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Acid News

IN THIS ISSUE

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AIR QUALITY AND HEALTH

New WHO air quality guidelines

The World Health Organization is strengthening its air quality guidelines for a number of pollutants and making them global.

A MEETING IN BONN in October last year marked the conclusion of several years' work within the WHO on revised guidelines for four outdoor air pollutants: particulate matter, ozone, nitrogen dioxide and sulphur dioxide. The results have so far only been published as a report of the meeting; the target date for the publication of the full material is set for late summer 2006.

The previous update of the World Health Organization's air quality guidelines was completed in 1997 and printed as a WHO publication in 2000, and was targeted mainly at Europe.

A great deal of new research has been published since then and there has been growing awareness among scientists and policy makers of the

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A newsletter from the Swedish NGO Secretariat on Acid Rain, the primary aim of which is to provide information on air pollution and its effects on health and the environment.

Anyone interested in these matters is invited to contact the secretariat. All requests for information or material will be dealt with to the best of our ability. Acid News is available free of charge.

In order to fullfill the purpose of Acid News, we need information from everywhere, so if you have read or heard about something that might be of general interest, please write or send a copy to:

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THE SWEDISH NGO SECRETARIAT ON ACID RAIN

The Secretariat has a board consisting of one representative from each of the following organizations: Friends of the Earth Sweden, the Swedish Anglers' National Association, the Swedish Society for Nature Conservation, the Swedish Youth Association for Environmental Studies and Conservation, and the World Wide Fund for Nature Sweden.

The essential aim of the secretariat is to promote awareness of the problems associated with air pollution, and thus, in part as a result of public pressure, to bring about the needed reductions in the emissions of air pollutants. The aim is to have those emissions eventually brought down to levels – the so-called critical loads – that the environment can tolerate without suffering damage.

In furtherance of these aims, the secretariat

• Keeps up observation of political trends and scientific developments.

• Acts as an information centre, primarily for European environmentalist organizations, but also for the media, authorities, and researchers.

• Produces information material.

• Supports environmentalist bodies in other countries in their work towards common ends.

• Participates in the lobbying and campaigning activities of European environmentalist organizations concerning European policy relating to air quality and cli-

Differing views on proposals

Thematic strategy and air quality directive have been debated by ministers and parliamentarians.

DURING THE LAST FEW MONTHS, intensive discussions and negotiations have taken place in the EU about the Thematic Strategy on Air Pollution and the European Commission's proposal for a new air quality directive.[1]

The thematic strategy

On 9 March the Council of Environment Ministers adopted its conclusions on the thematic strategy, in which they welcomed the strategy. The ministers said they acknowledge *"that even with effective implementation of current policies, there will remain very significant adverse impacts on human health and the environment from air pollution in 2020"*, and that they were *"convinced that the magnitude of these impacts is such that additional action must be taken to combat air pollution in the EU."*

The ministers described the emission targets proposed in the strategy for 2020 as *"an appropriate basis for further considerations"*, and urged the Commission to come forward with additional measures to further reduce emissions, including stricter emission standards (Euro VI) for heavy-duty vehicles. They demanded more action to reduce pollution from shipping and stationary combustion sources, as well as initiatives to cut emissions from agriculture.

It was recognized that a mix of national, EU, and international measures will be required to deliver the strategy's objectives in a cost-effective way, and that a better integration of air pollution issues into agricultural, energy and transport policies both at EU level and at national level is needed.

Moreover, the ministers noted *"with satisfaction"* that the Commission will come forward, as soon as possible, with a legislative proposal to revise the national emission ceiling directive.

The strategy has also been discussed in the European Parliament's environment committee.[2] The Parliament's rapporteur – the Dutch social democrat Dorette Corbey – has called for more ambitious reduction targets regarding the emissions of nitrogen oxides, fine particles ($PM_{2.5}$), and volatile organic compounds. Some other parliamentarians, such as Satu Hassi (Finland, Green Party) and Anders Wijkman (Sweden, Christian Democratic Party) want tougher emission reductions also for other air pollutants (ammonia and/or sulphur dioxide).

The discussions will result in a resolution from the Parliament. On 30 May, the environment committee report will be adopted, while adoption in a full plenary session is expected by June or July.

Action for better air quality by Milieudefensie (Friends of the Earth Netherlands). Many environmentalist organizations in Europe are deeply concerned over the compromises to the existing legislation that have now been proposed.

Air quality directive

The Commission was strongly criticized back in September last year when it presented its proposal for a new air quality directive and introduced several derogations that would in practise weaken existing air quality legislation (see AN 4/05, pp. 4–5). Under the Austrian presidency, the proposal has been intensively debated in the council's working party on the environment, i.e. the body with representatives from the member states' environment ministries that prepares the Council's common position that is to be adopted by the environment ministers.

Council negotiations take place behind closed doors, and public access to documentation from these negotiations is very limited. It is however clear that most member states want to weaken even further the obligations in the existing legislation, as compared to the Commission's proposal. It has for example been suggested that restrictions could be placed on the areas where air quality limit values apply – currently they apply everywhere in outdoor air, i.e. throughout the territory of the member states.

Regarding the concentration cap for fine particles ($PM_{2.5}$), which the Commission proposed should be set at 25 micrograms per cubic metre ($\mu g/m^3$) and be attained by 2010, member states have been discussing its replacement with a softer target value, which is to be complemented by a binding limit value (at the same level) to be attained five years later, i.e. by 2015.

Some member states have argued in favour of having no binding limit values at all for $PM_{2.5}$, but only target values. Moreover, there have been suggestions to extend the five-year derogation for attainment of existing and forthcoming limit values for several pollutants.

There appear to be widely differing views in the Parliament about the Commission's proposal. The rapporteur – the German liberal Holger Krahmer – has suggested replacing the binding concentration cap for $PM_{2.5}$ with a target value (as well as lowering the value from 25 to 20 $\mu g/m^3$), and exempting some areas (e.g. those "*to which the public do not have ac-*

New EU air quality directive

Continued from previous page

cess and which are uninhabited or not permanently inhabited") from compliance with air quality limit values. He has also proposed the introduction of a second-stage limit value for PM_{10}, i.e. an annual limit value of 32 $\mu g/m^3$ to be attained by 2010.

The list of proposed amendments by environment committee members contains a wide variety of proposals, from further weakening to significant strengthening of the air quality legislation. The former includes, for example, extending the proposed five-year derogation for attainment of limit values to longer time periods, lowering the level of ambition for the proposed $PM_{2.5}$ exposure reduction target, and removing the daily limit values for PM_{10}.

Some parliamentarians are however arguing for a significant strengthening of the air quality requirements. Proposals for such amendments include:

- ❏ Removing the proposed five-year derogation;
- ❏ Removing the proposed exemption for exceedances due to contributions from natural sources of air pollutants;
- ❏ Introducing second-stage daily and annual limit values for PM_{10} in line with the indicative limit values that are already included in the existing directive (1999/30/EC);
- ❏ Setting strict binding limit values for $PM_{2.5}$ at levels between 10 and 15 $\mu g/m^3$, to be attained by 2010; and,
- ❏ Strengthening the proposed exposure reduction target for $PM_{2.5}$, from 20 to 25 per cent between 2010 and 2020.

The Parliament's environment committee[2] will adopt its report on 30 May, and adoption by the full plenary is scheduled for mid-June. Agreement on a common position by the Council of Environment Ministers is expected by late June.

CHRISTER ÅGREN

[1] The Thematic Strategy on Air Pollution and the Commission's proposal for a new air quality directive are described in articles in Acid News 4/05, pp. 1–5. Comments from environmental NGOs to the strategy and the directive proposal can be downloaded from www.acidrain.org/pages/policy/sub6_10.asp

[2] The rapporteurs' reports, proposals for amendments by other parliamentarians, reports from the environment committee, and other information from debates in the Parliament are available at www.europarl.europa.eu.

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There is a pressing need for measures to improve air quality in Cairo and other megacities. WHO hopes that the proposed interim target values will speed up the process.

New WHO air quality guidelines

Continued from front page

global nature of the public health problems posed by exposure to air pollution.

One important new addition is that WHO has chosen to set guideline values for particulate matter. The previous version only gave guidance in the form of a statistical model relating exposure to risk, since researchers were unable to find a concentration that did not produce negative effects on health. It was therefore left to policy makers to decide what risk should be considered acceptable.

No threshold value for harmful effects has yet been determined, but during the course of revising the guidelines it was found that the dose-response approach has not worked well, particularly in developing countries.

WHO has therefore chosen to set values, which if achieved, would be expected to result in significantly reduced rates of adverse health effects. However it is stressed that there is a need to reduce exposure to non-threshold pollutants even where current concentrations are close to or below the proposed guidelines.

Given that air pollution levels in developing countries often far exceed the recommended guidelines, WHO also proposes interim target levels, in excess of the guideline values themselves, to promote steady progress towards meeting the guideline values.

The concentration values given refer to monitoring sites representative of population exposures. Levels may be higher close to specific sources such as major roads, power plants and other large stationary sources, and protection of populations living in such locations may require special measures to bring the pollution levels below the guideline values.

Particulate matter (PM)

WHO states that the risk for various outcomes has been shown to increase with exposure and there is little evidence to suggest a threshold below which no adverse health effects would be anticipated – the lower range of concentrations at which adverse health effects has been demonstrated is not far above the background concentration, which has been estimated at 3–5 $\mu g/m^3$ in the United States and western Europe for $PM_{2.5}$ (particles smaller than 2.5 micrometres).

The new WHO Air quality guideline values (AQG). They are recommended to be achieved everywhere in order to significantly reduce the adverse health effects of pollution.

Pollutant	Averaging time	AQG ($\mu g/m^3$)
$PM_{2.5}$	1 year	10
	24 hour (99th percentile)	25
PM_{10}	1 year	20
	24 hour (99th percentile)	50
Ozone	8 hour, daily maximum	100
Nitrogen dioxide	1 year	40
	1 hour	200
Sulphur dioxide	24 hour	20
	10 minute	500

The epidemiological evidence shows adverse effects of particles after both short-term and long-term exposures.

WHO considers that the link between dose and response can be used to set limit values, depending on local circumstances, but numerical values are also given to provide guidance on the concentrations at which increasing, and specified mortality responses due to particles are expected based on current scientific insights, see table. The 24-hour mean values refer to the 99th percentile of the distribution of daily values – that is the fourth highest value of the year.

The use of $PM_{2.5}$ levels is recommended to monitor the relationship between exposure and health effects.

However, much more data has been collected worldwide for PM_{10}. A $PM_{2.5}/PM_{10}$ ratio of 0.5 has been used to derive the PM_{10} guideline value. This ratio of 0.5 is close to that observed typically in urban areas of developing countries and is at the bottom of the range (0.5–0.8) found in urban areas of developed countries. If justified by local conditions, this ratio may be changed based on the local data when the local standards are set.

In addition to $PM_{2.5}$ and PM_{10}, ultra fine particles (UF) have recently attracted significant scientific and medical attention. These are particles smaller than 0.1 micrometres and are measured as the number of particles in a given volume of air.

While there is considerable toxicological evidence of the potential detrimental effects of UF particles on human health, the existing body of epidemiological evidence is insufficient to reach a conclusion on the exposure/response relationship to ultra fine particles. Therefore it was concluded that no recommendations can be provided as to guideline concentrations of UF particles at this point.

Ozone (O_3)

New research has shown effects at ozone concentrations below the previous guideline value of 120 $\mu g/m^3$ (60 ppb) as an eight-hour daily average, without clear evidence of a threshold. WHO is therefore lowering the eight-hour guideline value to 100 $\mu g/m^3$ (50 ppb).

WHO notes that it is possible that health effects will occur below this level in some sensitive individuals.

Based on time-series studies, the number of attributable deaths brought forward can be estimated at 1–2 per cent on days when the ozone concentration reaches this guideline level, as compared with the background level.

WHO also notes that there is some evidence that long-term exposure to ozone may have chronic effects, but it is not sufficient to recommend an annual guideline.

Nitrogen dioxide (NO_2)

There are studies supporting a lowering of the annual NO_2 guideline value. However, as NO_2 is an important constituent of combustion-generated air pollution and is highly correlated with other primary and secondary combustion products, it is not clear to what extent the health effects observed in epidemiological studies are attributable to NO_2 itself or to other correlated pollutants.

WHO therefore concluded that there is not sufficient evidence to change the guideline value of 40 $\mu g/m^3$ for annual NO_2 concentration. Similarly, new research does not provide any support for changing the guideline value of 200 $\mu g/m^3$ for one-hour NO_2 concentration.

WHO emphasizes that the present guideline was set to protect the public from the health effects of the gas NO_2 itself. If, instead, NO_2 is monitored as a marker for the concentrations and risks of the complex combustion-generated mixtures of pollution, a lower annual guideline value than 40 $\mu g/m^3$ should be used.

