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Evaluation of the Directive 2008/50/EC on Ambient Air Quality

An analysis of the intervention of the European Union on ambient air quality since 2008 with a specific focus on its effectiveness, efficiencycoherence, relevance, and EU added value.

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ABSTRACT

The EU Directive 2008/50/EC on Ambient Air Quality and Cleaner Air for Europe is one of the actions taken at the European Levelto reach sustainable air quality levels that do not threaten the Environment and EU citizens across EU Member States. After over 10 years, it was considered appropriate to evaluate the EU intervention with the aim to comment, on its shortcomings and to provide policy recommendations. According to the EU "better regulation guidelines", every assessment should use the evaluation criteria framework and investigate five main aspects of the intervention, namely effectiveness, efficiency, coherence, relevance and EU added value. Although this framework must guide every evaluation, the level of investigation implemented for each of the five criteria stills depends on the initiative being assessed, as well as the timing and data reliability. The analysis of the five criteria demonstrated a solid difficulty in implementing EU-wide measures to improve air quality. Although there's no doubt about the relevance, cohesion and EU-added value aspects of the Directive, its efficiency and effectiveness can be debated.

1. Environmental problem definition

The Intergovernmental Panel on Climate Change (IPCC) has produced reliable evidence indicating that the planet is on the brink of an unprecedented environmental crisis. Exponential anthropogenic Greenhouse Gas (GHG) emissions became relevant for addressing air pollutants, not only due to its impact on air quality levels, but also because some air pollutants contribute to the emission of greenhouse gases (IPCC, 2014). According to the IPCC Climate Report 2018, establishing a 1.5 °C increase limit of global warming would demand fast and unprecedented changes in all types of social activities (IPCC, 2018). Weather-related changes, such as increasing numbers of heat waves lead to fresh air shortage and decreasing air circulation, especially in large cities, which contributes to the accumulation of pollutants in the air (WHO, 2017). On the other hand, some air pollutants directly impact anthropogenic induced change in climate. Short-lived pollutants (SCLPs), such as black carbon can deposit on ice and snow, causes local warming and fastens the melting of ice.

The effects of massive contamination of the atmosphere by harmful gases have long been analyzed and there are almost no disagreements on the negative consequences for the global environment, biodiversity, ecosystems as well as the acidification of fertile soils (Paoletti et al., 2010). There's also no skepticism on the effect these may have on human health, with growing numbers of cases of respiratory diseases, allergies, greater cancer incidences as well as effects on the nervous system and high mortality rates (Svartengren, Strand, Bylin, Jarup, & Pershagen, 2000; Brunekreef & Holgate, 2002; Lv, Huang, Li, Yang, & Sun, 2011). Ensuring clean air is, therefore, a major governance challenge for decision makers all over the globe. Air quality legislations are aimed at ensuring that concentrations of harmful substances stay below a maximum permitted level (MPL), which requires monitoring practices for it to be assessed.

Within the European Union (EU) intervention, the European Commission (EC) has the authority to propose environmental policies as part of the policy cycle. Once a topic is defined as of public interest, it is included on the agenda. The EC proposes a policy package to the Parliament and the Council of Ministers, which is then further discussed as part of the overall decision-making process. Due to the well-established "trilogue" structure, a wide range of environmental topics can be addressed within a crosscutting scope (Jordan & Adelle, 2012).

The European Union acknowledges the importance of high clean air for health and to the environment. Since the industrial revolution, the continent experienced a considerable decrease of the quality of the air. This human-induced deterioration, mostly due to an acceleration of industrial activities and fossil-based energy production, as well as a strong increase in car traffic directly contributes to the problem. The last 20 years witnessed increasing awareness and efforts towards solving the problem, which led to dropping the emission values of, for instance, SO2 in Europe and US (Ritchie & Roser, 2017). This shows

the improving efforts of the nations and emphasizes the need for common standards and guidelines to support the transition.

The EU Directive 2008/50/EC on Ambient Air Quality and Cleaner Air for Europe is one of the actions taken at the European Level. It recognizes the "need to reduce pollution to levels which minimize harmful effects on human health, paying particular attention to sensitive populations, and the environment as a whole, to improve the monitoring and assessment of air quality including the deposition of pollutants and to provide information to the public," (EC, 2018).

