Particulate Matter in Ambient Air

The debate on the PM10 daily limit value

Reinhold Görgen and Udo Lambrecht

Numerous studies have demonstrated the negative effect of particulate matter on human health. The EU therefore introduced ambitious limit values for particulate matter (PM10) in ambient air as early as 1999: an annual limit and a daily limit that can be exceeded on up to 35 days a year. These values are binding since 2005. The daily limit is still exceeded in many cities throughout Europe.

Heated debates on the future of the daily limit are taking place at all levels of the EU in the context of the negotiations on the Commission’s proposal on a new Air Quality Directive. Suggestions range from allowing a compliance time extension to increasing the number of days the daily limit can be exceeded, and abolition of the daily limit value. The deliberations have not yet been concluded, but the decisive European institutions have voiced support for keeping the daily limit while at the same time extending the compliance deadline.

In this article, we will make the point that the problem can most probably be solved by allowing a compliance extension of around 5 years after the new directive enters into force. This would give the competent local authorities and the EU the time necessary to intensify their measures in order to comply with the daily limit in most areas where it is currently exceeded. An increase in the number of days the limit values may be exceeded, as called for by the European Parliament (EP), would therefore amount to an unnecessary lowering of the limit value.

I. Introduction

It is apparent that many European cities cannot comply with the daily limit value for particulates (PM10) which is in force since 2005. Particularly near very busy streets, the limit is exceeded. It is clear that in many cases compliance with the limit values cannot be guaranteed by proportionate local or national measures alone. Improvements and effective implementation of EU legislation (e.g. emission standards for vehicles) are necessary, too. They have a strong impact on transboundary and national emissions, but new EU regulations take time before they will become effective.

Because of the anticipated problems with PM10, the German Federal Government, with the support of other Member States, has repeatedly urged the EU Commission to carry out the proposed revision under Article 10 of Directive 1999/30/EC for the set date in 2003. However, instead of this revision, in September 2005 the EU Commission published a "Thematic Strategy on Air Pollution" and a proposal for a Directive on ambient air quality. This proposal contains an unchanged PM10 daily limit value as protection against short-term increases in concentration as well as an unchanged PM10 annual limit value to protect against long-term pollution.
tion. The Commission bases these limits on the World Health Organization’s air quality guidelines, which use epidemiological data to demonstrate that short-term and long-term exposure to particulates carries health risks.

Where the limit values for PM10 cannot be achieved because of site-specific dispersion characteristics, adverse climatic conditions, or transboundary emissions, the EU commission proposes an exemption from the obligation to apply the PM10 limits until the end of 2009 under strict conditions. The draft Directive provoked heated discussions on the definition of the daily limit value. The solutions put forward include (in addition to an exemption from the obligation to apply with the limits) increasing the number of days in which the limit values may be exceeded, as well as abolishing the daily limit value and replacing it with an equivalent annual mean value.

This paper presents the status quo of discussions on the Air Quality Directive in the EU, focusing on the definition of the PM10 daily limit value. It then provides an overview of the factors that influence PM10 concentrations. Third, data is provided to demonstrate that approximately 5 years after the date the new directive enters into force, it is highly likely that the current daily limit value can be complied with. This is shown specifically for the majority of monitoring points in Germany where the limit is currently exceeded.

II. Consultation status of the new Air Quality Directive

In its proposal for a new Air Quality Directive presented on 21 September 2005 (2005/447/EU), the EU Commission recommends that “existing air quality limit values for PM10 should remain unchanged, although it should be possible to postpone the deadline for compliance in cases where, notwithstanding the implementation of appropriate pollution abatement measures, acute compliance problems exist in specific zones and agglomerations. Any postponement for a given zone or agglomeration should be accompanied by a comprehensive plan to ensure compliance by the revised deadline”.

In addition, a concentration cap with limit value character and a long-term target for PM2.5 are introduced (for details see Table 1). On the basis of the most up-to-date scientific knowledge on the effects of particulates, the Commission has come to the conclusion that PM2.5 is a better measure of the contributions made by human beings to the concentrations of particles in the atmosphere, but that the risk from the coarse fraction (between PM2.5 and PM10) cannot be neglected.