Sulphur dioxide (SO_2)

WHO recommends that the guideline value for 10-minute exposure remains unchanged, but that the 24-hour mean is greatly reduced: from 125 to 20 $\mu g/m^3$. The basis for this is that effects associated with sulphur dioxide have been observed at much lower concentrations than before, even down to 5 $\mu g/m^3$. But because researchers feel there is still considerable uncertainty as to whether SO_2 is the pollutant responsible for the observed adverse effects or, rather, a surrogate for ultra-fine particles or some other correlated substance, the new guideline value has been set at 20 $\mu g/m^3$.

PER ELVINGSON

Source: **WHO air quality guidelines global update 2005. Report on a Working Group meeting, Bonn, Germany 18-20 October 2005.** Available at http://www.euro.who.int/Document/E87950.pdf

Reducing fine particles in the air cuts mortality risk

A LARGE BODY of epidemiological literature has found an association between increased fine particulate air pollution and acute and chronic mortality. The effect of improvements in particle exposure has been less clear.

A new American study has however filled this gap of knowledge. Researchers who extended the so-called Harvard Six Cities fine particulate air pollution study by eight years found that reduced levels of fine particle pollution ($PM_{2.5}$) during this period lowered mortality risk for participants.

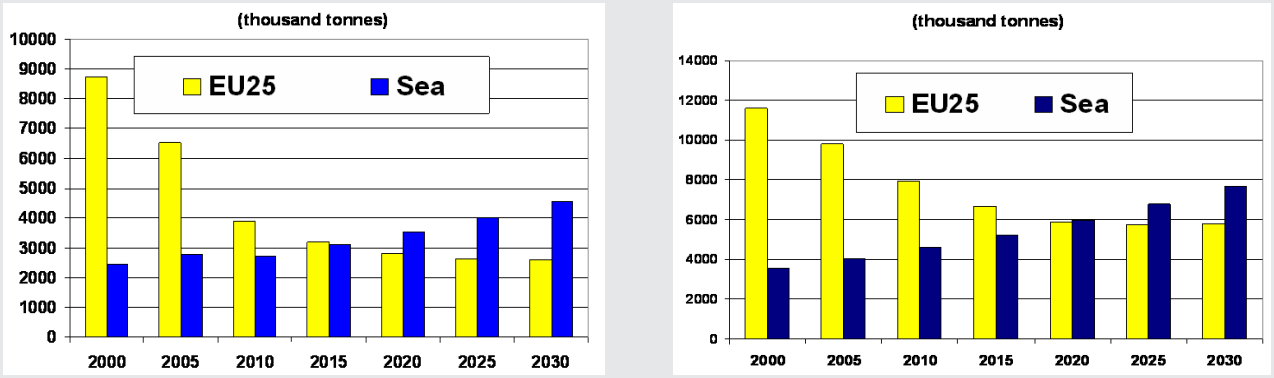
The findings of the original Harvard Six Cities study (1979–90) revealed an association between levels of $PM_{2.5}$ and mortality risk. The new study, which was conducted from 1990 to 1998, reports on this later period of reduced air pollution concentration. The drop varied between cities, from less than 1 to 7 $\mu g/m^3$ in long-term average concentrations.

The largest drops in adjusted mortality rates were in cities with the greatest reduction in $PM_{2.5}$ concentrations. The reduction was observed specifically for deaths due to cardiovascular and respiratory disease and not from lung cancer, the latter a disease with a longer latency period and less reversibility.

Further reading: Reduction in Fine Particulate Air Pollution and Mortality. Extended Follow-up of the Harvard Six Cities Study. Francine Laden, et al. American Journal of Respiratory and Critical Care Medicine. Volume 173, Issue 6; March 15, 2006. Abstract available at http://ajrccm.atsjournals.org/cgi/content/abstract/173/6/667

Stricter standards discussed

A significant motivator for tighter international standards is the actions that shore states and ports are taking – or threatening to take – to reduce shipping emissions of air pollutants.



Analysis under the CAFE programme by the EU Commission revealed that under current legislation, by 2020 emissions of sulphur dioxide (left) and nitrogen oxides (right) from international shipping in European waters will exceed those from all land-based sources in the Union.

THE FIRST SUBSTANTIVE meeting aimed at introducing stricter global air pollution emission standards for ships was held in London on 3–7 April. The discussions took place in the so-called Bulk Liquids and Gases (BLG) subcommittee of the Marine Environment Protection Committee (MEPC) of the International Maritime Organization (IMO).

Last July, the MEPC initiated a process to revise international standards on emissions from both new and existing ships of nitrogen oxides (NOx) and sulphur dioxide (SO_2), and to consider regulating emissions of fine particles (PM) and volatile organic compounds (VOCs) for the first time. The BLG was instructed to review relevant technologies for control of shipping emissions, study the levels and characteristics of ships' PM emissions, and to recommend actions to be taken to reduce the emissions. The review should be ready by 2007.

At its April meeting, BLG created an air pollution working group to proceed with this work. The working group discussions focused on the available emission reduction technologies for NOx, SO_2 and PM, their reduction potential and possible side impacts. The group also discussed potential structures for future regulations. As this was the first meeting, no substantive decisions were made.

Views from various countries, industry groups, and environmental organizations were presented both in official submissions[1] (documents distributed prior to the meeting) and during discussions.

Regarding emissions of NOx, most delegations appeared to favour a two-phase approach to new engine standards, with initial standards to be effective from around 2010, and a second step by about 2015. There was discussion about geographically defined NOx limits, either along the lines of so-called emissions control areas (which must be nominated by shore states and approved), or coastal zones pre-defined by a fixed distance from shore. Most delegations favoured a global standard – industry for uniformity's sake, and some countries due to concerns regarding global warming impacts (NOx is an important precursor in the formation of ground-level ozone, which acts as a greenhouse gas).

Most delegations favoured a global standard for NOx

Lists of NOx emission control technologies were produced, providing indicative values of NOx reduction potentials as well as information on possible side impacts, such as increased fuel consumption.

The sulphur discussion focused on refiners' claims that larger quantities of low-sulphur heavy bunker fuel will not be available. The oil industry claimed refining capacity does not (and is not likely to) exist to produce large enough volumes to meet a global low-sulphur fuel requirement, and that such a requirement would likely result in refineries moving to increase production of distillate fuel and largely abandoning the heavy bunker fuel market. This would be a big step forward environmentally, and could also benefit the shipping industry, since the quality of heavy bunker fuel today is quite variable and often poor. A switch to distillate fuels would however likely increase shipping costs.

It was noted that further reductions in sulphur limits and/or the designation of additional Sulphur Emission Control Areas (SECAs) will require either the availability of low-

sulphur fuels (desulphurized heavy bunker fuel or distillate fuel) or the use of exhaust gas cleaning technology (e.g. sea water scrubbing).

The discussion on PM focused on the desirability of further information. While many in the shipping industry now appear to be starting to recognize that fine PM is a substantial health problem, some claim that primary PM emitted from ship diesel engines may not produce identical impacts to PM emissions from land-based diesel engines. In the near term, one easy way to reduce primary PM emissions is to use cleaner fuel, i.e. to reduce fuel sulphur limits. Exhaust gas cleaning as a means to reduce PM emissions was also discussed.

On top of emissions of the primary PM that is formed in the engine during combustion, ship emissions of SO_2 and NOx give rise to so-called secondary PM in the form of sulphate and nitrate aerosols. Consequently, any measure that reduces emissions of SO_2 and NOx will also result in lowering ships' contribution to PM concentrations.

There was limited discussion on reduction of emissions from existing ships, and although many delegations complained about how difficult it will be to reduce emissions from existing ships, most agreed that something needs to be done. As regards NOx emissions, one relatively simple fix is a replacement of slide valves, which can reduce emissions by about 20 per cent or so. More efficient NOx-reducing techniques, such as selective catalytic reduction (SCR) exist, but are more expensive and require more significant modifications. Emissions of SO_2 and PM can be reduced either through lower sulphur fuel or exhaust gas cleaning.

From the discussions it appeared that one significant motivator for tighter international standards is the actions that shore states and ports are taking – or threatening to take – to reduce emissions. Such actions are taking place for example the United States (e.g. in California and some west coast ports) and in the European Union. Consequently, there was much discussion about the desirability of uniform international standards.

In order to meet the 2007 deadline, a correspondence group will be established to continue work on the new standards. This group will exchange information and proposals by e-mail and report to an intersessional BLG working group meeting, which tentatively is to be held in Norway on 13–17 November, 2006.

The next BLG meeting is scheduled for April 2007. Here, the aim will be to agree on a final draft revision of MARPOL Annex VI, which is to be submitted to the full MEPC. The MEPC will consider and possibly approve a revised Annex VI at its meeting in July 2007.

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DAVID MARSHALL

[1] See **NGO submission to the IMO meeting in London 3-7 April 2006, on the review of MARPOL Annex VI**. Available at http://www.acidrain.org/pages/policy/sub6_4.asp

IMO and MARPOL Annex VI

Globally, shipping activities are regulated by the UN International Maritime Organization, IMO. After years of negotiation, agreement was reached in 1997 on an air pollution annex to the MARPOL 73/78 Convention.

Annex VI establishes a global sulphur cap of 4.5 per cent for marine heavy bunker fuel, as well as designating two so-called sulphur emission control areas – the Baltic Sea and the North Sea – where the sulphur content of fuel used by ships must be below 1.5 per cent.

It also prescribes emission standards for NOx for diesel engines with a power output of more than 130 kW, but these standards are so weak that virtually all new engines have been in compliance since the late 1990s.

After a lengthy ratification process, Annex VI entered into force on 19 May 2005. The IMO's Marine Environment Protection Committee (MEPC) is the body responsible for setting international pollution control standards for shipping. In July 2005, the MEPC decided to initiate work to revise and strengthen Annex VI – a process that is to be ready by 2007.

NEWS IN BRIEF

Tax free shore-side electricity for ships

In-port emissions of air pollutants from shipping can be greatly reduced by using electricity supplied by cable from shore, instead of generating electricity with diesel engines onboard. The Swedish government wants to encourage shipowners to make the switch by exempting such electricity supplies from tax. At the North Sea ministerial conference in Göteborg at the start of May the participating countries agreed to encourage – for example by economic incentives – the provision and use of shore-side electricity.

The following week the European Commission issued a non-binding recommendation to the member states to offer economic incentives to port operators. It highlights in particular the possibility for electricity tax reductions. It also calls for the development of harmonized international standards and provides guidance on the costs, benefits and practicalities of connecting ships to the electricity grid. In most cases the environmental benefits of switching to shore-side electricity "considerably exceed" the costs, it says.

The promotion of shore-side electricity was an objective in last year's EU thematic strategy on air quality.

Source: **ENDS Europe DAILY**, 9 May 2006.

Cities pledge to slash carbon emissions

An association of European cities linked in partnership with indigenous rainforest peoples has resolved to reduce their emissions of carbon dioxide by 10 per cent every five years as a long-term strategy.

By doing so they intend to cut 1990 levels of per capita greenhouse gas emissions in half by the year 2030. To attain the long-term climate stabilization goal agreed by the cities, individuals would have to cut their emissions to the level of 2.5 metric tonnes of carbon dioxide equivalent per person per year.

The Climate Alliance of European Cities with Indigenous Rainforest Peoples is Europe's largest city network dedicated to climate protection, with more than 1,300 member municipalities located in 17 European countries. Close to 50 million European citizens live in member cities, which include Barcelona, Berlin, Luxembourg, Munich, The Hague, Venice, Vienna and Zurich.

Source: **Environment News Service** (www.ens-newswire.com), 9 May 2006.

NEWS IN BRIEF

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Heavy hybrids

The Volvo Group has developed a hybrid diesel-electric drive system for heavy vehicles. It is reported to enable a 35-per-cent reduction in fuel consumption in stop-start driving conditions, such as buses and lorries on busy urban routes. On intercity roads the fuel consumption is reduced by 9–10 per cent.

A key component of the hybrid solution is a combined starter motor, drive motor and generator that is mounted between the diesel engine and transmission. Because the electric motor and diesel engine are coupled in parallel they can operate simultaneously. During braking, energy is recovered and stored in a battery.

New battery technology is an important element of the new system. In collaboration with the part-owned company Effpower, Volvo has developed an efficient battery that is expected to cost one fifth as much as the nickel hydride batteries used in vehicles such as Toyota's hybrid cars.

Volvo expects to begin manufacturing heavy hybrid vehicles 2009. It is estimated that buyers will be able to recoup the additional purchase cost of around 35 per cent within one to two years.

Further information: www.volvo.com.