The Directive intends to reach sustainable air quality levels that do not threaten the Environment and EU citizens across EU Member States (MS). The main intention of this directive is to replace both the three out of four previously implemented (daughter-)directives and the directive 96/62/EG, the foundation for the four (daughter-) directives and the strategy for clean air (Sirini, 2009). The first directive, 1999/30/EG, was introduced to set limit values for SO2, NO2, NOx, PM10, and lead in the air. Directive 2000/69/EG puts specific limit on benzene and carbon monoxide. The directive 2002/3/EC establishes long-term objectives, target values, an alert threshold and an information threshold for concentrations of ozone in ambient air (European Commission, 2017a). The fourth directive 2004/107/EG, which was not part of the directive 2008/50/EC, sets limit values for the concentration of arsenic, cadmium, quicksilver, nickel and polycentric aromatized hydrocarbon.

In addition to bringing previous directives together, the directive 2008/50/EC sets a new limit value for Particulate Matter (PM) with a diameter of 2.5 or smaller and gives the mandate to national governments to take measures when limits are exceeded. The limit values resulting from the directive must be transported into national law within the countries and are shown in Appendix 1. Other elements of the directive are the possibility to discount natural sources of pollution when assessing compliance against limit values and the possibility for time extensions of three years (PM10) or up to five years (NO2, benzene) for complying with limit values.

The air quality legislation at the EU level was designed based on the following core aspects. Member States have to design and divide their territories into different zones. Then, within these areas, each country should measure the levels of pollution using established models and techniques and to communicate the results to the European Commission. In the areas where the air quality levels are below the established limits, the responsible Member State is expected to design and implement strategic actions to tackle the main sources of pollution before the deadline of the related measured period. In addition, air quality information should be made available to the public.

After over 10 years of implementation of the EU Directive 2008/50/EC framework, it was considered appropriate to evaluate the EU intervention with the aim to comment, on its shortcomings and to provide policy recommendations. These are, therefore, the main goals of the present paper.

2. Intervention logic approach

The European Union is considered the largest supranational body in the globe and is mandated with extensive powers in terms of policy making for environmental topics by its 28 Member States. The EU environmental governance, including air quality policies, implements 'top-down' decision- making processes using its authority, which was transferred by Members States via the Treaty of Lisbon. Although only some competences are transferred to the EU and the sovereignty remains with the Member States, air quality governance is still exercised hierarchically through the establishment of command-and-control chains. In hierarchical governance, power is employed through the development of regulations and subsequent monitoring, reporting as well as potential sanctions. In the case of the EU Air Quality Directive, for instance, in 2015 the EC referred Belgium and Bulgaria to the EU Court of Justice for persistently high levels of the dust particles in the air, which posed a threat to public health (European Commission, 2015).

The directives can be monitored by an intervention logic, which is implemented by the European Union and considers several aspects. For instance, it assesses how the involved sectors were expected to respond to a policy change as well as the expected measures motivated by the EU intervention, and the expected interactions between actors and actions in order to achieve the policy objective. Traditionally, the EU intervention analysis considers the following categories: needs; objectives; inputs; activities; outputs; results; impacts, external factors; other EU policies. The intervention is illustrated in the figure below where the arrows represent the causal interactions between the boxes.

The EU "better regulation guidelines" outline the main general principles that the European Commission staff must consider at the designing phase of new initiatives and policies as well as at the management and evaluations steps of the legislation in place. These principles serve as a basis for all phases of the EU law-making cycle (European Commission, 2017b).

