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The impact of Euro 5: facts and figures

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Summary

In its recent Euro 5 proposal, the European Commission has made a number of proposals for new emission requirements for passenger cars and light commercial vehicles. From an environmental point of view, the requirements for diesel-powered cars and light commercial vehicles are the most important. Due to the Euro 5 requirements, a particulate filter will be required as standard equipment for such diesel cars and vehicles beginning in 2010. This is a cost-effective measure to reduce the emission of particulate matter. The European Commission has chosen a relatively mild norm for the emission of nitrogen oxides; this was to prevent diesel cars and light commercial vehicles from requiring an NO_x catalyser in addition to the particulate filter. However, the air quality in many European cities would benefit from such a measure. In fact, this would be a cost-effective measure for quickly solving the bottlenecks in urban air quality.

This memorandum contains a brief evaluation of the recent Euro 5 proposal of the European Commission (EC, 2005). Where possible it quantifies the environmental effects and the costs of the Euro 5 emission requirements for the countries in the European Union in general, and specifically for the Netherlands. The evaluation focuses primarily on diesel passenger cars and light commercial vehicles, which in 2004 comprised nearly 50% of new vehicle sales in Europe; from an environmental viewpoint they are the most important.

The proposal

The European Commission recently published a proposal to implement more stringent emission requirements for nitrogen oxides (NO_x), particulate matter (PM_{10}) and Volatile Organic Compounds for passenger cars (see *Table 1*). This so-called Euro 5 proposal is an important instrument to give shape to the European ambitions for improving air quality, such as those that have been published in the Clean Air for Europe Strategy.

Table 1 Euro 4 and Euro 5 emission requirements and the emission requirements in Japan and the United States (COM, 2005)

		Passenger car Petrol		Passenger car diesel		Light commercial vehicles [c]	
		Particulate matter	Nitrogen oxides	Particulate matter	Nitrogen oxides	Particulate matter	Nitrogen oxides
		mg/km					
Euro 4	2005	-	80	25	250	25 / 60	80 / 390
Euro 5	2008/ 2009[a]	5[b]	60	5	200	5	60 / 310
Japan	2009	5	50	5	80	7	50 / 150
USA	2004/ 2009	6	40	6	40	6 / 10	70 / 120

a) Assuming political decision making in 2006.
b) For lean burn direct injection.
c) Low values: light commercial vehicles operating on petrol; high values: heavy commercial vehicles operating on diesel.

Effectiveness of European emission requirements

The instrument of European emission requirements for passenger cars has been effective. Due to the emission requirements, the air pollution caused by road transport in Europe has declined, with the exception of carbon dioxide. This improvement has taken place despite increased transport volumes (*Figure 1*).