Publication by the Commission of the proposal for a new Air Quality Directive set in train the EU consultation procedure, which involves both the Council and the European Parliament. The European Parliament (EP), after considerable discussion, gave its views on the Commission’s proposal on 26 September 2006 (first reading). The EP’s opinion involves weakening and tightening the limit values. MEPS want “greater flexibility (a maximum of 55 days per year) for Member States unable to meet the standards because of special geographical or climatic conditions or significant cross-boundary pollutions”. On the other hand, the annual limit value should be tightened from the current 40 μg/m³ to 33 μg/m³. The Parliament proposed the option of a compliance extension for PM10 of up to 6 years after the new directive comes into force. Extension should only be granted if “all appropriate measures have been taken at national, regional and local levels”. Instead of a cap the European Parliament is proposing an ambitious target value of 20 μg/m³ for PM2.5 from 2010. This should be replaced by a limit value of the same level from 2015.

The Commission expressed concerns about the European Parliament’s statement, in particular due to the extra time allowed for compliance with the PM10 limits and the weakening of the existing daily limit on concentrations of PM10, allowing it to be exceeded on up to 55 days per year instead of 35. With this relaxation of the limit values, the
people worst affected would be exposed to high concentrations for considerably more days per year.

The EU Council of Environment Ministers discussed the Commission’s draft Directive on 23 October 2006, and reached a political agreement (first reading), in which they spoke out in favour of retaining the current PM10 limit values, in particular the daily limit value. The Council also conceded the possibility of a compliance extension under the conditions proposed by the Commission. In the case of PM10, this compliance extension would run for a maximum of three years after the new directive comes into force. Instead of a concentration cap the Council also proposed a target value for PM2.5 of 25 µg/m³ from 2010, which would be replaced by a limit value at the same level from 2015. The Commission welcomes the political agreement of the Council.10

The Common Position was formally adopted by the Council on 25 June 2007. The second reading in the European Parliament will start in September 2007. As regards the timescale for the entry into force of the new Air Quality Directive, it will be assumed here that the Directive enters into force in 2008. (see Table 1)

As all the responsible EU bodies, that is: the Parliament, the Council and the Commission, have come out in support of a PM10 daily limit value, it can be assumed that such a limit value will be retained. Furthermore, all three bodies have demanded a compliance extension for PM10, but with differing duration. It would be desirable if, during the forthcoming negotiations, the Council and the European Parliament could agree on a compliance extension which is set in such a way that compliance with the limit value will be possible using reasonable measures and would not unnecessarily weaken health protection.

### Table 1: Consultation status in the EU on the particulates provisions of the Air Quality Directive as at June 2007

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Daily limit value from 2005 of 50 µg/m³, which may be exceeded on a max. of 35 days</td>
<td>a. Daily limit value from 2005 of 50 µg/m³, which may be exceeded on a max. of 35 days, but possibility for Member States to increase the number of exceedance days to 55 from 2010</td>
<td>Same as the Commission proposal</td>
<td></td>
</tr>
<tr>
<td>b. Annual limit value from 2005 of 40 µg/m³</td>
<td>b. Annual limit value of 40 µg/m³ in the period from 2005-2009</td>
<td></td>
<td></td>
</tr>
<tr>
<td>c. Annual limit value of 33 µg/m³ from 2010</td>
<td>c. Annual limit value of 33 µg/m³ from 2010</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Compliance extension for PM10</th>
<th>Exemption from the obligation until 31 Dec. 2009 at the latest</th>
<th>Extension up to 6 years after the new Directive comes into force</th>
<th>Extension up to 3 years after the new Directive comes into force</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Regulation PM2.5</th>
<th>Concentration cap of 25 µg/m³ from 2010</th>
<th>Exposure reduction target -20% (2010-2020)</th>
<th>a. Target value of 20 µg/m³ from 2010</th>
</tr>
</thead>
<tbody>
<tr>
<td>b. Limit value of 20 µg/m³ from 2015</td>
<td>Differentiated reduction targets, which take account of the different exposure levels</td>
<td>a. Target value of 25 µg/m³ from 2010</td>
<td></td>
</tr>
<tr>
<td>c. Limit value of 20 µg/m³ from 2015</td>
<td>Differentiated reduction targets, which take account of the different exposure levels</td>
<td>b. Limit value of 25 µg/m³ from 2015</td>
<td></td>
</tr>
</tbody>
</table>