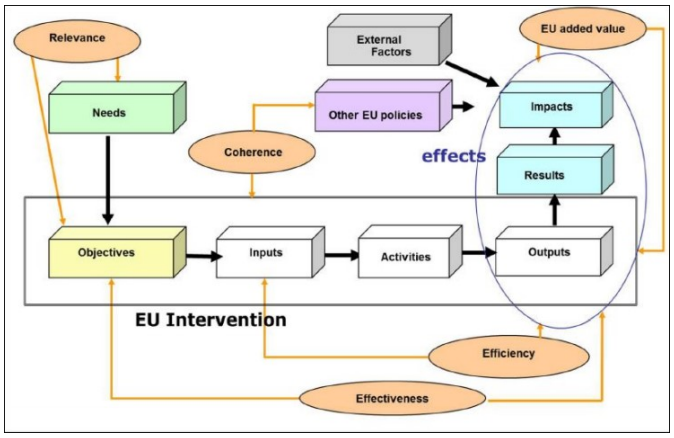

Figure 1: EU intervention (EC, 2017)

According to the guidelines, every assessment should use the evaluation criteria framework illustrated in figure 1 and investigate five main aspects of the intervention, namely effectiveness, efficiency, coherence, relevance and EU added value. Although this framework must guide every evaluation, the level of investigation implemented for each of the five criteria stills depends on the initiative being assessed, as well as the timing and data reliability. A brief explanation on each criterion is presented below:

- Effectiveness: involves analyzing the level of success of the implemented actions when it comes to achieving or progressing towards the planned objectives.
- Efficiency: reflects the nexus between the main resources used by an intervention and the positive or negative changes achieved.
- Relevance: considers the relationship between the societal needs and the main design aspects of the objectives of the intervention.
- Coherence: looks at the implementation harmony of different planned measures.

EU added-value considers the changes achieved by the planned measures that can be understood as a direct outcome of the EU intervention in place and, at the same time, argued that the achieved impact could not be accomplished only via national actions by Member States. The Commission uses an evaluation as a tool to study about the particularities and performances of its interventions as well as to compare its actual performance with the expected results. It serves to critically assess whether the implemented actions are in line with their initial purposes and if they are expected to achieve its main objectives with minimal costs.

The EC guidelines for evaluation present the task as an exercise going beyond an assessment of what has happened, looking into the main reasons behind an incidence and, if possible, the extension of the change it generated as a consequence. Furthermore, EC evaluations investigate evidences of causality. They assess relations of the identified changes and the intervention itself. Therefore, the passage of sufficient time is required for an evaluation to be successfully implemented.

Also, the Commission usually collects enough and varied evidence to serve as basis for solid evaluations. These usually take the format of reports, monitoring exercises, public consultations audits or costs assessments, which are all combined to contribute to the overall evaluation. This paper uses the official EC evaluation framework (Figure 1) with the aim to conduct an assessment based on the key criteria recognized by the Commission as essential factors that should be considered in the implementation cycle of every European directive. The present evaluation is to be considered as part of the usual comprehensive analysis conducted by the EC, as it is done independently and only includes information and data from reports that are publicly available.

3. Methodology

The intervention logic from the guidelines of the EU, explained in the previous chapter, will be used in this paper to assess the EU Directive 2008/50/EC as it's considered the most appropriate and used causality framework to analyze clean air policies implemented by the EU. This policy intervention helps to identify the main objectives of the directive which are analyzed and explained via five different evaluation categories previously explained namely relevance, effectiveness, coherence, efficiency and EU added value (European Commission, 2017c, 2017b). The intervention logic is widely used and accepted across the hierarchical structure of the European Union. Therefore, it served as a framework for evaluating the directive. Figure 2 reflects the framework used, which was built on the presented EU intervention logic.

The EU Intervention on ambient air quality considers both effects on human health and the environment as a whole. Using the EU Directive 2008/50/EC as a foundation, it is assumed that the main objective can be categorized in four different topics, which can be seen in figure 2. The first category (A), highlighted with a green color, addresses limit values to reduce pollution and maintain the air quality in areas where the air is deemed harmless to human health and the environment. The activities to achieve that objective address different sectors as the source of the pollution. The expected result of the objective is better standards for both the environment and human health. The second category (B), indicated in yellow, addresses measures taken to improve air quality and monitoring conducted to assess air quality. This identified

