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PART 2/3

COMMISSION STAFF WORKING DOCUMENT

EVALUATION

Evaluation of the National Emission Reduction Commitments Directive

{SWD(2025) 395 final}

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Glossary

Term/acronym	Meaning/definition	Term/acronym	Meaning/definition
AAQD	Ambient Air Quality Directive(s)	NECD	National Emission reduction Commitments Directive
Air Convention	UNECE Convention for Long-Range Transboundary Air Pollution (also referred to as CLRTAP)	NECD IA	The 2013 impact assessment underpinning the NECD
BCR	Benefit-cost ratio	NFR	Nomenclature for reporting
CAO	Clean Air Outlook	NH_3	Ammonia
CAP	Common Agricultural Policy	NMVOC	Non-methane volatile organic compounds
CLRTAP	UNECE Convention for Long-range Transboundary Air Pollution	NO_x	Nitrogen oxides
ERC	emission reduction commitment	OPC	Open public consultation
FTE	Full time equivalent	PaMs	Policies and measures
GAEC	Good agricultural environmental conditions	PM	Particulate matter
GP	Gothenburg Protocol (UNECE Air Convention)	$PM_{2.5}$	Fine particulate matter
IED	Industrial Emissions Directive	SO_2	Sulphur dioxide
IIR	Informative inventory report	Source legislation	EU legislation regulating emissions from specific sources (e.g. industrial sources, vehicles, etc.)
LPS (inventory)	Large Point Sources	TSC	Targeted stakeholder consultation
MRV	Monitoring, reporting and verification	WAM	Projection of compliance 'with additional measures'
MTFR	Maximum technically feasible reductions (GAINS)	WM	Projection of compliance with current measures ('with measures' scenario)
NAPCP	National Air Pollution Control Programme	ZPAP	Zero Pollution Action Plan

EU Member States

AT	Austria	EL	Greece	LV	Latvia
BE	Belgium	FI	Finland	MT	Malta
BG	Bulgaria	FR	France	NL	Netherlands
CY	Cyprus	HR	Croatia	PL	Poland
CZ	Czechia	HU	Hungary	PT	Portugal
DE	Germany	IE	Ireland	RO	Romania
DK	Denmark	IT	Italy	SE	Sweden
EE	Estonia	LT	Lithuania	SI	Slovenia
ES	Spain	LU	Luxembourg	SK	Slovakia

ANNEX III. EVALUATION MATRIX AND DETAILS OF ANSWERS TO THE EVALUATION QUESTIONS (BY CRITERION)

In this section we present the evaluation matrix. The evaluation matrix lists evaluation questions by evaluation criterion, and provides indicators and sources used to analyse them. The evaluation matrix considers the input of members of the interservice group.

Further chapters in this annex provide a detailed analysis by evaluation question.

1 THE EVALUATION MATRIX

1.1 Effectiveness

Question / Sub-question	Assessment criteria / points of comparison	Indicators	Data sources / collection methods	Data analysis approaches
1) To what extent has the NECD been successful in reducing emissions of the 5 pollutants for which it establishes national emission reduction commitments, to move towards achieving levels of air quality that do not give rise to significant impacts on and risks to human health and the environment?	i. Emissions of the five pollutants from each Member State have achieved (or are on track to achieve) emission reduction commitments (ERCs), across all Member States ii. Emissions are reduced so as to contribute to achieving air quality standards as defined in the AAQ Directives as well as to long-term air quality objectives	i. Emissions of the five pollutants over the evaluation period, relative to 2005 and respectively to the ERCs ii. Atmospheric concentration of air pollutants compared to WHO guideline exposure levels and EU air quality standards over the evaluation period, relative to 2005 and related quantified health impacts;	NECD emissions inventory data[1] (2020-2023 estimates from 2025 submissions) and Commission's review of national inventories[2]. EEA annual status briefings on achievement of emission reduction commitments[3], on air quality and premature deaths[4] and ecosystem data[5]. 4th Clean Air Outlook (CAO4) and preceding reports[6].	Quantitative: Emission trends (also by sector) over the evaluation period can be gained from emissions inventory data, and presentation of other quantitative clean air indicators (as listed in the respective column). Quantitative: Compliance & non-compliance margins in 2020-2022 for all Member States and the 5 pollutant ERC are

1 https://www.eea.europa.eu/en/topics/in-depth/air-pollution/national-air-pollutant-emissions-data-viewer-2005-2023
2 https://environment.ec.europa.eu/topics/air/reducing-emissions-air-pollutants/emissions-inventories_en#review-of-national-emission-inventories
3 https://www.eea.europa.eu/en/analysis/publications/air-pollution-in-europe-2025-reporting-status-under-the-national-emission-reduction-commitments-directive
4 https://www.eea.europa.eu/en/analysis/publications/europes-air-quality-status-2024, https://www.eea.europa.eu/en/analysis/publications/air-quality-status-report-2025/ and https://www.eea.europa.eu/en/analysis/indicators/health-impacts-of-exposure-to
5 https://www.eea.europa.eu/en/analysis/indicators/eutrophication-caused-by-atmospheric-nitrogen
6 https://environment.ec.europa.eu/topics/air/clean-air-outlook_en

Question / Sub-question	Assessment criteria / points of comparison	Indicators	Data sources / collection methods	Data analysis approaches
	as supported by the WHO guidelines. iii. Emissions are reduced so that EU is on track to meeting the air related targets of the Zero Pollution Action Plan (reduce by more than 55% the health impacts - premature deaths - of air pollution, and by 25% the EU ecosystems where air pollution threatens biodiversity, by 2030) iv. No infringement cases have been brought, and/or none brought for non-compliance with ERCs, and/or infringement cases brought for this reason have been successfully resolved.	iii. Quantified ecosystem impacts of air pollution and whether the EU is on track for the ecosystem-related ZPAP target iv. Number of ongoing infringement cases for non-compliance with ERCs, rationale for cases being brought and status	Data on infringement packages[7]. Emissions projections review (2023 and 2025) and horizontal reports. **Methods:** Desk research Stakeholder engagement.	calculated as part of the Commission's review of national inventories (and anticipated future compliance will be defined under studies such as the Emissions Projections Review (2023) and CAO4 and earlier versions, including analysis of the number of countries failing to meet ERCs and infringement cases brought. CAO4 and other studies (e.g. EEA Status of Air Quality reports) will inform the achievement of air quality standards, and the contribution of NECD to this.
2) To what extent have the following requirements of the NECD been instrumental in reaching the Directive's objectives:				
2a) the NAPCP, its template, the related requirements for transboundary consultations and consideration of the agricultural measures of Annex III, Part 2?	i. NAPCPs have been submitted by all Member States on time, and they comprehensively cover all the required aspects and are judged to be of sufficient quality (and updated and resubmitted as appropriate). ii. NAPCPs and PaMs address effectively compliance risks and gaps iii. The NAPCP template is useful and is followed; it allows for an effective review of PAMs	i. Extent and timing of NAPCP submission across Member States, their quality and coherence and comprehensiveness. ii. PaMs have been selected for adoption that address compliance gaps and they can credibly contribute to the targeted emission reductions. iii. Extent to which NAPCPs submitted follow the template; qualitative assessment of the	NAPCPs and PaMs submitted by Member States. NAPCP reviews (formal reviews by the Commission and shadow NGO evaluation for the EEB), horizontal reports on NAPCP reviews. Assessment of Policies and Measures in NAPCPs[8]. Evaluation of NAPs under the Nitrates Directive. Ongoing work for the Commission on the evaluation of	Detailed analysis of the NAPCPs has already been undertaken across several studies. These will inform the extent to which NAPCPs have been developed, the adherence to the requirements of the NECD, and their quality. Review reports also include information on whether recommendations on previous editions of NAPCPs have been followed up, which will inform the indicator on the effectiveness of Commission reviews.

7 January 2023 infringement package, November 2023 infringement package, November 2025 infringement package

8 NECD policies and measures database (europa.eu)

Question / Sub-question	Assessment criteria / points of comparison	Indicators	Data sources / collection methods	Data analysis approaches
	(all necessary data are made available) iv. Inter-ministry discussions and coordination between national, regional and local action took place, including when preparing NAPCPs and PaMs. v. The public has been consulted in accordance with Directive 2003/35/EC and the results captured in the NAPCPs. vi. Transboundary consultations have taken place in all relevant instances, have involved all relevant stakeholders, and have been effective, and the results captured in the NAPCPs. vii. Agricultural measures (mandatory and optional) have been considered by all Member States and have suitably been reflected in the NAPCPs. viii. NAPCP reviews by the Commission helped enhance the quality of the programmes. ix. Stakeholders believe that NAPCPs and their constituent elements have effectively supported achievement of the Directive's objectives.	effectiveness/usefulness of the template. iv. Extent of inter-ministry discussions and of coordination across governance levels to ensure policy coherence. v. The correct and timely consultation of the public, evidence in NAPCPs that results have been reflected. vi. Number of transboundary consultations the quality of discourse, and outcomes. vii. Extent to which additional agricultural measures under Annex III Part 2 have been considered, including in NAPCPs, and implemented. viii. Qualitative analysis of the extent to which recommendations in review reports were followed up in subsequent programmes. ix. Stakeholder opinion.	the Nitrates Directive and development of operating rules for livestock farms under the IED (to be reviewed further under Task 4 under the support contract). Results of task 4 under the support contract regarding the implementation of emission reduction measures under Part 2 of Annex III. Stakeholder engagement (mainly targeted consultation). **Methods:** Desk research Stakeholder consultation (targeted)	Stakeholder engagement will provide valuable insight into the extent to which NAPCPs and their constituent elements have contributed to the achievement of the Directive's objectives. Further analysis of uptake of Annex III part 2 measures will result from Task 4 of the support contract, complemented by the stakeholder consultation.
2b) inventories and projections reporting?	i. Inventories, projections and informative inventory reports (IIRs) have been submitted on time by all Member States and	i. Extent and timing of inventory, projection and IIR submissions across Member States.	Emission inventory and projections review outputs. Air Convention reporting guidelines and reporting	The reviews of inventory and projections will be the key source of information on the extent, quality, detail and comprehensiveness of

Question / Sub-question	Assessment criteria / points of comparison	Indicators	Data sources / collection methods	Data analysis approaches
	meet the requirements of the Directive ii. Submitted inventories, projections, and accompanying IIRs are of suitable detail and quality (transparency, consistency, completeness, comparability, accuracy). iii. Submitted inventories, projections, and IIRs are consistent across Member States, and in line with relevant guidance. iv. Technical corrections (TCs) and recommendations are minimal and are responded to in subsequent submissions. v. Stakeholders believe that inventories and projections, and their review have effectively supported achievement of the Directive's objectives.	ii. Quality and comprehensiveness of inventory, projections and IIRs. iii. Consistency in reporting across Member States. iv. Number of TCs and recommendations (& their trends and follow-up of recommendations in previous editions). v. Stakeholder opinion.	templates[9], EMEP/EEA guidebook 2023[10] Stakeholder engagement. **Methods:** Desk research Stakeholder consultation (targeted)	submissions across Member States. Stakeholder engagement will provide valuable insight into the extent to which the inventories and projections have contributed to the achievement of the Directive's objectives.
2c) ecosystem monitoring?	i. Monitoring of ecosystems is undertaken across Member States as required by Article 9 of the Directive, including through a representative sample of sites. ii. Monitoring is comprehensive and covers key impact indicators in Member States.	i. Extent of monitoring across Member States (site coverage). ii. Completeness of monitoring within each Member State (parameters covered, consistency between sites and monitoring data reported, use of Annex V of the NECD).	Reports (2018, 2019, 2022, 2023) on: national monitoring networks, monitoring data, monitoring sites and parameters[11]. Stakeholder engagement. **Methods** Desk research	Reports related to Article 9 will provide analysis of the extent, completeness, consistency and quality of monitoring. The extent and completeness of monitoring are challenging to assess because of the formulation in the Directive to coordinate with other impact monitoring

9 https://www.ceip.at/reporting-instructions/annexes-to-the-2023-reporting-guidelines
10 https://www.eea.europa.eu/publications/emep-eea-guidebook-2023
11 https://environment.ec.europa.eu/topics/air/reducing-emissions-air-pollutants/monitoring-ecosystem-impacts_en#useful-links-and-information-sources

Question / Sub-question	Assessment criteria / points of comparison	Indicators	Data sources / collection methods	Data analysis approaches
	iii. Reported monitoring data meets required quality standards, is consistent, and is coordinated with other relevant monitoring programmes (as per Article 9(1) of the Directive. iv. Stakeholders believe that ecosystems monitoring has effectively supported achievement of the Directive's objectives.	iii. Quality of reported monitoring data and its consistency with other programmes. iv. Stakeholder opinion.	Stakeholder consultation (mainly targeted)	programmes and the nature of reporting obligations. Stakeholder engagement will provide valuable insight into the extent to which this has contributed to the achievement of the Directive's objectives, if and where monitoring sites have been set up to fill gaps between existing programmes and the NECDs, and where and how monitoring data has been used to inform policy making.
3) To what extent have the flexibilities established by the NECD in Article 5(1) to (4) (inventory adjustments, "extreme weather event" flexibility, etc.) hindered or facilitated emission reductions?	i. Applications have been used as intended by the NECD. ii. Accepted applications have not significantly changed the national total emissions for compliance. Member States have still made reduction efforts despite using flexibilities. iii. Stakeholders agree that the use of flexibilities has positively contributed to the achievement of the Directive's objectives or did not hinder reaching its objectives.	i-1. Number of applications – split by flexibility type. i-2 - Improvement in inventories in line with new methodologies due to the possibility of adjustments ii. Quantified impact of accepted applications on emissions and their significance (e.g. in relation to national total emissions for compliance for a given pollutant) (where available) qualitative information on whether Member States made reduction efforts despite using flexibilities. iii. Stakeholder opinion.	Emission inventory review outputs. Stakeholder engagement. **Methods:** Desk research Stakeholder consultation (targeted)	The reviews of inventories will be the key source of information on the nature of applications submitted across Member States, their results and the potential impact on emission reductions. The assessment of flexibilities will differentiate across their types (Article 5(1) to (4)). To assess the usefulness of Article 5(1) flexibility, the process for updating inventory methodologies and the role of the EMEP guidebook will be considered. Stakeholder engagement will provide valuable insight into the extent to which adopted applications have contributed to the achievement of the Directive's objectives.
4) To what extent has the use of Gothenburg Protocol related	i. Gothenburg Protocol documents are used by all	i. Extent of use of Gothenburg Protocol related documents	Emission inventory and projections review outputs, (and	The review reports and stakeholder engagement will

Question / Sub-question	Assessment criteria / points of comparison	Indicators	Data sources / collection methods	Data analysis approaches
documents (guidelines, templates etc.), as stipulated in the NECD, contributed to the effective implementation of the NECD?	Member States, as set out by the NECD, and are used in a correct way. ii. Gothenburg Protocol related documents provide information needed for the implementation of the NECD. iii. Stakeholders agree that the use of Gothenburg Protocol related documents has positively contributed to the implementation of the Directive and the achievement of its objectives.	across Member States, and accuracy in their application. ii. Gaps in in the Gothenburg Protocol related documents compared to the information needed for reporting under the NECD (if any). iii. Stakeholder opinion.	Member State informative inventory reports if necessary). NAPCPs and their reviews – in particular in relation to agriculture measures and use of the ammonia guidance document. Stakeholder engagement. Study on differences between NECD and the Gothenburg Protocol **Methods:** Desk research Stakeholder consultation (targeted)	provide valuable insight into the extent to which Gothenburg Protocol documents (such as EMEP reporting guidelines including annexes, EMEP/EEA Guidebook) have been used by Member States, and their contribution to the achievement of the Directive's objectives.
5) To what extent have other EU policies or external factors affected emissions of the 5 pollutants?	i. Emissions of five pollutants over the evaluation period. ii. Other EU policies which have complemented the NECD to deliver emission reductions and have not curtailed reductions or increased emissions. iii. Sector specific policies show a clear link to the delivery of the NECD objectives and NECD has spurred more stringent source-specific legislation and non-legislative clean air programmes. iv. External factors have contributed to emission reductions or have had a	i. Changes to emissions of the five pollutants over the evaluation period. To the extent possible, attributed to changes due to NECD related requirements, other EU policies or external factors. ii. Emission reductions achieved by other EU policies, their relationship to the NECD and influence of NECD on the formulation of these policies. iii. Effect of sector-specific policies on emissions of air pollutants subject to ERCs. Their relationship to the NECD and	Evaluations and impact assessments of other EU policies that impact air pollutant emissions (e.g. sector-specific air pollution legislation, climate and energy policy). NAPCPs submitted by Member States. NAPCP reviews (formal reviews by the Commission and shadow NGO evaluation for the EEB), horizontal reports on NAPCP reviews. Assessment of Policies and Measures in NAPCPs[12].	Reviewing impact assessments and evaluation of other EU policies will identify projected emissions reductions and links to NECD. CAO4 and the integrated modelling approaches used consider the impacts of the NECD alongside other contributing policies (e.g. sector-specific legislation and climate and energy policies). The modelling could be used to provide insight into the role of NEC vs other EU policies in reducing emissions. CAO4 will also consider trends in external

[12] NECD policies and measures database (europa.eu)

Question / Sub-question	Assessment criteria / points of comparison	Indicators	Data sources / collection methods	Data analysis approaches
	significant detrimental effect on emission reductions. v. Stakeholders believe that the NECD has made an additional contribution to emission reductions, over and above other policies.	influence of NECD on the formulation of these policies. iv. Trends in external factors (as listed in the Intervention Logic), relative to the assumptions underpinning the 2013 NECD IA projections and how these affected air pollutant emissions. v. Stakeholder opinion.	CAO4 (in particular Task 3 and 5) and preceding studies. EEA reports. Stakeholder engagement. **Methods** Desk research Stakeholder consultation (OPC and targeted)	factors which influence emissions and the achievement of emission reductions. An analysis of measures implemented to deliver emission reductions and their underpinning rationale could help inform causal links to the NECD e.g. considering where Member States have had to implement additional policies and measures to achieve their commitments. Stakeholder opinion will provide further insight into the achievement of the NECD and the attribution of effects.

1.2 Efficiency

Question / Sub-question	Assessment criteria / points of comparison	Indicators	Data sources / collection methods	Data analysis approaches
6) What are the costs for implementing the NECD?				
a) administrative costs of Member State reporting obligations: inventory and projections reporting, preparation of NAPCP, ecosystem monitoring and reporting	i. Administrative costs for achieving the reporting obligations of the Directive are proportionate and do not include unnecessary costs. Variance by Member States is not due to inefficiency or ineffectiveness in implementation.	i. Administrative costs (€/year or per reporting obligation, as appropriate) 2017-2023, split direct and indirect, with consideration for how and why this varies by Member State.	Outputs of Task 3 of the supporting contract assessing administrative costs based upon data from stakeholder consultation and literature review. **Methods:** Desk research Stakeholder consultation (targeted)	Application of the Standard Cost Model to assess administrative costs. This will first establish actions driven by the NECD which lead to burden, assessing unit costs and recurrence of tasks, number of entities affected, etc. Data on unit costs of actions to come largely from stakeholder consultation as well as expert judgement.

Question / Sub-question	Assessment criteria / points of comparison	Indicators	Data sources / collection methods	Data analysis approaches
			Standard Cost Model Expert judgement	
b) abatement costs: emission reduction measures	i. Abatement costs for achieving the requirements of the Directive are proportionate and do not include unnecessary costs. ii. Abatement costs are proportionate relative to GDP.	i. Abatement costs (€) 2017-2023 and per year, split by sector, and direct and indirect costs. ii. Abatement cost as share of GDP.	Outputs of CAO 1-4 on abatement costs associated with the EU clean air legislative package. NAPCPs submitted by Member States, where these provide information on costs. NAPCP reviews (formal reviews by the Commission and shadow NGO evaluation for the EEB), horizontal reports on NAPCP reviews. Assessment of Policies and Measures in NAPCPs. Data on cost of measures targeting agriculture based on the evaluation of the Nitrates Directive. Stakeholder engagement. **Methods:** Desk research Stakeholder consultation (targeted, e.g. Member State national modelling exercises)	Utilise outputs of CAOs 1-4 to assess abatement costs of emission reduction measures, including sectoral split, extrapolating data on years if necessary. Analysis of NAPCPs and their reviews will provide insight into the measures implemented, and in some cases their costs. This question considers the costs of abatement measures and importantly links to Question 9 which considers the extent to which these can be attributed to the NECD.
c) administrative costs and adjustment costs for businesses	i. Administrative costs falling upon businesses for achieving the requirements of the Directive are proportionate and do not include unnecessary costs.	i. Administrative costs for businesses (€/year or per reporting obligation as required) 2017-2023, with consideration for how and why this may vary	Outputs of Task 3 of the support contract assessing administrative costs based upon data from stakeholder consultation and literature review.	Application of the Standard Cost Model to assess administrative costs. First establishing whether Member States have imposed any obligations on businesses to e.g. inform their national

Question / Sub-question	Assessment criteria / points of comparison	Indicators	Data sources / collection methods	Data analysis approaches
	ii. Adjustment costs falling upon businesses for achieving the requirements of the Directive are proportionate and do not include unnecessary costs. iii. Administrative and adjustment costs are proportionate relative to GDP.	by business type or size, split between direct and indirect costs. ii. Abatement costs for businesses (€) 2017-2023 and per year, split by sector and direct and indirect. iii. Administrative and adjustment costs for business as share of GDP.	Questions 6a and 6b. NAPCPs submitted by Member States. NAPCP reviews (formal reviews by the Commission and shadow NGO evaluation for the EEB), horizontal reports on NAPCP reviews. Assessment of Policies and Measures in NAPCPs. Stakeholder consultation. **Methods:** Desk research Standard Cost Model Stakeholder consultation (targeted)	reporting under NECD (there are no direct reporting obligations for businesses). Approach will then assess unit costs and recurrence of tasks, number of entities affected, etc. Data on unit costs of actions to come largely from stakeholder consultation. Analysis of adjustment costs will draw on the outputs of question 6b and undertake additional research and analysis to explore the extent to which these costs have fallen on businesses. Analysis of NAPCPs will detail some of the policies through which measures have been delivered, and responsibility for implementing them. Stakeholder consultation will also provide valuable insight.
7) What are the benefits of the implementation of the NECD (and reversely the costs of not implementing it) and do they outweigh the costs of implementation?	i. NECD has delivered substantial benefits for human and environmental health. NECD ii. Costs of non-implementation (i.e. non-compliance) to date have been minimised. iii. The benefits of implementation of the NECD outweigh the costs. iv. Benefits are in line or exceed expected benefits described in the initial NECD IA.	i. Monetised benefits of air quality improvements / reduction of emissions associated with the implementation of the NECD (€/year, share of benefits in GDP). ii. Impacts of non-implementation of the NECD, monetised as missed benefits due to non-compliance (remaining gap between emissions and ERCs). iii. Cost-benefit ratio.	Questions 1 and 5. CAO 1-4 NAPCP reviews. Outputs of Task 3 of the support contract. Questions 6a, 6b, 6c and 9. NECD IA 2013. European Commission study around the Costs of Non-implementation of EU Law (to conclude early 2025).	Questions 1 and 5 will explore the benefits of (and the extent to which they can be attributed to) the NECD. These will draw on the outputs of CAO 1-4 which explore the benefits of implementation of the EU's clean air legislative package (in particular 'ERC scenario' in CAO4). Benefits will be monetised as part of CAO4 using the most up-to-date approaches and valuation techniques.

Question / Sub-question	Assessment criteria / points of comparison	Indicators	Data sources / collection methods	Data analysis approaches
		iv. Comparison of cost-benefit ratio relative to that anticipated in the NECD IA.	**Methods:** Desk research Stakeholder consultation	Consideration of the wider benefits of measures (e.g. fuel savings, GHG emission reductions) can be made through review of the CAO 1-4 outputs, alongside the types of measures implemented as reported through the NAPCPs. In case of gaps in information, additional surveys or research will be conducted. The costs of non-implementation can be estimated by monetising the gap between emissions and the ERCs where they have not been achieved (from 2020). Task 3 of the supporting contract includes the analysis of benefits of implementation and where relevant, its lack of implementation, and will bring together the above analysis. Costs can be compared to benefits to derive the cost-benefit ratio. When doing so, costs need to be comparable to benefits in terms of price base, discounting, years covered, etc. The outturn cost-benefit ratio can then be compared to that anticipated in the 2013 IA. Throughout the analysis a consistent approach to attribution of effects to the NECD will be adopted, as under Questions 5, 6a, 6b, 6c and 9.

Question / Sub-question	Assessment criteria / points of comparison	Indicators	Data sources / collection methods	Data analysis approaches
				Stakeholder consultation will provide valuable insight into the perceived cost-effectiveness of the Directive, and the achievement of any wider benefits.
8) Have inefficiencies been identified, including in the handling and use of reported information? Is there potential for simplification and reduction of administrative costs (e.g. reporting overlaps under other policies, synergies with GHG reporting or other)?	i. The Directive does not lead to unnecessary or disproportionate costs. ii. Implementation of the Directive does not lead to inefficiencies, including in the handling and use of information.	i. List of actions and value of costs (where feasible) assessed to be unnecessary or disproportionate. ii. List of overlapping requirements in reporting and other actions (where removing/changing these would lead to simplification) and cost (where feasible).	Task 3 of the support contract. Outputs from service request on: "Analysis of and recommendations for the inventory reporting requirements under Directive (EU) 2016/2284 not linked to reduction commitments" Evaluation of the Energy Union Governance Regulation, literature regarding GHG reporting. Results of the 2023 Task force on Emission Inventories and Projections (TFEIP) questionnaire[13] that gathered views from the emissions inventory community on current and future reporting scope and streamlining opportunities. **Methods:** Desk research Stakeholder consultation (targeted)	Task 3 of the support contract includes an assessment of any potential unnecessary costs, based on in particular on stakeholder consultation data. Assessment and summary of stakeholder data on burden that overlaps with other legislation and international commitments, or is unnecessary, or is disproportionately high, or associated with inefficiencies. Review of existing relevant evaluations, surveys and studies (see examples in the "data sources" column) will be identified and analysed to complement stakeholder information.

[13] Available at: https://www.tfeip-secretariat.org/_files/ugd/e5a9c7_ac8c033829824496b952fca232e84079.pdf.

Question / Sub-question	Assessment criteria / points of comparison	Indicators	Data sources / collection methods	Data analysis approaches
9) Have other policies or factors affected the costs of compliance?	i. Synergies with other policies are captured, reducing the costs of complying with NECD. Trade-offs which may increase costs are avoided. ii. Consideration of costs over the evaluation period, relative to those anticipated in the 2013 NECD IA projects. iii. Other policies contribute to deliver NECD objectives and reduce cost of compliance iv. Stakeholders believe that the NECD and other policies act in synergy, without additional/ unnecessary costs.	i. Existence of synergies / trade-offs of NECD compliance with other policies. ii. Comparison of abatement costs relative to the 2013 NECD IA projections. iii. Costs of other EU policies that can directly be linked to NECD objectives and influence of NECD on the formulation of these policies. iv. Stakeholder opinion.	Question 5, 6a, 6b, 6c, 8a and 8b. Task 3 of the support contract. Evaluations and impact assessments of other EU policies that impact on air pollutant emissions (e.g. sector-specific air pollution legislation, climate and energy policy). NAPCPs submitted by Member States. NAPCP reviews (formal reviews by the Commission and shadow NGO evaluation for the EEB), horizontal reports on NAPCP reviews. Assessment of Policies and Measures in NAPCPs[14]. CAO4 (in particular Task 3 and 5) and preceding studies. NECD IA 2013. **Methods:** Desk research Stakeholder consultation (targeted)	Qualitative assessment of co-benefits/synergies and trade-offs of other policies with NECD objectives. The approach to considering the additional costs of the NECD will be consistent with that adopted under Question 5 which explores the additionality of effects. It will: - consider the cost estimates in light of those estimated in the 2013 NECD IA. - collate cost information from impact assessments of other EU policies. - use the outputs of CAO 1-4 to consider the contribution of other EU policies to overall cost of emissions reductions. - Consider where there is a clear direct (or indirect) link between emission abatement measures and the NECD. - Stakeholder opinion will provide valuable insight into the additional effect (and hence cost) of the NECD.

[14] NECD policies and measures database (europa.eu)

1.3 Coherence

Question / Sub-question	Assessment criteria / points of comparison	Indicators	Data sources / collection methods	Data analysis approaches
10) Internal coherence: Are the requirements under the NECD coherent with each other, e.g. reporting requirements including their timing?	i. All provisions are clear and unambiguous. ii. All provisions are consistent with one another, they do not contradict or overlap. iii. No gaps in the provisions which limit the achievement of the Directive's objectives. iv. No unintended consequences of the provisions, caused by incoherence are identified.	i. Clarity of provisions. ii. Consistency of provisions. iii. Comprehensiveness of provisions. iv. Unintended consequences. v. Influence of deadlines on quality and time relevance of input	NECD (and implementing and delegated acts and related guidance documents). NAPCP reviews. National inventory review reports and horizontal review reports[15]. Minutes of relevant meetings of the AAQEG. Stakeholder feedback. **Methods:** Desk research Stakeholder consultation (targeted)	This qualitative analysis will draw on a number of sources to identify any areas of internal incoherence, including: - Review of the Directive and acts adopted under the Directive by a legal expert. - The NAPCP review may help to identify variance between Member States in terms of their submissions, and whether variation was driven by ambiguity or gaps in the Directive itself or the NAPCP common reporting format, challenges associated with reporting deadlines (i.e. scheduling of inventory and projections reporting), or due to another reason. - Stakeholder engagement will be invaluable in determining the potential for internal coherence, in particular engagement with Competent Authorities.
11) Is the NECD coherent with the current and revised Ambient Air Quality Directives?	i. The wider requirements (other than ERCs) under the NECD have complemented the (current and revised) AAQ Directives in improving air quality and in helping Member States to	i. Complementarity as well as overlaps, gaps and inconsistencies between (current and revised) AAQ Directives and the NECD beyond the ERC.	AAQ Directives IA and supporting analysis, and AAQ Directives Fitness Check. Effectiveness (Questions 1 and 5). Efficiency (Questions 8b and 9).	Review of the coherence between the NEC and the AAQ Directives by a legal expert. Stakeholder opinion (in particular from Competent Authorities and NGOs) will inform the extent to which both

[15] https://environment.ec.europa.eu/topics/air/reducing-emissions-air-pollutants/emissions-inventories_en#review-of-national-emission-inventories

Question / Sub-question	Assessment criteria / points of comparison	Indicators	Data sources / collection methods	Data analysis approaches
	achieve (current and revised) air quality standards. ii. Achievement of AAQ Directives' requirements has not been challenged by the scope of NECD. There are no gaps or overlaps between the (current and revised) AAQ Directives and NECD which created inefficiencies.		Relevance (Question 19). Stakeholder engagement. **Method** Desk research Stakeholder consultation (OPC and targeted, in particular competent authorities and NGOs)	come together to drive action on air pollution, coordinating action at national and local level, and whether the wider requirements of the NECD are complementary and also help support achievement of the AAQ Directive's objectives. Efficiency analysis, in particular identifying any unnecessary costs will support the identification of overlaps with AAQ Directive, alongside stakeholder engagement. The analysis of the relevance of the NECD, in particular under Question 19, may help to inform whether any gaps detrimentally affected achievement of the AAQ Directive's objectives.
12) Coherence with other sectoral legislation and wider EU policies: Has the NECD proved coherent with:				
a) source legislation (e.g. Euro vehicle emission standards, Industrial Emissions Directive, Ecodesign legislation, Non-Road Mobile Machinery legislation, Fuel Quality Directive);	i. Source-specific legislation is coherent with the objectives and delivery mechanisms of the NECD and vice versa. ii. Source-specific legislation and NECD are complementary and coherent, and there are no gaps, contradictions of overlaps. iii. Improvement in or continuous coherence over time.	i. Coherence of source-specific legislation with the NECD ii. List of elements that may lead to incoherence between NECD and sectoral legislation and elements that lead to synergies and mutual reinforcement between the NECD and sectoral legislation. iii. Change in coherence over time.	Task 4 of the support contract outputs (related to IED). Source-specific impact assessments and evaluations (e.g. IED evaluation and IA). CAO4 and preceding reports. Effectiveness (Question 5). Stakeholder engagement, **Methods:** Desk research	The analysis will draw on the outputs of Task 4 of the support contract, which will consider coherence with agricultural policies (including IED). Stakeholder engagement will inform about synergies or contradictions, in particular from businesses and trade associations who will need to respond to the range of environmental legislation relevant for their sector. Sector-specific IAs and evaluations will have considered

Question / Sub-question	Assessment criteria / points of comparison	Indicators	Data sources / collection methods	Data analysis approaches
			Stakeholder consultation (targeted, in particular sectoral and trade associations)	coherence with NECD directly, in particular many have recently been issued following the EGD associated with proposed revisions to such legislation (e.g. Euro 7, IED). CAO and Question 5 will assess the effects of source-specific policies in combination with the NECD.
b) climate and energy policies including Fit for 55 legislation (including the CO_2 standards for light and heavy duty vehicles, Energy Efficiency Directive and energy efficiency first principle) and the Regulation on the Governance of the Energy Union and Climate Action (e. g. links between NAPCPs and national energy and climate plans – NECPs)	i. Climate and energy policies are coherent with the objectives and delivery mechanisms of the NECD and vice versa. ii. Climate and energy policies and NECD are complementary and coherent, and there are no gaps, contradictions of overlaps. iii. Improvement in or continuous coherence over time.	i. Coherence of climate and energy policies with the NECD. ii. List of elements that may lead to incoherence between NECD and climate and energy legislation and elements that lead to synergies and mutual reinforcement iii. Change in coherence over time.	Stakeholder engagement. Climate and energy policy impact assessments and evaluations (e.g. of the EU Climate Law). CAO4 and preceding reports. Effectiveness (question 5). Existing study – Increasing policy coherence between bioenergy and clean air policies and measures. **Methods:** Desk research Stakeholder consultation (OPC, targeted – in particular sectoral and trade associations)	Stakeholder engagement will be informative for identifying synergies or contradictions, in particular from businesses and trade associations who will need to respond to the range of environmental legislation relevant for their sector. Climate and energy policy IAs and evaluations will have considered coherence with NECD directly, in particular many have recently been issued as part of the European Green Deal. CAO and Question 5 will assess the effects of climate and energy policies and will provide insight into in combination with the NECD.
c) Common Agricultural Policy, in particular on ammonia (Article 13(2)(d) in relation to Annex III to the NECD);	i. Comprehensive uptake of mandatory measures in Annex III Part 2, and effective uptake of optional measures, supported by EU agricultural policy.	i. Extent to which EU agricultural policy supports measures defined in Annex III. ii. Obstacles to pollution reduction linked to EU agricultural policies/	Task 4 of the support contract. Stakeholder consultation. Evaluation of the Nitrates Directive.	Set out under Task 4 of the support contract, including stakeholder engagement and links with evaluation of the Nitrates Directive.

Question / Sub-question	Assessment criteria / points of comparison	Indicators	Data sources / collection methods	Data analysis approaches
	ii. EU agricultural policy does not present an obstacle to pollution reduction and there are no inconsistencies between EU agricultural policy and NECD (e.g. actions which may increase emissions). iv. Improvement in or continuous coherence over time.	inconsistencies between EU agricultural policies and the NECD. iii. Change in coherence over time.	**Methods:** Desk research Stakeholder consultation (targeted, in particular sectoral associations, NGOs and competent MS authorities)	
d) biodiversity related provisions (e.g. Water Framework Directive as regards aquatic ecosystems, Global biodiversity framework – target 7);	i. Biodiversity-related legislation is coherent with the NECD' objectives and delivery mechanisms and vice-versa. ii. There are no overlaps, gaps and contradictions. iii. Improvement in or continuous coherence over time.	i. Coherence between the NECD and biodiversity-related policies ii. Overlaps, gaps and contradictions. iii. Change in coherence over time.	Stakeholder engagement. Biodiversity related legislation impact assessments and evaluations (e.g. Nature Restoration Law). CAO4 and preceding studies. Efficiency Question 7. Coherence Question 11b. Zero Pollution Monitoring report and outlook. Assessments undertaken on coherence between NECD and Nitrates Directive. **Methods:** Desk research Stakeholder consultation (targeted, in particular sector NGOs and biodiversity experts in academia, competent MS authorities)	Stakeholder engagement will be informative for identifying synergies or contradictions, in particular from NGOs / environmental experts who will consider the extent to which reduction in air pollution and disposition driven by NECD provides a benefit to biodiversity and ecosystem services. Views of public authorities involved in the implementation of these policies will also be valuable in assessing coherence. Biodiversity related provision IAs and evaluations will have considered coherence with NECD directly, in particular many have recently been issued as part of the EGD (e.g. Nature Restoration Law). CAO models the change in impact of air pollution on ecosystem services, as does the Zero pollution monitoring report. These benefits will be captured

Question / Sub-question	Assessment criteria / points of comparison	Indicators	Data sources / collection methods	Data analysis approaches
				in analysis under Questions 7 and 11b. Wider reports have looked specifically at the coherence of NECD with other policies – e.g. work by AERU focusing on the Nitrates Directive.
e) other EU policies, such as innovation.	i. Synergies are identified and captured with wider EU policies. ii. There are no overlaps, contradictions or gaps with wider EU policies. iii. Improvement in or continuous coherence over time.	i. Capture of synergies between NECD and other EU policies. ii. Presence of overlaps, contradictions and gaps. iii. Change in coherence over time.	Stakeholder engagement. AAQ Directive IA and Fitness Check. **Methods:** Desk research Stakeholder consultation (targeted)	Stakeholder engagement will be informative for identifying synergies or contradictions, in particular given the wide-ranging scope, this will help identify directly more significant interactions. The AAQ Directive IA and Fitness Checks have considered coherence of overarching air policy with other EU policies and may usefully identify interactions also relevant for the NECD.
13) To what extent has EU funding contributed to the efficient implementation of the NECD?	i. Amount of air quality initiatives supported by EU funds is significant. ii. Air pollution abatement measures receives a substantial contribution from EU funds, in line with other environmental issues. iii. Improvement in allocation over time.	i. Quantity of EU funds supporting clean air initiatives, and in particular air emission reductions. ii-1. Proportion of EU funds supporting clean air, and in particular air emission reductions versus other initiatives. ii-2. Contribution of EU funds to the integration of new methods or technologies into the delivery	Internal Commission analysis (documented in 2020 implementation report). EU Fund trackers[16]. Cohesion Funds improving air quality[17]. LIFE Programme funded projects improving clean air, and in particular air emission reductions.	The methodology used to track EU funding available to implement clean air policy has been elaborated and adopted as part of the Commission's 2020 implementation report. To be revisited to understand what has changed and whether an update can be made. Analysis will compare the total quantity of funds targeted to air quality, in light of that dedicated

[16] https://environment.ec.europa.eu/topics/air/funding-clean-air_en and https://commission.europa.eu/strategy-and-policy/eu-budget/performance-and-reporting/horizontal-priorities/green-budgeting/clean-air-tracking_en

[17] Available from: https://cohesiondata.ec.europa.eu/

Question / Sub-question	Assessment criteria / points of comparison	Indicators	Data sources / collection methods	Data analysis approaches
		mechanisms of the NECD (to the extent possible) iii. Change in above indicators over time.	Horizon and FP7 projects on air quality (data base). Connecting Europe Facility (Transport infrastructure (CEF) funded projects). Funding for agriculture measures under CAP to be considered as part of Task 4 of the support contract. Stakeholder engagement. **Methods:** Desk research Stakeholder consultation (targeted, in particular Member States, NGOs and sectoral associations)	to other environmental issues (i.e. climate), and in light of the total costs of NECD (from Question 6).
14) Coherence with the international framework: Have the NECD and the Gothenburg Protocol proved to be sufficiently coherent?	i. The NECD effectively transposed the EU's commitments under the Gothenburg Protocol. ii. There is no variation between NECD and Gothenburg Protocol (in terms of e.g.(a) scope of sources, (b) geographical boundaries, (c) flexibilities, (d) reporting obligations (e) target dates, and (f) definitions and terminology) that creates ambiguity, unnecessary burdens and/or a risk that the EU's commitments will not be met.	i. Alignment of NECD ERCs and those established under the amended Gothenburg Protocol. ii. List of elements that may lead to incoherence between the NECD and the Gothenburg Protocol. iii. Change in coherence over time.	Past analysis to compare Directive (EC) 2016/2284 and the amended Gothenburg Protocol under the UNECE Air Convention. Documentation around the revision of the Gothenburg Protocol. Wider documentation and guidance issued under the UNECE CLRTAP. Stakeholder engagement (those involved in CLRTAP). Stakeholder engagement.	An analysis has already been undertaken to compare the NECD and Gothenburg Protocol. The analysis lists the similarities and differences between the documents (including consideration of geographical differences). The analysis to answer this evaluation question will explore whether any differences create unnecessary burden (also considered under Task 3 of the support contract).

Question / Sub-question	Assessment criteria / points of comparison	Indicators	Data sources / collection methods	Data analysis approaches
	iii. Improvement in or continuous coherence over time.		Task 3 of the support contract – assessment of unnecessary costs. **Methods:** Desk research Stakeholder consultation (targeted, in particular MS, experts involved in the CLRTAP, NGOs)	
15) To what extent has the non-inclusion of methane in the NECD hampered reduction of methane emissions (from agriculture, waste, energy) at EU and international level?	i. Emissions of methane have not sufficiently reduced over time, across sectors. ii. Synergies with climate, agriculture and energy policies at EU and international level are affected by the non-inclusion of methane in the NECD.	i. Emissions of methane over time, split by sector. ii. Coverage of methane in targets and measures under climate, agriculture, energy and waste policies at EU and international level, identification of gaps relevant for the NECD.	EEA air emissions reporting data. CAO4 and preceding reports. Modelling undertaken for the Fit for 55 package and individual climate related policies. Relevant evaluations and impact assessments (e.g. impact assessment of the regulation on the reduction of methane emissions in the energy sector). Analysis of inventory requirements not linked to emission reduction commitments. Question 12b. Stakeholder engagement **Methods:** Desk research Stakeholder consultation (targeted, in particular academia, emission projection experts,	The analysis will compare trends in reported methane emissions in the EU and across sectors. It will explore whether emissions have reduced (overall and by sector). CAO4 has a dedicated part considering CH_4, looking at the importance of EU vs non-EU/global reduction of CH_4 and implications on ozone. Stakeholder engagement will also provide valuable insight to this question, in particular whether Member States have implemented and/or considered methane specific emissions control policies and measures, have the tools to analyse relevant options, and hence deliver further emissions reductions if methane was included under the NECD.

Question / Sub-question	Assessment criteria / points of comparison	Indicators	Data sources / collection methods	Data analysis approaches
			NGOs, MS competent authorities, international bodies)	
16) Has coherence changed over time?	i. Coherence of NECD has improved or continued over time.	i. Coherence of NECD over time with respect to: internally; with other clean air legislation and targets; with sectoral legislation and wider EU policies; with EU funding; with the international framework; and re inclusion of methane emissions.	Outputs of questions 10-15 and supporting material.	The temporal aspect of coherence will be considered under each individual evaluation question 10-15 as it will rely on the same source material. This will be drawn together and presented under this question.

1.4 Relevance

Question / Sub-question	Assessment criteria / points of comparison	Indicators	Data sources / collection methods	Data analysis approaches
17) Has the relevance of the objectives of the NECD and of the means of achieving them changed over the past years, in particular in light of developments in:				
a) related policy fields (e.g. European Green Deal, Union climate and energy policies)	i. The objectives of the NECD remain relevant following the adoption of and follow-up to the European Green Deal, Zero Pollution Action Plan, Fit for 55, Euro 7 etc.).	i. Fit of objectives and mechanisms of the NECD with needs from the time of introduction until the time of the evaluation.	Documents setting out linked Union policies and programmes. NECD IA 2013. AAQ Directives fitness check and IA. CAO. Stakeholder engagement. **Methods:** Desk research Stakeholder consultation (OPC and targeted)	Qualitative analysis on how the objectives and mechanisms of the NECD fit with needs from the time of introduction until the time of the evaluation. The outputs of this question will link to Q18, which will consider overall relevance of the objectives in light of changes in the needs since the Directive was implemented, and in the future.
b) technical and scientific progress, including with regard to UNECE guidance related to ammonia and BAT under the Industrial Emissions Directive?	i. Changes in our understanding of the risks to human and environmental health, and/or to methodologies to assess them, have not had a material impact	i. Understanding of human and environmental health risk of exposure to air pollution and methodologies to assess effects.	CAO4 (and preceding versions). IED BREFs and BAT conclusions.	CAO4 will undertake a detailed review of the latest evidence around human and environmental risks, and methodologies to assess these. This will highlight

Question / Sub-question	Assessment criteria / points of comparison	Indicators	Data sources / collection methods	Data analysis approaches
	on the needs as defined in the intervention logic (in particular quantification of effects). ii. No change in UNECE guidelines on ammonia that significantly affect understanding of emission sources and associated levels of emissions (as known at the time of the evaluation). iii. No change in emissions abatement techniques, in terms of range of options, their feasibility, availability, costs and impact, which influence understanding of the level of cost-effective abatement across sectors and Member States.	ii. Robustness of UNECE Guidance on ammonia. iii. Range, cost and effectiveness of abatement techniques across different sectors (where feasible).	Service request assessing industry emissions to 2050. AAQ Directive IA. UNECE guidance for ammonia and discussions under Air Convention on its revision. CLRTAP Task Force on Reactive Nitrogen (TFRN) guidance/good practice documents. Assessments of relevance of Annex III, Part 2 measures for agriculture under Task 4 of the support contract. Stakeholder engagement. **Methods:** Desk research Stakeholder consultation (targeted, in particular scientific community, international stakeholders,	whether any changes have occurred that significantly impact on the needs expressed intervention logic (e.g. changing the scope of the need, or the size of effects). CAO4 will be based on the latest version of the GAINS model, which will contain an up-to-date database of abatement options, their effects and costs. It will run various scenarios, including one selecting all 'cost-effective' abatement techniques. This can be used to understand whether there have been significant technical developments which would influence the relevance of the NECD. This can be complemented by deeper dives into specific sectors or techniques where required, for example around industrial abatement techniques. This element will also be supported by the outputs of Task 4 of the support contract considering the agricultural sector.
18) How have the needs which the NECD was meant to address and identified in the intervention logic evolved and how would they evolve in the future? Would	i. Air pollution still causes significant levels of detrimental human health and environmental impacts, respectively to evolved needs (as set out in the Zero	i. Levels of human health and environmental impacts, now and in the future. ii. Levels of compliance with air quality standards, now and in the future (number of exceedances).	EEA reporting both on emissions and compliance with air pollution standards. EEA reporting on the human and environmental health burden of air pollution.	Assessment of effectiveness will strongly inform the extent of needs as they stand now, in particular for current impacts on human and environmental health, and progress towards longer-term

Question / Sub-question	Assessment criteria / points of comparison	Indicators	Data sources / collection methods	Data analysis approaches
the current objectives of the NECD still address them?	Pollution Action Plan and 2021 WHO guidelines). ii. Lack of compliance with air quality standards, now and in the future (revised standards). iii. Ratification of 2012 amended Gothenburg Protocol. iv. Complete/incomplete coverage of needs by objectives.	iii. Progress in ratifying 2012 amended Gothenburg Protocol, and status of international framework since and in the future. iv. Mapping of needs to objectives.	Question 1 and impacts on emissions, concentrations and health. Question 7 and assessment of costs of non-implementation. Question 11a and 11c on coherence with AAQ Directives. Question 14 considers coherence with international protocols. CAO4 and preceding versions. Stakeholder engagement (national, regional and local stakeholders). **Methods:** Desk research Stakeholder consultation (targeted)	air quality objectives, including those from the zero-pollution action plan. CAO4 will undertake analysis as to likely it is to meet these objectives under current policies (including 'ERC scenario' in CAO4). Assessment of coherence (question 14) will consider any developments in the Gothenburg Protocol and alignment, whereas here ratification of GP will be considered. This will also link to Q17a which considers relevance of the objectives related to synergy with other Union policies. A final step will then be to map the needs now and how they are expected to evolve in the future, against the general and specific objectives as defined in the intervention logic. This will identify any gaps and/or uncertainties.
19) Does the scope of the NECD remain pertinent?				
a) In terms of pollutants covered by emission reduction commitments (e.g., methane not included, condensable part of PM not specified)? b) In terms of pollutants and type of data covered by reporting obligations, but for which no reduction commitment has been established?	i. No reduction in the level of risk associated with exposure to pollutants under existing scope, and no new pollutants identified that pose a risk to human and/or environmental health. ii., iii. and v. For pollutants not covered by ERCs and/or reporting obligations, scientific developments (e.g. around	i. Range of pollutants with an established risk to human and/or environmental health, and levels of associated risk. ii. Understanding of pollutant sources, how emissions are generated, quantity of emissions, and levels of exposure.	NECD IA 2013. CAO 3 (condensables). Commission study on non-ERC NECD pollutants. Study on systematic assessment of monitoring of other air pollutants not covered under	The analysis will start with a review of the rationale and evidence supporting the selection of pollutants under different obligations from the 2013 NECD IA. It will then consider changes in the supporting evidence that influence the pertinence of the NECD's scope.

Question / Sub-question	Assessment criteria / points of comparison	Indicators	Data sources / collection methods	Data analysis approaches
	understanding sources, quantity of emissions, levels of exposure, robustness of emission estimation approaches have either: - not been sufficient to include these under monitoring or emission reduction obligations; and/or - have been sufficient but resulting risk level does not warrant their inclusion in monitoring or emission reduction obligations. iv. and v. For pollutants not covered by ERCs and/or reporting obligations, improvements in extent and robustness of monitoring has either: - not been sufficient to include these under obligations; and/or - have been sufficient but resulting risk level does not warrant their inclusion in obligations.	iii. Robustness of techniques to estimate emissions and exposure. iv. Extent of monitoring of different pollutants. v. Robustness of monitoring techniques of different pollutants.	Directives 2004/107/EC and 2008/50/EC[18]. WHO Air Quality Guidelines 2021. WHO HRAPIE2 and EMAPEC (forthcoming). Materials from the work of the Centres and Task Forces contributing to the UNECE Air Convention. AAQ Directive IA. Results of the 2023 TFEIP questionnaire that gathered views from the emissions inventory community on current and future reporting scope and streamlining opportunities. Review of documentation from groups in the Air Convention (TFTEI, TFRN for emissions controls, and the Centre for Integrated Assessment Modelling on the costs and optimisation of policies & measures. Stakeholder feedback. **Methods:** Desk research Stakeholder consultation (OPC and targeted)	The WHO review of its Air Quality Guidelines provided a comprehensive review of evidence of human health effects associated with exposure to different air pollutants. Likewise, where published over the course of the evaluation, the forthcoming HRAPIE2 and EMAPEC project outputs will help inform whether there has been a significant change in understanding of the risk of different pollutants. Analysis of work of the Centres and Task Forces contributing to the UNECE Air Convention will inform changes to the risks for environmental health from different pollutants. AAQ Directive IA assessed the evidence base supporting around emerging pollutants as part of the policy options (options A4, L1, L2 and Ø). The TFEIP questionnaire and non-ERC pollutants studies consulted a range of stakeholders on whether they thought existing reporting of emissions (in the Air Convention) was fit for purpose.

[18] https://op.europa.eu/en/publication-detail/-/publication/1c9b2b51-54dd-11ed-92ed-01aa75ed71a1/language-en

Question / Sub-question	Assessment criteria / points of comparison	Indicators	Data sources / collection methods	Data analysis approaches
c) In terms of sources of emissions accounted for complying with the emission reduction commitments (e.g. not covering certain agricultural emissions; aviation beyond landing and take-off, or international maritime traffic)?	i. The Directive captures key emission sources of different pollutants and captures the majority of emissions. ii. Directive covers all sectors and pollutants for which approaches to estimate emissions are suitably robust and certain. iii. Directive captures all sectors and pollutants which can be attributed in an acceptable way such that it does not pose implementation risk.	i. Quantity of emissions of different pollutants across sectors. ii. Guidance and approaches to estimating emissions from different source sector, and their robustness. iii. Robustness and acceptability of attribution of emissions.	This element will be analysed in detail in the supporting study. Technical literature and data related to each emissions source. TFEIP reports and past analysis to compare Directive (EC) 2016/2284 and the amended Gothenburg Protocol under the UNECE Air Convention. CAO3 and 4. Stakeholder feedback. **Methods** Desk research Stakeholder consultation (OPC and targeted)	The analysis will start with a review of the rationale and evidence supporting the selection/omission of sectors under different obligations from the 2013 NECD IA (i.e. Soil emissions were excluded because they were considered uncertain; aviation cruise/international maritime were excluded on the basis of challenges in source location as well as to avoid possible double reporting with other international obligations). It will then consider whether there has been a sufficient change in the supporting evidence to warrant a change. Task 5 under the support contract will critically consider the evidence base around emissions from: agriculture, aviation (beyond landing and take-off) and international maritime traffic. Sources not included in the NECD were analysed in the CAO3 and will be also reanalysed in CAO4 both in terms of compliance with ERCs as well as implications for health impacts.
e) In terms of the list of emission reduction measures quoted in Annex III on agricultural measures, including the split	i. Directive captures all measures which would effectively and efficiently abate emissions in the agriculture sector.	i. Qualitative assessment of whether the list of emission reduction measures is fit for purpose considering technical,	Sources for agriculture will be informed by Task 4 of the support contract. NECD IA 2013.	This analysis will start with consideration of the rationale for defining techniques as mandatory and optional. It will then consider whether: for those

Question / Sub-question	Assessment criteria / points of comparison	Indicators	Data sources / collection methods	Data analysis approaches
between mandatory and optional measures?	ii. Directive classifies as optional those measures where there may be material variation between Member States which could influence their effectiveness or efficiency. iii. Directive aligns with international frameworks with respect to mandating specific measures. iv. The Directive does not prescribe emission reduction measures that are already part of other source legislation.	scientific and international developments ii. Qualitative assessment of whether the split into mandatory and optional measures remains relevant. iii. Coherence with international frameworks. iv. List of overlaps or duplications with source legislation.	Stakeholder engagement (reviewing the existing measures, their uptake, the effectiveness of defining measures in Annex III, and also the need for new measures to be added). **Methods:** Desk research Stakeholder consultation (OPC and targeted)	measures currently captured in Annex III, whether this rationale still holds (both for their inclusion and status as optional/mandatory); the status of measures not listed in Annex III. This will draw on the analysis performed under Task 4 of the supporting study around relevance of the measures in Annex III in light of regulatory, technical and scientific progress.

1.5 EU added value

Question / Sub-question	Assessment criteria / points of comparison	Indicators	Data sources / collection methods	Data analysis approaches
20) To what extent is the initial subsidiarity analysis still valid?	i. Transboundary pollution remains a significant source of pollution across EU Member States.	i. Significance of transboundary pollution.	NECD IA 2013 Member State emissions reporting. CAOs. Questions 1, 7, 11a, 11c and 19c. AAQ Directive IA. Stakeholder engagement. **Methods:** Desk research Stakeholder consultation (OPC and targeted)	The basis for the analysis is the initial NECD IA, which sets out the initial subsidiarity analysis. The transboundary nature of air pollution and the nature of the products affected were part of this rationale. The analysis of other evaluation questions, including reflecting on the reported emissions data, will inform the extent to which transboundary air pollution remains an issue and explore the contribution of different sources to remaining emissions.

Question / Sub-question	Assessment criteria / points of comparison	Indicators	Data sources / collection methods	Data analysis approaches
				The transboundary aspect is something that has been highlighted in most of the CAOs. Stakeholder engagement and feedback on all these aspects will be a useful complement.
21) Do needs and objectives addressed by the NECD continue to require action at EU level?	i. Transboundary pollution remains a significant source of pollution across EU Member States. ii. A higher level of protection (i.e. greater or faster emission reductions) would not be achieved in the absence of the NECD; likely non-compliance with international commitments in the absence of the NECD iii. Significant variation in reductions in air pollution and associated costs would occur in the absence of NECD.	i. Significance of transboundary pollution. ii. Level of protection achieved relative to action at Member State level and relative to a situation where only the Gothenburg Protocol exists (no NECD). iii. Fairness and equity in reduction in air pollution and costs of abatement across EU Member States in the absence of NECD (qualitative assessment).	Effectiveness and efficiency evaluation questions. 2013 NECD IA AAQ Directive IA and Fitness Check. CAOs. Coherence (evaluation question 14). Stakeholder engagement. **Methods:** Desk research Stakeholder consultation (OPC and targeted)	The analysis of the effectiveness evaluation questions, including reflecting on the reported emissions data, will inform the extent to which transboundary air pollution remains an issue. The transboundary aspect is something that has been highlighted in most of the CAOs. Coherence analysis will consider the relationship to the international framework and differences in the involvement / commitment of Member States. Stakeholder engagement and feedback on all these aspects will be a useful complement.

2 DETAILED ANALYSIS OF THE "EFFECTIVENESS" EVALUATION CRITERION

BOX 1. Summary of evaluation questions on effectiveness

To what extent:

- has the NECD been successful in reducing emissions for the five main pollutants to reach the directive's objectives?
- have the reporting requirements been instrumental in reaching the objectives?
- have the flexibilities influenced the emissions trends of the five pollutants?
- have the links to the Gothenburg Protocol contributed to the effective implementation of the Directive?

2.1 To what extent has the NECD been successful in reducing emissions of the 5 pollutants for which it establishes national emission reduction commitments, to move towards achieving levels of air quality that do not give rise to significant impacts on and risks to human health and the environment?

The analysis below shows the trends in the emission of air pollutants based on the yearly emission inventories submitted by Member States. Inventories reflect changes to emissions resulting from measures adopted and implemented under different EU and national policies. Inventories also reflect changes due to external factors, e.g. the rate of uptake of green innovation and clean technologies, increased awareness of the effects of air pollution or developments at international level. The effects of the NECD could therefore not be isolated from those of other policies and external factors (see also Annex III 2.7.2 for further analysis.

2.1.1 Emissions of the five pollutants over the evaluation period, relative to 2005 and respectively to the 2020-29 ERCs

Member States are obliged to prepare annually national emission inventories for the five main pollutants for which the NECD establishes emission reduction commitments, and to submit them to the European Commission. They form the basis for further analysis of the evolution of emissions since 2005. According to Article 11(1) of the Directive, the European Commission has an obligation to inform the European Parliament and the Council on the progress made in its implementation. Two implementation reports were presented, one in 2020, and another in 2024[19].

These reports are complemented by the yearly briefing of the EEA on the status of reporting under the NECD[20] and the Clean Air Outlooks (CAOs)[21]. The CAO reports analyse the prospects for reducing air pollution in the EU and beyond, providing a trajectory to compliance, considering various policy scenarios.

19 COM(2020) 266 final and COM(2024) 348 final

20 EEA (2025) Air pollution in Europe: 2025 reporting status under the National Emission reduction Commitments Directive.

21 All available at: https://environment.ec.europa.eu/topics/air/clean-air-outlook_en.

This section looks at the status of implementation combining insights from these three sources.

The figure below shows the **trend of the five main pollutants** since 2005, the base year against which the NECD sets emission reduction commitments. From 2005 to 2023, $PM_{2.5}$ emissions fell by 38%. Emissions of SO_2 fell significantly between 2005 to 2023 with a decrease of 85%. Major reductions were also seen for nitrogen oxides (53%), and NMVOC (35%). Ammonia remains the biggest challenge. NH_3 emissions fell by 17% since 2005, the least out of all pollutants tracked (the ERCs set for ammonia are also the lowest out of the five pollutants).

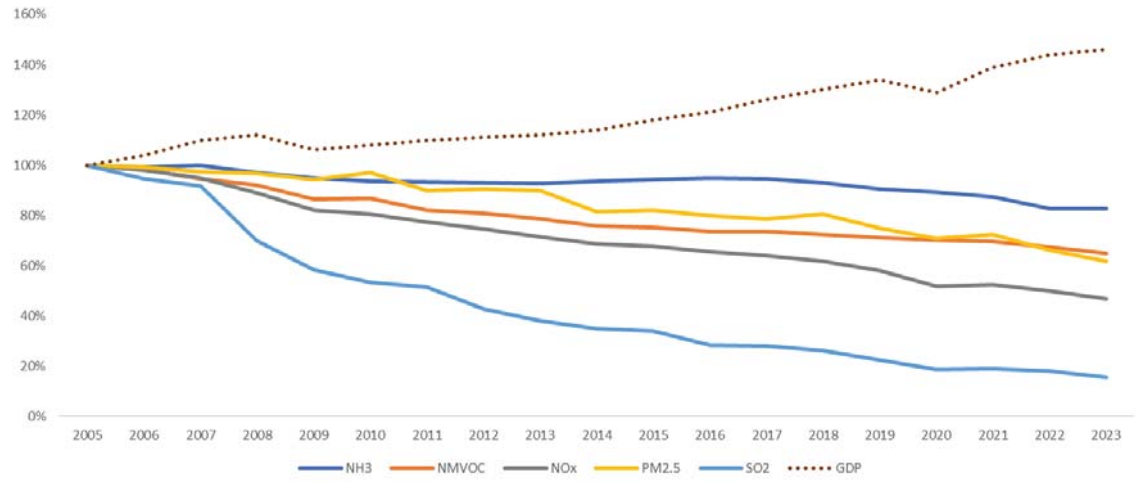


Figure A - 1 – 2005-2023 trends in EU emissions of NH_3, $PM_{2.5}$, NMVOC, NO_X and SO_2, as percentages of 2005 levels, set against EU Member States' GDP as a percentage of the 2005 GDP (source: EEA NECD briefing 2025)

Looking at the EU wide evolution hides discrepancies between Member States, whose changes over time are detailed in European Environment Agency (EEA) publications[22] and summarised in the table below.

