-related issues. An early example of this, with respect to urban air quality, was our technical input to the European Commission on the updating of the ***Gasoil Directive*** (93/12/EEC). This involved air quality modelling of two example cities (London and Cologne), along with an assessment of the refining implications of lower sulphur gasoil. The study demonstrated that a sulphur content below 0.2% for heating oil was not justified since air quality targets for SO_2 would be met by the increased use of natural gas and the impact of other already legislated initiatives (e.g. the ***Large Combustion Plant Directive***). This study also demonstrated the 'environmental tensions' that arise in the refining sector when lower sulphur products are required i.e. the resulting increase in energy consumption and CO_2 emissions—a recurring theme in such studies since that time.

In the global arena, CONCAWE's studies in support of the discussion within the International Maritime Organization (IMO) on emissions from international shipping made a significant contribution to the establishment of an SO_2 Emissions Control Area (SECA) concept embodied in Annex VI to MARPOL. This represented an important shift away from the 'blunt instrument' of a stringent global sulphur cap on ships' fuels. CONCAWE was able to demonstrate that such a measure would not be justified on either environmental or cost-effectiveness grounds.

These two examples were the 'forerunners' of the approaches that were to underpin large and important programmes such as Auto/Oil I and II and the current CAFE programme. Over the past ten years CONCAWE has continued to play its role as a contributing stakeholder by providing technical, scientific and economic information on a large number of legislative initiatives. The content of this input has been shaped by CONCAWE's conviction that not only industry, but society as a whole, is best served by air quality legislation that is based on achieving established air quality targets in a cost-effective manner.

At this landmark in our history, it is perhaps worthwhile reflecting on some of the Directives (more than 20) and Protocols that have come into force in the past decade.

The first was the ***Control of VOCs from Storage (Stage 1) Directive*** (94/63/EC.) brought into force at the end of 1995. Its purpose was to reduce hydrocarbon emissions (VOCs) from the gasoline retail network. This was a technically complex Directive and CONCAWE provided extensive assistance to the EU Commission services during the development phase. We also contributed to crucial debates such as the relationship between emission limits, cost and energy consumption. CONCAWE's access to the detailed data on the number of storage depots, retail service stations and delivery truck fleets in the EU also provided vital input into the design of the implementation phases of the Directive. By the end of

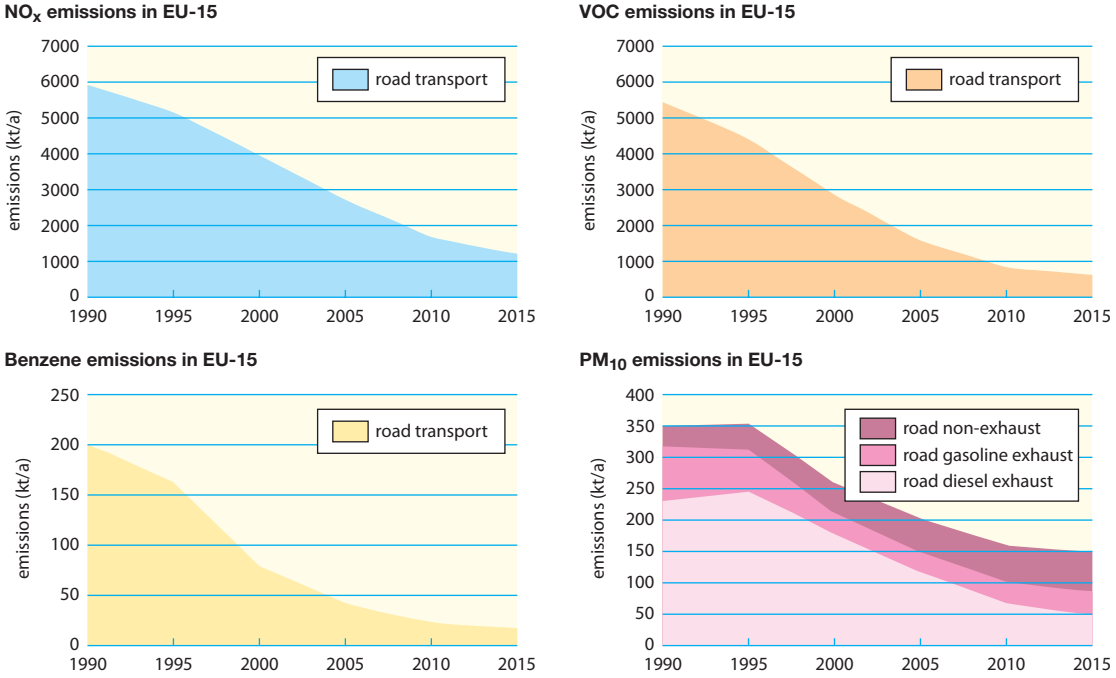

Figure 1
Actual and forecast levels of regulated emissions based on the impact of 'already mandated' measures in the EU.

These emission projections were made by the Commission's consultants as part of the Auto/Oil II Programme.

2001, more than 70% of service stations were fully equipped with 'Stage 1' vapour recovery facilities.