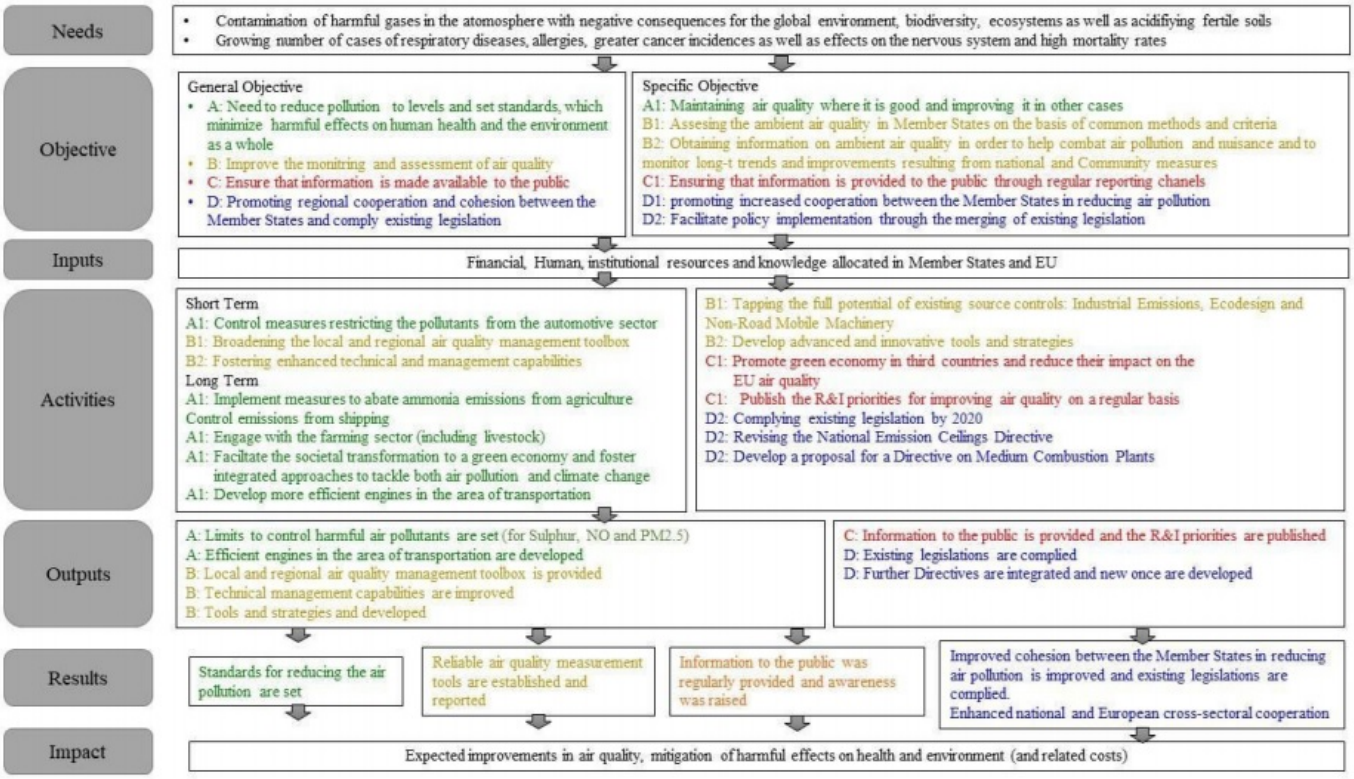

Figure 2: Intervention logic approach on Ambient Air Quality

objective highlights the importance of legitimate and valid data collected by the Member States to enable a comparison of performances both within a country during a certain time period and within international boundaries. Coherent and standardized measures have to been taken as long as comparisons can be made. The third category (C), shown in red, is assigned to the civil society and the information provided to the public. The last category (D), whose topics are colored in blue, is the integration of this directive into other directives. Those four topics will be analyzed in the aspect of the five criteria of the intervention logic.

4. Assessment of the five key criteria

There are five key criteria used to evaluate the different steps of the ambient air quality intervention. They are relevance, effectiveness, cohesion, efficiency and EU added value. Each of these is described in this section. The five key criteria help to analyze if the chosen four main categories A, B, C and D, explained in the previous chapter, are being addressed and implemented. An in-depth analysis of all categories for each key criterion would exceed the feasibility and available timing to finalize the study. Therefore, only the essential aspects are analyzed and outlined in this chapter.