Table A - 1 – Summary of 2005-2023 trends in EU emissions of NH_3, $PM_{2.5}$, NMVOC, NO_X and SO_2 for all Member States

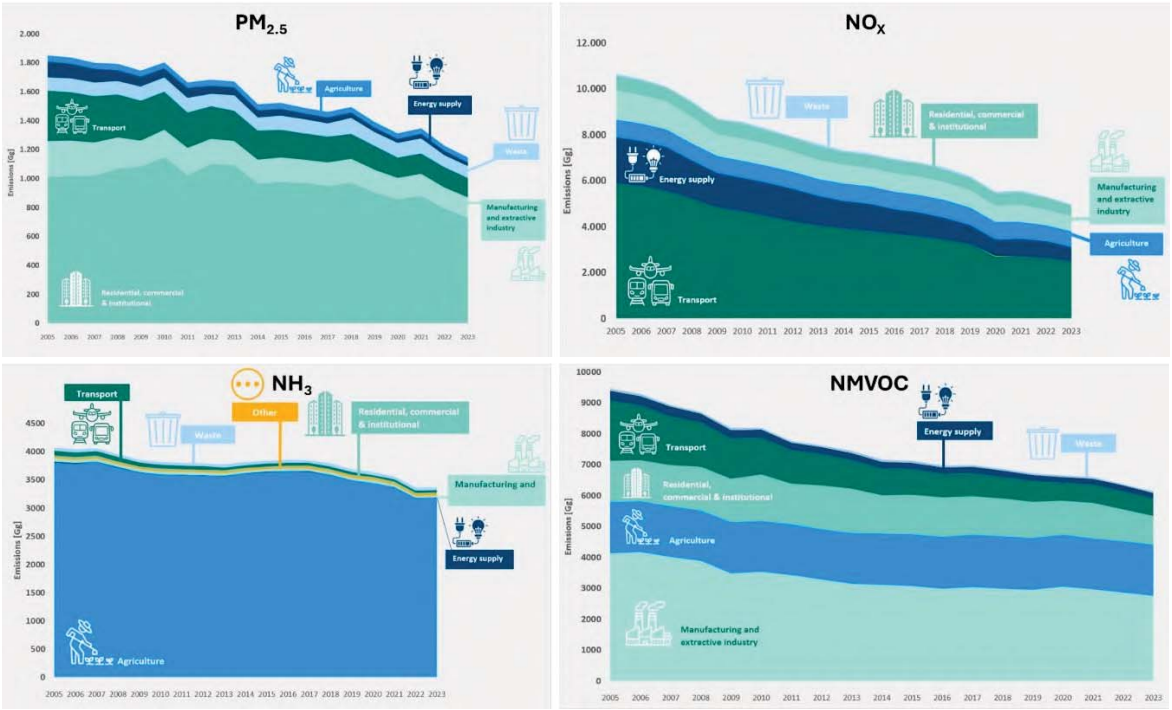
Member State	Pollutant				
	NH_3	NMVOC	NO_x	$PM_{2.5}$	SO_2
BE	-21%	-39%	-63%	-50%	-84%
BG	6%	-34%	-52%	-41%	-95%
CZ	-9%	-34%	-53%	-42%	-77%
DK	-33%	-39%	-61%	-48%	-69%
DE	-20%	-35%	-47%	-41%	-54%
EE	-7%	-28%	-51%	-43%	-86%
IE	-6%	-13%	-51%	-51%	-90%
EL	-17%	-59%	-55%	-45%	-93%
ES	-17%	-29%	-58%	-38%	-92%

[22] For pollutant trends per country, see EEA National air pollutant emissions data viewer 2005-2023. For the latest state-of-play on distance to compliance per Member State and an overall assessment of progress, see EEA NECD briefing 2025.

FR	-19%	-40%	-59%	-53%	-83%
HR	-46%	-51%	-44%	-40%	-91%
IT	-21%	-37%	-57%	-24%	-83%
CY	-14%	-46%	-44%	-56%	-73%
LV	5%	-32%	-31%	-46%	-56%
LT	-7%	-22%	-30%	-49%	-67%
LU	-12%	-40%	-82%	-50%	-87%
HU	-17%	-38%	-50%	-20%	-73%
MT	-9%	-29%	-53%	-58%	-99%
NL	-25%	-11%	-57%	-51%	-74%
AT	-6%	-37%	-56%	-44%	-59%
PL	-10%	-25%	-41%	-28%	-75%
PT	-2%	-23%	-53%	-24%	-84%
RO	-16%	-37%	-42%	-17%	-95%
SI	-18%	-42%	-57%	-43%	-94%
SK	-12%	-45%	-52%	-63%	-84%
FI	-26%	-51%	-57%	-50%	-70%
SE	-10%	-33%	-46%	-55%	-58%
EU27	-17%	-35%	-53%	-38%	-85%

Source: EEA National air pollutant emissions data viewer 2005-2023.

The charts below illustrate the main source sectors for the five pollutants. The coherence analysis in Annex III chapter 4 looks into the interplay with legislation regulating the main source sectors.



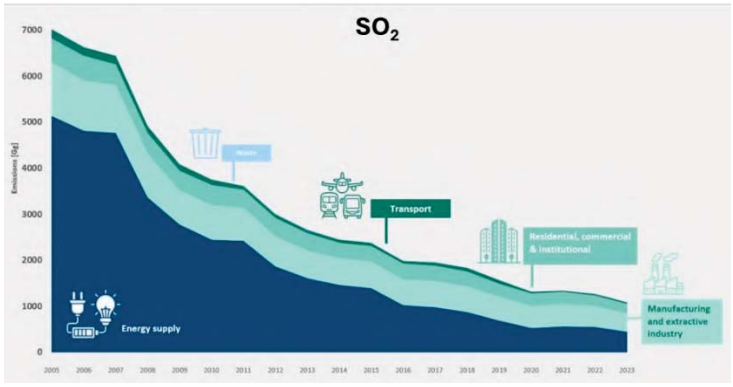


Figure A - 2 – 2005-2023 trends in EU emissions of NH_3, $PM_{2.5}$, NMVOC, NO_X and SO_2, with sectoral breakdown. Source: EEA compilation based on data reported by Member States

The table below provides the breakdown per Member State and pollutant on how this development at EU level translates into Member States performance against the Directive's ERCs. Compliance against the ERCs has been checked since 2022, the year in which Member States submitted emissions data for 2020. In line with Article 4(1), ERCs apply since 2020. Since the first compliance checks and subsequent legal proceedings to address non-compliance, there has been a slow, but notable improvement over time. This is most marked for ammonia, where the 11 non-compliance situations identified have reduced to 8 in the 2024 inventory submission, and to 5 based on the 2025 submission. This may still be subject to change in the course of the inventory review.

Table A - 2 – Overview of compliance with ERCs in 2023

Member State	Pollutant				
	NH_3	NMVOC	NO_x	$PM_{2.5}$	SO_2
BE	-22%	-54%	-66%	-59%	-267%
BG	8%	-23%	-43%	-35%	-388%
CZ	-5%	-34%	-50%	-43%	-137%
DK	-13%	-44%	-29%	-28%	-110%
DE	-19%	-51%	-21%	-25%	-72%
EE	-8%	-31%	-84%	-50%	-375%
IE	-5%	-27%	-24%	-64%	-253%
EL	-12%	-20%	-59%	-18%	-298%
ES	-16%	-24%	-50%	-37%	-325%
FR	-18%	-20%	-37%	-55%	-165%
HR	-76%	-46%	-27%	-37%	-379%
IT	-20%	-8%	-47%	-18%	-272%
CY	-4%	-19%	-4%	-23%	37%
LV	5%	-11%	-6%	-56%	-109%
LT	3%*	6%	23%	-55%	-38%
LU	-11%	-53%	-246%	-71%	-402%
HU	-9%	-22%	-44%	-9%	-112%
MT	-6%	-12%	-28%	-76%	-1701%
NL	-16%	-22%	-44%	-30%	-179%
AT	-5%	-38%	-51%	-44%	-81%

PL	-10%	-15%	-30%	-16%	-66%
PT	6%	-11%	-42%	-11%	-128%
RO	-4%	-23%	-2%	13%	-405%
SI	-22%	-46%	-49%	-33%	-472%
SK	6%	-52%	-44%	-74%	-175%
FI	-8%	-47%	-59%	-39%	-137%
SE	6%	-20%	-26%	-80%	-85%

*Source: Horizontal review report of 2025. *Shown in green to indicate compliance due to pollutant compensation flexibility, despite positive compliance percentage.*

Notes: Percentages express how much national totals for compliance need to be reduced by (in case of percentages >0) to meet emission reduction commitments (or, in case of percentages <0, how much national totals could increase by, while remaining compliant). Green cells indicate where compliance is achieved, and red cells indicate where compliance is not achieved. The compliance assessment takes into account the effects of the inventory review and flexibility applications (which the TERT recommended the EC to accept). While all decimal places were used for the calculation of the compliance numbers, only rounded values are shown here for easier reading.

The NECD stipulates ERCs for 2020 to 2029 and more ambitious ones for 2030 onwards. Assessing the effectiveness of the Directive involves checking whether Member States are currently on track towards meeting the more ambitious future commitments.

The EEA NECD briefing takes the yearly inventory submissions by Member States to illustrate where Member States stand as regards the Directive's commitments. The figure below shows both the current (2023 data) compliance situation, which is analysed in more detail below, and the current performance against the 2030 ERCs.

Looking at 2030, the biggest challenges are expected to be NO_x, $PM_{2.5}$ and NH_3 (see the figure below). Only four Member States[23] are already meeting their 2030 emission reduction commitments based on the 2023 data for all the five main air pollutants. As seen in the EEA briefing, the distance to the target is significant for many Member States and pollutants.

[23] Belgium, Estonia, the Netherlands and Finland.

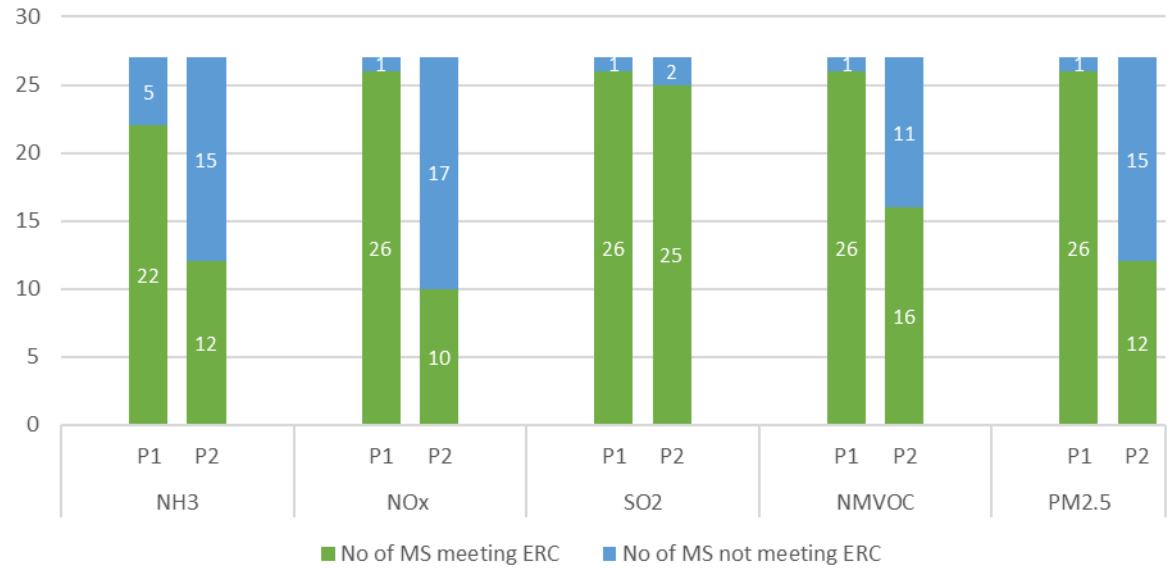


Figure A - 3 – Number of Member States meeting or not meeting ERCs for the 2020-29 (P1) and 2030 and beyond (P2) period, based on 2025 inventories reflecting 2023 emission data. Source: Member States reviewed inventories submitted in 2025 for P1 and EEA NECD briefing for P2.

Below we provide an overview of non-compliances with 2020-2029 ERCs based on inventory data of 2020-2023.

Table A - 3 – Overview of non-compliances with ERCs since the provision of the first inventories concerning the year 2020

Pollutant	Member States non-compliant in 2020*	Member States non-compliant in 2021**	Member States non-compliant in 2022***	Member States non-compliant in 2023****
NH_3	11 MS: AT, BG, DK, ES, HU, IE, LT, LU, LV, PT, SE	10 MS: AT, BG, DK, HU, IE, LT, LU, LV, PT, SE	8 MS: AT, BG, HU, IE, LT, LV, PT, SE	5 MS: BG, LV, PT, SE, SK
$PM_{2.5}$	3 MS: HU, LT, RO	3 MS: HU, PL, RO	2 MS: HU, RO	1 MS: RO
NMVOC	2 MS: LT, PL	3 MS: LT, LU, PL	1 MS: LT	1 MS: LT
NO_x	2 MS: LT, RO	2 MS: LT, RO	2 MS: LT, RO	1 MS: LT
SO_2	1 MS: CY	1 MS: CY	1 MS: CY	1 MS: CY

*According to inventories reported by Member States in 2022 (on which the letters of formal notice issued in January 2023 were based).

**According to inventories reported by Member States in 2023 (on which the letters of formal notice and reasoned opinions issued in November 2023 were based).

***According to inventories reported by Member States in 2024

****According to inventories reported by Member States in 2025.

Stakeholders responding to both OPC and TSC indicated that the Directive has made the greatest perceived contribution to reductions in sulphur dioxide (SO_2) and nitrogen oxides (NO_x), with moderate to significant impact also reported for $PM_{2.5}$ and ammonia (NH_3). Stakeholders considered that the NECD has had a less significant impact on emissions of non-methane volatile organic compounds (NMVOC), particularly amongst public authorities responding to the TSC. While the overall sentiment was that the Directive had

helped reduce emissions across all five pollutants, a minority of respondents in both consultations believed that for certain pollutants—especially NMVOC and NH_3 —the impact had been minimal or insufficient.

2.1.2 Are Member States on track towards the 2025 indicative maximum emission levels and 2030+ ERCs?

Article 4(2) of the Directive requires Member States to take the necessary measures aimed at limiting their 2025 emissions to the indicative level determined by the mid-point between the maximum allowed levels according to their 2020-29 and 2030+ ERCs. Article 4(2) also states that Member States may follow a non-linear reduction trajectory if this is economically and technically more efficient and provided that, as from 2025, it converges progressively on the linear reduction trajectory not affecting the emission reduction commitment for 2030. The inventory submission of 2027 (covering 2025 emissions data) will show whether Member States are indeed on a linear trajectory for 2025. For now, it is worth assessing current performance against the indicative 2025 levels determined by the mid-point between the currently applicable and the 2030+ ERCs to see whether Member States are on track.

According to emission inventories for 2023 (submitted by Member States in 2025), the following Member States need to reduce emissions further to ensure they are on a linear trajectory:

- NH_3: 13 Member States (AT, BG, CY, CZ, HU, LV, LT, LU, MT, PT, RO, SK, SE)
- NMVOC: 4 Member States (HU, IT, LT, PT)
- NO_x: 6 Member States (CY, DE, LT, MT, RO, SE)
- $PM_{2.5}$: 6 Member States (CY, HU, IT, PL, PT, RO)
- SO_2: 1 Member States (CY)

Ten Member States[24] already meet the 2025 indicative maximum emission levels for all five pollutants, based on emissions data for 2023 that they submitted in 2025.

Article 10(2) of the Directive requires Member States to submit, every 2 years, **projections** of air pollutant emissions for the years 2020, 2025 and 2030, which allows to assess the extent to which Member States are on track to meet their ERCs for 2020-2029 and for 2030 onwards. Projected emission levels for 2025 are also assessed against the linear trajectory between the 2020-2029 and 2030+ ERCs. Projections must cover a 'with measures' scenario (existing measures only) and, where relevant, a 'with additional measures' scenario (existing measures and planned additional measures). If a Member State projects that it will meet all of its emission reduction commitments under existing measures, no 'with additional measures' scenario is required.

[24] Belgium, Croatia, Denmark, Estonia, Finland, France, Greece, Netherlands, Slovenia, Spain.

The latest reporting of projections by Member States took place in 2025. All Member States submitted projections in time to be reviewed in detail[25]. For the 'with measures' scenario, non-compliance was most frequently projected for NH_3 (5 Member States in 2025 against the 2020-29 ERCs, and 8 Member States in 2030 against the 2030+ ERCs), highlighting the need for additional measures addressing NH_3 emissions. NMVOC, NO_x and $PM_{2.5}$ show similar occurrences of projected non-compliance both in 2025 with one or two Member States each and in 2030 with 6 (NMVOC, NO_x) and 4 ($PM_{2.5}$) Member States each. With one exception, meeting the SO_2 emission reduction commitments does currently not appear to be an issue across the EU.

Under the 'with measures' scenario, the analysis further shows that 19 Member States[26] project to fulfil *all* 2020-2029 emission reduction commitments in 2025, while the number falls to 13[27] for the 2030 commitments in 2030. All Member States that project not reaching their emission reduction commitments with existing measures need to put in place additional measures. However, 4 Member States that project non-compliance with one or more emission reduction commitments in their 'with measures' scenario did not report a 'with additional measures' scenario[28].

In parallel, of the 16 Member States that reported a 'with additional measures' scenario, one does not project compliance with all of the emission reduction commitments in 2025[29] and 6 in 2030[30]. These Member States (along with those projected to be in non-compliance in the 'with measures' scenario and not reporting a 'with additional measures' scenario) will need to put in place additional measures to fulfil their emission reduction commitments.

Projections submitted by Member States were also assessed against the **linear reduction trajectory** between emission reduction commitments in 2020 and 2030. While 19 Member States project their 2025 emissions to be in line with the 2020-2029 emission reduction commitment under the 'with measures' scenario, this number drops to 15[31] when assessed against the linear reduction trajectory in 2025. Considering also the 'with additional measures' scenario, 18 Member States[32] project to meet the linear trajectory.

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25 Member State review reports of the 2025 projections are available at: https://environment.ec.europa.eu/topics/air/reducing-emissions-air-pollutants/national-air-pollution-control-programmes-and-projections_en.

26 Belgium, Czechia, Denmark, Germany, Estonia, Greece, Spain, France, Croatia, Italy, Cyprus, Latvia, Luxembourg, Malta, Netherlands, Austria, Poland, Slovenia and Finland.

27 Belgium, Bulgaria, Cyprus, Denmark, Germany, Estonia, Greece, France, Italy, Latvia, Netherlands, Austria, and Finland.

28 Bulgaria, Czechia, Hungary and Sweden, this includes projected non-compliances for 2025 and 2030.

29 Ireland.

30 Spain, Ireland, Lithuania, Malta, Portugal and Slovenia.

31 Belgium, Denmark, Estonia, Greece, Spain, France, Croatia, Italy, Cyprus, Latvia, Netherlands, Austria, Poland, Slovenia, and Finland.

32 Belgium, Denmark, Estonia, Greece, Spain, France, Croatia, Italy, Cyprus, Latvia, Luxembourg, Netherlands, Austria, Poland, Portugal, Slovakia, Slovenia, and Finland.

The Commission also conducts its own modelling exercise to complement Member State projections to assess compliance prospects under different scenarios. The **Fourth Clean Air Outlook (CAO4)** summarises the results of the latest modelling (see table below).

Table A - 4 – Member States projected to miss their emission reduction commitments. (Source: 4th Clean Air Outlook, based on IIASA et al, 2025[33], modelling results)

Scenario	Year	NH_3	NMVOC	NOx	$PM_{2.5}$	SO_2
Baseline	2025	DK, IE, LV, NL, PT, SK, SE	-	LT, RO	RO	-
Baseline	2025 (indicative)	BG, CZ, DK, DE, IE, ES, FR, HR, LV, LU, HU, NL, PL, PT, SK, SI, SE	LT	LT, RO	CZ, HU, PL, RO, SI	-
Baseline	2030	BE, BG, CZ, DK, DE, IE, ES, FR, HR, CY, LV, LU, HU, NL, AT, PL, PT, RO, SK, SI, SE	LT, HU, SI	MT, RO	CZ, DK, CY, ES, HU, PT, RO, SI	-
All technical measures	2030	NL	-	-	-	-

Note: 2025 (indicative) means that the assessment is carried out against the linear reduction trajectory. ' - ' means all Member States are projected to meet the targets.

It is not surprising that there are some differences in the projected emissions and hence the projected status of compliance between the national projections submitted by Member States under Article 10(2) and the Clean Air Outlook projections. In most cases, this can be explained by differences in baseline assumptions that have remained despite overall good alignment[34]. Also, CAO4 does not provide a 'with additional measures scenario', but focuses on current policies in its baseline formulation.

Assessing both current emissions as well as projected emissions (and this conclusion holds across CAO4 and national projections) against the indicative 2025 levels and the more ambitious ERC for 2030 onwards shows that many Member States have not yet implemented effective measures to ensure they are on the right track. As part of the 4th Clean Air Outlook, an 'ERC scenario' was modelled to assess feasibility of compliance and necessary additional emission reductions to meet ERCs. **The analysis shows the abatement options Member States *could* have taken over 2015 to 2025 to meet the ERCs**.

- For **NH_3**, key additional measures are in agriculture, including improved mineral nitrogen fertiliser application ('Agr. Fertilizer – improved management' in Figure) referring primarily to applying urea fertilisers more efficiently, use of urease inhibitors, or substitution with for example ammonium nitrate – all of these actions will result in comparable reduction. The other major category is manure

[33] IIASA et al (2025) 'Support to the development of the fourth clean air outlook', Publications Office of the European Union, https://data.europa.eu/doi/10.2779/8768689.

[34] The authors of the support study underpinning CAO4 conducted consultation meetings with every Member State on national data and other assumptions informing the modelling baseline. IIASA et al. (2025) provide ample information on how both historic and projected data align between CAO4 and national inventory and projections data.

management which is distinguishing measures for different animal categories addressing housing, storage and application of manures on fields.

– Most additional reductions for **$PM_{2.5}$** are addressed through effective ban of agricultural residue burning and residential sector by accelerated introduction of more efficient and cleaner stoves and boilers.

– For **NO_x** (only LT and RO projected to be in non-compliance in 2025), measures include improved inspection and maintenance to reduce emissions from high emitting vehicles with either malfunctioning or tampered emission control systems (a low-cost though not necessarily easily implementable one), and further roll-out of cleaner vehicles across a number of vehicle classes.

– For **NMVOC** (only LT projected to be in non-compliance in 2025), it is about further controlling emissions from solvents.

For SO_2, the GAINS modelling projects compliance for all Member States in 2025. See the figure below for a visual illustration for NH_3, with additional pollutants presented in appendix 3 of the support study to this evaluation.

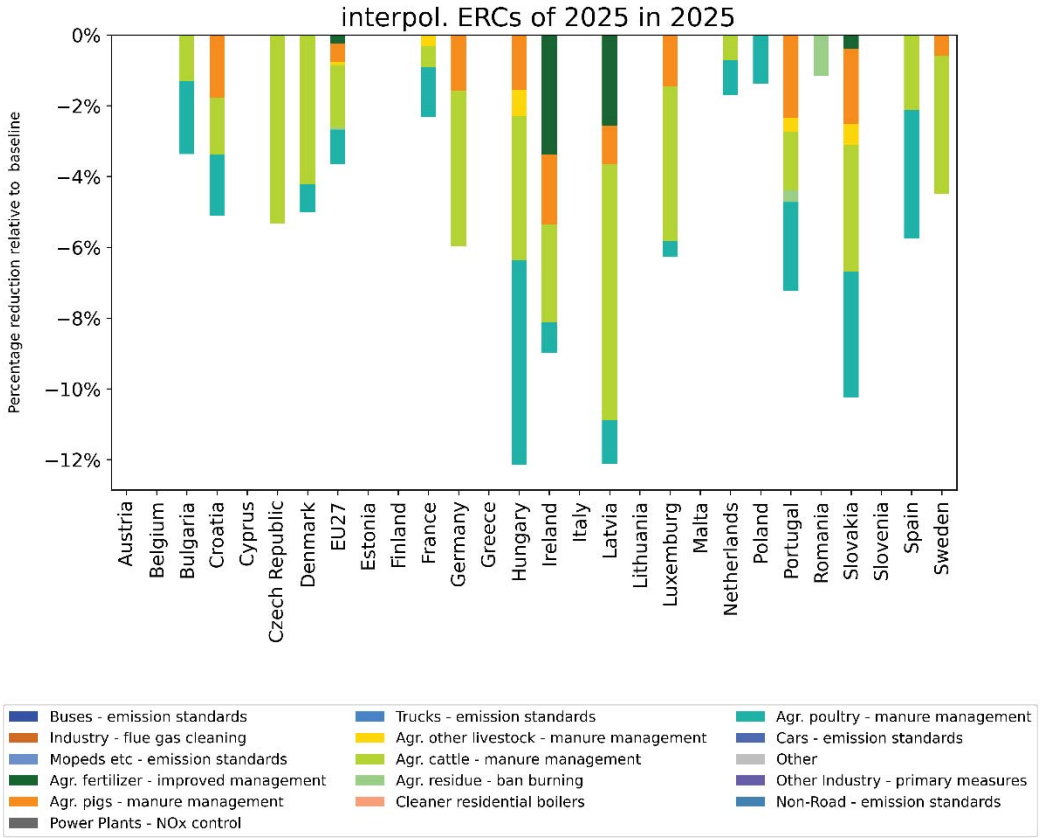


*Figure A - 4 – Key categories of measures to achieve additional reductions of **NH_3** emissions to reach indicative 2025 levels (interpolation between 2020-29 and 2030 ERCs). The figure shows % reduction of emissions in 2025 compared to the baseline, and types of measures needed, where applicable (where no bar is shown for a Member State, no additional reductions are required beyond the baseline).*

2.1.3 Effectiveness of air pollution abatement measures according to stakeholders

Stakeholders responding to the open public consultation (OPC) and targeted consultation (TSC)[35] shared some reasons why certain reduction commitments have not yet been reached by Member States.

Business stakeholders responding to both consultations were focussing on insufficient support for abatement technologies and their application, mentioning that this was a particular obstacle for small- and medium-sized enterprises. This was also echoed by a consumer organisation (OPC), that cited structural difficulties in critical sectors (e.g. agriculture and transport), where technical changes and significant investments are needed. Some public authority respondents (OPC, TSC) also highlighted the need for large investments as a barrier (e.g. to modernise industrial plants, resolve traffic problems, incentivise better agricultural practices, lack of subsidies and solutions for alternative heating for households) and added (TSC) that ammonia was a particular challenge, where a closer link with CAP would be needed. A public authority (TSC) also highlighted the contradiction between climate policy and the NECD concerning the use of wood combustion for heating.

One business stakeholder highlighted insufficient implementation in national law and lack of urgency to address the issue as a reason; one consumer organisation highlighted insufficient implementation of national policies (OPC). Environmental organisations responding thought that the lack of urgency was due to ERCs being too lenient; other NGOs responding also referred to lack of urgency and thought that enforcement should also consider reaching 2030 ERCs. Some public authorities cited insufficient ambition in NAPCPs (OPC), whilst others thought that the ERCs were too ambitious and risked negative socio-economic impact (TSC). According to individuals in a professional capacity responding to the TSC, lack of political will, structural problems and gaps in EU legislation (especially in the agriculture sector) were the main reasons.

Public authorities (TSC) added that inventories were not of sufficient quality, or that the timing and duration of measures did not allow to see their effects.

Some business and public administration stakeholders cited misalignment between policies, mentioning the AAQD, transport policies (Euro 7, NRMM) and agricultural policy.

Some of the citizen respondents to the OPC (7) cited the widespread use of wood burning as an obstacle to reaching ERCs.

[35] Due to the low number of contributions (53 for the open public consultation and 42 for the targeted consultation), replies are not representative and make it difficult to draw general conclusions. Most answers represent the view of a single stakeholder, unless specified otherwise.

2.1.4 Atmospheric concentration of air pollutants compared to WHO guideline exposure levels and EU air quality standards over the evaluation period, relative to 2005 and related quantified health impacts

Reaching ERCs is not an end in itself. Rather, and as stipulated in Article 1 of the NECD, it is a means '*to move towards achieving levels of air quality that do not give rise to significant negative impacts on and risks to human health and the environment*'. The air pollutant with the biggest impacts on human health in Europe is $PM_{2.5}$, followed by ozone (O_3) and NO_x. The NECD sets emission reduction commitments for direct emissions $PM_{2.5}$ and NO_x. While it does not regulate ozone emissions directly (as ozone is a secondary air pollutant that forms in the atmosphere by reactions of ozone precursors in the presence of sunlight and heat) it does set reduction commitments for the emissions of ozone precursors NO_x and NMVOC (but not for methane, which is an important ozone precursor also). Emissions of air pollutants influence ambient concentrations both directly (such as $PM_{2.5}$, NO_x or SO_2 emissions contributing to $PM_{2.5}$, NO_2 or SO_2 ambient concentrations, respectively) and indirectly (such as primary air pollutants undergoing chemical reactions in the atmosphere to form secondary air pollutants, see the ozone example above, or NH_3 emissions combining with SO_2 or NO_x to transform into secondary $PM_{2.5}$). Concentrations are also influenced by meteorological conditions that influence dispersion (wind speed and direction, precipitation) and orography (valleys can trap pollutants, leading to higher concentrations, whereas coastal regions might experience more immediate dispersion due to sea breezes). So, while there is an established link between pollutant emissions and concentrations, the exact relationship differs at the local scale.

Health impacts are assessed on the basis of concentration response functions that link the risk of health impacts (defined as either premature mortality or and morbidity linked diseases associated with air pollution) to changes in the concentration of a given air pollutant in ambient air. **Despite ongoing overall improvements in air quality, air pollutant concentrations in 2023 remained well above the guideline exposure levels recommended by the World Health Organization** (WHO) in its 2021 air quality guidelines. In 2023, most people living in urban areas in the EU were exposed to air pollution at levels that to some degree damage their health[36]. The EEA estimates that air pollution is the single largest environmental health risk in Europe and it is one that disproportionately affects sensitive and vulnerable social groups[37], making action to address air pollution also a matter of fairness and equality.

Air quality and thus associated health impacts are not the same across the EU, there are clear regional disparities. In 2023, the year for which the latest validated data are available, **$PM_{2.5}$** concentrations above the EU annual limit value were seen in Italy and some eastern European countries (see Figure A-5). Solid fuel use is the main reason for the situation in central and eastern Europe, together with an older vehicle fleet. In northern Italy, relatively high concentrations are due to the combination of a high density of anthropogenic emissions and meteorological and geographical conditions that favour the accumulation of

[36] European Environment Agency (2025) Air quality status report 2025.
[37] EEA Report No 22/2018.

air pollutants in the atmosphere and the formation of secondary particles. Within a given Member State, there are differences between rural and urban locations. EEA analysis furthermore points out differences between wealthier and less well-off regions: '*despite improving trends in air pollution for both the richest and poorest regions of the European Union over the 2007-2021 period, inequalities remain with $PM_{2.5}$ concentrations consistently higher by around one third in the poorest regions*'[38].

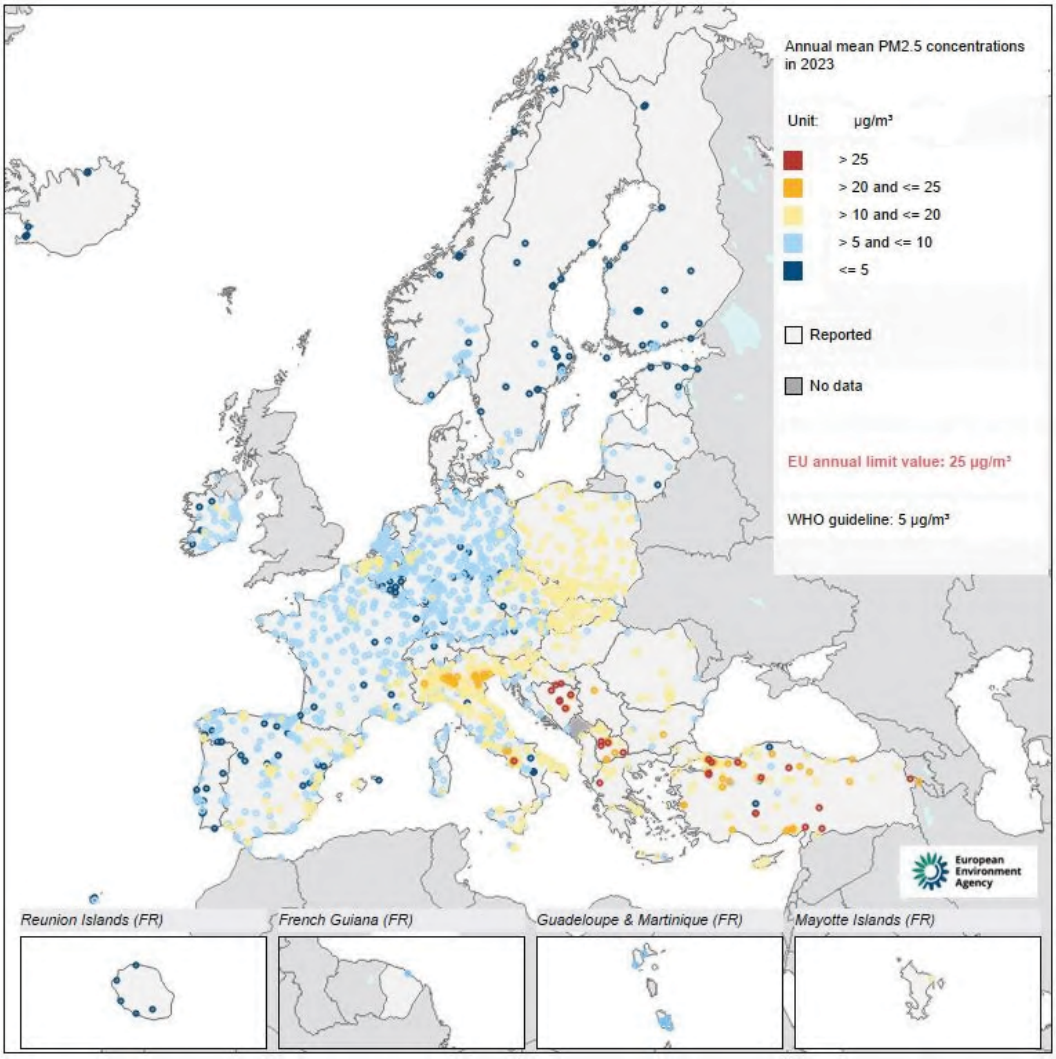


Figure A - 5 – Concentrations of $PM_{2.5}$ in 2023 in relation to the EU annual limit value and the WHO annual guideline level. Source: EEA air quality status 2025.

The average exposure indicator (AEI) for $PM_{2.5}$ between the base year (around 2010 or 2011) and 2023 shows how background concentrations have developed over time. Specifically, it assesses the general population's long-term exposure to $PM_{2.5}$ in urban areas and is based on a 3-year average measured at urban background stations. For

[38] Earlier EEA analysis (report 22/2018) has looked into 'Unequal exposure and unequal impacts' finding that '*uneven distribution of the impacts of air pollution, noise and extreme temperatures on the health of Europeans closely reflects the socio- demographic differences within our society*' and that '*in many European countries, such disproportionate exposure occurs in urban areas*'. It further finds that regions that are both relatively poorer and suffering from higher PM pollution '*are located mainly in eastern and south-eastern Europe*'. However, '*the link between socio-economic status and exposure to PM is also present at a finer-scale, local level*'.

instance, the AEI in year 2023 is the average of years 2023, 2022 and 2021. It is used as the basis for assessing whether Member States meet the national exposure reduction target (NERT) set in the AAQD (2008/50/EC). All Member States have reduced exposure of their urban population to $PM_{2.5}$ by at least 17% at a national level. Five Member States have at least halved levels of exposure, with several others close to halving. The figure below indicates that in relative terms, the biggest drops observed were in IE, LU, BG, CZ and DK. In absolute terms, the biggest drops were in BG, CZ, LU, BE and PL. The impressive drop in the AEI and hence reduced background concentrations can be attributed to reduced emissions at the national level, showing that the NECD working in synergy with source legislation have been effective in reducing population exposure to $PM_{2.5}$.

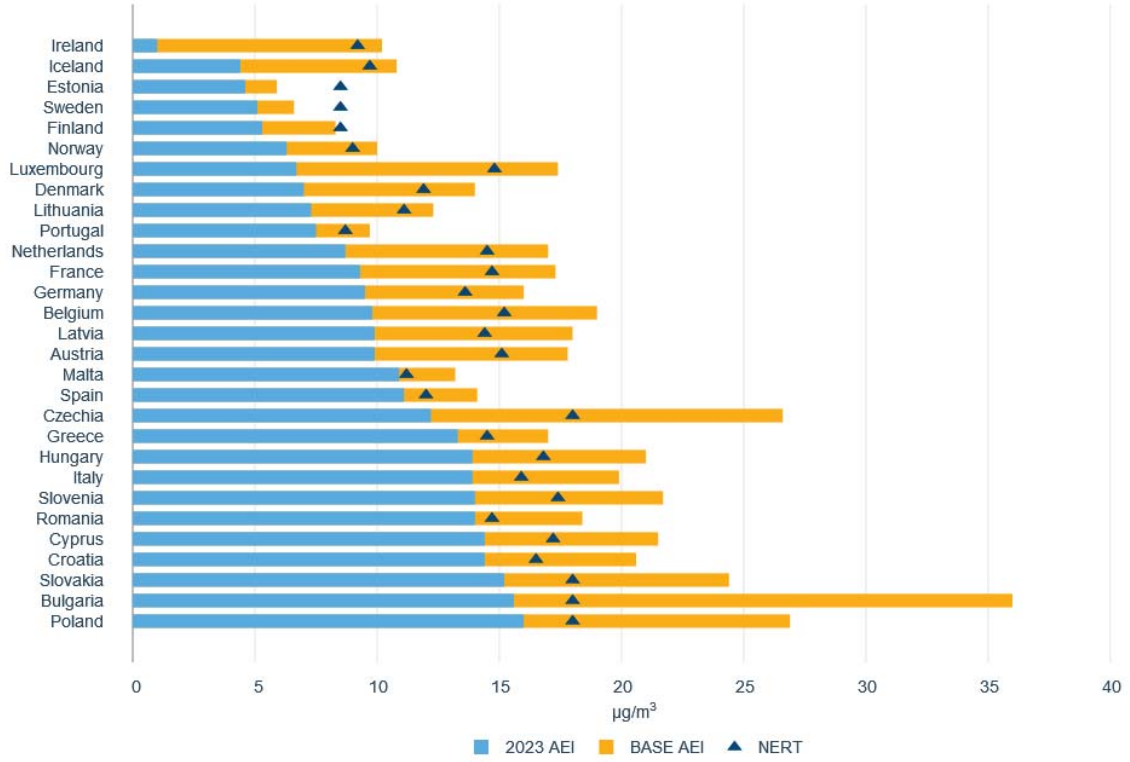


Figure A - 6 – Reduction in AEI 2023 in relation to the base AEI and distance to the NERT. Source: EEA[39]. Note: Total stacked bars indicate the initial baseline AEI for 2010 or 2011 (AEI 2015 in the case of Croatia). Triangles indicate the national exposure reduction target (NERT) to be met in 2023, applying the percentage reduction to the AEI baseline. Blue bars indicate the reported AEI2023. If the triangle is to the right of the blue bar, the NERT was achieved in 2023.

The zero pollution dashboard for regions[40] shows how concentrations of $PM_{2.5}$ have changed over 2016-2022 at the level of EU regions. It shows that from 2016 to 2020, 97% of regions have improved air quality, with 17 regions having improved air quality by one third or more. The EEA's European city air quality data viewer gives even more granular information on the air quality in European cities (>50 000 inhabitants) in 2022 and 2023 and allows for comparisons between cities. The resulting map shows a very similar pattern to above concentration map for $PM_{2.5}$. The leading source of **NO_2** is road transport, which emits NOx close to the ground, mostly in densely populated areas, disproportionately

39 https://www.eea.europa.eu/en/analysis/publications/air-quality-status-report-2025/average-exposure-indicator

40 The dashboard has been published as a prototype, aimed to be progressively finetuned.

contributing to population exposure. Other important sources are combustion processes in industry and energy supply. Concentrations above the annual limit value were found in some big cities with a high volume of traffic, as shown in the figure below.

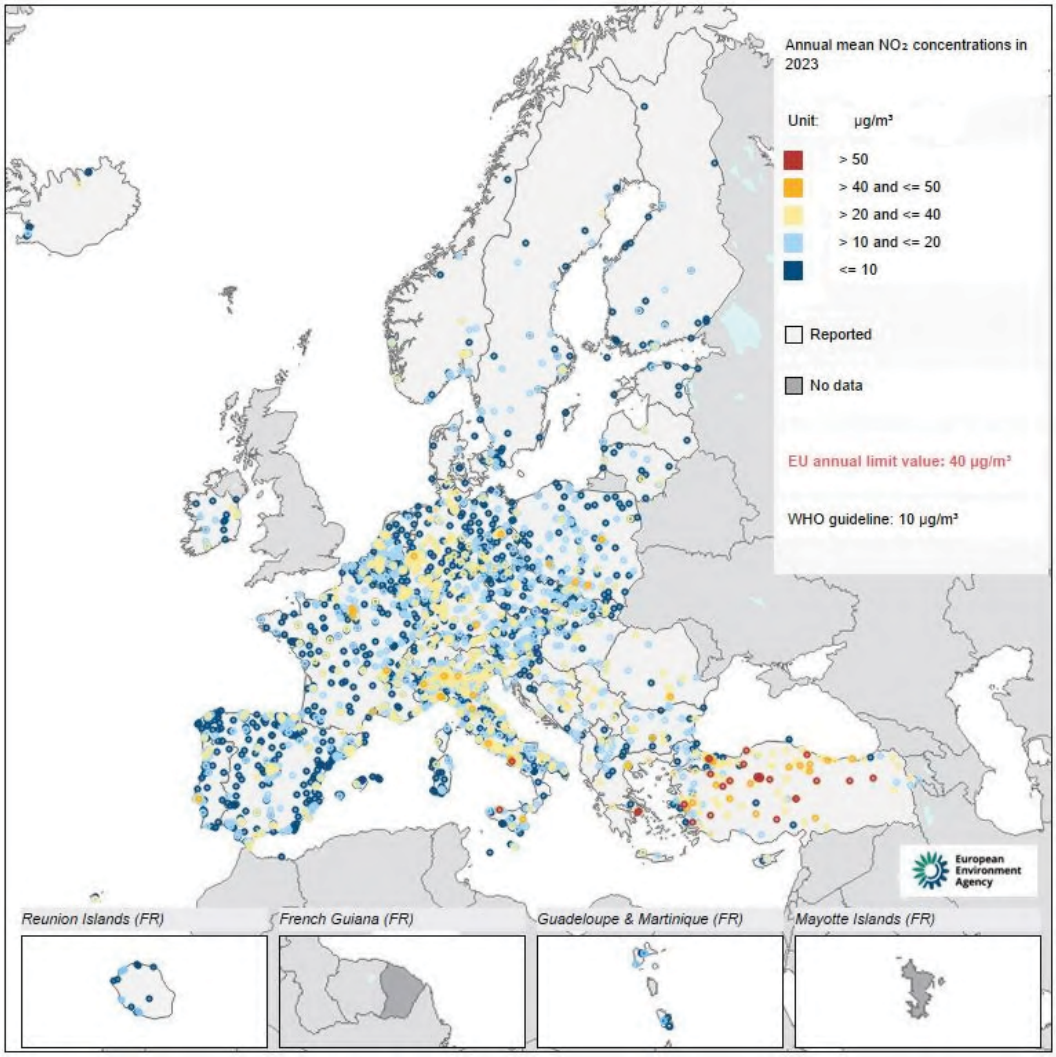


Figure A - 7 – Concentrations of NO_2 in 2023 in relation to the EU annual limit value and the WHO annual guideline level. Source: EEA air quality status 2025.

Ozone (O_3) is formed in the atmosphere when heat and sunlight cause chemical reactions between nitrogen oxides and volatile organic compounds (VOC). The NECD sets reduction commitments for NO_x and non-methane volatile organic compounds (but not for methane). Emissions of these gases occur from anthropogenic sources (transport and industry being important sources of NO_x and NMVOC, respectively) and, in the case of VOC, also from biogenic sources. Ozone concentrations in Europe are also strongly influenced by emissions of long-lived precursor pollutants (such as methane) from other parts of the northern hemisphere. Meteorology plays an important role and explains ozone peaks occurring in summer months. In 2023, the highest concentrations were found in the eastern Mediterranean Sea, Italy, the Iberian Peninsula and central Europe (see figure

below). Ozone concentrations have seen little reduction, with the population weighted SOMO35 exposure indicator having decreased by 10% over 2005 to 2020[41].

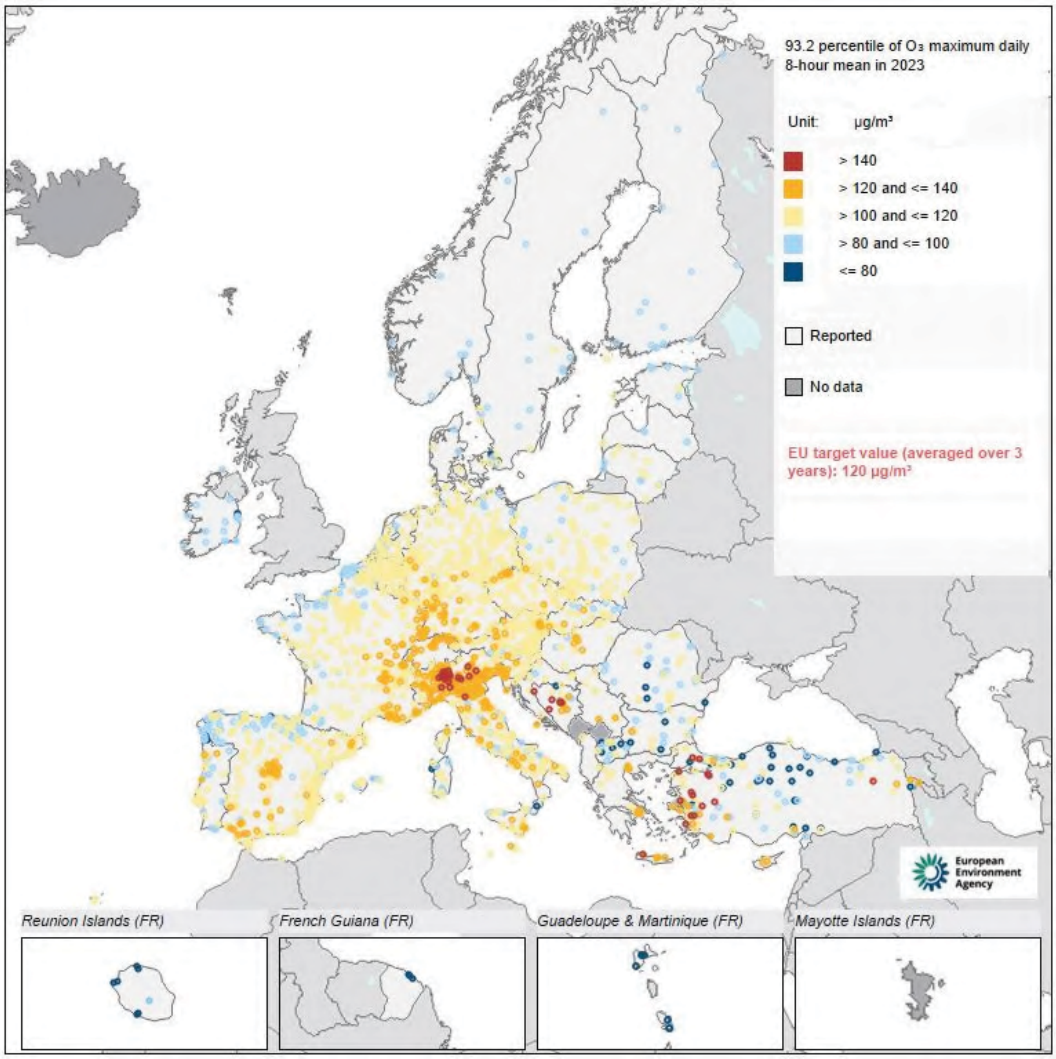


Figure A - 8 – Concentrations of O_3 in 2023 in relation to the EU target value. Source: EEA air quality status 2025.

Together with source legislation, the NECD and the AAQD form the three pillars of clean air policy. Whilst the AAQD focuses on exposure of citizens to pollutant concentrations at the local level, the NECD addresses pollutant emissions at national level, which contributes to reducing overall background air pollution. In this way, **the NECD helps achieve air quality standards in Member States set by the AAQD**.

At the same time, to comply with air quality standards under the AAQD, Member States implement air quality plans at local and/or regional level, including measures reducing air pollutant emissions, in turn contributing to complying with ERCs under the NECD. The extent of this effect depends on the particular situation in each Member States, including on how significant the emission reductions brought by local measures are in relation to the national total emissions for a given pollutant. In looking at the compliance situation in

[41] Based on GAINS model used for 4th Clean Air Outlook. The SOMO35 exposure indicator is calculated as the sum of the daily exceedances of maximum 8-hour ozone concentrations over 35 ppb threshold, summed over the whole year.

2022 for both the emission reduction commitments under the NECD and the corresponding air quality standards under the AAQD (see the table below), it is apparent that there is no close correlation between the two. For example, there are a number of Member States (11) that are compliant with all their NECD ERCs, yet continue to have at least one zone in exceedance under the AAQD. For some of those, this could be interpreted as a lack of coherence between the ambition level of ERCs and air quality standards. For others, exceedances under the AAQD are limited to one or very few zones. This would then represent a matter of resolving a local air quality hotspot, rather than one linked to an elevated level of national air pollutant emissions. In a few other Member States, the air quality limit values most closely associated with NECD main pollutants are met, yet there are non-compliances with ERCs, in several cases with those for ammonia for which monitoring requirements under the AAQD have only been introduced recently. The ozone target value under the AAQD is exceeded in a relatively large number of zones.

Table A - 5 – Overview of compliance in 2022 with emission reduction commitments under the NECD and selected air quality standards under the AAQD

	NECD (√=compliant, X=non-compliant in 2022 based on 2024 submission)					AAQD standards (number of zones in exceedance in 2022)				
	NO_X	NMVOC	SO_2	NH_3	$PM_{2.5}$	NO_2 (annual limit value)	PM_{10} (daily limit value)*	$PM_{2.5}$ (annual limit value)	SO_2 (daily and hourly limit values)	O_3 (target value, daily 8-hour mean)
AT	√	√	√	X	√	0	0	0	0	7
BE	√	√	√	√	√	3	2	0	0	0
BG	√	√	√	X	√	1	3	0	0	2
CY	√	√	X	√	√	0	0	0	0	1
CZ	√	√	√	√	√	0	1	0	0	2
DE	√	√	√	√	√	2	0	0	0	11
DK	√	√	√	√	√	0	0	0	0	0
EE	√	√	√	√	√	0	0	0	0	0
ES	√	√	√	√	√	1	1	0	0	10
FI	√	√	√	√	√	0	0	0	0	0
FR	√	√	√	√	√	4	1	0	0	12
GR	√	√	√	√	√	1	3	0	0	2
HR	√	√	√	√	√	0	1	1	0	2
HU	√	√	√	X	X	0	1	0	0	2
IE	√	√	√	X	√	0	0	0	0	0
IT	√	√	√	√	√	9	28	6	0	47
LT	X	X	√	X	√	0	0	0	0	0
LU	√	√	√	√	√	0	0	0	0	1
LV	√	√	√	X	√	0	0	0	0	0
MT	√	√	√	√	√	0	0	0	0	1
NL	√	√	√	√	√	0	0	0	0	0
PL	√	√	√	√	√	4	14	1	0	0

	NECD (√=compliant, X=non-compliant in 2022 based on 2024 submission)					AAQD standards (number of zones in exceedance in 2022)				
	NO_X	NMVOC	SO_2	NH_3	$PM_{2.5}$	NO_2 (annual limit value)	PM_{10} (daily limit value)*	$PM_{2.5}$ (annual limit value)	SO_2 (daily and hourly limit values)	O_3 (target value, daily 8-hour mean)
PT	√	√	√	X	√	2	0	0	0	1
RO	X	√	√	√	X	2	4	0	0	6
SE	√	√	√	X	√	0	3	0	0	0
SI	√	√	√	√	√	0	1	0	0	1
SK	√	√	√	√	√	0	3	0	0	0

Note: The AAQD sets both a daily and an annual limit value for PM_{10}. Overall, compliance with the annual limit value for PM_{10} is higher. To highlight outstanding challenges, compliance with the daily limit value has been used for the purposes of this overview.

In terms of **health impacts**, approximately 239 000 premature deaths are attributable to exposure to $PM_{2.5}$ in the EU, 70 000 to O_3 and 48 000 to NO_2 in 2022[42]. At the same time, clear improvements have been tracked over time, with the number of deaths in the EU attributable to $PM_{2.5}$ falling by 45% between 2005 and 2022. Latest EEA data show a decrease of 57% between 2005 and 2023[43], leading to 182,000 deaths from exposure to fine particulate matter ($PM_{2.5}$), 63,000 from exposure to ozone (O_3) and 34,000 from exposure to nitrogen dioxide (NO_2) in the EU in 2023[44]. If this trend continues, which depends in particular on the effective implementation of all existing and planned legislation, the EU is set to overachieve the target to reduce the number of premature deaths by 55% by 2030 compared to 2005, which was established in the Zero Pollution Action Plan (ZPAP). The 4th Clean Air Outlook (CAO4) report shows that by 2030, depending on the scenario assumption, premature deaths may fall between 62% to 68% compared to 2005.

42 https://www.eea.europa.eu/en/analysis/publications/harm-to-human-health-from-air-pollution-2024. Note that estimations for the environmental burden of disease are made individually for the respective air pollutants: they cannot be added together as they exhibit a degree of correlation (especially in the case of $PM_{2.5}$ and NO_2). Note also that these estimates are based on air pollution concentration *monitoring* and only include premature deaths attributable to air pollution above WHO air quality guidelines levels, unlike the estimate from CAO4 *modelling* results shown in Figure A-9, which reflects all impacts (including below WHO guidelines level), to remain consistent with previous Clean Air Outlook analyses.

43 The number of estimated attributable deaths is subject to a certain interannual variability, as seen in the time series of the indicator: https://www.eea.europa.eu/en/analysis/indicators/health-impacts-of-exposure-to.

44 https://www.eea.europa.eu/en/analysis/publications/harm-to-human-health-from-air-pollution-burden-of-disease-status-2025

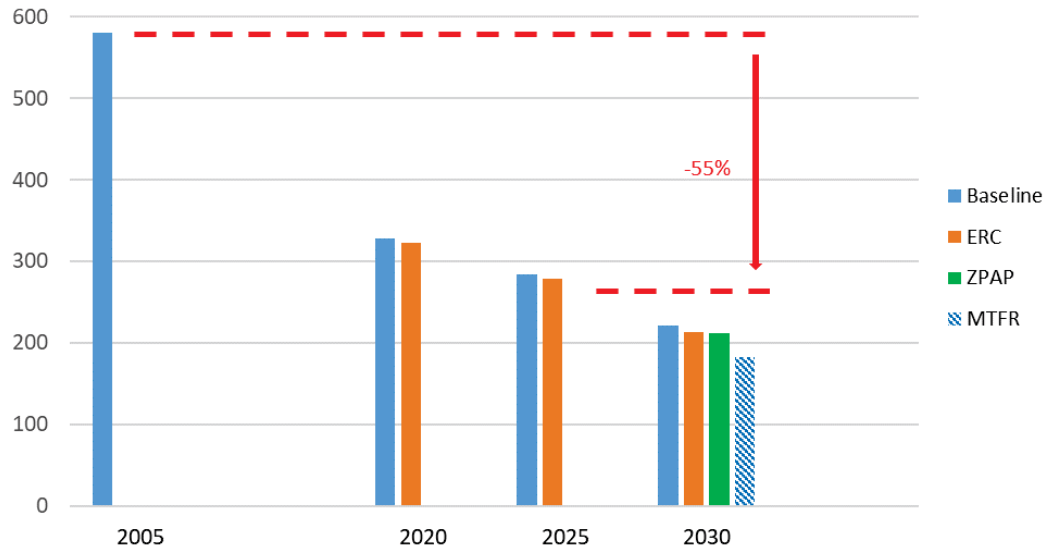
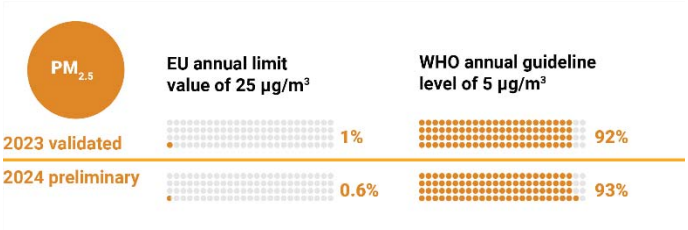


Figure A - 9 – Cases of premature deaths attributable to the exposure to total $PM_{2.5}$ concentrations in the EU27, in thousand cases per year. Source: CAO4, based on IIASA et al. (2025). Note: The marked 55% refers to the Zero Pollution target. Only anthropogenic sources of $PM_{2.5}$ are included, in line with the way the zero pollution target was set. 'ERC' is a scenario in which the model assumes Member States meet their ERC (within feasibility constraints), 'ZPAP' is a scenario that estimates the cost-effective set of measures needed to reach the 25% reduction target at EU level, 'MTFR' is the maximum technical feasible reduction scenario.$_{2.5}$ are included, in line with the way the zero pollution target was set. 'ERC' is a scenario in which the model assumes Member States meet their ERC (within feasibility constraints), 'ZPAP' is a scenario that estimates the cost-effective set of measures needed to reach the 25% reduction target at EU level, 'MTFR' is the maximum technical feasible reduction scenario.

Figure A-10 shows what the latest data on air pollutant concentrations means for **compliance with EU air quality standards** and **WHO air quality guideline levels** for different pollutants. Due to progress made over time driven by EU clean air policies and source legislation pulling in the same direction, the compliance situation with current EU air quality standards is good for the vast majority of monitoring stations for $PM_{2.5}$ and NO_2, with challenges remaining for meeting the ozone target value.

However, concentrations remain above the WHO air quality guideline levels for $PM_{2.5}$ at the vast majority (>90%) of monitoring stations. For NO_2, air quality at around a third of monitoring stations is already in compliance with the more stringent WHO guideline level. For ozone, most stations report values above WHO guideline level.



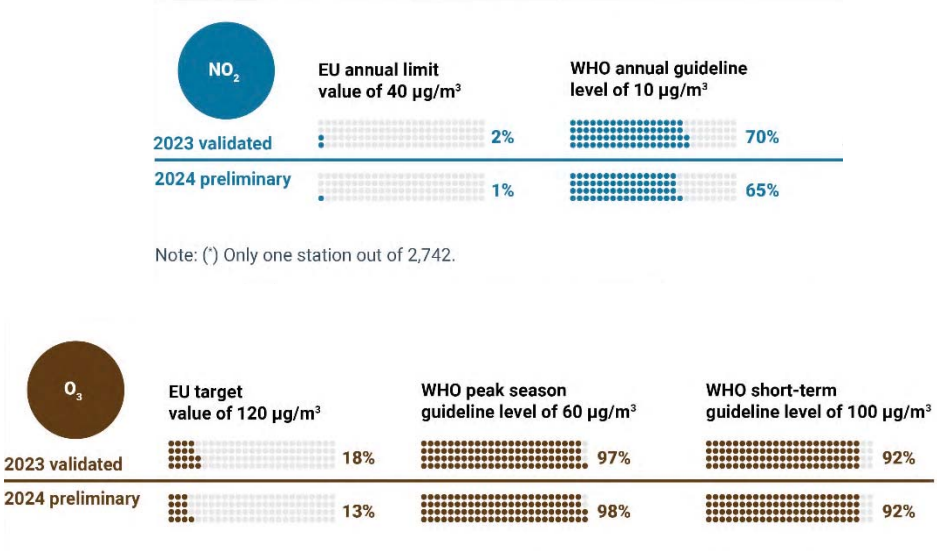


Figure A - 10 – Percentage of reporting monitoring stations registering concentrations above the EU limit values (target value in the case of O_3) and the WHO guideline levels in 2023 and (based on preliminary data) 2024. Source: EEA air quality status 2025

There was broad agreement across **stakeholders** (and this holds across both the OPC and TSC) that the NECD has played a positive role in improving air quality in the EU. In the OPC, over three-quarters of respondents considered the Directive to have contributed either moderately or significantly to better air quality and the reduction of associated health and environmental risks. Similarly, the TSC results showed an overwhelming consensus across all stakeholder groups that the Directive had contributed to improved air quality. While the majority view was positive, a small minority — most notably among NGOs, industry representatives and public authorities — expressed more neutral or sceptical views, suggesting that in some contexts the Directive's impact may have been limited or difficult to attribute.

2.1.5 Quantified ecosystem impacts of air pollution and whether the EU is on track for the ecosystem-related ZPAP target

Ecosystem impacts of air pollution

Air pollution does not only cause harm to humans, but also affects ecosystem health through acidification, eutrophication and ozone impacts:

- **Acidification** ('acid rain'): Air pollutants like SO_2 and NO_x can react with water in the atmosphere to form acid rain. This acidic precipitation can lower the pH of soil and water bodies, damaging aquatic habitats, killing fish and other aquatic life, and leaching essential nutrients from the soil, which adversely affects plant growth.

- **Ozone damage**: Ground-level ozone, formed when volatile organic compounds, including methane and non-methane ones, and NO_X react in the presence of sunlight, can harm plants by damaging leaf tissues, reducing photosynthetic efficiency, and impairing growth. This can lead to decreased agricultural yields and affect the health of forests and other vegetation.

– **Eutrophication**: Nitrogen is present in the air in different forms, including as nitrogen monoxide, nitrogen dioxide and ammonia. Nitrogen pollution, often from agricultural runoff or vehicle emissions, can lead to eutrophication in water bodies. This process accelerates the growth of algae, which can deplete oxygen in the water upon decomposition, leading to dead zones where aquatic life cannot survive. In sensitive terrestrial ecosystems such as grasslands, if critical loads[45] for nitrogen deposition are exceeded, sensitive species can be lost.

Ecosystems can further be damaged by particulate matter settling on leaves and soil, affecting photosynthesis and respiration in plants, and by contamination through heavy metals.

Acidification has significantly reduced – by 63% over 2005-2020[46] – and is set to continue to reduce: By 2030, less than 3% of the ecosystem area in the EU would suffer from acid deposition exceeding critical loads, compared to 15% in 2005 (CAO4). This demonstrates the benefits of the significant decrease in SO_2 emissions that has already been achieved over the past decades.

The situation is considerably less positive when looking at the **eutrophication** impacts of air pollution[47]. The EEA estimated that in 2022, 73% of the ecosystem area in the EU were above the critical load for eutrophication[48] (the figure below shows the spread of eutrophication across Europe). At Member State level, the highest exceedances of nitrogen critical loads in 2022 were found in the Po Valley in Italy, on the border areas between the Netherlands and Germany, along the border between Denmark and Germany and in north-eastern Spain, with some additional hotspots in the Netherlands and its border areas with Belgium. The total area where nitrogen deposition exceeded the critical loads for eutrophication fell by 13% between 2005 and 2022 (and by 12% over 2005-2020, to have a figure corresponding to the one above derived from the GAINS model for acidification).

45 The critical load refers to a threshold below which the ecosystem can absorb pollutants deposited from the atmosphere without disruption. Deposition above this threshold is likely to disrupt terrestrial and aquatic ecosystems and lead to changes in species diversity. Critical loads are different for different ecosystem types.

