AERISEUROPE
Air Quality Intelligence

EURO 7/VII UNDER THE MICROSCOPE

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Contents

Euro 7/VII Under the Microscope

Introduction:

Air Quality in European cities continues to be an issue of policy and public concern at European, national and city level. Over the last five years attention has largely focused on non-compliance with the current ambient air quality limits values (AQLV) for nitrogen dioxide (NO_2). However, since the European Commission's revision of the EU Ambient Air Quality Directive (AAQD) now aims to reduce the permitted concentrations of other specific pollutants (e.g., $PM_{2.5}$, PM_{10} and Ozone) towards the WHO guidelines[1,2] this is likely to increase the pressure to reduce emissions from those sources that are believed to be major contributors to non-compliance.

The European Commission have started to prepare draft regulatory proposals for the next iteration of vehicle emission standards. To assist in the formulation of these Euro 7/VII proposals, the Commission contracted members of CLOVE (Consortium for Ultra Low Vehicle Emissions) to conduct a series of studies.

In response to this and as a contribution to an evidence based further understanding, ACEA commissioned Aeris to undertake a series of independent studies[3,4,5,6,7]. Each study was designed to put the contribution of road transport emissions into a Europe-wide context by examining the impact on urban air quality that currently mandated emission reduction measures from all contributing sectors would achieve. The studies also explored the impact of fleet change to zero-emission vehicles (ZEV) dictated by future new vehicle CO_2 fleet targets. The studies also undertook a detailed assessment of what a further tightening of Euro standards, including a range of hypothetical 'Euro 7/VII' emission limits, could contribute to the improvement of air quality, compared to other available actions, such as old vehicle scrappage schemes. While a major focus of these studies was NO_2, given the probable tightening of AQLVs for $PM_{2.5}$, PM_{10} and ozone, the impact on these additional pollutants were also assessed to put the contribution of EU road transport emissions (and their further reduction) into an overall EU air quality perspective.

In this paper we bring the key findings of these studies together and examine them through the lens of the overall European Air Quality policy making process, including the consistent application of the Principle of Proportionality enshrined in the EU Treaty itself. Hence the title, "Euro 7/VII under the microscope".

[1] (WHO, 2005) *WHO Air quality guidelines for particulate matter, ozone, nitrogen dioxide and sulfur dioxide*

[2] At the time of writing this paper, the new WHO guidelines (WHO 2021) had not yet been published so their implications are not explored.

[3] (Aeris Europe Limited, 2021) *Euro 7 Impact Assessment: The outlook for air quality compliance in the EU and the role of the road transport sector.*

[4] (Aeris Europe Limited, 2021) *Euro 7 Impact Assessment: The outlook for air quality compliance in the EU and the role of the road transport sector – Nitrogen Dioxide Supplement*

[5] (Aeris Europe Limited, 2021) *Euro 7 Impact Assessment: The outlook for air quality compliance in the EU and the role of the road transport sector - Ozone supplement*

[6] (Aeris Europe Limited, 2021) *Euro 7 Impact Assessment: The outlook for air quality compliance in the EU and the role of the road transport sector- Particulates Supplement*

[7] (Aeris Europe Limited, 2021) *Cost-Benefit Analysis of a range of Euro7/VII scenarios and pre-Euro 6/VI scrappage scenarios*

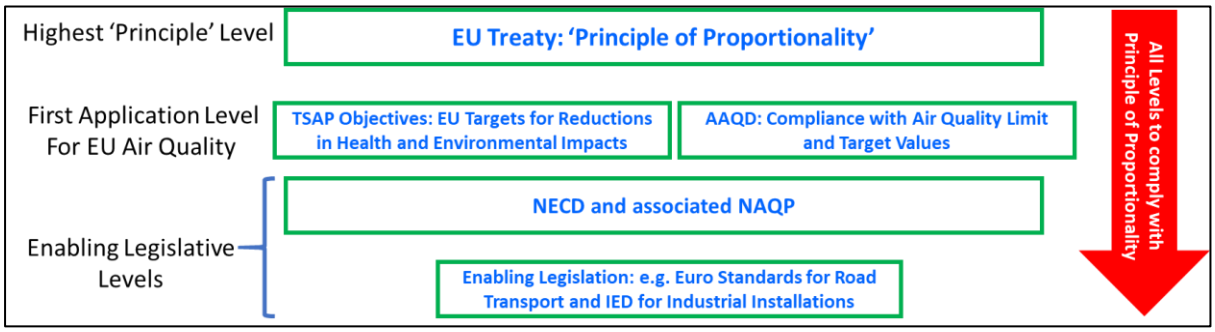
The Overall European Air Quality Policy Making Process:

At the outset, it is important to understand the overall process of European Air Quality policy making. In a somewhat simplified form, this is depicted in **Figure 1** below.