4.1 Relevance

The relevance of the objective on ambient air quality is difficult to assess because the directive was initiated in 2008 and will be in place until 2020. Since policies are still in the implementation stage, only preliminary assessments about the change of relevance are possible at this moment. Once the intervention is concluded, it will be possible to make firm statements on whether the intervention has relevance.

Air pollution is seen as the largest single environmental risk for health, recognized in May 2015 by the World Health Assembly (WHA) resolution (WHO, 2017). The pollutant concentration has been reduced over the last decade, but it still is at such high levels that it causes harm to human health and ecosystems. The strongest negative effects such as premature mortality and increased morbidity, remain still mainly in urban areas, where the majority of the European citizens live (Guerreiro, et.al., 2014). The number of people exposed to air pollutants is even higher if we compare the standards of the air quality directive with the more stringent one of the World Health Organization (WHO) air quality guideline values set for the protection of human health and which are also considered in the directive for ambient air quality. For PM2.5, 7-8% of the urban population was exposed to higher concentrations than the limits set by the EU. If we compare this with the standards

of WHO, 82- 85% was exposed to concentrations above the guideline's values. This highlights the continuing relevance for all categories since the target values are still far from the current state (European Environment Agency, 2017a).

4.2 Effectiveness

One component that differentiates the directive on ambient air quality from others is that in article 22 of the directive the member states have the possibility to postpone the attainment of deadlines. However, the extension of the deadlines is restricted to certain conditions the Member States have to meet before the EU approves the postponement. The postponement of limit values refers to the pollutants nitrogen dioxide, benzene or to particulate matter (PM10), whereby the extended deadline for nitrogen dioxide and benzene was from January 2010 to January 2015 and for PM10 the limit value applied for a three-year period ending in 2011 (European Commission, 2017d). These could be for instance appropriate measures at national, regional and local level, which disclose site-specific dispersion characteristics, adverse climate conditions or transboundary contributions. When the limits of the directive are exceeded, Member States are required to adopt and implement air quality plans to resolve the issue.

Over the last two years, the Commission launched legal action against 12 Member States due to non- compliance of the air quality standards for NO2. In February 2017, the Commission set final warnings to five countries, namely Germany, France, the UK, Spain and Italy because of persistent breaches of the NO2 limits (Air Clim, 2017). A similar proceeding can be observed for standards for PM10, which 16 countries did not meet and hence have face legal actions (Crisp, 2017). The highest number of reported exceedances of air quality objectives is in urban areas, due to its high population densities and related economic activities, such as traffic (European Environment Agency, 2017b). The Air Quality in Europe Report from 2016 showed that in 2014 around 85 percent of the urban population in the EU was exposed to fine particulate matter at levels deemed harmful to health by the World Health Organization (WHO).

The Commission published several papers with guidelines and information provision to support the Member States in the enforcement of air quality standards, namely the mandate for a comprehensive review of the EU air policy, the implementation of a broad consultation process (Stakeholder Expert Groups) and the revised version of the Circular Economy Package of waste, recycling and landfill laws. This shows the efforts taken to address category B, to improve the measures to monitor conducted data. Despite continuous guiding and information provision, "the Commission remains concerned about the overall pace of progress in achieving the limit values set by EU legislation in Member States", (European Commission, 2017e).

Despite the failure of most of the Member States to meet the legal limits, the legal action of the Commission has slowed down. In December 2017 five out of seven countries, which have been taken to court after a warning in February, have gotten away without prosecution. So far only Bulgaria has been found guilty of failing the act, which lowers the possibility of meeting the targets in the given time period (European Environment Bureau, 2017). Another objective of the air directive is to ensure that information is made available to the public (category C) (Art. 26). The general public and organizations must always have access to up-to-date information on air quality. This information must be updated every day. This is done by providing information on websites, teletext, in press and also by public displays. The EEA, for instance, manages several important databases on air quality such as AirBase (Gemmer & Xiao, 2013). The information provision is sufficient, although the simplicity of its application by the end-user is still a weak aspect of the EC-Methodology. The methodology requires large numbers of data images and modeling resources, which lead both to complexity and subjectivity in its application and information provision (Barnaba et al., 2017).