46 Based on the GAINS model used for the 4th Clean Air Outlook.

47 Assessed as area of ecosystems where nitrogen deposition exceeds the critical loads.

48 https://www.eea.europa.eu/en/analysis/publications/impacts-of-air-pollution-on-ecosystems-in-europe

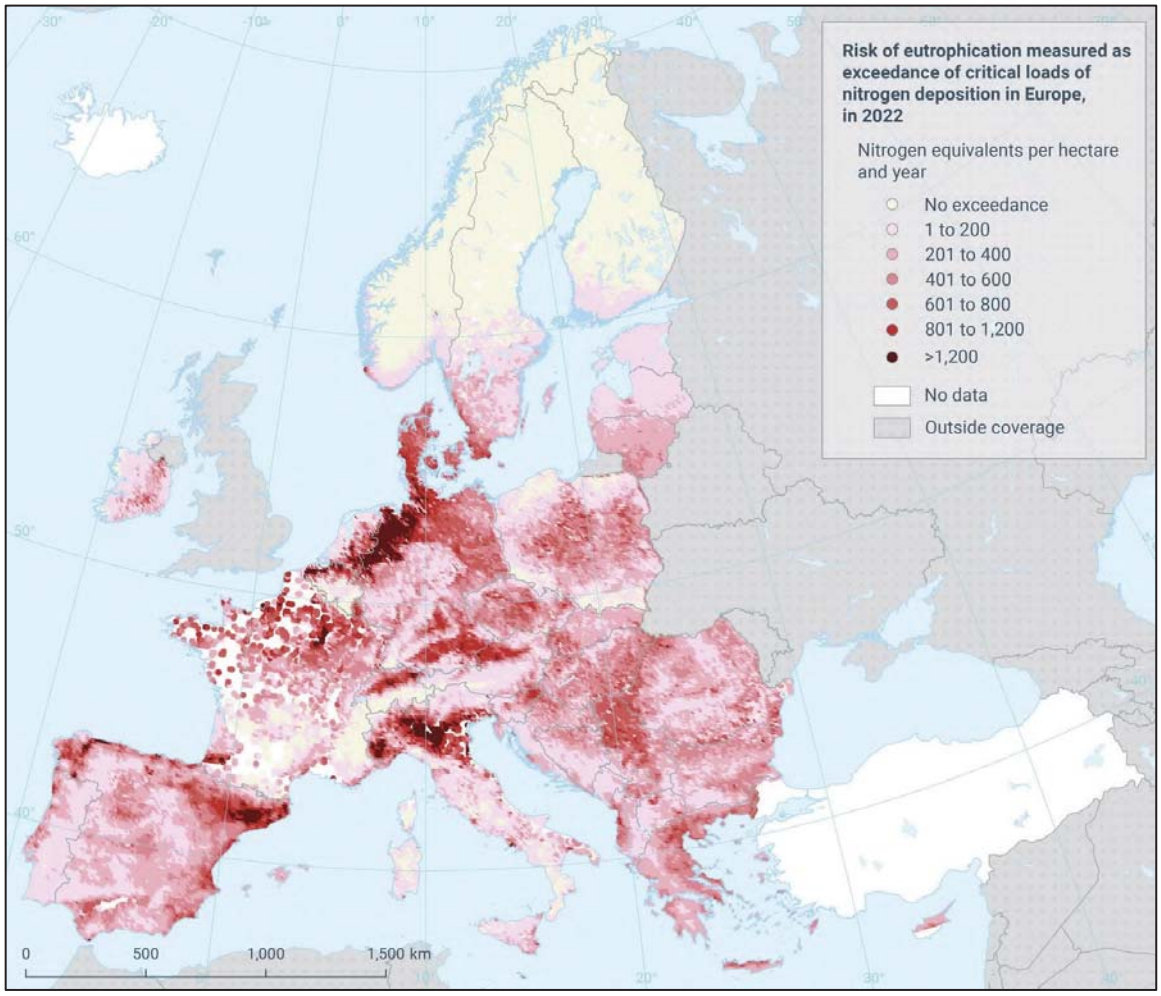


Figure A - 11 – Atmospheric nitrogen deposition above critical loads for eutrophication in Europe in 2022. Source: EEA (2024) Impacts of air pollution on ecosystems in Europe.

The ZPAP aims to reduce pollution in the EU to levels not harmful to human health or ecosystems. Target 3 of the plan sets an objective to reduce the area of ecosystems where nitrogen deposition exceeds critical loads by 25% by the year 2030, compared to levels in 2005. Based on the latest projections done in CAO4, the EU will not achieve this target under baseline policies only (Figure A - 12). Under the baseline scenario, 69% of the EU ecosystem area would still suffer from eutrophication in 2030 (compared to 86% in 2005, with expected additional benefits from implementing the Nature Restoration Regulation[49]). Under the same baseline conditions, protected areas would continue to be highly affected in 2030, with 60% of Natura 2000 areas suffering from eutrophication (compared to 78% in 2005). If all technical measures were taken ('MTFR'), the share of the EU ecosystem suffering from eutrophication would fall to 59% (to 49% in Natura 2000 areas) by 2030.

[49] Regulation (EU) 2024/1991 of the European Parliament and of the Council of 24 June 2024 on nature restoration and amending Regulation (EU) 2022/869.

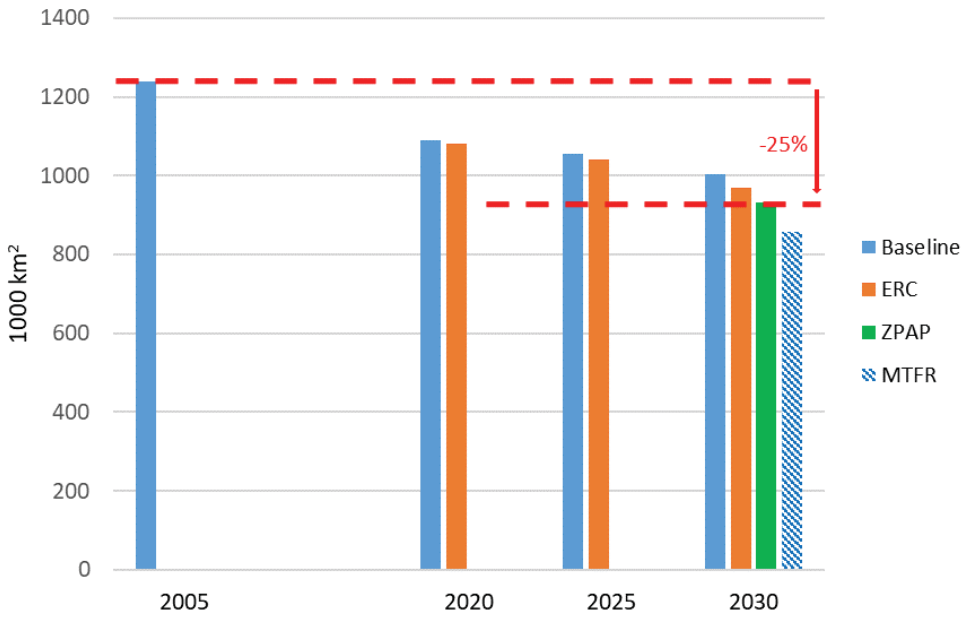


Figure A - 12 – Ecosystem area in the EU-27 where the critical loads for eutrophication are exceeded. Source: CAO4 based on IIASA et al. (2025). Note: The marked 25% indicates the zero-pollution target. 'ERC' is a scenario in which the model assumes Member States meet their applicable ERCs (within feasibility constraints), 'ZPAP' is a scenario that estimates the cost-effective set of measures needed to reach the 25% reduction target at EU level, 'MTFR' is the maximum technical feasible reduction scenario.

There are also important **ecosystem impacts from exposure to ground-level ozone**, with direct economic consequences on forests (reduced timber production) and cropland (reduced yields). In 2022, almost one third of Europe's agricultural lands were exposed to ground-level ozone (O_3) concentrations above the threshold value set for protection of vegetation in the AAQD. The highest wheat yield losses in 2022 were estimated in Belgium (7.3%), France (6.9%), Czechia (6.6%) and Spain (6.4%), while the highest potato losses were estimated for Czechia (10%), Slovenia (8.9%) Germany (8%) and France (7.1%)[50].

2.1.6 Number of ongoing infringement cases for non-compliance with ERCs, rationale for cases being brought and status

In 2022 (based on 2020 data), the Commission found 19 cases of non-compliance with the national emission reduction commitments for 2020 to 2029, spread over 14 Member States[51]. While all five pollutants are concerned, most non-compliance cases related to ammonia. As a consequence, the Commission issued letters of formal notice to these 14 Member States[52].

In 2023 (based on 2021 data), the compliance assessment showed that most non-compliance cases had not been resolved, and that there were a few additional breaches.

50 EEA web report no 22/2024, Impacts of air pollution on ecosystems in Europe.
51 Bulgaria, Denmark, Ireland, Spain, Cyprus, Latvia, Lithuania, Luxembourg, Hungary, Austria, Poland, Portugal, Romania and Sweden.
52 https://ec.europa.eu/commission/presscorner/detail/EN/inf_23_142

The Commission followed up accordingly, with three[53] additional letters of formal notice and nine[54] reasoned opinions issued in November 2023[55]. The case against Spain for not meeting ammonia reduction commitments was closed in 2023, as the inventory submitted in 2023 showed compliance across the time period covered by the case. In November 2025[56], the Commission decided to refer four Member States[57] to the Court of Justice of the European Union and issued a letter of formal notice to another Member State[58] for failure to comply with ERCs.

2.2 To what extent has the NAPCP and related requirements been instrumental in reaching the Directive's objectives?

This section explores the contribution of the NAPCPs, the NAPCP template and related requirements for transboundary consultations and agricultural measures of Annex III part 2 to the objectives of the NECD. Unless stated otherwise, the findings presented in this section result mainly from the horizontal review report of the NAPCP submissions[59].

2.2.1 Extent and timing of NAPCP submission across Member States, their quality, coherence and comprehensiveness.

Article 6 of the Directive requires Member States to draw up, adopt and implement national air pollution control programmes (NAPCPs). The NAPCP is the principal governance tool under the NECD supporting Member States to achieve the national emission reduction commitments for 2020-2029 and 2030 onwards and to contributing effectively to the achievement of the air quality objectives. Additional policies and measures (PaMs) selected for adoption by Member States to further reduce emissions where required constitute an essential part of the mandatory content. These additional PaMs have to be reported via the 'EEA-PaM tool', a web-based tool developed by the European Environment Agency (EEA).

Timeliness

In accordance with Articles 6 and 10 of the Directive, Member States were required to provide the Commission with their first NAPCP by 1 April 2019 and to update it at least every four years thereafter. There have been significant delays in meeting this obligation (see table below). Only seven Member States submitted their first NAPCP on time and only 6 out of the 26 Member States for which an update had been required so far, submitted

53 Luxembourg, Poland and Romania.
54 Bulgaria, Cyprus, Ireland, Hungary, Latvia, Lithuania, Austria, Portugal and Sweden.
55 https://ec.europa.eu/commission/presscorner/detail/en/inf_23_5380
56 https://ec.europa.eu/commission/presscorner/detail/en/inf_25_2481
57 Bulgaria, Lithuania, Portugal and Sweden.
58 Slovakia.
59 Ricardo (2022) Horizontal Review Report, which summarises the results of the reviews of first NAPCP by 25 Member States, and one updated NAPCP provided by Ireland and (2024) Horizontal Review Report, which summarises the results of the NAPCP and PaM reviews submitted by 18 Member States, between 15 October 2022 and 1 October 2024. All but one NAPCPs covered are updated programmes.

it within the deadline. First and updated NAPCPs taken together, the deadlines for 14 NAPCPs was missed by more than one year[60].

Table A - 6 – Overview of Member States' timeliness in submitting their NAPCPs (November 2025)

Number of Member States meeting/ missing the deadline		
NAPCP	**1 April 2019**	**At the latest 4 years after the previous submission**
Submission within the deadline	**7 MS** (26%)	**6 MS** (22%)
Late submission	**20 MS** (74%), including: — 2 MS missing deadline by less than two months — 12 MS missing deadline by 2 to 12 months — 6 MS missing deadline by more than 1 year	**13 MS** (48%), including: — 4 MS missing deadline by less than two months — 7 MS missing deadline by 2 to 12 months — 2 MS missing deadline by more than 1 year
No submission	**0 MS** (0%)	**7 MS** (26%) having not submitted, including 6 MS missing the deadline by more than 1 year
Deadline not yet due	**0 MS** (0%)	**1 MS** (4%)

Infringement procedures were opened in February and July 2020 for five Member States for failure to submit their first NAPCP. All Member States concerned subsequently submitted their NAPCP and the procedures were closed. In July 2025, the Commission opened infringement procedures by sending letters of formal notice to six Member states concerning their failure to submit NAPCP updates[61].

The NAPCP is a central governance instrument for Member States to ensure that their emission reduction commitments are met. Of the 40 (first and updated) NAPCPs that were not submitted on time or are still missing, 18 concern 12 Member States that are subject to an open infringement procedure for failing to meet their ERC for at least one pollutant. Although the requirement and deadlines for NAPCP submission apply equally to any Member State, delays in submitting NAPCPs are particularly problematic for Member States not meeting their emission reduction commitments where late submission reflects limited progress in addressing sources of pollution at the Member State level. In addition, delays in updating the NAPCPs affect the Commission's ability to assess the progress made by Member States that fail to meet or that are at risk of not meeting their national emission reduction commitments.

60 This statement corresponds to the situation observed in November 2025.
61 https://ec.europa.eu/commission/presscorner/detail/en/inf_25_1628

Article 6(4) of the NECD requires that Member States update the PaMs contained in the NAPCPs within 18 months of the submission of the latest national emission inventory or national emission projections if according to the submitted data the Member State is found to be non-compliant or at risk of non-compliance. Only 8 updates were submitted by the deadline, as shown in the table below.

Table A - 7 – Overview of Member States' timeliness in submitting their PaMs (November 2025)

PaMs (27 PaMs updates)	At the latest 18 months after the submission of the latest national emission inventory or national emission projections if it shows non-compliance or risk of non-compliance with ERCs
Submission within the deadline	8 submissions (30%)
Late submission	13 submissions (48%)
No submission	6 submissions missing (22%)

Member States give various reasons for delays in reporting NAPCPs and PaMs, including internal problems linked with the adoption of the NAPCP (change of government, lengthy inter-ministerial consultations or public consultations), the wish to align the submission with the finalisation of the NECP, the need to collect better data or the wish to examine possible additional measures.

Through **targeted engagement of competent authorities,** some respondents addressed the frequency of updates, mentioning that it does not seem necessary to update the NAPCP every 4 years, particularly for those Member States that are meeting (or are anticipated to meet under baseline projections) their ERCs.

Completeness

The Commission adopted in October 2018 an implementing act laying down a **common format for NAPCPs**[62], in application of Article 6(10) of the Directive. Member States are required to use this common format according to Article 2 of the implementing act. The common format differentiates between mandatory and optional reporting content.

Mandatory content

Most Member States have provided almost all mandatory reporting content in their first submission, with minor gaps in the information on additional PaMs and in the reporting of emission projections. Another frequent shortcoming is the lack of explanations provided when a Member State follows a non-linear emissions trajectory, with only three of the 14 Member States in that situation providing an explanation to support it. Only two Member States had significant gaps in mandatory reporting requirements in their first submission.

17 Member States have submitted updated NAPCPs. The majority of these are considered to be complete or mostly complete with minor gaps, with only two Member States having major gaps in mandatory content requirements. The most common gap is the lack of detail

62 Commission Implementing Decision (EU) 2018/1522 of 11 October 2018 laying down a common format for national air pollution control programmes under Directive (EU) 2016/2284 of the European Parliament and of the Council on the reduction of national emissions of certain atmospheric pollutants.

in reporting the projected impacts on air quality improvement in the "with measures" (WM) scenario. Inconsistencies between information provided in the NAPCP and via the EEA-PaM tool were also identified. The reporting of information when a Member State follows a non-linear emission reduction trajectory remains a gap, with only two out of six Member States providing an adequate explanation.

Overall, Member States' NAPCPs have been rather complete as regards the mandatory content.

Optional content:

The reporting of optional content in NAPCPs varies substantially among Member States. The most commonly reported optional content in first NAPCP submissions included accompanying graphics, optional measures relating to agriculture in Annex III Part 2 to the NECD, identification of authorities responsible for source sectors and an executive summary.

The reporting of certain optional content in the first NAPCP is considered particularly helpful for assessing effectiveness of measures, such as:

- the estimation of costs and benefits of additional PaMs. This information was provided by 8 Member States (Bulgaria, Czechia, Estonia, Spain, Croatia, Romania, Slovakia and Sweden), with Romania having particularly comprehensive information. In addition, Denmark provided some limited information regarding the estimation of costs of additional PaMs and Cyprus reported information on the costs of some of the already adopted PaMs.
- the projected impacts of additional PaMs on the environment (under a WAM scenario). This information has not been reported by any Member State.

Regarding updated NAPCPs, the extent to which Member States reported optional content continued to vary widely. Optional content that was most frequently reported included an executive summary, identification of authorities responsible for source sectors and accompanying graphics.

The reporting of certain optional content in the updated NAPCP is considered particularly relevant for assessing effectiveness of measures, such as:

- interim targets to monitor progress of selected PaMs in the EEA-PaM tool submissions. Only three Member States provided this information (Luxembourg, Lithuania and Poland).
- the estimation of costs and benefits of the PaMs considered for adoption and associated sources of funding. This information was reported by four Member States (Cyprus, Lithuania, Spain and Slovenia).
- the projected impacts of additional PaMs on the environment (under a WAM scenario). Germany was the only Member State to provide this information.

In sum, **reporting of optional content has been highly variable**, which is readily explained by the optional nature of the related reporting items. There has been rather **limited reporting on optional content that is considered particularly relevant for assessing effectiveness of measures**, such as costs and benefits, and interim targets to monitor progress in implementing PaMs.

As further outlined in the support study to this evaluation, the fact that Member States provided few data on costs and benefits of measures meant that this information was of limited use to inform the efficiency analysis under this evaluation.

Quality and coherence

Coherence of NAPCP emission projections and emission projections reported under Article 10(2)

Consistency between projections reported in the NAPCP and projections submitted by Member States under Article 10(2) is part of the assessment of the likelihood of non-compliance with the emission reduction commitments performed when reviewing NAPCPs. This assessment comprises a comparison of the reported date of projections, the base year (where available) and the emission values.

For reporting of air pollutant emission projections under Article 10(2), the NECD specifies that projections need to be consistent with the inventory year 'x-3'. When reporting projections using the NAPCP common format, Member States were asked to report the date of emission projections and the year of the historical inventory used for their development (i.e., base year) (Tables 2.5.1 and 2.8.1 of the common format). For the first submission, the base year for projections presented in the NAPCPs has not been widely reported by the Member States in their NAPCPs whereas it has been reported by the majority of Member States in their updated NAPCPs.

For the first submissions of NAPCPs, all submissions of the NAPCPs presented WM projections. Where the WM scenario showed non-compliance with emission reduction commitments, all Member States except two included a WAM scenario projection. The vast majority of Member States submitted projections in their NAPCPs that were considered as consistent or as inconsistent with minor inconsistencies with the latest available emission projections under Article 10(2). 8 Member States had major inconsistencies in their WM scenario and 3 Member States had major inconsistencies in their WAM scenario, as different conclusions on projected compliance with at least one emission reduction commitment can be drawn depending on the dataset used.

Regarding updated NAPCPs, out of 16 NAPCPs that included projections in their NAPCPs, 12 Member States were found to be consistent or inconsistent with minor inconsistencies with their latest Article 10(2) projections. Only one Member State was found to have inconsistencies that compromised the projected achievement of its emission reduction commitments.

Coherence with air quality policies

The emission reduction commitments set out in **the NECD** are intended **to contribute to achieving air quality levels** that do not give rise to significant negative impacts on and risks to human health and the environment.

Article 6 of the NECD requires Member States to assess to what extent national emission sources are likely to have an impact on air quality in their territories (and neighbouring Member States) and consider compliance with air quality objectives as part of the preparation of their NAPCP. Annex III Part 1 of the NECD lists the following as a minimum content requirement for the NAPCP regarding air quality:

- the progress made by current policies and measures in reducing emissions and improving air quality, and the degree of compliance with national and Union obligations; and
- policy options considered to meet the emission reduction commitments and to further improve the air quality, and where available the impact of the PaMs on air quality.

Consequently, the NAPCP common format requires information on air quality policy priorities, progress made by current PaMs in improving air quality, projected improvement in air quality under WM and WAM scenarios and an assessment of how selected PaMs ensure coherence with air quality objectives in a Member State and, where appropriate, neighbouring Member States.

The progress achieved by current PaMs in improving air quality has been demonstrated by the Member States through reporting on historical trends in ambient air pollutant concentrations and results of compliance assessment with EU limit values. This reporting is in line with the requirements of the NAPCP common format. In some cases, Member States have provided a reference or a weblink to the air quality plans in order to demonstrate what PaMs have been in place to date. However, only two Member States have decided to adopt additional PaMs, beyond those required to meet the emission reduction commitments, in order to further improve air quality or meet air quality objectives.

The PaMs selected for adoption by the Member States will overall contribute to the improvement in air quality across Europe through reduction in emissions of NECD pollutants. Section 2.6.2 of the common format allows Member States to report on the impact of PaMs selected for adoption on air quality to ensure coherence with the AAQD, albeit as an optional content.

The **completeness and quality of the reporting** of that section by Member States **varies and is dependent on the air quality priorities of each Member States**. In the first submissions of NAPCPs, out of the 22 Member States providing WAM scenarios, 18 Member States reported on impacts on air quality of PaMs selected for adoption (WAM scenario), either quantitatively or qualitatively. Only two Member States did not provide any information on air quality impacts of the WAM scenario PaMs. For the updated

NAPCPs, Member States have claimed that impacts on air quality have been taken into account qualitatively when selecting PaMs for adoption. Impacts of individual PaMs on air quality were not reported by any Member State. Member States have expressed in their EEA-PaM tool submissions that the impact on air quality from PaMs cannot be determined at an individual level.

Coherence with other policy areas

One of the objectives of the NECD as stated in Article 1(2) is to contribute to '*enhanced synergies between the Union's air quality policy and other relevant Union policies, in particular climate and energy policies*'.

There are many **links between air policies and climate/energy policies**, as emitting sources of greenhouse gases and of air pollutants are often the same. Therefore, one measure can often help to meet both air and climate goals (e.g. developing clean transport modes, better insulation of buildings to reduce energy consumption). However, there can sometimes also be trade-offs (e.g. the use of bioenergy for domestic heating).

Air and energy/climate legislation refer to one another and require links to be made between the NAPCPs and the national energy and climate plans (NECPs) submitted under Regulation (EU) 2018/1999 on the Governance of the Energy Union and Climate Action[63]. Regulation (EU) 2018/1999 requires Member States to draft NECPs, including policies and measures to demonstrate how they will achieve their objectives in the five dimensions of the energy union.

According to Annex III Part 1 of the NECD, NAPCPs should include a description of the policy framework in context of which the programmes have been developed including the relationship to priorities set in other relevant policy areas such as climate change, and an assessment of how selected policies and measures ensure coherence with plans and programmes set up in other relevant policy areas.

The Commission's guidance on developing NAPCPs specifically invites Member States, when drafting their respective NAPCPs, to consider the policies and measures planned also with a view to climate and energy obligations. In turn, Commission guidance[64] on drafting NECP updates encourages Member States to update their NECPs closely with their NAPCP updates, paying special attention to strengthening the assessment of the impact of planned policies and measures on air pollutant emissions.

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63 Regulation (EU) 2018/1999 of the European Parliament and of the Council of 11 December 2018 on the Governance of the Energy Union and Climate Action, amending Regulations (EC) No 663/2009 and (EC) No 715/2009 of the European Parliament and of the Council, Directives 94/22/EC, 98/70/EC, 2009/31/EC, 2009/73/EC, 2010/31/EU, 2012/27/EU and 2013/30/EU of the European Parliament and of the Council, Council Directives 2009/119/EC and (EU) 2015/652 and repealing Regulation (EU) No 525/2013 of the European Parliament and of the Council, OJ L 328, 21.12.2018, p. 1.

64 Commission Notice 2022/C 495/02 on the Guidance to Member States for the update of the 2021-2030 national energy and climate plans.

Due to different legal deadlines and delays in submitting NAPCPs and NECPs, submission dates may not align. Consistency between the two may therefore need to be ensured on the basis of draft NECPs. Nevertheless, the links between air and climate/energy should be reflected in the final NECPs that were due by 30 June 2024. According to the Commission's 2023 assessment of draft updated NECPs[65] more than half of the submitted plans did not include the required information on the impact of policies on projected emissions of the main air pollutants under the Directive, or on the alignment of NAPCP with energy and climate programmes. The final assessment[66] encourages Member States to further consider synergies and trade-offs of the planned measures with air pollution when implementing their updated NECPs. An NAPCP capacity building workshop held in January 2022, however, highlighted examples where Member States managed to integrate the NAPCP with the NECP despite the challenging differences in legal deadlines.

Through **targeted engagement of competent authorities**, several Member States indicated that improvements could be made by better aligning NECP and NAPCP reporting deadlines. Two Member States commented that it might be desirable to harmonise the reporting deadlines between the NECP and the NAPCP, with one directly linking the mismatch in deadlines to delays in the adoption of NAPCPs. However, some Member States commented that having the two deadlines completely aligned would increase the burden of reporting, with some Member States suggesting a delay of one month to spread the workload.

According to the 2023 assessment of NAPCPs, the programmes describe generally well the energy and climate change priorities in the policy framework. Most Member States have included information on the key greenhouse gas reduction targets, as well as on their renewable energy and energy efficiency objectives. However, multiple Member States have raised that achieving coherence between NECPs and NAPCPs is challenging. This is reflected through the lack of detail provided in NAPCPs on coherence with NECP. NAPCPs often built on what was already included in the NECPs and were then used to rectify some of the measures which were unfavourable for air quality e.g. concerning the use of biomass.

The analysis of the NAPCPs indicates that links between clean air and climate and energy policies could be strengthened to increase the effectiveness of the underlying policies. This would involve a more systematic assessment of those links, including of synergies and trade-offs between them. As an example of trade-offs, two Member States (Cyprus and Ireland) selected PaMs for adoption that prioritised objectives set out in the NECP that conflicted with achieving emission reductions for NH_3[67]. These PaMs were selected with

65 COM(2023) 796 final.
66 COM(2025) 274 final.
67 Ireland selected measures including the replacement of calcium ammonium nitrate fertiliser applied to grassland with inhibited urea products and increased liming of soils which are projected to result in an increase in NH_3 emissions. Cyprus selected measures aiming at promoting the anaerobic digestion for the treatment and management of animal waste which *can* have an adverse effect on NH_3 emissions.

the aim of reducing greenhouse gas emissions but are likely to increase NH_3 emissions if not accompanied by measures aimed at decreasing NH_3 emissions.

Through the targeted engagement of competent authorities, it has also been conveyed that there is potential for enhanced coherence between NAPCPs and NEPCs. This would include

- a merger of the reporting of PaMs databases and energy and climate and air quality reporting,
- the possibility in the NAPCP to cross-reference the NECP, and/or
- a sub-chapter in the NECP on air quality.

In addition to links with energy and climate measures, **NAPCPs should also seek synergies with agricultural measures** to reduce above all ammonia emissions. Ammonia is primarily emitted through agricultural activity, both from livestock management and cultivation of crops (fertiliser use). The Commission has monitored the integration of clean air considerations into Member States' 2023 strategic plans under the 2023-2027 Common Agricultural Policy. It focused on incentivising Member States to develop and implement interventions and result indicators that are directly relevant for reducing ammonia emissions, given the challenges for several Member States to further reduce their ammonia emissions. As regards NAPCPs, according to the 2024 assessment, nine of the 18 Member States having submitted an NAPCP and/or PaMs update selected additional agricultural PaMs for adoption according to the EEA-PaM tool. Six Member States (Austria, Estonia, France, Ireland, Luxembourg and Slovenia) reference the 2023-2027 CAP Strategic Plan as the priority policy programme to which additional agricultural PaMs are aligned. One Member State (Slovenia) demonstrates how the CAP Strategic Plan is the main source of funding for agricultural PaMs in the NAPCP.

2.2.2 PaMs having been selected for adoption address compliance gaps and they can credibly contribute to the targeted emission reductions

According to Annex III Part 1 of the NECD, Member States need to include in their NAPCPs the policy options considered and selected to comply with their emission reduction commitments. For those PaMs selected for adoption, the Member States should report a timetable for adoption, implementation and review and the competent authorities responsible (Table 2.7.1 of the common format). This reporting must be done via the web-based 'EEA-PaM tool', managed by the EEA.

PaMs reported in NAPCPs are collated by the EEA into the NECD policies and measures database[68] (also known as the EEA-PaMs or PaMs database). In total, the database (version '3, Dec. 24') captures 809 measures reported by Member States in their NAPCPs (noting this may contain some duplicate measures). Examining the PaMs database more broadly, there is significant variation between Member States regarding the number of PaMs reported, ranging from zero identified by Bulgaria, Finland and the Netherlands, to over

[68] Latest update available at the time of this analysis was 'ver. 3, Dec. 2024': https://www.eea.europa.eu/en/datahub/datahubitem-view/2f8a584f-3175-42e5-ae33-a08c5535c9ae

157 measures identified by Lithuania. Similarly, the number of these PaMs which are adopted or not currently adopted varies considerably, with 12 Member States having adopted all identified measures and five countries having adopted none of them. Although informative, the quantitative analysis of the PaMs is limited and must be taken with some caution for various reasons, including the fact that the expected impact of PaMs can vary significantly from one to another and that inconsistencies and errors in reporting are common.

The assessment of PaMs reported has been performed for each submission in the NAPCP review reports[69] and summarised in horizontal review reports[70]. The extent and level of detail of the reporting by Member States on their additional policies and measures across the Member States and across the PaMs themselves.

The key challenge the Member States are facing is to reduce emissions of pollutants from the largest emission sources: agriculture (NH_3); combustion in commercial, institutional and household sectors and road transport ($PM_{2.5}$); and industrial solvent use (NMVOC). **The analysis of PaMs showed that Member States have prioritised the consideration and adoption of PaMs for those sectors that contribute to the largest share of emissions.** According to 2022 horizontal review report more than half of the PaMs considered for the transport, agriculture and energy supply sectors covered by the report have been selected for adoption. The 2024 horizontal review report concluded than more than two thirds of the PaMs considered for the agriculture sector covered by the report have been selected for adoption, and over half the transport and energy consumption PaMs considered covered by the report were selected for adoption. However, very few PaMs were considered and selected for adoption in the industrial processes and waste management sectors.

Given that the majority of the PaMs selected for adoption in the context of the first NAPCP were due for adoption in 2019, 2020 and 2021, they were unlikely to deliver the emission reductions required for Member States to comply with the 2020-2029 emission reduction commitments in 2020. This is due to the very short time available for the successful implementation (although this depends on the exact design of PaM). However, PaMs selected for adoption in the NAPCPs are likely to contribute to the attainment of 2020-2029 emission reductions commitments after 2020 (i.e. in the period from 2021 to 2029) and are important in the context of achieving compliance with the emission reduction commitments for 2030 onwards.

According to the national emission projections reported by Member States in 2025, when taking into account also additional PaMs scenarios, four Member States project to be in non-compliance in 2025 against 2020-29 ERC, and nine in 2030 against 2030+ ERC. These Member States have to take additional measures to reach their ERC.

[69] Reports available at https://circabc.europa.eu/ui/group/cd69a4b9-1a68-4d6c-9c48-77c0399f225d/library/a1071db5-2697-4528-b7c5-fe0d1d026e5c.

[70] 2022 Horizontal Review Report and 2023-2024 Horizontal Review Report.

According to the **targeted stakeholder consultation**, there was a broad view among public authorities and non-governmental organisations groups that NAPCPs and PaMs have supported the identification of the most cost-effective actions to reduce emissions. In the **open public consultation**, a majority of respondents indicated that the Directive has somewhat supported the identification and uptake of cost-effective measures. The targeted consultation also concluded that for NO_x, NMVOCs, and SO_2, the majority of the views was that the PaMs were appropriate, although there were significant minority views that they were too lenient. For NH_3 and $PM_{2.5}$, the majority view was the PaMs were too lenient, although there was a significant minority view that they were appropriate. The replies to this question were clearly divided between those of the NGO stakeholder group indicating that the PaMs were too lenient and the majority of the responses from the public sector group indicating that the PaMs were appropriate.

When reporting via the EEA-PaM tool, the Member States have to provide the title of the PaM and an additional description. Both fields were completed by all Member States and often the descriptions provided further details to supplement the PaM title. However, in many instances, the description of the PaMs was not extensive and did not provide specific information on PaM design and focus. In some cases, PaMs reported in the NAPCP were inconsistent with the PaMs reported via the EEA-PaM tool (e.g. in terms of the overall number of PaMs, PaMs selected for adoption, projected emission reductions).

Several gaps in PaMs reporting which reduce the potential to assess to which extent the PaMs are appropriate or sufficient to allow Member State to meet their ERCs have been identified in horizontal review reports. A summary of those shortcomings is listed below:

- **Pollutants targeted by the PaM** – some PaMs were listed to target multiple, if not all, pollutants relevant to the NECD. Many of these PaMs did not have quantified emission reductions for these pollutants, and no explanation was given how the PaM could reduce emissions for each pollutant where it is not obvious (e.g. information campaigns on increasing energy efficiency resulting in a reduction in NH3 emissions).
- **Planned uptake of the PaM** – linked to the above, the descriptions of the PaMs to describe assumptions on the projected uptake of PaMs was often lacking. This information is useful to provide context to how emission reductions were estimated, and to give insight in the work required to be conducted within the given implementation period. Such information could include, for example in the residential sector, if a PaM was assumed to be improving energy efficiency of buildings: the anticipated rate at which buildings will be modernised (i.e., how many buildings per year); or in the road transport sector: the rate of electrifying public transport fleet (i.e. total vehicles per year).
- **Anticipated emission reductions compared to business as usual** – the impact on emission reductions can be reported by the Member States either for a single PaM or for packages of PaMs. The review has found the majority of emission reductions were not quantified, while in principle it should have been possible to quantify them. Where the emission reduction was reported for a package of PaMs, it makes

it difficult to assess whether the PaMs included in a given package could realistically lead to the reported emission reductions or to determine which individual PaMs are expected to make the largest contribution to emission reductions. Where emission reductions were reported at individual PaM level, the lack of information on the design of PaMs and their planned uptake made it difficult to assess their credibility. Estimations of quantified reductions could also not be compared with similar PaMs selected for adoption by different Member States or compared to each Member States' WM and WAM projections included in the NAPCP.

- **Uncertainty of emission reductions** – very few Member States reported likely emission reductions from the PaMs in ranges. Best practice is for Member States to account for uncertainties related to the uptake and potential impacts of PaMs and clearly explain these.
- **Type of policy instruments** – many PaMs were reported against multiple policy instruments. While in principle this is valid as a PaM can make use of several tools (e.g., combining fiscal support with awareness raising), it has often been difficult to clearly understand what is being proposed where multiple policy tools were coupled with a generic description of a PaM.
- **Timescales for implementation** – many PaMs were reported to have implementation start dates prior to the date of publication of the NAPCP, and 2030 as the end year of implementation. PaMs with an implementation start date that significantly predates the adoption date of the NAPCP cannot be considered to be truly additional. Moreover, it is acknowledged that assigning an implementation end year of 2030 is appropriate for PaMs selected for adoption in order to achieve 2030 emission reduction commitments. However, it is often unclear what will be achieved within the timeframe if interim targets are not provided, especially if a Member State is projected to follow a nonlinear emission reduction trajectory. Very few Member States included interim targets in the EEA-PaM tool submission.
- **Costs and benefits** – information on the costs of PaMs considered and selected for adoption have rarely been reported within the NAPCP and/or EEA-PaM tool submission. Inclusion of the cost estimates would increase the confidence in the analysis that Member States have conducted in preparation of NAPCPs and planning for implementation and allow for sharing of best practices and information among Member States.

Article 6 of the Directive also specifies that Member States must include in their NAPCPs measures for the agricultural sector, laid down as obligatory in Part 2 of Annex III and may include measures laid down as optional in Part 2 of Annex III or measures having equivalent mitigation effect (Table 2.6.4 of the common format). All of the first NAPCP submissions either select the agricultural measures referred to in Annex III, Part 2 of the Directive in their NAPCP, or provide evidence that these measures are already in place and implemented through other programmes or action plans. The 2024 horizontal review report also highlighted that, although NH_3 is the pollutant for which the fewest PaMs have

been selected for adoption in the submission covered by the report, all Member States that selected additional PaMs for adoption included PaMs that are stated to target NH_3.

Annex IX presents in further details the trend of NH_3 emissions and strategies to reduce those in three Member States – summarised in the box below. These examples underscore that Member States face very distinct challenges. Denmark's agricultural sector is characterised by intensive production so that BATc under the IED have played an important role. In Austria and Ireland, CAP funding helped in progressing towards ERC achievement. The analysis suggests that further elements to successfully reducing NH_3 emissions are regulatory measures (such as mandating certain practices), coupled with extensive dialogue with the main stakeholders involved, notably the farming sector, to win support for such measures.

BOX 2. Reducing NH_3 emissions in Denmark, Ireland and Austria

Denmark started addressing NH_3 emission from agriculture in 1987 and applied best practices early on. The NECD set a relatively ambitious ERC of 24% for Denmark for both the 2020-29 and the 2030+ period. Policies addressing NH_3 emissions included the use of IED BATc, complemented with additional provisions, which is particularly relevant in Denmark, with 90% of the agricultural land dedicated to intensive production. Furthermore, requirements on the use of manure and its storage and voluntary agreements on animal feed were put in place. Whilst inventories for 2020 and 2021 showed non-compliance with the 2020-29 ERC for ammonia, 2022 and 2023 inventories register compliance. Projected compliance for the ERCs of 2030 beyond also show compliance.

Austria's agricultural sector is characterised by a many small-scale farms, often operating in mountainous areas, many of which engage in animal husbandry. NH_3 emissions have been on the rise since 2005 until 2017, with reductions achieved since then, and more accelerated reductions in recent years. The NECD sets an ERC for NH_3 of 1% over 2020-29, and 12% as of 2030.

Austria has made use of CAP support to promote NH_3 reduction measures but considered that mandatory measures are needed to complement. To reach agreement on mandatory measures, extensive consultations across ministries and involving key stakeholder, including from the farming sector, were conducted, and detailed background knowledge on reduction measures and activity data was sourced. Austria adopted an ammonia reduction ordinance (entered into force in January 2023), which obliges rapid (within 4 hours) incorporation of fertilisers as well as covering of manure storage.

Inventory data for 2020-2022 showed non-compliance with the ERC. The latest inventory submitted in 2025, indicates compliance, with a reduction of close to 6% achieved since 2005. The updated Austrian NAPCP submitted in 2024 also projects compliance with the 2030 ERC for NH_3 based on additional measures.

NH_3 emissions in **Ireland** have seen a steep increase between 2011 and 2018, with its agricultural sector increasingly specialised towards livestock production, particularly beef and dairy, with removal of EU milk quotas leading to increased production. The NECD sets an ERC of 1% for the current period, and 5% for 2030+. Inventory data for 2020-2022 showed non-compliance with the NH_3 ERC.

The implementation of measures improving farm efficiency and mitigating harmful emissions, notably low-emission slurry spreading and the use of inhibited urea fertiliser, have counteracted to some extent the rise of emissions from increased production. Ireland has intensified efforts in past years to increase uptake of these and other reduction measures. A marginal abatement cost curve for ammonia provided by Teagasc, the Agriculture and Food Development Authority, provided quantified reduction potential to abate ammonia emissions and associated costs and benefits and hence an evidence base to select measures.

CAP support is available under the 2023-27 CAP Strategic Plan and several measures are benefiting both commitments under the NECD and the Nitrates Directive. Irish authorities actively seek to ensure synergies between the two. Direct engagement with farmers has also been noted as a factor to success. According to the inventory submitted in 2025, 2022 and 2023 NH_3 emissions are below the maximum allowed level stipulated in the NECD.

2.2.3 *Extent to which NAPCPs submitted follow the template; qualitative assessment of the effectiveness/ usefulness of the template*

The Commission adopted in October 2018, an implementing act laying down a common format for national air pollution control programmes[71], in application of Article 6(10) of the Directive. Member States are required to use this common format according to Article 2 of the implementing act. The Commission also adopted a guidance[72], developed in accordance with Article 6(9) of the Directive, to support Member States in developing their NAPCPs.

A **large majority of Member States use the common format albeit sometimes only partially**:

- For the submission of their initial NAPCP, 14 Member States used the common format, 12 Member States partially used it and one Member State did not follow it. Gaps and insufficient detail were more commonly identified where Member States did not fully use the common format or did not report their PaMs via the EEA-PaM tool.
- Of the 17 updates of NAPCPs received, the common format was used by ten Member States, partially used by three and not used by four.

An assessment[73] of the common format identified 29 recommendations to improve the drafting and reporting of the NAPCPs respecting the requirements of the NECD, as well as one recommendation that would require a modification of the NECD.

Five recommended changes aim to reduce the overall burden of reporting NAPCP. This includes reducing the repetition of mandatory reporting content for PaMs considered for adoption (section 2.6.1 of the common format) and PaMs considered and selected for adoption (section 2.7.11 of the common format), such as implementation years and responsible authorities. It also includes reducing the scope of optional reporting content, such as the executive summary and reporting of costs for PaMs considered but not selected for adoption. Considering that the common format has been elaborated in view of the reporting of the first NAPCP, various recommended changes also relate to the improvement of the NAPCP common format to make it timeless.

Seven recommendations were made that would increase reporting burden but are considered valuable to increase transparency of proposed measures. They are inspired by reported content from some Member States' NAPCPs that is considered best practice, and include reporting:

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71 Commission Implementing Decision (EU) 2018/1522 of 11 October 2018 laying down a common format for national air pollution control programmes under Directive (EU) 2016/2284 of the European Parliament and of the Council on the reduction of national emissions of certain atmospheric pollutants.

72 Guidance for the development and update of National Air Pollution Control Programmes under Directive (EU) 2016/2284 of the European Parliament and of the Council on the reduction of national emissions of certain atmospheric pollutants (2019/C 77/01).

73 Ricardo (2024) Assessment on the suitability of the NAPCP common format and EEA-PaM tool.

- the sources of funding to implement PaMs,
- the updates and progress made to PaMs selected for adoption under the previous NAPCP, and
- further details on the coherence between a Member State's NAPCP and NECP.

Further suggestions were made for **updating the EEA PaM tool** such as:

- Enabling users to download their PaM tool submission for inclusion in the main text of the NAPCP. This could reduce the occurrences of inconsistencies between the reporting of PaMs within the NAPCP and in the PaM tool.
- Enabling users to update an earlier PaMs submission in the PaM tool, for easier tracking of updates of adopted PaMs.

Although no quantification could be made, it is estimated that such changes would lead to **significant time savings in reporting**.

Through the **targeted stakeholder consultation**, one respondent noted that although reporting around PaMs is important, there are inherent difficulties in the quantitative assessment of impacts, action by action, which may not be equally complex for all measures and in some cases, may be impossible. The respondent elaborated that knowing the reduction potential of certain actions is valuable for developing the action plan, but a detailed assessment, measure by measure, for each Member State, generates significant and unnecessary costs. Therefore, it is considered that an overall assessment of the plan is sufficient to monitor compliance with the trajectory, particularly when this assessment shows compliance with the objectives is sufficient.

Other suggestions for simplification around NAPCPs offered through the **targeted engagement of competent authorities** included:

- Improving the reporting system, with one stakeholder expressing that the reporting system for the policies and measures under climate reporting (EEA's ReportNet3.0) is much more user friendly than EIONET,
- Providing a more user-friendly template for reporting PaMs that would allow users to download and complete it offline, make modifications as needed without errors or data loss, and include prefilled data where possible would be highly beneficial.
- Adjusting the common format to make it more suitable for NAPCP updates (noting that the current template was more appropriate for the first NAPCPs submitted in 2019).

2.2.4 Consultations conducted in preparing NAPCPs

Public consultations

Article 6(5) of the Directive requires Member States to consult the public, in accordance with Directive 2003/35/EC, and relevant competent authorities on their draft NAPCP or any significant updates prior to the finalisation of those programmes.

Although **a large majority of Member States provided partial or complete evidence that public consultations were carried out** during the development of the NAPCP, only five NAPCPs provide enough details to explain how comments received during consultation were incorporated while five others provide explanation of why comments have not resulted in any changes.

Out of the 44 NAPCP submissions, 10 NAPCPs do not provide evidence of public consultations and 18 submissions do not provide clear information on how the public consultation impacted the NAPCP.

A study carried out by the environmental NGO European Environmental Bureau (EEB)[74] reports that responses to a survey of selected EEB member organisations indicated that public consultations on the first submissions of NAPCPs lacked appropriate timeframes, often being conducted at a late stage in the development of the NAPCP and having little impact on the final NAPCP.

Inter-ministry discussions and coordination across governance levels

Insufficient coordination between national, regional, and local levels within Member States is a widely recognised challenge in air pollution policy implementation. OPC results indicated that a majority of respondents, particularly public authorities, NGOs, and EU citizens, strongly agree that better coordination is needed. Business associations and industry representatives show a mix of agreement and uncertainty. TSC respondents largely echo these concerns, with significant agreement among academic institutions, NGOs, and public authorities, though some industry associations and other stakeholders remain uncertain or neutral.

Similarly, concerns were raised about insufficient capacity at the regional and local levels to effectively design and deliver air pollution policy. Academic and research associations, individuals in a professional capacity, industry associations, and some public authorities agreed that this remains a challenge, while NGOs were divided in their views with more disagreeing.

Transboundary consultations

Article 6(6) of the Directive requires Member States to conduct transboundary consultations, where appropriate. **Only three Member States have reported to have consulted neighbouring countries, namely Luxembourg, Czechia and the Netherlands**. In the case of Czechia, Poland was consulted on the first NAPCP, resulting in a sharing of emission data. In its updated NAPCP, Czechia reported to have consulted Poland and Slovakia, however, it remains unclear how comments received were taken up. In the case of the Netherlands, their NAPCP indicates that no comments were received following the transboundary consultation. Luxembourg states that transboundary consultations were carried out with authorities from neighbouring countries where

[74] EEB (2020), National Air pollution Control Programmes : analysis and suggestions for the way forward, pp. 26-27.

appropriate. However, it does not provide further evidence of these transboundary consultations being conducted or of their results.

While other Member States have not provided information on transboundary consultations, **about half of the remaining Member States have provided some sort of analysis of transboundary impacts of emissions**.

Views on transboundary consultations yielded mixed results. OPC stakeholders reported a range of opinions, with NGOs, business associations, and EU citizens indicating there was some level of help to support achieving the objectives, but with a high degree of uncertainty. TSC stakeholders were mostly neutral, though some industry associations and NGOs noted moderate benefits. Public authorities, however, largely maintained a neutral stance.

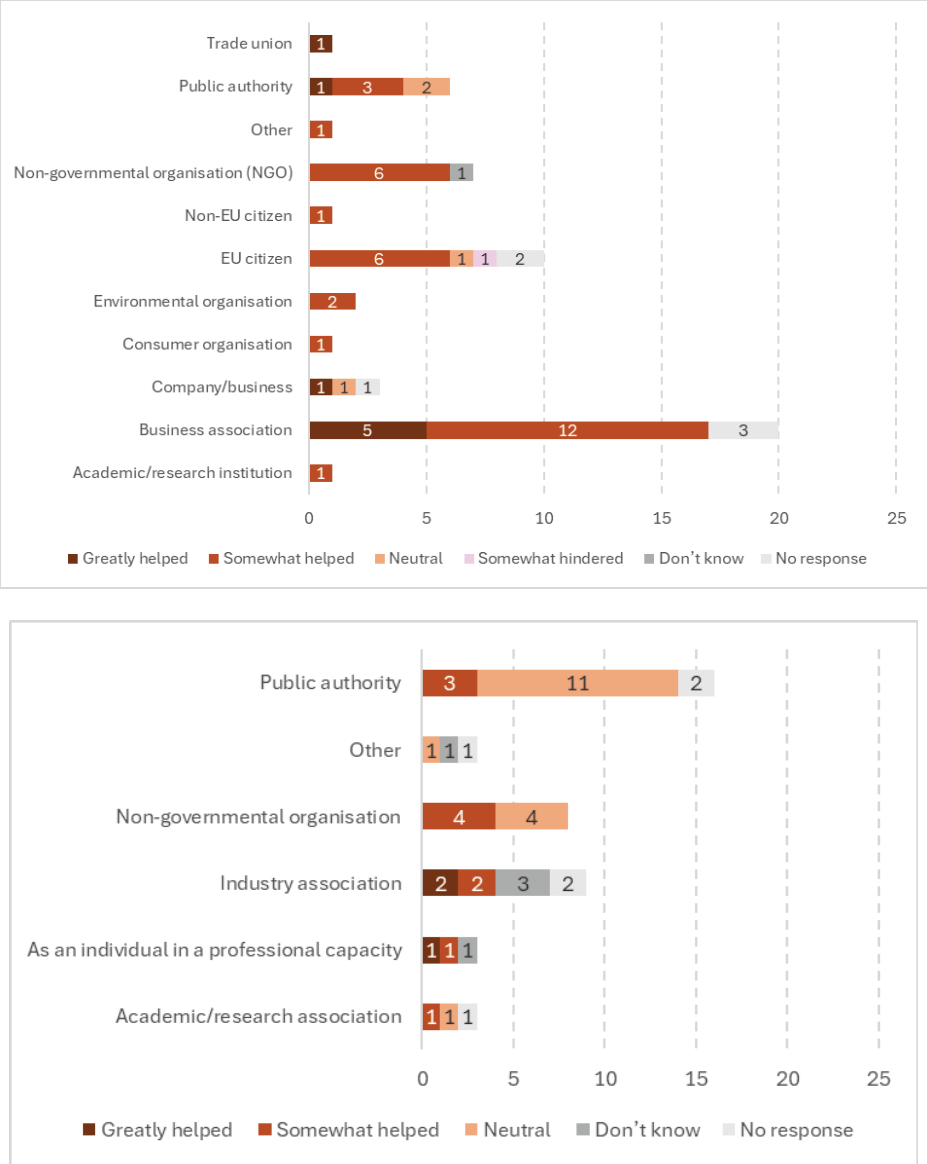

Figure A - 13 – Responses to the question on whether the requirement for transboundary consultations as part of NAPCP development helped achieve the Directive's objectives. OPC responses are shown in the top graph, TSC responses in the bottom graph.

When asked to elaborate, respondents to the TSC generally thought that in principle this requirement was important due to the transboundary nature of air pollution. Across different stakeholder groups, respondents agreed that currently this requirement is not carried out to an extent to be productive. According to some NGO respondents, this was due to the weak wording in the Directive, requiring to carry out transboundary consultations "where appropriate". At the same time, some Member State public authorities argued that transboundary consultations should be limited to situations where emissions have impacts in other Member States and should not be mandatory.

2.2.5 Extent to which additional agricultural measures under Annex III Part 2 have been considered, including in NAPCPs, and implemented

To reduce air pollutant emissions from agriculture, in particular NH_3 and $PM_{2.5}$ emissions, Member States are required, according to Article 6(2) of the Directive, to include in their NAPCPs the emission reduction measures laid down as mandatory in Annex III Part 2 of the Directive. Furthermore, Annex III Part 2 covers a list of optional measures which Member States may implement on a voluntary basis.

BOX 3. List of agricultural measures in Annex III Part 2

A: Measures to control ammonia emissions

Measure A1: Member States shall establish a national advisory code of good agricultural practice to control ammonia emissions, taking into account the UNECE Framework Code for Good Agricultural Practice for Reducing Ammonia Emissions of 2014, covering at least the following items:

(a) nitrogen management, taking into account the whole nitrogen cycle;
(b) livestock feeding strategies;
(c) low-emission manure spreading techniques;
(d) low-emission manure storage systems;
(e) low-emission animal housing systems; and
(f) possibilities for limiting ammonia emissions from the use of mineral fertilisers.

Measure A2: Member States may establish a national nitrogen budget to monitor the changes in overall losses of reactive nitrogen from agriculture, including ammonia, nitrous oxide, ammonium, nitrates and nitrites, based on the principles set out in the UNECE Guidance Document on Nitrogen Budgets.

Measure A3: Member States shall prohibit the use of ammonium carbonate fertilisers and may reduce ammonia emissions from inorganic fertilisers by using the following approaches:

(a) replacing urea-based fertilisers by ammonium nitrate-based fertilisers;
(b) where urea-based fertilisers continue to be applied, using methods that have been shown to reduce ammonia emissions by at least 30 % compared with the use of the reference method, as specified in the Ammonia Guidance Document; and
(c) promoting the replacement of inorganic fertilisers by organic fertilisers and, where inorganic fertilisers continue to be applied, spreading them in line with the foreseeable requirements of the receiving crop or grassland with respect to nitrogen and phosphorus, also taking into account the existing nutrient content in the soil and nutrients from other fertilisers.

Measure A4: Member States may reduce ammonia emissions from livestock manure by using the following approaches:

(a) reducing emissions from slurry and solid manure application to arable land and grassland, by using methods that reduce emissions by at least 30 % compared with the reference method described in the Ammonia Guidance Document and on the following conditions:

(i) only spreading manures and slurries in line with the foreseeable nutrient requirement of the receiving crop or grassland with respect to nitrogen and phosphorous, also taking into account the existing nutrient content in the soil and the nutrients from other fertilisers;

(ii) not spreading manures and slurries when the receiving land is water saturated, flooded, frozen or snow covered;

(iii) applying slurries spread to grassland using a trailing hose, trailing shoe or through shallow or deep injection; and

(iv) incorporating manures and slurries spread to arable land within the soil within four hours of spreading;

(b) reducing emissions from manure storage outside of animal houses, by using the following approaches:

(i) for slurry stores constructed after 1 January 2022, using low emission storage systems or techniques which have been shown to reduce ammonia emissions by at least 60 % compared with the reference method described in the Ammonia Guidance Document, and for existing slurry stores at least 40%;

(ii) covering stores for solid manure; and

(iii) ensuring farms have sufficient manure storage capacity to spread manure only during periods that are suitable for crop growth:

(c) reducing emissions from animal housing, by using systems which have been shown to reduce ammonia emissions by at least 20 % compared with the reference method described in the Ammonia Guidance Document; and

(d) reducing emissions from manure, by using low protein feeding strategies which have been shown to reduce ammonia emissions by at least 10 % compared with the reference method described in the Ammonia Guidance Document.

B: Emission reduction measures to control emissions of fine particulate matter and black carbon

Measure B1: Without prejudice to Annex II on cross-compliance of Regulation (EU) No 1306/2013 of the European Parliament and of the Council, Member States may ban open field burning of agricultural harvest residue and waste and forest residue. Member States shall monitor and enforce the implementation of any ban implemented in accordance with the first subparagraph. Any exemptions to such a ban shall be limited to preventive programmes to avoid uncontrolled wildfires, to control pest or to protect biodiversity.

Measure B2: Member States may establish a national advisory code of good agricultural practices for the proper management of harvest residue, on the basis of the following approaches:

(a) improvement of soil structure through incorporation of harvest residue;
(b) improved techniques for incorporation of harvest residue;
(c) alternative use of harvest residue; and
(d) improvement of the nutrient status and soil structure through incorporation of manure as required for optimal plant growth, thereby avoiding burning of manure (farmyard manure, deep-straw bedding).

Measure C: Preventing impacts on small farms

In taking the measures outlined in Sections A and B, Member States shall ensure that impacts on small and micro farms are fully taken into account. Member States may, for instance, exempt small and micro farms from those measures where possible and appropriate in view of the applicable reduction commitments.

Overview of the state of implementation of Annex III Part 2 agricultural measures by Member States

A difficulty encountered in assessing the extent to which NAPCP have contributed to the implementation of Annex III Part 2 measures is that Member States do not have to report

agricultural measures already implemented in the NAPCP. Therefore, examining only the Annex III Part 2 measures mentioned in the NAPCP does not give the full picture of their implementation.

A literature review of Member State implementation of Annex III Part 2 measures was conducted by the consultant supporting the evaluation, utilising Member State NAPCP reporting and the PaMs database, as well as where relevant, information from the Member State IIRs. The preliminary findings were shared with Member State authorities for confirmation and additional information. Responses were received from 22 Member States (AT, BE, DK, FI, FR, EL, IE, IT, LV, LU, ES, PL, PT, SK, HR, CY, MT, NL, RO, SE, SI, LT), with BG, CZ, EE, DE, and HU absent. For those that did not respond, the assessment was based only on a desk-based review.

In the assessment full implementation of mandatory measures (A1, A3, and C) was understood as meaning all aspects of the measure, including all sub-measures (for A1). In cases where specific regulation is in development or not yet published, with sufficient detail provided by the Member States, this was assessed as being partially implemented. For optional measures (A2, A4, B1, B2), the uptake of sub-measures has been assessed. Optional measures have been assessed as partially applied where the measure is being developed but not yet operational.

Mandatory measures have been widely implemented. The assessment shows that 13 Member States have fully implemented all three mandatory measures (AT, CY, DK, FR, DE, HU, IE, IT, LV, LT, ES, PT and SE), while six have fully implemented two (BE, BG, FI, EL, RO and SI). Table A-7 shows that measure A1 (establishing a national advisory code of good agricultural practice to control ammonia emissions) has been fully or partially implemented in all Member States, and the mandatory element of measure A3 (prohibition of ammonium carbonate fertilisers) has been implemented in all Member States except FI and SK. No information regarding the implementation of measure C (avoiding impacts on small and micro farms) was found for seven Member States (CZ, EE, HR, LU, MT, NL, PL) and SK informed that no such rules had been adopted. These cases are all marked as not applied in Table A-7. It should be noted though that measures C does not directly act on emission reductions. A detailed assessment per (sub)measure is available in the support study to this evaluation[75].

All Member States have applied optional measures, albeit to varying degrees. ES has applied all 17 optional sub-measures in full, while FR, DE and LT have either fully or partially applied the complete range of measures. 10 Member States have applied less than half the optional measures available to them (AT, BE, CZ, EE, LU, MT, NL, PL, RO, SK). Optional measures have typically lower uptake, with A2 (establishment of a national nitrogen budget) not being applied in 12 Member States and only partially in 5, where the development of such a budget is underway. Uptake for measure B2 (a national advisory code for harvest residues) is also low, not being applied in 11 Member States and partially applied in 3. Measure A4 includes a number of optional sub-measures for mitigation of

[75] See support study section 3.2.2.

ammonia emissions from manure application, storage and animal housing, and there are varying levels of implementation of the specific sub-measures. This ranges from A4b.iii (sufficient manure storage capacity) with the highest uptake (18 Member States) to A4a.iv (incorporation manures and slurries into soil within 4 hours) with the lowest uptake (10 Member States). These measures can be particularly effective for reducing ammonia emissions (depending on the specific measure implemented in practice) but can also be costly to implement with some practical challenges.

The reason for the lower uptake of optional measures is not fully clear, but is partially related to perceived higher costs, lower effectiveness or less relevance. In a small number of cases, Member States indicated the measures are not/less relevant due to local circumstances or general practices (A3, B1, B2d).

When considering the current emission inventories and projections for ammonia, there does not appear to be a clear correlation between uptake of Annex III Part 2 Measures and meeting emission reduction commitments for ammonia. Therefore, the extent to which Annex III Part 2 measures have helped to drive ammonia reductions in countries that are meeting their ERCs is not clear. It is important to note that some of the measures listed in Annex III, Part 2 are described in general terms which results in a broad range of ways of implementing them and consequently of effectiveness. For example, measure A4bii encompasses low emission storage systems including options with abatement efficiency from 40-100%. Therefore, the measure can be implemented with options that could be more effective than others.

According to replies to the OPC, the agricultural measures in Annex III Part 2 of the Directive are perceived as somewhat helpful to achieving the Directive's objectives (27 respondents; 66%). Respondents in the TSC thought that the variation in uptake of voluntary measures was a reason why they are not contributing more to the objectives, while mandatory measures would have been better.

Table A - 8 – Uptake of Annex III Part 2 measures across all Member States

	A1	A2	A3	A3 (a)	A3 (b)	A3 (c)	A4 (a)i	A4 (a)ii	A4 (a)iii	A4 (a)iv	A4 (b)i	A4 (b)ii	A4 (b)iii	A4 (c)	A4 (d)	B1	B2 (a)	B2 (b)	B2 (c)	B2 (d)	C
AT	**Y**	P	**Y**	Y	Y	Y	P	P	P	P	P	P	P	Y	Y	Y	N	N	N	N	**Y**
BE	**Y**	P	**Y**	P	P	Y	P	P	P	P	NI	NI	NI	P	NI	Y	P	P	P	P	**P**
BG	**Y**	Y	**Y**	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	N	N	N	**P**
HR	**P**	N	**Y**	NI	NI	NI	P	P	P	P	P	P	P	P	P	Y	N	N	N	N	**N**
CY	**Y**	P	**Y**	N	Y	Y	P	Y	Y	N	P	P	Y	P	P	Y	Y	Y	Y	Y	**Y**
CZ	**Y**	N	**Y**	NI	Y	NI	NI	NI	NI	P	P	NI	NI	P	NI	Y	NI	NI	NI	NI	**N**
DK	**Y**	Y	**Y**	Y	Y	Y	NI	NI	NI	NI	Y	Y	Y	Y	Y	Y	N	N	N	N	**Y**
EE	**Y**	N	**Y**	NI	NI	NI	NI	NI	Y	P	P	P	NI	NI	NI	Y	NI	NI	NI	NI	**N**
FI	**Y**	Y	**P**	P	P	Y	Y	Y	Y	P	Y	Y	Y	Y	Y	Y	P	N	P	P	**Y**
FR	**Y**	Y	**Y**	Y	Y	Y	Y	Y	Y	Y	P	P	Y	P	Y	Y	Y	Y	Y	Y	**Y**
DE	**Y**	Y	**Y**	P	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	**Y**
EL	**P**	N	**Y**	Y	Y	Y	Y	Y	Y	N	P	Y	Y	N	N	Y	Y	Y	Y	Y	**Y**
HU	**Y**	P	**Y**	Y	Y	Y	N	Y	P	P	Y	N	Y	Y	P	P	Y	Y	N	Y	**Y**
IE	**Y**	Y	**Y**	N	Y	Y	Y	Y	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	**Y**
IT	**Y**	Y	**Y**	Y	Y	Y	NI	NI	Y	P	Y	Y	NI	Y	Y	Y	Y	NI	NI	Y	**Y**
LV	**Y**	N	**Y**	NI	Y	Y	Y	Y	P	Y	Y	P	Y	P	P	Y	N	N	Y	Y	**Y**
LT	**Y**	P	**Y**	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	**Y**
LU	**P**	NI	**Y**	NI	NI	NI	NI	NI	Y	Y	Y	Y	Y	Y	NI	N	NI	NI	NI	NI	**N**
ES	**Y**	Y	**Y**	Y	Y	Y	Y	Y	Y	P	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	**Y**
MT	**P**	N	**Y**	N	N	Y	Y	Y	n/a	P	N	Y	Y	N	NI	Y	NI	NI	NI	NI	**N**
NL	**P**	N	**Y**	NI	NI	NI	P	NI	NI	Y	Y	NI	NI	Y	Y	Y	NI	NI	NI	NI	**N**
PL	**Y**	N	**Y**	N	N	Y	Y	Y	Y	P	N	N	Y	N	NI	Y	NI	NI	NI	NI	**N**
PT	**Y**	Y	**Y**	NI	NI	Y	P	P	P	P	Y	Y	Y	Y	P	N	NI	NI	NI	NI	**Y**
RO	**P**	N	**Y**	P	Y	Y	NI	NI	NI	P	NI	NI	NI	N	N	Y	P	P	P	Y	**Y**
SK	**Y**	N	**N**	P	P	P	Y	Y	Y	N	Y	Y	N	P	Y	Y	N	N	N	N	**N**
SI	**Y**	Y	**Y**	Y	Y	Y	P	Y	Y	Y	Y	N	Y	Y	Y	Y	NI	NI	NI	NI	**P**
SE	**Y**	N	**Y**	NI	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	**Y**

Notes: Mandatory measures are in bold.