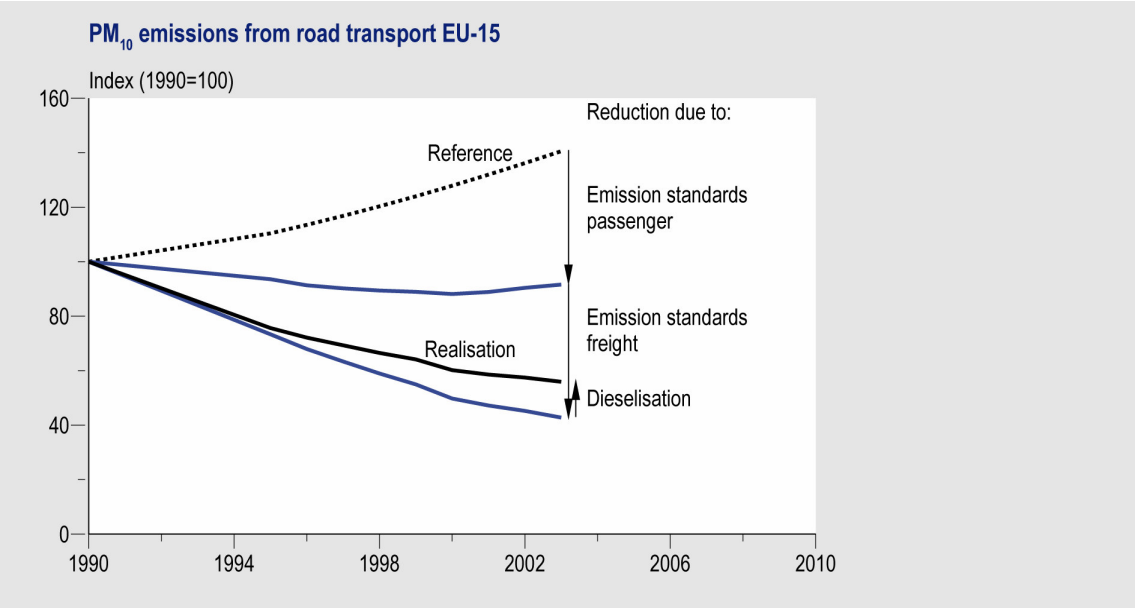

Figure 1 The effect of sequential Euro emission requirements on particulate emissions from road traffic in the EU-15 (Netherlands Environmental Assessment Agency, 2004).

The problem

The air quality in Europe is improving. Nevertheless, in many European cities the limit values for nitrogen dioxide and particulate matter are being exceeded (*Figure 2*). Local road traffic is largely responsible for the exceedances of the limit value for nitrogen dioxide. This usually concerns bottlenecks along highways and in cities, where local traffic can determine up to 55% of the concentration of nitrogen dioxide (EEA, 2006). The contribution of local road traffic to the particulate matter problem is more limited. In this case, the contribution amounts to no more than 25% (EEA, 2006; Buijsman *et al.*, 2005).

Research has shown that there are between 2,300 and 3,500 premature deaths annually in the Netherlands that can be linked with short-term exposure to particulate matter. It is also possible that ten thousand to several tens of thousands of people die approximately ten years prematurely due to long-term exposure to particulate matter (Buijsman *et al.*, 2005; Knol and Staatsen, 2005). In contrast, a direct health effect from the current concentrations of nitrogen dioxide has not been demonstrated. However, nitrogen dioxide is seen as an indicator for hazardous traffic-related emissions (WHO, 2004a, 2004b). Nitrogen also has a eutrophying effect on natural habitats. The share of passenger cars and light commercial vehicles in the total emission of nitrogen (on land and at sea, including ammonia) amounted to 12% in 2000, and with the full implementation of current legislation will decrease to between 5% and 6% (IIASA, 2004).

It is expected that many EU countries will still exceed the limit values for nitrogen dioxide in situations where there is heavy road traffic (EEA, 2006) and will also exceed the NEC ceilings for nitrogen oxides (Entec, 2005). However, the Euro 5 requirements for emissions of nitrogen oxides can make an important contribution to meeting these requirements in the period thereafter: 2010-2020.