The improvement of monitoring and assessment of air quality is fundamental for achieving the directive. However according to the Commission, much more effort is still needed at local, regional and national levels to meet their obligations (European Commission, 2017e). Furthermore, the methodology used to measure desert dust and, therefore ,PM 10 is criticized as being largely based on past, extensive work on the Iberian Peninsula, with little investigation on the actual applicability of the used method to other regions. For example, a study conducted in Italy proved that the results of the EC-methodology largely differ from other methodologies and that due to the complex orography of certain regions the applicability of the used methodology is questionable (Barnaba et al., 2017). This indicates that the objective of category B, to enable a comparison of conducted data is not fully implemented yet. Another striking aspect of the air quality regulation is that spatial planning is not directly connected to the air quality guidelines. The term 'environment' is too broad and does not mention if spatial planning is included in that or not. Good spatial planning requires an assessment of zones on the basis of research to safeguard against designations, which are irresponsible in terms of air quality (Priemus & Schutte-Postma, 2009).

4.3 Cohesion

The Clean Air Policy Package for Europe from 2013 is designed to ensure full compliance with existing legislation by 2020 at the latest. The goal, identified in this study as category D, is to align directives both horizontally and vertically with other directives on national, regional and local level. Therefore, high efforts have been taken to achieve that objective. For example, in article 18 of the Industrial Emissions Directive (IED) of 2010 there are integrated environmental quality standards, addressing the objectives of the directive from 2008.

On a global level, the transboundary effects of air pollution have been addressed through the Convention on Long-Range Transboundary Air Pollution (CLRTAP) of the United Nations Economic Commission for Europe (UNECE). This convention, which was introduced in 1979, is implemented through several sub-protocols from which one is the National Emission Ceilings Directive. The revision of this directive is one of the activities under the ambient air quality directive, which ensures the attainment of the Gothenburg Protocol targets (Van Der Kamp, 2017). In the initial phase however, some inconsistencies between other directives occurred, such as the standards for vehicles (EURO5 and EURO 6 diesel), which could not meet the expected emission reduction for nitrogen oxides (NOx). Furthermore, it is criticized that commercial vehicles fueled by benzine are not sufficiently available on the market whereby the dependency on diesel vehicles is still very strong (ZHS, 2017; European Environment Agency, 2017a). Progress is expected from 2017 when new on-road vehicle tests will be used. Therefore, a conclusion on the cohesion to the automobile sector is still premature.

Ammonia (NH3) and methane (CH4) are major contributors to Particulate Matter and ozone. Although the agricultural sector is the major contributor to the emission of these pollutants, the efforts to reduce the emission are low compared to other sectors. This is due to a lack of legislation, which only regulates large pig and poultry farms in the Industrial Emission Directive (IED), but not cattle, which is the largest emitter of ammonia (European Environment Bureau, 2017). Hence there is lack cohesion between the agricultural legislation and the legislation on clean air, which indicates that the targets of category D are not fully met.

4.4 Efficiency

For the process to inform the revision of the EU's Thematic Strategy on Air Pollution adopted the same methodology as the one used for the development of the Strategy in 2005 under the Clean Air for Europe (CAFE). The methods focused on the use of updated health functions, incidence data, for PM2.5 and ozone, based on the REVIHAAP and HRAPIE studies led by WHO-Europe (WHO, 2013b, 2013a).

The International Institute for Applied Systems Analysis (IIASA) Report 11 takes into consideration the anticipated development of emissions and their effects by 2030, presenting detailed scenarios for policy examination for both 2025 and 2030 (International Institute for Applied Systems Analysis, 2014). The main results present scenarios focused on the current legislation (CLE), a Maximum Technically Feasible Reduction (MTFR), as well as a series of intermediate possibilities for 2025 and 2030. The Cost-benefit Analysis (CBA) of Final Policy Scenarios for the EU Clean Air Package, conducted as part of the Report 11 by IIASA on the EU's Thematic Strategy on Air Pollution (TSAP), focused on the health benefits of improved air quality under the scenarios (EMRC, 2014). The CLE scenario for 2025 estimates a shortening of life expectancy across the EU population of 2.7 million life years per year due to the exposure to PM2.5, despite the already implemented measures to restrict air pollution. The number could be reduced to 2 million in the MTFR scenario. Other health impacts estimated for 2025 include 330 million days of restricted activity (RADs) attributable to PM2.5 exposure in the EU28, falling to 240 million under MTFR.