Y = yes, measure applied. N= no, measure not applied. P= measure partially applied. NI = no information provided. N/A = measure not applicable in Member State

2.2.6 Qualitative analysis of the extent to which recommendations in review reports were followed up in subsequent programmes

Article 10(1) of the Directive requires the Commission to examine the national air pollution control programmes and their updates. In this context, recommendations are made to Member States to ensure compliance or act on areas for improvement in their submission of NAPCPs and PaM. Encouragements are made for Member States to include optional reporting content that improves the quality of NAPCP and PaMs reporting beyond the minimum requirements of the Directive, which can be considered good practice and is commendable.

Recommendations to Member States are prioritised according three categories, namely:

1. Ensuring compliance – non-compliance with the NECD, where the minimum content is not reported and/or the Member State does not demonstrate how it may achieve its emission reduction commitments.
2. Areas for improvement – the NAPCP is reported to be compliant with its emission reduction commitments and provides the minimum content required by the common format but areas for improvement to strengthen compliance have been identified.
3. Encouragements – where optional reporting and/or the NAPCP could be closer aligned with the guidance document on preparation of initial NAPCPs to strengthen the quality of the NAPCP.

To date, 17 Member States have updated their first NAPCP. **The degree to which Member States have acted on recommendations from previous NAPCP review reports varies**. No Member State fully acted on all relevant recommendations. Some Member States acted on only some recommendations fully, whereas some Member States acted on all recommendations only partially.

According to the **targeted stakeholder consultation**, there is a **consensus** on the fact that NAPCP reviews by the Commission have somewhat **improved the quality of the programmes**. For the two groups that provided the most responses – public authorities and NGOs – the view that NAPCP reviews by the Commission have somewhat improved the quality of the programmes was held by a significant majority. The **majority** of stakeholders replying to that consultation also expressed the view that the NAPCP reviews by the Commission have somewhat **improved the effectiveness of the programmes**.

2.2.7 Effectiveness of NAPCPs according to stakeholders

According to the majority of respondents to the OPC and TSC, the development and submission of NAPCPs contributed positively to reaching the objectives of the NECD. 8 OPC (5 business associations, one business and one public administration and one trade union) and 12 TSC respondents (6 public authorities and three industry associations) thought it greatly helped, and 33 OPC (12 business associations, 8 NGOs, 6 EU citizens,

3 public administrations) and 16 TSC (6 public authorities, four NGOs and three industry associations) respondents indicated that it somewhat helped. Only one stakeholder responding to the OPC (EU citizen) and two respondents to the TSC (industry association and other stakeholder) thought that it somewhat hindered reaching objectives.

When prompted to expand their reply, respondents to the TSC across several stakeholder categories stated that NAPCPs were a central management tool to help Member State plan the national policies and measures to meet ERCs. At the same time, stakeholders mentioned some limitations that reduce the effectiveness of the tool, including:

- issues of conflicting timing with NECP submissions (public administrations, individuals in a professional capacity);
- NAPCPs did not prove to be a sufficiently strong tool to trigger compliance with ERCs (NGOs);
- consultations did not trigger changes to NAPCPs (NGOs);
- insufficient readiness of implementing the measures by governments and economic sectors (public administrations).

Stakeholder feedback on more detailed aspects of NAPCPs has been integrated into above sections.

2.3 To what extent has inventories and projections reporting been instrumental in reaching the Directive's objectives?

2.3.1 Extent and timing of inventory, projection and IIR submissions across Member States (submissions and meeting requirements)

Table A - 9 –Timeliness of emission inventories, informative inventory reports and emission projections[76]

Number of MS meeting/missing the deadline (in brackets: [deadline missed by more than two weeks])

Obligation	**Deadlines**								
Emission inventories – 15 February	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**
Deadline met	17 MS (63%)	22 MS (81%)	21 MS (78%)	21 MS (78%)	26 MS (96%)	26 MS (96%)	25 MS (93%)	26 MS (96%)	21 MS (78 %)
Deadline missed	10 MS [4 MS]	5 MS [4 MS]	6 MS [2 MS]	6 MS [1 MS]	1 MS [0 MS]	1 MS [0 MS]	2 MS [1 MS]	1 MS [0 MS]	6 MS [5 MS]
Informative Inventory Report – 15 March	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**
Deadline met	20 MS (74%)	22 MS (81%)	21 MS (78%)	20 MS (74%)	23 MS (85%)	24 MS (89%)	21 MS (78%)	26 MS (96%)	22 MS (81%)
Deadline missed	7 MS [5 MS]	5 MS [4 MS]	6 MS [4 MS]	7 MS	4 MS [0 MS]	3 MS	6 MS [2 MS]	1 MS [1 MS]	5 MS [4 MS]

[76] Submission dates as reported in the Central Data Repository.

				[4 MS]		[0 MS]			

* Member States may resubmit inventories due to errors within four weeks.

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Emissions projections – 15 March	**2017**	**2019**	**2021**	**2023**	**2025**
Deadline met	16 MS (59%)	19 MS (70%)	19 MS (70%)	13 MS (48%)	18 MS (67%)
Deadline missed	11 MS [7 MS]	8 MS [5 MS]	8 MS [6 MS]	13 MS [9 MS]	9 MS [4 MS]

National gridded data by source category – 1 May	**2017**	**2021**	**2025**
Deadline met	17 MS (63%)	19 MS (70%)	17 MS (63%)
Deadline missed	10 MS [9 MS]	8 MS [5 MS]	10 MS [6 MS]

Large Point Sources by source category – 1 May	**2017**	**2021**	**2025**
Deadline met	16 MS (59%)	19 MS (70%)	17 MS (63%)
Deadline missed	11 MS [10 MS]	8 MS [5 MS]	10 MS [7 MS]

Most Member States submit emission inventories, emission projections and IIRs on time, with most delays occurring in the reporting of re-submissions of emission inventories and of submissions of emissions projections. Timeliness of reporting has globally improved throughout the NECD evaluation period, with the exception of projections.

An infringement procedure was opened for one Member State for failure to submit its emission inventory, projections, and the informative inventory report all due by or before mid-March 2023. The Member State concerned subsequently complied with all reporting obligations and the procedure was closed.

In most cases, delays did not prevent the Commission from performing its assessment but they hinder a timely monitoring of progress and ensuring a comprehensive overview of compliance with emission reduction commitments.

As regards projections and to complement table A-9 above, a few Member States have, in past submission rounds, not provided a WAM scenario even though their WM scenario projects non-compliance for one or several pollutants.

2.3.2 Quality, comprehensiveness and consistency of reporting of inventories, projections and IIRs

2.3.2.1 Quality of inventories for main pollutants

In line with Article 10(3)(a), the Commission, assisted by the EEA, regularly checks Member States' emission inventories '*to verify the transparency, accuracy, consistency,*

comparability and completeness of information submitted'. Inventory reviews under the NECD have been conducted since 2017. Especially in recent years the reviews have focused on the five main pollutants, to ensure high-quality emission estimates for the pollutants subject to emission reduction commitments. The quality of inventories on 'non-ERC' pollutants, i.e. pollutants that are reported but for which the NECD does not establish reduction commitments, is addressed at the end of this section. Reviews result in findings per Member State that are summarised in national inventory review reports, as well as an EU-level summary or 'horizontal' review report. All reports are available online[77].

The purpose of these reviews goes beyond quality assessing the submissions made in a given year. They also ensure that the Commission relies on solid evidence when checking compliance and possibly following up with infringement procedures. Furthermore, the reviews involve a continuous dialogue between the review team and the inventory compilers in Member States with the aim of increasing the quality of inventory submissions over time. The funding of a detailed review process is thus partly capacity building provided to Member States by the Commission. Further efforts from the Commission's side have been made to promote good quality inventories, which included:

- a dedicated capacity building component as part of the 2017 inventory review, also to ensure high-quality emission estimates for 2005, the base year of the NECD,
- a dedicated capacity building regarding the development of national emission inventories in 2021, including the preparation of guidance material for integration into the EMEP/EEA Guidebook
- the development (by the JRC) of the AgrEE tool for emissions from the agriculture sector, as well as
- using the TAIEX Peer-2-Peer tool to provide practical support to a Member State in improving its inventory.

Looking at the review outcomes over the years, **the quality of inventory submissions has improved over time**, across the EU. Still, while most Member States submit inventories of good quality, the quality of a few inventories remains significantly poorer. Important areas of improvement exist across all sectors and pollutants[78].

As part of the 2023 inventory review, the team of consultants supporting the Commission and the EEA in the exercise, drafted a report identifying best practices in inventory compilation along with identifying current quality issues[79]. This collection includes both Member States with a long track record of high-quality submissions, also given long-standing engagement in the Air Convention, and Member States that have significantly improved their submissions more recently.

Transparency

Lack of transparency remains one of the issues that most limits the review process. Transparency is ensured through IIR which should, among others, provide descriptions,

77 https://environment.ec.europa.eu/topics/air/reducing-emissions-air-pollutants/emissions-inventories_en
78 These conclusions are supported by the horizontal review reports issues in recent years.
79 Aether (2023) NECD Emissions inventory review: Examples of best practice in emissions inventories.

references and sources of information of the methodologies and assumptions used in compiling the inventories. IIRs that are consistently assessed as being of good quality are not only extensive, but many also provide direct access to Excel tables, either on-line or as report annexes.

A key take-away message is that transparency issues are typically associated with a limited or complete lack of information being provided in the IIR. The IIR needs to provide sufficient documentation relating to the sources and the emission estimates to enable verification and allow the emissions inventory review team to replicate the calculations used to determine the emissions estimates.

Accuracy

Tier 1, tier 2 and tier 3 methodologies: A tier represents a level of methodological complexity. Tier 1 is the basic method, tier 2 is intermediate, and tier 3 is the most demanding in terms of complexity and data requirements. Tier 2 and 3 are generally considered to be more accurate, while the use of default parameters in tier 2 methods reduces notably the possibility to reflect country specific conditions and the effect of policies and measures[80]. The occurrences of tier 1 methodologies being used for key sources has decreased across recent years. There are still some occurrences, but these are now relatively isolated instances. This reflects improvements made to the EMEP/EEA Guidebook as well as the success of the inventory reviews and the supporting work.

Uncertainty analyses: Many Member States continue to not report an uncertainty analysis. This is a key tool in interpreting the emission inventory outputs as well as in steering improvement activities. The barrier is thought to be associated with the Member States' resources/prioritisation rather than a lack of good guidance material.

Completeness

There have in the past been some recurring completeness issues, but the majority of these have been addressed. Some isolated cases remain and are identified each year during the review. A lack of completeness can arise from either inadequate resources for identifying relevant existing emission sources in the country, a lack of data for estimating emissions from existing sources, or insufficient or unclear guidance presented in the EMEP/EEA Guidebook. The respective Member State will need to work on addressing issues that arise from a lack of resources and/or data. Proxy solutions have been developed to overcome shortcomings of the EMEP/EEA Guidebook, and these are considered in chapter 4 below.

Consistency and Comparability

Consistency is generally of a good standard across the Member States, and where issues arise, they are typically isolated errors, such as transcription errors, which are then corrected in future reporting. The availability of a common Guidebook plays a key role in

[80] In fact, 'Tier 2' reflects a wide range of methods, with more sophisticated Tier 2 methods relying on the use of country-specific information, while others do not.

ensuring consistency. Comparability is rarely an issue, with common definitions and reporting structures being used across all Member States.

The 2023 best practice report[81] concluded that '*[whilst] there has been a significant improvement in addressing recurring issues found during the NECD emissions inventory reviews, it may now be slower to address the remaining issues. This is because many require a new or amended methodology to be developed and published in the EMEP/EEA Guidebook, and then implemented by the MS*'.

BOX 4. Lithuania working on improving its emission reporting

Reviews of Lithuanian emission inventories showed several shortcomings in the reporting of emissions leading to a high number of corrections and recommendations covering all sectors in the inventory review reports. Difficulties encountered were found to related to technical issues as well as inventory management issues:

- Use of a methodology and/or emission factors to calculate emissions for a key category not in line with the reporting guidelines and EMEP/EEA guidebook. Member States are not applying a tier 2 or tier 3 methodology when calculating their air pollution emission estimates for key categories;
- Emission estimates not estimated for some emission sources.

Inventory management issues

- Lack of information provided in Member States' informative inventory reports regarding data sources, parameters, assumptions and methodologies used to estimate air pollution emissions estimates;
- Use of coherent approach in compiling air pollution and greenhouse gas emission inventories, for one or more sectors (including use of common underlying data and assumptions within separate air pollution and greenhouse gas emission inventories).

LT participated in capacity building for Member States regarding the development of national emission inventories in 2021 proposed by the Commission.

In its latest NAPCP, LT included measures targeting the improvement of inventory data.

On 15 to 17 May 2023, a TAIEX-EIR expert mission took place requested by the Lithuanian Environmental Protection Agency. Among the aims was to:

- strengthen the administrative capacity regarding data sources and compilation, in particular in the sectors fuel combustion and industrial processes, to allow to apply more precises inventory methodologies for key emission categories;
- increase the transparency of the Informative Inventory Report;
- improve the capacity to quantify effects of policies and measures.

The review of the 2024 emission inventory showed that progress had been made in terms of accuracy of the inventories and transparency of the IIR for certain pollutants.

In the NECD inventory review 2024, the technical expert review team tagged the TACCC (transparency-accuracy-consistency-completeness-comparability) principle(s) that were relevant for the findings. Transparency was the principle that was relevant for the highest number of findings (157), followed by accuracy (89) and consistency (64). The accuracy flag was assigned most often to technical corrections (12) and revised estimates (nine) since these types of findings are related to and intend to improve the accuracy of emission estimates (see Figure below). It is important to note that the number of findings does not necessarily correlate with quality or the lack thereof. Findings include observations of

[81] Ibid.

different nature, including minor and more significant issues. The same holds true for comparing number of findings across Member States (related statistics are available in the 2024 horizontal review report).

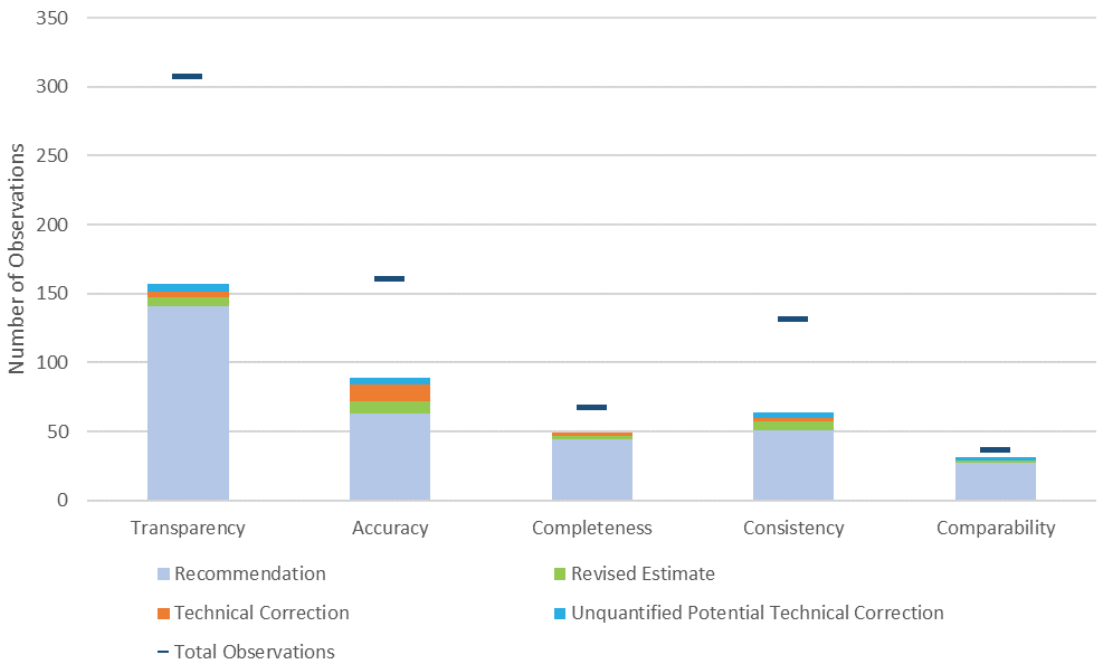


Figure A - 14 – Number of findings by TACCC principle. Source: 2024 horizontal review report based on findings documented in the EEA EMRT-NECD tool. Note: Since a finding may relate to more than one TACCC principle, the number of findings in this graph does not add up to the total number of findings.

The table below shows the findings for main pollutants and PM_{10} from the NECD inventory reviews 2017-2022 that were not (fully) implemented. It is apparent that the number of open findings first issued in the year 2022 is very high with 56 findings, out of which eleven were related to a key category[82]. The reason for this high number is that the NECD inventory review 2022 was an 'in-depth' review of main pollutants (and main pollutants have been reviewed in depth since), leading to a much higher number of total findings than in previous years, during which the reviews have focused on other types of reported data (gridded and LPS data, heavy metals and POPs).

[82] A key category means a source category of emissions that has a significant influence on Member States total emissions. Key categories are defined as those which, when ordered in descending order of magnitude, cumulatively add up to 80 % of the total level (i.e. a Member State's total emissions). More details on the concept and calculation of key categories are available in the EMEP/EEA Guidebook.

Table A - 10 – Findings for main pollutants and PM_{10} from the NECD inventory reviews 2017-2022 that were not (fully) implemented

	From 2017	of which KC	From 2018	of which KC	From 2019	of which KC	From 2020	of which KC	From 2021	of which KC	From 2022	of which KC	**Total**	**of which KC**
	Number of not (fully) implemented findings in the 2023 inventory submission													
EU total	13	5	1	0	5	2	7	2	9	2			**35**	**11**
	Number of not (fully) implemented findings in the 2024 inventory submission													
EU total	6	3	1	0	3	1	7	2	3	1	56	11	**76**	**18**

Note: KC= key category. 2023 is based on 26 Member States as Croatia was not reviewed in the NECD inventory review 2023 since it did not submit any inventory within the reporting deadline in 2023. Findings from the NECD inventory review 2023 (2022 for the first row) have not been included in this analysis since Member States might still be working on the implementation of those findings. Both reviews focused on main pollutants, therefore, previous findings relating to other pollutants and LPS and gridded data that Member States have not (fully) implemented are not included in this table.

In terms of **sectors with recurring issues**, the top sectors typically include the industrial processes and product use (IPPU) sector, but also energy, waste and agriculture. The 2023 best practice paper (Aether, 2023) provide a more detailed discussion of what are typical remaining issues and what recent solutions were found in recent years for some of them.

2.3.2.2 Quality of inventories for 'non-ERC' pollutants as well as of large point source and gridded data

In accordance with Article 8 and Annex I and Annex IV to the NECD and in addition to inventories for the five main air pollutants, for which the NECD sets emission reduction commitments, Member States are required to also report annually inventories of black carbon (BC) '*if available*', PM_{10}, carbon monoxide (CO), heavy metals (Cadmium, Mercury, Lead), and persistent organic pollutants (POPs), for which the Directive does not establish emission reduction commitments[83]. Member States *shall* also report emissions for large points sources (LPS) and gridded data every four years. Furthermore, under the same article of the Directive, Member States *may* prepare annual inventories for other heavy metals (Arsenic, Chromium, Copper, Nickel, Selenium and Zink and their compounds) and total suspended particles.

The most recent in-depth reviews by the Commission related to non-ERC pollutants occurred:

[83] The analysis here is to a large extent informed by a report commissioned by DG ENV and prepared by Aether, CITEPA and Ricardo, published as: European Commission: Directorate-General for Environment, *Analysis of and recommendations for the inventory reporting requirements under Directive (EU) 2016/2284 not linked to emission reduction commitments – Final report*, Publications Office of the European Union, 2023, https://data.europa.eu/doi/10.2779/035489. [*henceforth:* Aether, CITEPA and Ricardo, 2023].

- In 2019 for POPs and heavy metals (Cd, Hg, Pb) with a follow-up review in 2020. In 2025, POPs and heavy metals have been reviewed again, but the quality analysis was not concluded in time for this evaluation.
- In 2020 for gridded data and LPS with a follow up review in 2021.
- In 2021 for CO, PM_{10} and BC with a follow-up review in 2022.

The corresponding horizontal review reports have all been published[84]. Above cited DG ENV commissioned work assessed the comprehensiveness and quality of current Member State reporting of non-ERC pollutants, drawing on submitted historical inventory data, with the most recent datasets taken into account being the 2023 submissions (giving a timeseries up to 2021). This work was based on reviewing the horizontal review reports of above-mentioned reviews as well as additional data checks performed and stakeholder feedback gathered in the course of the service request.

In terms of other types of data, i.e. **LPS and gridded data**, it is hard to conclude whether the outputs of the 2020 and 2021 horizontal review reports imply a greater need to prioritise improvements in terms of comprehensiveness or quality between either of these spatial data sets. However, it does appear clear that **there are at least some technical improvements that are required across most Member States**. A small number of Member States received multiple priority recommendations, and this is particularly the case in relation to **gridded data**.

The horizontal review report for 2021 indicates that there may be **lowest quality and comparability of inventories for BC, PM_{10}, TSP and CO, with BC standing out as potentially the lowest quality pollutant among the group**. As a newer pollutant within NECD reporting, it is perhaps unsurprising that there is greater variance between Member States in terms of the quality of reporting for this pollutant at this stage.

Additional checks on **BC** and **PAHs** emission inventories undertaken by Aether, CITEPA and Ricardo (2023) found potential reporting errors for both pollutants across multiple Member States. However, the largest number of potential errors were identified in the PAH emissions data, and these potential errors occurred across more Member States than it was the case for other (groups of) pollutants analysed.

These checks do not indicate the magnitude or significance of potential error(s), but **the findings do raise questions about the quality of the reported data and reduce confidence in the accuracy and completeness of reporting for both BC and the PAHs**.

Where trend anomalies are observed, this may be a result of genuine changes e.g., changes in industrial activity that cause an associated change in emissions. However, when aggregating emissions totals to EU27 level and for all sectors, it is expected that these genuine interannual changes would become increasingly masked for most pollutants, leaving a smooth trend. On this basis, the observed trends at EU27 level for the non-ERC

[84] https://environment.ec.europa.eu/topics/air/reducing-emissions-air-pollutants/emissions-inventories_en#review-of-national-emission-inventories

pollutants highlight **POPs, notably HCB and total PAH as having emissions trends and interannual changes that might imply greater trend inconsistencies in comparison to other non-ERC pollutants**.

As to stakeholder feedback gathered during the service request, the quality of reporting of pollutants not regularly covered within inventory reviews under the NECD[85], as well as those that are reported on a voluntary basis[86], has been highlighted as needing improvement, particularly by the modellers and users of national emissions data. The improvements needed for these pollutant groups cover all quality criteria, but transparency and accuracy are the most commonly identified.

2.3.2.3 Quality of projections

Projections need to be of good quality for a reliable assessment of the future risk of non-compliance. This also allows Member States to adopt well-targeted additional measures addressing the sectors and sources of pollution where more effort is required. The Commission reviews Member States' emission projections for each reporting cycle (every 2 years)[87] and takes into account the latest reporting guidelines. Five quality assessment criteria for projections are set in Annex IV, Part 2 to the Directive: transparency, accuracy, consistency, comparability and completeness.

Transparency

Lack of transparency has been identified as the main shortcoming, with a majority to all Member States failing to provide sufficient detail on the methodologies, input datasets and assumptions used for preparing their projections in their IIRs. Sometimes available information is spread across multiple documents e.g., within the IIR, separate methodology reports or other documents, which renders the analysis of submissions more cumbersome. This lack of transparency is a recurring finding of the reviews across the past rounds of submissions.

Accuracy

Results of checks related to accuracy vary significantly across the Member States. This suggests that there are no particular cross-cutting barriers (such as lack of guidance) to compiling projections to a good standard of accuracy. While generally there is variation across Member States rather than pollutants, projections for SO_2 have tended to be of better accuracy than those for the other pollutants.

The level of transparent and comprehensive reporting by Member States is a key factor influencing the accuracy of projections (this links back to the need for more transparency and clear descriptions of methodologies and assumptions used in the IIR). Many of the accuracy issues raised are associated with the use of Tier 1 methodologies; simple methods

85 Such as heavy metals and POPs.
86 Such as BC.
87 https://environment.ec.europa.eu/topics/air/reducing-emissions-air-pollutants/national-air-pollution-control-programmes-and-projections_en

for estimating future emissions from key categories; or an incompleteness in the emissions inventory which present an underestimation of national total emissions.

Consistency

Consistency issues are found frequently in the reviews. Minor consistency issues raised in the reviews are often associated with misallocation of emission sources in the projections, and exclusion from the projections of some small emission sources present in the historical inventory. For a limited number of Member States, there are inconsistencies with a potentially more significant impact on national totals, that is inconsistencies between the emissions reported in the reference year in projection submissions and the values included for that year in the historical inventory.

Comparability and completeness

Across the reviews, comparability has been assessed as being of a good standard for most or even all Member States. This is in line with the finding that Member States generally make good use of the existing guidance, guidelines and templates available to support comparable submissions[88].

Completeness is of good standard in a majority of Member States. While improvements are still possible, there is limited impact on overall quality of projections.

Overall quality assessment over time

As regards the overall quality assessment of projections, there is some improvement over time, though it has been somewhat slower than for inventories (with a more marked improvement in the latest, 2025 submission). One reason for this can be that more resources are devoted to the process of reviewing inventories, which includes the yearly dialogue between the review team and Member States as part of the review[89]. This process can be seen as a capacity building mechanism for Member State inventory compilers, leading to better quality submissions overtime. As regards the quality assessment of past submission of projections:

- 2019 projections: 1 out of 28 reviewed submissions had a "good" quality ranking across all five pollutants (5 Member States had a "good" quality ranking for at least four pollutants), whereas major improvement needs across all five pollutants have been identified for 5 out of the 28 Member States.
- 2021 projections: 4 out of 25 reviewed submissions had a "good" quality ranking across all five pollutants (6 Member States had a "good" quality ranking for at least four pollutants), whereas major improvement needs across all five pollutants have been identified for 9 out of the 25 Member States.

88 I.e. the best practice guidance presented in the 2019 EMEP/EEA Air Pollutant Emissions Inventory Guidebook and the annexes to the 2023 reporting guidelines.

89 While there is a Q&A process with Member States also for the projections review, it is less detailed, with fewer iterations.

- 2023 projections: 4 out of 21 fully reviewed submissions had a "good" quality ranking across all five pollutants, whereas major improvement needs across all five pollutants have been identified for 7 out of 21 Member States.
- 2025 projections: 9 out of 27 fully reviewed submissions had a "good" quality ranking across all five pollutants, whereas major improvement needs across all five pollutants have been identified for 3 out of 27 Member States.

The **number of recommendations and encouragements** varies by sector. Throughout the submission rounds, agriculture, energy and transport were the sector with the most recommendations. In terms of total number of recommendations and encouragements, these have remained roughly stable across reviews, with considerable variation across Member States. But similar to inventories, the number of findings is not necessarily an indicator of quality.

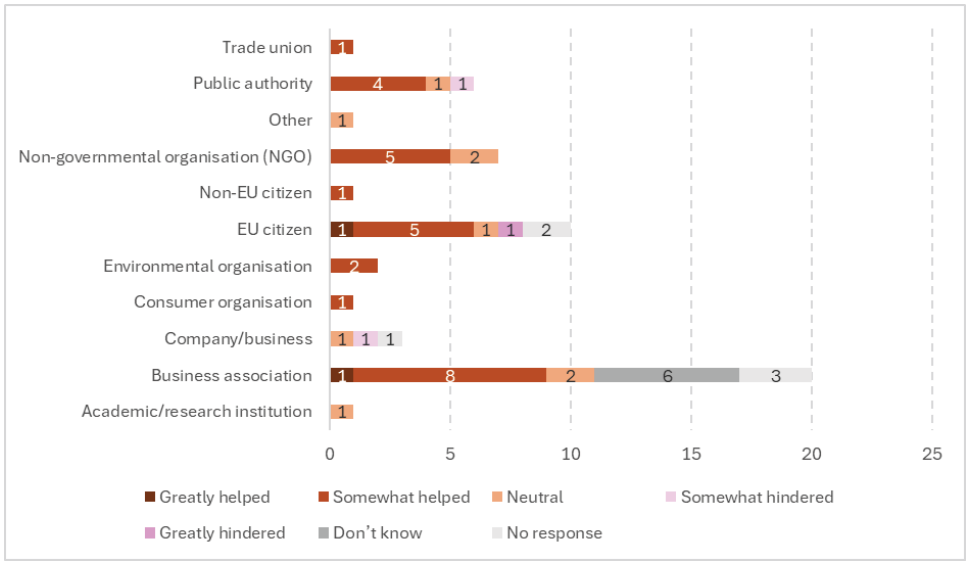
In 2023, the Commission adopted a delegated act[90] making targeted amendments to two annexes of the Directive that require Member States to use, as of 2025, the latest template[91] for the reporting of projections adopted under the UNECE Air Convention. This will produce emission projections in higher resolution by disaggregating source sectors in the same way as it is done for inventories, giving Member States an improved basis for designing targeted additional measures. Already in 2023, while not yet mandatory to use, around half of the Member States reported their projections in the more disaggregated version of the submission template. In 2025, all Member States reported in the new template in line with the amended Directive.

2.3.3 Effectiveness according to stakeholders

The majority of respondents replying to both open public and targeted **stakeholder consultations** considered the reporting of emission inventories and projections of future emissions at least as somewhat helpful. This support was expressed across all stakeholder groups.

[90] Commission Delegated Directive (EU) 2024/299 of 27 October 2023 amending Directive (EU) 2016/2284 of the European Parliament and of the Council on the methodology for the reporting of projected emissions of certain atmospheric pollutants.

[91] Annex IV template available here: https://www.ceip.at/reporting-instructions/annexes-to-the-2023-reporting-guidelines.



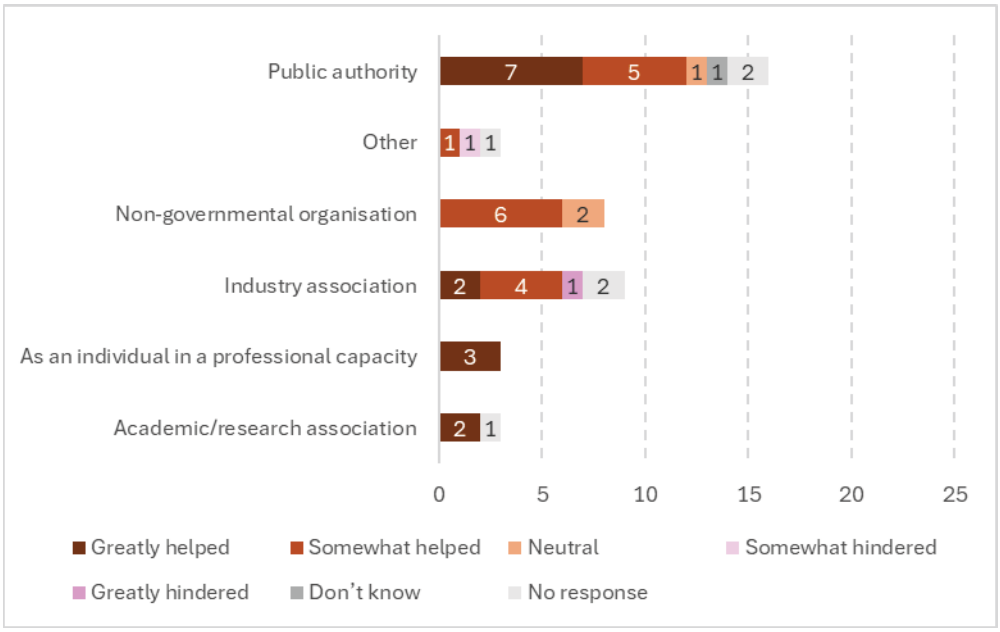
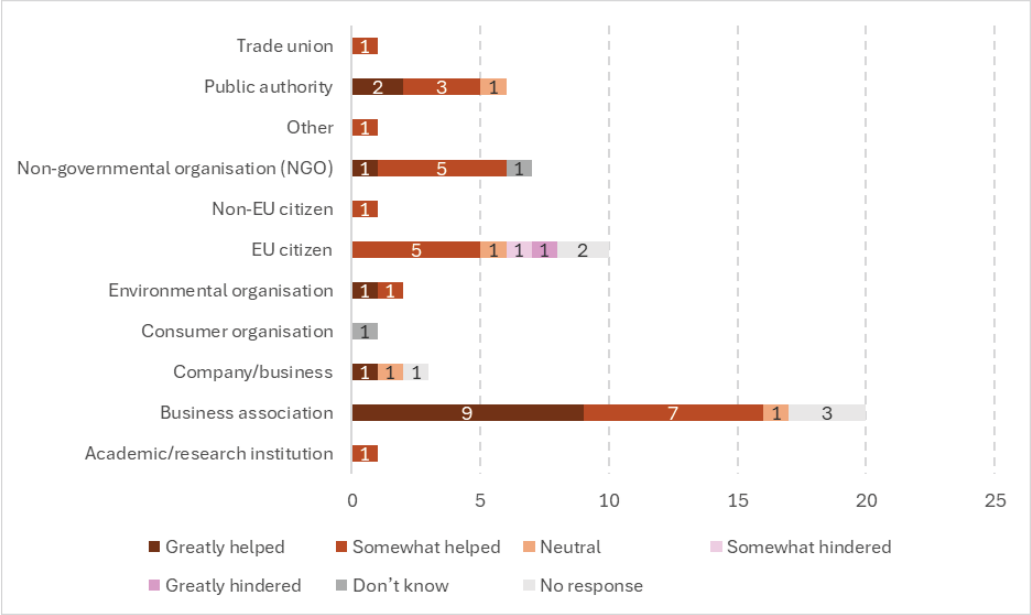


Figure A - 15 – To what extent have inventories helped achieve the Directive's objectives (OPC replies on top, TSC replies bottom)



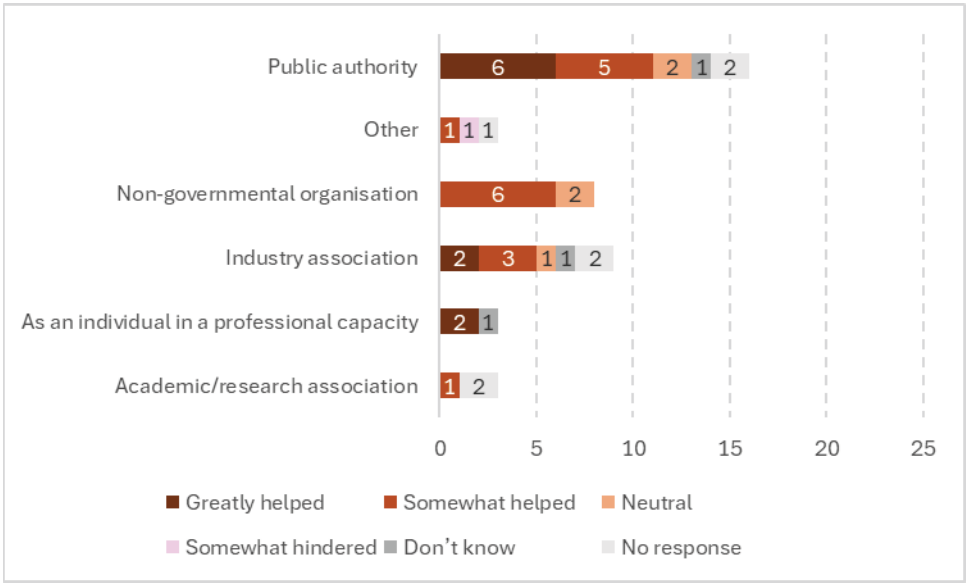


Figure A - 16 – To what extent have projections helped achieve the Directive's objectives (OPC – top figure; TSC – bottom figure)

When prompted to expand on their reply, TSC respondents highlighted that **inventories** were crucial to monitor progress towards ERCs and to inform the implementation of reduction measures (academia, NGOs, public administrations). One individual in a professional capacity remarked that the reliance on the methodologies used under the Air Convention was useful. One public administration thought that the added value of inventories under the NECD was limited, as Member States report to the Air Convention.

Some respondents thought that **projections** were essential to help Member States understand whether they are on track and to inform adjustment to NAPCPs and PaMs (academia, NGOs, public administrations). One public authority thought that inventories were of more significance for understanding the development of emissions respectively to projections.

2.4 To what extent has ecosystems monitoring been instrumental in reaching the Directive's objectives?

Following Article 10 (4) of the NECD, every four years Member States have to report to the Commission data about their monitoring of impacts of air pollution upon ecosystems based on a network of monitoring sites that is representative of their freshwater, natural and semi-natural habitats and forest ecosystem types, taking a cost-effective and risk-based approach, as stated in Article 9. The reporting is done in two steps (Article 10(4) of the NECD):

- by 1 July 2018, and then every four years, Member States report the location of the monitoring sites and the associated indicators used for monitoring air pollution impacts,
- by 1 July 2019, and then every four years, Member States report the monitoring data on ecosystems impacts.

Annex V to the NECD lists optional indicators that Member States can use for this monitoring. To support Member States in monitoring and reporting, the Commission produced a number of tools:

- Commission Guidance notice on ecosystem monitoring;
- Guidance on monitoring site selection (2022)[92];
- Reporting template - updated in 2022 for the second reporting cycle in 2022-2023, in close consultation with Member States and the EEA, has developed a reporting template.

The use of the template is voluntary, and it allows Member States flexibility as to which data they can report.

Since the adoption of the NECD in 2016, two cycles for this reporting obligation have been completed by Member States (2018/19 and 2022/23). The Commission has contracted work to analyse the data reported by Member States to establish the quality of the reported data and to draw possible conclusions from the data on the impact of air pollution on ecosystems. This section is based on these reports, all available on the Commission website.

2.4.1 Extent of monitoring across Member States (site coverage)

In both reporting cycles (2018-2019 and 2022-2023), all Member States complied with their reporting obligations, and most of them did so in a timely manner (see table below). During the first cycle of reporting (2018/19), all Member States used the standardised reporting template for at least a portion of their 2019 data submission. During the second

[92] Guidance note on site selection – support to Member States regarding the monitoring of effects of air pollution on ecosystems according to Article 9(1) of the NECD, Ecologic Institute for the European Commission, 2022.

cycle, all Member States used the (updated) reporting template apart from three Member States[93].

Table A - 11 – Timeliness of ecosystem reporting

Reporting obligation	Deadlines	
Monitoring sites and indicators	**1 July 2018**	**1 July 2022**
Deadline met	19 MS (70%)	18 MS (67%)
Deadline missed	8 MS [6 MS]	9 MS [4 MS]
Monitoring data	**1 July 2019**	**1 July 2023**
Deadline met	16 MS (59%)	22 MS (81%)
Deadline missed	11 MS [5 MS]	5 MS [2 MS]

Note: Number of MS meeting/missing the deadline, according to submission dates as reported in the Central Data Repository, and according to reports made by consultants. In brackets: [deadline missed from more than two weeks].

The Commission's assessment of Member States' **first reporting cycle** showed that the network of sites and reported data were not sufficiently representative and adequate to monitor the effects of air pollution on ecosystems. The analysis of monitoring sites reported in 2018-19 concluded that some ecosystems especially sensitive to air pollution (heathlands, bogs and acid-sensitive grasslands) are underrepresented, even in Member States where these ecosystems are widespread. However, in most Member States, various levels of exposure to different pressures are monitored through sites located in both low and high sulphur and nitrogen deposition areas, thus providing a positive contribution to the representativeness of the reported data.

Building on the lessons learnt from the first reporting cycle, a guidance note on site selection was prepared by the Commission, supported by the EEA and Member State experts. It aims to help each Member State set up a representative monitoring network. Furthermore, the optional reporting template was adapted following feedback from Member States and the EEA. The analysis of **the second reporting cycle** shows an increase in the total number of sites and parameters reported compared to the first submission (+14%), with a total of more than 4700 sites reported in 2022. At national level, however, there are both cases of increased number of sites and of a reduced number of sites from 2018 to 2022. Similar to the first cycle, two Member States, Germany and Sweden, still account for around 60% of the reported sites.

Although the distribution of sites is more aligned with the distribution of ecosystem types across the EU, the ecosystem types 'rivers and lakes' and 'woodland and forest' remain overrepresented, while cropland, wetland and heathland/shrubland sites remain underrepresented.

In relation to the deposition of nitrogen and sulphur, the reported sites were located across the range of deposition values. Since Member States should take a **risk-based approach** for the selection of monitoring sites, locations with higher pollution pressures should be

[93] Denmark, Estonia, Slovenia.

preferred. Due to the uneven nature of the site numbers per Member State, it is difficult to draw conclusions in relation to whether the proportion of sites in different deposition level areas is appropriate. Nor can it be determined from the submitted data the degree to which critical loads exceedances played a role in decisions on site location. However, there are clearly some areas of high deposition and high critical load exceedance where monitoring is either absent or extremely limited, namely the Po Valley in Italy, Northern Spain and Northern France. Monitoring of ozone effects on non-woody species seems mainly to be limited to areas with low to moderate ozone concentrations, with the latter generally characterised by high ozone fluxes (POD).

2.4.2 Completeness of monitoring within each Member State (parameters covered, consistency between sites and monitoring data reported, use of Annex V)

Information about the completeness of reporting by the Member States is presented in Table A-12 below. The completeness of data is assessed against the list of core parameters which the Commission and the Member States agreed on. This table gives an overview of the data provided on the main freshwater and terrestrial parameter groups. Only when, for a specific parameter group, no data for all of the parameters within that group are reported, it is listed as 'no data' in this table. For the parameters on *Nitrate Leaching* and *Carbon Flux,* respectively only 2 and 3 out of 27 countries have reported data. 10 out of 27 Member States have reported on the ozone related parameter groups *Ozone foliar damage* and *Exceedance flux-based critical levels of ozone*. These four parameter groups are the ones that the fewest Member States have reported on. Croatia and Portugal have not reported on any of the terrestrial parameters, while Greece and Luxembourg have not reported on any of the freshwater parameters. No Member State has reported against all core parameters.

In general, it is clear that the current dataset is highly heterogeneous (i.e. variable in terms of the site types, measurement protocols and parameters measured), both spatially and temporally. This is not surprising due to the increase of the set of indicators / parameters since 2018. The method used by Member States to judge whether their sites to be representative (as required by the NECD) isn't always clear from the provided data and/or accompanying documents.

For investigating different source-effect relations, specific parameters have to be available in the dataset being monitored. The current dataset gives the opportunity for investigating source-effect relations only for a limited number of sites. This holds for about 10 to 350 sites, depending on the source-effect relations, this means that, only for about 0.2% to 7% of the sites, source-effect relations can be investigated.

Table A - 12 – Overview of data provided in the 2023 data submissions from EU Member States by parameter groups. Source: 2022/23 data analysis report

	Freshwater			Terrestrial										
	Physical and Site Parameters	Chemical parameters	Acidification and eutrophication species and indicators	Physical and Site Parameters	Soil horizon profile and description	Soil acidity and Eutrophication - based on soil (not for Cropland)	Soil acidity and Eutrophication - based on soil porewater	Nitrate Leaching	Vegetation Parameters	Ozone foliar damage	Exceedance flux-based critical levels of ozone - PODY	Atmospheric concentration of pollutants (eutrophication/ acidification)	Carbon flux	Atmospheric deposition
Austria					no data					no data			no data	
Belgium										no data				
Bulgaria								no data			no data		no data	
Croatia				no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
Cyprus					no data			no data	no data	no data	no data		no data	
Czechia								no data		no data	no data		no data	
Denmark	no data							no data		no data	no data		no data	
Estonia			no data					no data		no data	no data		no data	no data
Finland			no data					no data		no data			no data	
France			no data					no data			no data		no data	
Germany	no data		no data					no data					no data	
Greece	no data	no data	no data					no data			no data		no data	
Hungary			no data					no data			no data		no data	
Ireland								no data		no data	no data		no data	
Italy				no data								no data	no data	
Latvia								no data		no data	no data		no data	
Lithuania								no data			no data		no data	
Luxembourg	no data	no data	no data		no data	no data		no data					no data	no data
Malta			no data				no data	no data			no data			no data
Netherlands			no data					no data		no data			no data	no data
Poland			no data		no data	no data		no data		no data	no data		no data	
Portugal	no data			no data	no data	no data	no data	no data	no data	no data	no data	no data	no data	no data
Romania						no data		no data			no data		no data	
Slovakia							no data	no data	no data				no data	
Slovenia								no data					nodata	
Spain								no data		no data			no data	
Sweden								no data		no data	no data		no data	

Note: Each column in the table corresponds to one parameter group. A blank cell means that the Member State has provided data for at least one parameter in the given parameter group.

No Member State's 2023 data submission matched completely what was expected from the sites and parameters submission in 2022. While for some the discrepancies were small, for others the variation was very large. The net result of this across all Member States is that data has been reported for 20% fewer parameters in 2023 than were indicated in the 2022 sites and parameters reports. The reasons for these discrepancies are not clear, neither from the data submissions themselves nor from the accompanying documents. Overall, it appears that Member States are not always able to predict which data they will be able to report. More detailed analysis is available in the 2022/23 data analysis report.

There were also significant differences between the **monitoring frequencies** (and thus data averaging times) suggested by the reporting template and what was submitted by Member States with, again, the level of difference varying by Member State (see Table 3-4 in the 2022/23 data analysis report).

2.4.3 Quality of reported monitoring data and its consistency with other programmes

Based on the findings of analysing the reported data of these two cycles, no generalised statements are possible for the quantification of impacts of air pollution on ecosystems across the EU. This is also due to the considerable differences between the datasets reported by Member States during the two cycles (both spatially and temporally, and in terms of monitoring site types, measurement protocols and parameters monitored). This prevents a reference point being put in place for the future assessment of the Directive's longer-term effectiveness.

While the datasets produced through Article 9 reporting are potentially highly valuable in establishing the state (and changes in the state) of ecosystems across the EU, the role of air pollution in these, and the benefits of reducing emissions over time in terms of increasing ecosystem value, the current quality of submitted data is too low. To draw meaningful conclusions from the submitted data, there is a need for greater consistency and coherence both within and between Member State data submissions. This would require reducing the variability in Member State approaches to the process of collecting and submitting ecosystem impact data. This may require clearer guidance to Member States, besides the templates and guidance notes already provided, to steer them towards a clearer overall purpose.

Concretely and based on the analysis of data submitted during the 2nd reporting cycle, two analyses were attempted:

1) to assess what could be discerned about the state of ecosystems by comparing data across biogeographical regions regardless of Member State boundaries, and

2) to assess whether simple causal chains could be established between emissions and final ecosystem outcomes using the data submitted.

For the **first analysis**, it was found that the data submitted was too heterogenous to allow a comparison across biogeographical regions to be undertaken. Gaps in the datasets, variability in data averaging times both within and between Member State datasets, and other such discrepancies meant that a meaningful comparison could not be undertaken.

For the **second analysis**, a logic model was constructed (see Figure A-17 below) and Member State terrestrial data submissions compared to the steps in the logic model. While this analysis has clear limitations, it was concluded that no Member State (as outlined in detail per Member State in the annex to the 2022/23 data analysis report) could reliably construct a full causal chain from emissions to impacts using the data collected and submitted under Article 9 and 10(4). In other words, beyond attempting to draw EU-wide conclusions, the reported data is also considered insufficient to draw conclusions for Member States separately. Only for individual ecosystems where the reported monitoring data is sufficiently complete to establish a direct relationship between the source (air pollutant emission source) and the receptor (ecosystem), it is possible to quantify the effects of air pollution on the basis of the reported monitoring data.

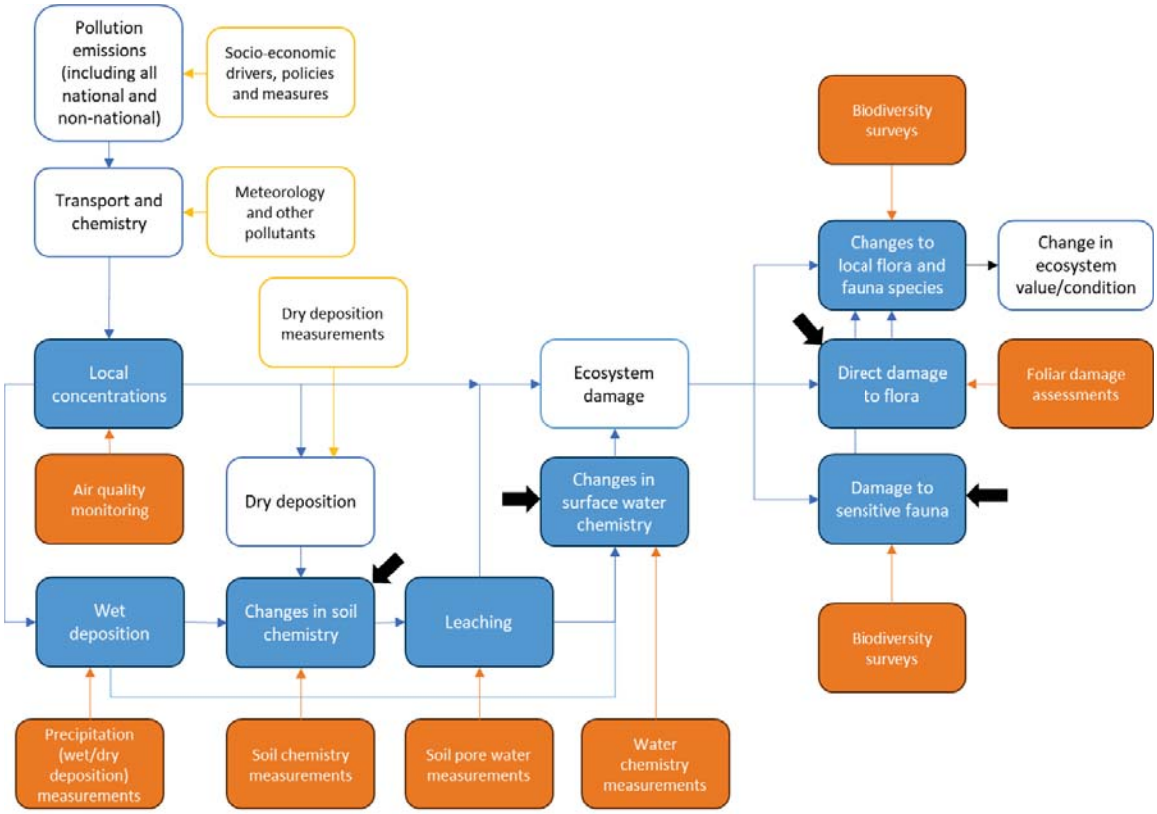


Figure A - 17 – Simple ecosystem data logic model. Source: 2022/23 data analysis report.

The Directive explicitly requires Member States to take a **cost-effective approach**, by **coordinating with other monitoring programmes** established pursuant to Union legislation, the LRTAP Convention and to make use of the data collected under those programmes. This approach was widely used by Member States in both reporting cycles, since most of the data provided follow international protocols, such as those from the International Cooperative Programmes (ICP) or from other EU directives (most commonly, the Water Framework Directive and the Habitats Directive. This limits the administrative costs of the Directive's requirements to monitor ecosystem impacts and its consistency with other programmes.

Starting with 2026, Eurostat will start collecting ecosystems data based on Regulation (EU) 691/2011. The data gathered will be complementary to the NECD reporting (there are no overlaps in the data required). Developments in this area should be kept under review to analyse how data resulting from this Regulation could contribute on indicators for monitoring the impact of air pollution on ecosystems.

2.4.4 Effectiveness according to stakeholders

Stakeholder feedback gathered corroborates the current challenges observed in the ecosystems monitoring and reporting as outlined above. In the stakeholder workshop, one participant (competent authority) stated that ecosystem reporting seems irrelevant as it is. Targeted engagement of competent authorities revealed a perception that ecosystems monitoring was **ineffective largely due to the voluntary design and implementation of national monitoring programmes**. One Member State went on to suggest that the

requirement as it stands does not generate data as intended and should either be removed or have more specific requirements or guidance developed **to ensure the data produced is more comparable across Member States**.

Stakeholders were divided in their opinions about the contribution of ecosystems monitoring and reporting to the objectives of the NECD.

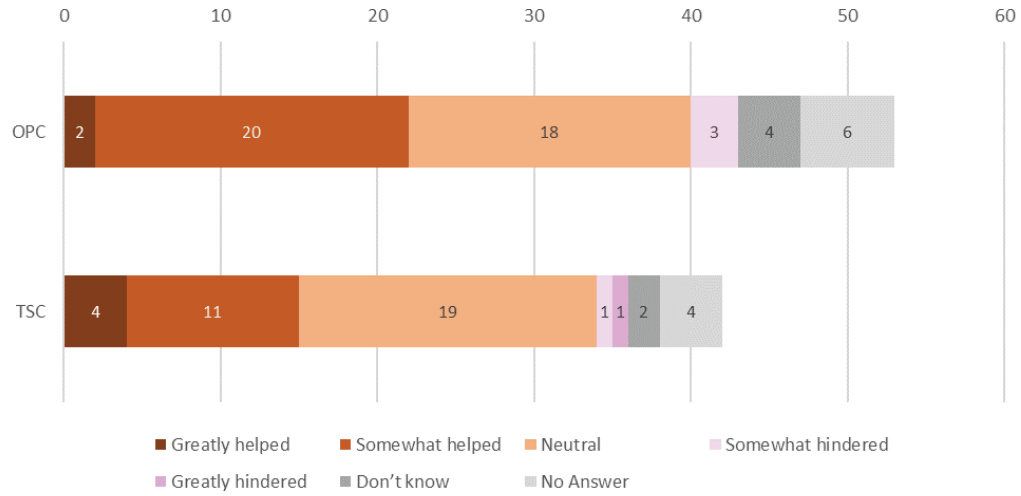


Figure A - 18 – OPC and TSC replies on the contribution of ecosystem monitoring and reporting to the NECD objectives

In both consultations, a relatively high number of respondents considered that this requirement had a neutral effect (18 OPC, 19 TSC). Most OPC respondents thought that this requirement helped somewhat, and only two respondents considered it greatly helpful; three respondents thought that it somewhat hindered reaching the NECD objectives. 11 TSC respondents considered the requirement somewhat helpful, and four considered it helped greatly.

Through the open public consultation, one public authority suggested that ecosystem monitoring should be reformulated in such a way to allow for conclusions to be drawn, making better use of existing monitoring data for entire territories.

Input from the TSC regarding the effectiveness of ecosystem monitoring pointed to the lack of harmonisation of protocols (e.g. different monitoring frequencies, different parameters, lack of methodological harmonisation) and the voluntary design as being obstacles to the effectiveness of this requirement. These issues were highlighted across the different stakeholder groups responding. At the same time, individuals in a professional capacity and NGOs highlighted the importance of monitoring the effects of air pollution on ecosystems.

A specific challenge highlighted by a public authority was that the current models were not able to take into account influencing factors other than air pollution, skewing the results.

2.5 To what extent have the flexibilities established by the NECD in Article 5(1) to (4) (inventory adjustments, "extreme weather event" flexibility, etc.) hindered or facilitated emission reductions?

2.5.1 Number of applications – split by flexibility type

Article 5 of the Directive provides for four exceptions to compliance with an emission reduction commitment that Member States may invoke:

- Adjusting emission inventories where non-compliance would result from applying improved emission inventory methods updated in line with scientific knowledge since the emission reduction commitments were first set, under certain conditions stipulated in Annex IV Part 4 to the Directive – Article 5(1);
- Averaging national emissions over three years in case of an exceptionally cold winter or an exceptionally dry summer[94] – Article 5(2);
- Compensating for non-compliance with one emission reduction commitment by an equivalent emission reduction of another pollutant, if a more stringent level than the cost-effective reduction was set for that pollutant – Article 5(3);
- Sudden and exceptional interruption or loss of capacity in the power and/or heat supply or production system leading to non-compliance – Article 5(4).

While the flexibility based on adjustments under Article 5(1) was part of the Commission's proposal for the Directive, the other three flexibilities were added by the co-legislators. The flexibilities according to Article 5(1), (2) and (4) are based on similar flexibilities agreed in the Gothenburg Protocol.

Since the entry into force of the Directive, no Member State has made use of the flexibilities according to Article 5(2) and Article 5(4). One Member State made use of the flexibility according to Article 5(3) in 2024 for one pollutant for one inventory year and in 2025 for one pollutant and four inventory years. The flexibility allowing for adjustments to the emission inventory is used most frequently.

Table A - 13 – Use of flexibilities since the application of the ERCs[95] according to Annex II to the Directive

Year of application	Type of flexibility	Country	Source sectors	Inventory years concerned	pollutant	Acceptance yes/no
2022	Inventory adjustment Article 5(1)	Ireland	2H2 Food and Beverages (Spirits)	2005, 2020	NMVOC	yes
2023	Inventory adjustment Article 5(1)	Ireland	2H2 Food and Beverages (Spirits)	2005, 2020, 2021	NMVOC	yes

[94] To support the assessment of eligibility for this flexibility, the Copernicus Climate Change Service developed a tool to identify years when a Member State may have experienced an exceptionally cold winter or an exceptionally dry summer.

[95] Article 21(2) of the Directive provided a transitional provision that enabled the application of this flexibility also to the emission ceilings under Directive 2001/81/EC applicable until 31 December 2019. This use of the flexibility was not considered in the evaluation as it does not relate to the emission reduction commitments stipulated by the NECD.

Year of application	Type of flexibility	Country	Source sectors	Inventory years concerned	pollutant	Acceptance yes/no
2024	Inventory adjustment Article 5(1)	Ireland	2H2 Food and Beverages (Spirits)	2005, 2020-2022	NMVOC	yes
2024	Inventory adjustment Article 5(1)	Czechia	3Da1 Inorganic N-fertilizers	2005, 2020-2022	NH3	yes
2024	Pollutant Compensation Article 5(3)	Lithuania	NH_3 national total	2020	NH3	yes
2025	Inventory adjustment Article 5(1)	Ireland	2H2 Food and Beverages (Spirits)	2005, 2020-2023	NMVOC	yes
2025	Inventory adjustment Article 5(1)	Czechia	3Da1 Inorganic N-fertilizers	2005, 2020-2023	NH3	yes
2025	Pollutant Compensation Article 5(3)	Lithuania	NH_3 national total	2020-2023	NH3	yes
2025	Inventory adjustment Article 5(1)	Finland	3B Manure Management 3D Agricultural soils 5B2 Biological treatment - Anaerobic digestion 6A Other (cats & dogs)	2005, 2020, 2021	NH3	yes

Rationale for flexibilities:

The flexibilities related to extreme weather conditions and unexpected loss in capacity to provide energy have the purpose to cater for unforeseeable, extreme situations forcing Member States to deviate from their emission reduction policy to meet immediate needs of their population. They are similar to the concept of force majeure preventing a party from fulfilling its obligation under contractual law.

The flexibility based on a compensation of non-compliance for one pollutant by an emission reduction beyond the emission reduction commitment for another pollutant is linked to the fact that when those commitments were agreed, some Member States were expected to reduce certain emissions beyond what had been determined to be a cost-effective effort in the Thematic Strategy on Air Pollution Report No 16 of 16 January 2015 (TSAP 16). The report, which consists of parts 16a and 16b, provides an optimisation calculation for the most cost-effective emission reductions by Member State to reach the aim of reducing health impacts in 2030 by 52% compared to 2005 which was set out in the Clean Air Package in 2013.

The flexibility allowing an adjustment to emission inventories accounts for the fact that a Member State is non-compliant because it has used better methods to establish its inventories since the emission reduction commitments were set in the amended Gothenburg Protocol. Article 5(1) provides that the 2020-2029 emission reduction commitments are considered to have been set on 4 May 2020, date on which the amended Gothenburg Protocol was adopted. The point of comparison is thus the methodological status set out in the EMEP/EEA guidebook applicable at that time. Member States should thus be dissuaded not to improve their inventory methods to avoid becoming non-

compliant because of applying a better inventory method. The details of this flexibility are stipulated in Article 5(1) and Annex IV Part 4.

2.5.2 Improvement in inventories in line with new methodologies due to the possibility of adjustments

The possibility to apply for adjustments to inventories has been included in the NECD in alignment with the Air Convention to encourage Member States to continuously improve their emission inventories based on the best available science and data quality criteria. The adjustment flexibility allows Member States to embrace better inventory methods without running the risk that the application of those improved methods would bring them into non-compliance with their emission reduction commitments because those methods were not used when the emission reduction commitments were set. Regular updates of the EMEP/EEA guidebook ensure that new inventory methods recognised by the scientific community are identified. It should be noted though that on the one hand, not every improvement of inventories would justify an adjustment, as the conditions are well defined. For example, updated activity data that leads to an increase in emissions would not fulfil the criteria for an adjustment. On the other hand, not every improvement of inventory compilation leads to an increase in emissions. To the contrary, in many cases it has been shown that more sophisticated inventory methods (avoiding the use of default values) entail lower emission estimates.

2.5.3 Quantified impact of accepted applications on emissions and their significance (e.g. in relation to national total emissions for compliance for a given pollutant), (where available) qualitative information on whether Member States made reduction efforts despite using flexibilities

Ireland – adjustment

Table A - 14 – Approved adjustment for Ireland based on the circumstance 'new emission source'

Description	Reference	Pollutant estimates (kt)				
		2005	2020	2021	2022	2023
NMVOC						
National total for compliance		77.171	65.624	67.723	67.278	63.752
Effect of the flexibility application submitted by the Member State, which the TERT recommended DG ENV to accept						
2H2 Food and Beverages (Spirits)	Adjustment IE-1	-8.376 (11%)	-20.340 (31%)	-23.874 (35%)	-24.735 (37%)	-23.194 (36%)
National total for compliance after adjustment		68.795	45.284	43.849	42.543	40.558
Maximum allowed emissions stemming from the National Emission Reduction Commitments (updated to take into account inventory adjustment, where applicable		-	51.596	51.596	51.596	51.596

Source: National Inventory Review Report 2025 for Ireland

For Ireland adjustment applications for NMVOC inventories for the years 2005, 2020, 2021, 2022 and 2023 on the grounds of the identification of a new emission source category that was not accounted for at the time when the emission reduction commitments were set, were approved in 2025. While in 2005, the new emission source category constituted about 11% of the non-adjusted national total for compliance, this figure has risen to 37% in 2022 and 36% in 2023. This increase can be attributed to two developments, a decrease of emissions from other sources of NMVOC and an increase of NMVOC emission from the newly identified source.

This example shows that the adjustment has led to improved inventories, providing more precise emission estimates. However, this has not gone hand in hand with a reduction of emissions from this new source.