No real reductions

The "real world" emissions of nitrogen oxides (NO_x) from diesel-driven cars are much higher than the figures suggested by testing procedures required under EU law, according to research by two German technology institutes. In fact, NO_x emissions from diesel cars have not seen a significant reduction in the last 13 years, despite much stricter standards. Part of the reason is said to be that the test cycle relates to a much smaller area of engine performance than encountered in true road driving conditions. This has allowed manufacturers to tune engines to reduce NO_x solely on the test cycle, a practice known as "cycle beating".

Source: **T&E Bulletin**, March 2006.

CONGESTION CHARGING

Continued success for the Stockholm trial

CONGESTION ON THE STREETS of inner city Stockholm has been reduced considerably and residents are showing an increasingly positive attitude towards the charging trial in the city.

The ongoing evaluation of the congestion charging trial shows that car traffic increased slightly in April, but no more than would normally be expected in spring. Traffic flow was 22 per cent lower than in the same month last year, which is much higher than the 10–15 per cent estimated before the start of the trial. In many cases car journey times at rush hour have been halved.

Around 100,000 fewer vehicles now travel in and out of the city each day. Some 40,000 commuters have switched to public transport, but it is not yet known where the rest have gone. It is likely that car pooling has increased and that people have avoided making some journeys. Many employers are reporting an increase in the number of employees who are interested in teleworking.

For public transport, congestion charging not only means more commuters, but also that buses can travel faster through the inner city. One consequence is that drivers on many services have to stop and wait at bus stops to avoid running ahead of the timetable. Rescheduling of timetables offers considerable scope for extending services at no extra cost, since the same buses and drivers can be used more effectively.

In the case of the retail sector the retail index shows high sales figures during spring. There is no evidence that congestion charging has had a harmful impact on inner city trade.

Before the trial began a large majority of Stockholm residents were negative towards the trial, but during spring opinion has gradually turned, and in April 51 per cent said that the trial was a good decision, 40 per cent said it was bad, and 9 per cent were unsure.

Over the spring period Stockholm has received a steady stream of study visits from other cities around the the world, all of which are struggling to cope with a steadily growing mass of cars that are clogging their road systems.

A referendum will be held in September to decide whether congestion charging is brought in permanently in Stockholm. It remains to be seen whether other cities will choose to follow suit.

PER ELVINGSON

Information: www.stockholmsforsoket.se/templates/page.aspx?id=2453. For information on congestion charging in London, see Transport for London, www.tfl.gov.uk/tfl/cclondon/cc_publications-library.shtml

Swiss tax shifting

The amount of freight traffic crossing the Alps by road fell again in 2005, suggesting that Switzerland's policy of encouraging a shift from road to rail is working, albeit slowly. The 2005 figure of 1.2 million transit journeys was four per cent down on the 2004 figure and 14 per cent down on 2000, the year Switzerland introduced its distance-related charge for lorries. The volume of goods transported by road through the Alps has increased by 400,000 tonnes (three per cent), which suggests load factors for lorries are improving. Rail has maintained its share of the market in Switzerland. By contrast, France and Austria report figures showing rail losing market share to road.

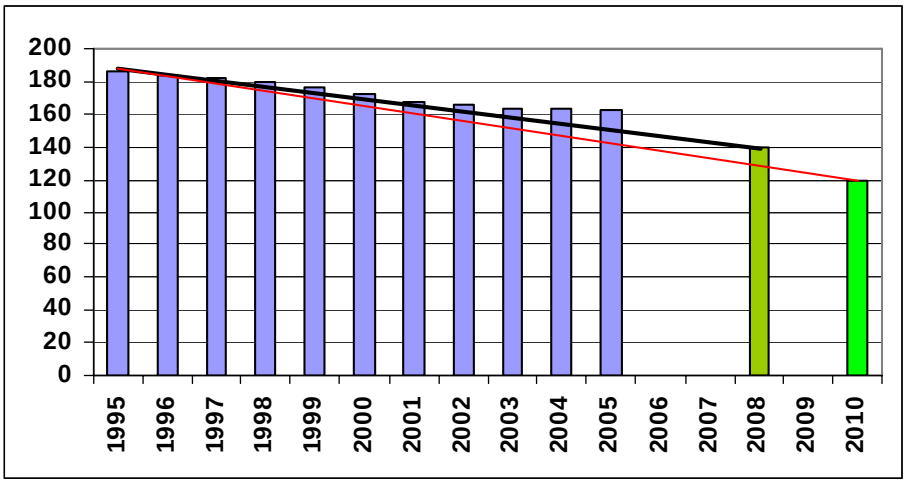
Source: **T&E Bulletin**, April 2006.

Fewer empty lorries

The German Office for Freight Transport has published a study on developments in German freight transport since the motorway kilometre charge was introduced in January 2005. It shows that internet sites selling freight space on lorries that would otherwise return from a journey empty have seen such growth that there has been a 13-per-cent reduction in "empty truck kilometres" in the first year alone.

Source: **T&E Bulletin**, April 2006.

Car industry failing on CO_2 pledge



Average emissions of carbon dioxide from new cars (grams per kilometre) sold in the EU15 from 1995 to 2005, and targets for 2008 (140 g/km) and 2010 (120 g/km).

CARMAKERS are defaulting on their pledge to tackle climate change, new figures show, according to the European Federation for Transport and Environment (T&E).

Last year, car industry efforts to improve fuel efficiency only went a third of the way towards meeting the commitment made to the EU in 1998.

European manufacturers sold cars that produce on average 160 grams of CO_2 per kilometre last year, down only one per cent on the previous year, according to sales figures analyzed by T&E. The average for Japanese makers was 169 g/km, and emissions from Korean cars went up in 2005 to 172 grams per kilometre.

The European Automobile Manufacturers Association (ACEA) promised the European Commission in 1998 to reach average emissions of 140 grams of CO_2 per kilometre for new cars by 2008. The Japanese and Korean car makers' associations, Jama and Kama, do have an extra year to meet the 140 g/km target, but T&E said the figures suggested manufacturers would be lucky even to manage 150 g/km by 2008-09.

Further improvements in efficiency are not expensive and can be made with widely available existing technology, says T&E. A report for the European Commission last year showed that the cost of meeting the EU's own target for new cars of 120 grams of CO_2 per kilometre would be on average 577 euro per car.

Meeting the EU target would result in twenty-five per cent lower fuel bills. At today's prices that would mean a 1,000 euro saving for the average car over three years.

Further information: T&E website (new address): www.transportandenvironment.org

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CAR EMISSIONS

Growing support for stricter standards for diesel-driven cars

IN DECEMBER the Commission published its proposal for new emission standards for passenger cars, the so-called Euro 5 proposal (AN 1/06). The Commission envisages a 200 mg/km limit on diesel car emissions of nitrogen oxides (NOx), effective from 2008. Further limits, applicable from 2013, would be set only after a review in 2009.

But Germany and several other countries believe a lower value should be set, and that the next step should be decided now.

Germany's representative told a meeting of EU competition ministers in March that there was a growing consensus among EU states that the proposed Euro 5 standards could be tightened, and that the automotive industry would benefit from being given the next round of emissions targets now.

The idea of an early Euro 6 NOx standard received support from a broad majority of environment ministers meeting a few days earlier. Seventeen member states expressed an opinion on the issue and 14 gave support in principle to the drawing up of the next round of targets. Three member states expressed their opposition.

T&E, the European Federation for Transport and Environment, said Germany's call for post-Euro-5 targets now was helpful. It also welcomed the idea of having the same NOx limit for diesel and petrol cars, but said it could be a lot stricter than the 80 mg/km in the German proposal and implemented much sooner than 2013.

"If EU car makers want to sell diesels in the US," said Aat Peterse at T&E, "they will have to comply with standards much tougher than Euro-5 from next year, so why wait?"

Source: **T&E Bulletin**, April 2006.

NEWS IN BRIEF

Bad air in Madrid

Air quality in Madrid last year did not meet the requirements set by EU legislation, according to a report by Ecologistas en Acción.

"Since the main agent of air pollution in Madrid is the road traffic, anything considered as serious attempts would be to reduce the use of cars in the city," write Ecologistas en Acción in a press release. The organization reports that the City Council is instead investing in increasing car access by building more roads. Despite several promises, no plan has yet been presented to control pollution.

Further information: Ecologistas en Acción (report in English), www.ecologistasenaccion.org

A request for more renewable energy

The summit of EU leaders in March called on the Commission to look at raising the share of renewable sources to 15 per cent of energy used in the EU by 2015 from a current target of 12 per cent by 2010. They also called for a study into raising the proportion of biofuels in the transport sector to eight per cent by 2015 from a goal of 5.75 per cent by 2010.

One important reason for the growing interest in renewable energy is the rising cost of oil and increased dependency on foreign supplies – the bloc is projected to rely on non-EU countries for 70 per cent of its energy in 20–30 years' time, up from 50 per cent now.

Ministers want higher target levels to be set for 2015 despite the fact that the Commission reported earlier in spring that the targets for 2010 are unlikely to be met. The leaders asked the Commission to study how progress towards these targets could be improved.

Power plants linked to premature deaths

About 700 premature deaths and 30,000 asthma attacks in the United States each year are linked to current air pollution from six fossil-fuelled power plants in Maryland, according to a study by the Maryland Nurses Association.

The study indicates that while individuals in Maryland are at greater risk from this pollution than residents of other states, the total public health burdens outside of the state are higher than inside, due to long-range transport of pollutants.

Further reading: **Environment News Service** (www.ens-newswire.com), 15 February 2006.

SWEDEN

Take off for green cars

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The Swedish definition of a green car permits the use of fossil fuels, on condition that carbon dioxide emissions from the car do not exceed 120 grams per kilometre. Diesel cars must have particle filters. Volkswagen's new diesel-engined Polo BlueMotion meets the requirements.

AROUND 15 PER CENT of the new cars that were sold in Sweden in the first quarter of this year are classed as green vehicles, marking a sharp upswing over the previous year. The best sellers among them are cars fuelled by ethanol.

The sharp increase is probably due to the appearance of several new models on the market, including versions of the Volvo V50 and Saab 9-5 that can run on both petrol and E85 (85 per cent ethanol, 15 per cent petrol), as well as the fact that green cars have free access to the trial congestion-charging zone in Stockholm. The latter means a saving of around 100 euro per month for commuters who drive green cars.

Interest in ethanol-powered cars is also promoted by the high price of petrol – because it is tax exempt, ethanol is currently slightly cheaper than petrol. For several years now the taxation class has been considerably lower for company car users who choose green vehicles. And with effect from this year green cars will also be subject to reduced annual vehicle tax. Several municipalities offer free parking for green vehicles.

In the case of government authorities, from this year at least 75 per cent of all cars that are bought or leased during a calendar year must be green vehicles (with certain exceptions). Green vehicles are defined as follows:

❑ A vehicle that runs on petrol or diesel and has carbon dioxide emissions that do not exceed 120 grams/km on the EU driving cycle (equivalent to around 5 litres of petrol or 4.5 litres of diesel per 100 km). Particle emissions from diesel cars must not exceed 5 mg/km.

❑ A car that runs on an alternative fuel. However, such cars still have to meet minimum energy efficiency requirements – energy use must not exceed the equivalent of 9.2 litres of petrol per 100 kilometres over a combined driving cycle.

At present, all the cars available in Sweden that can run on alternative fuels fulfil the government requirements for green vehicles. But only a handful of petrol and diesel cars meet the standard at present, including the Toyota Prius HSD and Honda Civic Hybrid petrol-electric hybrids, the Smart microcar and the most fuel-efficient versions of the Citroën C3, Peugeot 107, Toyota Aygo and VW Polo BlueMotion, for example.

Government authorities buy and lease a relatively small number of vehicles each year, but the definition of green vehicles is still important, as it is used by many municipalities and companies during procurement.

PER ELVINGSON

Further information: www.miljofordon.se/english

Small but dangerous

Recent research indicates that fine particles ($PM_{2.5}$) in the air in the year 2000 caused an average shortening of statistical life expectancy of more than eight months in the EU, equivalent to 3.6 million life years lost annually. This means that fine particles have the most serious effects on people's health of all air pollutants.

Environmental Fact sheet No. 20 May 2006

An extended version of this fact sheet is available at www.acidrain.org/pages/publications/factsheets.asp

See also related fact sheets in this series:

No. 19, December 2005: The CAFE programme and the thematic strategy on air pollution

No. 17, September 2004: EU emission standards for light and heavy road vehicles

No. 16, May 2004: EU directive on national emission ceilings (NEC)

No. 10, June 2002: EU legislation on air pollution

No. 9, June 2001: Air pollution and health

Available at www.acidrain.org/pages/publications/factsheets.asp

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Effects on human health

A large number of studies carried out in both the United States and in Europe have shown that when the concentration of small particles in air rises, even from low levels, there is a rise in mortality from respiratory, cardiac and circulatory diseases, and more people seek hospital care for bronchitis and asthma. WHO (2005a) summarizes the state of knowledge as follows:

- Particles (PM) in general increases the risk of respiratory death in infants younger than one year, affects the rate of lung function development, aggravates asthma and causes other respiratory symptoms such as coughs and bronchitis in children.
- Fine particles ($PM_{2.5}$) seriously affect health, increasing deaths from cardiovascular and respiratory diseases and lung cancer. Increased $PM_{2.5}$ concentrations increase the risk of emergency hospital admissions for cardiovascular and respiratory causes.
- Coarse particles (PM_{10}) affects respiratory morbidity, as indicated by hospital admissions for respiratory illness.