### III. Impact of transboundary air pollution and meteorological conditions on PM10 concentrations

Emissions from local, regional and national sources contribute to PM10 concentrations. Meteorological factors have a high influence on the daily average. Beside local dispersion conditions (e.g. urban canyons), meteorological conditions (wind speeds, wind directions, mixing layer height, washouts etc.)
and long-distance transport of pollutants also highly influence PM10 concentrations. Under particular conditions (e.g. low wind speeds, low mixing layer heights), elevated concentrations of particulates can occur although there is no change in emission patterns. Such situations are termed “particulate episodes” in this document. During particulate episodes, high concentrations of particulates often occur over a large area.

The concentration of PM10 is exemplarily shown for two sites in Berlin, one close to a very busy street in downtown Berlin, and one at a station in the periphery of the city (see Figure 1). Despite differences in local emissions and dispersion conditions, the profile of PM10 concentrations over the course of the year is very similar, being determined by particulate episodes. This is exemplified with three episodes from the year 2005, which are further described below.

- In the period from 4 to 10 February 2005, high PM10 concentrations occurred even at the periphery of the city, despite good conditions of atmospheric exchange. This was attributed to air masses with high concentrations from easterly and south-easterly directions.11
- In early March 2005, changes in the wind direction led to the air above the city moving around in circles and gradually accumulating particulate matter.12
- At the end of March 2005, pollutants accumulated due to inversions.

The PM10 concentrations measured at the periphery of Berlin exceeded 50 μg/m³ during particle episodes. But during all three episodes, the PM10 concentrations at the traffic station were significantly above the concentrations at the station at the periphery.

Conclusion: At the periphery of cities and in rural districts, high concentrations only occur during particulate episodes.

IV. How is the PM10 daily limit value defined and what reductions are necessary for compliance?

The PM10 daily limit average may be exceeded on up to 35 days per year, in order to take account of unusual and adverse weather conditions.

The justification of the EP for raising the number of exceedance days is based on the existence of

---

“special geographical or climatic conditions or significant cross-boundary pollutions.” There is absolutely no doubt that high concentrations occurring over large areas are affected by meteorological conditions and transboundary pollution and not by changes in emission patterns. The question here is whether such conditions exist for more than 35 days per year.

Analyses by the German Federal Environment Agency (UBA) for Germany show that at rural background stations between 2000 and 2005, averaged over all stations, limit values were only exceeded (daily average > 50 \( \mu g/m^3 \)) on 6 to 15 days. Even in 2003, when meteorological conditions were extreme, the daily average was only exceeded more than 35 times at 4% of these stations. In view of that, it can be assumed with certainty that in Germany there are considerably less than 35 particulate episode days per year.

These episode days are thus taken into account by current legislation, which permits 35 days in excess of the limit values. On these days, there is consequently no obligation to make an attempt which is pointless from the outset to try to comply with the limit value using local measures. The EU Commission also justified the 35 permitted exceedence days on the basis that these will “take account of unusual and adverse meteorological conditions.”

Likewise the EU Air Quality Directives do not require taking measures that last only “short-time” during particulate episodes, as has repeatedly been under discussion. However, when a limit value is exceeded, Framework Directive 96/62/EC requires measures to be taken in the short term – meaning immediately – in order to reduce that risk and to limit the duration of such an occurrence.