The EU Treaty and the Principle of Proportionality:

All EU legislative processes must necessarily flow out of the principles set forth in the EU Treaty itself. In this regard, a requirement which needs to be met at all levels of policy making, is the so-called 'Principle of Proportionality' [8]. According to the European Court of Justice (ECJ) case law, the Principle of Proportionality requires *"that measures taken by the Community institutions should be appropriate to achieve the objective pursued without going beyond what is necessary to that end."*[9] There are two important parts to this statement: (1) The 'objective to be pursued' and (2) the phrase 'without going beyond what is necessary to that end'.

Figure 1: The Relationship Between Overarching EU Legislative Instruments and Enabling Legislation for Emission to Air



The objective(s) to be pursued:

In the particular case of air quality and the setting of objectives there are two main EU Legislative Instruments (see the first application level of Figure 1): The Ambient Air Quality Directive (AAQD) and the Thematic Strategy on Air Pollution (TSAP). In each case, these set forth air quality objectives for the EU to be achieved by a given date in time.

The TSAP Objectives: In the case of the TSAP, these are overall EU-wide objectives expressed as percentage reductions in the health impacts (e.g., Years Of statistical Life Lost over the EU population) and percentage reductions in environmental impacts (e.g., Area of EU ecosystems exceeding their critical loads) from a reference year (e.g., 2005) to a policy target year (e.g., 2030). The main enabling legislative instruments to meet these objectives are the National Emission Ceilings Directive (NECD) together with more sectorally specific, targeted instruments e.g., Euro standards for Road Transport and the Industrial Emissions Directive (IED).

In the case of the NECD, the individual ceilings, by Member State and pollutant, are allocated on the basis of achieving the TSAP objectives for the EU in the most cost-effective way (based on the IIASA GAINS model), thus aligning this enabling legislative instrument with the principle of proportionality. Furthermore, with a view to better aligning the NECD objectives with the objectives of the AAQD, the current NECD includes the requirement for individual Member

[8] See Treaty on the Functioning of the European Union, Protocol (No 2) on the application of the principles of subsidiarity and proportionality, Article 5.

[9] ECJ, judgement of 9.8.94, Case C-359/92, Germany v. Council, (1994) ECR I- 2681, par. 44

States to sectorally allocate their overall ceilings reduction obligations in a way that best serves the goal of meeting the mandated AQLVs[10].

The AAQD Objectives: In the case of the AAQD, these objectives are in the form of binding Ambient Air Quality Limit Values (AQLVs) or aspirational (i.e., non-binding) Air Quality Target Values (AQTVs). In each case, they are based on the process undertaken by the World Health Organisation (WHO), that includes evidence based risk assessment. The results of the WHO work are published in their 'Air Quality Guidelines for Europe'[11].

In the context of overall EU Air Quality policy making, it is important to understand that the WHO Air Quality Guidelines form only the starting point for establishing binding AQLVs or aspirational AQTVs under the AAQD, a process involving a subsequent and separate Risk Management step at EU level.

The WHO, in its 2005 guidelines, clearly recognised that risk assessment is, by its very nature, a 'single issue' focused, therefore a subsequent and separate 'risk management' process is required to account for the other important factors in our 'multi-risk' world. Here is a quote from the preface to those guidelines:

'It should be emphasised, however, that the guidelines are health-based or based on environmental effects, and are not standards per se. In setting legally binding standards, considerations such as prevailing exposure levels, technical feasibility, source control measures, abatement strategies, and social, economic and cultural conditions should be taken into account.'[12]

It is vital that we understand the importance of what the WHO is saying here. Their guidance is based on a 'risk assessment' of a given pollutant. As such it provides important data on the relationship between exposure level and risk. However, in taking these data forward to the establishment of binding limit values, many other practical and societal factors need to be accounted for. It is interesting to note that among these the WHO themselves recognise the importance of economic factors[13].