People are not all affected equally by air pollutants – certain sections of the population are much more sensitive than average. These include children, the elderly and those with underlying disease, such as respiratory disorders.

Short-term exposure

WHO (2005a) states that short-term changes in PM_{10} at all levels lead to short-term changes in acute health effects. Effects related to short-term exposure include inflammatory reactions in the lungs, respiratory symptoms such as cough and bronchitis, adverse effects on the cardiovascular system and increases in medication use, hospital admissions and mortality.

Although long-term exposure gives rise to the most serious health effects (see below) the acute effects that arise from short-term exposure to high concentrations are important, since they affect a large proportion of the population, for example in the form of restricted activity days (see table 1). WHO stresses that, based on known health effects, both short-term (daily) and long-term (annual), guidelines are needed for fine as well as coarse particles.

Long-term exposure

Because long-term exposure to PM results in a substantial reduction in life expectancy, the long-term effects clearly have greater significance to public health than the short-term effects (WHO 2005a).

The effects of long-term exposure include increases in lower respiratory tract symptoms and chronic obstructive pulmonary disease, reductions in lung function in children and adults, and reduction in life expectancy, due mainly to cardiopulmonary mortality and probably to lung cancer. These effects are demonstrable even at levels well below the limit values.

$PM_{2.5}$ shows the strongest association with mortality: An increase in long-term concentration of $PM_{2.5}$ by 10 $\mu g/m^3$ increases the risk of deaths from all causes by 6 per cent.

These estimates are based on exposure comparisons between cities, and assume that all residents of a city have the same average exposure levels. But recent research in California has shown that assessments of exposure that are based only on community average concentrations may lead to an underestimation of the health risks by a factor two or three (EC 2005d).

Significance of size and origin

It is the very smallest particles that are believed to be the most harmful, because when they are inhaled they can penetrate deep into the lungs. The focus of debate is now turning to $PM_{2.5}$. However, many researchers point out that coarse particles ($PM_{2.5}$–PM_{10}) also have considerable health effects and their levels also need to be reduced.

The shape and chemical composition of the particles as well as their size are thought to influence their harmfulness, as do the substances that adhere to their surfaces.

At present it is not possible to distinguish between the health effects of particles with different origins, so for the time being all particles in the same size range are regarded as equally harmful. Toxicology studies indicate, however, that so-called primary particles from combustion have a higher toxic potential than secondary particles (see box). These primary particles are often rich in metals and organic compounds, and also have a relatively high surface area (WHO 2004a).

How many are affected?

Knowledge of the concentrations in the air and the links that exist between exposure and response makes it possible calculate the effects.

Effects in Europe 2000

In the EU thematic strategy on air pollution (EC 2005a) the health effects of levels of fine particles ($PM_{2.5}$) in the air in the year 2000 are estimated to lead to an average shortening of statistical life expectancy of more than eight months in the EU, equivalent to 3.6 million life years lost annually.

This effect is comparable to the loss of life expectancy due to road accidents in the EU, even though it does not include secondary organic aerosols and only refers to impact on the population over 30 years of age, thus underestimating the total impact.

Geographically, the greatest damage to health occurs in the Benelux area, in northern Italy, and in parts of Poland and Hungary. In these areas, the average loss in life expectancy may be more than one year. See Figure 1.

In addition to premature deaths, particles cause a range of other effects on people's health, including increased need for respiratory medication in adults and children and almost 350 million days of restricted activity in 2000, see table 1.

Effects in Europe 2020

Under the current legislation scenario the average loss of life expectancy in the EU caused by $PM_{2.5}$ is expected to drop from 8 months in 2000 to 5.5 months in 2020. The number of life years lost will fall from 3.6 to 2.5 million, see table 1.

Bigger improvements are possible if further measures are taken to reduce levels. The effects on life years lost and premature deaths of implementing the thematic strategy and maximum technically feasible reductions are shown in table 2.

Cleaner air brings huge benefits

Improvements in health generate the largest quantified monetary benefits when air pollution is reduced. The European Commission (EC 2005c) shows that the benefit of reducing the average background concentration of $PM_{2.5}$ by 20–25 per cent between 2010 and 2020 is estimated to be between 37 and 119 billion euro per annum in 2020. These figures are between five and 24 times higher than the estimated costs, which range between 5 and 8 billion euro per annum.

Table 1. Estimated health damage due to $PM_{2.5}$ in the EU 2000 and through implementation of current legislation (CLE) 2020. Source: EC 2005c.

Health effect	Units (1000s)	2000	2020 CLE
Mortality - long-term exposure	Life years lost	3,619	2,467
Mortality - long-term exposure	Premature deaths	348	272
Infant mortality	Cases	0.68	0.35
Chronic bronchitis	Cases	164	128
Respiratory hospital admissions	Cases	62	42
Cardiac hospital admissions	Cases	38	26
Restricted activity	Days	347,700	222,000
Respiratory medication use, children	Days	4,200	2,000
Respiratory medication use, adults	Days	27,700	20,900
Lower respiratory symptoms (LRS), children	Days	192,800	88,900
LRS, adults with chronic disease	Days	285,300	207,600

Guidelines and standards

The World Health Organization, WHO, has until recently been unwilling to set any air quality guidelines for particles, since it is considered unlikely that a level will be found that does not have harmful effects. Instead, it has given a dose-response relationship, that can be used to calculate for example how many people would be affected by a given level of particles in the air.

In the revised WHO air quality guidelines that were adopted in autumn 2005 (WHO 2005c) it is stated that the link between exposure and effects can still be used, depending on local circumstances, to establish limit values. But numerical values are also given to provide guidance on the concentrations at which increasing, and specified mortality responses due to PM are expected based on current scientific insights, see table 3.

A working group under the EU CAFE programme reported in a position paper (CAFE 2004) that for health reasons the EU should aim for a reduction in annual mean concentrations of $PM_{2.5}$ to levels of around 10 $\mu g/m^3$ or lower. In the short term, by 2010, the group recommended that limit values in the range 12–20 $\mu g/m^3$ should be considered.

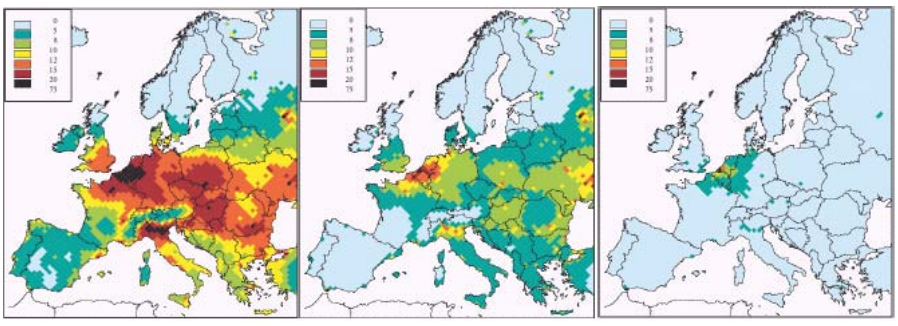
EU limit values

Limit values for PM_{10} were adopted in 1999. The directive came into effect in 2001, and the PM_{10} limit values became legally binding in the EU in January 2005, see table 3.

In September 2005 the Commission presented a proposal for a new directive (EC 2005b) that would mean retaining the current PM_{10} standard and adding a new standard for $PM_{2.5}$ – as so called concentration cap of 25 $\mu g/m^3$ as annual mean – to be met by 2010.

As a rule of thumb, levels of $PM_{2.5}$ are around 60–70 per cent of PM_{10} levels, so the proposed concentration cap for $PM_{2.5}$ does not represent any strengthening of requirements in relation to the PM_{10} standard that is already in force. On the other hand the proposal allows a number of concessions to the current regulations,

Figure 1. Loss in statistical life expectancy that can be attributed to anthropogenic contributions to $PM_{2.5}$ (months). For the emission levels in the year 2000 (left), and for two projected emission levels for 2020: CLE (centre) and MTFR (right).



including more time for countries to meet the limit values and the opportunity to discount pollutant contributions from natural sources for compliance purposes.

To complement the new concentration cap it is proposed that member states should reduce average human exposure to urban background levels of $PM_{2.5}$ over the period 2010–2020. A general, non-binding 20-per-cent reduction is proposed.

The United States

In 1997 the USA set an annual limit value of 15 µg/m^3 for $PM_{2.5}$ which is to be met by 2010. The state of California has had a limit value of 12 µg/m^3 since 2003.

In a review of the federal limit value that was carried out in 2005 a Staff Paper from the Environment Protection Agency proposes that in light of the latest scientific information the limit value should be reduced, and levels as low as 12 µg/m^3 are being discussed (US EPA 2005).

Emissions of primary particles

Emissions of primary particles are considered to have fallen in recent decades, but the true extent is still inadequately known. According to the EU thematic strategy on air pollution, emissions of primary particles ($PM_{2.5}$) in 2000 totalled 1,744,000 tonnes in the EU.

According to the baseline scenario (current legislation) that is used in the thematic strategy, emissions of $PM_{2.5}$ would fall by 45 per cent between 2000 and 2020 (to 969,000 tonnes), mainly as a result of stricter emission standards for cars and heavy vehicles.

Emissions from international shipping in European waters are expected to rise over the same period from 210,000 to 330,000 tonnes.

It is possible to achieve larger reductions in emissions than predicted under the baseline scenario if additional measures are taken. If the thematic strategy is implemented, emissions of primary $PM_{2.5}$ from land-based sources in the EU would fall to 712,000 tonnes in 2020. The maximum technically feasible reduction is calculated as 606,000 tonnes by 2020.

Note that the figures above refer solely to emissions of primary particles. A significant proportion of the particles that are found in the atmosphere are, however, secondary particles formed from other pollutants, particularly nitrogen oxides, sulphur dioxide and ammonia. See box.

Distribution by sector

At EU level the household and transport sectors account for the largest emissions of primary particles ($PM_{2.5}$). The household sector is dominated by emissions from domestic wood stoves while transport is dominated by diesel engines.

Abatement options

Special attention should be given to those particles that, in laboratory trials, show the highest toxicity and often occur in hotspots. These include particles from combustion processes, and particularly exhaust fumes from diesel engines. In urban areas, up to 10 per cent of the population may be living in such "hot spots". WHO concludes that the public health burden of such exposure is significant (WHO 2004b).

A large, but unregulated source, is domestic wood stoves.

It is important that abatement programmes do not focus solely on meeting the relevant limit values for PM_{10}, as this could mean that too great an emphasis is placed on the largest particles. These admittedly represent the largest fraction by weight, but are not likely to have the biggest effect on health.

It is also important to avoid focusing solely on local hotspots where limit values are exceeded. It is at least as desirable to reduce the background levels, since it is long-term exposure that accounts for the majority of the most serious health effects.

Table 2. Estimated health effects (premature deaths) due to exposure to $PM_{2.5}$ in EU25 in 2000 and in 2020 for three scenarios: Current legislation (CLE), Thematic Strategy (TS) and Maximum technically feasible reductions (MTFR).

PM: Premature deaths.

		2020 scenarios		
Country	**2000**	**CLE**	**TS**	**MTFR**
Austria	5500	4590	3660	3230
Belgium	12880	10030	8010	7280
Cyprus	230	270	260	260
Czech Rep.	9070	6450	4680	4190
Denmark	3270	2730	2250	1960
Estonia	630	410	360	320
Finland	1270	1250	1200	1070
France	42090	34740	27010	23700
Germany	75040	62590	46610	42330
Greece	7230	6910	6410	6140
Hungary	12870	8410	6000	5460
Ireland	1170	960	760	650
Italy	50690	37890	30580	27840
Latvia	1330	910	810	730
Lithuania	2190	1680	1450	1310
Luxembourg	320	290	200	180
Malta	192	206	190	182
Netherlands	15440	13970	10550	9510
Poland	32850	24890	19440	17890
Portugal	5040	3540	2830	2460
Slovakia	4250	3390	2470	2210
Slovenia	1580	1280	1010	890
Spain	19940	14190	11830	10880
Sweden	3280	2680	2380	1990
UK	39470	27370	19910	17570
Sum EU25	347822	271626	210860	190232

Table 3. Guidelines, target values and limit values.