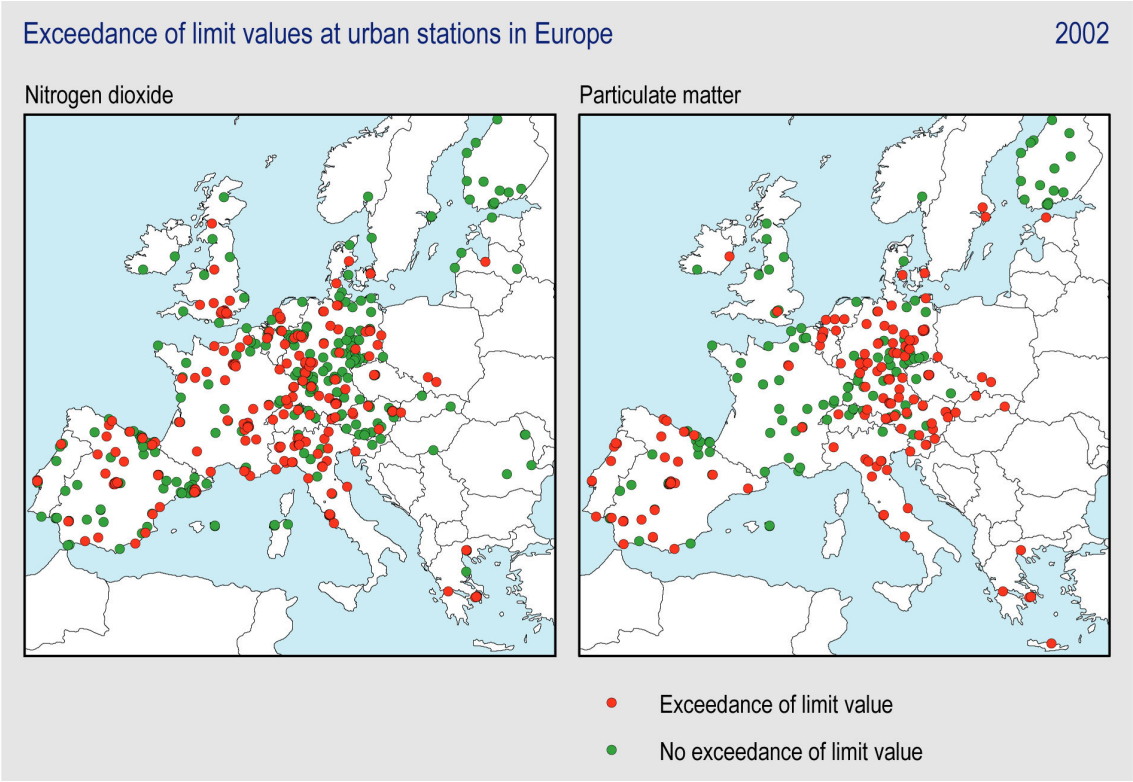

Figure 2 On the left, exceedances of the limit value for the annual average concentration of nitrogen dioxide (40 µg/m³) at urban stations. On the right, exceedances of the limit value for the 24-hour concentration of particulate matter (a maximum of 35 days with a 24-hour average concentration above 50 µg/m³) at urban stations. Data for 2002. Source: AIRBASE.

Evaluation of the Euro 5 proposal

1. *Ambition level of Euro 5*

The more stringent emission requirement for particulate matter proposed in Euro 5 is undisputed and is comparable with requirements that will go into force in Japan and the United States beginning in 2009 (*Table 1*). In contrast, the more stringent emission requirement that is proposed for nitrogen oxides for diesel passenger cars and light commercial vehicles in Euro 5 is disputed (see *textbox: Reactions of stakeholders to the Euro 5 proposal*). In the next section we will therefore explore the impact of a more stringent emission requirement for diesel passenger cars than the one recently proposed by the Commission.

2. *Effect on emissions and air quality*

Particulate matter

The implementation of Euro 5 emission requirements for new passenger cars around 2010 will achieve its maximum effect around 2020. In the Netherlands, this will result in a 2.4 million kg reduction in particulate matter emissions. This is a 50% reduction in the combustion emissions from road traffic. This concerns the health-relevant fraction of particulate matter: particles with a diameter smaller than 2.5 µm. The more stringent emission requirements for particulate matter will lead to a modest decline in the total particulate matter concentration in the air (Hammingh *et al.*, 2005). The European Commission estimates that particulate matter emissions will decline by 26 million kg as a result of the Euro 5 proposals (EC, 2005), which is a decrease of more than 40% of the combustion emissions caused by road traffic.

Reactions from stakeholders to the Euro 5 proposal

- The automobile industry argues in favour of delaying the implementation of the new requirements until between 2010 and 2012.
- The automobile industry endorses the Euro 5 emission requirements for particulate matter.
- Environmental organisations request a much more stringent emission requirement for nitrogen oxides for diesels, comparable to that which is in force in the USA and Japan (40 and 80 mg/km respectively). It must be noted, however, that in the USA and Japan, the share of diesel engines in new sales of vehicles is very small; this is less than 1% in Japan and around 3% in the USA. This makes it easier to propose strict requirements on diesel emissions in these countries.
- The automobile industry – the German automobile industry, which both worldwide and in Europe is the largest producer of diesel passenger cars – does not want any emission requirements for nitrogen oxides on diesel passenger cars that are more stringent than those already proposed. According to the automobile industry, the treatment of diesel exhaust gases, which is required to meet more stringent emission requirements, is not yet ready for the market, will also be too costly and will increase fuel consumption.
- However, manufacturers of catalysers state that such treatment technologies are ready for large-scale application and are already being used for heavy commercial vehicles and European diesel passenger cars that are sold in the United States. The additional costs are estimated at several hundred Euros per car (EC, 2005; Rijkeboer *et al.*, 2003).
- On the basis of data from the British Vehicle Certification Agency, the International Council on Clean Transportation (2005) has shown that virtually all petrol cars, and approximately half of diesel cars that satisfy the Euro 4 emission requirement for nitrogen oxides in the UK, also satisfy the proposed Euro 5 requirements.
- The Dutch government argues in favour of a rapid implementation of a more stringent standard for emissions of nitrogen oxides from diesel passenger cars and light commercial vehicles by making a Euro 6 requirement of 80 mg NO_x/km part of the Euro 5 proposal. This would stimulate and guarantee a more rapid introduction of clean diesel cars and light commercial vehicles.