14 Even in the urban background, which is influenced by local emissions, more than 90% of stations complied with the daily limit value in most years. Even in 2003, when meteorological conditions were extreme, the daily average was exceeded more than 35 times at only 25% of these stations.
16 See, e.g., Klingner et al., “Reduktionspotenziale verkehrsbezüglich der Maßnahmen in Bezug zu meteorologisch bedingten Schwankungen der PM10- und NOx-Emissionen”, Gefahrstoffe 2006, Nr. 7/8 (Juli/August), p. 66: “It is not possible to identify short-term, economically and socially justified reduction measures for the effective control of PM10 events caused by meteorological conditions.”
The magnitude of the 36th highest daily average value is the appropriate indicator for quantifying the necessary PM10 reductions.

As 35 exceedance days per year are permitted under the current regulations, the 36th highest daily average in a year defines the reduction needed. The daily limit is attained if the 36th highest daily average is 50 μg/m³ and lower.

For the station chosen to illustrate this, "Berlin, Frankfurter Allee", the PM10 daily averages for 2005 have been arranged according to their magnitude (Figure 3). The 35 highest values ranged between 59 and 191 μg/m³. The 36th highest value was 58.6 μg/m³. Accordingly, for 2005, a reduction of the daily average on exceedance days of a maximum of 8.6 μg/m³ would have been sufficient to comply with the limit value in the area around Frankfurter Allee.

At the Berlin-Friedrichshagen monitoring station, the PM10 concentrations were considerably lower, despite a very similar annual pattern. At Berlin-Friedrichshagen the daily limit value was exceeded only 15 times. The 36th highest value was 10 μg/m³ below the daily limit value. Figure 2 (opposite page) shows very clearly that the daily averages can be arranged in two groups: first, the group with the 35 highest values, which include the extreme values during particulate episodes, and second, the group with no unusual weather conditions.

In 2005, a reduction by 10 μg/m³ would have been sufficient to dramatically reduce the number of stations exceeding the limit value in Germany.

In 2005, the daily limit value was exceeded at 60 monitoring points in Germany. These monitoring points were almost exclusively strongly affected by vehicle emissions. The highest concentrations occurred at the monitoring sites “Stuttgart Neckartor”, “Munich/Landshuter Allee” and “Dortmund Brackeler Str.”. At these locations, the 36th highest values were 84, 72, and 65 μg/m³ respectively. In total, the 36th highest value exceeded a concentration of 60 μg/m³ at only 10 monitoring stations. This means that a reduction by 10 μg/m³ at the other monitoring sites on all exceedance days in 2005 would have been sufficient to comply at additional 50 monitoring stations (83% of stations not...
complying in 2005) with the daily limit value. For about 2/3 of the sites a reduction of only 5 μg/m³ is necessary to comply with the limit. A reduction by 10 μg/m³ would be sufficient to dramatically reduce the number of stations exceeding the daily limit value in Germany and also many other Member States with comparable situations.19

(see Figure 3, page 283)

Otherwise, an increase of the number of exceedance days would legally exempt many municipalities from carrying out measures. According to a study by the Federal Environment Agency, raising the number of exceedance days from 35 to 55 in 2005 would reduce the number of stations with exceedances by around two thirds.

The following chapter describes the measures which, within a time span of approximately 5 years from the date the new directive enters into force, will make compliance with the current PM10 daily limit value possible at most of the locations where it is currently being exceeded.

V. Measures for reducing the PM10 concentration

Particles are directly emitted (primary particles) or are formed as secondary particles by intermediate reactions of gaseous precursor substances (e.g. NOx, SO2 and NH3) in the atmosphere. Local, regional and national/EU-wide emissions of both groups contribute to the observed concentration of PM10.

Emissions of primary PM10 as well as those of precursor substances will be reduced over the coming years using appropriate reduction measures at all levels. The impact of this reduction on PM10 concentration approximately 5 years after the new directive enters into force will be examined below.

Urban background concentrations will drop by around 5 μg/m³.

On account of EU-wide legislation (e.g. emission standards for vehicles, Large Combustion Plant Directive), national legislation and the implementation of both in Member States, air quality will improve further over the next few years. Based on the CLE-scenario (current legislation),20 PM10 emissions will decline about 14% in 2010 (20% in 2020) for Germany, both in comparison with 2000. Emissions of NOx will be reduced by 29% (45%) and SO2 by 30% (34%), while the decline in NH3 emissions will only amount to 2% (5%).