	Max. 24-hour mean value (µg/m^3)	**Annual mean value** (µg/m^3)
PM10		
WHO guideline (WHO 2005c)	50 (99th percentile*)	20
EU limit value, from 2005 (Directive 1999/30/EC)	50 (96th percentile*)	40
Preliminary EU limit value 2010 [B]	*50 (98th percentile*)*	*20*
Guide value, Sweden, from 2010	35 (90th percentile*)	20
Guide value proposed by IMM [C]	30	15
PM2.5		
WHO guideline (WHO 2005c)	25 (99th percentile*)	10
EU concentration cap from 2010 [D]		25
US limit value from 2010	65 [E]	15
Limit value, California		12
Guide value, Sweden, from 2010	20 (90th percentile*)	12
Limit value proposed by CAFE working group [F]		12-20

* The percentile is a statistical measure that indicates how many times (in this case days) a limit value may be exceeded. 90th percentile = 37 exceedances per year. 96th percentile = 35 exceedances per year. 98th percentile = 7 exceedances per year. 99th percentile = 4 exceedances per year.

[A] European Union 1999, Directive 1999/30/EC.

[B] Interim values in present directive (1999/30/EC). In the proposal for the new directive (EC 2005b) the Commission want to eliminate these, however.

[C] IMM = National Institute of Environmental Medicine, Sweden, 2000.

[D] EC 2005b.

[E] Should be reduced to 35 µg/m^3 according to proposal by EPA in December 2005.

[F] CAFE 2004.

A significant proportion of the regional background level consists of secondary particles (see box). Reducing the level of these particles requires measures in those sectors of society that produce large emissions of sulphur dioxide, nitrogen oxides and ammonia.

The Commission is currently preparing the revision of the directive on national emission ceilings (NEC), which sets binding requirements for maxium total emissions of sulphur dioxide, nitrogen oxides, volatile organic compounds and ammonia, for each member state. A proposal for a revised directive that will require more far-reaching reductions in the air pollutants that act as precursors to secondary particles, is foreseen by mid-2007. The proposal may include national emission ceilings also for primary particles.

References

CAFE 2004. Second Position Paper on Particulate Matter. CAFE Working Group on Particulate Matter. 20 December 2004.

EC 2005a. Thematic Strategy on Air Pollution. COM(2005) 446.

EC 2005b. Proposed Directive on Ambient Air Quality and Cleaner Air for Europe. COM(2005) 447. Can be downloaded at http://europa.eu.int/comm/environment/air/cafe

EC 2005c: Commission staff working paper: Impact assessment of the thematic strategy on air pollution and the directive on "Ambient air quality and cleaner air for Europe". SEC(2005) 1133.

EC 2005d. Science for Environment Policy. DG Environment News Alert. 5 December 2005.

IMM 2000. Particles in ambient air – a health risk assessment. Pershagen, G. (Ed.). Scandinavian Journal of Work, Environment & Health. Vol. 26, suppl. 1, 2000.

US EPA 2005. Review of the National Ambient Air Quality Standards for Particulate Matter: Policy Assessment of Scientific and Technical Information. QAQPS Staff Paper. EPA-452/R-5-005. www.epa.gov/ttn/naaqs/standards/pm/s_pm_index.html

WHO 2000. Air Quality Guidelines for Europe. Second Edition. WHO Regional Publications, European Series, No. 91.

WHO 2004a. Health Aspects of Air Pollution. Results from the WHO Project "Systematic Review of Health Aspects of Air Pollution in Europe", June 2004.

WHO 2004b. Health Aspects of Air Pollution – answers to follow-up questions from CAFE, Report on a WHO working group meeting, Bonn, Germany 15-16 January 2004. Available at www.euro.who.int/document/E82790.pdf.

WHO 2005a. Particulate matter air pollution: how it harms health. Fact sheet EURO/04/05. Berlin, Copenhagen, Rome, 14 April 2005.

WHO 2005b. Press Release EURO/08/05. Berlin, Copenhagen, Rome, 14 April 2005.

WHO 2005c. WHO air quality guidelines global update 2005. Report on a Working Group meeting, Bonn, Germany 18-20 October 2005. Available at www.euro.who.int/Document/E87950.pdf

An extended version of this fact sheet is available at www.acidrain.org/pages/publications/factsheets.asp

What are particles?

Particulate matter (PM) is an air pollutant consisting of a mixture of particles that can be solid, liquid or both, are suspended in the air and represent a complex mixture of organic and inorganic substances. These particles vary in size, composition and origin.

Their properties are summarized according to their aerodynamic diameter, called particle size. The measurements used at present are the weights of two particular fractions:

PM_{10}, particles with an aerodynamic diameter smaller than 10 µm[1], which may reach the upper part of the airways and lung.

$PM_{2.5}$, with an aerodynamic diameter smaller than 2.5 µm. These are regarded as more dangerous because they penetrate more deeply into the lungs and may reach the alveolar region.

WHO (2004a) divides particles into three groups: *coarse*, diameter 2.5-10.0 µm; *fine,* 0.1-2.5 µm; and *ultrafine,* less than 0.1 µm.

Weight and number

Most measurements, and all current air quality standards for particles, refer to the weight of particles in different size ranges, such as PM_{10} and $PM_{2.5}$. Both are measured in units of µg/m^3. The ultrafine particles ($PM_{0.1}$) represent only a fraction of measured PM_{10}-levels, but may make a considerable contribution to health effects.

Apart from the fact that there are many more small particles for a given unit of weight they also cause more damage, since they can penetrate further into the airways and have a much larger surface area per unit weight. The number of particles should therefore provide a better measure of their harmfulness, but is more difficult to measure.

Primary and secondary

Primary particles are those that are formed during combustion, but may also consist of dust, small soot flakes, pollen, etc. Major sources of man-made emissions are combustion processes (often small-scale appliances) and internal combustion engines (primarily diesel engines).

Secondary particles consist mainly of sulphate and nitrate salts that are formed in the air from sulphur dioxide and nitrogen oxides. Ammonia and volatile organic compounds are also of interest. Any source that emits these substances therefore contributes to their formation. Most fine particles in air are of secondary origin.

Long-range transport

The size of the particles determines the time they spend in the atmosphere. While sedimentation and precipitation remove PM_{10} from the atmosphere within a few hours of emission, $PM_{2.5}$ may remain there for days or even a few weeks.

Consequently, $PM_{2.5}$ can be transported over long distances. In most places only a small proportion of the background concentration is traceable to local emissions, and a large percentage, particularly of the finest fractions, consists of particles that were emitted in other locations or formed as secondary particles in the atmosphere. In urban environments, along major roads for example, the local contribution can be considerable, however.

Current levels

Particles occur naturally in air, in the form of wind-blown dust, sea salt and desert sand, for example. The natural background level varies with the local geography as well as climatic conditions. As a mean, the natural input to PM_{10} in Europe varies from 3 to 8 µg/m^3 in most EU regions, with the highest values recorded in the southern part of the union (CAFE 2004).

In Europe it is PM_{10} concentrations that are measured most widely. The limit values that have been in effect in the EU since 2005 are exceeded by a large margin in many cities (primarily the daily limit value). Particularly high concentrations of particles can occur close to major emission sources (such as roads and small-scale combustion installations), but also during periods of stable weather, when the air is not mixed. At roadside stations, local traffic usually accounts for the major contribution (including exhaust and abrasion products), with 40 to 55 per cent of the annual PM_{10} levels and 45–60 per cent of $PM_{2.5}$ (CAFE 2004).

[1] Actually particles of such a size that 50 per cent pass through a given sampling filter. µm = micron = one thousandth of a millimetre. 10 µm = one hundredth of a millimetre.

Tighter emission requirements emerging all around the world

The non-road vehicle and engine sector includes such diverse categories as tractors, fork lifts, construction machinery, tractors, locomotives, inland ships, lawn movers, chainsaws, etc. So far emission standards have been less stringent than for road vehicles.

IN EVERY CORNER of the world, for every type of new road vehicle, there is a clear trend toward lower and lower emissions levels. Over the next decade, this pattern will move toward similar controls on non-road vehicles and fuels and will finally address the last holdouts – aircraft and marine vessels. Driving these trends are several factors:

❏ Continued growth in the production and use of vehicles (especially in China and other parts of Asia) and their concentration in urban areas where pollution levels remain unacceptably high;

❏ The growing accumulation of health studies which show adverse impacts at lower and lower levels and in the case of particles (PM) at virtually any level;

❏ Advances in vehicle technology and clean fuels which are making it possible to achieve lower and lower levels at reasonable costs.

On the regulatory front, vehicle emissions standards and fuel requirements continue to be tightened all over the world. Major developments in the last few years include the following:

❏ The European Union has mandated the widespread availability of near zero sulphur levels in both petrol and diesel fuel by 2005 and its universal use by 2009. It is in the process of implementing the already adopted Euro 4 standards for light duty vehicles and the Euro IV and V standards for heavy duty vehicles. Finally it is already far along in developing so called Euro 5 standards for light duty vehicles and Euro VI standards for heavy duty road engines. Whatever Euro 5 standards are adopted will likely go into effect earlier than the mandated date in many countries since several member states will encourage early introduction through tax incentives. So called pseudo-Euro 5 standards for particles have been adopted by the Commission to provide a common EU-wide basis for these tax schemes.

❏ In the US, the Tier 2 and LEV 2 standards are gradually being phased in across the nation and California, respectively. In spite of a series of court challenges and political battles, the 2007–10 heavy duty engine requirements and low sulphur fuel standards remain on track and are expected to go into effect on schedule. The Environment Protection Agency (EPA) has also adopted very stringent requirements for non-road diesel engines and fuels which will require the same degree of controls for most categories as the road standards. This will be discussed in more detail below.

Many other countries including Australia, China, Thailand, South Korea, Japan and Brazil are also gradually phasing in tighter controls on road vehicle emissions and their fuels.

Non-road vehicles and engines: The remaining challenge

As the road vehicle sector is being cleaned up, the non-road sector increasingly stands out as the mobile source with the weakest limits. One result is that it is becoming an increasingly important component of the overall emissions inventory.

For example, in the United States, baseline emission inventory estimates for the years 2000 and 2020 are summarized in Table 1. This table shows that of the total emissions from mobile sources in 2000, large non-road diesel engines contribute about 36 and 46 per cent of nitrogen oxides (NOx) and PM emissions, respectively.

By 2020, without further control, non-road diesels are expected to contribute 52 per cent of both NOx and PM mobile source emissions. Population growth and the effects of other regulatory control programmes are factored into these projections.

The non-road vehicle and engine sector is broad and widely encompassing and includes such diverse categories as construction machinery, fork lifts, tractors, locomotives, inland ships, lawn movers, chainsaws, etc.

In view of the serious public health and environmental concerns associated with ground-level ozone, particulates and nitrogen dioxide, and the

Table 1. Various source categories' share of total US emissions from mobile sources in 2000 and 2020 (per cent).

Category	PM		NOx		NMHC		CO	
	2000	2020	2000	2020	2000	2020	2000	2020
Non road petrol	14	18	4	3	43	58	33	42
Non-road diesel	46	52	36	52	5	3	2	2
Road vehicles	34	23	59	33	50	37	64	54
Aircraft	6	7	1	4	2	4	1	2

PM = particulate matter. NOx = nitrogen oxides. NMHC = non-methane hydrocarbons. CO = carbon monoxide.

increasingly dominant contribution that non-road vehicles and engines make to emissions that cause these problems, it is critically important that these sources be controlled to the same degree as road diesel vehicles. Starting during the mid to late 1990s, the US, EU and Japan initiated control efforts. In stark contrast with the on-road efforts in each of these regions, there was a clear effort to coordinate and harmonize these efforts right from the beginning. As a result, it appears likely that at the conclusion of the process, globally harmonized non-road requirements will largely be in place.

The US programme

The US Clean Air Act requires EPA to establish non-road engine standards that provide for the *"greatest degree of emission reduction achievable through the application of technology which the Administrator determines will be available for the engines or vehicles to which such standards apply, giving appropriate consideration to the cost of applying such technology within the period of time available to manufacturers and to noise, energy, and safety factors associated with the application of such technology"*.

Starting in the mid-1990s, both the US EPA and the California Air Resources Board have proceeded to introduce controls on a variety of non-road sources. The first standards, called Tier 1, 2 and 3, were introduced in 1999, and gradually strengthened over 3–4 year intervals. These controls are quite modest, however, and require no exhaust after-treatment for either PM or NOx.

During the late 1990s and into the early 21st century, EPA adopted stringent regulations for on-road diesel trucks and buses to be phased in from 2007 to 2010 that will result in the introduction of advanced PM and NOx control technologies. In parallel, EPA required the introduction of low-sulphur diesel fuel with a maximum of 15 ppm sulphur, starting in 2006.