One response to this has been the growing use of Cost-Benefit Analyses (CBA) which incorporates methodologies that monetise the health benefits[14]. Here, if the monetised benefits equal or exceed the cost of the measure(s) required to deliver them, then in principle the measure(s) would be justified. We will look at application of this approach in addressing the question of whether a Euro 7/VII step would be justified in more detail later in this report. Before then, it is worth making just one important, policy relevant point regarding its current usage.

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[10] (European Commission, 2016) *Directive (EU) 2016/2284 – reduction of national emissions of certain atmospheric pollutants.* (Note: Importantly, this capacity to sectorally allocate ceilings cannot be applied to the road transport sector.)

[11] (WHO, 2005) *WHO Air quality guidelines for particulate matter, ozone, nitrogen dioxide and sulfur dioxide*
(WHO, 2021) *WHO global air quality guidelines: particulate matter (PM2.5 and PM10), ozone, nitrogen dioxide, sulfur dioxide and carbon monoxide*

[12] Preface to (WHO, 2000) *Air Quality Guidelines for Europe, Second Edition, European Series No.91*

[13] At the time of writing this paper, the new WHO guidelines (WHO 2021) had not yet been published so their implications are not explored here. However, prior to going to print they were published and, in a 'first look', it is highly disappointing to observe that the importance of a subsequent 'Risk Management' step in the setting of binding Air Quality Limit values is no longer emphasised.

[14] In the case of reduced statistical life expectancy (the dominant component of monetised health benefits), monetisation is based on so-called 'Willingness To Pay' (WTP) surveys of 'a representative' group of participants. The individual responses to the survey typically vary by some three orders of magnitudes and tend to be skewed toward the lower end of the range of expressed values i.e., the median value is typically at half the mean value.

By its very nature, CBA is 'single issue' focused and therefore does not address the key policy relevant question of whether greater benefit would derive from spending this money on a different societal risk. In light of the multiplicity of problems facing society, without such a consideration, how is the legislator to fulfil his responsibility to ensure that societal monies are spent in a way that maximises the overall health/environmental benefit to society? Such considerations are surely aligned with the Proportionality Principle.

Binding AQLVs and Enabling Legislation: Whether or not a subsequent and separate Risk Management process (as recommended by the WHO) underpins the AQLVs mandated in the AAQD or they are informed by CBA analysis, in each case **they are the EU Legislators final and binding view on the appropriate level of managing the particular risk associated with exposure to that particular pollutant while the legislative instrument remains in force.** Despite this, there was much discussion during the AGVES meetings over the relationship between compliance with AQLVs and the justification for the introduction of Euro 7/VII emission standards.

While some stakeholders, in the writer's view rightly, see that this linkage is central and vital to an evidence based assessment of the justification for a Euro 7/VII step; other stakeholders have gone as far as suggesting compliance with current or even future AQLVs should be decoupled from the justification for tougher Euro limits.

Into this diversity of views, we surely need bring the clarifying light of the Treaty's 'Proportionality Principle' i.e*., 'that measures taken by the Community institutions should be appropriate to achieve the objective pursued without going beyond what is necessary to that end*'.

The objective pursued, in the context of air quality legislation, is of course compliance with the AQLVs or progress towards achieving them through the enabling legislated emission reduction instruments. The measures taken therefore need to be those required to achieve compliance '*without going beyond what is required to that end*'. The words 'without going beyond what is required to that end' should have profound implications regarding the justification for further action in the air quality arena. **If the binding air quality limit values to be met at urban air quality monitoring sites, as mandated in EU legislation (the Objectives), are achieved by already mandated legislation or by other already implemented measures, or certain further measures are demonstrated to have no negligible impact on compliance, how can such further measures be justified under this stipulation in the Treaty itself? Of course, if 'the Objectives' change (e.g., tougher AQLVs or compliance requirements in a revised AAQD) then further measures across all sectors to meet the revised objectives are likely to be required and those measures should themselves be determined according to the principle of proportionality to achieve the required result.**

In the light of this, it is now appropriate to summarise the finding of the Urban Air Quality study undertaken by Aeris.