Czechia – adjustment

Table A - 15 – Approved adjustment for Czechia based on the circumstance 'new emission factor'

Description	Reference	Pollutant estimates (kt)				
		2005	2020	2021	2022	2023
NH_3						
National total for compliance		78.983	77.030	76.445	76.085	71.531
Effect of the flexibility application submitted by the Member State, which the TERT recommended DG ENV to accept						
3Da1 Inorganic N-fertilizers	Adjustment CZ-3	-3.548 (4%)	-7.682 (10%)	-7.084 (9%)	-6.493 (9%)	-4.583 (6%)
National total for compliance after adjustment		75.435	69.349	69.361	69.592	66.948
Maximum allowed emissions stemming from the National Emission Reduction Commitments (updated to take into account inventory adjustment, where applicable)		-	70.155	70.155	70.155	70.155

Source: National Inventory Review Report 2025 for Czechia

In 2025, Czechia submitted an adjustment application based on improved emission factors for determining emission from inorganic N-fertilisers that differed significantly from those used when the emission reduction commitments were set. Though the total consumption of mineral fertilisers in Czechia had been decreasing since 2016, the production of NH_3 had increased following calculations using the revised emission factors[96]. The application was approved and brought the Member State into compliance with its NH_3 emission reduction commitment in the years 2020, 2021, 2022 and 2023 with adjustments constituting 10%, 9%, 9% and 6% of the national total emissions for compliance respectively. While emissions from the source in question have increased between 2005 and 2021, they have decreased between 2021 and 2023 showing continued efforts to tackle the emission source despite the use of flexibility.

[96] CZ Informative Inventory Report of 2025, p. 156.

Lithuania – compensation

Table A - 16 – Article 5(3) flexibility for Lithuania compensating NH_3 emissions with $PM_{2.5}$ emission reductions

Reference number	Year	NH_3 emission level (kt)	NH_3 "excess emissions" (kt)	$PM_{2.5}$ emission level (kt)	$PM_{2.5}$ emission "over-achievement" (kt)	NH_3 excess emissions expressed in $PM_{2.5}$ equivalence (kt)	Sufficient for complying with NH_3 ERC?
LT_2025_1	2020	39.220	6.116	11.460	2.781	1.187	yes
LT_2025_1	2021	38.180	5.076	11.640	2.601	0.985	yes
LT_2025_1	2022	34.968	1.864	11.013	3.228	0.362	yes
LT_2025_1	2023	34.134	1.030	9.159	5.082	0.200	yes

Source: National Inventory Review Report 2025 for Lithuania

In 2024 and 2025, Lithuania applied for the use of the flexibility under Article 5(3) of the NECD regarding its NH_3 emissions. It was the first time that a Member State made use of this kind of flexibility. Lithuania was eligible as its emission reduction commitment for NH_3 for 2020 to 2029 had been set at a more stringent level than the cost-effective emission reduction identified in TSAP 16. In 2024, Lithuania demonstrated that the emission reductions achieved for $PM_{2.5}$ beyond the respective emission reduction commitment could make up for the non-achievement of the required reduction for NH_3 in 2020. The NH_3 emissions compensated for under this flexibility amounted to about 15% of the national total emissions considered for compliance. As the flexibility was applied only to the year 2020, there is a continued need to reduce NH_3 emissions to come into compliance. In its NAPCP of 2024, Lithuania set out ongoing and planned measures tackling NH_3 emissions, such as more efficient use of fertilisers and updating solutions for the design and operation of manure and wastewater management structures. In 2025, Lithuania applied the flexibility to its NH_3 emissions in the years 2020 to 2023. Despite the possibility to use the Article 5(3) flexibility, NH_3 emissions decreased between 2020 and 2023.

Finland – adjustment

Table A - 17 – Approved adjustment for Finland based on the circumstances 'new source' and 'new emission factor'

Description	Reference	Pollutant estimates (kt)				
		2005	2020	2021	2022	2023
NH_3						
National total for compliance		40.903	33.723	32.946	29.995	30.160
Effect of the flexibility application submitted by the Member State, which the TERT recommended DG ENV to accept						

Description	Reference	Pollutant estimates (kt)				
		2005	2020	2021	2022	2023
3B Manure Management 3D Agricultural soils 5B2 Biological treatment - Anaerobic digestion 6A Other (cats & dogs)	Adjustment FI-1	-2.238 (5%)	-3.017 (9%)	-3.033 (9%)	-	-
National total for compliance after adjustment		38.665	30.705	29.912	-	-
Maximum allowed emissions stemming from the National Emission Reduction Commitments (updated to take into account inventory adjustment, where applicable)		-	30.932	30.932	-	-

Source: National Inventory Review Report 2025 for Finland

In 2025, Finland applied improved emission inventory methods to the entire NH_3 time series, which led to non-compliance with the NH_3 emission reduction commitment in the years 2020 and 2021 for the first time. Finland introduced an adjustment application for those two years covering several source sectors based on the inclusion of new emission sources and on the application of updated emission factors for determining emissions from specific sources, which was accepted. Using better inventory methodology did not lead to non-compliance in the years 2022 and 2023 as NH_3 had already further decreased for those years. This shows that in this case the use of the adjustment and the efforts to reduce NH_3 were independent of each other.

The flexibilities under Article 5(2) and Article 5(4) have not yet been used by Member States and hence no data on their impacts are available.

2.5.4 Effectiveness according to stakeholders

Overall, public authorities tend to consider that flexibilities have helped achieving the emission reduction commitments, while NGOs are more critical in this respect. NGOs in particular argued that allowing adjustments, pollutant swapping, and exemptions under certain conditions introduces a degree of ambiguity that can weaken the coherence of the policy framework and reduce the incentive for sustained action. According to the targeted stakeholder consultation, the flexibility under Article 5(1) on adjustments is considered to hinder emission reductions by the majority of NGOs (6 out of 8), while some public authorities are of the view that it greatly helped in reducing emissions. The fact that flexibilities under Article 5(2) and 5(4) have not yet been used and the flexibility under Article 5(3) only once, is reflected in the replies to the stakeholder consultations which indicate to a large extent ‘not applicable’, ‘don’t know’ or ‘no response’. Three stakeholders commented that adjustments are an incentive to improve inventory methods used, two of which from the health sector adding that this should be monitored to ensure that Member States reduce emissions in a cost-effective manner.

2.6 To what extent has the use of Gothenburg Protocol related documents (guidelines, templates etc.), as stipulated in the NECD, contributed to the effective implementation of the NECD?

2.6.1 Extent of use of Gothenburg Protocol related documents across Member States, and accuracy in their application.

Although the NECD is more prescriptive than the Gothenburg Protocol (GP) in terms of its requirements and the obligations placed on Member States, much of the guidance accompanying the NECD, such as on the development of emissions inventories, derives from the bodies and processes associated with the GP.

Under the NECD, Member States must use the Guidelines for Reporting Emissions and Projections Data under the Convention on Long-range Transboundary Air Pollution (EMEP Reporting Guidelines), and in particular their reporting templates, to prepare their inventories, projections and informative inventory reports. The reporting templates are used by all Member States, allowing them to report data in response to both their obligations under the NECD and their obligations under the Air Convention. Next to the EMEP Reporting Guidelines, the most important guidance referenced in the NECD is the EMEP/EEA Air Pollutant Emission Inventory Guidebook which contains methodologies for calculating emission inventories and projections for all sectors. The methodologies contained in the Guidebook are applied by most Member States in the compilation of their emission inventories. The NECD requires that emissions from key categories are calculated according to the methodologies defined in the Guidebook, unless Member States use compatible methodologies that lead to more accurate estimates. The Guidebook has been the major reference work on emission inventories methodologies in Europe for decades now and has been a collective effort of many scientists that distilled their knowledge in measuring and modelling emissions into well-known and used methods and inventory models, such as the COPERT model for road transport emission inventories.

Other guidance and documents describing good practices developed by the UNECE Air Convention (see Guidance documents) are also relevant for Member States when they want to estimate the effect of various policies on the pollutant emissions regulated by the NECD. Note that some of these guidance documents need to be updated to technical progress in order to remain relevant.

BOX 5. Links with the Air Convention and its Gothenburg Protocol
The equivalent of the NECD is the Gothenburg Protocol (GP) under the UNECE Air Convention. The NECD and the GP have many similarities and are overall very coherent. Importantly, Member States prepare emission inventories, projections and Informative Inventory Reports (which e.g. explain assumptions taken) using well established methodologies set out in EMEP Reporting Guidelines, the EMEP/EEA air pollutants emission inventory guidebook and further guidance material adopted under the Air Convention. There are, however, also certain elements that are different between the two instruments (see Annex III, 4.5. for a complete list). The main elements missing from the GP are ERCs for post 2030, the requirement to submit NAPCPs, detailed monitoring and reporting of impacts on ecosystems, detailed descriptions of measures to reduce ammonia from agriculture and most importantly a strong enforcement mechanism.

In some instances, the NECD provides a more detailed description, relative to the GP, of possible measures to be considered for reducing emissions of ammonia from agriculture. Both the NECD and GP make reference to the Air Convention ammonia guidance

document on measures for agriculture, where significantly more detail is provided on specific measures for manure application and storage, livestock housing and livestock feeding strategies. National advisory codes of good agricultural practice to control ammonia emissions, have been established by 21 Member States and partially implemented by six Member States according to the support study. The NECD also refers to the Air Convention guidance on national nitrogen budgets, which was adopted after the most recent amendments to the GP.

The NECD also includes possible optional measures to be considered for the control of PM and black carbon emissions from agriculture linked to management of harvest/forestry residue and waste. No such equivalent is included within the GP.

The targeted **stakeholder** consultation included questions on the effectiveness of various Gothenburg Protocol related documents and asked participants to comment on whether each of them is beneficial to the effective implementation of the NECD. The response rate to these questions was moderately high, with most responses coming from public authorities and NGOs, while industry associations, when replying, mainly responded '*don't know*'.

Generally, all of the documents were considered to have been beneficial. The documents that were considered most beneficial were the EMEP Guidelines, the EMEP reporting templates, and the EMEP/EEA Guidebook. These documents were considered very beneficial by most public authority respondents, with most NGOs considering the EMEP/EEA Guidebook as being very beneficial.

There were some small minority views (by a few public authorities and the small number of academic respondents) that some of the documents[97] had not been beneficial.

As part of additional comments provided in the TSC, six NGOs commented that the EMEP guidelines would be even more effective if widely used by all Member States. On the EMEP/EEA Guidebook, three public authorities commented that the methodological guidance provided in the EMEP/EEA Guidebook, while being essential, does not sufficiently reflect the technological progress in combustion technologies. In particular, the Guidebook could be clearer on the treatment of condensable particulate matter, which, according to these three respondents, should not be counted towards reduction commitments.

[97] Guidance document on economic instruments to reduce emissions of regional air pollutants, the Guidance document on control techniques for emissions of sulphur, NO_x, VOC, and particulate matter (including PM_{10}, $PM_{2.5}$ and black carbon) from stationary sources, the Guidance Document on Emission Control Techniques for Mobile Sources, and the Code of good practice for wood burning and small combustion installations.

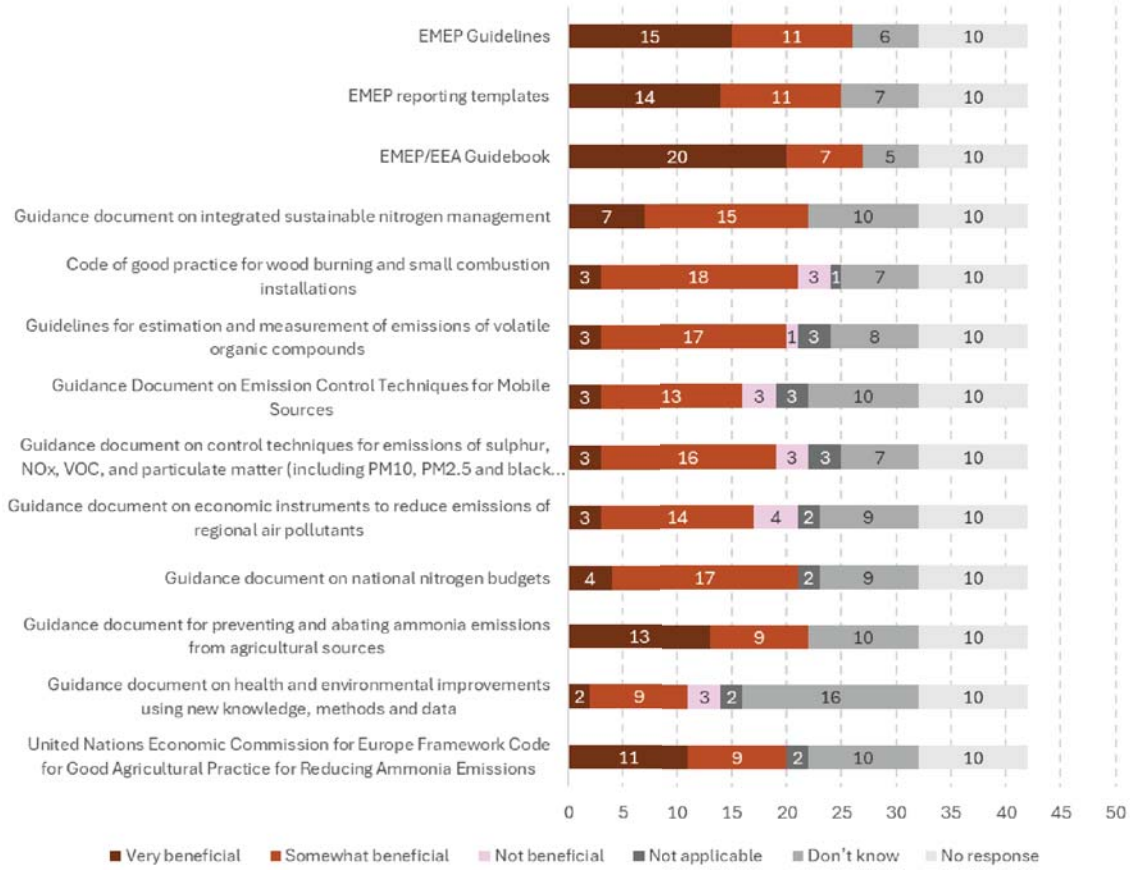


Figure A - 19 – Summary of the responses to the TSC sub-questions on whether the Gothenburg Protocol related documents (guidelines, templates etc.) are beneficial to the effective implementation of the NECD.

2.6.2 Gaps in in the Gothenburg Protocol related documents compared to the information needed for reporting under the NECD (if any)

There are certain gaps and improvements required in the Guidance documents under the Gothenburg Protocol, mostly deriving from the fact that work to produce these documents is underfunded. Efforts are being made to prioritise those gaps and deal with them according to the resources available. For instance, a 2024 Commission project reviewed all improvement areas and gaps of the EMEP/EEA Air pollutant emission inventory guidebook in order to address them, either via Commission or Member State led projects. The review identified more than 200 issues that required improvement over the various sectors with varying degree of importance.

While the focus of the EMEP/EEA Guidebook is on historical inventories, guidance on projections had been very limited and only in the 2019 version of the Guidebook was it expanded to some extent. The findings of a Commission contract showed that the lack of detailed sector specific guidance on air pollution emission projections limited the accuracy of Member State projections[98]. The guidance produced as part of that Commission contract fed into the 2019 update of the EMEP/EEA Guidebook which improved the situation.

[98] Assistance to Member States in Developing National Air Pollution Projections, Service Request 1 under Framework Contract ENV.C3/FRA/2017/0012.

2.7 To what extent have other EU policies or external factors affected emissions of the five pollutants?

2.7.1 Changes to emissions of the five pollutants over the evaluation period

Emissions of the five main air pollutants have been decreasing in the EU since the 2005 reference year, as was shown in Figure A-1. Figure A-20 below shows changes to the level of the five main pollutants since 2016, when the NECD was adopted, based on the 2024 emission inventories (including data up to 2022). It also displays the projected total emissions for 2025 and subsequent 5-year periods based on projections of the 4th Clean Air Outlook. These projections take into account the expected effect of relevant EU policies in force in 2024 and the effect of PaMs under the NAPCPs based on the GAINS model[99]. This figure also indicates key NECD, EU policy and external events that could have influenced changes in emissions.

Please note that the effect of NAPCPs and PaMs is expected to be spread out over the years. This is due to NAPCP and PaM submissions that are spread out over time (e.g. some Member States still have not delivered updated NAPCPs in 2025[100]); and PaMs showing their effects on the medium to long term. Considering that the first submission deadline for NAPCPs was in 2019 and that data is reported with a two-year time lag, the period for which we have inventory data that could reflect impacts of PaMs is limited, limiting also conclusions regarding the effect of external factors that show on mid- to long-term (e.g. effects of the Russian military aggression against Ukraine).

[99] See a detailed explanation of the GAINS model in Annex II

[100] See analysis on the timeliness of NAPCPs in Annex III section 2.2.1.

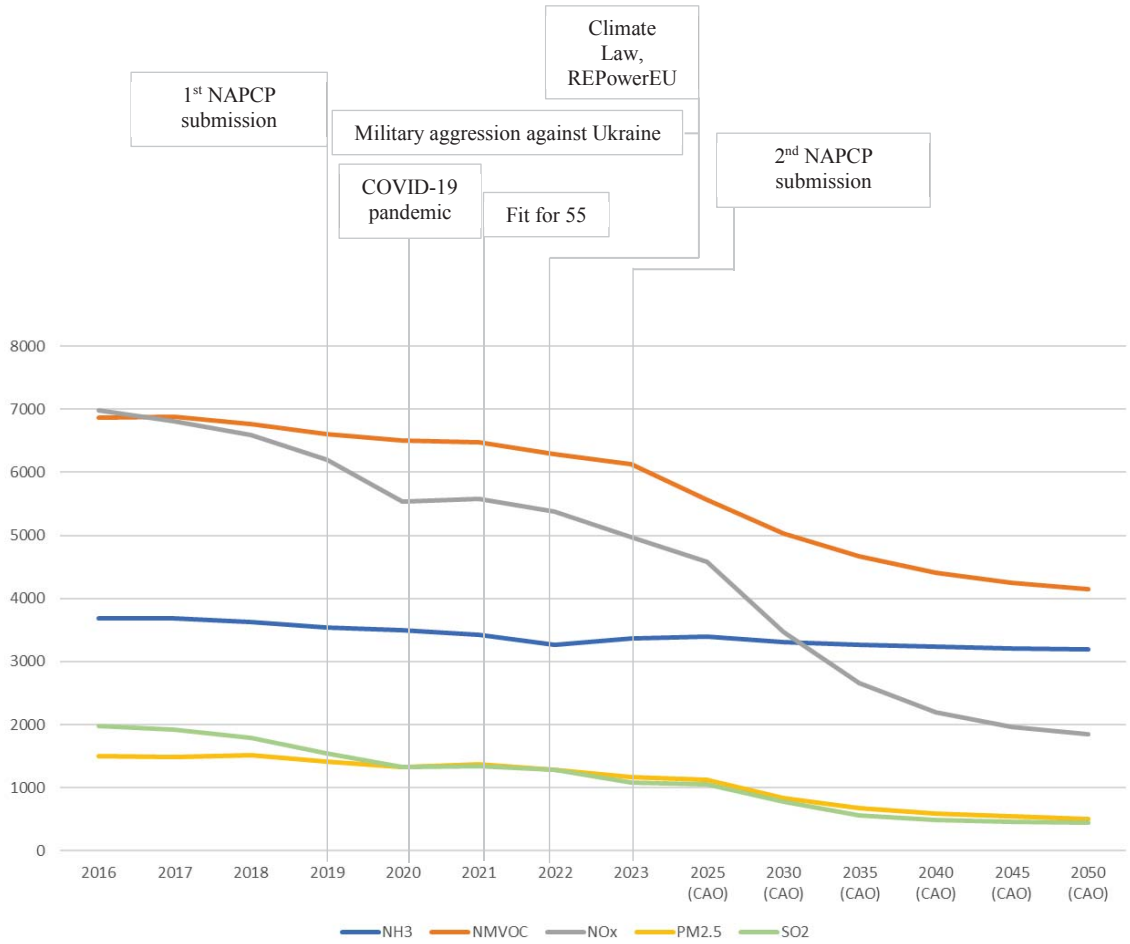


Figure A - 20 – Evolution of emissions of the five main air pollutants over time based on NECD inventories (up to 2022) and projections of the 4th Clean Air Outlook baseline scenario (as of 2025), combined with main EU policy and external effects.

The kick-off of the cycle of NAPCPs and related Member State PaMs shows correlation with sharper drops in NO_x emissions. There may be some correlation between the outbreak of the COVID-19 pandemic and drops in NO_x and SO_2 emissions, followed by an increase in 2021 and further decrease starting from 2022. According to projections of the 4th Clean Air Outlook, the combined effect of EU and Member State policies in place in 2024 should lead to further drop of emissions in the future.

The overall reduction was higher than the aggregated reduction at EU level as set out in the NECD. This represents an indication of the total effort of all Member States – however, in line with the Directive, Member States have to achieve their ERC at national level, the NECD does not establish a reduction commitment for the EU (Article 4 only refers to Member States).

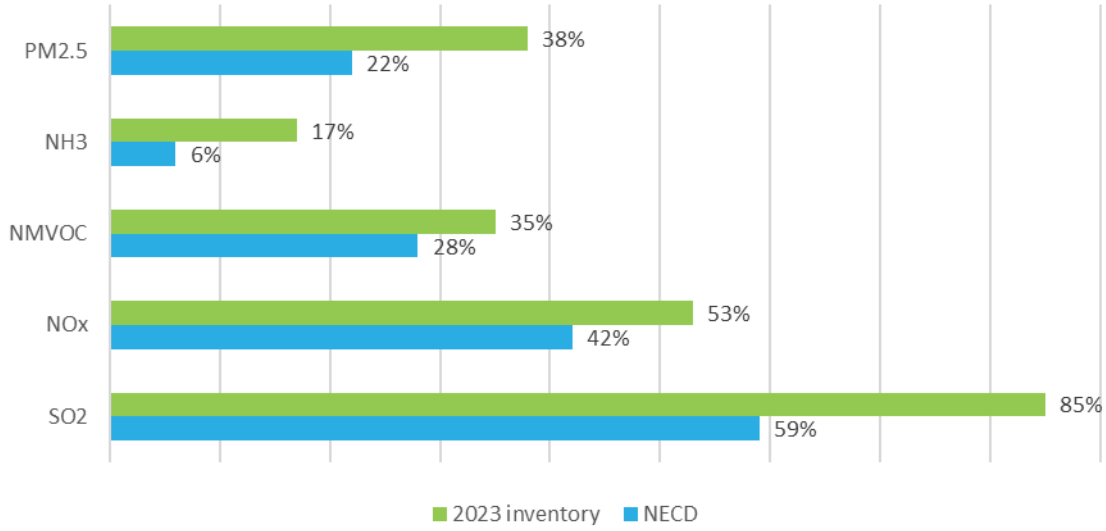


Figure A - 21 – Percentage of reductions for the period 2020-2029 as set out in NECD (EU28) and the current status according to the 2023 air emission inventories submitted by Member States in 2022 (EU27)

Below we present the approaches we took to attribute these changes to the NECD-related requirements, or other EU policies or external factors; and the results of these analyses.

Effects of other EU policies – MS indications in the PaMs database

When reporting their policies and measures in the PaM tool, Member States had to specify whether the PaM resulted from the implementation of a Union policy. According to the categorisation provided by Member States, 38% of the 1290 PaMs in the database were linked to another EU policy besides the NECD. A PaM could be linked to several policy areas at the same time.

The figure below provides an overview of the number of references per policy area.

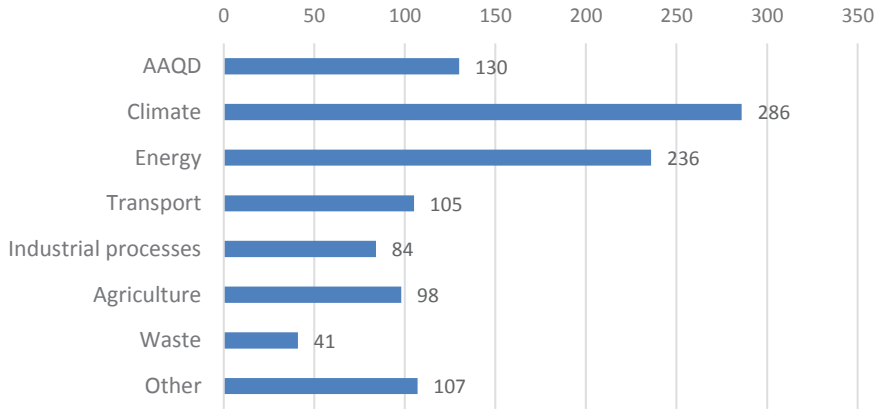


Figure A - 22 – Number of references to other EU policy areas in PaMs (Source : elaboration based on EEA PaMs database, date of extraction : 31/10/2024)

The analysis suggests that most of the measures (62%) were put in place due to the NECD. This number represents an over-estimation, as some Member States did not link their PaMs to other policies even where there was a clear link (result of a point check).

Despite this weakness, the analysis above suggests that a significant part of PaMs was put in place as a result of the NECD, and therefore, a related important part of emission reductions are expected to be due to the NECD. This link cannot be quantified, as we do not have data on the emission reductions per PaM and we do not have a reliable figure on the number of PaMs triggered by the NECD alone.

Effects of other EU policies – analysis of impact assessments and evaluations of related policies

To further analyse the contribution of other policies to the reduction of the five main air pollutants covered by ERCs under the NECD (NH_3, NMVOC, NO_x, $PM_{2.5}$ and SO_2) during the evaluation period, we analysed impact assessments and evaluations available on related EU policies. The analysis sought quantified data on the expected or actual effect of these EU policies on the five main air pollutants with the aim of separating out the effect of the NECD to the extent possible.

A summary of this analysis is presented in the table below.

The policies included were either:

1) first implemented during the evaluation period (2016–2024), with *ex-ante* (impact assessment) or *ex-post* (evaluation) impacts on air pollution; or

2) initially implemented prior to the evaluation period but evaluated over a timeframe overlapping with the NECD evaluation period.

The table was compiled based on impact assessments and evaluations of policies that had an influence on air pollutants covered by the NECD throughout the evaluation period. Evaluations represent the most appropriate source, as they are backward-looking and reflect the effect of legislation in force. Data from impact assessments are often based on estimates and projections, thus data derived from them have higher uncertainty. Furthermore, the selected policy option may be modified during the co-legislation process, which limits the validity of the data in the impact assessment for the policy as adopted. These uncertainties have to be considered when drawing conclusions based on data in impact assessments.

2.7.2 *Emission reductions achieved by other EU policies, their relationship to the NECD and influence of NECD on the formulation of these policies*

<table>
<tr><th>Legislation</th><th>Air pollutants in common</th><th>Source of information</th><th>Are effects on air pollution quantified?</th><th>Quantified information on air pollution</th><th>Comments on disentangling the effects of the NECD and the legislation analysed</th></tr>
<tr>
<td>Transport:
Euro 6/ Euro VI</td>
<td>NOx
PM</td>
<td>Evaluation[101] (reference period: for Euro 6: 09/2014 – 2020; for Euro VI: 2013-2020)</td>
<td>Yes</td>
<td>Emission savings related to the introduction of Euro 6 and VI emission standards compared to the respective baselines Euro 5 and Euro V for NO_x, PM and CO emissions were calculated, backward-looking over the evaluation period (2013/2014 until 2020), as well as forward-looking, up to 2050, at EU-28 level.

Cumulative emissions savings from light-duty vehicles (cars and vans) related to the implementation of Euro 6 compared to Euro 5
<table>
<tr><th></th><th>2014-2020</th><th>2020</th><th>2021-2050</th><th>Expected change in 2020(In 2007 IA)[102]</th></tr>
<tr><td>NO_x (% change compared to Euro 5)</td><td>1 680 kt (21.8%)</td><td>450 kt (36.7%)</td><td>44 190 kt (78.1%)</td><td>24%</td></tr>
<tr><td>PM</td><td>10 kt (6.4%)</td><td><10 kt (10.0%)</td><td>250 kt (17.0%)</td><td>0%</td></tr>
</table>
</td>
<td>How is this policy relevant to the NECD?

The successive Euro emission standards for vehicles set emission limits for air pollutants, with varying levels of stringency depending on the version of standards as well as the category of vehicles considered.

Therefore, Euro emission standards help Member States meet their NECD emission reduction commitments (ERCs) by ensuring a reduction of relevant air pollutant emissions from road transport. To reach ERCs, emissions from road transport can be further targeted by national policies (e.g. through incentives for early adoption of clean vehicles, scrappage schemes, etc). Out of the PaMs included in the PaM tool, Member States linked 10 of the total of 1110 PaMs specifically to the Euro 6/VI legislation[104].

Looking at the pollutants covered by the evaluation of the Euro 6/VI emission standards based on national air emission inventories provided under the NECD[105], in 2022, road transport represented 35.5% of NO_x emissions and 8.1% of $PM_{2.5}$ emissions. Based on data reported to the Gothenburg Protocol, the share of road transport within total CO</td>
</tr>
</table>

[101] Euro 6/VI Evaluation Study, European Commission, 2022
[102] Compared to the baseline (Euro 5), values from an Additional IA following changes in final agreement (EC, 2007).
[104] This number may be higher in reality, as Member States do not always provide information on linkages to other EU policies.
[105] EEA, National air pollutant emissions data viewer 2005-2022, 2024 edition, accessed 20 February 2025.

CO	2 780 kt (11.5%)	820 kt (17.7%)	60 810 kt (14.3%)	n.a.		

Expected emission savings for NOx in the year 2020 from the implementation of Euro 6 compared to Euro 5 were fulfilled (24% expected and 36% observed).

Cumulative emissions savings from heavy-duty vehicles (buses and lorries) related to the implementation of Euro VI compared to Euro V

	2013-2020	**2020**	**2021-2050**	**Expected change in 2020(in 2007 IA)[103]**
NO_x (% change compared to Euro V)	4 000 kt (35.7%)	900 kt (52.0%)	60 500 kt (76.4%)	37%
PM	< 10 kt (13.5%)	<10 kt (22.6%)	300 kt (52.5%)	22%
CO	1 500 (43.1%)	300 kt (61.9%)	21 700 kt (90.0%)	n.a.

Expected emission savings for NO_x in the year 2020 from the implementation of Euro VI compared to Euro 5 were fulfilled (37% expected and 52% observed).

emissions in the EU27 was 24.7%[106]. Based on the same inventories, in the period 2014-2020, NO_x emissions from road transport decreased by 33.9%, $PM_{2.5}$ emissions by 30.3% and CO emissions by 29.3%. These figures include the effect of the Euro 6/VI emission standards and other Member State policies and measures to address these emissions.

What effects did Euro 6/VI emission standards have on emissions over the NECD evaluation period?

For the 2014-2020 period, NO_x emissions from heavy-duty and light-duty vehicles reported by MS were 18 446 kt[107]. During the same period (2014-2020) the evaluation report calculated 5 680 kt NO_x emission savings due to the introduction of Euro 6/VI, i.e. the savings brought on by Euro 6/VI correspond to about 30% of the total NO_x emissions reported by this sector for the same years.

Limitations

In NAPCPs, Member States typically complement EU level measures (e.g. the introduction of the Euro standards) with other national or regional measures, thus the reductions seen in NECD inventories are not solely due to the application of Euro standards.

Such measures include promotion of e-mobility by scrappage schemes, low or no taxes for electric vehicles, preferential lane usage and free parking, urban access restrictions for older vehicles, higher taxes for polluting vehicles, etc.

The evaluation of Euro 6/VI computes emission savings for PM emissions, without distinguishing between $PM_{2.5}$ and

[103] Commission Staff Working Document, Annex to the Proposal for a Regulation on the approximation of the laws of the Member States with respect to emission from on-road heavy duty vehicles and on access to vehicle repair information, Impact Assessment, SEC(2007) 1718.

[106] EEA, Air pollutant emissions data viewer (Gothenburg Protocol, Air Convention) 1990-2022, 2024 edition.

[107] EEA, National air pollutant emissions data viewer 2005-2022, 2024 edition, accessed 20 February 2025.

					$PM_{10,}$ making it difficult to compare emission savings brough by Euro 6/VI to $PM_{2.5}$ ERCs. *Conclusions* **It is thus clear that the Euro 6/VI emission standards for vehicles helped Member States meet their ERCs over the NECD evaluation period.** **However, it is not clear what share of the decrease in emissions from road transport is due to ERCs and implementation of national policies and measures under the NECD; and what share can be attributed directly to vehicle emission standards. For the years 2014-2020 the NO_x emissions saved by the introduction of Euro 6/VI seem to account for 30% of the total emissions from road transport.** **The percentage that could be accounted by additional measures due to the NECD cannot be easily quantified as measures introduced in MS are potentially connected to several EU policies (e.g. National Energy and Climate Plans for the electrification of road transport).**
Transport: Roadworthiness Directives[108]	NO_x, CO, hydrocarbons (HC, relevant for NMVOC)	Impact Assessment[109]	Yes.	The impact assessment calculated impacts on CO, NO_x, and HC emissions for the preferred option: 6.98 kt NO_x eq. of annual emissions savings compared to the baseline.	*How are these policies relevant to the NECD?* The Roadworthiness Package Directives are set to ensure vehicles meet safety and environmental standards on the road, for instance by setting periodic inspections or roadside inspections for heavy duty vehicles. Although these Directives were set to ensure that the emission levels are complied with during the lifetime of the vehicle, they fail to correctly measure emissions from the latest Euro 5 and Euro 6 vehicles and therefore have less emission savings than expected originally (mostly by removing from circulation older polluting vehicles). The

[108] Directive 2014/45/EU, Directive 2014/46/EU, Directive 2010/47/EU.
[109] Commission Staff Working Document Accompanying the document Proposal for a Roadworthiness Package, SWD(2012) 206 final.

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<td>Roadworthiness Directive is currently under revision to address the issue of measuring emissions from the newest generation of vehicles more efficiently, among others.

What effects did the Roadworthiness Directive have on emissions over the NECD evaluation period?

In general, the Roadworthiness Directives are contributing by eliminating from circulation older or grossly non-compliant vehicles. Their contribution to emission reduction is hard to estimate.

Some Member States, like the Netherlands, or Germany have already introduced more modern testing methods during their inspection schemes and are expected to have obtained higher emission reductions.

Conclusions

Thus, this piece of legislation has marginal direct effects on air pollutant emissions, but it could potentially assist by ensuring the emission savings expected from Euro emission standards. The extent of this effect depends on the testing methods used.</td>
</tr>
<tr>
<td>Transport: Non-road mobile machinery Regulation (NRMM Regulation)</td>
<td>NO_x, PM</td>
<td>Review support study[110]</td>
<td>Yes.</td>
<td>The technical support study to the review calculated emissions for 2019 NRMM for the EU-28:
<table>
<tr><td>(in kt)</td><td>NO_x</td><td></td><td>PM</td><td></td></tr>
<tr><td></td><td>2005</td><td>2019/ 2020 [111]</td><td>2005</td><td>2019/ 2020</td></tr>
<tr><td>Agriculture & construction</td><td>1 032</td><td>535.67</td><td>62.06</td><td>27.66</td></tr>
<tr><td>Inland waterways</td><td>119</td><td>107</td><td>4.2</td><td>4</td></tr>
<tr><td>Railways</td><td>295</td><td>187</td><td>6</td><td>4</td></tr>
</table>
</td>
<td>How is this policy relevant to the NECD?

The NRMM Regulation requires engine manufacturers to obtain type-approval for engines of different power ranges. To obtain this, engines must meet emission limits for air pollutants. Air pollutants NO_x, PM, CO and hydrocarbons (HC, relevant for NMVOC) are covered by emission limits for at least one category of NRMM under the Regulation.

According to the review support study, “NRMM sources are relevant contributors to total NO_x emissions; in 2016 the sector accounts for about 10% of total emissions. [They]</td>
</tr>
</table>

[110] EC (2019), Technical support for the review obligations under Regulation (EU) 2016/1628 (NRMM).

[111] For Agriculture & construction, data was available for 2019. For inland waterways and railways, data was available for 2020.

				Total NRMM | 1 446 | 829.67 | 72.26 | 35.66 The review study calculates projections until 2050 as well: for agriculture and construction equipment, NO_x emissions are projected to further decrease until after 2030 and remain constant afterwards. Similarly, PM emissions are expected to remain constant and very low after 2030. For railways, NO_x and PM emissions are expected to gradually decline until 2040, then remain constant. For inland waterways, they are expected to continue constantly declining until 2050.	contribute somewhat to total $PM_{2.5}$ (about 3,5 % in 2016), [and] significantly to BC emissions (about 16 % in 2016).” Thus, the NRMM Regulation helps Member States to comply with ERCs for these pollutants. *What effects did the NRMM Regulation have on emissions over the NECD evaluation period?* According to the review support study, NO_x emissions covered by the NRMM Regulation decreased by 42.6% between 2005 and 2019, and PM emissions decreased by 49.3%. Over the rest of the NECD evaluation period (2019-2025), NO_x and PM emissions are projected to continue decreasing due to the introduction of new emission limits stages, but no precise quantitative data was available from the review study. *Technical limitations* The review support study recognises that NO_x emissions calculated in their study are about 45% higher than the ones reported in emission inventories under the NECD: “This might be due to different methods and emissions factors used across Member States”. *Conclusions* **Emissions covered by the NRMM Regulation decreased drastically between 2005 and 2019 and are expected to decrease further. The NRMM Regulation is very likely to contribute to this decrease but it remains unclear what share of the decrease can be attributed to the NRMM Regulation or to national measures taken due to the NECD; this is further complicated by the fact that methods (e.g. emission factors) used to calculate emissions under the NRMM and the NECD differ.**

Transport: Sulphur Directive	SO_2, PM	Implementation Report[112]	No	A technical report for the International Convention for the Prevention of Pollution from Ships (MARPOL)[113], used to assess a potential delay of the new limit initially set for 2020 to 2025, estimated the costs of delaying. Keeping 2020 as the entry into force of the new sulphur limit would result for the year 2020 in 8 400 000 kt of SO_x worldwide annual emissions savings compared to delaying to 2025, as well as 740 000 kt of PM worldwide annual emissions savings. In terms of health benefits, 3 700 deaths would be avoided for 2020 in Europe compared to a delay to 2025. These numbers cannot be put in relation to the NECD as they refer to worldwide emissions.	*Why is this policy relevant to the NECD?* The 2012 revised Sulphur Directive (codified in 2016) establishes maximum sulphur contents for some land and marine fuels as well as fuels used in port operations. It aligns with the sulphur in fuel limits for maritime transport set by the International Convention for the Prevention of Pollution from Ships (MARPOL) in Regulation 14 of Annex VI, revised in 2008 and entered into force in 2010[114]. It applies, however, to both domestic and international ship flags. By setting maximum sulphur content limits, the Sulphur Directive primarily helps reduce SO_2 emissions and secondary PMs. It also indirectly contributes to lowering $PM_{2.5}$ concentrations[115]. Established sulphur limits are more stringent within SO_x Emission Control Areas (SOx-ECAs), where they are recognised as leading to a significant decrease in SO_2 concentrations for coastal areas in the EU[116] The Baltic Sea and North Sea were designated by the International Maritime Organisation in 2007-8 as SO_x-ECAs. A more stringent sulphur requirement in SOx ECA was introduced the last time in 2015. This requirement also entered into effect in the Mediterranean on 1 May 2025 and will apply in the Northeast Atlantic in 2027 (exact month to be confirmed). *What effects did the Sulphur Directive have on emissions over the NECD evaluation period?*

[112] Report from the Commission on implementation and compliance with the sulphur standards for marine fuels set out in Directive (EU) 2016/802 relating to a reduction in the sulphur content of certain liquid fuels, COM(2018) 188 final.

[113] International Maritime Organization, Marine Environment Protection Committee, Air Pollution and Energy Efficiency, Study on effects of the entry into force of the global 0.5% fuel oil sulphur content limit on human health, MEPC 70/INF.34.

[114] Resolution MEPC.176(58), Revised MARPOL Annex VI.

[115] Secondary $PM_{2.5}$ is formed in the atmosphere from precursor emissions including SO_2, NO_x and NH_3.

[116] Report from the Commission on implementation and compliance with the sulphur standards for marine fuels set out in Directive (EU) 2016/802, COM(2018) 188 final.

					The 2018 Implementation Report estimates that, based on studies conducted by Member States, the new sulphur cap at 0.10% since 2015 in SO_x-ECAs "lead to a significant reduction of sulphur dioxides concentrations in ambient air in regions bordering the SO_x-ECAs." It also states that further reductions of SO_2 concentrations in ambient air are expected from the new 2020 sulphur cap outside of SO_x-ECAs. To date, no report more recent than 2018 quantified the impacts of the 2020 new sulphur limit. However, a technical report from MARPOL estimates 3 700 deaths to be avoided in Europe due to the introduction of this new limit for the year 2020 (see left column). According to the **2nd European Maritime Transport Environmental reports** launched on 4th February 2025 SOx emissions in the EU have dropped by about 70% since 2014, largely due to the introduction in 2015 of stringent sulphur limits in ECAs in Northern EU but also in 2020 of the global sulphur cap. Given the still very high sulphur content of marine fuels, the upcoming ECAs in the Mediterranean in the North-East Atlantic Ocean are crucial to deliver further reductions. *Limitations* The Sulphur Directive covers SO_2 emissions in the EU from both national and international maritime traffic (Article 1). However, air pollutant emissions from international maritime traffic are not included in national compliance totals under the NECD (Article 4(3)). This approach is in line with the approach taken under the UNECE Air Convention. Both under the NECD and the UNECE Air Convention, inventories of emissions from international shipping are reported. Looking at SO_2 emissions, international maritime traffic accounted for more than 90% of SO_2 emissions from total maritime traffic in 2022, according to emission inventories

					submitted under the NECD[117]. Thus, the largest source of SO_2 emissions from maritime traffic, including ships engaged in international trade, while regulated by the Sulphur Directive, is not included in national compliance totals under the NECD (see Annex III section 5.3.3.1). The effects of the Sulphur Directive were measured by some Member States for coastal areas in terms of concentrations, not air pollutant emissions as this is not a requirement and that directive. However, as a proof of principle, EMSA calculated emission inventories for the period 2014 till 2019, based on real ship movements, for both domestic and international shipping to cover the period of entry into force on SOx ECA requirements and the global cap in 2020. This was done through a number of Cooperation Agreements between EMSA and DG ENV[118]. This does not allow to fully quantify the contribution of the Sulphur Directive to the effectiveness of the NECD. *Conclusions* **The Sulphur Directive impacts positively the evolution of SO_2 emissions inventoried under the NECD. Contribution to compliance with ERCs is more limited as the NECD does not count emissions from international maritime traffic towards ERC compliance.**
Transport: Fuel Quality Directive (FQD)	NOx, PM10, VOC	Evaluation (reference period: 1995 – 2014)[119]	Yes.	The evaluation period for the FQD does not match the evaluation period of the NECD, therefore it is not possible to use the data therein to assess the contribution of the FQD to the effectiveness of the NECD in this evaluation.	*How is this policy relevant to the NECD?* The Fuel Quality Directive (FQD) aims to minimise the negative effects on health and environment from the use of

[117] EEA, National air pollutant emissions data viewer 2005-2022, 2024 edition, accessed 21 January 2025.

[118] Cooperation agreement between EMSA and DG ENV 070201/2015/714227/ENV.C.3 For the development of inventories of shipping emissions based on shipping activity data for domestic, short sea and international shipping through a functionality in THETIS-S including the relevant technical assistance; EMSA-FMI pilot project 'Application of STEAM to the North Sea area – NOx from Ships during October 2009–' 2011 (Project developed with the Finnish Meteorological Institute to use a Ship Traffic Emissions Assessment Model to calculate various types of air emissions from shipping in the North Sea, on the basis of real ship movement information (AIS messages from SafeSeaNet); FMI of emission estimates (CO2, CO, SOX, NOX, PM) using Ship Traffic Emissions Assessment Model (STEAM) for the EU sea area in 2011 (EMSA)

[119] Commission Staff Working Document, Evaluation of Directive 98/70/EC relating to the quality of petrol and diesel fuels ('Fuel Quality Directive'), SWD (2017) 178.

				The evaluation of the FQD concluded that reductions over the period 1995-2014 did not meet the levels expected at the time of the adoption of the FQD, despite being significant (e.g. decline in NO_x by -51% and in PM_{10} by -42%). The evaluation concludes that both "the FQD and the vehicle emissions standard legislation have jointly contributed to the observed emission reductions" for road transport.	petrol and diesel fuels in road transport and non-road mobile machinery by establishing minimum quality standards including through a ban on lead in petrol and a limit of sulphur content in diesel fuels; and regulating vapour pressure of summer petrol. Therefore, FQD requirements help reduce emissions of air pollutants covered by ERCs in the NECD. The FQD contributes to reducing SO_2 emissions through: — the limit in sulphur content; — reducing particles emissions through a PAH fuel quality standard; — reducing VOC emitted during fuel evaporation by a lower volatility requirement during summer; and — indirectly to reducing PM and NO_x by technological progress brought by the sulphur threshold which was required for the use of catalysts according to the FQD evaluation. *What effects did the FQD have on emissions over the NECD evaluation period?* As the latest evaluation on the FQD covers the period between 1995-2014, there is no data available on the NECD evaluation period (2016-2025). Although it is clear that the FQD contributed to reducing emissions as explained above, its contribution during the NECD evaluation period is not quantifiable. *Conclusions* **Impacts on air pollution of the FQD during the evaluation period of the NECD (2016-2025) were not available. Although it is not possible to quantify the contribution of the FQD to reaching NECD ERCs, it is clear that the FQD has a positive impact in particular for SO_2 emissions from transport.**
Industrial Emissions Directive (IED)	All NECD pollutants	Evaluation – reference		Industrial emissions to air are reported to the European Pollutant Release and Transfer Registry (E-PRTR) by large	*Why is this policy relevant to the NECD?*

		period: 2010-2019[120]		(agro-)industrial installations, when above certain annual load thresholds, with the latest available data coming from 2023. Between 2016 and 2023, the reported emissions decreased by 43.5% for NO_x, 30.9% for NMVOC, 33.7% for NH_3, 49% for PM_{10}, and 58.2% for SO_x[121]. Concerning NH_3, the IED evaluation specified that NH_3 emissions at EU level have remained fairly static over the evaluation period (2010 to 2017) compared to 2008, but that "only a few percent of this is emitted by agro-industrial activity regulated under the IED (mainly from intensive rearing of poultry or pigs)." According to the supporting study to the evaluation of the IED, at the time of the evaluation (2020), only two studies looked at the impacts of BAT Conclusions on sectors at EU level[122]. The first one projected emission reductions in an ex-ante assessment for **Large Combustion Plants**, before best available techniques (BAT) conclusions were finalised. However, from January 2016, existing LCPs had to comply with emission limit values set in annex V of the IED. In 2015, the LCP sector was responsible for around 44% of SO_x and 14% of NO_x emissions in the EU and was thus a significant contributor to air pollution. Compliance with minimum emission limit values as fixed in Annex V of the IED was expected to deliver emission reductions of 45% for SO_2, 32% for NO_x and 50% for dust on average between 2013 and 2030, compared to the 2013 baseline. Additional reductions	Under the Industrial Emissions Directive (IED), large industrial installations (including intensive livestock rearing above a certain threshold) require a permit granted by national authorities to operate. Permit conditions are based on the best available techniques (BATs), and the conclusions of these BATs ('BATCs') are adopted as Commission implementing decisions for each relevant sector. Notably BATCs can include a range of emission limit values called BAT associated emission levels (BAT-AELs). The evaluation of the IED[124] indicated that in 2017 installations covered by the Directive were responsible for over half of anthropogenic emissions to air of CO_2, SO_X, NMVOC and heavy metals (Cd, Hg and Pb), and were key sources of NO_X (32%) and PM_{10} (28%), and represented about 5% of NH_3 emissions[125]. Looking at the relationship between the level of pollutants reported to the European Industrial Emissions Portal and for the NEC inventories in 2023, IED covered 17% of the NO_x emissions reported to the NEC inventories. The same share was 3% for NMVOC, 4% for NH_3 and 47% for SO_x (please note that the NECD inventories include SO_2 emissions only). This could be used as a proxy for the share of air emissions covered by the IED. Large combustion plants, refineries, intensive rearing of pigs and poultry, and iron and steel represent the highest share of emissions covered by the IED.

120 Commission Staff Working Document, Evaluation of Directive 2010/75/EU on industrial emissions (integrated pollution prevention and control), SWD(2020) 181.

121 EEA (2025), European Industrial Emissions Portal

122 EC (2020), Support to the evaluation of the Industrial Emissions Directive.

124 SWD(2020) 081.

125 The support study notes that the analysis of various informative data sources and published reports (including modelled data) indicated that the share of emissions from some activities under the IED were likely to be a substantial under-estimate. This could have been due to installations within Member States either not meeting the reporting threshold set in the E-PRTR or under reporting at Member State level.

				were expected in case of uptake of BAT associated emission levels in permit conditions. For **iron and steel**, an ex-post assessment of the impacts of implementing the BAT conclusions found that they had led to reductions in emissions of 13.9kt of SO_2, 0.5kt of NOx, 8kt of dust (particulate matter), 0.5t of mercury and 12.9g of polychlorinated dibenzo-p-dioxins and dibenzofurans (PCDD/F) in 2016[123], thus at the very beginning of the NECD evaluation period.	*What effects did the IED have on emissions over the NECD evaluation period?* The IED is expected to have contributed to significant emission reductions for SO_2, NO_x and NMVOC (see left) over the NECD evaluation period and this decrease is likely to be driven by the LCP sector. To estimate the contribution of the IED to the reduction of air pollutants under the NECD, we calculated the share of reductions between 2016-2023 based on data of the European Industrial Emissions Portal within the reductions for the same period based on the NECD inventories: this resulted in an estimated share of IED-related emission reductions of 33% for NO_x, 12% for NMVOC, 22% for NH_3 and 79% for SO_x (please note that whilst the European Industrial Emissions Portal has values for SOx, the NECD inventories include SO_2 emissions only). *Limitations* Figures displaying emission reductions in the industry are available but cannot only be attributed to the IED: the supporting study on the evaluation of the IED states that it is challenging to separate the impacts of IED measures from other factors, such as reduced economic activity and the effect of other sectoral policies**.** *Conclusions* **It is clear that the IED contributes significantly to limiting air pollutants covered by NECD ERCs from installations included under the IED. However, because of the challenge of splitting emission reductions due to the IED and other sectoral policies (and the NECD and other sectoral policies), it is not possible to estimate the**

[123] PCDD/F are part of persistent organic pollutants (POPs) and as such PCDD/F emissions are reported by MS under the NECD but are not covered by ERCs.

					share of the IED in delivering reductions in air pollutant emissions for the NECD. The estimated order of magnitude of this share could be 33% for NO_x, 12% for NMVOC, 22% for NH_3 and 79% for SO_x (with the additional limitation that the NECD inventories include SO_2 emissions only). Furthermore, regarding the NECD, the evaluation stated that: "BAT conclusions contribute to achieving the reduction targets set under the NECD. However, **there is no evidence of Member States systematically choosing to set stricter requirements for IED sectors to contribute to national emission ceilings**"[126].
Climate/Energy: Regulation on the Governance of the Energy Union and Climate Action	All.	Evaluation[127] & NECP guidance[128]	No		*Why is this policy relevant to the NECD?* The Regulation on the Governance of the Energy Union and Climate Action requires Member States to draft National Energy and Climate Plans (NECPs), including policies and measures to demonstrate how they will achieve their objectives in the five dimensions of the energy union. The current plans cover the 2021-2030 period. MS were required to update their NECPs by June 2024. MS are required to report in their NECPs on the impacts on air pollution of the policies and measures put forward. *What effects did the Regulation on the Governance of the Energy Union and Climate Action have on emissions over the NECD evaluation period?* The evaluation refers to the NECD. Although co-benefits between energy, climate and clean air policies are clear, this relationship is not analysed in-depth or quantified. The

[126] Emission ceilings were applicable under the NECD until 31 December 2019 according to Article 21(2) of the NECD.
[127] Commission Staff Working Document, Evaluation Accompanying the document Report from the Commission on the Review of the Regulation on the Governance of the Energy Union and Climate Action, SWD(2024) 200.
[128] C 495/24.

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<td>evaluation highlights the difficulties in co-ordinating the development of NECP and NAPCPS, mainly because of their different timing.

Conclusions

The two policies are expected to mutually reinforce each other. However, it is not possible to conclude on the extent to which the two policies influence each other's effectiveness.</td>
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<tr>
<td>Energy:
Medium combustion plants (MCP) Directive</td>
<td>SO2, NOx, PM</td>
<td>Impact Assessment[129] - entry into force: end 2015.</td>
<td>Yes</td>
<td>Emission limit values (ELVs) set in the Medium Combustion Plants (MCPs) Directive are following the ones set in the 2012 amended Gothenburg Protocol.
Projected emissions from medium combustion plants were calculated in the impact assessment for the year 2025, for a baseline with no EU action and for the preferred policy option (applying Gothenburg Protocol's emission limit values: option 7D).
Emissions from MCPs in 2010, and projected for 2025 with two different scenarios
<table>
<tr><td rowspan="2">Emissions (kt/year; % change compared to 2010 levels)</td><td rowspan="2">2010</td><td colspan="2">2025</td></tr>
<tr><td>No EU action</td><td>Applying Gothenburg ELVs (7D)</td></tr>
<tr><td>SO_2</td><td>301</td><td>174 (- 42%)</td><td>39 (-87%)</td></tr>
<tr><td>NO_x</td><td>554</td><td>455 (- 82%)</td><td>348 (-37%)</td></tr>
<tr><td>PM</td><td>53</td><td>48 (- 13%)</td><td>3 (-94%)</td></tr>
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<td>Why is this policy relevant to the NECD?

The Medium Combustion Plants (MCP) Directive covers combustion plants equal to or greater than 1 MW and less than 50MW and thus complements the IED (that covers large combustion plants) and the emission standards adopted under the Ecodesign directive (that cover small combustion plants and appliances).

The MCP Directive implements emission limit values for MCPs, set by the 2012 revised Gothenburg protocol, for NOx, SO_2 and PM, pollutants all covered by ERCs under the NECD.

What effects did the MCP Directive have on emissions over the NECD evaluation period?

The MCP Directive contributes to further reduce SO_2, NO_x, and PM emissions compared to no EU action (see table to the left). The projected annual reductions according to the MCP impact assessment correspond to 13.3% for SO_2 and 7.3% for NO_x of EU-level emissions from energy supply and manufacturing and extractive industry, as submitted in 2022 emission inventories under the NECD[130].The MCP Directive is thus expected to bring significant emission</td>
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[129] SWD (2013) 531 final/2.

[130] EEA, National air pollutant emissions data viewer 2005-2022, 2024 edition, accessed 21 January 2025.

					reductions for SO_2 and NO_x in energy- and industry-related sectors. *Limitations* The MCP Directive's impact assessment and the NECD use different base years: MCPD uses 2010, whilst the NECD uses 2005. Furthermore, even if emission limits set in the MCP Directive were applied for new plants as of December 2018, they are only applied as of 2024 or 2029 for existing plants (depending on the type of combustion plant). The extent of the contribution therefore cannot be quantified. *Conclusions* **The MCPD is expected to have led to significant emission reductions that contribute to reaching NECD ERCs. However, it is not possible to quantify this contribution due to the use of different base years, changes to the MCPD proposal during its adoption and due to the timeline for the application of Directive to existing plants.**
Energy: Ecodesign Directive and Energy Labelling Regulation	PM, NOx, CO, NMVOC	Ecodesign Impact Accounting Report (EIA)[131]	Yes.	Annual savings in the ECO scenario (Ecodesign and Energy labelling measures until 2023) compared to the business-as-usual (BAU) scenario (without Ecodesign and Energy labelling measures), for years 2020 and 2022. This accounting covers: space heating, space cooling, water heating, ventilation, lighting, electronics, food preservation, cooking, cleaning, industry components, transport (tyres) and energy sector (utility transformers). Emission savings due to Ecodesign in kt and compared to the BAU baseline were the following:	*Why is this policy relevant to the NECD?* The 2009 **Ecodesign Directive** and subsequent implementing Regulations established ecodesign requirements for energy-related products. In particular, they set energy efficiency targets and air pollutant emission limits for local space heaters, solid fuel boilers, space and combination heaters, and water heaters. Emission limits are set for NO_x for all devices, with additional limits for PM, organic gaseous compounds (OGCs), and CO specifically applied to solid fuel local space heaters and solid fuel boilers. As NO_x, $PM_{2.5}$ and NMVOC (that are included in

[131] EC (2024), Ecodesign Impact Accounting Report 2023.

% compared to BAU	2020	2022
NO_x (kt SO_2 eq.)	83 (33%)	98 (41%)
CO (kt)	143 (7%)	244 (12%)
OGC[132] (kt)	10 (7%)	14 (11%)
PM (kt)	10 (6%)	18 (11%)

NO_x emissions are calculated in kt SO_2 eq., as ecodesign measures focus on the impact on acidification. These emissions equate to 118.6 kt NO_x for 2020 and 140 kt NO_x for 2022.

OGCs) are covered by ERCs under the NECD, the Ecodesign Directive helps MS comply with the NECD. Additionally, the **Energy Labelling Framework Regulation** enhances energy efficiency by allowing consumers to make informed choices that reduce energy use. This was expected to contribute to reducing air pollutant emissions emitted by the use of energy-related products also covered by the Ecodesign Directive.

What effects did the Ecodesign & Energy Labelling legislation have on emissions over the NECD evaluation period?

The Ecodesign Impact Accounting Report 2023 (EIA) estimates that, compared to the business-as-usual scenario, legislation related to Ecodesign & Energy Labelling allowed to save up to 41% of NO_x emissions and 11% of PM emissions covered in the report for the year 2022.

According to emission inventories submitted by Member States under the NECD in 2022[133], energy supply and residential, commercial & institutional sectors contribute at EU level for 1 282 kt NO_x emissions (23.8% of total NO_x emissions) and 823 kt $PM_{2.5}$ emissions (64.3% of total $PM_{2.5}$ emissions). Thus, savings expected for 2022 from Ecodesign measures represent 10.9% of NO_x emissions and 2.2% of $PM_{2.5}$ emissions from energy supply and residential, commercial & institutional sectors[134].

Limitations

The 2023 EIA specifies that NO_x emission savings results are "incomplete because insufficient data were available from the preparatory studies and impact assessments to

[132] Organic Gaseous Carbon (OGC) emissions are essentially equivalent to Volatile Organic Compound (VOC) emissions: NMVOC and methane.
[133] EEA, National air pollutant emissions data viewer 2005-2022, 2024 edition, accessed 21 January 2025.
[134] EEA, National air pollutant emissions data viewer 2005-2022, 2024 edition, accessed 21 January 2025.

					quantify the NO_x emissions for the Solid Fuel Boilers and for a part of the Local Space Heaters." In addition, in impact indicators used in EIA reports, no distinction is made between NO_x and SO_2 emissions, reported as acidification emissions in kt SO_2 - eq. Furthermore, the EIA Report does not distinguish between $PM_{2.5}$ and PM_{10} emissions. Therefore, any comparison made between expected PM emission savings from Ecodesign and Energy Labelling measures on the one hand and $PM_{2.5}$ emissions as inventoried under the NECD on the other hand remains an approximation. It is also likely that this overstates the impact that Ecodesign and Energy Labelling measures had on $PM_{2.5}$ emissions, given that a part of the reduction will concern PM_{10}. *Conclusions* **Emission savings from Ecodesign and Energy Labelling legislations help further reduce air pollutant emissions, in particular from heating and cooling devices. However, we cannot determine what part of the emissions reductions occurring over the NECD evaluation period are due to the Ecodesign and Energy Labelling framework, also because of methodological differences.**
Energy: Ecodesign – Regulation on Local Space Heaters and Regulation on Solid Fuel Local Space Heaters	NO_x, PM, CO, OGC	Impact Assessment[135] & Revision	Yes.	The impact assessment from 2015 dealt with two categories of local space heaters (LSHs): solid fuel LSHs (wood and coal) and non-solid fuel LSHs (liquid, gas and electric).	*Why is this policy relevant to the NECD?* Ecodesign Regulations concerning local space heaters (LSHs) set energy efficiency targets and emission limits for NO_x. For solid fuel LSHs, additional emission limits for PM, OGCs and CO are set. Thus, this has direct impact on NO_x,

[135] Commission Staff Working Document, Impact Assessment Accompanying the document 'Commission Regulation implementing Directive 2009/125/EC with regard to ecodesign requirements for local space heaters, and Commission Delegated Regulation implementing Directive 2010/30/EC with regard to energy labelling for local space heaters', SWD(2015) 90.

<table>
<tr>
<td></td>
<td></td>
<td>Impact Assessment[136]</td>
<td></td>
<td>Impacts on emissions from option A under the impact assessment (the closest to the final measures adopted) are the following, projected for 2030:
<table>
<tr><th>Projected emissions in 2030 (kt/year)</th><th>BAU</th><th>Option A</th></tr>
<tr><td>PM</td><td>94</td><td>60</td></tr>
<tr><td>CO</td><td>1433</td><td>993</td></tr>
<tr><td>OGC</td><td>49</td><td>47</td></tr>
</table>
</td>
<td>$PM_{2.5}$ and NMVOC (that are included in OGCs) emissions, all covered by ERCs under the NECD.

Solid fuel local space heaters are covered by the Ecodesign Regulation for solid fuel local space heaters[137]. $PM_{2.5}$ emissions from small biomass installations amount to around 38% of the total $PM_{2.5}$ emissions by all sources and fuels, with around two thirds of that share emitted only by solid fuel local space heaters[138].

What effects did the Ecodesign Regulations related to Local Space Heaters have on emissions over the NECD evaluation period?

Impacts on air pollutant emissions are available only for the year 2030, thus after the NECD evaluation period.

For non-solid fuel LSHs, a new impact assessment preceding a revision looks backward over the period 2000-2020 and states: “As it was the case for the 2015 IA, there is still very little data regarding NO_x emissions from local space heaters in the EU, and it has not been therefore possible to quantify the impact of the LSH Regulation on NO_x emissions.” However, the limit value for NO_x emissions set at 130 mg/kWh is recognised by stakeholders as having led to a significant decrease of NO_x emissions for many products.

Limitations

Impacts from the 2015 regulations of both categories of LSHs on emissions are likely to be lower than depicted here, as the adopted measures are globally less stringent than the ones displayed in option A of the impact assessment.</td>
</tr>
</table>

[136] Commission Staff Working Document, Impact Assessment Accompanying the document ‘Commission Regulation implementing Directive 2009/125/EC as regards ecodesign requirements for local space heaters and separate related controls and repealing Regulation (EU) 2015/1188’, SWD (2024) 62.

[137] Regulation (EU) 2015/1185 implementing Directive 2009/125/EC with regard to ecodesign requirements for solid fuel local space heaters.

[138] JRC (2023), Improving the estimation of air pollutant emissions from small-scale combustion sector and JRC(2024), Air pollution trends in the heating and cooling sector in the EU-27: A forward look to 2030

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<td></td>
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<td></td>
<td>Additionally, for solid fuel LSHs, new ecodesign requirements entered into application only in 2022.