In light of the progress being made in the development of advanced technologies to reduce emissions from on-road diesel engines and the continuing concerns about non-road diesel impacts on air quality discussed above, EPA concluded that it was necessary to look once again at what is the *"greatest degree of emission reduction achievable"*.

It was recognized that significant further reductions in non-road emissions will require fuel quality improvements that enable advanced after-treatment technologies and so it entails adopting non-road fuel and engine changes in a single coordinated programme. EPA also concluded that the technologies developed should initially be engineered for the on-road fleet before being phased onto the non-road sector.

On May 11, 2004, the EPA adopted a comprehensive national programme to reduce emissions from non-road diesel engines. Based in large part on the 2007 road diesel programme, the proposal sets out 1) new engine exhaust emissions standards and emissions test procedures, including not-to-exceed requirements, for non-road engines used in most kinds of construction, agricultural, and industrial equipment, and 2) sulphur control requirements for non-road, locomotive, and marine diesel fuels.

EPA concluded that exhaust standards associated with the non-road rule would result in PM and NOx emissions levels that are in excess of 95 per cent and 90 per cent, respectively, below comparable levels today.

These standards will begin to take effect in the 2008 model year, with a phase-in of standards across five different engine power rating groupings. See table 2 and 3. Diesel fuel used in non-road, locomotive, and marine applications would meet a 500 ppm sulphur cap starting in June 2007, a reduction of approximately 90 per cent. In June 2010, sulphur levels in non-road diesel fuel (excluding locomotive or marine diesel fuel) would meet a 15 ppm cap, for a total reduction of over 99 per cent.

EPA expects the entire non-road diesel engine inventory to comply with these new non-road standards by 2030 (based on estimated fleet turnover). The programme's estimated environmental benefits include reductions of 738,000 tonnes of NOx and 129,000 tonnes of PM annually by 2030.

The anticipated health benefits of these emission reductions are enormous and include the annual prevention of 12,000 premature deaths, 15,000 heart attacks, and more than 280,000 cases of respiratory symptoms in children.

EPA has estimated the costs of the programme to average from one to three per cent of the total purchase price of most non-road diesel equipment, with the net cost of ultra-low sulphur fuel averaging about four cents per gallon (approximately one euro cent per litre). Annual benefits are expected to outweigh annual costs by about 15 to 1.

Durability requirements and test procedures

Useful life durability requirements for non-road diesel engines remain unchanged from current durability requirements, i.e. 5 years or 3,000 hours for smaller engines, increasing to 10 years or 8,000 hours for the larger ones (>50 horsepower).

EPA is also including new test procedures and related certification requirements to better ensure emissions control over real-world engine operation and to help provide for effective compliance determination. The agency is requiring that Tier 4 PM and NOx emission standards will be met on both current steady-state duty cycles and a new transient test cycle. Transient testing will begin in the model year that Tier 4 PM and/or NOx standards first apply (i.e. 2011–2013). Transient tests will include both cold-start and hot-start testing.

Locomotive and marine engines

EPA has indicated that, with respect to locomotive and marine application, it is their intent to propose new future emission standards for these engines that could require the use of

high-efficiency exhaust emission control technology and thus the use of 15 ppm sulphur diesel fuel. In the final non-road rule the requirement for the production of ultra-low sulphur diesel fuel for locomotive and marine applications is included starting in June 2012, two years after the introduction of 15 ppm sulphur fuel for other non-road applications.

EPA intend to establish future emission standards modeled in large part on the 2007–2010 road diesel and Tier 4 non-road diesel programmes (e.g. significant reductions in PM and NOx emissions through the use of advanced emission control technologies). These future locomotive and marine standards could start as early as 2011, and will include all engines up to 30 litres displacement per cylinder.

The EU programme

The file of Non-Road Mobile Machinery[1] (NRMM) currently contains three directives, the mother directive 97/68/EC, the amendment directive 2002/88/EC and the last amendment directive 2004/26/EC. The directives regulate exhaust emissions from and test procedure for the different types of engines.

The mother directive covers diesel fuelled engines for common NRMM. It became effective from January 1999 for certain types of engines. The first stages covers diesel fuelled engines between 37 and 560 kW.

The second directive (2002/88/EC) covers spark ignited engines up to 18 kW for engines installed in handheld and non-handheld equipment. Stage I (and Stage II) became effective in August 2004 with some exemptions for certain applications.

The third directive (2004/26/EC) covers diesel fuelled engines from 19 to 560 kW for common NRMM and regulates the emission in three further stages. The directive also includes railcars and locomotives and inland waterway vessels and for the two latter categories there are no upper limits concerning engine power.

The different stages in the third directive are as follows:

- ❏ Stage III A covers engines from 19 to 560 kW including constant speed engines, railcars, locomotives and inland waterway vessels – from January 2006.
- ❏ Stage III B covers engines from 37 to 560 kW including, railcars and locomotives – from January 2011.
- ❏ Stage IV covers engines between 56 and 560 kW – from January 2014.

The final Stage IV requirements closely match those adopted by the US EPA (US Tier 4) as illustrated in Tables 2 and 3.

A review of the EU Stage IV requirements is planned, however, at the end of 2007, to consider some issues that have been highlighted, as further stages for inland waterway vessels, flexibilities, in-use-compliance, durability testing, preventing cycle beating, and cycle by-pass at testing, further exemptions etc.

Table 2: PM emission standards for non-road mobile engines: EPA Tier 4 vs. EU Stage III &IV.

hp	EPA (g/kWh)		EU (g/kWh)	
	Date	PM	Date	PM
<25	2008	0.40 [a]	no standards	
25-50	2008	0.30	2007	0.6
	2013	0.03	no further standards	
50-75	2008	0.30 / 0.40 [b]	2008	0.4
	2013	0.03	2013	0.025
75-175	2012	0.02	2012	0.025
175-750	2011	0.02	2011	0.025
>750	2011	0.10	no standards	
	2015	0.03/0.04 [c]		

a: Technology review will consider long-term PM standard. b: 0.40 (non-pull-ahead) standard optional:~equivalent to EU, but requires 2012 start for 0.03 standard. c: 0.03 applies to mobile machinery, 0.04 to generator sets.

Table 3. NOx emission standards for non-road mobile engines: EPA Tier 4 vs. EU Stage III & IV.

hp	EPA (g/kWh)		EU (g/kWh)	
	Date	NOx	Date	NOx
<25	current Tier 2 remains until 2007 review		no standards	
25-50	2013	4.7 NOx+NMHC [a]	2007	7.5 NOx+HC [e]
50-75	2008	4.7 NOx+NMHC [a b]	2008	4.7 NOx+HC
75-175	2012	3.4 [c]	2012	3.3
	Dec 31, 2014	0.40	Oct 1, 2014	0.4
175-750	2011	2.0 [c]	2011	2.0
	2014	0.40	2014	0.4
>750	2011	0.67 / 3.5 [d]	no standards	
	2015	0.67 / 3.5 [a d]		

a: Technology review will consider long-term NOx standard. b: This is a Tier 3 standard. c: This is the alternative (averaged phase-in) standard. (For 75-175 hp: per the 25-25-25-100% phase-in option). d: NOx in 2011: 0.67 only for >1200 hp gensets, 3.5 for all others. In 2015: 0.67 extended to ALL gensets. e: Matches EPA Tier 2 standard that takes effect in 2004.

Conclusions

After years of delay, the US, EU and Japan have started to move aggressively to reduce emissions from the non-road vehicle and engine sectors. Significantly, each region has worked closely together to harmonize requirements and it is expected that complete harmonization for non-road diesels will eventually occur, along the lines established by the US EPA's recently adopted rule. During the next few years both the EU and Japan will be reviewing the next stages of their non-road control efforts to determine their final requirements.

Since it will be many years before the non-road fleet will turn over to vehicles meeting EU Stage IV or US Tier 4 emissions levels, retrofit efforts are getting a great deal of attention at the present time.

MICHAEL WALSH

[1] The definition of non-road mobile machinery means a mobile machine, transportable industrial equipment or vehicle with or without bodywork, not intended for the use of passenger or gods-transport on the road, in which an internal combustion engine as specified in Annex I is installed.

Further reading: The report **Nonroad Vehicle Emissions Requirements around the World** is available at www.walshcarlines.com/mpwdocs.html

Note: 1 horsepower (hp) = 1.36 kWh.

Some room for improvement

The ongoing review is scheduled to conclude in 2007 with a long-term vision.

THE EUROPEAN COMMISSION is currently undertaking a review of the Integrated Pollution Prevention and Control (IPPC) Directive. This is the key instrument of EU industrial policy relating to the environment, and it covers a wide range of industrial and agricultural processes.

The IPPC Directive currently applies to all new plants and will include all existing ones by October 2007. Its key concept is Best Available Techniques (BAT), which requires that the installation must use the best option for reducing pollution that can be economically and technically justified. It is implemented through legally binding integrated permits that take account of the overall impact of the plant to air, land and water, and its use of energy and other resources. BAT can be determined either at the site-specific level or via general binding rules applied across a whole industrial sector or sub-sector.

Guidance for determining BAT at the local level is provided by benchmark BAT standards set in an information exchange process centred on Seville. The benchmark standards are set out in a series of BAT Reference Documents (BREFs).

Given the complexity of the directive, particularly its fusion of centralized and decentralized elements, there is inevitably room for improvement, both in the directive itself and in its implementation. This became clear in the Commission's 2003 Communication, following stakeholder consultations. Whilst there was an overall positive reaction to IPPC and a general call for regulatory stability, more attention was needed on coverage, interpretation and legislative interactions, and there were some calls for additional scope for emissions trading.

These findings were included in an IPPC Implementation Report[1] published in 2005. This highlighted delays in transposition, with infringement proceedings ongoing against 8 member states. It also underlined the limited progress that has been made in the implementation of the directive, with the consequent need to accelerate activity in the face of the October 2007 deadline. The report also identified a number of other implementation issues, including the use of BREFs, coordination within competent authorities and arrangements for reviewing permits.

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To support member states and help improve the situation, the Commission has launched an IPPC Implementation Action Plan. This includes full transposition of the directive, the finalising of the BREFs and the development of implementation guidance for member states. It will also monitor progress towards the 2007 deadline and run compliance checks at individual installations. Some of these tasks will be developed within a review, which also addresses the issues raised in the 2003 Communication, and takes account of the Thematic Strategies and the Better Regulation and Lisbon Agendas.

The core objective of the review is to undertake *'An ambitious review whilst not altering the fundamental principles, objectives and ambition of the present Directive (high level of environmental protection, integrated approach, BAT, permitting …)'.*

This will involve the input of several groups. The IPPC Experts Group will contribute on policy orientation, IMPEL will look at enforcement, a stakeholder hearing will involve the public in the debate, and an IPPC Advisory Group, made up of member states, industry and environmentalist organizations, will examine the development of input studies.

There are five of these studies, which are being undertaken by a range of consultants.[2] The one considering implementation looks at both the quantity and quality of permits, collecting information on the number issued to new and existing plants, and the number that remains to be issued. To assess the quality of permits, some will be examined in detail, representative of a range of industrial sectors and member states.

Two further studies look at possible amendments to IPPC, and one of these examines whether technical amendments are required. This study looks at possible amendments in relation to permitting and monitoring, the BAT Information Exchange Process and Annex I of the

directive (i.e. its scope).

The other study of possible amendments considers the scope for legislative streamlining, citing the example of power plants, which are subject not only to IPPC, but also to the Landfill, Waste Incineration, Environmental Impact Assessment, Emission Trading and Large Combustion Plant Directives. It examines the way that IPPC and these other measures interact, and the possibilities for streamlining this. It also considers the interaction of IPPC with possible emission trading schemes for pollutants such as sulphur dioxide and nitrogen oxides.

IPPC contains a degree of inherent flexibility, resulting from the decentralization of the permit writing process and the requirement to take account of local factors. A fourth study therefore analyses the different approaches to implementation made possible by this flexibility, and considers their impact on the competitiveness of industry.

The fifth study examines the potential for improving the environmental performance of IPPC installations beyond minimum regulatory compliance. This includes incentives for the innovation and enhanced deployment of environmental technologies, and the use of economic instruments, environmental management systems, administrative relief, voluntary systems etc.

A further study assesses the environmental impact of the IPPC directive, but this is being undertaken by the European Environment Agency, largely outside the remit of the Advisory Group.

The review is scheduled to conclude in 2007 with a long-term vision on industrial emissions control. Should any legislative proposals be judged appropriate, these are unlikely to come into effect before 2012 at the earliest, with no change being made in the short-term. Therefore progress towards the critical 2007 deadline for compliance with IPPC by all relevant installations remains unchanged and increasingly urgent.

LESLEY JAMES

Friends of the Earth (England, Wales and N.Ireland) and part of the EEB representation on the IPPC Advisory Group.