Euro 7/VII Under the Air Quality Compliance Lens:

The results of Aeris UAQ study demonstrate that the currently mandated (Base Case) measures (i.e., Euro 6d for light-duty vehicles and Euro VI (step D/E) for heavy-duty vehicles) will bring about widespread compliance with the current NO_2 and $PM_{2.5}$ air quality limit values by 2025. By this horizon year, annual mean compliance is forecast to be achieved in 98.6% of

EU[15] NO_2 urban monitoring stations and 99.2% of EU $PM_{2.5}$ urban monitoring stations. By the horizon year of 2030, currently mandated measures are predicted to achieve compliance with both the NO_2 and $PM_{2.5}$ annual mean limit values in 99.5% of EU urban monitoring stations **Furthermore, the study found that all of the 'beyond the baseline road transport scenarios'[16] explored have negligible additional impact on the base case compliance picture. This remains the case even if the current $PM_{2.5}$ annual mean limit value were to be reduced to the WHO guide value of 10µg/m^3.**

Moreover, if further reductions in concentration of key air pollutants are to be realised, then the results of the Aeris study indicate that the most effective strategy would be to target those sectors that are demonstrated to have the greatest scope for reduction, for example domestic and commercial combustion (NO_2 and $PM_{2.5}$) or agriculture ($PM_{2.5}$ secondary).

Furthermore, since the remaining areas of NO_2 and $PM_{2.5}$ non-compliance are limited to a very small number of air quality monitoring stations (less than 0.5% in 2030), achieving compliance in these instances would be more effectively realised by introducing local measures that target the specific contributors to non-compliance at these geographically limited areas. **None of the modelling in the Aeris study suggests that any further European-wide measures for road transport are warranted to achieve compliance with the currently legislated AQLVs**.[17]

In the specific case of urban ozone, the Aeris study results indicate that widespread non-attainment of the target values in the current Ambient Air Quality Directive (AAQD)[i] will continue out to 2035. The study also shows that the magnitude and extent of this non-attainment increases significantly if the lower threshold[18] in the current WHO guidelines is applied. **However, the effect of reducing road transport emissions beyond that achieved in the Base Case does not improve the ozone attainment situation in urban areas**.

On the contrary, the reduced availability of nitric oxide (NO) from further reductions in NO_X emissions from road transport, in a number of the cities studied, was found to result in an increase in ozone levels and non-attainment from decreased ozone titration. This ozone response to NO_X emission reductions creates an 'environmental tension' since reductions in NO_X designed to reduce NO_2 health impacts results in increased ozone health impacts in such cities. This suggests targeted, city specific measures, rather than introduction of tougher EU-wide NO_X emission limits would be a wiser route to address the diminishingly small residual 'islands of NO_2 non-compliance'

What the above clearly demonstrates is: Under the 'Air Quality Compliance Lens', Euro 7/VII is not seen as a currently justified step and certainly would not meet the 'Principle of Proportionality' enshrined in the EU Treaty.

[15] Including the UK

[16] Including a zero NO_X emission limit case for Diesel Passenger Cars

[17] For Air Quality Limit Values see Appendix 1

[18] The current Ambient Air Quality Directive includes a target value for the maximum number of ozone exceedance days above a threshold of 120µg/m3 in a year. However, the 2015 WHO Air Quality Guidelines reduced the threshold to 100 µg/m3. At the same level of ozone at each of the EU monitoring station, such a lowering of the threshold, as demonstrated in the Aeris Urban Air Quality Study, substantially increases non-compliance with the current target value.

Euro 7/VII Under the CBA Lens:

While noting the importance of the problem of CBA being 'single issue focussed' as discussed earlier in this paper, we nevertheless now turn to the question of whether the air quality related benefits of a possible Euro 7/VII step provide a 'CBA based' justification for its introduction.

The CBA study undertaken by Aeris examined the cost benefit aspects of the various Euro 7/VII scenarios considered in the Urban Air Quality study as well as some additional scenarios, including early replacement of pre-Euro 6/VI vehicles. The methodology used to undertake the cost-benefit analysis was based on the EU Commission's 'Handbook on the external costs of transport'[19]. While Aeris have a number of reservations regarding the Handbook[20], its methodology was adopted in this study to ensure alignment with the CBA work which we understand is being undertaken by the CLOVE consortium and the European Commission in preparing the necessary impact assessment to justify any regulatory proposals.