The CBA results shown in the table below aggregate costs and benefits for EU28 for 2025, demonstrates the net benefits for moving from a CLE scenario to MTFR. Changes in life expectancy are valued using the value of a life year (VOLY).

An equivalent pattern is observed for 2030. However, comparison of results indicates that the same outcome holds: that marginal benefits exceed costs up to (at least) the level of scenario B7.

The conducted CBA focused only on health effects. It should be considered that the inclusion of other effects (e.g. the impacts to materials and crops assessed) would strengthen the conclusions reached. Also, there's a need to analyze the costs and benefits related to the European environment in order to fully comprehend the efficiency of the EU intervention.

The CBA demonstrates, however, that the health effects are already enough to conclude that the overall benefits for all scenarios up to B3 for 2025 and B7 for 2030 are higher than the costs. The report shows that proceeding beyond this point to the MTFR scenario would not generate a net monetarized health benefit compared to the costs under all cases except the least conservative position on mortality valuation.

Net benefits, EU28	CLE - B1	B1 - B2	B2 - B6	B6 - B3	B3 - B4	B4 - MTFR
Costs	222	979	2,138	1,289	51	42,327
Net benefits						
Total with median VOLY	14,176	13,344	9,482	1,609	-42	-27,579
Total with mean VOLY	28,987	28,056	21,444	4,559	-35	-12,638
Total with median VSL	25,864	25,513	18,794	4,044	-58	-15,907
Total with mean VSL	48,994	49,070	37,340	8,762	-72	7,277

Table 1: Net health benefits of the scenario for 2025 €M/year

Net benefits, EU28	CLE - B7	B7 - MTFR
Costs	3,334	47,347
Net benefits		
Total with median VOLY	35,140	-28,063
Total with mean VOLY	74,437	-8,606
Total with median VSL	70,012	-11,059
Total with mean VSL	135,371	21,002

Table 2: Net health benefits of the scenario for 2025 €M/year

4.5 EU added value

EU action on air quality established ceilings on national emissions of pollutants and have set maximum levels of air pollutant concentrations in the air, and limit values for air pollutant emissions at source, through introducing EU-level standards for certain installations. Evidence shows that without the EU efforts and technological improvements since the 1970s, the level of the main air pollutants in the EU-27 in 2010 would have been 1.69–2.29 times higher (Crippa et al., 2016). There are also calculations available to demonstrate that 80 000 premature deaths are avoided each year in the EU thanks to air quality legislation and improved technologies (Turnock et al., 2016). Research also estimated that perceived economic costs of poor air quality would have been 33 % higher without EU action and improved technology. Furthermore, the EU measures prolonged life expectancy in western and central Europe by 4–5 months, indicating a success of category A, to set limit values (EPRS, 2017).

Moreover, there's a clear synergy between EU air quality and climate and energy policies. Changes in energy use motivated by climate and energy policies would directly contribute to the achievement of targets for air pollutants. It can be stated that the reduction target for nitrogen oxides, for instance, would be achieved in nearly all EU Member States by climate and energy policies, without technical abatement measures aimed at improving air quality.

Also, the proposed climate and energy policy would close the gap between the sulfur dioxide and volatile organic compounds emission level under the reference scenario and the national emission ceilings, on average, by 60%. The remaining gap would be closed through relatively inexpensive technical measures.

PBL states that a simultaneous implementation of air quality and climate policies would not lead to additional reductions for these pollutants due to fewer required technical air pollution abatement measures to bring the targets within reach. As a consequence, the costs for air quality policy in the European Union would be halved (PBL, 2017).