[1] http://europa.eu.int/comm/environment/ippc/ippc_report.htm

[2] Details of these studies and other review documents are held on a designated website, available to the public at http://forum.europa.eu.int/Public/irc/env/ippc_rev/library

Slow implementation

Many EU states risk missing the October 2007 deadline to issue permits under the IPPC directive, figures released by the European Commission show.

Around 40,000 existing installations across the EU should be issued with new operating permits by October 2007. Figures now released show that across 18 EU states an average 43 per cent of installations have had existing permits reconsidered in line with IPPC rules or new permits granted. No data is available for the other seven states.

Among best performers are Luxembourg (96 per cent), Belgium (85) and Germany (83). Other contries are doing less well. France reports only 36 per cent progress, the UK 27, Poland 7 per cent and Slovenia no progress at all.

Source: **Environment Daily**, 3 April 2006.

IPPC directive – the EEB perspective

The European Environmental Bureau (EEB) is cautiously supportive of IPPC, but welcomes the review's focus on implementation and measures for going beyond BAT, which address its concerns about decentralized permit writing and the essentially dynamic nature of BAT.

However, whilst welcoming genuinely better regulation, the EEB is very concerned that current pressures could result in a lowering of environmental standards. It is particularly concerned about a possible modifying of IPPC to allow for further emissions trading at this early stage, especially given that the existing amendment to allow for carbon trading cut all links with BAT for CO_2.

It has also submitted technical proposals to address the practical problem of assessing the remaining life component of BAT assessments. Other technical concerns include specified review periods and the use of approved contractors for monitoring.

NEWS IN BRIEF

Not so fuel efficient

Today's commercial passenger planes are no more fuel-efficient than their equivalents of fifty years ago. Aviation industry claims of a 70-per-cent improvement in fuel efficiency are false. These are the main conclusions of a report by the Dutch National Aerospace Laboratory, published by the European Federation for Transport and Environment, T&E.

The 70-per-cent figure only includes improvements made during the jet era and ignores propeller-based planes of the 1950s. But the study also shows that even the efficiency gains made over the jet era have been exaggerated.

Particles from wood

Germany's environment agency Umweltbundesamt is now following Denmark in calling for fine particle (PM_{10}) emission controls on small wood burning stoves. PM_{10} emissions from small wood fires roughly equal those from all road vehicles in Germany, the agency stresses. And while emissions from small-scale coal burning has decreased since 1995, the emissions from wood stoves have increased, leaving total emissions from small-scale heating more or less constant.

Umweltbundesamt proposes stricter, more widely applicable limit values and greater communication with end users to drastically reduce emissions. It is also researching the possible use of filters.

Source: **Environment Daily,** 15 March 2006.

Shoppers are local

A British survey suggests shop owners overestimate the importance of the car among their customers. The cycle initiative Sustrans questioned 840 shoppers and 126 shop owners in Bristol – the shop owners estimated that 41% of customers arrived by car, whereas only 22% had done so; and the owners thought just 12% of customers lived less than 800 metres away and 40% 3km away, while the real figures were 42% and 88%. Sustrans says the findings suggest local businesses have more to gain from measures o promote walking and cycling than they think.

Risks and options in the limelight

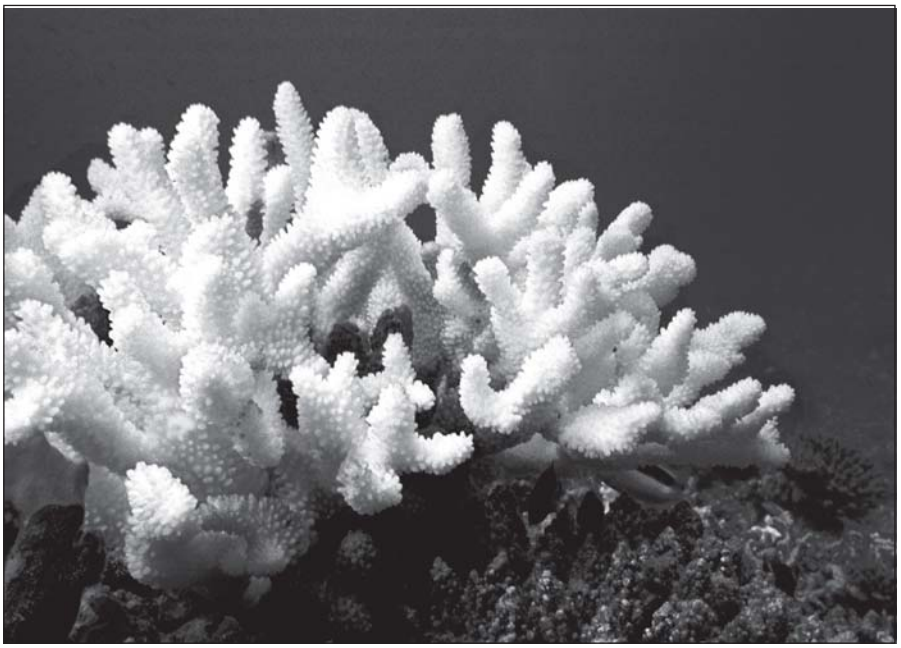
There is evidence that sensitivity is likely to be higher than previously thought.

"This book will serve as more than a record of another conference or event. It will provide an invaluable resource for all people wishing to enhance global understanding of the science of climate change and the need for humanity to act to tackle the problem."

So writes UK Prime Minister Tony Blair in the preface to the book *Avoiding Dangerous Climate Change*, and he is right. The next major assessment report on the global climate by IPCC, the Intergovernmental Panel on Climate Change, is not expected until autumn 2007. Until then, this book is the best summary of the state of knowledge that is currently available.

The content of the book is based on the findings that were presented at a conference in Exeter, UK, in 2005. It contains extended and peer-reviewed versions of the papers presented at the conference.

Two questions were discussed in Exeter: what level of greenhouse gases in the atmosphere is too high, and what are the options for avoiding such a level?



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An increase in global temperatures of just 1ºC is likely to lead to extensive coral bleaching, thereby seriously threatening one of the world's most diverse and valuable ecosystems.

Risks greater than feared

Compared with the IPCC Third Assessment Report, which was published in 2001, there is now greater clarity and reduced uncertainty about the impacts of climate change. In many cases the risks are more serious than previously thought.

A number of critical temperature levels and rates of change relative to pre-industrial times were noted. These vary around the globe and between specific regions and sensitive ecosystems.

For example, an increase in global temperatures of about 1°C is likely to lead to extensive coral bleaching. A regional increase above present levels of 2.7°C may be a threshold that triggers melting of the Greenland ice cap. This could even occur with a global mean temperature rise of 1.5°C above present levels, or 2°C above the mean pre-industrial temperature, and over a thousand-year period could result in the rising of sea levels by up to seven metres.

In general, surveys of the literature suggest increasing damage if the climate warms up 1 to 3°C above current levels. Serious risk of large-scale, irreversible system disruption, such as reversal of the land carbon sink and possible destabilization of the Antarctic ice sheets is more likely above 3°C. Such levels are well within the range of climate change projections for the century.

Sensitivity and emission pathways

There is evidence that sensitivity is likely to be higher than previously thought. Based on new insights into the uncertainty ranges of climate sensitivity, stabilization at 450 ppmv CO_2 equivalent would imply a medium likelihood (50 per cent) of staying below 2°C warming.

Different models suggest that delaying action would require greater action in the future to achieve the same temperature target, and that even a delay of five years could be significant. If action to reduce emissions is delayed by 20 years, rates of emission reduction may need to be three to seven times greater to meet the same temperature target.

Options for emissions reductions

Options for significantly reducing emissions over the long term already exist, according to the report. Large reductions can be attained, using a portfolio of options whose costs are likely to be smaller than previously considered.

There are no magic bullets, however. A portfolio of options is needed and excluding any options will increase costs. Multi-gas strategies, emission trading, optimal timing and strong technology development, diffusion and trading are all required to keep costs of low-level stabilization relatively low.

PER ELVINGSON

Avoiding Dangerous Climate Change. Ed. H.J. Schellnhuber. Published by Cambridge University Press (406 pp., £77.00, US$130.00), ISBN 0521864712. Details are available at www.cambridge.org/0521864712. The book and a summary can be downloaded free of charge at www.defra.gov.uk/environment/climatechange/internat/dangerous-cc.htm.

Global warming could more than quadruple

Sea level rise could reach 11.4 metres by the year 3000.

RESEARCH by the British Environment Agency shows that the decisions of this generation will leave a legacy of increasing climate change over the next millennium unless there is a major reduction in emissions.

Whilst most studies only look at temperature and sea level rises up to the year 2100, this study by the Tyndall Centre for Climate Change Research has explored where they are heading into the next millennium. The report says that by the year 3000:

❑ Global and regional warming could more than quadruple after 2100. Temperatures could rise from 1.5°C, if emissions are minimized, to as much as 15°C if we continue burning fossil fuels – more than four times the predictions for the year 2100. The EU target is that "global annual mean surface temperature increase should not exceed 2°C above pre-industrial levels".

❑ Sea levels will still be rising at the end of this millennium and could reach 11.4 metres by the year 3000. This figure compares with the Intergovernmental Panel on Climate Change (IPCC) global average sea level change of 0.16 to 0.69 metres by the 2080s. A global sea level rise of just two metres will flood large areas of Bangladesh, Florida and many low lying cities, and displace hundreds of millions of people.

❑ Abrupt climate change events could occur. Business-as-usual emissions could lead to the collapse of currents in the Atlantic, causing North Atlantic sea temperatures to fall by 3°C, affecting agriculture and marine life particularly at the latitude of the UK. If emissions continue, Arctic sea ice could completely disappear all year round, causing North Atlantic seas that were previously cooled to heat up to 8°C, accompanied by UK land temperature increases of up to 5°C within 20 years.

❑ Abrupt changes may be triggered many decades before they actually occur. Even after emissions have completely ceased there is still a legacy from decades past – a "sleeping giant" in the climate system.

❑ Ocean pH is predicted to fall dramatically, posing a threat to marine organisms, such as corals and plankton. Such fundamental changes to plankton would have large implications for the rest of the marine ecosystem.

❑ Climate changes could be even greater if the climate system turns out to be more sensitive to the level of greenhouse gas emissions than the conservative assumptions made in this study.

The report takes into account a wide range of possible levels of future emissions of carbon dioxide and it looks at three scenarios:

1. what happens if emissions are "minimized" – which means they are reduced steadily to zero between 2020 and 2200 (implying humans burn a further 1,130 gigatonnes of carbon, GtC, by 3000);
2. what happens in the event of "business as usual", with humans burning all of the remaining 4,000 GtC of conventional fossil fuel reserves by the year 3000; and
3. what happens in the worst-case scenario – if humans burn 15,000 GtC by 3000 by accessing unconventional fuels such as oil shales and methane hydrates.

The only scenario that may avoid dangerous climate change over the long term is the minimum emissions scenario, which allows for about one quarter of known fossil fuels to be used. This scenario allows for a small increase in global emissions by 2025 with a steady linear phase-out by 2200.

Further reading: The report **Climate Change on the Millennial Timescale**, by the Tyndall Centre for Climate Change Research and Environment Agency can be downloaded from www.environment-agency.gov.uk/news/1299456?

CLIMATE NEWS IN BRIEF

Polar bears classified as threatened

The World Conservation Union, IUCN, has added 530 species to its "Red List" of endangered species since the last version released two years ago.

Without a reversal of global warming trends, it predicts polar bear populations would drop more than 30 per cent in the next 45 years as melting ice caps deprive the animals of their habitat. The impact of climate change is increasingly felt in polar regions, where summer sea ice is expected to decrease by 50–100 per cent over the next 50–100 years. Previously listed by IUCN as a conservation-dependent species, the polar bear now moves into the threatened categories and has been classified as Vulnerable.

IUCN said countries worldwide needed to boost efforts to preserve biodiversity through reduced emissions, tighter fishing and hunting controls, and other measures.

Source: www.iucn.org, 2 May 2006.

Rise in greenhouse gas concentrations

Levels of carbon dioxide in the Earth's atmosphere have increased over the past year relative to a 1990 benchmark, according to the Annual Greenhouse Gas Index issued by the US National Oceanic and Atmospheric Administration (NOAA).

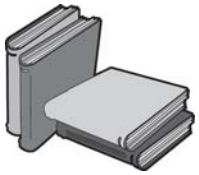
During 2005, global CO_2 increased from an average of 376.8 parts per million (ppm) to 378.9 ppm, an increase of 2.1 ppm. The pre-industrial CO_2 level was approximately 278 ppm. Overall, NOAA said, the Annual Greenhouse Gas Index shows a continuing, steady rise in the amount of heat-trapping gases in the atmosphere, although the constant or declining growth rates of methane and CFCs have slightly slowed the overall growth rate of the index.

Source: Environment News Service, 1 May 2006.