One key Heavy-Duty Euro VII Scenario under the CBA lens: To date, there are limited data available on the actual costs of achieving 'beyond Euro VI' emissions limits (i.e., achieving the limits adopted in the scenarios considered in the Aeris CBA study). However, ICCT[21] have recently published the results of a study which explored the cost implications for alternative technology configurations designed to meet the CLOVE consortium's proposal as presented at the April 2021 AGVES meeting.[22] While the CLOVE consortium proposed a range of limits, including a 90th percentile limit of 90mgNO_X/kWh at end-April 2021, ICCT chose to assess an even lower NO_X limit at 80mgNO_X/kWh. To achieve this, ICCT report a technology cost range of €1500 to €4700 in 2025 and €1400 to €4300 in 2030.

The Aeris CBA study indicates that the 'NO_X Benefit Supported' cost increase per vehicle in moving from the current Euro VI NO_X emission limit of 460mg/kWh to the ICCT scenario (i.e., 80mgNO_X/kWh), averaged over all Heavy Duty vehicle classes, is €947. This represents the benefits supported cost increase for a single step from Euro VI to the 80mgNOx/kWh emission limit case. Comparing this value with ICCT's cost range of €1500 to €4700 in 2025 suggests, at least at an indicative level, that **the actual costs would range from 1.6 to 5 times the benefits i.e., the benefits would not support the costs involved, even if the emission limit of 80mg/kWh would be technically feasible and achieved with the simpler (lower cost) configuration considered by ICCT.**

Moreover, based on the results of the range of 'beyond Euro VII' scenarios explored in the Aeris study, if detailed actual cost data were available for the incremental steps considered in this study, it is clear that the incremental costs for the more stringent Euro VII steps would be even less supported by the incremental NO_X related benefits.

What the above clearly demonstrates is: Under the 'Cost Benefit Analysis Lens', the Euro VII steps currently under consideration by the CLOVE consortium are clearly not seen as justified and would not meet the 'Principle of Proportionality' enshrined in the EU Treaty.

[19] (European Commission, 2019) *Handbook on the external costs of transport*

[20] These reservations include the assumptions regarding the concentration-response relationship for direct mortality effects of Nitrogen dioxide and the assumed value for a 'life-year lost' (VOLY)

[21] International Council on Clean Transportation

[22] (International Council on Clean Transportation, 2021) *Estimated cost of diesel emissions control technology to meet future Euro VII standards*

One Euro 7 Passenger Car Scenario under the CBA Lens: The results of the Aeris study[23] indicate that the NO_X benefits for a diesel passenger car going from Euro 6d (80mgNOx/km) to a Euro 7 NOx limit of 35mg/km would support an increase in the new vehicle cost (above Euro 6d) of €126 and the corresponding figure for a petrol passenger car (Euro 6d limit 60mgNOx/km) would be €21. Although actual data for the increases in the cost/vehicle to achieve 35mgNOx/km are not presently available, it is highly unlikely that the limited benefits above would justify these costs.

A Better Way:

The compelling case of early replacement of pre-Euro VI HDV with new Euro VI vehicles: All three of the early replacement of pre-Euro VI scenarios explored in the Aeris CBA study (i.e. Euro III, IV and V early replacement) indicate that, on an individual vehicle basis, the resulting benefits (NO_X plus PM) for early replacement of pre-Euro VI vehicles range from some €4,900/replaced vehicle (Euro III with only three years of remaining life) to more than €16,000/replaced vehicle (Euro V with fifteen years of remaining life). These are compelling numbers: **Compared to any of the Euro VII scenarios (including the zero emission limit case), early replacement of pre-Euro VI vehicles offers more than ten times the benefit/vehicle and would deliver immediate, air quality related, benefits for society at large.**

Early replacement of pre-Euro 6 passenger cars with the latest new Euro 6d vehicles: In the case of diesel but particularly in the case of gasoline vehicles, the 'Benefits Supported' incentives for the early replacement of a pre-Euro 6 passenger car with a new Euro 6d vehicle were found to fall well short of the incentives required to attract a vehicle owner to take up an early replacement scheme.

[23] Averaged over the three COPERT classes and for an assumed average vehicle life of ten years

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Appendix 1

EU Ambient Air Quality Limit Values

Pollutant	Frequency	Value ($\mu g/m^3$)	Allowed Exceedances
Nitrogen Dioxide (NO_2)	Hourly Exceedance	200	18
Nitrogen Dioxide (NO_2)	Annual Mean	40	0
Particulate Matter ($PM_{2.5}$)	Annual Mean	25	0
Particulate Matter (PM_{10})	Daily Exceedance	50	35
Particulate Matter (PM_{10})	Annual Mean	40	0