Conclusions

Information on impacts from the LSH Regulations on air pollution during the evaluation period of the NECD (2016-2025) was not available. Although it is not possible to quantify the contribution of the LSH Regulations to reaching NECD ERCs, it is likely that the LSH Regulations limit emissions falling under ERCs. It is likely that further emission reductions will materialise after the NECD evaluation period.</td>
</tr>
<tr>
<td>Energy: Ecodesign: Regulation on solid fuel boilers</td>
<td>PM, CO, OGC</td>
<td>Impact Assessment[139] - entry into application of standards: 2020 (Review ongoing) & Ecodesign Impact Accounting (EIA) Report[140]</td>
<td>Yes.</td>
<td>The impact assessment preceding the proposal for a regulation of solid fuel boilers assessed impacts on PM, CO and OGC (equivalent to VOC) emissions. According to the baseline scenario (BAU), PM emissions are expected to decrease by 81.7% between 2010 and 2040 without any further EU action due to the replacement of highly polluting old boilers.

Impacts on emissions for option B (closest to the final measures adopted) for 2020 and 2030 are the following:

<table>
<tr><td>Pollutants (kt/year)</td><td>2010</td><td colspan="2">2020</td><td colspan="2">2030</td></tr>
<tr><td></td><td>BAU</td><td>BAU</td><td>Option B</td><td>BAU</td><td>Option B</td></tr>
<tr><td>CO</td><td>1,928.9</td><td>613.8</td><td>539.6</td><td>291.7</td><td>146.1</td></tr>
<tr><td>OGC</td><td>166.2</td><td>52.2</td><td>45.0</td><td>24.7</td><td>10.5</td></tr>
<tr><td>PM</td><td>101.7</td><td>40.1</td><td>35.1</td><td>25.1</td><td>13.6</td></tr>
</table>

The 2023 Ecodesign Impact Accounting report stated the following for solid fuel boilers (figures related to emissions from the total number of solid fuel boilers): “The Ecodesign</td>
<td>Why is this policy relevant to the NECD?

The Ecodesign Regulation concerning solid fuel boilers set energy efficiency targets and emission limits for NO_x, PM, OGCs and CO. This has direct impacts on NO_x, $PM_{2.5}$ and NMVOC (which are part of OGCs) emissions, all covered by ERCs under the NECD.

What effects did the Ecodesign Regulation on solid fuel boilers have on emissions over the NECD evaluation period?

Impacts on emissions of air pollutants were quantified in the impact assessment for PM, CO and OGC for the year 2020, with savings brought by option B (closest to final measures adopted) representing respectively 12.5%, 12.1%, and 13.8% of emissions from solid fuel boilers in absence of EU action.

Limitations</td>
</tr>
</table>

[139] Commission Staff Working Document, Impact Assessment Accompanying the document Commission Regulation implementing Directive 2009/125/EC with regard to ecodesign requirements for solid fuel boilers, and Commission Delegated Regulation supplementing Directive 2010/30/EU with regard to energy labelling of solid fuel boilers and packages of a solid fuel boiler, supplementary heaters, temperature controls and solar devices, SWD(2015) 92 final.

[140] EC (2024), Ecodesign Impact Accounting Report 2023.

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<td>measures are projected to decrease OGC emissions from 89 kt/a in 2015 to 16 kt/a in 2030 (-48% vs. no measures), PM emissions from 74 kt/a to 27 kt/a (-27% vs. no measures), and CO emissions from 1069 kt/a to 231 kt/a (-40% vs. no measures).”</td>
<td>In the impact assessment, emission limit values in option B were supposed to be applied from 2018. In the adopted Regulation, emission limit values were applied from 2020 onwards. Therefore, impacts during the evaluation period of the NECD are likely to be lower than those displayed here.

From the Ecodesign Impact Accounting Report, emission reductions projected for 2030 are lower than initially projected in the IA, coherent with the fact that adopted policy options were less ambitious than the preferred option (option B).

Conclusions

It is clear that Ecodesign measures contribute to further reducing PM, CO and NMVOC emissions from solid fuel boilers (even under the baseline scenario emissions are expected to decrease extensively). However, it remains unclear to what extent this is already happening over the evaluation period of the NECD and the contribution cannot be quantified.</td>
</tr>
<tr>
<td>Energy: Ecodesign: Regulation on Space & combination heaters</td>
<td>NO_x</td>
<td>Impact Assessment[141] - entry into force of standards: 2015 onwards</td>
<td>Yes.</td>
<td>Quantified impacts on acidification for the preferred policy option in the impact assessment were the following:
<table>
<tr><td></td><td rowspan="2">2005</td><td colspan="2">2020</td></tr>
<tr><td></td><td>BAU</td><td>preferred option</td></tr>
<tr><td>Acidification (kt SO_x eq./yr)</td><td>821</td><td>783</td><td>515</td></tr>
</table>
</td>
<td>Why is this policy relevant to the NECD?

According to the impact assessment, space and combination heaters were “responsible for around 5% of all acidification pollution emissions in the EU-27 in 2005, around 821 kt SO_x equivalent.”

The Ecodesign Regulation concerning space and combination heaters sets energy efficiency targets and emission limits for NO_x. Thus, this has a direct impact on NO_x emissions, covered by ERCs under the NECD.</td>
</tr>
</table>

[141] Commission Staff Working Document, Impact Assessment Accompanying the document Commission Regulations implementing Directive 2009/125/EC with regard to ecodesign requirements for space heaters and combination heaters, and supplementing Directive 2010/30/EU with regard to energy labelling for space heaters, combination heaters, packages of space heaters, temperature control and solar device and packages of combination heater, temperature control and solar device, SWD(2013) 297 final.

				The impact assessment estimated to save 268 kt SO_x eq. per year in 2020 compared to the business-as-usual scenario. It is not possible to match these figures to air emissions as calculated for the purposes of the NECD, as the impact assessment calculates SO_x equivalents for acidification summing up both NO_x and SO_x emissions.	*What effects did the Ecodesign Regulation on space & combination heaters have on emissions over the NECD evaluation period?* According to the impact assessment, in 2020 acidification emissions due to space and combination heaters are expected to be 34.2% lower in the preferred option scenario compared to an absence of EU action (BAU scenario). *Limitations* The option adopted in the Regulation does not correspond to any option considered in the IA, therefore impacts on acidification are likely to differ from the figures displayed here. A review of the Regulation is ongoing, with the Commission adoption planned for 2026. However, at the time of drafting the NECD evaluation, no further information was available on emission reductions achieved. *Conclusions* **It is likely that Ecodesign measures contribute to further reducing NO_x emissions from space and combination heaters. However, due to a change between the preferred option and the final Regulation, it is not possible to quantify this contribution.**
Energy: Ecodesign: Regulation on water heaters and hot water storage tanks	NO_x	Impact Assessment[142] - Entry into force of standards: 2015.	Yes.	Impacts on acidification were calculated for the preferred policy option in the impact assessment: 2005 | 2020	*Why is this policy relevant to the NECD?* According to the impact assessment, water Heaters are a "significant contributor to EU acidification (and smog) emissions (500-600 kt SO_x equivalent per year, 5-6% of total)". This is equivalent to 714-857 kt of NO_x emissions,

[142] Commission Staff Working Document, Impact Assessment Accompanying the document Commission Regulations implementing Directive 2009/125/EC with regard to ecodesign requirements for water heaters and hot water storage tanks, and supplementing Directive 2010/30/EU with regard to energy labelling of water heaters, hot water storage tanks and packages of water heater and solar device, SWD(2013) 295.

				<table><tr><td></td><td></td><td>BAU</td><td>preferred option</td></tr><tr><td>Acidification (kt SO_x eq./yr)</td><td>562</td><td>603</td><td>476</td></tr></table> Savings of 127 kt SO_x eq./year were expected from implementing the preferred option for 2020. As only NO_x emissions were taken into account here (see annex VII of the Impact Assessment), this equates to 181 kt NO_x/year[143] of emission savings for 2020.	i.e. minimum 9.3% of total 2013 (year of publication of the Impact Assessment) NO_x emissions according to emission inventories submitted under the NECD[144]. The Ecodesign Regulation concerning water heaters set energy efficiency targets and emission limits for NO_x. Thus, this has direct impacts on NO_x emissions, covered by ERCs under the NECD. *What effects did the Ecodesign Regulation on water heaters have on emissions over the NECD evaluation period?* Emissions savings computed for 2020 are expected to represent 21.1% of emissions leading to acidification from the use of water heaters in absence of EU action. A review of the Regulation is ongoing, with the Commission adoption planned for 2026. However, at the time of the NECD evaluation, no further information was available on emission reductions achieved. *Limitations* Emission savings due to Ecodesign measures for water heaters were not available over the NECD evaluation period (2016-2025), therefore, they cannot be put in relation to emission reductions occurring from the NECD. *Conclusions* **It is likely that Ecodesign measures contribute to further reducing NO_x emissions from water heaters. However, quantified impacts on air pollutant emissions from the Ecodesign Regulation on water heaters were available only for the year 2020 and not over the entire NECD evaluation period (2016-2025).**

[143] Based on acid equivalency factors used in the Ecodesign Impact Accounting Report 2023, 1 kt NO_x = 0.7 kt SO_2 eq.

[144] EEA, National air pollutant emissions data viewer 2005-2022, 2024 edition, accessed 21 January 2025.

<table>
<tr>
<td>Energy: Energy Efficiency Directive</td>
<td>SO_2, NO_x, $PM_{2.5}$</td>
<td>Evaluation 2021[145] & COMBI project[146]</td>
<td>Yes</td>
<td>Under H2020 Energy Efficiency, the Commission funded a small number of projects that studied the wider benefits of energy efficiency, including better air quality, and tried to quantify them.
Notably, the project Calculating and Operationalising the Multiple Benefits of Energy Efficiency in Europe (COMBI) computes (using existing models such as the GAINS model) impacts on air pollutant emissions in a scenario where 21 different energy efficiency improvement actions are developed (scenario EFF) and in a baseline scenario without these actions (scenario REF) for 2030.
Emissions displayed below are the total anthropogenic emissions from all major energy-using sectors in EU-28.
<table>
<tr><td rowspan="2">Emissions in kt</td><td>2015</td><td colspan="2">2030</td></tr>
<tr><td>REF</td><td>REF</td><td>EFF</td></tr>
<tr><td>SO_2</td><td>3 010.3</td><td>2 259.4</td><td>2 048.5</td></tr>
<tr><td>NO_x</td><td>7 549.1</td><td>4 722</td><td>4 405.1</td></tr>
<tr><td>VOC</td><td>6 608.8</td><td>5 386.9</td><td>5 216.4</td></tr>
<tr><td>$PM_{2.5}$</td><td>1 318.5</td><td>971.7</td><td>906.2</td></tr>
</table>
Energy efficiency improvement actions that are accounted for in the EFF scenario include:</td>
<td>Why is this policy relevant to the NECD?

The Energy Efficiency Directives (EED) set EU level targets of reductions in energy consumption by 2020 and 2030.

According to the latest available emission inventories submitted by MS under the NECD[147], energy supply is a main source of SO_2 emissions, accounting for 43.70% of total SO_2 emissions[148], and for 14.2% of total NO_x emissions[149]. According to the same inventories, energy use is also a main source of $PM_{2.5}$ emissions in 2022, as residential combustion[150], mainly linked to heating, accounts for 58.8% of total $PM_{2.5}$ emissions. As the EED will contribute to reducing energy consumption, SO_2, NO_x and $PM_{2.5}$ emissions reductions are expected due to less combustion of fuels, with all three pollutants covered by ERCs under the NECD.

What effects did the Energy Efficiency Directive have on emissions over the NECD evaluation period?

The EED recast has set a target of reducing energy consumption by 11.7% compared to the projected consumption levels in 2030. The EED was evaluated in 2021[151] and co-benefits for clean air legislation were identified but not quantified: "the lack of data to quantify the impacts of multiple benefits [including air pollution] of the</td>
</tr>
</table>

[145] Commission Staff Working Document, Evaluation of Directive 2012/27/EU on Energy Efficiency, Accompanying the Proposal for a Directive on energy efficiency (recast), SWD(2021) 625.

[146] Mzavanadze (2018), Calculating and Operationalising the Multiple Benefits of Energy Efficiency in Europe, WP3 Air pollution, Quantifying air pollution impacts of energy efficiency, D3.4 Final report.

[147] EEA, National air pollutant emissions data viewer 2005-2022, 2024 edition, accessed 21 January 2025.

[148] Excluding emissions exempted under Article 4(3) of the NECD.

[149] Including agricultural emissions.

[150] NFR category 1A4bi.

[151] Commission Staff Working Document, Evaluation of Directive 2012/27/EU on energy efficiency, Accompanying the Proposal for a Directive on energy efficiency (recast) SWD(2021) 625.

				- Residential and non-residential refurbishment of buildings (notably space heating and cooling): actions 1 to 8; - Passenger and freight transport: actions 9 to 15; Industry: actions 16 to 21.	energy efficiency action has been recognised as an important obstacle in this evaluation." The COMBI project estimates the potential impacts on air pollutant emissions from energy efficiency improvement actions for 2030 (see left). Biggest emission savings compared to a baseline with no action are expected for SO_2 and NO_x. *Limitations* Impacts on air pollution emissions quantified in the COMBI project cannot be attributed only to the EED, as underlying energy efficiency improvement actions are linked to other policies as well, e.g. transport and ecodesign policies. *Conclusions* **Information on impacts on air pollution during the evaluation period of the NECD (2016-2025) was not available. Although it is not possible to quantify the contribution of the Energy Efficiency Directive to reaching NECD ERCs, it is likely that the EED contributes to limiting emissions falling under ERCs, with the highest benefits expected for SO_2 and NO_x.**
Renewable Energy Directive	SO_2, NO_x, $PM_{2.5}$	Impact Assessment[152] & EEA dashboard[153]	Yes.	The impact assessment of the latest revision of the RED (2023) refers to the impact assessment of the Effort Sharing regulation[154] for more details about impacts on air pollutant emissions. Emission reductions are calculated for the year 2030 in the baseline scenario and in the central scenario of Fit for 55 (MIX). The MIX scenario captures effects from all policies	*Why is this policy relevant to the NECD?* Under the Renewable Energy Directive (RED), each Member State is required to set a minimum target for renewable energy in its energy mix. Increasing reliance on renewable energy reduces the use of other energy sources, such as fossil fuels, whose combustion contributes significantly to air pollution. At the same time, the biomass

[152] Commission Staff Working Document, Impact Assessment Accompanying the proposal for a Directive amending Directive (EU) 2018/2001, Regulation (EU) 2018/1999 and Directive 98/70/EC as regards the promotion of energy from renewable sources, and repealing Council Directive (EU) 2015/652, SWD(2021) 621 final.

[153] EEA (2024), Dashboard – Impacts of renewable energy use on decarbonisation and air pollutant emissions [Accessed 17 February 2025].

[154] Commission Staff Working Document, Impact Assessment Accompanying the document Regulation amending Regulation (EU) 2018/842 on binding annual greenhouse gas emission reductions by Member States from 2021 to 2030 contributing to climate action to meet commitments under the Paris Agreement, SWD(2021) 611 final.

from the Fit for 55 proposal, i.e. increased energy efficiency targets under the revised Energy Efficiency Directive, stricter greenhouse gas emissions targets under the Effort Sharing Regulation, etc.

kt (% change compared to 2015)	2015	2030	
	Baseline (REF)		MIX (central scenario)
$PM_{2.5}$	1365	-41.2%	-50%
SO_2	2473	-56.9%	-68.5%
NO_x	7218	-54.3%	-59%

In an *ex-post* assessment[155], the EEA estimated the impact of changes in the renewable energy sources (RES) consumption since 2005 on air pollutant emissions. Compared to a scenario in which RES consumption would have remained at the 2005 levels[156], the consumption of renewable energy across the EU in 2022 led to a:

- a decrease of 207 kt of SO_2 emissions,
- a decrease of 85 kt of NO_x emissions,
- an increase of 124 kt of $PM_{2.5}$ emissions,
- an increase of 299 kt of VOC emissions.

The increase in $PM_{2.5}$ and VOC emissions is associated to an increase in biomass combustion as a source of energy in small-scale installations and households, which do not fall under the remit of the RED.

combustion used as a source of renewable energy emits air pollutants.

What effects did the RED have on emissions over the NECD evaluation period?

Impacts on air pollutant emissions from the RED Directive were not quantified for the 2009 Directive or for the 2018 revision of the RED. The impact assessment regarding the 2018 revision[157] mentions impacts on air pollution from the perspective of increasing reliance on combustion of biomass as a source of renewable energy. However, the impact assessment concludes that other policies are more appropriate to legislate on air pollution from biomass combustion, such as the Ecodesign Directive.

The impact assessment linked to the 2023 revision of the RED as part of the Fit for 55 package mentions impacts on air pollutant emissions. Under the MIX scenario (central scenario of Fit for 55), an additional 10% of emission savings for $PM_{2.5}$, SO_2, and NO_x were expected in 2030 compared to the REF scenario, i.e. baseline used for all impact assessments within Fit for 55.

In its 2024 ex post assessment, the EEA estimates an increase in $PM_{2.5}$ and VOC emissions (that include NMVOC) due to the increased use of biomass combustion as a source of energy since 2005.

Limitations

The only quantified impact on air pollutant emissions is emission savings expected from the implementation of the

[155] EEA (2024), Dashboard – Impacts of renewable energy use on decarbonisation and air pollutant emissions [Accessed 17 February 2025].

[156] In this assessment, according to the methodology report of 2019, final consumption of RES is fixed at 2005 levels, but the final energy demand in every following year of the time series corresponds to the real final energy demand reported to Eurostat. This means that, in the baseline against which the evolution of emissions is assessed, for every year after 2005 fossil fuel consumption replaces all RES consumption that is above the 2005 levels.

[157] Commission Staff Working Document, Impact Assessment Accompanying the proposal for a Directive on the promotion of energy from renewable sources (recast), SWD(2016) 418 final.

					2023 revision of the RED for the year 2030 (and this is not the impact of RED alone, but of the suite of measures proposed under the Fit for 55 package). Therefore, no quantification over the NECD evaluation period is available. The *ex-post* assessment from the EEA provides an estimate of how the increased use of renewable energy impacted emissions from SO_2, NO_x, $PM_{2.5}$ and VOC over the NECD evaluation period. However, it also captures effects from variations in overall energy consumption linked to the Energy Efficiency Directive. This is the case because emissions are compared to a baseline where the final energy demand still corresponds to the real final energy demand, with RES consumption above its 2005 levels being replaced by fossil fuel consumption. Furthermore, for the years after 2020, emission factors are derived from the 2020 GAINS model and thus are not accounting for Ecodesign regulations entering into force after 2020, such as the Regulation on solid fuel local space heaters, where emission limit values entered into application only in 2022. *Conclusions* **On the one hand, the RED improves the effectiveness of the NECD, as it reduces reliance on fossil fuels, thereby contributing to a decrease in air pollutant emissions.** **On the other hand, under the RED biomass is seen as a contribution to the renewable energy target (subject to the sustainability criteria, which, however, do not cover pollutant emissions). The promotion of this solution in some areas of Europe led to a higher use, which impacts negatively $PM_{2.5}$ and VOC emissions, particularly when used in small, inefficient heating appliances in households.**

					Based on figures provided by the EEA *ex-post* analysis of 2024 and on NECD emission inventories[158], the combined effect of policies increasing the use of renewables (thus, including the RED), contributed for the year 2022 by: **— 3.6% of the total SO_2 emission reductions in 2022 compared to 2005 emission levels[159];** **— 1.6% of the total NO_x emission reductions in 2022 compared to 2005 emission levels[160];** **— An increase in $PM_{2.5}$ emissions that suggests that biomass combustion (mostly at a small, household scale) hindered 6 percentage points additional emission reductions for $PM_{2.5}$ over the 2005-2022 period[161];** **— An increase in VOC emissions, also mainly due to small-scale biomass combustion. As NECD inventories only include NMVOC and the EEA analysis covers VOC emissions, a quantification of this relationship is not possible.** **Overall, the RED contributes positively to the effectiveness of the NECD in achieving ERCs for SO_2 and NO_x.**

158 EEA, National air pollutant emissions data viewer 2005-2022, 2024 edition, accessed 25 February 2025.

159 For SO_2 emissions, from 2005 to 2022 EU-wide emissions from national compliance totals decreased from 6 987.3 kt to 1 289.8 kt, thus resulting in 5 697.5 kt of emission reductions. Out of these emission reductions, 207 kt can be attributed to the increase of RES consumption based on the EEA analysis, representing 3.6% of the total SO_2 emission reductions.

160 For NO_x emissions, from 2005 to 2022 EU-wide emissions from national compliance totals decreased from 10 685.9 kt to 5 383.8 kt (before removing agricultural emissions), thus resulting in 5 302.1 kt of emission reductions. Out of these emission reductions, 85 kt can be attributed to the increase of RES consumption based on the EEA analysis, representing 1.6% of the total NO_x emission reductions.

161 For $PM_{2.5}$ emissions, from 2005 to 2022 EU-wide emissions from national compliance totals decreased from 1 881.4 kt to 1 279.0 kt, thus resulting in 602.4 kt of emission reductions (32% of 2005 emissions). Based on the EEA analysis, $PM_{2.5}$ emissions would be 125 kt lower in 2022 if RES consumption would have frozen at 2005 levels. This would represent a decrease in $PM_{2.5}$ emissions of 38% instead of the observed decrease in emissions of 32% over the 2005-2022 period, thus 6% additional emission reductions.

Water Framework Directive		Fitness Check[162] - reference period: 2000-2017	No		*Why is this policy relevant to the NECD?* Under the Water Framework Directive (WFD), MS are required to draft River Basin Management Plans (RBMPs) and to implement Programmes of Measures (PoMs) to protect and, where necessary, restore water bodies in order to reach good chemical and ecological status of surface water bodies, good chemical and quantitative status of groundwater bodies, and to prevent further deterioration. *What effects did the WFD have on emissions over the NECD evaluation period?* The fitness check identifies clear synergies between the NECD and the Water Framework Directive relating to eutrophication. The main synergy is that implementing the NECD contributes to reducing atmospheric deposition of nutrients. Atmospheric deposition is the pressure which affects the highest amount of water bodies under the WFD. Therefore, the implementation of NECD helps reaching the objectives of the WFD. Additionally, the fitness checks also indicates that measures put in place to reach the objectives of both Directives are closely linked. This could lead to potential synergies. *Conclusions* **No quantification of the relationship between NECD and Water Framework Directive is provided. It is mainly the NECD that contributes to reaching the objectives of the WFD. Additionally, measures from both directives are closely linked, which could lead to synergies in implementation.**

[162] Commission Staff Working Document, Fitness Check of the Water Framework Directive, Groundwater Directive, Environmental Quality Standards Directive and Floods Directive, SWD(2019) 439 final.

Nitrates Directive	NO_x, NH_3	External technical report[163] Ongoing evaluation	No		*Why is this policy relevant to the NECD?* The Nitrates Directive requires Member States to designate Nitrate Vulnerable Zones, to establish Codes of Good Agricultural Practice to be followed on a voluntary basis, and to establish Nitrate Action Programmes (NAPs), to be followed within Nitrate Vulnerable Zones. The Nitrates Directive and the NECD are synergetic, as manure and fertiliser application are both sources of nitrate pollution to water (that the Nitrates Directive aims to reduce) and sources of NO_x and NH_3 emissions to the air, both of which are covered by ERCs under the NECD. *What effects did the Nitrates Directive have on emissions over the NECD evaluation period?* A technical report analysing Nitrate Action Programmes, and in particular their interactions with policies and measures in NAPCPs from Member States was published in 2020 and concluded that measures from both policies were mostly synergetic. *Conclusions* **No quantification of the relationship between NECD and Nitrates Directive is available. However, it is likely that the Nitrates Directive contributes to reducing NO_x and NH_3 emissions.**
Common Agricultural Policy[164]	NH_3	Impact assessment Clean air tracking[165]	Yes	*Based on the impact assessment for the 2023-27 CAP* The 2018 impact assessment used modelling to estimate that ammonia emissions would reduce between 0.3% and 0.8% in the various options.	*Why is this policy relevant to the NECD?* The Common Agricultural Policy (CAP) provides funding for famers in various forms, including funding conditional to the uptake of environmental farming practices. Some of

163 EC (2020), Project on the identification of approaches and measures in action programmes under Directive 91/676/EEC.
164 https://agriculture.ec.europa.eu/common-agricultural-policy/cap-overview_en
165 EC (n.d.), Clean-air tracking, accessed 15 February 2025.

				Based on funding for clean air via the CAP The Commission reports on the uptake of EU funds to support the objectives of the NECD, and developed a methodology to do so under the first NEC implementation report. For the 2014-2020 CAP cycle (extended to 2022), the methodology for clean air tracking allocated 40% to any intervention linked to focus area 5B (energy efficiency) and focus area 5D (reducing greenhouse gases and ammonia emissions from agriculture) under the European Agricultural Fund for Rural Development (EAFRD). The total CAP funding attributed to clean air between 2014 and 2022 is estimated[166] to EUR 1 314 million[167], out of a total budget for the EAFRD of EUR 135 billion[168], thus representing less than 0.97%. Regarding the 2023-2027 CAP Cycle, the methodology for clean air tracking has as a starting point the result indicators (RI), in particular R.13 (Reducing emissions in the livestock sector: share of livestock units (LU) under supported commitments to reduce emissions of greenhouse gases (GHG) and/or ammonia, including manure management) and R.20 (Improving air quality: share of utilised agricultural area (UAA) under supported commitments to reduce ammonia emissions) as set up by Regulation on CAP strategic plans (Regulation EU nº 2021/2115). Member States have to select RIs for each intervention that they support through the CAP. Interventions linked to R.13 and R.20 contributing principally to air quality were allocated	these practices have impacts on NH_3 emissions. As agriculture is responsible in 2023 for more than 94% of NH_3 emissions at EU level according to emission inventories submitted by Member States under the NECD[170], the CAP is particularly relevant to the NECD's effectiveness. *What effects did the Common Agricultural Policy have on emissions over the NECD evaluation period?* The NECD evaluation period covers two different CAP cycles: 2014 to 2020 (extended to 2022) and 2023-2027. During both cycles, the long-standing ban on burning crop residues (GAEC 3) contributes to reducing all 5 pollutants under the scope of the NECD. This effect is not quantified. In the first cycle, air pollution reduction measures were funded mainly via the 'second pillar' of the CAP with the European Agricultural Fund for Rural Development (EAFRD) through Rural Development Programmes, set by Member States. In the second cycle, interventions funded by Member States in their CAP Strategic Plans (CSP) could be linked to result indicators R.13 and R.20 that aim to decrease ammonia emissions. According to the mapping study[171], 7.4% of utilised agricultural area (UAA) are targeted through interventions linked to R.20 and 2.43% of LU are targeted through interventions linked to R.13. Eco-schemes; environmental, climate-related and other management commitments

[166] Funding for clean-air between 2014 and 2020 is available in the first NEC implementation report, funding for 2021 and 2022 attributed to clean air is available in the clean-air tracking for 2021-2027.

[167] As a sum of EUR 1 138 million from the EAFRD for 2014-2020, EUR 98 million for 2021, and EUR 78 million for 2022.

[168] As a sum of EUR 100 billion from total funding for the EAFRD for 2014-2020, EUR 26.9 billion allocated to the EAFRD for 2021 and 2022, and an extra 8.1 billion from the recovery instrument NextGenerationEU (see https://agriculture.ec.europa.eu/common-agricultural-policy/financing-cap/cap-funds_en).

[170] EEA data viewer 2025.

[171] Mapping and analysis of CAP strategic plans

				100% and interventions contributing significantly to air quality 40%. Other interventions contributing to reduce air pollution (mainly investments in manure and fertilisers management, but also advice or cooperation) are not linked to these indicators and its contribution is not quantified. The total CAP funding attributed to clean air between 2023 and 2027 is estimated to EUR 1 610.5 million, out of total planned financial allocations under the CAP Strategic Plans for 2023-2027 of EUR 264.1 billion[169], thus representing 0.71%.	(ENVCLIM) and sectoral support are not widely used to tackle air pollution and ammonia emissions but the study concluded that Member States' choices in the CSPs will likely contribute to reduce air pollution. The reasons are that several other instruments in the CAP plans have the potential to tackling air pollution and in particular investments. The same study found that 24 CSPs also include investment interventions under the CAP addressing air pollution. Support is given to improved manure storage techniques (21 interventions in 17 CSPs) and precision farming techniques (23 interventions in 17 CSPs specifically refer to 'precision farming', however all CSPs support precision farming technologies). Investments are also programmed into fertilisation techniques to reduce nutrient losses, such as slurry injection and solid manure incorporation (four interventions in four CSPs). Some CSPs also rely on COOP actions (enabling greater collaboration and concentration between farmers and producers; 20 COOP actions in 12 CSPs) and KNOW actions (knowledge and information actions, e.g. advice provision; 10 KNOW interventions in 6 CSPs) to help reduce air pollution. In the impact assessment preparing the 2023-27 cycle, the reduction effect of actions taken under the CAP was estimated in the range of 0.3-0.8% of the then current NH_3 emissions but more precise estimates on NH_3 or other air pollutants are not available. This is also due to the aggregated nature of data reporting for RDPs and CSPs. The broad categorisation of Focus Area 5D as targeting both GHG and NH_3 emissions further complicates the assessment.

[169] EC (n.d.), Common Agricultural Policy Funds, accessed 15 February 2025.

					Looking at the ERCs defined in the NECD, an overall lowering of NH_3 emissions of 6% would be needed at EU level respectively to 2005 in the period 2020-29 (please note that a reduction of 16% was reported in 2022 but reduction commitments are only defined at MS level, the EU percentage is indicative). Reaching the ERCs is generally a combination between action driven by CAP and other relevant EU and national policies. In both cycles, CAP funding attributed to clean air remained limited (see left). *Technical Limitations* The use of result indicators enables more precise tracking in the 2023-2027 cycle; however, result indicator R.13 combines GHG and ammonia emissions, and this limits tracking specific to air pollution. Other instruments like investments are not quantified under these indicators but are expected to contribute to the NEC objectives. The estimated range of 0.3%-0.8% of NH_3 emission reductions in the impact assessment also goes with uncertainties. The options analysed were not mutually exclusive and were meant to be illustrative of different ways of reaching CAP objectives. This was done to reflect that the contents of future MS CAP strategic plans could not be known when drafting the impact assessment. Support to improve air quality is provided to farmers in the form of voluntary measures, and the actual contribution will also depend on the adoption of these measures during the programming period. More precise estimates on NH_3 based on the actual plans or on effect on other air pollutants are not available. *Conclusions*

					In conclusion, the CAP provided the framework necessary to support practices and investments to reduce air pollution from agriculture. **As several of the possibilities under the CAP are not widely used, as the actual support is provided using a number of voluntary interventions, the extent of this contribution cannot be quantified at the time of writing this evaluation.** **Although it is possible to track funding that contributed to reducing ammonia emissions and to improving air quality, the actual economic contribution of other interventions like investments cannot be determined based on the information available before the implementation of the plans.**
Ambient Air Quality Directives (AAQD)	SO_2, NO_x, $PM_{2.5}$, NMVOC, NH_3	Fitness Check[172]	No.		*Why is this policy relevant to the NECD?* Together with source legislation, the NECD and the AAQD form the three pillars of clean air policy. Whilst the AAQD focuses on exposure of citizens to pollutant concentrations at the local level, the NECD addresses pollutant emissions at national level, which contributes to reducing overall background air pollution. *What effects did the AAQD have on emissions over the NECD evaluation period?* To comply locally with air quality standards under the AAQD, Member States implemented locally air quality plans including measures reducing air pollutant emissions, in turn contributing to complying with ERCs under the NECD. *Conclusions*

[172] Commission Staff Working Document, Fitness Check of the Ambient Air Quality Directives Directive 2004/107/EC relating to arsenic, cadmium, mercury, nickel and polycyclic aromatic hydrocarbons in ambient air and Directive 2008/50/EC on ambient air quality and cleaner air for Europe, SWD(2019) 427.

					It is not possible to disentangle the effect of the AAQD and the NECD as both instruments contribute together to reducing harmful effects of air pollution.

Conclusions

The analysis of evaluations and impact assessments of relevant EU policies did not allow to provide a quantitative assessment of how much other relevant EU policies contributed to reductions of emissions of the five main air pollutants, and thus to the effectiveness of the NECD. This was mainly due to the following factors:

- evaluations or impact assessments could not quantify the contribution of the two policies to each other's objectives, due to e.g. lack of reliable and comparable data series, covering a sufficient time span to identify possible correlations.
- the way of calculating emissions of air pollutants differed between the two policies, e.g. in terms of sources included, emission factors used, focus on concentrations of air pollutants (rather than quantities emitted), quantification of acidification emissions instead of separate NO_x and SO_2 emissions, etc.
- other methodological differences, e.g. a different base year or the period analysed not matching the evaluation period of the NECD.

In some cases, the information presented in the detailed table above is sufficient to conclude on whether the contribution of the policy to reducing emissions was significant or less so; whilst in other cases the extent of the contribution could not be determined. Statements on the significance of the contribution are based on factors such as the contribution of the sector(s) to emissions of the five main air pollutants, the extent of the coverage of the sector(s) concerned by the policy and the available figures on reductions of emissions of the five main air pollutants in the evaluation period.

The table below summarises these conclusions.

Table A - 18 - Summary of findings on the contribution of other relevant EU policies to the effectiveness of the NECD

Policy	Extent of contribution to the effectiveness of the NECD in reducing the five main air pollutants
Transport: Euro 6/VI	Around 30% of NO_x from road transport emissions in the period 2014-2020 Significant positive contribution for emission reductions from road transport
Transport: Roadworthiness Directives	Not quantifiable Marginal positive contribution, enabler of emission savings by Euro standards
Transport: Non-road mobile machinery regulation	Not quantifiable Positive, but unclear level of contribution
Transport: Sulphur Directive	Not quantifiable Positive contribution for SO_2 emissions from maritime transport (only domestic, not international transport).
Transport: Fuel quality directive	Not quantifiable Positive for SO_2 emissions, but unclear level of contribution. Most of these reductions took place already before the adoption of the NECD.
Industrial Emissions Directive	The estimated order of magnitude of the contribution of the IED to reduction of air pollutants covered by NECD ERCs in the period 2016-2022 could be 33% for NO_x,

	12% for NMVOC, 22% for NH_3 and 79% for SO_x (with the additional limitation that the NECD inventories include SO_2 emissions only). The numbers give an order of magnitude only, as also the effects of the IED are intertwined with other sectoral legislation.
Climate/energy: Regulation on the Governance of the Energy Union and Climate Action	Not quantifiable Significant co-benefits[173]
Energy: Medium combustion plants Directive	Not quantifiable Positive, but unclear level of contribution
Energy: Ecodesign Directive and Energy Labelling Regulation	Not quantifiable Positive, but unclear level of contribution for energy-related products
Energy: Ecodesign for local space heaters and solid fuel local space heaters	Not quantifiable Positive, but unclear level of contribution
Energy: Ecodesign for solid fuel boilers	Not quantifiable Positive, but unclear level of contribution
Energy: Ecodesign for water heaters	Not quantifiable Significant positive contribution for emissions from this product group
Energy: Energy Efficiency Directive	Not quantifiable Significant positive contribution for air pollutant emissions from energy supply and consumption
Energy: Renewable Energy Directive	Positive contribution by reducing fossil fuel burning; negative contribution through considering biomass as a contribution to the renewable energy target, even if the use of biomass in small, inefficient heating appliances in households contributes to $PM_{2.5}$ and NMVOC emissions. Positive combined effect for NO_x and SO_2, negative combined effect for $PM_{2.5}$ and NMVOC. In the context of policies contributing to regulating renewables (thus including, but *not limited to the RED*): • 3.6% of the total SO_2 emission reductions in 2022 compared to 2005 emission levels; • 1.6% of the total NO_x emission reductions in 2022 compared to 2005 emission levels; • An increase in $PM_{2.5}$ emissions that suggests that biomass combustion (mostly at a small, household scale) hindered 6 percentage points additional emission reductions for $PM_{2.5}$ over the 2005-2022 period; • An increase in VOC emissions, also mainly due to small-scale biomass combustion. As NECD inventories only include NMVOC and the EEA analysis covers VOC emissions, the extent of this effect is unclear.
Water Framework Directive	Possible synergies in the implementation of measures between both directives, leading to a contribution of unknown extent (no quantification available)
Nitrates Directive	Not quantifiable Positive contribution to reducing NO_x and NH_3 emissions from agriculture, but unclear level of contribution
Common Agricultural Policy	Not quantifiable

[173] The presence of significant co-benefits is confirmed in a scientific paper investigating the co-benefits from the European Emissions Trading System on emissions of $PM_{2.5}$, SO_2, and NO_x. While acknowledging that individual policy effects cannot be fully isolated, the authors provide empirical evidence for pollution reductions likely due to the EU ETS, translating into health co-benefits (Basaglia P., Grunau J. and Drupp M.A., 2024, The European Union Emissions Trading System might yield large co-benefits from pollution reduction, PNAS, Vol. 121 No.28).

	Positive and potentially significant contribution to reducing NH_3 emissions from agriculture, but the level of contribution is unclear and crucially depending on the extent of uptake of funding streams and eco-schemes
Ambient Air Quality Directives	Not quantifiable Significant co-benefits

2.7.3 Trends in external factors (as listed in the intervention logic), relative to the assumptions underpinning the 2013 NECD IA projections, and how these effect air pollutant emissions

The external factors that have been identified in the intervention logic (Figure 1 in the main part) have partly seen significant development over the evaluation period. Other external factors have emerged that could not have been foreseen at the time of the impact assessment, notably the Covid-19 pandemic and the Russian military aggression against Ukraine, addressed in section 2.7.1 above. Below are some further examples of external factors, how they changed, and what impact this has had on air pollutant emissions.

Strengthening of international climate policy including the EU's response: The Paris Agreement was agreed in 2015 and entered into force on 4 November 2016, when the condition of ratification by at least 55 countries accounting for at least 55% of global greenhouse gas emissions had been met. The 2nd Clean Air Outlook[174] (CAO2) analysed several climate scenarios with regard to their effects on air pollution. Some of these scenarios were based on the cases developed for the Commission's 'Long-term strategic vision for a prosperous, modern, competitive and climate neutral economy'[175], including a scenario relying on the circular economy and lifestyle changes, and another relying on technological solutions. A further scenario modelled in CAO2 corresponds to the Commission's 2020 proposal for a 55% reduction in greenhouse gases by 2030[176]. While the results from CAO2 are forward-looking, they confirm the co-benefits highlighted already above, i.e. that actions to fight climate change most often help to reduce air pollutant emissions. The climate scenario reflecting a move towards a circular economy and lifestyle change is the one that contributes most to reducing air pollutant emissions according to CAO2 modelling. The smallest contribution was identified for $PM_{2.5}$, likely due to increased use of bioenergy in the more ambitious climate scenarios.

The war in Ukraine led to a further strengthening of EU energy and climate policy in order to end the EU's dependency on gas, oil and coal imports from Russia, building on the Fit for 55 proposals and in line with the climate neutrality objective of the European Green Deal. The REPowerEU plan tabled additional measures to rapidly save energy for households, businesses and industry, and to accelerate the clean energy transition including by proposing higher targets for renewable energy and energy efficiency for 2030. As part of the Third Clean Air Outlook[177], the Commission has tested projections on the EU energy

[174] COM(2021) 3 final
[175] COM(2018)773 final.
[176] COM(2020) 562 final.
[177] COM(2022) 673 final.

mix incorporating, on top of the measures included in the baseline scenario, the potential consequences of phasing out fossil fuels from Russia and the main **REPowerEU** measures announced at the time (so not factoring in the full suite of measures eventually adopted)[178], to assess their impact on air pollution. The analysis showed that while the accelerated roll-out of renewable energy (notably wind and solar) would bring long-term benefits, the rebound of coal use due to phasing out Russian gas would worsen air quality in the short term, requiring abatement measures.

Dieselgate: The Dieselgate scandal emerged in 2015, when it was revealed that Volkswagen and other car manufacturers had been installing software in cars, so-called 'defeat devices', designed to detect when the cars were undergoing emissions testing and to temporarily reduce emissions to meet regulatory standards. However, during regular driving conditions, these vehicles emitted pollutants, particularly NO_x, at levels far exceeding legal limits. This led to developments in EU policy (later followed by others) with the introduction of stricter emission standards and testing procedures, with impacts on air emissions, notably NO_x (as addressed in section 2.7.2 above, see Euro 6 entry). As of 1 September 2017, new car models have to pass new and more reliable emissions tests in real driving conditions ("Real Driving Emissions" – RDE) as well as an improved laboratory test ("World Harmonised Light Vehicle Test Procedure" – WLTP) before they can be driven on European roads[179]. The NECD impact assessment already assumed some improvements as regards real driving emissions[180]. Euro 7 introduced some further strengthening of rules by addressing non-exhaust emissions (from brakes and tyres) from new light-duty vehicles, and by introducing stricter exhaust emission limits for new heavy-duty vehicles. The effects of this, however, are only to be seen in future years.

The practical effect of this on emission inventories and projections, was that the emissions of road transport had to be recalculated using new assumptions for the emission factors of Dieselgate-affected vehicles once the extent and levels were better understood. This took place around 2019, with an approximate increase of 10-15% for emissions of Dieselgate-affected vehicles.

Low emission zones (LEZ): These are used as a tool by municipalities to limit access of the most polluting vehicles to certain urban centres. There is evidence that they have been effective in limiting air pollutant emissions from vehicles, of relevance amongst the NECD main pollutants mainly for NO_x, but also $PM_{2.5}$. However, given the NECD addresses *national* emissions and LEZ being a tool to address air pollution *locally*, it is not possible to establish with any certainty whether increased numbers of LEZ have had a noticeable impact on national level emissions of air pollutants addressed by the NECD. There have rather been attempts to quantify impacts on local air quality[181]. Logika prepared a short

178 In COM (2022) 230 and SWD (2022) 230.

179 As per Commission Regulation (EU) 2017/1151 of 1 June 2017

180 Table 7 of the IA states as part of baseline assumptions, that no new EU source control measures are assumed other than relying on emission reductions yielded by current legislation, including resolution of real-world emissions not later than 2017.

181 An overview of LEZ and other urban vehicles access restriction schemes is for example provided here: https://urbanaccessregulations.eu/low-emission-zones-main/impact-of-low-emission-zones.

review for the Clean Cities Campaign (2022) in the context of the revision of the AAQD, evaluating the air emission (particularly NO_x and PM) mitigation potential and evidence of LEZs and zero emission zones (ZEZs). The report noted that '*well-designed, carefully implemented and stringently enforced LEZs can make a significant contribution to improving air quality in urban areas'*, with reductions in NO_2 concentrations of around 40% having been seen, it also notes that the effect on $PM_{2.5}$ concentrations is smaller and puts a general disclaimer that '*the impacts of LEZs and ZEZs on air quality are difficult to assess with precision. This is mainly due to the problems of constructing a robust counter-factual, and in isolating the effect of the Zone from the wider changes to the vehicle fleet and driver/operator behaviours (as well as wider societal changes)*'. All this relates to the impact on concentrations in ambient air, it is even more difficult to draw conclusions on (national) emissions of air pollutants.

Increased knowledge and awareness on clean air issues: The intervention logic refers to several issues under these headings. As regards increased knowledge on the fraction of condensable particulate matter, on black carbon, on soil emissions, ozone-methane interactions, the evidence base has indeed expanded significantly over the evaluation period. Condensable particulate matter emissions are both better understood, reflected in integrated assessment modelling and increasingly also in Member State emission inventories. Similarly soil emissions are now reflected in integrated assessment modelling and can thus be adequately reflected in setting future emission reduction commitments, as is currently done in the context of the revision of the Gothenburg Protocol. Increased interest in methane, including from a climate action perspective, has reconfirmed the need to tackle methane emissions, given its role as a short-lived but very potent climate forcer and as a powerful precursor to ozone. All these are addressed in more detail in other parts of this document (under relevance). The further development of WHO Air Quality Guidelines is addressed below (under relevance).

Increased awareness and better information of the public is an important component of successfully implementing clean air policy, as it can help build public support for clean air policy and measures. An October 2022 Eurobarometer has tested attitudes of European towards air quality, confirming that air quality is still a serious concern for European citizens. There has also been a perceived clearer messaging in the common media about air pollution being a problem in recent years. At EU level, there are a number of sources that provide information to the public and which have been initiated or further developed over the past years. Whether that is an indication of increased awareness or a response to it, is difficult to assess. The European Air Quality Portal managed by the European Environment Agency (EEA) links to several databases on air pollutants in the EU. Of particular relevance for raising public awareness are the Air Quality Index and Air Quality Index App, both developed by the EEA to provide the public with Europe-wide near real time data for five key air pollutants. The website also contains multiple links to national and regional air quality websites. EEA has also compiled a repository of successful citizen science examples of using simple low-cost devices to measure local air pollution levels and hence complement the official monitoring done in line with AAQD requirements. The Commission also organises the EU Clean Air Forum (mandated through Article 12 of the

NECD), a major clean air policy event taking place every two years and which brings together clean air stakeholders and interested parties to exchange on the main clean air issues.

While it is not possible to establish any direct link from such developments to levels of air pollutant emissions, public involvement in clean air action can play an important role in accompanying the implementation of the EU acquis in this area.

2.7.4 Stakeholder opinion on the contribution of other EU policies to the reduction of emissions

Both in the OPC and TSC, most respondents thought that other policies had a positive contribution to reducing emissions of air pollutants covered by the NECD.

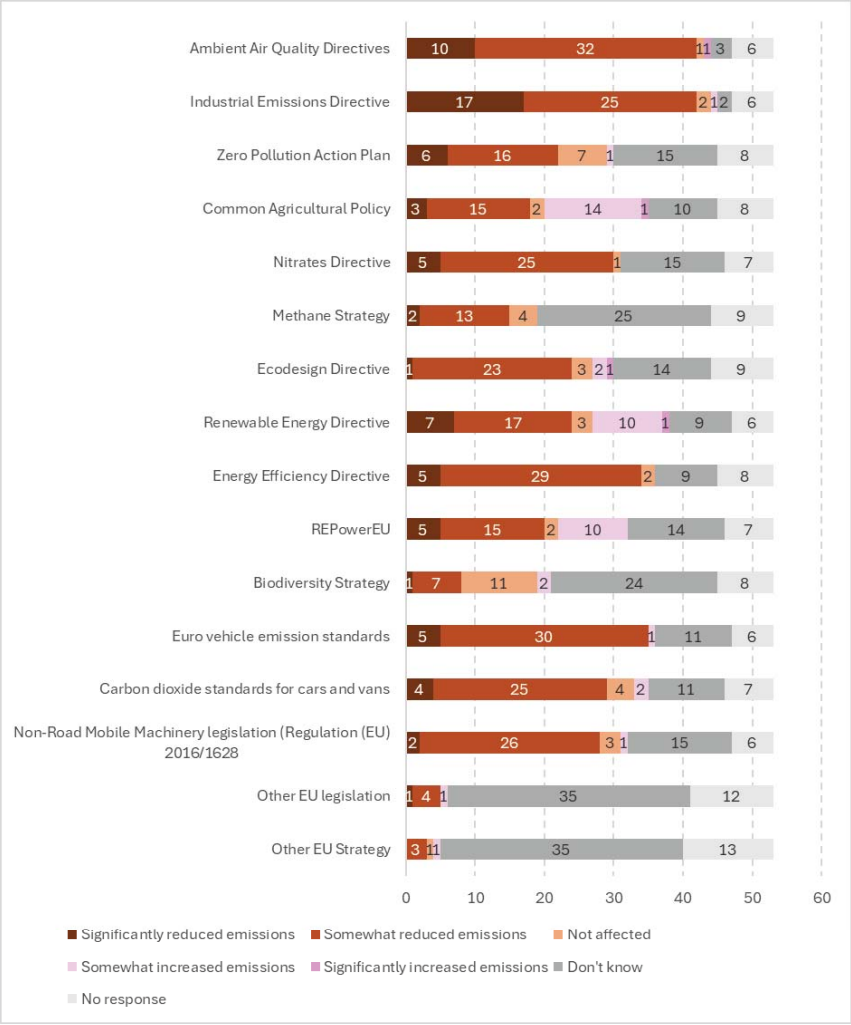

Figure A - 23 – OPC responses on the influence of other EU policies on emissions of NECD pollutants

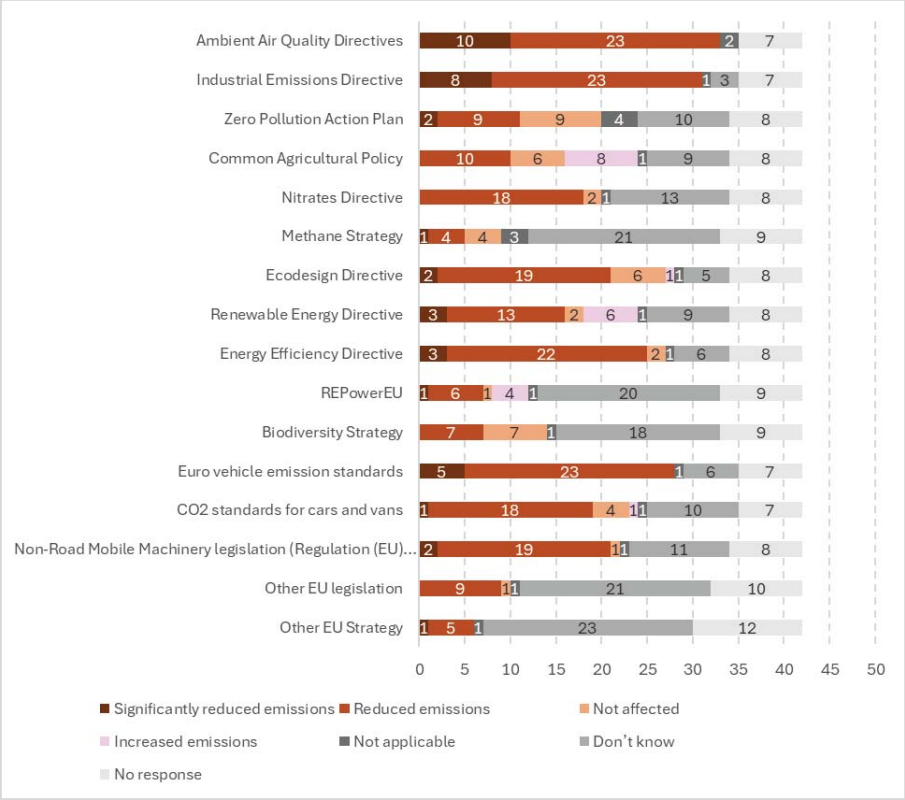

Figure A - 24 – TSC responses on the influence of other EU policies on emissions of NECD pollutants

The AAQD and the IED were thought to have contributed the most significantly to the reduction of air pollutants (10 OPC and 10 TSC replies indicating significant reductions, 32 OPC and 23 TSC replies indicating reduced emissions). Most other policies were also thought to have contributed positively, with no replies indicating counter-effects. This applies to the ZPAP, the Nitrates Directive, the Methane Strategy and the Energy Efficiency Directive.

Opinions were mixed regarding some other EU policies. No further explanation was provided on the replies:

- **CAP**: Most respondents saw positive effects (three OPC replies indicated significant reduction, 15 OPC and 10 TSC replies indicated reductions). 14 OPC and 8 TSC respondents (out of which 6 NGOs for both OPC and TSC) thought that the CAP resulted in an increase in emissions, one OPC respondent (EU citizen) indicated that these increases were significant.
- **Renewable Energy Directive**: Most respondents saw positive effects (7 OPC and three TSC respondents indicated significant reduction, 17 OPC and 13 TSC respondents indicated reductions). 10 OPC (out of which 4 NGOs) and 6 TSC (out of which 4 public authority) respondents thought that the RED resulted in an increase in emissions, one OPC respondent (EU citizen) indicated that these increases were significant.
- **Ecodesign Directive**: Most respondents saw positive effects (one OPC and two TSC respondents indicated significant reduction, 23 OPC and 19 TSC responses indicated reduced emissions). Two respondents to the OPC (one trade union and

one NGO) and one TSC respondent (public authority) thought the initiative increased emissions, and one OPC respondent (EU citizen) thought that these increases were significant.

- **REPowerEU:** Most respondents thought that the contribution was positive (5 OPC and one TSC respondent indicated significant reduction, 15 OPC and 6 TSC respondents indicated reductions). 10 OPC (out of which 5 NGOs) and 4 TSC respondents (distributed across stakeholder groups) thought that the initiative resulted in an increase of emissions. When expanding on the reply, one stakeholder indicated the issue of wood burning.
- **Biodiversity strategy**: Most respondents thought that the contribution was positive (one OPC reply indicated significant reductions, 7 OPC and 7 TSC respondents indicated reduced emissions). 2 respondents to the OPC (EU citizens) thought that the initiative increased emissions.
- **Euro vehicle emission standards and NRMM:** Most respondents thought that the effect was positive, there was only one OPC response (EU citizen) that indicated increased emissions
- **CO2 emission standards for cars and vans:** Most respondents thought that the effect was positive, there were two OPC responses (EU citizen, consumer organisation) that indicated increased emissions.
- In open contributions, some **other** initiatives were mentioned as counter-productive. The Commission Communication on ensuring availability and affordability of fertilisers (fertiliser support without environmental requirements). Greater consistency in funding could enhance policies.

3 DETAILED ANALYSIS OF THE "EFFICIENCY" EVALUATION CRITERION

BOX 6. Summary of evaluation questions on efficiency

Under the efficiency criterion, the analysis looked at the costs (administrative and adjustment costs) and benefits of the NECD, including how other policies or external factors affected costs and benefits.
It also examined whether there were any inefficiencies and potential for simplification. The analysis refers to policies and external factors that affected costs of compliance, where relevant.

3.1 What are the costs for implementing the NECD?[182]

3.1.1 Administrative costs of Member State reporting obligations

'Administrative burdens' are defined as "specific types of compliance costs incurred by enterprises, public authorities, and citizens in meeting administrative obligations. This captures a broad range of administrative activities including labelling, reporting, registration, provision of data, as well as monitoring and assessments needed to generate

[182] The analysis of this indicator is taken from the support study: Logika Group, RPA Europe, Aether, IIASA, EMRC & the University of Hertfordshire (2025), Logika Group, RPA Europe, Aether, IIASA, EMRC & the University of Hertfordshire (2025), Final report on supporting the evaluation of Directive (EU) 2016/2284 on the reduction of national emissions of certain atmospheric pollutants (NECD).

the information"[183]. The analysis followed the Standard Cost Model (SCM) guidance under the Better Regulation Toolkit to assess the administrative burden associated with compliance with the NECD. The analysis captures all costs associated with reporting under the NECD, covering 'information requirements' imposed on Member States, businesses and the European Commission itself.

Several **challenges** arose when assessing the administrative burden of the NECD. First, Directive (EU) 2016/2284 replaced the preceding Directive 2001/81/EC which required Member States to limit national emissions of SO_2, NO_X, VOC and NH_3 prepare and report annually on national emission inventories and projections. Any upfront costs of putting systems and processes in place to meet these obligations had been invested a significant time ago in response to Directive 2001/81/EU, and information on such upfront costs was unavailable. The present analysis estimated as far as possible the total cost of complying with the NECD, taking into account new, additional activities introduced by Directive (EU) 2016/2284 and activities 'carried through' from Directive 2001/81/EC (in particular reporting on inventories and projections), to provide an overall burden estimate to use as a basis for subsequent simplification analysis (see Annex III section 3.5)

Another challenge related to the fact that some NECD requirements have links and overlaps with other policies and initiatives. One such example is the requirement for ecosystem reporting, where the NECD mandates that this activity is streamlined with networks already established under existing legislation. Another key interaction is with the requirements laid out under the Gothenburg Protocol (GP): one objective of the NECD was to bring the GP requirements into EU legislation, so there is a strong similarity between the obligations of the NECD (EU) 2016/2284 and the requirements of the GP (indeed the approach taken in the Impact Assessment accompanying the Commission's proposal for the NECD did not attribute reporting costs to the proposed Directive given these were undertaken already under the GP). Some of the main similarities between the two instruments include (but are not limited to)[184]:

- Both instruments set the same ERCs for the same pollutants for 2020 and beyond (although the NECD also includes a set of ERCs applying to 2030+, unlike the GP).
- Both share common emission inventory compilation and reporting requirements. Both rely on the same set of guidance documents and guidebook (developed jointly by EMEP/EEA).
- Both require the development and dissemination of a Code for Agricultural Practice to control ammonia emissions.
- Both require countries to prioritise emission reduction measures for black carbon when implementing measures to reduce particulate matter emissions.

[183] See Tool 58 of the European Commission's Better Regulation Toolbox

[184] A more detailed overview of the coherence between the NECD and the Gothenburg Protocol is provided in Annex III **Error! Reference source not found.**

One key difference between the instruments, however, is that reporting of projections occurs more frequently under the NECD (EU) 2016/2284 (every 2 years) compared to the GP (every 4 years). A review report comparing the obligations under the GP with those of the NECD identified four areas where the administrative burden from the latter is (arguably) greater[185]. These were:

- flexibilities (NECD Art. 5);
- the requirements for NAPCPs (NECD Art. 6);
- the reporting of emissions inventories and projections (NECD Art. 8);
- and the reporting of ecosystems impacts data (NECD Art. 9).

That said, the analysis found that the potential additional burdens from the NECD are small, and it could be argued that they are not additional at all.

3.1.1.1 Methodology

Following SCM guidance[186], the administrative obligations in the NECD were first identified and mapped to specific Articles. Each obligation was profiled in terms of: (1) obligation summary, (2) the relevant article, (3) a comparison of the obligation with the requirements of the GP, (4) the responsible body/ implementing authority for the obligation, (5) whether the requirement is voluntary or mandatory and (6) the frequency of which the obligation is required. A mapping of all obligations with a potential associated administrative burden are captured in the following table.

Table A - 19 – Summary table of key obligations identified within the NECD with an impact on administrative burden

Obligation	Article	Mapping of obligation to GP	Responsible body	Voluntary/ mandatory	Frequency
Demonstration that the use of flexibility (Art. 5) fulfils relevant conditions	Articles 5 and 8(4)	Article 13(2), Annex II, para 5	Member State competent authorities	Mandatory, if used	As required - potential to be multiple times[187]
Review and assess the use of flexibilities	Article 5(6)	N/A	European Commission with assistance from the EEA	Mandatory	As required - potential to be multiple times[188]
Development of NAPCPs	Article 6	Article 6	Member State competent authorities	Mandatory	Every 4 years
Facilitation of the elaboration and implementation of	Article 6(7)	N/A	European Commission	Mandatory	As required

185 Logika Group (2023), Comparison of the NECD and the revised Gothenburg Protocol.
186 See the European Commission's Better Regulation Toolbox, chapter 8.
187 In the period of 2022-2025, there were 9 applications.
188 In the period of 2022-2025, there were 9 applications.

Obligation	Article	Mapping of obligation to GP	Responsible body	Voluntary/ mandatory	Frequency
NAPCPs through the exchange of good practice					
Establish guidance on the elaboration and implementation of NAPCPs	Article 6(9)	N/A	European Commission	Voluntary	One-time[189]
Specify, by means of implementing acts, the format of the NAPCPs	Article 6(10)	N/A	European Commission	Mandatory	One-time[190]
Development of emission inventories	Article 8(1) with reporting under Article 10(2)	Article 7(1) para b	Member State competent authorities	Mandatory	Annual
Development of spatially disaggregated national emission inventories and large point source inventories	Article 8(2) with reporting under Article 10(2)	Article 7	Member State competent authorities	Mandatory	Every 4 years
Development of an informative inventory report	Article 8(3) with reporting under Article 10(2)	Article 7	Member State competent authorities	Mandatory	Annual[191]
Development of emissions projections	Article 8(2) with reporting under Article 10(2)	Article 7(1) para b section i	Member State competent authorities	Mandatory	Every 2 years
Development of EU-wide emission inventories and informative inventory report	Article 8(6)	N/A	European Commission with assistance from the EEA	Mandatory	Annual

189 One guidance was developed: Guidance for the development of National Air Pollution Control Programmes under Directive (EU) 2016/2284 of the European Parliament and of the Council on the reduction of national emissions of certain atmospheric pollutants, (2019/C 77/01).

190 One implementing decision was adopted: Commission Implementing Decision (EU) 2018/1522 of 11 October 2018 laying down a common format for national air pollution control programmes under Directive (EU) 2016/2284 of the European Parliament and of the Council on the reduction of national emissions of certain atmospheric pollutants.

191 See Table D 'Annual reporting requirements on informative inventory report referred to in Article 8(3)' of Annex I to Directive (EU) 2016/2284.

Obligation	Article	Mapping of obligation to GP	Responsible body	Voluntary/ mandatory	Frequency
Development of EU-wide emission projections	Article 8(6)	N/A	European Commission with assistance from the EEA	Mandatory	Every 2 years[192]
Development of EU-wide spatially disaggregated Union-wide emission inventories and Union-wide large point source inventories	Article 8(6)	N/A	European Commission with assistance from the EEA	Mandatory	Every 4 years
Monitoring and reporting of air pollution impacts on ecosystems	Article 9 with reporting requirements in Article 10(4)	Article 8	Member State competent authorities	Mandatory	Reporting every 4 years
Review of Member State NAPCPs	Article 10 (1)	N/A	European Commission with assistance from the EEA	Mandatory	According to Member State NAPCP updates and submissions
Review of Member State emissions inventories (and projections[193])	Article 10(3)	N/A	European Commission with assistance from the EEA	Mandatory	First year of reporting and "regularly" thereafter – in practice, according to Member State submissions of inventories and projections
Implementation report to the European Parliament and Council	Article 11	Article 10	European Commission	Mandatory	Every 4 years
Facilitation of the European Clean Air Forum	Article 12	N/A	European Commission	Mandatory	Every 2 years
Participation in the European Clean Air Forum	Article 12	N/A	Member State Competent Authorities	Voluntary	Every 2 years

[192] Fulfilled via the Clean Air Outlooks (CAOs). Four CAOs were published.

[193] Article 10(3) does not explicitly mention an obligation of the Commission to review projections. But the rules have been interpreted to this effect.

Obligation	Article	Mapping of obligation to GP	Responsible body	Voluntary/ mandatory	Frequency
Ensure dissemination of NAPCPs, inventories, projections and inventory reports to the public	Article 14(1)	Article(s) 4 and 5	Member State competent authorities	Mandatory	In line with inventory and report updates
Ensure dissemination of Union-wide emission inventories, projections and inventory reports to the public	Article(s) 14(2) and 14(3)	N/A	European Commission	Mandatory	In line with inventory and report updates
Transposition into national legislation	Article 20	N/A	Member State competent authorities	Mandatory	One-time

3.1.1.2 Points of comparison

In 2013, the Commission published an Impact Assessment (IA) alongside the proposed NECD. The IA quantified potential administrative costs for several options, including the preferred option which became the basis of the Commission proposal for the NECD. The IA quantified *additional* costs over and above the baseline which included Directive 2001/81/EU, meaning that activities already undertaken under Directive 2001/81/EU were not assessed. Furthermore, requirements relating to inventories and projections were not assessed, as the IA considered that Member States would have to undertake these activities in any case under the GP. It is important to note that the obligation to develop and submit emissions inventories and projections existed before the adoption of Directive 2016/2284, and as a result so too did the associated burden.