Source: stakeholder consultation on Euro 5; see http://europa.eu.int.

Nitrogen oxides

The additional emission reduction of nitrogen oxides in the Netherlands resulting from the Euro 5 proposals will amount to 7 million kg in 2020. This is 7% of the emissions from road traffic. With a more stringent norm, for example 150 mg/km, this effect would increase to 14 million kg in 2020. In the European Union as a whole, emissions of nitrogen oxides will decline by 135 million kg due to the Euro 5 proposal (EC, 2005a). This is a reduction of 16% of the emissions from road traffic. With a more stringent norm – such as 150 mg/km – the Europe-wide reduction in 2020 would amount to 270 million kg.

Exceedances of the limit value for the annual average concentration of nitrogen dioxide in urban areas in Europe are closely linked to traffic emissions. Exceedances therefore occur primarily at points with heavy traffic (EEA, 2006). More stringent Euro 5 emissions requirements for nitrogen oxides would then contribute directly to the accelerated solution of these bottlenecks (*Figure 3*). Cars that are currently sold on the European market must satisfy the Euro 4 requirements (light vehicles, beginning in 2005) and the Euro V requirements (heavy vehicles, beginning in 2008. As a result, the air quality in European cities continues to improve (*Figure 3, scenario CLE*). Nevertheless, not all bottlenecks will be eliminated due to these measures. To eliminate all bottlenecks in the future, more stringent emission requirements in the order of a 40%-85% reduction are necessary in relation to Euro 4 and V norms (EEA, 2005; Beck et al., 2005; see also *Figure 3, scenario MFR*).

The urgency of implementing these more stringent requirements is determined primarily by Article 20 of the new Air Quality Directive (EC, 2005b) which stipulates that a maximum extension of five years (until 2015) can be obtained in order to meet the limit values for nitrogen dioxide. To satisfy the provisions in Article 20 within the term provided, a rapid implementation of ambitious Euro 5 norms is required (Hammingh *et al.*, 2005, Beck *et al.*, 2004).