The future urban background concentrations of PM10 were calculated using the REM-CALGRID model21 based on these figures. Using the meteorological conditions of 2000, an urban PM10 background concentration of 15 to 20 μg/m³ was estimated for 2010, with values of 20 to 25 μg/m³ for larger agglomerations and 25 to 28 μg/m³ in parts of the Ruhr area. This corresponds to a reduction of 3 to 6 μg/m³ in urban areas in relation to 2000. The urban PM10 background concentrations will decrease by a further 2 to 3 μg/m³ by the year 2020.

EURAD calculations22 for the City of Bottrop (Ruhr area) show a reduction in base levels ("urban background") from 27 μg/m³ (2005) to 24 μg/m³ (2010) and 23 μg/m³ (2015) which is comparable with the results of the CALGRID calculations.

A similar calculation was carried out for Belgium.23 The urban background concentration in Belgium will fall by approximately 5 μg/m³ between 2005 and 2015. This is within the order of magnitude of the reductions calculated for Germany.

On the basis of these estimates, it can be assumed that the urban background concentrations for PM10 in Germany will decline between 2005 and 2015 by an annual average of about 5 μg/m³. Due to larger reductions on exceedance days,24 it can be assumed that the 36th highest daily value be reduced even earlier by this amount.

19 Higher reductions are necessary in Poland and Italy, for example.
22 Janßen et al., Vorbeugender Gesundheitsschutz durch Mobilisierung der Minderungspotentiale bei Straßenverkehrslärm und Luftschadstoffen - Teilprojekt: Möglichkeiten und Grenzen der Stadtplanung am Beispiel Bottrop-Ebel (Endbericht), Kassel 2006.
Stricter EU emission standards for vehicles will also reduce local traffic emissions and therefore reduce PM10 concentrations by around 3 μg/m³. EU emission standards for motor vehicles (e.g. Euro 5 and Euro 6 for passenger cars) will also reduce traffic emissions in busy inner city streets. The contribution by local traffic to PM10 concentrations ("street incremental") near busy streets amounts to about 25%. This contribution consists of exhaust emissions as well as emissions due to road abrasion and tyre and brake wear.

The decrease in inner city vehicle emissions was estimated using TREMOD\textsuperscript{25}. Tail pipe particle emissions from diesel vehicles in inner cities in Germany will decline by 44% between 2005 and 2010, and even by 60% by 2013 due to replacement of older vehicles by cleaner vehicles. Assuming local traffic emissions contribute to PM10 concentrations in the order of 10 μg/m³ in 2005 and tail pipe emissions contribute half of this, the foregoing development will lead to an incremental reduction of street concentrations by 2.2 (2010) or 3 μg/m³ (2013).

A potential reduction of 4.1 μg/m³ (2010) and 5.7 μg/m³ (2015) relative to 2005 was calculated for the City of Bottrop\textsuperscript{26} due to improved vehicle technology. On the assumption that these potential reductions are gained equally in the area of broad-scale emissions and local traffic emissions, the figures are in the same order of magnitude as the estimates using TREMOD.

According to these estimates PM10-concentrations resulting from local traffic ("street incremental") will decline by around 3 μg/m³ between 2005 and 2013. As was the case for urban background, it can be assumed that the decrease will be higher during exceedance days.

Local traffic measures can lead to a decrease of 5 μg/m³ in the PM10 concentration. Low Emission Zones (LEZ), speed limit restrictions, public transport improvements, restrictions on domestic heating with biomass, and other measures are planned in many cities. The PM10 emission reduction potential for vehicles due to "local measures" and their impact on PM10 concentrations were quantified in a Federal Environment Agency study\textsuperscript{27}. Measures to reduce precursor substances were not taken into account.