Administrative burdens analysed in the IA only concerned costs for Member State competent authorities (burdens for other parties, such as the European Commission, were not included) and were assessed at Member State level and for the EU28 as a whole. The administrative costs associated with the preferred option were **a one-off cost of €8.5 m and €3.1 m annual costs** (adjusted to 2025 prices[194], including EU27 only), as presented in the table below. All these costs were anticipated to fall on Member State competent authorities.

Table A - 20 – Summary of administrative burdens related to the Commission Proposal for the NECD assessed in 2013 IA based on preferred option (all adjusted to 2025 prices and recalculated for EU27).

Requirement	Initial administrative costs	Annual administrative costs

[194] Uplifts use ECB data series 'HICP - Overall index, Euro area 19 (fixed composition) as of 1 January 2015, Monthly', series key 'ICP.M.I8.N.000000.4.ANR'.

Comprehensive coherent national air pollution control programmes requiring that benefits for air quality be maximised	€6.3m	€219 000
Ecosystem monitoring representative of sensitive ecosystems coordinated with the LRTAP Convention to assess the effectiveness of the NECD in protecting ecosystems	€1.9m	€2.9m
Annex I monitoring and reporting (black carbon)	€249,000	Annual costs were not assessed

The IA is the starting point for the points-of-comparison of the evaluation. Subsequent to the IA, changes were made to the EC proposal on the NECD (as assessed in the IA) in the co-legislation process. Some of these changes have the potential to impact on the administrative burden associated with complying with the requirements of the Directive.

It is not possible to accurately quantify the impact of these changes on the administrative burdens assessed in the IA. These differences limit the use of the IA as a point of comparison for administrative costs. That said, the comparison shows that overall, there are no identified increases of administrative costs for Member States based on the change from proposal to adopted legal text. There are some additional obligations for the European Commission and EEA affecting their administrative costs – however, these were not quantified in the IA. The nature of these changes with further explanation of the impact they have on costs are elaborated in the sections below.

Table A-22 presents a summary of the changes made to the proposal which could have the greatest effect on administrative burdens. Not all administrative burdens associated with the European Commission's proposal were assessed in the IA, and as such some of the changes in the following table relate to the difference between the European Commission's proposal for the NECD and the NECD as implemented, rather than comparing between the costs quantified in the IA (as shown in the table above) and those implied by the NECD as implemented.

It is not possible to accurately quantify the impact of these changes on the administrative burdens assessed in the IA. These differences limit the use of the IA as a point of comparison for administrative costs. That said, the comparison shows that overall, there are no identified increases of administrative costs for Member States based on the change from proposal to adopted legal text. There are some additional obligations for the European Commission and EEA affecting their administrative costs – however, these were not quantified in the IA. The nature of these changes with further explanation of the impact they have on costs are elaborated in the sections below.

Table A - 21 – Summary of the changes made between the EC proposal and adopted legal text and impacts on administrative burdens

Impact	Article	Reasoning
Increased cost for Member States	None	N/A

Impact	Article	Reasoning
Increased cost for European Commission	Reporting (Arts. 10, 11)	Additional steps for European Commission to check validity of submissions under Article 6; potential higher cost linked to adoption of European Commission decisions in cases where Member States and European Commission cannot reach agreements on technical corrections within NAPCPs; increased frequency of developing implementation report and increased content for reports.
	European Clean Air Forum (Art. 12)	New obligation to set up the Forum.
	Review (Art. 13)	Commitment to review Directive with specific provisions for ammonia pollution; and to assess impact of mercury and consider measures.
	Delegation (Article 16)	Additional report on delegation
Decreased cost for Member States	NAPCPs (Art. 6)	Reduced reporting frequency.
	Inventories and projections (Art. 8)	Reduced reporting frequency for spatially disaggregated and LPS inventories and simplifying the flexibilities regime.
	Ecosystems reporting (Art. 9)	Indicators changed to voluntary.
	Annex I monitoring and reporting for black carbon	Directive wording changed to "if available".
	Annex III part 2 – agricultural measures	Measures changed to voluntary. Part of these measures will include a cost.
	Annex IV – methodologies for inventories, projections and IIRs	Member States have more time to prepare projections and some wording changes provide slightly more flexibility.
Decreased cost for Member States and Commission	ERCs (Art. 4)	Removal of proposed ERC for methane results in one less pollutant in scope, affecting related reporting and reviews.

3.1.1.3 Costs of NAPCP development (Article 6)

Article 6 of the NECD requires Member State competent authorities to draw up, adopt and implement NAPCPs to limit their anthropogenic emissions in line with their respective ERCs. This measure is mandatory, and programmes must be updated every 4 years. All Member States are required to develop NAPCPs, hence (at least) 27 competent authorities[195] are required to report under this Article every 4 years. However, not all Member States met the deadline for submitting their NAPCP. In many cases, there were significant delays in delivering the NAPCPs[196].

[195] Targeted engagement of competent authorities revealed that in the case of Belgium, policies are the responsibility of three regions (Flemish region, Walloon region and Brussels capital region). The implementation of the NECD is done at the regional level. This means emissions inventories, projections and NAPCPs are prepared at the regional level and as a final step, compiled by an interregional institute before being reported to the Commission. Stakeholder insight revealed that this regionalisation results in additional administrative burdens.

[196] See Annex III section 2.2.1 for a detailed assessment on the timeliness of NAPCP submissions.

The administrative burden associated with developing NAPCPs is driven by the supporting actions undertaken, and the approaches taken by Member States to carry out these actions. Although targeted engagement of competent authorities revealed the exact process of compiling NAPCPs can differ between Member States, this typically consists of a set of common steps[197]:

- develop a baseline of emissions, which includes gathering data already available from other obligations (NECD emissions inventory and emissions projections, AAQD plans, National Energy and Climate Plans) to identify and review relevant existing measures with an emissions impact;
- estimate the emissions impact of existing measures, which is likely to require engagement with others internal to government;
- identify any areas of potential non-compliance and the need for new measures;
- undertake optioneering to identify, develop and estimate the impacts (although this is not always necessary) of potential new measures (some may undertake preliminary analysis of costs and benefits as a voluntary step);
- review/sign off across government;
- public consultation (which is a requirement of the NECD) and transboundary consultation (obligatory where appropriate);
- final sign-off and submission.

Key **steps which carry the most significant burden** are the estimation of emission impacts of existing measures, and the development of new measures where needed and estimation of their emission impacts. Insights from one Member State also noted that sometimes additional emissions projections are developed, depending on the timeframe for the adoption of the NAPCP. Through the targeted consultation of competent authorities, multiple respondents highlighted that burden is heavily dependent on the state of play per Member State in relation to their reductions commitments.

One activity involved in the development of NAPCPs is **transboundary consultation** during the NAPCP development process. A very large majority of Member States did not carry out a transboundary consultation. Only 2 Member States are known to have carried out at least one: Czechia and the Netherlands. The 2020 EEB review found that this work between Czechia and Poland '*demonstrated both what can be achieved through [existing community level] cooperative programmes [e.g. the UNECE EMEP programme] and the additional PaMs and benefits which are available [e.g. where existing PaMs can be enhanced to deliver additional benefits, or their benefits are realised across multiple countries]* '[198]. These consultations led on to extensive talks on joint modelling work, which goes beyond the mandatory requirements of the NECD (so, while potentially very useful to engage in such discussions, the related costs cannot be attributed (fully) to

[197] European Environmental Bureau. (2020) National Air Pollution Control Programmes: analysis and suggestions for the way forward, page 38.

[198] European Environmental Bureau. (2020) National Air Pollution Control Programmes: analysis and suggestions for the way forward, page 52.

implementing the NECD). However, overall, the same EEB review concluded that '*most Member States failed to undertake [transboundary consultation] in a meaningful way*'[199]. This suggests that willingness to facilitating these conversations is dependent on Member State ambition and resource levels.

Furthermore, the burden has also been influenced by the **process followed** to develop the NAPCP in each Member State. The precise process followed varies by Member State and is dependent on the governance structure of the country. For instance, insights around the legislative process of developing an updated NAPCP in one Member State were elaborated through an interview with the competent authority. The process, beyond the typical requirements, includes outreach to other ministries and administrations to analyse possible impacts of individual policies and develop a final list. Following this, the final list was then circulated for feedback, and this process took around 1 month. It is important to note that there are great differences in administrative structures of different Member States; roles and responsibilities are split differently. Therefore, burden can be affected by how accessible all required parties are to those developing the NAPCP.

Another variable relates to national **governance structure**. In particular, in Belgium, the national governance structure is split into three regions. The 2023 horizontal review report of the most recent NAPCP publication found that in the case of Belgium, whilst the NAPCP was submitted on time and all reporting requirements were satisfied, "*different sections of the NAPCP were written by different responsible competent authorities*"[200]. This suggests a higher administrative burden to produce Belgium's combined NAPCP, an assumption confirmed through targeted engagement with the competent authority.

Administrative burden will also depend on the extent to which **voluntary actions have been completed** in the process of developing an NAPCP, such as conducting an impact assessment or cost-benefit analysis of measures. In response to the targeted stakeholder consultation, one Member State provided a monetary figure (a contract value) for cost-benefit analysis work, estimating this at €200 000.

The Commission is required to examine the NAPCPs and their updates in the light of the requirements set out in Article 4(2) [ERC] and Article 6 [NAPCPs]. The Commission is also obligated to specify the format of the national air pollution control programmes.

Costs identified in the 2013 NECD IA

Administrative costs linked to the preparation of NAPCPs were assessed in the IA. The IA estimated an initial, **one-time cost of €6.3 m** and an annual ongoing cost of **€219 000 per annum** (total for the EU-27, recalculated to exclude the UK, 2025 prices). The IA suggested that the initial and ongoing costs would be greatest for Belgium, which may reflect the administrative effort based on the governance structure of the Member State.

[199] Ibid.
[200] Ricardo (2023), NAPCP Interim horizontal review report – final, page 18.

Member States with the smallest initial and ongoing costs related to NAPCP development were Bulgaria, Lithuania and Latvia.

The IA costs are reflective of the Commission's proposal for the NECD, but as noted above, some changes were enacted by the legislator. The key change relating to the NAPCP reporting obligations was that the frequency with which Member States needed to revise their NAPCPs was loosened from every 2 years (in the proposal) to every 4 years (in the adopted NECD). Considering that the frequency of reporting was halved, this could also be assumed to halve the yearly cost, resulting in an annual illustrative cost of **€110 000 per annum** (50% of cost reduction, 2025 prices).

The IA did not include an estimate of the administrative burden falling on the Commission.

Further evidence on costs related to administrative burden

Evidence regarding the administrative burden of preparing NAPCPs in **published sources** is very limited.

In its 2022 NAPCP, Lithuania[201] reported a financial obligation to 'To carry out applied research for air pollution inventory and reduction (control), and air quality assessment, projection and improvement'. This included a cost-benefit analysis of meeting WHO guideline levels, and assessing regulation, feasibility and needs. The financial obligation reported was of €0.5m over 10 years (from 2020 to 2029). As for the estimates, this is significantly greater than the costs estimated in the IA for Lithuania, which was estimated at €16 000 annually. However, this action incorporates many wider activities beyond those which may support the preparation of the NAPCP. No further estimations of costs of preparing an NAPCP have been identified throughout other NAPCPs submitted up to March 2025.

When considering data around administrative costs incurred in practice, it is important to also consider what was delivered and whether the NAPCP covered all obligations. The 2023 horizontal review report assessed all NAPCPs, and policies and measures (PaMs) submitted between October 2022 and the finalisation of the report. Broadly it concluded that "*the quality of reporting on the (PaMs) varied across the Member States and across the PaMs themselves*"[202]. It found that there were gaps in the reporting of PaMs across all sectors and Member States who had submitted updated PaMs, related to:

- planned uptake of voluntary, economic and fiscal PaMs;
- anticipated emission reductions at individual or group-level PaMs;
- uncertainty analysis;
- clarity in timescales for implementation;
- costs and benefits.

[201] Ibid.
[202] Ricardo (2024) NAPCP final horizontal review report – final.

Furthermore, some Member States (EE, DK, RO) either did not make use of the common reporting format or did so partially. Most Member State submissions did address the majority of the mandatory content required by the NECD; however, detail was assessed as insufficient in many cases[203].

The most recent horizonal report update (published December 2024) found that only one Member State submission had sufficient information to meet the mandatory reporting requirements of the NAPCP. Similarly to the situation reflected in the interim update in 2023, cost and benefit information was a consistent gap within the description of PaMs provided across all sectors. It is important to note that reporting on costs and benefits of PaMs is optional. In summary, "*Only two Member States (Cyprus, Romania) used both the NAPCP and EEA-PaM tool to report the cost data of additional PaMs. Three Member States (Spain, Lithuania and Slovenia) reported information on the absolute costs and sources of funding for additional PaMs in the NAPCP only. Romania was found to have the most comprehensive information reported on the costs and benefits of PaMs"*[204].

Online stakeholder consultations indicated the development of NAPCPs as in important source of costs, although less so than abatement costs. Most respondents to both consultations thought that this item represented a moderate cost (11 respondents both in the OPC and TSC), with some respondents indicating high costs (5 in OPC and 2 TSC) and some indicating low/ minimal cost (6 OPC, 3 TSC). Public authorities responding to the TSC were the ones driving the responses indicating high or moderate costs; whilst in the OPC, responses were more spread out, with several business associations (7) thinking that NAPCP development entailed a moderate cost for Member States.

Targeted engagement with competent authorities provided significant insight into the actual administrative burden experienced in developing NAPCPs. Data was gathered in the form of a survey, and checked and elaborated through follow up clarifications and interviews where required. 16 Member States responded, with 15 providing data on the actual administrative costs of developing an NAPCP. Data was provided in a variety of ways, including some time estimates, some contract values, and some monetary values. Some Member States provided this information as a total per reporting period, and some as an annual figure.

Using the data provided by competent authorities, the study team have undertaken additional analysis develop illustrative monetary estimates of the burden for different Member States where possible. The table below presents the results of the analysis and key steps and assumptions taken in the analysis to develop the estimates – it is important to note that this table presents the outputs of analysis undertaken by the study team and does not present values provided by the competent authorities themselves. Where time estimates are provided, these were then monetised using the relevant Member State annual wage rate

[203] Ibid: page 21.
[204] Ricardo. (2024) Review of National Air Pollution Control Programmes and Policies and Measures, page 65.

for public authorities[205]. Where days were given, the assumption was 230 working days in a year[206]. These rates were inflated to 2025 prices. In some cases (Belgium, Greece and Portugal), no Member State specific wage rate was available in Eurostat, in which case the EU27 average was used.

Table A - 22 – Estimated administrative burden of developing first and updated NAPCPs – results of support study analysis using data provided in response to targeted engagement of competent authorities (2025 prices)

Member State	Development of *first* NAPCP (€)	Development of updated NAPCP (€)	Key assumptions and data notes
Belgium (Flanders)	Not provided	651 000	Cost of updated NAPCP also covers costs of projections and development of Flemish Air Policy Plan (having broader scope than NAPCP) – it was not possible to differentiate. Cost based on 2 FTEs per year (for four years) plus € 300 000 of contract values (which were not only used for NECD-related activities). Only based on Flanders – not national level data.
Germany	239 000	239 000	Based on number of days of work indicated by competent authority (1 000 days for each initial and updated NAPCP), using wage rates defined on Eurostat for Germany.
Denmark	450 000	39 400	Raw data based on contract values, salaries and numbers of days worked. The stakeholder engagement interview clarified that this accounted for 'three months of someone's time'. Therefore, the updated NAPCP is based on an assumed resource of 120 days
Estonia	290 000	150 000	Raw data provided was a total monetary figure.
Greece	11 440	5 720	Raw data provided was total days of work (60 and 30 for initial and ongoing, respectively)
Spain	375 000	500 000	Raw data provided was a yearly monetary figure, so each have been increased (see bullet points below) to reflect total.
Finland	90 000	90 000	Raw data provided was a total monetary figure, for both initial and ongoing work.
France	152 000	152 000	1 FTE each for initial and ongoing as indicated by competent authority. Competent authority explicitly stated that each cost item (initial and ongoing) is 4 years of work for one FTE.
Croatia	28 900	30 904	Raw data provided was total days of work and contract values.
Luxembourg	Not provided	33 200	Number elaborated during interview, based on burden being worth 90% of one person's FTE and number of months of work (4). Estimate relates to compilation of the NAPCP text and does not include burden of data generation and elaboration of measures.

[205] Eurostat (2025), Mean annual earnings by sex, economic activity and collective pay agreement (retrieved in April 2025). It is possible that these numbers are highly conservative, as indicated by one Member State during consultation. However, it was not possible to apply specific rates to all Member States. Eurostat figures have been used to ensure consistency.

[206] This is an assumption and could vary in practice by Member State, but this will be within bounds of uncertainty around the analysis.

Member State	Development of *first* NAPCP (€)	Development of updated NAPCP (€)	Key assumptions and data notes
Netherlands	Not provided	10 400	Raw data provided was number of weeks (6-8). No other data given. Assumptions made based on daily wage rate and 1 FTE.
Portugal	263 000	52 600	Numbers estimated by the support study based on the information provided by competent authority during survey. Initial NAPCP estimate includes combined time taken to develop NAPCP and national air quality strategy: 'a lot of the NAPCP work was done for the 2016 national strategy for air which took a team of 5 about 2 years in total'. For ongoing, there were two team members working since 2020 on the update, but not all their time - assumed 20-40%.
Romania	372 000	224 000	Raw data provided was contract values and salaries
Sweden	164 000	164 000	Raw data provided was contract values and salaries.
Slovakia	47 200	35 400	Raw data provided was total years of work: 2 years and 1.5 years for initial and ongoing, respectively). Assumed for 1 FTE.
Member State average (total per reporting period, excl. outliers)	**€207 000 (range €11 400 – €290 000)**	**€137 000 (range €5 720– €500 000**	Average cost across Member States excludes Belgium, where costs only represent Flanders.

The table shows that costs for developing NAPCPs (and updating them) are variable amongst Member States. One key variable, elaborated throughout interviews with competent authorities, was compliance with ERCs: where projections indicate non-compliance with a pollutant, this can lead to a much greater administrative effort as Member States need to identify, develop, assess, cost, and consult on PaMs for inclusion in the NAPCP.

The numbers presented in the table above come with significant assumptions and caveats, namely:

- In some cases, it has been impossible to split costs with other obligations, such as for Belgium, where the cost estimate captures development of NAPCP and emissions projections. For this reason, this data has not been included in the analysis of average costs across Member States.
- Where annual figures were provided, this was multiplied by 2 to find a total for the first NAPCP development, and by 4 (unless Member States mentioned otherwise, such as France) for estimating costs of NAPCP updates. This was done to generate estimates of the 'total' cost of each NAPCP, rather than an average annual cost.

From these calculations, a comparison can be made to the estimated administrative burdens presented in the IA. The IA presented an initial cost, which is compared to the estimate for the number for the development of the first NAPCP. The IA also presented an ongoing

annual cost, which is compared here to the cost of updating NAPCPs (for this comparison, the study estimate is divided by four to account for the 4-year updating period, to present a total cost for updating the NAPCP). The IA provided Member State estimations, so for the purposes of comparison, only the estimations for Member States mentioned above (excluding Belgium) are used.

A comparison between the IA estimates and those made in this analysis is presented in the table below. From the comparison, it appears that the IA estimated broadly correctly the burden associated with developing and submitting the first NAPCP and underestimated the burden of updating NAPCPs.

Table A - 23 – Difference between IA and study estimates in terms of administrative burden for NAPCP development

Obligation	IA estimate (average, 2025 prices, per NAPCP)	Evaluation estimate (average, per NAPCP)	Difference between averages (%)
NAPCP (initial)	€270 000	€207 000	-23%
NAPCP (annual cost)	€11 364[207]	€34 000	+199%

NAPCPs also carry a burden for the European Commission. These costs **reflect NAPCP reviews, which have been estimated to cost over the 2016-2025 period €615 579, or around €61 579 per annum.** However, this may not be reflective of all costs, as this does not include staff time for the European Commission or EEA, which is not feasible to disaggregate.

Attribution of costs

The obligations of the NECD interact with those under other legislation and commitments, as noted in the introduction of this section. This challenges to what extent the administrative burden of meeting the obligations should be attributed to the NECD. With respect to NAPCPs, two key areas of interaction have been identified in the evidence gathering: interactions with the GP, and with national energy and climate plans (NECPs) submitted under Regulation (EU) 2018/1999.

The **Gothenburg Protocol** requirements do not mandate the development of NAPCPs. However, although the majority of responses to the targeted engagement of competent authorities did not identify an interaction, 3 Member States stated that the administrative burden associated with the first NAPCP development completely overlapped with the GP requirements and a further 2 Member States said this overlap was partial. Two Member States elaborated this interaction further, stating that whilst the exact process of developing and submitting an NAPCP is not mandatory under the GP, decisions have been adopted under the GP encouraging Parties to report on policies and strategies to improve

[207] The IA provided an estimation of €9 470 annually. This was based on an expected 5-year reporting period. Therefore, in order to make these estimations comparable with the current study, we have adjusted this estimate upwards by 1.2 (5/4) in order to account for the fact that NAPCPs are needed every 4 years.

understanding of how Parties are meeting their obligations[208]. This current reporting practice on strategies and policies replaces the previous practice (in force until 2010) in which strategies and policies were monitored using two questionnaires sent to the Parties every two and four years, respectively[209]. Therefore, whilst the obligations are not identical, there is overlap in terms of the specific works needed.

The latest report from the European Commission to the Council and Parliament on NECD implementation noted many links between **NAPCPs and the national energy and climate plans (NECPs)** submitted under Regulation (EU) 2018/1999. Guidance for developing each document refers to the other document, so it is likely that some of the costs are shared, for example when projections modelling informs both documents. As identified by one Member State, the NECP considers and adopts packages of sectoral policies and measures that are also relevant for NECD commitments, upon which the NAPCP can build, if further efforts are required to raise the level of ambition to achieve the ERC. This indicates shared burden, but also that there is also work that needs to be done for NAPCPs above that required for the development of NECPs. Furthermore, the specific detail of what Member States need to report for PaMs included in NAPCPs and the defined structure required for the NAPCP creates a NECD attributable burden. Through the targeted engagement of competent authorities, 5 Member States indicated there was some level of overlap with NECP development, with one stating that this overlap was significant. However, 6 Member States stated that there were no overlaps with NECP development. Where Member States elaborated, this was because NECP and NAPCPs are developed separately in these Member States.

The **targeted engagement with competent authorities** also identified interactions with other areas of legislation and reporting, albeit in fewer cases:

- 3 Member States stated there were partial overlaps with activities to compile GHG inventories;
- One highlighted that there were partial overlaps with other national statistical requirements;
- 2 Member States stated there were overlaps with the AAQD;
- One highlighted some overlap in burden with the Common Agricultural Policy.

It was not clear from the stakeholder engagement activities whether these interactions were positive (i.e. synergies were captured, reducing overall burdens) or negative (e.g. where synergies were not captured, and efforts duplicated). In the case of NAPCP development, limited data was received in terms of this clarification. Stakeholders responding to the TSC raised the need to better synchronise with other reporting obligations in terms of timing. The most cited reporting item was NECPs, and there was one mention of Transport Master

[208] See, for example, EB Decision 2013/2 'Reporting on strategies, policies and other measures to implement obligations under the Convention and its Protocols', as amended by decision 2016/3 'Improving the effectiveness of reporting on strategies, policies and other measures to implement obligations under the Convention and its Protocols'.

[209] See https://unece.org/info/Environmental-Policy/Air-Pollution/events/20227: documents ECE/EB.AIR/2009/12 and ECE/EB.AIR/2009/13.

Plans in this regard. Regarding the GP, a public authority highlighted that the alignment between the two has been important to reduce duplication of effort (this remark referred to both instruments in general, and not the NAPCPs specifically).

Within the OPC, stakeholders identified some opportunities to strengthen the link between NAPCP development and the implementation of efficient, targeted measures, including through better alignment with national capacities. In terms of the cost and complexity of preparing NAPCPs, stakeholders in the OPC also raised that there is a concern regarding a duplication of reporting requirements across various legislation, such as the Industrial Emissions Portal, the Corporate Sustainability Reporting Directive (CSRD), and the Industrial Emissions Directive.

Overall, it appears that activities to develop the NAPCPs interact to some extent with activities and processes to meet obligations under other legislation and commitments, particularly with the requirements with NECP development and (to a lesser extent) requirements under the GP. However, whilst there is some interaction in some cases, this is certainly not the case across all Member States. Furthermore, although some activities may interact, there are other activities which must be undertaken which are specific to developing NAPCPs.

3.1.1.4 Ecosystems monitoring and reporting (Article 9)

Article 9 of the NECD requires Member State competent authorities to monitor the negative impacts of air pollution on ecosystems. To do this, Member States shall coordinate efforts with other monitoring programmes established under other relevant legislation[210]. Member States shall report, every four years as of 1 July 2018, the locations, associated indicators and, every four years as of 1 July 2019, the data referred to in Article 9.

Article 9 states that monitoring must take a cost-effective and risk-based approach. To this end, the Directive requires that Member States shall, where appropriate, use monitoring networks already established under other legislation. Optional monitoring indicators are listed in Annex V of the Directive. This allows Member States flexibility when meeting this obligation.

However, reviews of ecosystems data reported have identified that the lack of consistency in reporting approaches used by Member States has created issues in comparability across Member States and biogeographical regions. A 2023 analysis report for Article 9 ecosystem monitoring argues that *the nature of the reporting obligation under Article 9 of the NECD – that reporting is mandatory but what is reported is non-mandatory – means that inconsist*encies and *issues […] are, to an extent, inevitable*[211]. This suggests that the

[210] Including Directive 2008/50/EC, Directive 2000/60/EC of the European Parliament and the Council and Council Directive 92/43/EEC and, if appropriate, the LRTAP Convention and, where appropriate, make use of data collected under these programmes.

[211] Williamson, T. *et al.* (2023). Ecosystem data reported by Member States under Directive 2016/2284. Report no. J11/13789A/11-D03, page 27.

reporting burden may differ between Member States, since Member States adopt different approaches to report data.

A further factor which may impact on the burden associated with this obligation is that Member States with a large surface area and/or greater variability in ecosystem types may require more monitoring than some smaller countries, suggesting a difference in administrative burden relative to the size and/or type of landscape between Member States.

Costs identified in the 2013 NECD IA

The IA assessed potential administrative costs of ecosystem reporting over 955 sites at the EU level (excluding the UK)[212]. Based on this, it estimated a total **initial cost of €1 930 000** and an **annual cost of €2 930 000** (both excluding the UK, 2025 prices). The IA found that this obligation may create the greatest administrative burdens for Italy and France. The Member States where this was estimated as the least burden was for Malta and Latvia.

This implies a cost per monitoring site of around €2 000 for initial installation, and €3 100 for ongoing monitoring and reporting (adjusted to 2025 prices).

The cost identified in the IA is likely to be an overestimation based on what was eventually adopted. Changes in the co-legislative process to the legal text made all indicators optional, and the 'cost-effective and risk-based approach' was added. As a consequence, the administrative burden is expected to be lower in practice relative to the IA, although it is not possible to split the remaining mandatory reporting costs from the optional monitoring elements.

Further evidence on costs related to administrative burden

The administrative burden will be driven in part by the overall number of monitoring sites and data to be reported, which in turn will reflect the size and variability of ecosystems to be covered in a representative network, and the indicators chosen by the Member State. In practice, as shown in the table below, the total number of sites for which monitoring data was reported in 2018 were over four times the figure estimated in the IA. Furthermore, the total number of sites as of 2022 reflected a further increase of 14% at the EU level from 2018, although numbers decreased for a handful of Member States (Belgium, Cyprus, Germany, Hungary, Lithuania, Slovakia and Sweden). As of 2022, Germany and Sweden have most reporting sites (Germany having 2003 alone), which together account for around 65% of total EU reported sites in 2022[213].

Table A - 24 – Number of sites per Member State in 2018 ecosystem monitoring reporting round compared to the 2022 reporting round

Member State	# of sites in 2018	# of sites in 2022	Member State	# of sites in 2018	# of sites in 2022
Austria	18	66	**Italy**	15	275

[212] Based on the number of ecosystems types defined under the Natura 2000 framework, categories 3, 6 and 9 have been used as a proxy of the number representative ecosystems types by Member State.

[213] Williamson, T. *et al.* (2023) Member State ecosystem impact data (sites and parameters): Full analysis. Report no. J11/13789A/11-D02, Annex A3

Member State	# of sites in 2018	# of sites in 2022	Member State	# of sites in 2018	# of sites in 2022
Belgium	56	54	**Latvia**	9	10
Bulgaria	27	27	**Lithuania**	17	13
Croatia	19	38	**Luxembourg**	7	7
Cyprus	128	24	**Malta**	3	3
Czechia	24	27	**Netherlands**	297	315
Denmark	54	54	**Poland**	11	11
Estonia	3	5	**Portugal**	6	58
Finland	34	37	**Romania**	27	37
France	21	273	**Slovakia**	43	39
Germany	2 052	2 003	**Slovenia**	15	19
Greece	4	4	**Spain**	14	55
Hungary	120	113	**Sweden**	1 060	1 057
Ireland	43	113	**Total sites**	4 127	4 737

A 2024 review report[214] found that some Member States do not report data for all ecosystem types, relative to the range of types expected to be covered based on their context. This has improved since 2018 and is now closer to the distribution of ecosystem types across the EU. Guidance issued in 2019 by the Commission[215] listed 112 core (non-mandatory) indicators. The coverage of these indicators varies greatly between different sites and Member States. In addition, not all Member States report on all sites (as is the case in France) and reporting within Member States may also vary, with some areas reporting more or less than others.

The French competent authority has shared estimates of the administrative effort associated with this obligation, highlighting that the task has been expensive and is increasingly so[216]. The governance structure of fulfilling the requirements of Article 9 in France includes 4 data providers, 1 data coordinator and 1 validation body. body. An annual budget of €500,000 is allocated for one provider. For another data provider, €419,000 were allocated for the last biannual round (2020-2021). Compared to the annual costs identified for France in the IA, the above figures indicate that the IA annual costs were a significant underestimation (these were €269 000 in total per annum, 2025 prices). The presentation also noted planned work items related to increasing the scope of the national ecosystems monitoring work going forward. This includes increasing the number of ecosystem types covered by both biogeographical characteristic and MAES (mapping and assessment of ecosystems and their services) type, improving spatial coverage and increasing the variety of data reported where appropriate for amphibians, insects, mammals and birds. In the same presentation, there was a perceived unnecessary duplication of work at the Member State level as well as an unclear link between the data requested and the overall stated goal of the Directive (this is discussed further in Annex III section 3.5).

214 Williamson, T *et al.* (2024). NECD Art 9 Ecosystem Monitoring summary

215 European Commission. (2019) Commission Notice on ecosystem monitoring under Article 9 and Annex V of Directive (EU) 2016/2284 of the European Parliament and of the Council on the reduction of national emissions of certain atmospheric pollutants (NEC-Directive). Further European Commission guidance published includes guidance on site selection and a reporting template.

216 Unpublished presentation – Ministère de la transition écologique et de la cohesion des territoires (2024) "NEC/Ecosystems reporting: The French Experience.

In its 2022 NAPCP, Lithuania reported a financial obligation 'To develop monitoring of the impact of ambient air pollution on ecosystems under the International Cooperative Programmes (ICP) of the 1979 Convention on Long-range Transboundary Air Pollution, implement such monitoring, assess and publish monitoring results, and raise public awareness' of €1.5 million over 10 years (from 2020 to 2029). As for the estimates for France, this is significantly greater than the costs estimated in the IA for Lithuania (both upfront and ongoing - €10 700 and €16 000 respectively). No further estimations of costs of ecosystem monitoring have been identified throughout other NAPCPs submitted up to March 2025.

Most respondents to the **online stakeholder consultations** thought that costs related to ecosystem monitoring and reporting were moderate (11 OPC, 10 TSC), with some OPC respondents indicating that these costs were high (6). Some stakeholder thought that these costs were low/minimal (7 OPC, 6 TSC). Other respondents either indicated that it was "not applicable", or that they did not know or provided no response (29 OPC, 26 TSC). Public authorities responding to the TSC were the ones driving the responses indicating moderate costs (8 replies); whilst in the OPC, responses were more spread out, with several business associations (6) thinking that ecosystem monitoring and reporting entailed a moderate cost for Member States.

Targeted engagement with competent authorities provided further insight into the actual administrative burden experienced with the requirements under Article 9. 12 Member States provided some data or information regarding burdens, out of the 16 total who provided responses. Data provided included some time estimates, and some monetary figures. Some Member States provided these values either as totals per reporting period, or costs per annum. Some Member States also did not provide data for both the initial and ongoing assessments.

Using the data provided by competent authorities, the support study has undertaken additional analysis develop illustrative monetary estimates of the burden for different Member States where possible. The table below presents the results of the analysis and key steps and assumptions taken in the analysis to develop the estimates - – it is important to note that this table presents the outputs of analysis undertaken by the study team, and does not present values provided by the competent authorities themselves.

Table A - 25 – Estimated administrative costs of monitoring and reporting ecosystems impacts under Article 9 – results of the support study analysis based on data provided by competent authorities (total €, 2025 prices)

Member State	Monito-ring and reporting of ecosystem impacts – per first reporting (€)	Monitoring and reporting of ecosystem impacts – per ongoing reporting (€)	Calculated costs per site based on ongoing reporting (€)	Key assumptions and data notes
Belgium (Flan-ders)	Not provided	Not provided	-	— No data provided

Member State	Monito-ring and reporting of ecosystem impacts – per first reporting (€)	Monitoring and reporting of ecosystem impacts – per ongoing reporting (€)	Calculated costs per site based on ongoing reporting (€)	Key assumptions and data notes
Germany	180 000	120 000	€60	— Raw data provided included number of days of work (750 and 500, for upfront and then every 4 years, respectively) and contract value of €42 000 within the ongoing reporting section on database software.
Denmark	Not provided	75 000	€1 390	— Data provided listed €50 000 worth of monitoring costs and 'some tens of thousands of euros' collating data. In total, assumed €75 000 here.
Estonia	Not provided	7 430	€1 450	— Data was "at least one person spends quite a few days". Calculation assumes one person spending 60 days (based on expertise of the support study team)
Spain	438 000	488 000	€8 870	— Monetary figures given (total value).
Finland	323 000	420 000	€11,400	— Monetary figures given (total value).
France	1 020 000	6 720 000	€24 600	— Cost estimations made based on budgets provided to monitoring programmes RENEFECOR and BRAMM. Data shared with EC and study team.
Luxem-bourg	222 000	443 000	€63 300	— Data given in interview. 1 person on an FTE basis (i.e., 2 years for the first reporting and 4 for the ongoing cycle).
Nether-lands	360 000	720 000	€2 290	— Data provided is annual, and raw data was a monetary estimate that was defined as NECD attributable burden only.
Portugal	148 000	160 000	€2 760	— Data provided included contract values. Further person-time costs were elaborated by the support study, based on survey feedback from the competent authority. Set up costs required 2 FTEs (one for terrestrial and one for aquatic, over the course of 2 years. — No estimation of person time was provided for ongoing work (cost based on external services only).
Romania	Not provided	3 400 000	€91 900	— Raw data provided gave a total monetary figure for ongoing reporting (2024-2028). No estimation provided for first / set-up reporting.
Sweden	17 000	77 300	€73	— Raw data provided included number of days of work (75 and 10, for initial set up and ongoing, respectively), plus €75,000 in contract values for ongoing work. Assume that this data is totals. — Number does not include monitoring itself, only data gathering and reporting. The monitoring itself is conducted for reasons other than the NECD, including compliance with AAQ Directive and national forest monitoring.

Member State	Monito-ring and reporting of ecosystem impacts – per first reporting (€)	Monitoring and reporting of ecosystem impacts – per ongoing reporting (€)	Calculated costs per site based on ongoing reporting (€)	Key assumptions and data notes
Slovakia	350 000	760 000	€19 500	— Provided both number of days worked, and total costs for each period (total values). Total values therefore used here.
Member State average (Excl. outliers)	**€337 000 (range €17 000 to €1 020 000)**	**€1 152 000 (range €7 430 to €6 720 000)**	**€19 000 (range €60 - €91 900)**	— Average cost does not include any quantification for Belgium or Netherlands, given the latter is scaled up from annual estimates. — Average costs assess whole reporting cycles (2 years for the initial reporting and 4 years for an ongoing cycle).

The table shows that costs for monitoring and reporting under Article 9 are variable amongst Member States. Generally, it was easier for Member States to report ongoing costs than set-up costs, but this also varied.

The numbers presented in the table above come significant assumptions and caveats, namely:

- The wage rate used was based on disaggregated rates per Member State according to Eurostat (inflated to 2025 prices)[217]. In some cases (Belgium, Greece and Portugal), no Member State specific wage rate is available. Therefore, the EU27 average was used in these cases, where data was received in terms of person days or FTEs.
- In some cases, it has been impossible to split costs with other obligations, which may skew the overall figure. For instance, where costs have been provided, attribution solely to the NECD is not possible (see attribution discussion below).
- In many cases, Member States were unable to separate the costs of monitoring and reporting, so this attribution is largely unknown, meaning some figures may be particularly large. This is certainly the case for Romania and France.

The calculated average administrative cost for set-up of the ecosystems monitoring and submission of the initial reporting is €337 000 per Member State, and the ongoing work has been reported on average as €1 152 000 per Member State per reporting period. Assuming an ongoing reporting cycle of 4 years, average ongoing work per annum is estimated at €288 000. It is not possible to produce an estimate of total burden for EU27 with any robustness given data was not collected for all Member States and given the observed variance between Member States in the data that was provided.

From these calculations, it is possible to compare to the original estimates made in the IA, as presented in the table below. The IA presented an initial cost, which is compared to the

[217] https://ec.europa.eu/eurostat/databrowser/bookmark/c79f8989-a62d-4cb4-af76-7f9a92dd09af?lang=en

estimate for the number for the development of the first ecosystems report. The IA also presented an ongoing annual cost, compared to the ongoing cost of ecosystems reporting (for this comparison the IA estimate is multiplied fourfold to account for the 4-year updating period, to present a total cost for providing updated ecosystems reporting). Comparing between the IA estimates and the data gathered by this study, it appears that the IA may have significantly underestimated the burden associated with ecosystems reporting (see table below), and more so in regard to the initial reporting.

The lower IA cost is likely driven by the lower number of monitoring sites anticipated in the IA (955) relative to those in practice (4 737 recorded).

This contrasts to the cost per site being higher in the IA relative to the data collected from stakeholders. This may be for a number of reasons, for example Member States may have found efficiencies in developing a much larger network, and/or in response to the stakeholder consultation respondents may have simply noted reporting costs in some cases, and in others the cost of monitoring and reporting.

It is notable that the cost varies significantly between Member States, and only sometimes explained by the number of sites. For instance, France's ongoing cost is very large, however the actual cost per site is closer to average. In contrast, Romania reported an expenditure of 3.4 million for the whole ongoing reporting process (costs between 2020 and 2024), based only on 37 sites (as of 2022).

Table A - 26 – Difference between IA and study estimates in terms of administrative burden for ecosystems monitoring and reporting (annual averages per Member State).

Obligation	IA estimate (2025 prices)	Study estimate (average)	Difference (%)
Ecosystems (initial)	€88 200	€337 000	+282%
Ecosystems (ongoing/ per annum)	€134 000	€288 000	+115%
Ecosystems (ongoing/ per annum/ per site).	€3 068	€850	-72%

In terms of burden on the European Commission and EEA for Article 9, costs are expected to relate primarily to Article 9 reporting, for which the EEA could provide yearly monetary estimations. Total costs relevant to Article 9 spent since the implementation of the NECD (2016-2025) equal €364 00, which include on average around €29 000 across 2024 and 2025 to cover a contract on soil monitoring.

The European Commission initiated a project on capacity building on ecosystem monitoring and contracts for the review of ecosystem monitoring reporting by Member States. The total cost of these activities for the period 2016-2025 was €639 520. This does not include staff time dedicated to this strand of work, which is not possible to split from the total. Cost estimates for the EEA and the Commission were not made for the purposes of the 2013 impact assessment, so no comparison is possible.

Attribution of costs

The obligations of the NECD interact with those under other legislation and commitments, as noted in the introduction of this section. This challenges to what extent the administrative burden of meeting the obligations should be attributed to the NECD.

With respect to ecosystems reporting, this obligation is designed specifically to rely on **pre-existing monitoring networks** at the disposal of Member States and developed through other legislation. Hence there is likely to be a strong interaction between the monitoring activities which contribute to meeting the obligations of the NECD and other legislation. The reporting burden is more clearly additional due to a NECD designed reporting template, albeit it is not obligatory to use this. However, estimates of administrative burden in this study are not split between monitoring networks and reporting, and the latter is most likely minimal. This is not to say that this is the case in all instances. In France, direct clarification on the figure provided was sought, and the competent authority confirmed that the NECD is the only piece of EU legislation for which the costs of RENECOFOR and BRAMM are directly related (albeit they contribute to reporting under the Air Convention), suggesting that monitoring may not have used existing networks.

Comparing specific actions undertaken for fulfilment of Article 9 NECD obligations against actions under other legislation for the purpose of mapping administrative burden attribution is impossible because every Member State fulfils this requirement differently. Measuring protocols could be based on other legislation (i.e. Directive 2000/60/EC, Habitats Directive) but could also be based on national legislation. It can also be a mixture of both.

Through the targeted engagement of competent authorities, 6 Member States stated that there were interactions with other legislation. Key interactions identified were with the Water Framework Directive (WFD), the Habitats Directive, and other national legislation. One Member State summarised that from the perspective of monitoring the effects of air pollution on ecosystems, it is not possible to state that NECD activities support compliance with other legal frameworks, instead other frameworks are utilised to support the implementation of Article 9 of the NECD.

Furthermore, the targeted engagement of competent authorities also revealed that:

- 7 Member States stated there were at least partial overlaps with the GP requirements, with one signalling this overlap is ‘significant’ and for 3 others the overlap was complete.
- Two Member States specifically stated that there are at least partial overlaps with national programmes.

However, data received for the purposes of this study did highlight instances where there have been new, NECD attributable burden. In some cases, new requirements have been set up for the sites. One Member State explained that for existing sites, new parameters have

been added to be recorded. Another Member State explained that new metrics (the POD metric) have led to additional calculation and reporting work.

Some Member States reported additional work which had not been streamlined; albeit the effort was optional.

In terms of overlaps with other legislation, in the case of ecosystems monitoring and reporting, these overlaps were typically judged as positive, where data was able to be used from existing networks. However, some industry associations and public authorities stated within the TSC that there are challenges to capturing fully potential synergies with actions required by other legislation. Reasons for this, provided within the TSC include:

- Some indicators from other monitoring programmes (CLRTAP) are not fully compatible, as they are measured at different temporal resolutions;
- Given the 'vague' definition of the requirements for monitoring the effects of air pollution on ecosystems, it is not entirely clear which ICPs procedures are to be implemented and to what extent, and
- Some stakeholders hold perceptions that other Directives (such as the Water Framework Directive) and programmes are not relevant for ecosystem monitoring under the NECD, since they serve different purposes.

Overall, based on the data provided, there is a strong overlap between NECD monitoring and existing monitoring (but not for all Member States), as well as interaction with some national programmes and the GP. Whilst some burden is shared, there will be some level of additional burden, and it may not be quite as low as was anticipated in the IA. Information is not available on which components are additional per Member State, and therefore, quantification of this additional burden is not possible.

3.1.1.5 Emissions inventories and projections

Article 8 of the NECD requires Member State competent authorities to prepare and annually update national emission inventories and informative inventory reports, for pollutants set out in Annex I Table B and national emission projections for the pollutants in Annex I Table C. It also requires Member States to prepare and update spatially disaggregated national emission inventories and large point source inventories every 4 years.

Inventories and projections are compiled following the EMEP/EEA Guidebook, a consistent guide used to compile inventories under the NECD and GP. Inventories and projections are typically compiled by the competent authorities; thus, the costs of compilation are likely to be absorbed into the running costs of the national agencies. Some Member States procure varying levels of support from external consultancies.

The European Commission reviews Member State emissions inventories (and projections[218]). Review reports on national inventories reveal that since 2018, all Member

[218] Article 10(3) does not explicitly mention an obligation of the Commission to review projections. But the rules have been interpreted to this effect.

States had submitted updated inventories every year. The only exception has been in the 2023 report which did not include Croatia's submission, as it arrived after the legal deadline.

The 2024 review report on Member State inventories and informative inventory reports (IIRs) found that the quality of submissions varied greatly[219]. In total, 1 049 observations were made (EU-27 level) which resulted in 544 *findings* (the difference between the two numbers being observations that were resolved during the review without needing follow-up action). Most findings resulted in *a recommendation*, others led to *revised estimates* provided by Member States, *to technical corrections* calculated by the review team, or to *unquantified potential corrections*[220]. These observations suggest that submissions vary based on quality and detail provided, which may be an indicator of the level of effort undertaken to compile each (e.g. how sophisticated the methods chosen to estimate emissions were, whether data is collected only for the purpose of emission inventories or existing data are used), and thus of related costs.

The European Commission is empowered to adopt delegated acts adapting Annex I and IV to developments within the framework of the Air Convention. During the evaluation period, one delegated act was adopted, with the purpose to align the approach in the Directive with the revised reporting guidelines regarding emission projections adopted by the Executive Body of the UNECE Convention on Long-Range Transboundary Air Pollution in December 2022.

Costs identified in the 2013 NECD IA

The IA did not quantify administrative burden associated with compiling inventories nor projections. These were not defined as a separate, additional cost of Directive (EU) 2016/2284 due to Member State commitments under the GP.

There are differences between the inventory and projection compilation for the GP and the NECD, in particular relating to flexibilities and their usage in the NECD, finalised during the co-legislative process. Such differences in the potential usage of flexibilities under the NECD are minor.

Further evidence on costs related to administrative burden

Data regarding the costs of inventory and projections compilation in **published sources** is very limited.

There is some indicative information available in Lithuania's 2022 NAPCP annexes[221]. Costs were provided for various PaMs, including '*improving the quality, reliability and completeness of the inventory and projections of emissions to ambient air and increase the*

[219] Aether and UBA. (2024) Final Horizontal Review Report. Service Contract No. 09.0202/2023/903481/SER/ENV.C.3. The quality of inventories and projections is analysed in detail in Annex III section 2.2.
[220] Ibid.
[221] Šaulytė Skairienė, D. (2022) LT NAPCP 2022 Annexes.

publicity of inventory reports'. In total, measures related to this were estimated to cost €2 090 000 between 2020 and 2029 (2025 prices). Of this total, €1 540 000 was attributed to the Environmental Protection Agency and the Ministry of Environment of the Republic of Lithuania related to the '*strengthening of administrative capacities, and development of the Lithuanian pollutant emission inventory by applying the highest possible level of detail'*. The final €550 000 estimated in this category related to the '*development of applied research for air pollution inventory and reduction (control), and air quality assessment, projection and improvement'*.

Romania provided annual cost estimations for certain measures related *to improving the reporting and recording* of certain pollutant emissions[222]. These are shown in the following table.

Table A - 27 – Cost estimates for inventory improvements in Romania

Pollutant	Sector	Annual cost (2025 prices)
$PM_{2.5}$	NFR Category 2.A.1 Cement production	€34 800
$PM_{2.5}$	NFR Category 2.A.2 Lime production	€35 000
NMVOC	Category 2.D.3.a Domestic solvent use including fungicides	€54 200

In its NAPCP, Hungary estimated the cost of 'Development of an emissions inventory + monitoring', focusing on developing country-specific emissions factors for agriculture and improving the system of data collection at holding level. The estimated cost was €1.9 million (it is uncertain whether this is a total or annual cost, and if the former over what period this would be spent), noting that further assessment of costs is underway.

No further estimations of costs of preparing an NAPCP have been identified throughout other NAPCPs submitted up to March 2025.

Although no longer part of the EU, data is available regarding the costs of compiling inventories and projections in the UK. This work is still required under the UK transposition of the Directive despite Brexit and hence can act as a comparative estimate of the costs for EU27. The contracted cost for Compilation and Reporting of the National Atmospheric Emissions Inventory is £32million over a period of ten years[223]. The major caveats with this figure are that the UK's contract also includes compilation of the greenhouse gas emissions inventory, with the air quality pollutant emission estimates being under half of this contract value. Furthermore, the contract also includes the generation of outputs which are not used for the NECD. Assuming an illustration 60/40 split between climate and air related activities, this could present an approximate cost of around £1.3 million per annum to develop the air emissions inventory.

[222] Ministry of the Environment, Water Management and Forestry (2023) National Air Pollution Control Programme, page 152.

[223] Based on publicly accessible contract value for tender of the delivery of the National Atmospheric Emissions Inventory (NAEI).

Most respondents to the **online stakeholder consultations** thought that costs related to inventories and projections were moderate (15 respondents in both OPC and TSC), with some OPC (3) and one TSC respondent indicating that these costs were high. Five respondents to the OPC thought that these costs were low/minimal. Other respondents either indicated that it was "not applicable", or that they did not know or provided no response (30 OPC, 26 TSC). Public authorities responding to the TSC were the ones driving the responses indicating moderate costs (12 replies); whilst in the OPC, responses were more spread out, with several business associations (7) thinking that inventories and projections reporting entailed a moderate cost for Member States.

Targeted engagement with competent authorities provided further insight into the actual administrative burden in relation to the development and submission of emissions inventories and projections under the NECD. Data was shared by competent authorities in a range of formats, including costs per annum. In some cases, as displayed in the table below, these costs were provided together without possibility for splitting between inventory-related burden and projections-related burden.

Using the data provided by competent authorities, the study team have undertaken additional analysis to develop illustrative monetary estimates of the burden for different Member States where possible. The table below presents the results of the analysis and key steps and assumptions taken to develop the estimates – it is important to note that this table presents the outputs of analysis undertaken by the study team and does not present values provided by the competent authorities themselves.

Table A - 28 – Estimated administrative costs of developing and submission of emissions inventories and projections – results of support study analysis based on data provided by competent authorities

Member State	Development and submission of emissions inventories (€ per annum)	Development and submission of emissions projections (€ pa)	Key assumptions and data notes
Belgium (Flanders)	439 000	439 000	— Cost for projections also includes NAPCP development. — Team of ten working on emissions inventories (air and climate) — Data covers GHG work – not possible to separate. — Only based on Flanders – not national picture.
Germany	383 000	950 000	— Raw data provided included number of days (1 600 and 1 500 for inventories and projections, respectively) per year and contract values worth c. €1.9 million every two years for projections.
Denmark	500 000		— Data covers both inventory and projections – not possible to separate precisely. — Raw data provided was an overall budget for inventories and projections, for GHG and air of €1.6 million per year. Indication that 'approximately one third 'of the

Member State	Development and submission of emissions inventories (€ per annum)	Development and submission of emissions projections (€ pa)	Key assumptions and data notes
			total budget of €1.6 million per annum was for air quality.
Estonia	62 000	285 000	— Raw data provided included number of people involved (~10) — Raw data also included number of days worked to develop inventories (500 days).
Greece*	5 720	5 720	— Raw data provided was a monetary estimate of just NECD attributable burden.
Spain	1 090 000	195 000	— Raw data provided is a monetary estimate. Covers both GHG and air emissions.
Finland	270 000		— Raw data provided was number of days of work as an annual average (770). — Competent authority also included a monetary estimation of €270 000 for the whole process. — Data covers both inventory and projections – not possible to separate
France	1 500 000	40 000	— Raw data provided included 1 FTE for inventory/ projections development and reporting. — Projections estimate is low as this only includes cost of external support contract and does not capture time resource. This exercise involves numerous government departments as well as external service providers to define key assumptions, such as energy consumption, agricultural data, or road traffic. Furthermore, this exercise requires greenhouse gas projections not quantified here — The inventory costs include GHG inventory costs.
Croatia	116 000	41 700	— Raw data provided included days worked per year and number of people
Luxembourg	1 550 000		— Data covers both inventory and projections – not possible to separate
Netherlands	2 912 000	168 000	— Raw data provided were monetary estimates
Portugal	307 000	Not provided	— Inventory costs based on 7 FTEs per annum. Estimates elaborated by the support study based on information shared by competent authority in response to survey.
Romania	143 000	105 000	— Raw data provided included monetary estimation based on team salaries and days of work, as well as contract values.

Member State	Development and submission of emissions inventories (€ per annum)	Development and submission of emissions projections (€ pa)	Key assumptions and data notes
Sweden	2 080 000		— Raw data stated €2 million for air and climate inventory projections, gridded data, LPS and review processes. This included 1.5 FTE related to air administration. — Whilst some of the inventory work could be assigned to only one of the multiple processes it is used for (mentioned above), most of the work captured in by the cost would relate to both air and climate.
Slovakia	40 900	16 000	— Raw data provided included number of hours worked per obligation (2 603 and 2 005 hours for inventories and projections, respectively) and contract values for each (5 350 and 2 250 also respectively).
Average MS cost combined (per annum) (excl. outliers)	**€749 000 (Range €56 900 to €3 080 000)**		— Belgium excluded as costs are for Flanders only. — Greece excluded as an outlier, as seems particularly low. — Spain, France, Luxembourg, Portugal and Sweden also excluded as data provided could not be split between air and climate costs.
Average cost combined (per annum) (assuming 50/50 GHG split)	**€728 000 (Range €56 900 to €3 080 000)**		— Belgium excluded as costs are for Flanders only and include costs beyond inventories and projections. — Greece excluded as an outlier, as seems particularly low.

Further information on wage rates is the same as for the analysis under the NAPCP development and ecosystems obligations. The wage rate used was based on disaggregated rates per Member State according to Eurostat (inflated to 2025 prices)[224]. In some cases (Belgium, Greece and Portugal), no Member State specific wage rate is available. Therefore, the EU27 average was used in these cases, where data was received in terms of person days or FTEs.

As displayed in the table above, data across Member States differs widely in terms of how information was provided, how it was split, and whether respondents were able to estimate a split between air and climate-related work. In the case of Greece specifically, data provided did not include all air-related work, so it is excluded as an outlier. Since some Member States could not estimate a split in the number between inventories and projections, averages are established based on combined totals for inventories and projections for each Member State, and an average estimated across those.

[224] https://ec.europa.eu/eurostat/databrowser/bookmark/c79f8989-a62d-4cb4-af76-7f9a92dd09af?lang=en

This reveals that the representative **average cost for Member States (excluding outliers) for the development of inventories and projections is €749 000 per annum**. That said, the amount of effort varies significantly by Member State, with the estimated range of €56 900 to €3 080 000. Furthermore, there is no pattern to observe generally in terms of which obligation (i.e. inventories or projections) is typically considered to be more of an administrative burden.

In many cases it is not possible to precisely unpick the time spent on air emissions inventories projections from that spent on GHG emission inventories (5 Member States explicitly noted that burden figures covered both air and GHG inventory development). These cases are excluded from the above estimate. However, assuming an illustrative 50/50 split between GHG and air inventories, including these 5 Member States the annual average cost per Member State for development of inventories and projections would be €728 000 per annum.

In terms of burden on the European Commission, these costs reflect EU27 inventory and projections development, review reports on Member State submissions, and support to and capacity building for Member States. In terms of contract values, it is clear that inventory reviews are the major cost item, amounting to €4.7 million for the period between 2016-2025. Projection review costs amounted to €750 000 for the same period. The Commission also invested in capacity building for both inventories and projections, amounting to €846 000. Staff cost is not included in these numbers, as they cannot be split per activity.

Attribution of costs

The obligations of the NECD interact with those under other legislation and commitments, as noted in the introduction of this section. This challenges to what extent the administrative burden of meeting the obligations should be attributed to the NECD. With respect to emissions inventories and projections, two key areas of interaction are with: (1) similar requirements under the GP, and (2) the development of GHG emission inventories.

Member States must report emission inventories and projections under the **Gothenburg Protocol** and as mentioned above, requirements of the NECD and those in the GP are aligned to the greatest extent possible. This is because, in the case of inventories and projections, more so than other obligations, one activity fulfils both objectives (with very limited differences in scope, with the exception of more frequent projection reporting under NECD), and therefore, 'overlaps' are more commonly referred to as efficiency gains, rather than burdensome double reporting. A key difference between the two instruments (GP and NECD) relevant to administrative burden is the fact that projections are submitted every two years under NECD and every four years under the GP. Hence, there are additional costs to complying with the NECD obligations in the reporting year that does not align with reporting under the GP.

The NECD's inclusion of ERCs for 2030 can also give rise to the need for additional reporting compared to the GP. Member States reporting projections that forecast non-compliance with the NECD's ERCs are required to develop a projections scenario that

includes the impacts of additional policies and measures, to demonstrate their planned actions to ensure compliance.

A further difference is around flexibilities. The GP includes a number of flexibilities similar to those laid out in the NECD. The only exception is the flexibility under Article 5(3) of the NECD, which has no equivalent under the GP. Therefore, where the flexibilities established under Article 5(3) of the NECD are used this may be more directly attributable to the NECD, but any additional burden is expected to be negligible. One Member State used this flexibility in 2024.

There are also some small differences in relation to scope. The GP, for instance, includes emission limits and other requirements for stationary and mobile sources, fuels and NMVOC contents of products which are not included in the NECD. The NECD also excludes some emissions of some pollutants falling under certain sectors (emissions of NO_X and NMVOC from activities falling under NFR codes 3B Manure management and 3D Agricultural soils from compliance assessments)[225]. Overall, however, the variation is scope of emissions sources is not expected to lead to any significant difference in burden between the NECD and GP.

Through the targeted engagement of competent authorities, Member States elaborated the extent of the interaction. Nine Member States reported that there are complete overlaps between the compilation of inventories under the NECD and that conducted under the GP, with a further 2 stating that there are overlaps that are 'significant' (i.e. the activities to prepare both inventories are the same and require little additional effort to prepare one or the other). In turn, six Member States suggested that there are complete overlaps between the projections developed under the NECD and those conducted under the GP, with another one stating that this overlap was 'significant'. This overlap has been seen as positive given that the majority of activities to meet both obligations are same.

Further insights on the interaction with the GP were provided through the targeted stakeholder consultation, which asked stakeholders to state to what extent the NECD has helped to deliver on international commitments under the GP related to the development of emissions inventories (q. 4.1.55 24)[226]. 20 of 41 respondents (across public authorities, non-governmental organisations, industry associations, academia and individuals in professional capacity) stated that the NECD provided large or some efficiency improvements in this area. Most positive responses came from public authorities and non-governmental organisations. The only stakeholder group to state it has had the opposite effect was 1 respondent from an industry association. There was a similar picture when asked about emissions projections (q. 4.1.56 24); with 23 of 41 respondents stating that the obligation led to large or some efficiency improvements. All stakeholder groups had respondents who corroborated this. In terms of reporting of emissions inventories and projections, 21 stakeholders stated efficiency improvements related to meeting GP

[225] Logika (2023) Service Request 7: Comparison between the Directive (EU) 2016/2284 and the amended Gothenburg Protocol under the UNECE Air Convention.

[226] The detailed reports on the online stakeholder consultations are annexed to the support study to this evaluation.

requirements due to compliance with the NECD, 12 of which suggested that these were 'large'. All stakeholder groups had respondents who corroborated this, however most positive response came from non-governmental organisations and public authorities.

The interaction of activities to compile air and **GHG emission inventories** was elaborated through the targeted engagement of competent authorities, with several Member States explaining that it is often the same team and even the same individuals who are responsible for compiling both, often with responsibilities spit by sector. However, in other cases coordination between ministries can be very limited, with work to develop air quality and GHG inventories occurring in different teams, presenting a significant additional burden. Targeted engagement of competent authorities provided insight into the size of the interaction, with 12 of 16 Member States reporting at least a partial overlap between inventory compilation under the NECD and GHG inventories under the Regulation on the governance of the energy union and climate action (Governance Regulation). In the case of projections, 11 Member States noted that work overlaps with activities undertaken to develop GHG inventories under the Governance Regulation. Typically, this work is conducted by the same or at least overlapping teams, hence some of the activities to prepare the air and GHG inventory are shared (and not duplicated). However, this is not the case across all Member States and depends on the administrative structure of the competent authority.

The targeted engagement of competent authorities also noted several other, less significant, interactions:

- 3 Member States stated that there are partial or indirect overlaps between inventories and NECP development, with 3 Member States noting interactions between projections and NECP development.
- 2 Member States report there are overlaps between inventories and national reporting on statistics, with 1 Member State noting a partial overlap between projections with national reporting on statistics.

Overall, key overlaps with other legislation for emissions inventories and projections relate to work conducted also under the GP. This work is almost a complete overlap. The most relevant difference here is the need to produce projections every 2 years instead of 4 under NECD. The other significant overlap relates to GHG inventories and projections under the Governance of the Energy Union and Climate Action regulation.

3.1.1.6 Summary of administrative costs

Member State competent authorities

The table below brings together the analysis of the individual obligations based on the stakeholder feedback. For each key obligation (Article 6, Article 8 and Article 9), Member States varied significantly in how much additional burden the obligations created based on national circumstances (as shown by the ranges presented). For example, with respect to NAPCP development, multiple competent authorities highlighted that burden is heavily dependent on the state of play per Member State in relation to their reduction

commitments. The findings suggest that the costliest obligation associated with the NECD are the development, submission, and reporting of emissions inventories. Whilst this analysis does not include all obligations, it is anticipated that other obligations would not significantly impact burden.

The table also combines the average estimates for individual obligations to illustrate a combined cost for an average Member State. Given the variance between Member States and the partial coverage of the data, it is not possible to estimate a cost for EU27 with any certainty.

A representative estimate of the total administrative annual burden facing a typical Member State may be in the region of **€1 071 000 per annum** (2025 prices).

Table A - 29 – Summary estimates of administrative burden of obligations under the NECD and related policy drivers – average cost per Member State (based on those who completed the targeted engagement of competent authorities) (EUR, 2025 prices)

Obligation (main policy driver)	Upfront cost (range) – first reporting period	Ongoing cost (range) per reporting period	Ongoing cost (range) per annum	Representative annualised ongoing cost (central)
Inventories and projections (NECD, GP)	Not assessed	n/a	€749 000 (Range €56 900 to €3 080 000)	€749 000
NAPCPs (NECD, Governance Regulation)	€207 000 (range €11 400 – 290 000)	€137 000 (range €5 720 – 500 000)	n/a	€34 000
Ecosystems monitoring and reporting (mainly NEC-driven)	€337 000 (range €17 000 to €1 200 000)	€1,152,000 (range from €7 430 to €6 720 000)	n/a	€287 000
TOTAL	**Not assessed**[227]	**n/a**	**n/a**	**€1 071 000**

Note: Member State figures were often totals for several work strands, including the Gothenburg Protocol (GP), the AAQD and GHG inventories under the Governance Regulation. Figures were excluded from the average cost across Member States where Member State data did not allow a split of costs between air pollutant and GHG inventories. In the case of ecosystems reporting and NAPCPs, it was not possible to make an adjustment to better isolate the costs of the NECD, however, Member States noted that these costs were mainly NECD-driven. In the case of ecosystem monitoring, some costs may be shared with obligations stemming from e.g. Water and Marine Strategy Framework Directives. The analysis did not attempt a split with the GP.