The ***Air Quality Framework Directive*** (96/62/EC), which came into force in November 1996, paved the way for the Commission to adopt a more comprehensive environmental quality approach to future policy development. Its purpose was to establish a framework for the setting and attainment of air quality objectives. Under this Framework Directive the Commission has proposed four Daughter Directives, the last of which has just been published. These Directives set limit values and alert thresholds for a list of air pollutants that include sulphur dioxide, nitrogen dioxide, particulate matter, lead, ozone, benzene, carbon monoxide and (in the 4th Directive) target levels for heavy metals and polycyclic aromatic hydrocarbons (PAHs).

The Commission's acidification/ozone strategy aimed to address the problems of acidification, eutrophication and regional ozone. This major initiative began in the mid-1990s and culminated in the ***National Emission Ceiling Directive*** (2001/81/EC). It was also 'effects based' and benefited from the extensive work/tools/databases of the UNECE which underpinned the development of the second ***Sulphur Protocol*** (Oslo Protocol) and of the multi-pollutant/multi-effects '***Gothenburg Protocol***'.

The 2001 revision of the ***Large Combustion Plant Directive*** (2001/80/EC) fixed new limit values for power stations and large furnaces and boilers while the ***National Emissions Ceilings Directive*** (2001/81/EC) aimed at limiting SO_2, NO_x, VOCs and NH_3.

Road transport came sharply into focus during the 1990s, as a result of growing concerns over urban air quality and the anticipated large increase in the number of vehicles. During this period, the Commission moved away from the technology-driven approach of previous Directives to an environmental quality-driven approach. This new way of thinking was applied in the two European Auto/Oil Programmes.

CONCAWE was a major stakeholder in both Auto/Oil programmes which, as a so-called 'Tripartite Initiative', involved close cooperation between the oil industry, the auto industry and the Commission. Throughout this work, our in-house modelling capabilities proved to be invaluable in understanding the impact of various emissions reduction scenarios on future air quality levels in

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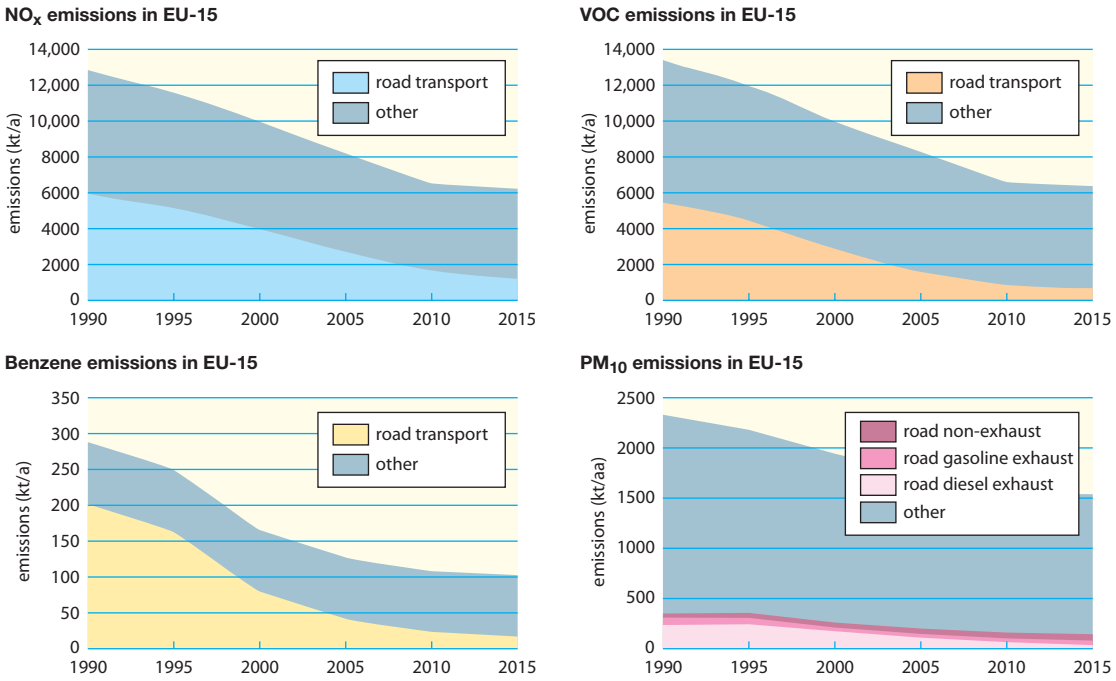
Figure 2
By 2010, emissions from transport will have been dramatically reduced, bringing other sources into focus.



Europe. The outcome of the programmes brought in new legislation that introduced sweeping changes to European road fuels specifications, not least the virtual elimination of sulphur (by 2009) and the rapid phase out of lead as a gasoline additive completed in 2000.

Achievements and challenges

What has been the impact of this legislation on air quality? Has there been an improvement between then and now? And what will the future look like? Even without further legislation in the pipeline, where will we be, in terms of air quality, in ten years time?

Figure 1 highlights the very significant actual and forecast reduction in all four regulated pollutants considered in the second Auto/Oil programme. It shows the impact of 'already mandated' measures including, for the transport sector, the requirements of Euro-4 emission standards for light-/heavy-duty vehicles and of the 2000/2005 ***Fuels Directive***. It also demonstrates, for the non-road sectors, the effect of the ***National Emission Ceiling Directive***.