– Among local measures examined, the greatest potential reduction is offered by LEZ\textsuperscript{28}. Only vehicles with specified environmental characteristics are allowed to enter these zones. The reduction, however, is considerably influenced by the characteristics of the zone, e.g. size, types of vehicle allowed, start year. If, for example, all diesel vehicles which do not meet the EURO 3 standard are excluded from 2010 on and this mileage is not replaced by other vehicles, the diesel particle emissions will decline by approximately 34%\textsuperscript{29}. This would lead to a reduction of the PM10 concentration for the two cities considered in the study by 4% and 6% respectively.

– A complete local ban on heavy duty vehicles would reduce the PM10 concentration by around 4%.

– The reduction effect of organisational measures for traffic exclusion and rerouting depends to a large degree on the way these are implemented. A reduction of 30% in traffic volume gives a drop of around 4% in the PM10 yearly average in these streets.

Assuming an annual PM10 mean value of 35 μg/m³, the foregoing reduction potential of a LEZ would result in a PM10 concentration reduction of around 1.4 to 1.8 μg/m³; a complete ban on lorries yields an estimated reduction of around 1.4 μg/m³. The reduction potential decreases in the case of a lower level of compliance and lower emission levels of the affected vehicles. In addition, it should be noted that reduction potentials cannot be added together in all cases. For example,

\textsuperscript{25} TREMOD: Transport Emission Model, developed by IFEU Heidelberg under contract with the German Federal Environment Agency (Umweltbundesamt), Dessau.

\textsuperscript{26} Janßen et al., Vorbeugender Gesundheitsschutz durch Mobilisierung der Minderungspotentiale bei Straßenverkehrslärm und Luftschadstoffen - Teilprojekt: Möglichkeiten und Grenzen der Stadtplanung am Beispiel Bottrop-Ebel (Endbericht), Kassel 2006.

\textsuperscript{27} Diegmann et al., Maßnahmen zur Reduzierung von Feinstaub und Stickstoffdioxid, Dessau 2006.

\textsuperscript{28} A regulation of this kind is planned for Berlin from 2008.

\textsuperscript{29} Depending on the local share of different types of vehicles, the reductions can also be different. A 45% reduction of exhaust diesel particles compared to the trend was calculated for Berlin assuming that, from 2010, only diesel vehicles which fulfil Euro 3 as a minimum were allowed (see Senatsverwaltung für Stadtentwicklung, Luftreinhalte- und Aktionsplan für Berlin 2005-2010 - Anhang, Berlin 2005).

\textsuperscript{29} Hentze, Praktische Erfahrungen zur Verringerung der Luftschadstoffbelastung PM10 und NO2 durch verkehrliche Maßnahmen in Düsseldorf, Presentation at the Conference "Praktische Erfahrungen zur Verringerung der verkehrseingedrungenen Luftschadstoffbelastungen in Städten", on 6 March 2006.
the reduction potential of a LEZ decreases with an increasing proportion of diesel cars with particle filters.

A similar reduction potential was calculated for Corneliusstraße in the City of Düsseldorf. A route concept for lorries will lead to a reduction of 2.2 μg/m³. Introducing low-emission vehicles in the municipal fleet and public transport (Rheinbahn) accounts for a further reduction of 2 μg/m³. Reducing traffic jams contributes 1 μg/m³. An overall reduction of over 5 μg/m³ can therefore be anticipated from these three local measures alone.

A calculation based on statistical models shows that a maximum reduction of 8 μg/m³ in the PM10 concentration could be achieved by closing a road. Regional reduction measures over a period of 1 to 2 days (emissions similar to "weekend situation") would lead to a reduction of the daily average up to 18 μg/m³.

According to these calculations, local traffic measures can currently contribute to a reduction of the PM10 annual average value of around 5 μg/m³ at locations with heavy traffic. Because of the reductions of emissions from vehicles in the next years due to stringer exhaust emission standards, this potential will also decrease.

Measures already implemented confirm the estimated reduction potential of local measures.

Closure of a main street in Frankfurt (Oder), where traffic was reduced to 20% of original levels (resident access traffic only), led to a decrease in the PM10 concentration of several μg/m³.