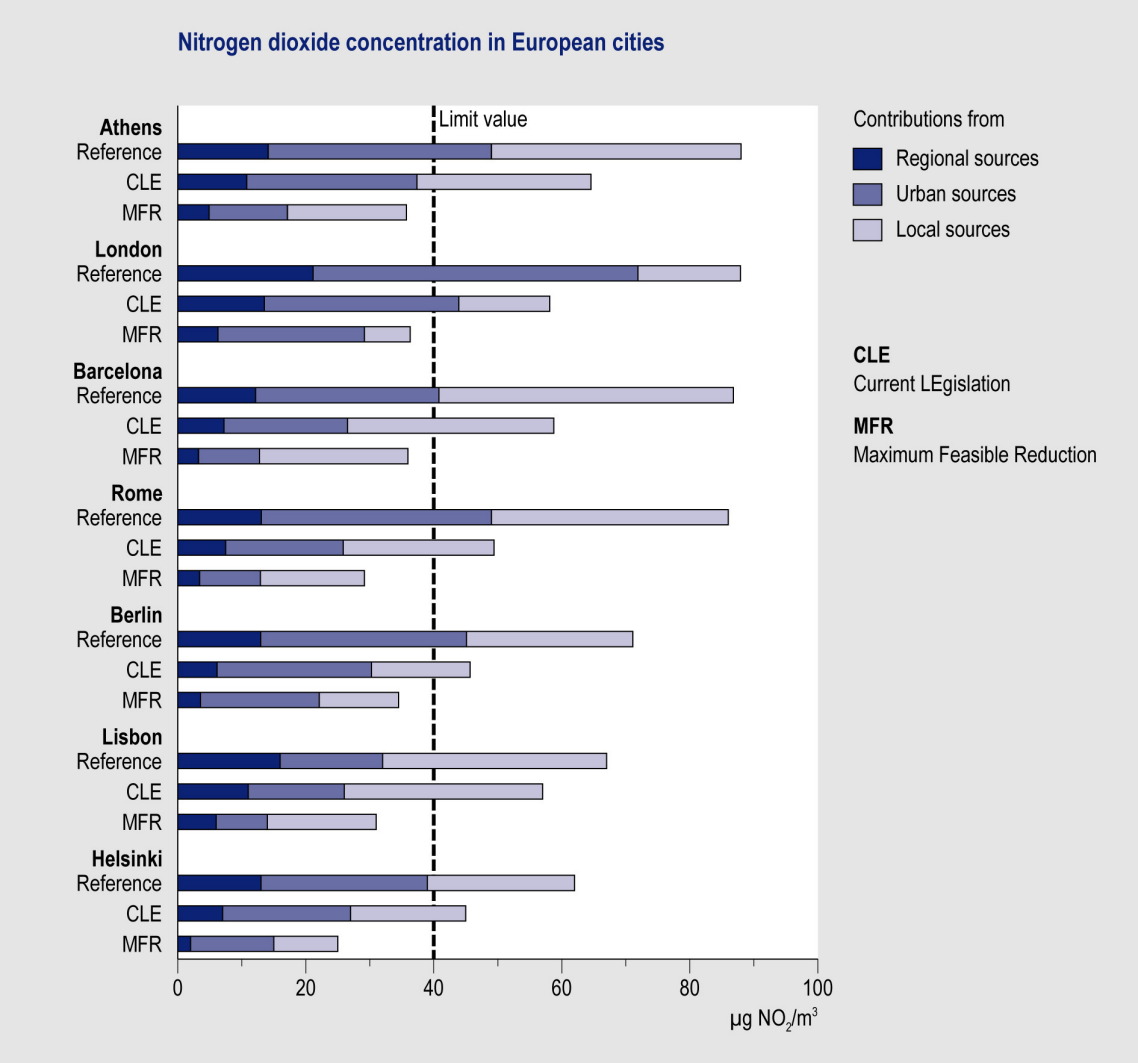

Figure 3 Illustrative results of model calculations for the annual average concentration of nitrogen dioxide in streets with heavy traffic in a number of European cities. REF: model calculations for the year 2000. CLE (Current LEgislation): all vehicles satisfy the Euro 4 (for light vehicles) and Euro V (heavy vehicles) requirements, respectively. MFR (Maximum Feasible Reduction): all vehicles satisfy emission requirements of -40 to - 85% with respect to scenario a. The complete effect of the measures in the scenarios will be reached during the period 2020-2030. Source: EEA, 2006; Cofala et al., 2005.

3. Cost aspects

Particulate matter

The additional costs of a particulate filter, which is required to satisfy the Euro 5 requirements, will be € 350 to € 400 per vehicle. European research into the health hazard of particulate matter emissions caused by traffic has shown that the damage caused by particulate matter, when it is emitted in heavily-populated areas, amounts to € 340/kg. The costs of particulate filters are estimated at € 50 - € 250/kg particulate matter, and are therefore cost effective. In thinly-populated areas the cost effectiveness is not as clear.

Nitrogen oxides

The additional costs of the current Euro 5 proposal are minimal because many vehicles already satisfy this norm (*Table 1*). More stringent requirements for diesel passenger cars and light commercial vehicles – 100 mg/kg for example – will necessitate additional

treatment of the exhaust gasses. The added costs of this treatment are estimated at approximately € 100 - € 300 per vehicle (EC, 2005; Rijkeboer *et al.*, 2003; McDonald, 2004). This amounts to roughly € 3 to € 10 per kg of reduced emissions of nitrogen oxides. Such costs are comparable with the costs of measures in other sectors that are currently being taken to achieve the NEC emission aim for nitrogen oxides for the Netherlands in 2010. These costs amount to € 5 - € 7 per kg (Beck *et al.*, 2004). For alleviating the bottlenecks in urban air quality, road traffic measures are many times more effective than measures in other sectors (Hammingh *et al.*, 2005).

4. Coherence in European policy

The ambitions of the European Commission regarding air quality for the year 2020, as they have recently been published in the thematic strategy for air quality, are coherent with the Euro 5 proposals for particulate matter. However, the recently-proposed Euro 5 requirement for nitrogen oxides will be inadequate in various European cities to meet the limit values for the annual average concentration of nitrogen dioxide in the period 2010-2020 (*Figure 3*).

5. Relationship between Euro 5 and national policy

The Euro 5 proposal and the supplementary national policy concerning air quality are like communicating vessels. As the Euro 5 proposal becomes more ambitious in terms of the year of implementation, emission requirements and so forth, less supplementary national policy will be required to satisfy the statutory demands for air quality in terms of particulate matter and nitrogen dioxide and to meet the NEC emission ceiling for nitrogen oxides. European emission requirements are therefore a cost-effective method to improve national and local air quality, and in this way to satisfy statutory air quality requirements.

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