A fall of 60–90% in emissions is forecast by 2010, despite the anticipated continuing growth in road transport. This trend continues beyond 2010 as a consequence of further penetration of Euro-4 technology into the overall European fleet.

In the case of primary PM_{10}, it is evident that by 2015, exhaust emissions are reduced to a level that is of the same order as the non-exhaust sources (brake/tyre wear). However, when transport emissions are put in the context of all other sector contributions, particularly for PM emissions, new policy priorities are perhaps indicated (Figure 2).

These charts provide an important perspective for 'post 2010' policy. To achieve further compliance with the EU Air Quality Target for Ozone will demand further NO_x and possibly VOC reductions. The dominance of non-transport sources of these two precursor emissions in 2010/15 indicates a need to move away from the exclusive focus on road transport in developing future strategies to address ozone.

In the case of primary particulates, given the growing recognition that PM_{10}/$PM_{2.5}$ are long-range transportable pollutants, the dominance of non-road transport sources may shift the policy focus away from road transport,

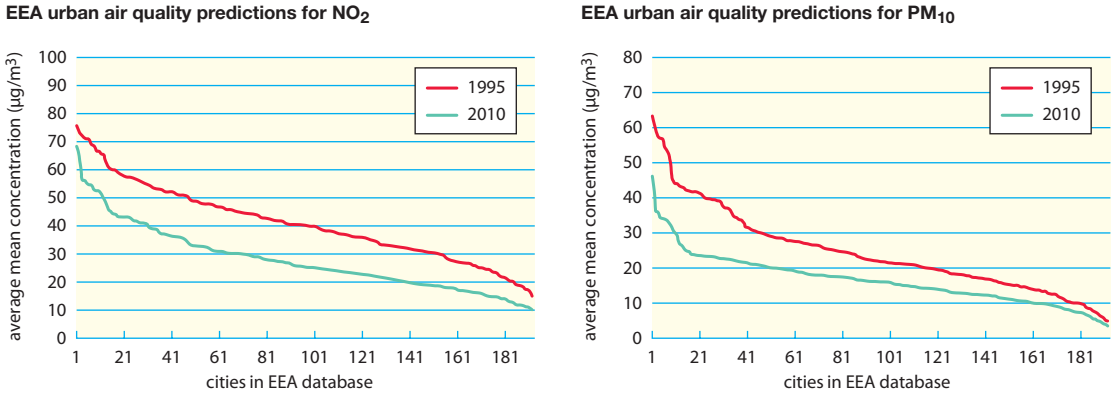


Figure 3
Significant improvements in air quality have been achieved in the past 10 years and this trend is forecast to continue during this decade as a result of already agreed measures.

unless the nature of particulates from transport is identified as having a much greater health impact than those from other sources.

Trends in emissions provide a useful perspective on the efficacy of environmental policy and future policy priorities, but they do not tell the whole story. The goal of such policy is improved air quality in the EU.

Figure 3 provides such a perspective. These charts were developed by the European Environment Agency (EEA) as part of the second Auto/Oil Programme using their so-called c-Q model to assess the improvement in air quality for some 200 EU cities based on the emission changes given in the previous charts.

The NO_2 annual mean target of 40 µg/m^3 is recognised as being much tougher than the short-term 1-hour limit of 200 µg/m^3. The EEA projection for 2010 shows a significant improvement in the degree of compliance (from 50% of the cities to about 90%). However, southern European cities in particular are expected to need to implement further measures in order to achieve compliance, given the higher conversion of NO to NO_2 due to higher levels of ozone.

The EEA projection here indicates a significant improvement between 1995 and 2010 but a significant level of non-compliance in 2010 against the indicative 20 µg/m^3 annual mean target.

Understanding the contributions to this residual level of non-compliance is vital for the design of appropriate amelioration policies. Figures 1 and 2 showed that, at least in terms of mass, the majority of particulates will originate from sources other than vehicle exhaust, and primarily from non-transport sources. In addition, when all these 'primary emissions' are placed in the perspective of secondary sources (derived from SO_2, NO_x and NH_3 emissions) they themselves become less important.

Data collected so far and the future predictions indicate that significant air quality improvements have been achieved in the past 10 years and this trend will continue during this decade as a result of already agreed measures.

The CAFE (Clean Air For Europe) programme embraces the concepts that underpinned the Auto/Oil programmes but with a broader scope, including all industrial sectors and incorporating the review/revision of human health or environment-based targets. Its long-term goal is stated as 'Long-term, strategic and integrated policy to protect against the effects of air pollution on human health and the environment'. The key pollutants of concern in CAFE are particulate matter and ozone. The programme is due for completion in mid-2005.

CONCAWE is participating as a stakeholder, and a specific support structure has been set up. The programme places great emphasis on improved modelling to enable the prediction of the effects of emissions down to urban scales. This is an area where CONCAWE may have a significant contribution to make. What can be done cost-effectively, and what we as an industry might need to do, is still under discussion.