Due to a ban of lorries on Silbersteinstraße in Berlin, the number of lorries was roughly halved (the proportion of lorries fell from 6% to 3.2%). This resulted in a decline in the PM10 concentration of around 3 – 4 μg/m³.

In the town of Nauen in Brandenburg, the total amount of traffic decreased by approx. 30% and heavy traffic by approximately 50% due to the construction of a local bypass. The monitoring station there recorded a decrease in the traffic-related PM10 concentration of approx. 8 μg/m³. The reduction in the PM10 total concentration was around 15%. After replacement of an older road surface which had undergone repair work several times with a new asphalt surface, a reduction in the total concentration of PM10 of approximately 35% was observed, and for traffic-related additional loading of approximately 50%.

Additional action at national, EU and international levels will contribute to a further reduction in pollution levels.

The German Federal Government has initiated or prepared action to reduce the emission of primary particles and precursor substances:

- The retrofitting of cars with particle filters is supported by a tax rebate of 330 €. Taxes for vehicles not equipped with particle filters will rise. Retrofitting of vehicles has impacts on local emissions, but also on emissions in rural areas.
- The Federal Ordinance on Large Combustion Plants (13. BImSchV) and the Technical Instructions on Air Quality Control (TA Luft) have been amended. Emission limits for particulates have been tightened. For example, for combustion plants with a thermal output > 50 MW, the particulates limit value was lowered from 50 mg/m³ to 20 mg/m³ from 2004 onwards.
- The "Energiesteuergesetz" (Energy Tax Act) which entered into force on 1 August 2006 includes tax benefits in favour of low-sulphur heating oil as of 1 January 2009. Use of low sulphur oil will lead to lower emissions of particulates. In early 2007, in a joint statement with the Federal Environment Ministry, the mineral oil industry promised to ensure a country-wide supply of low-sulphur heating oil in Germany by 1 January 2009. This will reduce the sulphur content by a factor of 20 compared to EU rules that enter into force in 2008. In addition, the mineral oil industry has also promised to ensure better availability of sulphur-free diesel for ships. This allows exhaust technology already available for road vehicles – such as particle filters and NOx-reducing technology – to be employed for inland waterways vessels as well.
- In the case of heating appliances in residential buildings and apartments (small heating installations), legal adjustments are planned with the

31 Klingner et al., "Reduktionspotenziale verkehrsbeschränkender Maßnahmen in Bezug zu meteorologisch bedingten Schwankungen der PM10- und NOx-Immissionen", Gefahrstoffe 2006, Nr. 7/8 (Juli/August), p. 66.
34 Landesumweltamt Brandenburg, Luftreinhaltplan Nauen (Entwurf), Potsdam 2004.
amendment of the Small-Scale Combustion Plant
Ordinance (1. BImSchV), which should make a sig-
nificant contribution to the reduction of particu-
lates.

– In order to reduce emissions from heavy duty
vehicles, a wider spread of charging rates for lor-
ries based on emission classes is planned, which
will also lead to a further lowering of NOx emis-
sions. The Government is also supporting the pur-
chase of low-emissions heavy duty vehicles
(“Lkw-Innovationsprogramm”).

– In the agriculture sector, NH3 emissions will be
reduced further.

At the European level, the “Thematic Strategy on Air
Pollution” opens the way for further progress
towards an efficient air pollution control policy. In
this process, the increased inclusion of air pollution
issues related to the Community’s agricultural, en-
ergy and traffic policy is of crucial importance.

Climate change policies will have considerable
ancillary benefits in air pollution abatement, as well.
It is assumed that climate change policies will
reduce the overall cost of air pollution abatement
measures needed to meet the objectives of the
Thematic Strategy.

First steps have also been taken for reducing the
steadily increasing contribution to particle concen-
trations due to marine traffic. According to informa-
tion from the EU, in European coastal areas 20 to
30 % of the inorganic secondary particles come from
ships. Germany has, jointly with other Member States,
initiated the revision process for air pollution control
regulations in the IMO (International Maritime
Organization) and will do what it can to achieve sig-
nificant decreases in the emissions of particles, sul-
phur oxides and nitrogen oxides as soon as possible.