5. Policy recommendations and final remarks

A report by the European Environmental Bureau (EEB) criticized the revised NEC Directive, which was born out of the ambient air quality directive, for not being more ambitious (European Environment Bureau, 2017). Even if this directive is fully implemented, around 250 000 Europeans are still expected to die prematurely in 2030 because of air pollution. Therefore, the EEB called on the Member States to implement the new and existing air quality legislation (beyond the minimum requirements) and on the Commission to enforce it, whilst also proposing new sector-specific legislation.

The analysis of the five criteria is in line with the findings of the EEB report and demonstrated a solid difficulty in implementing EU-wide measures to improve air quality. Although there's no doubt about the relevance, cohesion and EU-added value aspects of the Directive, its efficiency and effectiveness can be debated.

In 2011–2013, the Commission reviewed EU air policies, and adopted, as a consequence, the Clean Air Policy Package. A Clean Air Programme for Europe was proposed with the aim to establish new objectives for EU air policy for 2020 and 2030, which can be seen as a recognition of

the need of improving the measures in place in order to achieve the desired impact on air quality. The Directive 2016/2284/EU became the new main legislative instrument for achieving the new 2030 objectives and reduce emissions of damaging substances, namely SO2, NOx, VOCs, ammonia and fine particulate, at the Member State level (Annesi-Maesano, 2017). Although the new directive guarantees the extension of the emission ceilings previously established in the 2008 Directive for 2010-2020 it does not ensure stricter legal actions against Member States that do not restrict emission levels. Furthermore, Directive 2016/2284 transfers the 2020 reduction goals from the EU for fitting these under the reviewed Gothenburg Protocol, whilst it establishes more ambitious goals for 2030. However, not only it fails to include methane under its scope, but also allows some level of flexibility in the reduction actions implemented, such as in the case unforeseen circumstances affecting the energy supply (extreme weather).

Furthermore, the 2008 Directive's standards are softer than the real impacts on health from air pollution. Although it sets health standards both at short and long terms, EU ambient air quality ceilings are much less ambitions than the World Health Organization guidelines for SO2 and PM2.5, PM10 and for ozone (European Court of Auditors, 2018).

Another warning comes from the fact that most Member States did not successfully implement the Directive. The implementation of appropriate measurements of air quality is crucial as this is the allows the Commission to push MS to take actions and enforce the achievement of the air pollution goals.

There's a need therefore, for additional initiatives to reduce air pollution emissions. A new sector-specific legislation for light-duty and heavy-duty vehicles would reduce the emission of nitrogen oxides and address the higher than expected on road nitrogen oxides emission, especially in urban areas. This could be reached by stricter requirements for car makers and by removing non-compliant cars from the market and replacing them with products of higher environmental standards (Wates, 2017). Further mitigation actions on regional level for addressing traffic could be a better management of peak demand traffic levels or giving incentives to citizens to use public transportation (Barnaba et al., 2017; Amato et al., 2009).

Due to only marginal decreases in the emission of pollutants in the agricultural sector, we would highly recommend addressing agricultural activities, in particular the cattle industry and align these standards with the ambient air quality directive. Measures promoting farming practices and biogas production towards higher environmental standards and the use of organic fertilizing methods would impact the air quality standards on a larger scale and therefore improve the performance of the Member States to meet their limit values (Comments on draft NAPCP).

Furthermore, stricter legal actions have to be taken against non-compliance of Member States. The legal activities of the European Commission against non-compliance of Member States are a sufficient pressure for improving incentives to increase the air quality.

As for improvements of the established targets, the EU should consider an update on the limits for PM, S02 and O3 in order to make these in line with the recent WHO guidance and should decrease the amount of times concentrations are allowed to exceed the standards. Also, a short-term limit for PM2.5 should be established.

An adaptation of air quality strategies should be put on the table in order to have a stronger result- orientation, with solid requirements on yearly reporting. Also, it's crucial to detail the requirements for placing measuring stations both for industries and traffic as well as to establish a minimum level of stations per type. Wherever there's a need, the EC should be able to demand additional monitoring spots in order to measure air levels.

Accurate air quality monitoring is a crucial step in order to successfully achieve the desired impact and it would be extremely hard to evaluate an EU intervention if the available data is not precise or only illustrates a partial scene of air pollution.

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