Sea rise could be 'catastrophic'

A study in the journal Science suggests a threshold triggering a rise in sea level of several metres could be reached before the end of the century. Greenland could be as warm by 2100 as it was 130,000 years ago, when melting ice raised sea levels by three to four metres.

Source: **Science**, 24 March 2006.



Recent publications

Changing Climates. The Role of Renewable Energy in a Carbon-constrained World (2006)
Renewable energy must play a major role in the global energy supply to meet the increasingly serious environmental and economic threats of climate change, according to this report from the Renewable Energy Policy Network for the 21st Century (REN21). The report uses a range of different scenario analyses from the International Energy Agency and other institutions to show how national and regional strategies can help to grow the renewable energy sector and reduce greenhouse gas emissions.

36 pp. Can be downloaded from www.ren21.net/climatechange/

The Impact of Euro 5: Facts and Figures
A ten-page summary by the Environmental Assessment Agency (MNP) in the Netherlands. MNP Report 500043002. Can be downloaded at www.rivm.nl/bibliotheek/rapporten/500043002.pdf

Determining factors in traffic growth: Developments, causes and possible future directions
An analysis of the determining factors in traffic growth, intended to help identify possible courses of action to reduce transport pressures on the environment.

66 pp. Published by Umweltbundesamt, the German Environment Agency. No. 32/2005. Can be downloaded at www.umweltbundesamt.de/index-e.htm

Climate Change in Germany – Vulnerability and Adaptation of Climate-sensitive Sectors
A study carried out for Umweltbundesamt, the German Environment Agency. No. 10/2005. Can be downloaded at www.umweltbundesamt.de/index-e.htm

Hydrogen Technologies for Sustainable Energy Supply
In order to promote more economically competitive hydrogen technologies, this study from the International Energy Agency (IEA) explores the potential of hydrogen and fuel cells in future energy markets. It also provides recommendations for governments regarding the wider use of hydrogen at national and international levels.

Available in pdf format at http://www.iea.org/bookshop/add.aspx?id=308

Still a negative trend

MORE GOODS AND PASSENGERS are being transported farther and more frequently across Europe. While greenhouse gas emissions from other sectors have decreased, those from transport have increased substantially since 1990. These are some of the conclusions in the latest transport indicator report[1] from the European Environment Agency (EEA).

Passenger transport increased by 30 per cent between 1990 and 2002, while freight transport increased by 34 per cent over the same period. Air passenger transport grew at the fastest rate: 96 per cent between 1990 and 2002.

Although data on passenger transport is patchy, there is no evidence of a shift from road to rail, according to EEA. Occupancy rates for cars are declining, while the average loads carried by lorries either remain stable or are declining.

Greenhouse gas emissions from transport in Europe increased by 22 per cent from 1990 to 2003 while decreasing in other sectors.

The report foresees that many European cities will continue to fail air quality limits and that the health effects are severe: estimates suggest that as many as 350,000 people die prematurely every year in Europe due to present concentrations of fine particles in the air, and road transport makes an important contribution to the exposure.

There are a number of initiatives to align price structures better with the external impact of transport, says the EEA. However, transport prices are generally well below the marginal social cost level, which is resulting in over-consumption of transport.

[1] The report **Transport and environment 2005: facing a dilemma** (EEA Report 3/2006) is the agency's sixth annual environmental assessment of transport in Europe. Most of the data comes from the period 1999–2002 though for some issues it reports trends up to 2003. Can be downloaded at http://reports.eea.eu.int/eea_report_2006_3/en

Serious doubts from environmentalist NGOs

IN FEBRUARY the European Commission adopted an EU strategy for biofuels. The aims are to promote biofuels in both the EU and developing countries; to prepare for large-scale use of biofuels by improving their cost-competitiveness; and to support developing countries' production of plants to make biofuels.

Environmentalist NGOs have expressed serious doubts about the strategy for various reasons. These range from concerns about insufficient safeguards on eco-certification of the agricultural raw materials used to make biofuels, to outright rejection of the strategy's plan to allow the use of biofuels to count towards carbon dioxide emission targets for car fleets.

Aat Peterse, policy officer at T&E, the European Federation for Transport and Environment, comments: "There is some potential for biofuels to deliver certain environmental benefits, but however surprised some people may be to hear environmental organizations playing down an idea that ought to be suited to them, it is important that we are honest about the limits to what biofuels can do. The benefits will only be delivered if the production of biofuels is sustainable in terms of its impact on biodiversity, water and soil, and if an adequate eco-certification process is applied to all biofuels used in the EU."

Source: **T&E Bulletin**, March 2006.

Take part in our E-mail campaign!

The Swedish NGO Secretariat on Acid Rain and the "Für Heuersdorf" Association are conducting an e-mail campaign addressed to the German Chancellor Angela Merkel.

If you would like to take part, please send the text in the right hand column to Mrs. Merkel. It can be done from the secretariat's website: **www.acidrain.org**

Dear Chancellor Merkel,

Global warming must be kept below an average of 2°C to avoid catastrophic climate change. This target has been adopted by the European Union.

As an industrial nation, Germany greatly contributes to destabilizing the Earth's atmosphere. I therefore call upon the German government to legislate binding reductions of greenhouse gas emissions of at least 40 per cent by 2020 and 80 per cent by 2050 (referred to 1990).This means that the use of fossil fuels must be quickly phased out. No new lignite mines should be opened in Germany and no further historic villages like Heuersdorf destroyed. Energy conservation and renewable energy sources are entirely adequate for replacing lignite fuels.

Background: German lignite mining

Lignite, or brown coal, is the main domestic fuel resource in Germany. In contrast with the diminishing global reserves and increasing prices of natural gas and oil, lignite appears to offer long-term energy security. The deposits lie close to the surface, allowing relatively inexpensive strip mining to be employed.

However, lignite is ultimately very costly to use because of factors not reflected in market prices. According to a study by the Wuppertal Institute, released by the German environmental ministry in October 2004, the financial burdens of environmental and health detriments are estimated at a minimum of 3.5 billion euro annually. When the comprehensive effects of climate change and a number of indirect subsidies are added, the total hidden costs of lignite use may be as high as 35 billion euro per year.

Rather than reducing lignite consumption to enhance environmental integrity, liberal operating permits have been granted to the mining companies under the Federal Mining Act. This policy means a continuous destruction of valuable environments, among them the medieval village of Heuersdorf in Saxony.

Further reading: **Status and Impacts of the German Lignite Industry.** By Jeffrey H. Michel. Can be downloaded at www.acidrain.org/pages/publications/reports.asp

Further publications

Global Environment Outlook 2006
This book from UN Environment Programme (UNEP) presents a survey of the global environment and is the third in an annual series. A special feature focus analyzes the environmental, socio-economic and public health impacts of energy-related air pollution.

Available online at www.unep.org/geo/yearbook/yb2006/. Printed copies (100 pp. US$20.00) can be ordered from the website above or from Earthprint Ltd., P.O. Box 119, Stevenage, Hertfordshire SG1 4TP, UK.

Particle reduction plans in Europe: Implementation of the first daughter directive on ambient air quality in Europe
A snapshot report from the European Environmental Bureau, EEB (see AN 4/05, p.6). Now available for download at www.eeb.org/activities/air/

Air pollution at street level in European cities
Looks at traffic hotspots in European cities during 2000 and makes projections for air quality in 2030. The cities surveyed were Antwerp, Athens, Barcelona, Berlin, Brussels, Budapest, Copenhagen, Gdansk, Graz, Helsinki, Katowice, Lisbon, London, Marseilles, Milan, Paris, Prague, Rome, Stuttgart and Thessalonica.

EEA Technical report No 1/2006. Can be downloaded at http://reports.eea.eu.int/technical_report_2006_1/en

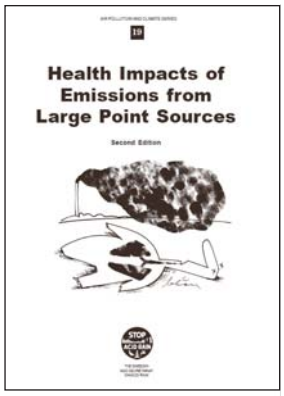
Market-based instruments for environmental policy in Europe
Presents an assessment of the developments in the use of market-based instruments in European environmental policy. Covers a range of instruments, such as environmental taxes, charges and deposit-refund systems, environmental tax reform, emission trading schemes and subsidies.

Published by the European Environment Agency. EEA Technical report No 8/2005. Can be downloaded at http://reports.eea.eu.int/technical_report_2005_8/en.

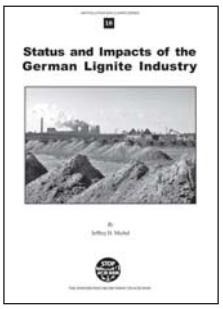
Integration of environment into EU agriculture policy (2006)
This report aims to provide a reflection of the achievements and obstacles in the integration of environmental concerns into EU agriculture policy.

EEA Report No 2/2006, available at http://reports.eea.eu.int/eea_report_2006_2.

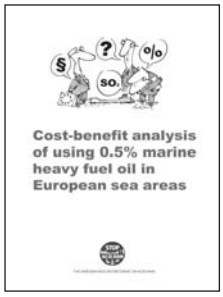
Recent publications from the Secretariat



Health Impacts of Emissions from Large Point Sources
This study combines the health impact assessment methodology used by EU's CAFE programme with an emissions database for European large point sources, to assess health damage linked to emissions of nitrogen oxides and sulphur dioxide on a plant by plant basis. It finds that the emissions from large point sources in Europe could be responsible for more than one million life years lost in Europe every year. Some of the worst polluting plants may each be responsible for the annual loss of between 10,000 and 20,000 life years. By Mike Holland, EMRC. Second Edition, March 2006.



Status and Impacts of the German Lignite Industry
This report includes a historical treatment of German lignite use and discusses many of the hidden costs involved: excessive greenhouse gas emissions, depletion of groundwater resources, and destruction of hundreds of villages. Special consideration is paid to eastern Germany, where lignite accounts for up to 85 per cent of electrical power consumption in some regions. By Jeffrey H. Michel, April 2005.



Cost-benefit analysis of using 0.5% marine heavy fuel oil in European sea areas
A lowering of the sulphur content of marine heavy fuel oil to 0.5 per cent would reduce SO_2 emissions from international shipping around Europe by more than three quarters by 2010. The benefits of such a measure clearly outweigh the costs, according to this study. By Christer Ågren, January 2005.

Atmospheric emissions from large point sources in Europe
This report identifies and lists the 200 largest emitters of sulphur dioxide and the 200 "best" fossil-fuelled power stations, in terms of SO_2 and NOx emissions per useful output. By Mark Barrett, SENCO. Published 2004.

HOW TO ORDER. Single copies of the above mentioned material can be obtained from the Secretariat (free of charge within Europe). Please call for quotation if more copies are required. Can also be downloaded in pdf format from www.acidrain.org

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Coming events

For the latest news and direct links, please visit www.acidrain.org.

CLRTAP Task Force on Hemispheric Transport of Air Pollution. Moscow, Russia, 6-8 June 2006.

A Sustainable Path for Biofuels in the EU. Brussels, Belgium, 7 June. *Information*: www.transportenvironment.org.

Particles in Europe. Antwerp, Belgium, 13-14 June. *Information*: www.aamg-rsc.org

Low Carbon Vehicle Partnership – Annual Conference. London, UK, 15 June. *Information*: www.lowcvp.org.uk

8th International Conference on Greenhouse Gas Control Technologies. Trondheim, Norway, 19-23 June 2006. *Information*: www.ieagreen.org.uk/ghgt8.html

Exposure and Health Effects of Traffic-related Air Pollution. Stockholm, Sweden, 20-21 June. *Info*: www.snap.se

EU Environment Council. 26-27 June.

21st European Photovoltaic Solar Energy Conference and Exhibition. Dresden, Germany, 4-8 September 2006: *Info*: www.photovoltaic-conference.com

2006 European Renewable Energy Policy Conference. Brussels, Belgium, 12-14 September 2006. *Information*: www.erec-renewables.org/events/

European Mobility Week. 16-22 September. *Info*: www.mobilityweek-europe.org

CLRTAP Working Group on Strategies and Review. Geneva, Switzerland, 19-22 September 2006.

Third International Conference on Biomass for Energy. Kiev, Ukraine, 18-20 September. www.biomass. kiev.ua/conf2006

OPTIMUM² Mobility Event. Amsterdam, The Netherlands, 28-29 September 2006. *Information*: www.optimum2.org

Climate Change As A Driving Force For Energy Efficiency. Brussels, Belgium, 28 September 2006. *Information*: http://haymarket.ec-messenger.com

CLRTAP Workshop on technology change, emission trends and projections. Beijing, China, (prel.) 18-20 October.

CAFE Steering Group. Brussels, Belgium, 8-9 November 2006.