Wider initiatives to reduce transboundary particu-
late concentrations are underway within the frame-
work of the UN/ECE (United Nations Economic
Commission for Europe) Convention on Long-Range
Transboundary Air Pollution. There are plans to
include National Emission Ceilings for PM2.5 in an
amended Multi-Pollutant Protocol. Proposals to this
effect are currently being developed in a working
group chaired jointly by Germany and the UK.

The PM10 daily limit can be complied with at most
locations approximately five years after the new Air
Quality Directive enters into force.

It has been shown that the urban PM10 back-
ground concentrations in Germany will decrease in
non-attainment-areas on average by around 5 μg/m³
between 2005 and 2015 as a result of EU-wide
measures and national legislation that have already
been introduced. In addition, the reduction of local
traffic emissions due to more stringent emission
standards of vehicles will lead to a decline by
approximately 3 μg/m³ in the period from 2005 to
2013 at sites with heavy traffic. It can therefore be
assumed that concentrations near busy streets will
decrease on average by around 8 μg/m³ in the five
years after the new Air Quality Directive enters
into force, even without any additional local meas-
ures. If the additional international, national, and
local measures described here also enter into force
without delay, there is a high likelihood that a
reduction of 10 μg/m³ on all exceedance days
occurring during the year can be achieved within
this timeframe.

A weakening of the daily limit value, e.g. by
increasing the number of permitted exceedance
days, is therefore not necessary if a compliance
extension of approximately 5 years is agreed upon.
As demonstrated, compliance with the daily limit
value can be achieved by then with appropriate
measures at the majority of stations in Germany
which currently exceed the limit. For the few loca-
tion where extremely high concentrations are
observed, the measures described above would not
be sufficient. However, increasing the number of
exceedance days to 55 would not be of any help at
these locations, as the concentration on the 56th
highest day would still be well above 50 μg/m³ at
these stations.

At this point, we also want to emphasise again
that a compliance extension will not release the
Member States from their actual legal obligation to
carry out measures now if the limits are exceeded.

VI. Summary

Two years after entering into force, the daily limit
value is still being exceeded in many cities of
the European Union. The EU Commission, in its
proposal for a new Air Quality Directive, suggests
retaining the current daily limit value, but with
respect to the compliance problems proposes
strictly regulated exemptions from the obligation
to enforce those limits until 31 December 2009
at the latest. In their initial statements, the EP
and Council have likewise retained a daily limit
value. These bodies also support a compliance extension. In order to allow more time for carrying out measures, the EP is suggesting a compliance extension of a maximum of six years, and the Council one of a maximum of three years, calculated from the date the new directive enters into force. As all relevant EU bodies have come out in support of a PM10 daily limit value, it can be assumed that a limit value of this kind will essentially be retained.

This paper shows that a compliance extension of approximately five years from the date the new directive enters into force would be sufficient to ensure that the current daily limit value (maximum of 35 days with 50 μg/m³ of PM10) will not be exceeded at a majority of German monitoring points if EU, national, and local measures are efficiently implemented. The appropriate indicator for estimation of the necessary compliance extension is the magnitude of the 36th highest daily average of PM10 concentrations. It has been shown that a reduction of PM10 concentrations in the order of 10 μg/m³ is needed at those locations in Germany that currently exceed the limit. The measures needed to achieve a reduction of 10 μg/m³ of PM10 are described. Also, in other Member States with comparable PM concentrations, the same reduction will lead to compliance with the daily limit at a majority of monitoring sites.

If the timeline for compliance is extended, a further weakening of the limit value by increasing the number of permitted exceedance days is not necessary. It is unnecessary, would weaken the level of health protection achieved, and would relieve local authorities from undertaking local measures that they are currently legally obliged to.

It also needs to be mentioned that a compliance extension will not release the Member States from their current legal obligation to carry out measures now if the limits are exceeded. Therefore the reduction potential of local measures is also demonstrated in this paper. Local measures can currently contribute to a reduction of the PM10 annual mean of around 5 μg/m³ at locations with heavy traffic.