The table below brings together the comparison between estimates of administrative burdens presented in the IA and estimates made in this study (cost of inventories and projections was not included in the IA). The findings elaborated above find that overall,

[227] A total for the upfront cost was not estimated given: (a) no data was available on upfront costs (likely given that these activities were broadly carried forward from previous Directive 2001/81/EC and hence implemented many years ago) and (b) initial cost are likely to be very different to the ongoing annual cost, therefore it is not appropriate to attempt to use ongoing annual costs as a basis for estimating initial costs.

the impact assessment underestimated the administrative burden that Member States would face for NAPCPs and ecosystems reporting, in some cases significantly.

Table A - 30 – Summary comparison of estimates between IA and updated evidence base – average cost per Member State (based on 16 replies to the targeted engagement of competent authorities) (€, 2025 prices)

Obligation	IA estimate – first reporting	Study estimate – first reporting	Relative difference	IA estimate – ongoing reporting (per annum)	Study estimate – ongoing reporting (per annum)	Relative difference
NAPCPs	€270 000	€201 000	-23%	€11 400	€34 000	+199%
Ecosystems reporting	€88 200	€337 000	+282%	€134 000	€287 000	+114%

European Commission and European Environmental Agency costs

Information on the burden placed on the European Commission and EEA was collated by these organisations and provided via direct communication to the study team.

For the **European Commission**, information was provided on the total staff time committed to the NECD and total contract values for projects related to reporting from 2016 to 2025. Over the ten-year period, using average costs as defined by the Directorate-General Budget of the European Commission[228], the average annual staff cost for the European Commission is estimated to be around €520 000, with a total estimated burden over the period of around €5 200 000. The contract values within the same period totalled around €12 100 000. Together, the **total estimated costs for the European Commission are therefore €17 300 000 over the 10-year period, or €1 730 000 on average per annum**. It was not possible to disaggregate staff time per specific obligation, however this detail does exist for the contract values per work area. The area where most resources were committed was to inventory reviews (roughly 43% of contract values), whereas the smallest outsourced cost item relates to total NAPCP reviews (roughly 5% of contract values).

The **European Environment Agency** also supports the implementation of the NECD. Data provided related to budget, contractor costs and EEA staff time. Average annual costs between 2016 and 2025 for the EEA were estimated to be around **€230 000 per annum, or €2 300 000 over the period from 2016 to 2025** (2025 prices). These costs have been broadly consistent over the evaluation period, but experienced a one-year rise in 2020 related to an increase in outsourced 'Reporting support' (before reducing to 2021). Costs have steadily increased from 2023 onwards (owed, at least in part, to the more recent task of ReportNet 3 migration and Article 9 task, both of which have been conducted by ETC-

[228] DG BUDG (2023), Average costs to be used for estimates of "Human Resources" in the Legislative Financial Sheets (unpublished).

DI. The costliest task item in most years over the period has been the EEA staff time dedicated to reporting (ENV1).

3.1.1.7 Key conclusions

- The NECD places a number of obligations on Member State competent authorities, the European Commission and the EEA which carry an administrative burden. It was not possible to fully disentangle the administrative burden associated with the NECD, given interactions with other legislation (in particular the GP, AAQD and the Governance Regulation - (EU)2018/1999). Where information reported by Member States allowed it, we have applied a split of costs to arrive to a cost estimate for administrative costs linked to the NECD. This concerned mostly a split between GHG inventories and obligations stemming from the Governance Regulation, on one side, and the NECD on the other side. The key obligations that present a significant administrative burden fall on Member States and are: (i) Article 6 NAPCP development, (ii) Article 9 Ecosystems monitoring and (iii) Article 8 emissions inventories and projections.

- The IA identified additional administrative burden for all Member States for changes proposed relative to Directive 2001/81/EC. These included: developing NAPCPs, reporting on ecosystem monitoring and developing inventories for black carbon. Total additional costs were estimated to be a **one-off cost of €8.5 million and €3.1 million annual costs** (adjusted to 2025 prices). However, changes to the proposal during the co-legislative process challenge these figures as a point-of-comparison, resulting in an expected reduction in burden for Member States and a slight increase for the European Commission. The IA did not assess costs for emissions inventories and projections.

- Targeted engagement with competent authorities through the support study yielded substantial data on which estimates of costs could be made for a subset of Member States and for different obligations. For an average Member State, **compliance with the obligations of the NECD could place a burden on the competent authority in the region of €1,071,000 per annum**, but there is a wide variation between Member States (estimated range €70 000 - €10 300 000 per annum across all obligations). The key obligation is the burden associated with the development and submission of emissions inventories and projections. Challenges were experienced in terms of the provision of data, with Member States often reporting different amounts and varying quality of information.

- There are some key reasons for the differences experienced between Member State competent authorities, dependent on the obligation. For NAPCPs, key differences can be explained, at least in part, by factors such as whether the Member State reached compliance with the ERCs. This was identified as a key factor by Member States during the targeted engagement. Where projections indicate non-compliance with a pollutant, this can lead to a much greater administrative effort as Member States need to identify, develop, assess, cost, and consult on PaMs for inclusion in the NAPCP.

Burden for ecosystems reporting can be dependent on whether the Member State taps into existing networks, and on how many sites they include in their monitoring. In terms of inventories and projections, differences often depend on data availability. Some Member States cannot report this data disaggregated between air pollutants and GHGs, because oftentimes this work is conducted by the same team, at the same time.

— A significant proportion of costs should not be attributed to the NECD alone. For example, actions undertaken to fulfil requirements under emissions inventories and projections are almost all entirely shared with the requirements under the GP, and, in some cases, with GHG inventory actions under the Governance of the Energy Union and Climate Action Regulation. Activities undertaken to fulfil requirements under ecosystems monitoring share significant costs with the Water framework Directive, Habitats Directives and other relevant national legislation. Again, many competent authorities signalled a high degree of crossover in work here with the GP. Finally, whilst NAPCP development and submission is not a requirement under any existing legislation, including the GP, there are still shared costs, particularly in relation to NECP development under the Governance of the Energy Union and Climate Action Regulation. Costs could not be split between reporting streams to different EU policies, therefore global figures provided were not included in the total. Furthermore, to reflect the fact that the NECD transposed obligations from the GP into EU law with related obligations falling on Member States, this evaluation considered these costs to fall entirely on the NECD.

— Whilst the IA did, in places, underestimate the burden associated with the NECD for Member State competent authorities, overall, the costs associated with administrative burden are very insignificant compared to estimates of abatement costs. This chimes in with the opinion of **stakeholders** via the open and targeted stakeholder consultations: most respondents thought that the costs of developing NAPCPs, inventories and projections reporting and ecosystems monitoring and reporting were moderate, ad were lower than abatement costs (which were considered high by a higher number of respondents than in the case of administrative burdens for public authorities).

— Average annual costs have also been identified for the **European Commission and the EEA (€1 730 000 and €230 000 on average per annum respectively).**

3.2 Abatement costs of reduction measures

Adjustment costs are defined in the Better Regulation Guidelines as investments and expenses that businesses, citizens, or public authorities have to bear in order to adjust their activity to the requirements contained in a legal rule.

The NECD sets national Emission Reduction Commitments (ERCs) for five main air pollutants. Member States must decide how to meet their ERC for each pollutant through the deployment of policies and measures (PaMs) to abate air pollutant emissions. These actions will carry costs (‘abatement costs’) in the form of upfront investment costs

associated with putting the measure in place, and ongoing costs to keep the measure operational over its lifetime. Although the obligation to meet ERCs is placed on Member State competent authorities in the first instance, costs may be passed on to businesses and other actors depending on how each Member State chooses to meet its ERCs and on the design of other EU policies which influence the deployment of emissions controls.

Two key **challenges** have arisen in the analysis of abatement costs: the ability to attribute costs of emissions controls to the NECD alone, and the fact that key sources of evidence around costs are modelling studies which focus on costs in future years.

It is not possible to assess precisely a cost attributable to the NECD alone, as the implementation of measures which deliver emissions reductions are driven by a range of interacting policies (of which NECD is one) and external factors. The NECD (which sets targets for air pollutant emission reductions) sits as part of the wider clean air policy to deliver improved air quality across the EU, complementing the Ambient Air Quality Directives (which sets standards for air pollutant concentrations) and a range of EU source-specific instruments (which impose specific requirements on individual sources of emissions). Source-specific instruments include, among others: vehicle emissions standards (also known as 'Euro standards') and Best Available Technique conclusions (BATc) implemented through the Industrial Emissions Directive (IED). The implementation of many abatement measures will be driven by the source-specific instruments but also contribute to meeting overall ERCs. Hence the separate pillars of the clean air policy act together to drive action to reduce emissions and improve air quality.

The significant challenge of attributing costs to the NECD was repeatedly highlighted by **stakeholders** through different engagement activities:

- At the stakeholder workshop, a stakeholder recognised it may not be possible to identify costs of the NECD directly given interactions with the wider clean air policy.
- Through the targeted engagement with competent authorities, three highlighted that emissions reductions are often the result of a combination of policies and measures, making it almost impossible to attribute certain total costs to any single driver. One competent authority presented the example of NO_x emission reductions in their Member State in the transport sector. The stakeholder explained that these reductions were achieved by a combination of interacting influences: EU CO_2 emission vehicle standards, introduction of low emission zones in major urban centres, financial measures (e.g. fuel price setting, clean vehicle incentives, road tax reform), behavioural response to 'dieselgate' (the scandal around diesel engines emission tests) amongst other factors. Another competent authority noted that the AAQD has predominantly been the driver of action around air pollution over the last few years, but the underlying measures will also contribute to achievement of obligations under the NECD.
- In response to the open public consultation, the majority of respondents noted that many other policies and strategies had 'significantly reduced' or 'somewhat reduced

emissions'[229], in particular: AAQD, IED, Euro vehicle emissions standards, Energy Efficiency Directive, Nitrates Directive, CO_2 standards for cars and vans and non-road mobile machinery.

- Through the targeted stakeholder consultation, respondents identified several factors that had increased costs (including 'dieselgate' and the war in Ukraine and changes in energy markets) and those that decreased costs (including UNFCCC - referring to action taken to meet energy and climate commitments, the COVID-19 pandemic and Low Emission Zones).

Although it is not possible to assess the costs of the NECD directly, studies have explored the costs of meeting the ERCs. These capture the costs of emissions controls implemented in response to the different factors, and hence also capture the cost of actions which would at least be partly attributable to the NECD but would also be influenced by other policies and external factors. These are key evidence sources for the analysis and are summarised in this section, in each case reflecting on their scope.

In specific instances where additional measures are taken at Member State level to meet their ERCs under the NECD (separate to those obligated through EU-level source-specific legislation), the associated costs (and benefits) can be more directly attributed to the NECD. One example of this was identified by the competent authority of Denmark, which noted that measures included in its initial NAPCP submission to abate ammonia emissions could more clearly be attributed to the NECD. A Member State highlighted another example in a meeting of the Ambient Air Quality Expert Group related to the NECD, namely specific action on domestic solid fuel burning. However (and as explored in the following sections), cost data on all PaMs is not complete hence even if we could establish a list of PaMs which can be more directly associated with the NECD, a representative total cost could not be estimated based on reported data.

In addition, the NECD mirrors and extends the Gothenburg Protocol (GP) to the UNECE Convention on Long-Range Transboundary Air Pollution (CLRTAP), to which 25 EU Member States[230] and the EU itself are signatories. The 2020-29 ERCs set under the NECD were implemented to enshrine in EU law the emission reductions committed to under the GP. As such, the costs (and benefits) of meeting the 2020-29 ERCs under the NECD are inseparable from those of meeting similar requirements under the GP. That said, any costs (and benefits) of meeting the 2030+ ERCs are more clearly attributable to the NECD.

A second challenge lies in the **nature of the key modelling studies** (namely the impact assessment (IA) and Clean Air Outlook (CAO) series) which consider costs of the NECD and associated emissions controls, in particular:

- The modelling presented in these studies considers the impacts in different years (usually in 5-year intervals), however the year for which impacts are assessed varies across the studies. The year 2030 is used across these studies as a common modelled

[229] Where a policy has reduced emissions, this logically implies that it has already reduced the costs of further emissions reductions to meet ERCs under the NECD.

[230] Italy and Poland did not ratify the GP (status as of October 2024).

year but is beyond the time period in scope of this evaluation (2016- 2025). The modelling does not routinely estimate the costs for a common set of years in the period leading up to 2030. In practice, Member States will incur costs before 2030 (including over the evaluation period) so that they can achieve the ERCs by the compliance date. This is particularly the case given Member States must demonstrate they are following a linear trajectory towards meeting ERCs (unless they explain their use of a non-linear trajectory under Article 4(2)). **The analysis in this section mainly refers to impacts in 2030 as this presents a common point of comparison across the modelling studies and is the basis for ex post analysis to identify costs for 2016-2025 (which is used to draw conclusions for the evaluation period).** In some places it refers to the analysis undertaken for 2025 – where this is the case it is either for contextual purposes, or as an illustration of impacts in 2030, but where similar analysis was not presented in the IA for 2030. **Further ex-post analysis has been undertaken using the outputs of these studies to illustrate the implied impacts over the evaluation period**.

- **These studies present modelled, rather than reported or measured costs (and benefits).** The GAINS model attempts to stay as close to reality as possible: each CAO involves a detailed review of EU policies and the most recent Member State NAPCPs, to align as far as possible the starting point for the modelling with abatement measures taken up in practice. However, this is not a perfect exercise as consistent and complete information is not always available, and the construction of the scenario in GAINS is limited to deploying the techniques defined within the model. As such, there is likely to be some variation between the measures simulated as adopted and those taken up in practice. To minimise this variation, the Commission has asked the modelers (IIASA and partner organisations) to conduct consultation meetings with each Member State, to align the assumptions in the GAINS baseline as close as possible to the national contexts of Member States, while maintaining EU-wide consistent energy and agricultural activity projections that were developed along the work on the European Green Deal. That said, these studies present a key source of insight regarding costs and benefits as there is limited wider evidence regarding these impacts elsewhere in the literature.

This section reviews evidence regarding costs across a range of studies and sources, proceeding as follows presenting:

- evidence presented in the IA as a starting point-of-comparison (modelled data);
- evidence from the subsequent CAO series (modelled data);
- additional analysis and modelling undertaken related to abatement costs using the outputs of the CAOs to inform the NECD's evaluation, specifically to explore further the costs of emissions controls, and illustrate the impacts over the evaluation period (modelled data);
- review of information submitted by Member States through their NAPCPs and captured in the PaMs database (reported data);
- wider evidence identified through literature and gathered through stakeholder engagement.

Throughout the section all estimates of costs (and benefits) have been adjusted to 2025 prices using ECB inflation data[231] to allow comparability between studies.

3.2.1 Points of comparison – impact assessment

In 2013, the Commission published an impact assessment (IA) alongside the proposal for the NECD. Following the Better Regulation Guidelines, the IA presents the points-of-comparison against which further evidence collected on costs (and benefits) under the present evaluation should be compared. The IA presented an analysis of the costs and benefits of a range of options against a baseline. Under the baseline of 'no additional EU action', no new EU policies were envisaged. More specifically, the baseline was based on the assumptions set out in the following table.

Table A - 31 – NECD IA baseline assumptions (see table 7 of the IA)

Regulatory area	Assumption
AAQ Directives	No change. Existing limit values, attainment dates, and other provisions, are maintained; Enforcement continues and is extended where appropriate.
NECD for 2020 - Directive 2001/81/EC	Reduction commitments for 2020 only in line with the 2012 amendment of the GP (met on the baseline trajectory).
EU source controls	No new EU source control measures other than relying on emission reductions yielded by current legislation, including resolution of the 'real world emissions' issue (relating to vehicle emissions) not later than 2017.
Member State source controls	All Member State actions required to reach compliance with AAQ Directives and NECD (Directive 2001/81/EC) continue as guided also by ongoing Time Extension Notification (TEN) conditions[232] and/or EU enforcement actions.
EU support measures	No new supporting measures other than on-going revisions of TENs [Trans-European Networks], targeted workshops supporting that process and availability of existing EU funds.

With respect to ERCs, the IA assessed policy objectives for two time periods: 2020 and for 2025-30 (in the latter testing options implemented in either 2025 or 2030). For both time periods the IA assessed the impacts of different levels of ambition, defined in terms of different levels of emissions reduction achieved. The impacts were modelled using the GAINS integrated modelling system[233], simulating varying levels of deployment of technical abatement measures available in 2012. To estimate the costs, the modelling selected the most cost-effective group of abatement measures to deliver the required gap closure objectives.

For **2020**, the IA considered two options:

[231] Uplifts use ECB data series 'HICP - Overall index, Euro area 19 (fixed composition) as of 1 January 2015, Monthly', series key 'ICP.M.I8.N.000000.4.ANR':

[232] Referring to postponement related to attainment deadlines for specific air pollutants under Directive 2008/5/EC.

[233] See https://gains.iiasa.ac.at/models/, and also Annex II for further detail.

— 5A - Adopt new EU source control legislation to reduce air pollution.

— 5B - Amend the National Emission Ceilings Directive (Directive 2001/81/EC) so as to include stricter provisions compared to the recently agreed amendment of the Gothenburg Protocol.

Option 5A defined ERCs in line with those contained in the 2012 amendment of the GP and was identified as the preferred option. The IA concluded that: *Although the Gothenburg commitments represent a substantial emission reduction over the 2010 NECD ceilings, in fact they will be achieved by the baseline emission trajectory; as such they will not require additional technical measures beyond those already decided.* Hence the IA concluded that the 2020 option under the NECD implied no additional cost over and above the baseline over this time period.

For **2025-2030**, the IA considered five options defining different levels of 'gap closure' for the long-term health effects of $PM_{2.5}$ (expressed as premature deaths) between the baseline and the Maximum Technically Feasible Reduction scenario (or MTFR): 25% gap closure (Option 6A), 50% (6B), 75% (6C), 100% (6D) and >100% (6E) of the gap closure. The table below presents the costs estimated by the IA where the options are implemented in either 2025 or 2030. Option 6E, compliance with the then applicable WHO Guideline values (of 10µg/m^3 for $PM_{2.5}$) was assessed as impractical as even the MTFR was modelled to fall short of the required emission reductions in the period 2025-30.

Table A - 32 – Baseline and additional abatement costs (incremental pollution control expenditure) by option (€m per annum, EU28, adjusted to 2025 prices, replicating IA tables 8 and 15)

Year	Baseline	6A	6B	6C	6D	6E
2020	124 199	n/a	n/a	n/a	n/a	n/a
2025	132 704	336	1 830	7 047	71 561	n/a
2030	140 212	323	1 571	6 366	77 155	n/a

Table A - 33 – Costs of achieving objectives of policy option 6C, split by Member State (€m per annum, adjusted to 2025 prices, replicating IA Table A7.4), in 2030

Member State	Abatement Cost (€m)	Abatement Cost (% of total EU27)	Member State	Abatement Cost (€m)	Abatement Cost (% of total EU27)
Austria	134	2.3%	Latvia	5	0.5%
Belgium	172	2.8%	Lithuania	20	0.6%
Bulgaria	84	1.8%	Luxembourg	5	0.1%
Croatia	50	0.8%	Malta	-	0.0%
Cyprus	2	0.0%	Netherlands	97	1.5%
Czech Rep.	164	2.9%	Poland	951	17.4%
Denmark	18	0.6%	Portugal	105	2.0%
Estonia	8	0.1%	Romania	178	5.2%
Finland	20	0.3%	Slovakia	131	2.1%
France	534	9.1%	Slovenia	67	1.2%
Germany	1,262	20.3%	Spain	476	7.4%
Greece	100	2.0%	Sweden	23	0.3%
Hungary	142	2.3%	**EU-28**	**6,366**	**n/a**
Ireland	29	0.5%	**EU-27**	**5,646**	**100%**
Italy	871	15.9%			

The IA outlined that the economically rational interim objectives for air pollution policy are those which maximise net benefits (i.e. where the marginal cost equals the marginal benefit). Following this logic, the IA identified Option 6C (75% of the gap closure for $PM_{2.5}$ health effects) as the option which maximised the net benefit and proposed this as the preferred option.

The IA also presented a split of the costs of achieving the objectives of policy option 6C by Member State, as replicated in the table below. The Member States facing the largest abatement costs under the preferred option were anticipated to be Germany (22% in 2030), Poland (17%) and Italy (15%)[234]. Removing the UK, the starting point-of-comparison for the abatement costs assessed by the IA are therefore:

— Annualised abatement cost of €6 270 m in 2025 across EU27 (2025 prices).

— Annualised abatement cost of €5 650 m in 2030 across EU27 (2025 prices).

The IA also considered the contribution of source controls to the achievement of the overall target and the gap left for Member States to fill to achieve ERCs. A summary of the economic effort required to achieve the preferred policy option is presented in the following table for 2025 (the IA did not present an equivalent table for 2030). Of the total modelled effort required, **around 33% of the total abatement cost was anticipated to be incurred due to national air pollution control measures**. Considering the discussion around attribution above, these costs could be more directly attributed to the NECD, whereas the attribution of other costs is shared between the NECD and other legislation (e.g. source-specific and energy and climate legislation).

Table A - 34 – Economic effort required to achieve objectives of 6C policy option and potential contribution of EU and Member States instruments (€m per annum, EU28, adjusted to 2025 prices, replicating IA Table 26), for 2025

Instrument	Sub-sector	Economic effort (€m)	Economic effort (%)
EU28 total		**7 125**	**100%**
Ecodesign		2 245	31.5%
NRMM		216	3.0%
MCP		582	8.2%
IED		1 758	24.7%
Of which:	cement	516	7.2%
	glass	44	0.6%
	refineries	440	6.2%
	chemicals	79	1.1%
	solvents	23	0.3%
	pigs and poultry	655	9.2%
National air pollution control measures		2 323	32.6%

Following the IA, changes were made to the Commission proposal for the NECD (as assessed in the IA) in the co-legislation process. Some of these changes impacted on the abatement costs associated with complying with the ERCs. The following table presents a

[234] Although data has only been replicated for 2030, the IA showed the same pattern of effects for abatement costs in 2025, with the same three Member States facing the most significant costs.

summary of the key changes alongside a qualitative assessment of the likely impacts in comparison to the costs assessed in the IA.

Table A - 35 – Analysis of changes between Commission proposal and NECD, and influence on cost estimates

Relevant article and summary of change	Impact on abatement costs
Article 4(1) and Annex II The Commission proposal contained ERCs that are applicable from 2020 (i.e. those from the revised GP) and from 2030 (it did not contain intermediate ERCs for 2025 as suggested in the IA). The negotiations did not affect ERCs for the 2020-2029 period. For the period beyond 2030, changes were made. ERCs were reduced (made less ambitious) by on average: 2% for SO_2; 6% for NO_X; 10% for NMVOC; 8% for NH_3; 2% for $PM_{2.5}$ at EU level (noting that the Directive does not set EU ERCs). At Member State level, in a few instances ERCs were strengthened, whilst in most cases there were reduced to a varied extent. Range of changes were the following: for SO_2 varying between 6% more and 15% less; for NO_X varying between 4% more and 31% less; for NMVOC varying between 2% more and 22% less; for NH_3 varying between 2% more and 16% less; for $PM_{2.5}$ varying between 9% more and 30% less. The Commission proposal contained ERCs for methane, which were deleted during the negotiations.	**Cost impact versus IA: Significant reduction** The NECD adopted ERCs which apply from 2020-29 and 2030+, not from 2025. Hence when considering the costs defined in the IA for the 2025-30 period, it is more appropriate to focus on those assessed for 2030. Although there will likely be costs prior to 2030 as Member States ramp-up their abatement efforts to meet the 2030 ERC by the compliance date, these are unlikely to be as significant as the costs modelled in the IA for 2025 (which simulate the ERCs being met by 2025). Changes to the 2030 and beyond ERCs were in most cases reductions (except in isolated cases of specific pollutants for specific Member States) and thus are expected to reduce adjustment costs. Although the proposal for methane ERCs was removed, this would not impact on the costs assessed in the IA as the IA did not include an assessment of the costs of meeting methane ERCs.
Art. 4(3) Addition of exclusion from ERCs for NO_X and NMVOC emissions from NFR sectors 3B (manure management) and 3D (agricultural soils).	**Cost impact versus IA: minor reduction** Introducing an exclusion has likely lowered costs in practice as it makes meeting the ERCs less ambitious (i.e. Member States require less abatement).

It is not possible to accurately quantify the impact of the co-legislative changes on the points-of-comparison (costs estimated in the IA). That said, further detail is provided in the IA which provides insights into the potential influence of the changes.

The NECD aims to reduce EU-wide $PM_{2.5}$ emissions by 49% by 2030 relative to 2005. In the IA, option 6B is anticipated to deliver a 45% reduction, and option 6C a 51% reduction. Hence the abatement cost point-of-comparison intuitively lies between the costs for 6B and 6C. The IA also performed sensitivity analysis around the main modelled options, including marginal deviations around the preferred option. The results of sensitivity tests for varying levels of gap closure between options 6B and 6D are presented in the following table for 2025 (the same analysis is not presented for 2030). As can be seen from the table, the costs increase significantly as ambition is increased above 50%.

Table A - 36 – Total abatement costs in 2025 for sensitivity cases ranging between Option 6B (50% gap closure for PM2.5 health impacts) and Option 6D (MTFR) (in €m per annum, EU28, adjusted to 2025 prices, replicating results from IA Table 24)

Option	6B			6C			6D
Gap closure	50%	65%	70%	75%	80%	85%	MTFR
EU28-wide TOTAL	1 830	3 797	5 103	7 047	10 098	14 812	71 561

The NECD EU-wide emissions reduction of 49% sits two-thirds of the way between the modelled reductions for options 6B and 6C which are 45% and 51% respectively. Translating this into the 'gap closure', two-thirds of the way between the 50% (option 6B) and 75% (option 6C) gap closure is 66%. This suggests that the cost of the option implemented in the NECD could in fact be closer to the 65% sensitivity modelled in the IA. The sensitivity analysis was performed for 2025 and not 2030. For illustration, assuming that the same pattern of exponential increase in costs applies to the IA modelling of impacts for the options in 2030, the **annualised abatement cost of the NECD as implemented could intuitively sit in the range between €2 800 to €3 000 million in 2030 across EU27**[235], substantially lower than the €5 650m per annum from Table A-33.

This estimation was not made as part of the original IA modelling and hence should be treated as illustrative. Furthermore, it is only based on matching the reduction in $PM_{2.5}$ emissions between the modelled options in the IA and the NECD EU-wide emission reductions – it does not check the alignment of the reductions in NO_X, SO_2, NH_3 and NMVOC emissions under the 65% sensitivity run in the same way. That said, the EU-wide emissions reductions for these pollutants reduced more significantly (relative to $PM_{2.5}$) between those associated with the IA preferred option and those implemented in the NECD.

3.2.2 Clean Air Outlook modelling

The CAO studies have undertaken forward-looking analysis of the prospects for reducing air pollution in the EU by 2030 and beyond, assessing the implications of emission reductions in terms of air quality, health, ecosystem impacts and their costs and benefits to society. The modelling underpinning the CAO reports has been based on the same broad (but updated) methodological approach as the one followed for the preparation of the Commission's NEC proposal and accompanying IA, deploying the GAINS integrated modelling system. As noted above, these studies present modelled, rather than reported or measured costs (and benefits). Furthermore, as for the IA, the CAO series does not define a cost solely attributable to the NECD, given the challenges in isolating its effects relative to other complementary legislation. These caveats aside, the CAO series offers a useful insight into how the estimation of costs has evolved over time with subsequent outlooks, and given it uses the same modelling approach, offers a consistent comparison to the

[235] Derived from an annualised abatement cost of around €3 300 to 3 400 m in 2030 across EU28, assuming that the UK's proportion of the total estimated cost remains constant across scenarios.

points-of-comparison modelled in the IA. Through the targeted engagement of competent authorities, stakeholders also highlighted the CAO series as a key source of comparative material on costs and benefits on implementing technical measures but also highlighted the limitation that the GAINS model does not yet consider the full potential of non-technical or local measures which can also contribute to emissions reductions.

The CAO series assesses the impacts and costs of different emission reduction scenarios. A list of selected scenarios most relevant for this evaluation are presented in the following table.

Table A - 37 – Description of key scenarios included in the CAO series

CAO	List of key modelled scenarios
CAO1 (completed in 2018)	**PRIMES 2016 REFERENCE activities projection** with the legislation already in place in 2014 (the 'pre-2014' legislation), with the new legislation adopted after 2014 (the 'post-2014' legislation). with full implementation of the technical emission control measures (MTFR). cost-effective achievement of the emission reduction requirements (ERRs). **CLIMATE AND ENERGY POLICY activities projection** with the new legislation adopted after 2014 (the 'post-2014' legislation). with full implementation of the technical emission control measures (MTFR). cost-effective achievement of the emission reduction requirements (ERRs).
CAO2 (completed in 2020)	**Baseline scenarios** CAO2 baseline – latest EU-wide legislation and already adopted national air pollution control measures. This also includes the 32% target for renewable energy and 32.5% for Energy Efficiency in 2030. NAPCP – as CAO2 baseline, plus additional measures (policies and measures selected for adoption of the NAPCPs), also known as 'CAO2 WAM'. **The latest climate policy scenario** NAPCP scenario as above, plus Mix55 scenario from 2020 Commission proposal[236], also referred to as CAO2 MIX55_TECH_WAM'.
CAO3 (completed in 2022)	**Baseline scenarios** Baseline - Green Deal, Fit for 55 climate and energy package, plus latest EU-wide legislation, including legislative proposals for IED update (as regards agriculture) and for EURO7, and adopted national air pollution control measures. REPowerEU – baseline as above, plus alternative energy scenario reflecting for EU27 in response to the war in Ukraine including measures announced in May 2022, also referred to as CAO3 RePower'.
CAO4 (completed in 2025)	**Baseline** – captures developments since CAO3 in EU climate and energy legislation (including reflecting latest political agreements on the legislative initiatives part of the "Fit for 55" package and REPowerEU initiative) and source-specific legislation (such as final revision of Euro 7 and IED), alongside developments in national air pollution control legislation and programmes (based on NAPCPs and discussions with Member States). **ERC** – cost-optimized scenario where all Member States meet all their 2020-29 emission reduction commitments by 2020 and 2025, and 2030 ERCs by 2030.

As can be seen from the table, inclusion of the NECD in different scenarios has evolved over time, which has influenced the analysis and what conclusions can be drawn regarding

[236] Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions: *Stepping up Europe's 2030 climate ambition Investing in a climate-neutral future for the benefit of our people*, COM/2020/562 final.

the impacts of the NECD. A summary of the assessment under each CAO study is captured in the table above.

Under **CAO1**[237], a 'pre-2014' legislation scenario was modelled for consistency with the IA baseline, containing the same scope of legislation. A 'post-2014' legislation scenario (also referred to as the '2017 legislation' scenario) was also modelled, capturing additional measures put in place following the completion of the IA modelling, specifically: the introduction of the Ecodesign Directive, the Medium Combustion Plant Directive (MCPD), and Non-Road Mobile machinery (NRMM) Directive. No update was made to the measures assumed to be introduced at Member State level. These scenarios were used as alternative baseline scenarios against which other scenarios were assessed. The costs of the scenarios were presented for modelling year 2030 only.

Against the 'pre-2014' legislation baseline (i.e. similar to the IA baseline), CAO1 assessed an additional (above baseline) estimated cost of **€2 630 million per annum** (adjusted to 2025 prices and EU27) in 2030 to meet the 2030+ targets[238]. When comparing to the '2017 legislation' baseline (i.e. when capturing the three Directives implemented post-2014 in the baseline), the additional costs in 2030 to meet 2030+ ERCs fall to **€1 405 million per annum** (adjusted to 2025 prices, EU27).

Relative to the costs assessed in the IA, the total cost of meeting ERCs assessed under CAO1 appears to be lower. The CAO1 estimated cost of €2 630 million per annum is significantly lower than the cost of the preferred option 6C in 2030 (estimated to be €5 650 million, adjusted to 2025 prices, EU27). It is also below the illustrative cost adjusted to account for changes implemented in the co-legislative process (estimated range of €2 800 million – 3 000 million in 2030, adjusted to 2025 prices, EU27).

Under **CAO2**[239], the updated baseline captured EU air pollution legislation as of 2020. The sets of policies and measures were compiled under the following scenarios:

The legislation included into the CAO2 baseline contained EU-wide legislation (including: IED and associated BAT, MCPD, Ecodesign, Fuel Quality Directive, Directives relating to sulphur content in fuels, NRMM, vehicle standards up to Euro 6/VI) as well as already decided additional national air pollution control policies and measures.

The NAPCP scenario, representing additional national air pollution control policies and measures that have been reported by Member States in their NAPCPs and PaMs database as 'selected for adoption', in addition to the policies and measures of the CAO2 baseline legislation.

In addition, the baseline also captured energy and climate targets to 2030 (32% renewable energy target, 32.5% energy efficiency in 2030). Underlying activity projections were

237 See 'Overview' and 'Economic Impact' consultant reports.

238 CAO1 only estimated total cost for pre-2014 legislation baseline for EU28. Here an EU27 cost is estimated for comparability with other cost estimates. This assumes the UK proportion of total cost is the same for pre-2014 legislation baseline as under the 2017 legislation baseline.

239 See consultant report and annex.

updated to those consistent with the Commission's June 2019 assessment of the draft national energy and climate plans (NECPs) submitted by Member States. Consequently, the gap between the 2030 ERCs and the updated baseline under CAO2 is much smaller than the same gap under CAO1, partly due to the inclusion of EU climate policy measures and to additional national pollution control policies and measures that have been adopted since CAO1.

The construction of the scenarios under CAO2 make it more challenging to disaggregate costs of meeting ERCs and identify the effects of the NECD specifically. This is because: (a) no scenario was modelled to meet ERCs, and (b) the CAO2 baseline captured national air pollution control policies and measures based on a review in 2020, hence this will incorporate any measures put in place by Member States between adoption of the NECD and CAO2 and hence cannot be separated out.

The **additional cost of NAPCP measures** 'selected for adoption' over the CAO2 baseline was estimated to be **€1 740 million per annum in 2030** (EU27, adjusted to 2025 prices). This estimate is higher than the additional effort estimated under CAO1 required to meet ERCs (€1 405 m per annum by 2030 for EU27). In addition, under the NAPCP scenario not all Member States are modelled to achieve their ERCs, hence the cost of meeting ERCs would be higher than that estimated (although analysis of further measures required to meet ERCs was undertaken, CAO2 contained no estimates of the costs associated with these measures). The CAO2 report also did not provide a breakdown of abatement costs by Member State. Furthermore, the reports also do not present the achievement of other abatement scenarios (e.g. maximum technically feasible reduction - MTFR) relative to ERCs.

Under **CAO3**[240], the baseline scenario included underlying energy and agriculture projections reflecting the full implementation of the "Fit for 55" climate and energy package according to the respective legislative proposals and supporting modelling. The baseline captured EU legislation on air pollution and already implemented national policies and measures. In addition, this scenario included: implementation of the agricultural part of the proposal for a revised IED available at the time; the preliminary assumptions for the introduction of the Euro 7 emission standard for road vehicles; and introduction of the Sulphur Emission Control Area (SECA) for the Mediterranean Sea. However, the specification of the scenarios under CAO3 prevents drawing insights on the costs of the NECD as all existing action (at EU and Member State level) was captured in the baseline and cannot be isolated, and no scenario was run to assess the effort required to meet ERCs. Of the wider scenarios run, the MTFR achieves the broadest compliance against ERCs - this meets the requirements for all but one pollutant in one Member State (NO_x in Malta). That said, the MTFR significantly increases costs and over-achieves against many ERCs (hence these costs would overstate the costs of meeting ERCs).

The baseline was again updated under the **CAO4** study. The CAO4 baseline relies on the latest available expectations on future development trends, and on the most recent climate

[240] See consultant report and annex.

(based on 2040 climate target analysis), energy (most recent REPowerEU) and transport (such as Euro 7 as adopted) policies. The baseline also captures updated implementation of the revision of the IED reflecting updated assumptions on the uptake of certain agricultural practices and abatement techniques in Member States, including (relative to the proposed option modelled in CAO3): changes around achievement of BAT-AEL ranges; amended thresholds for pig and poultry farms over which IED requirements apply; and removing obligations on cattle farms. Another key element included in the baseline has been the information provided by Member States in the latest versions of their air pollutant emission projections and NAPCPs (primarily related to additional PaMs), gained through discussions with the Member States. Projections for non-EU countries were also updated.

CAO4 modelled a scenario designed to achieve ERCs – hence this can provide more direct comparison to the results of the IA (unlike the scenarios modelled under CAO2 and 3 where such a scenario was not modelled). However, comparability with the IA is complex as a greater number of policies and measures implemented to achieve the ERCs are captured in the CAO4 baseline relative to the IA. Hence the additional cost of achieving ERCs relative to the CAO4 baseline scenario will not capture the cost of all additional action taken to meet ERCs from the implementation of the NECD in 2018. The cost of additional measures to meet 2030+ ERCs over the baseline is estimated to be **€720 million per annum in 2030** (EU27, adjusted to 2025 prices). This is significantly lower than the cost of meeting ERCs estimated under the IA and CAO1 and likely reflects that **more of the policies and measures taken to achieve ERCs are now captured in the CAO4 baseline, including national air pollution control policies as well as (EU and national level) measures from related policy areas that create clean air co-benefits.**

CAO4 also estimates an additional cost of meeting the 2020-29 ERCs in 2020 of €162 million per annum, adjusted to 2025 prices. This is different to the IA, which suggested no additional effort was required over and above the baseline. This reflects the experience in practice that several Member States did not meet ERCs for particular pollutants in 2020, and hence additional effort should have been taken.

CAO4 presents an additional cost of meeting a linear interpolation between 2020 and 2030 ERCs for 2025 of €101 m per annum (adjusted to 2025 prices). This and the above cost in 2020 can be used to illustrate the costs over the evaluation period from 2016 to 2025. Assuming a linear trend between modelled years, and from zero additional cost in 2016, the present value cumulative cost of meeting ERCs (relative to the CAO4 baseline) is estimated to be around €678 m.

Table A - 38 – CAO key results and estimated abatement costs of meeting ERCs additional to the baseline (€m per annum, all adjusted to 2025 prices)

Study	ERCs	Key findings
IA	2020-29	No additional cost over and above the baseline over this time period
	2030+	The starting point-of-comparison for the abatement costs assessed by the IA for option 6C are: Annualised abatement cost in 2030 additional to the baseline of **€5 650 m across EU27**.

Study	ERCs	Key findings
		Accounting for changes made in the co-legislative process, illustrative estimates provide annualised abatement cost in 2030 additional to the baseline of around **€2 800 to 3 000 m in 2030 across EU27**. Assuming national air pollution control measures represent 33% of total cost, this produces **a cost for national air pollution control measures of around €1 000 m per annum** in 2030 across EU27.
CAO1	2020-29	No analysis performed of effort (and costs) required to achieve 2020-29 ERCs.
	2030+	Additional estimated cost of **€2 630 m per annum** in 2030 across EU27 additional to the baseline to meet the 2030+ targets relative to 'pre-2014' legislation baseline. Only a few Member States will have to take additional measures for SO_2 and NO_X beyond the fully implemented post-2014 legislation to meet ERCs. In contrast, the post-2014 legislation will not be sufficient to meet the ERCs for $PM_{2.5}$ and NH_3. Modelling suggests an **additional cost in 2030 of €1 405 m per year for EU27** to meet the NECD ERCs, over and above the '2017 legislation' baseline. Most of the difference in comparison to the 'pre-2014 legislation' baseline was seen in the domestic sector, in particular resulting from implementation of the Ecodesign provisions for solid fuel stoves and boilers.
CAO2	2020-29	CAO2 baseline projection suggests several Member States would not meet their 2020 ERCs: four countries for NO_X, seven countries for $PM_{2.5}$, 10 countries for NH_3 countries, and two countries for NMVOC. However, no costs are estimated to close the gap to ERCs.
	2030+	**Additional cost of NAPCP measures 'selected for adoption' over CAO2 baseline estimated to be €1 740 m in 2030 across EU27.** However, under the CAO2 baseline and NAPCP scenarios several Member States are estimated not to meet their 2030+ ERCs. Most prominently, for 22 out of the 27 Member States the baseline scenario results in higher NH_3 emissions in 2030 than allowed by the NECD (and for 15 Member States in the NAPCP scenario). For NO_X, $PM_{2.5}$, and NMVOC, respectively, the baselines of two Member States exceed their ERCs. No costs are estimated to close the gap to ERCs.
CAO3	2020-29	The baseline projections indicate that, for SO_2, all countries would be in compliance in 2025 with the 2020-29 ERC. For NO_X there is one country projected to be non-compliant in the baseline in 2025, none for $PM_{2.5}$ and for NMVOC, and 13 countries with projected non-compliance for NH_3. That said, relative to an indicative "2025 ERC" resulting from a linear reduction trajectory between 2020 and 2030 ERCs, the baseline projections indicate that: for SO_2 all countries are in compliance; for NO_X there are two countries projected to be non-compliant in the baseline in 2025, three for $PM_{2.5}$, one for NMVOC, and 19 for NH_3. **No scenario estimates the cost of meeting ERCs.**
	2030+	In 2030 in comparison to the 2030+ ERCs, no countries exceed their SO_2 ERCs, three exceed for $PM_{2.5}$, four for and NMVOC, one for NO_X, and 20 countries exceed their 2030+ ERC for NH_3. **No scenario estimates the cost of meeting ERCs**. MTFR meets ERCs for all but one pollutant in one Member State (NO_X in Malta). However, costs are significantly increased and MTFR over-achieves against many ERCs.
CAO4	2020-29	In the baseline, in 2020 the following number of Member States are modelled to exceed their ERCs: SO_2 one, NO_X three, $PM_{2.5}$ two, NMVOC three and NH_3 eleven. By 2025, all countries will comply with the ERC for SO_2 and NMVOC, with one exceeding $PM_{2.5}$, two for NO_X and seven for NH_3. However, more Member States have emissions above their linear trajectory to 2030. The additional costs of meeting ERCs over and above the baseline is estimated to be **€162 m per annum in 2020, and €101 m per annum in 2025 across EU27** (latter based on gap between baseline emissions and linear interpolation between 2020-29 and 2030+ ERCs in 2025)**.**
	2030+	For SO_2, the baseline projections indicate that all countries will be in compliance in 2030 and beyond. For NO_X, emissions of two countries were estimated above the ERCs for 2030. Eight Member States might be above the

Study	ERCs	Key findings
		$PM_{2.5}$ ERCs in 2030[241]. For NH_3, the majority (21) Member States are estimated to be in non-compliance in 2030. For NMVOC, three Member States are anticipated to be in exceedance by 2030. Under the ERC scenario, all Member States achieve the 2030 ERCs. The additional cost of meeting ERCs over and above the baseline is estimated to be **€718 m per annum in 2030 across EU27**.

[241] Although several of these instances are rather small according to GAINS calculations, i.e., Cyprus, Denmark, Portugal, within 1% of ERCs.

Table A - 39 - Additional costs above the baseline of achieving ERCs, split by Member State across CAO modelling studies in 2030 (€m per annum, price base adjusted to 2025), and ratio of costs between CAO4 and CAO1 studies – replicates table 3 from CAO1 Economic Impacts report and Table 5-8 from CAO4 (Member State split not provided for CAO2 and CAO3)

MS	CAO1		CAO4		Ratio of costs	Member State	CAO1		CAO4		Ratio of costs
	€m	% EU27	€m	% EU27			€m	% EU27	€m	% EU27	
AT	8	1%	-	0%	0%	LV	2	0%	2.2	0%	144%
BE	21	2%	0.6	0%	3%	LT	2	0%	-	0%	0%
BG	6	0%	1.3	0%	21%	LU	3	0%	2.2	0%	72%
HR	17	1%	6.7	1%	40%	MT	-	0%	2.3	0%	n/a
CY	-	0%	-	0%	n/a	NL	116	8%	1.9	0%	2%
CZ	35	2%	22.4	3%	64%	PL	76	5%	24.9	3%	33%
DK	2	0%	1.0	0%	68%	PT	9	1%	8.4	1%	92%
EE	8	1%	-	0%	0%	RO	14	1%	151.0	21%	1,102%
FI	6	0%	-	0%	0%	SK	6	0%	1.0	0%	17%
FR	111	8%	9.9	1%	9%	SI	3	0%	44.8	6%	1,473%
DE	805	57%	290.7	41%	36%	ES	17	1%	17.3	2%	103%
EL	5	0%	-	0%	0%	SE	2	0%	0.4	0%	25%
HU	14	1%	105.8	15%	772%	UK	56	n/a	n/a	n/a	n/a
IE	61	4%	22.2	3%	36%	**EU-28**	**1 461**	**n/a**	**n/a**	**n/a**	**n/a**
IT	62	4%	0.1	0%	0%	**EU27**	**1 405**	**100%**	**718**	**100%**	**n/a**

The reduction in additional abatement costs for meeting 2030+ ERCs at EU27 level between CAO1 and CAO4 hides variation across Member States, as presented in the table above. Some Member States see their additional costs rather stable between the studies (for example, Latvia, Portugal and Spain). For many Member States, costs have decreased substantially in line with EU27 wide trend (for example, Austria, Belgium, Bulgaria, Croatia, Estonia, Finland, France, Greece, Italy, Lithuania, Netherlands, Poland, Slovakia, Sweden). However, for a few other Member States, cost estimates have increased significantly, not only in terms of relative share of total EU27 costs, but also in absolute terms (for example, Romania, Hungary and Slovenia which under CAO4 face 21%, 15% and 6% of total EU27 costs respectively, whereas under CAO1 all facing very low - 1% or less - of total EU27 additional abatement costs).

It is difficult to identify precisely the reasons for the changes in cost structures given the large number of changes in the modelling between CAO1 and CAO4. That said, this is likely to reflect a mix of:

- changes to modelling assumptions that were previously too optimistic - e.g. in CAO1, assumptions around progress in the residential sector in Romania, Hungary and Slovenia were more optimistic relative to CAO4, with the latter capturing updates to emissions factors and technology structure based on new information available from Member States) and
- Some Member States have implemented effective air pollution control policies in recent years, while others have not yet sufficiently invested to ensure ERC compliance, and thus lag behind what was expected. E.g. assumptions around NOx emissions from transport in Romania were also more optimistic under CAO1, with

consultation under CAO4 revealing that fleets were older than assumed and emissions reductions in transport progressing slower than depicted in the modelling.

3.2.3 Additional modelling carried out for the evaluation – analysis of the cost of emission controls

The CAO series provide useful insight into the costs of emissions controls. However, it is challenging to use the CAO results to understand the influence of the NECD because over successive CAOs more and more abatement effort (some of which may be attributable to the NECD) is captured in the baseline. Hence, assessing the costs of achieving ERCs relative to the baseline (where such as scenario has been modelled) will not capture the costs of all abatement measures which have in some way been influenced by the NECD.

Further analysis has been performed using the outputs of the IA and CAO series to provide a different perspective on the costs of emissions controls and attempt to overcome this challenge.

The analysis presented in the CAO series compares the costs of the scenarios relative to the baseline in a given year – for example comparing scenario costs in 2025 to baseline costs in 2025 to present a net additional cost of the scenario in 2025. Instead, additional analysis has been performed comparing the costs under the baseline and scenarios in different modelling years *all relative to the baseline costs in 2015*. Hence, this analysis will capture the costs of all additional emission controls taken up after 2015.

The year 2015 is selected as this is the closest modelled year to the year in which the NECD was adopted. After this point it is likely that almost all further emissions controls are linked to the implementation of the NECD to varying degrees. However, not all these costs are linked and hence this analysis overstates the costs of the NECD.

It is also important to note that the outturn costs from this analysis will also be influenced by the underlying changes in activity (e.g. energy projections) which GAINS takes as an input from PRIMES model. These changes in activity influence the quantity and hence cost of emissions controls taken up in the scenario. These changes in activity will carry a cost to society (e.g. cost of additional renewable electricity generation), but these costs are not captured in GAINS and in the figures presented here. It is possible that these underlying activity levels have also been somewhat influenced by the implementation of the NECD. For example, efforts to introduce cleaner fuels or stoves/boilers in the residential sector would reduce emissions, however a key motivation for local action is likely to have been exceedance or concentration targets under the AAQD. Likewise, some Member States have introduced policies to control or reduce the number of animals and improve the efficiency of fertiliser application to reduce ammonia emissions, but the adoption of these practices may also have been influenced by the need to comply with the Nitrates Directive and Water Framework Directive. These examples illustrate that activity levels are influenced by a wide range of factors which vary in importance across Member States. That said, many of these factors are likely to be much more significant than the NECD, hence any influence of the NECD (and hence attribution of costs associated with changes

in activity to it) is anticipated to be small and certainly much less important than its influence on the take up of emissions controls.

The following table presents the costs extracted from the IA and CAO series and the relative change versus the 2015 baseline. The table also presents a cumulative Present Value cost over the period from 2016-2025, estimated by taking a linear extrapolation between modelled years, and discounting to 2016 using a 3% discount rate.

Table A - 40 – Analysis of IA and CAO cost estimates relative to 2015 (€m, 2025 prices, present value discounted to 2016 using 3% discount rate)

Study	Scenario	Absolute cost				Net cost relative to 2015		Total present value of net costs over period 2016-25
		2015	2020	2025	2030	2020	2025	
IA	Baseline	110 000	124 000	133 000	140 000	14 600	23 100	95 000
CAO2	Baseline	90 600	103 000	107 000	104 000	12 100	16 700	72 500
	NAPCP	-	103 000	108 000	106 000	12 000	17 700	75 200
CAO3	Baseline	88 700	88 000	98 900	95 500	-738	10 200	22 400
CAO4	Baseline	87 300	87 500	103 000	94 400	201	15 600	37 800
	ERC	-	87 700	103 000	95 100	363	15 700	38 500

Note: CAO1 costs are not assessed as only costs for 2030 are presented in the reporting. All figures in the table are rounded to 3 significant figures, hence in some cases the net cost may not reflect the difference in the rounded absolute costs between years.

Looking first at CAO4, which presents the latest and most up-to-date modelling, **the total (discounted) costs between the adoption of the NECD in 2016 to 2025 is estimated to be €37.8 billion**, with a slightly higher cost of €38.5 billion estimated to reach the linear extrapolation of ERCs in 2025.

These cost estimates are much greater than those presented in the previous section, where only the additional costs of the scenario above the baseline in a given year are considered. **The cost estimates here capture all changes post 2015 in the modelling**, of which the majority are likely to be in some way linked to the implementation of the NECD, but not all and hence this analysis overstates the cost of the NECD.

Between CAO4 and the other CAOs and IA, the absolute costs have changed significantly. It is not possible to fully unpick all the drivers for this change, but a key influence has been the sequential updates made to the underlying activity projections. It is also apparent from the table that in each CAO the absolute costs peak in 2025 and reduce to 2030. Again it is not possible to unpick the reasons for this, but it is likely to be the net effect of two competing drivers: (a) more and more stringent (i.e. expensive) measures (reflecting legislation) on each source; and (b) changes in underlying activity data which reduce the volume of sources to which emissions controls are applied (e.g. electrification of vehicles, switch from coal to renewable electricity generation). Changes in activity data reflect the effect of policies (including that of the NECD) on activities resulting in emissions of air pollutants.

In terms of net costs relative to the 2015 baseline in each study, the 2025 costs are fairly stable across studies. However, there is a large difference in the cost change between 2015 and 2020 between studies – there is a larger increase in costs between 2015 and 2020 in the IA and CAO2, and a much smaller increase under CAO4 (and even a decrease under CAO3). This result then drives the difference in total present value calculated between the studies. Again, it is not possible to unpick the precise drivers for this.

3.2.4 Additional modelling carried out for the evaluation – developing a new counterfactual

The costs assessed in the previous section will capture emissions controls taken up after 2015 but will also be influenced by the underlying changes in activity (e.g. energy projections) which GAINS takes as an input from the PRIMES model. To try and isolate the costs of additional emission controls alone (which are likely to be more closely attributable to policies additional to the 2015 baseline), additional modelling work has been undertaken under the CAO4 study.

This analysis developed a new 'counterfactual' scenario under which emission controls were held constant at 2015 levels. By comparing this counterfactual scenario to the CAO4 baseline, the analysis sought to provide further insight into the contribution of emission controls to the costs of achieving ERCs, relative to changes in activity levels.

Using this approach, **the costs associated with additional emission control measures post-2015 (in CAO4 baseline) are estimated to be**

- €12.3 billion in 2020, €24.6 billion in 2025 and €28.4 billion in 2030.
- This is equivalent to 0.08% of EU GDP in 2020, 0.14% of GDP in 2025 and 0.15% of GDP in 2030. Hence although additional emissions controls have carried a cost, relative to GDP these are relatively small.
- Deploying the same linear extrapolation approach between modelled years as in the previous section, this modelling implied a **total present value of costs between 2016-2025 of around €92 billion.**

This modelling is unable to provide an estimate of the costs solely attributable to the NECD as it also captures the combined influence of all policies acting together on emission controls but **can be interpreted as an upper limit of costs**.

Furthermore, given **this analysis isolates the costs of emissions controls over the 2016-2025 period**, which are more closely attributable to the NECD and policies affecting air quality, this analysis **could be seen to provide a more direct assessment of the related adjustment costs.** However, as noted above, it is possible that the NECD may have in some way also influenced underlying activity levels used as an input to the modelling, although the strength of effect is likely to be much less important than for emissions controls. Where the NECD has had some bearing on activity levels, this will also lead to this approach overstating the costs of the NECD as changes in activity levels have reduced costs.

Comparing between the two figures, the costs of emissions controls alone at €92bn are significantly higher than the combined costs of emissions controls and activity at €37.8bn – this demonstrates the significant reduction of costs that has been driven by changes in activity levels post-2015.

For the EU27 and all individual Member States costs are higher in all years under the CAO4 baseline relative to the counterfactual, as additional mitigation measures are taken up delivering greater emission reductions under the CAO4 baseline. The overall cost of these measures differs by Member State but again in comparison to GDP these costs are relatively small, with impacts in 2025 ranging from 0.45% in the Netherlands and Sweden, to 0.4% in Lithuania. The following figure also presents a comparison of the additional costs in the CAO4 baseline relative to the counterfactual but presents this relative to GDP of each Member State (for each Member State and modelling year separately).

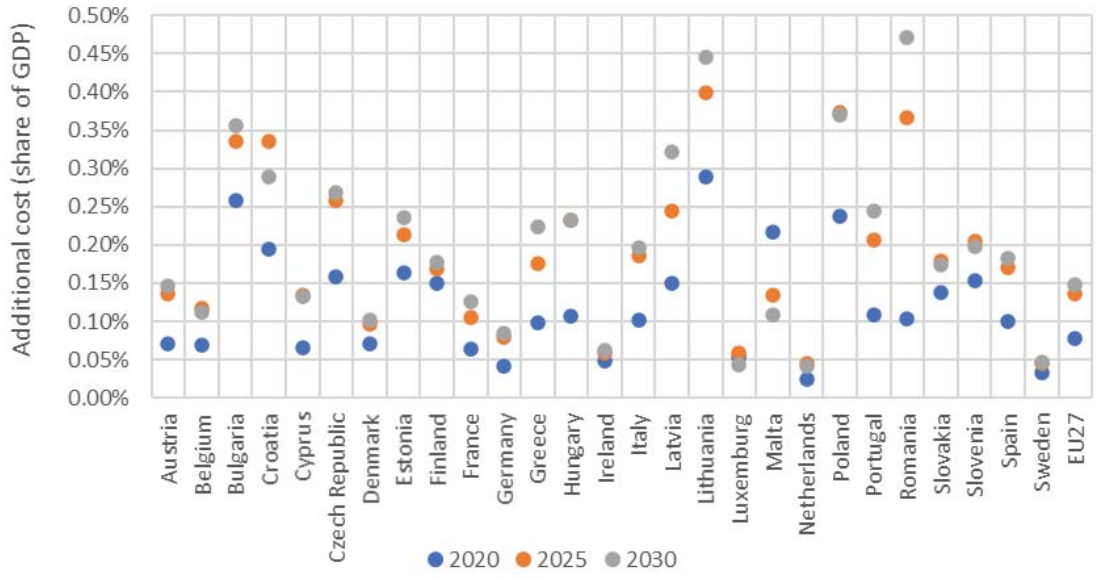

Figure A - 25 – Difference in abatement costs between the CAO4 baseline and the counterfactual (holding emissions controls at 2015 levels) - additional costs as a proportion of GDP

There is a more significant increase in costs from 2020 to 2025, than from 2025 to 2030. The cost difference is largely driven by more widespread adoption of measures in the transport sector (i.e. vehicle fleet turnover leads to a greater proportion of the fleet meeting the latest Euro standards), rather than additional policies in that sector post-2015. Furthermore, the analysis was also performed for different pollutant sources (e.g. cars, trucks). The comparison of costs between the CAO4 baseline and the counterfactual across 2020, 2025 and 2030 is seen to vary by pollutant source. This suggests that the NECD and other policies delivering emissions controls have had a greater influence on some sources relative to others, potentially placing a greater cost on some sectors relative to others.

3.2.4.1 NAPCPs and PaMs database (reported data)

Article 6 of the NECD requires Member State competent authorities to draw up, adopt and implement NAPCPs to limit their anthropogenic emissions in line with their respective ERCs. This is mandatory, and programmes must be updated every 4 years. NAPCPs describe the policies and measures (or PaMs) which Member States have or will adopt to meet their ERCs. Member States can optionally include cost-benefit analysis of these policies and measures. We carried out an analysis of data available on the costs (and benefits) of measures taken to meet ERCs, with the aim of identifying those driven primarily by the NECD.

The Commission periodically undertakes **horizontal review reports on the NAPCPs**. The latest report was published by the Commission in December 2024. This report presented the consolidated results of the EU-wide reviews of the NAPCPs and PaMs submitted by EU Member States between 15 October 2022 and 1 October 2024. At the time of the finalisation of the report, 18 Member States had submitted an NAPCP and/or PaMs. The review report includes a section summarising the information regarding the costs and benefits of PaMs, which is optional content in the NAPCP format. The primary conclusion was that **information on costs and benefits is rarely reported**. In fact, only two member states (Cyprus and Romania) used both the NAPCP and PaM tools to report this data. Three Member States (Spain, Lithuania and Slovenia) reported information on the absolute costs and sources of funding for additional PaMs in the NAPCP only. Romania was found to have the most comprehensive information reported on the costs and benefits of PaMs.

The 2022 horizontal review report analysed the PaMs of the 2019-2021 NAPCPs and included information submitted from all Member States (apart from Romania), giving a more complete picture of available information on PaMs costs and benefits. According to this report, 10 Member States (Bulgaria, Czechia, Estonia, Croatia, Slovakia, Sweden, Denmark, Cyprus, Ireland, and Latvia) submitted some form of PaMs cost estimation in their NAPCPs or through the EEA-PaM tool. Though this reflects a broader representation of Member States than the 2024 report, the information was mostly limited to a single value and was not supported by information on timescales or assumptions made, making it impossible to determine the robustness of the estimates. As such, the broad conclusions regarding cost and benefit assessment in this report are much the same as the updated 2024 version.

PaMs reported in Member State NAPCPs are combined by the EEA into the National Emission reduction Commitments Directive (NECD) policies and measures database[242] (also known as the EEA-PaMs or **PaMs database**). In total, the database captures 809 measures reported by Member States in their NAPCPs (noting this may contain some duplicate measures). Examining the PaMs database more broadly, there is significant variation between Member States regarding the number of PaMs reported, ranging from zero identified by Bulgaria, Finland and the Netherlands, to over 157 measures identified by Lithuania. Similarly, the number of PaMs which are adopted or not currently adopted

[242] Latest update available at the time of drafting this evaluation is 'ver. 3, Dec. 2024'

varies considerably, with 12 Member States having adopted all identified measures and five countries having adopted none of them.

Regarding the sectors addressed, transport and agriculture are the sectors for which most PaMs are reported, while waste management and industrial processes have the fewest identified measures (see figure below).

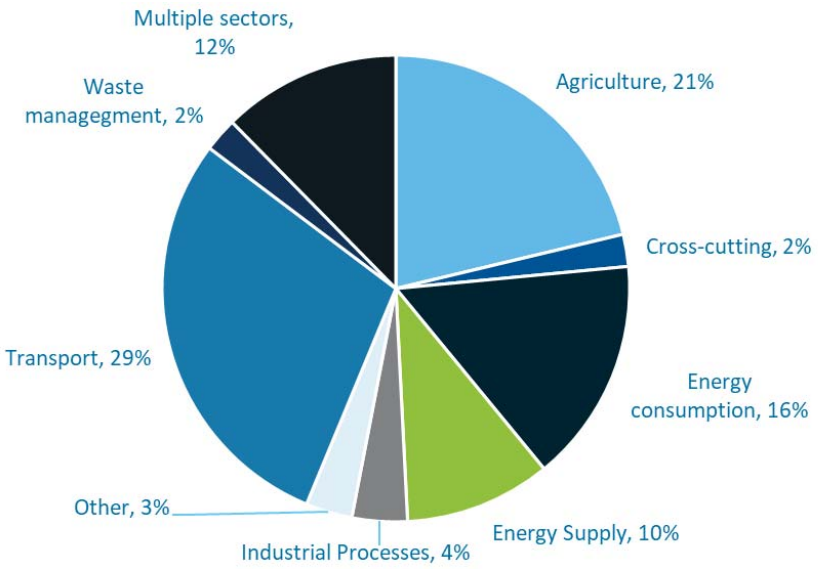

Figure A - 26 – Sectoral distribution of PaMs (source: EEA PaMs database, December 2024 version)

The cost data available in the PaMs database is also limited – a summary is shown in the Table A-41. Comparing the count of measures for which cost data is provided to the number of measures identified overall in the database, only 31 measures have any cost information, out of the total 809 PaMs (4% of measures). Data is only included for four Member States, and from these only Romania provided a dataset that allows to analyse the cost-effectiveness of measures (i.e. data is provided on both costs and benefits). To provide further illustration of the data contained, a summary of the cost and benefit information provided by Romania is included in the box below.

It is also uncertain how comparable estimates are between Member States, given no further information is provided regarding the figures or their estimation. This applies both in terms of the methodologies used to assess costs and benefits and consistency in their expression (for example, the price base used for each Member State's data is not clarified, nor whether these are per annum costs or cumulative). In addition, the absence of complete data for more than one Member State means data cannot be compared to other countries across sectors or measures, making it more challenging to sense-check cost estimations across Member States.

In summary, the lack of complete data and uncertainty around the methods used and data contained makes it impossible to estimate a complete, or even a partial, assessment of costs of NECD using the PaMs database.

BOX 7. Member State example: Romania's PaM costs

In the PaMs database, Romania provides cost data for measures across 5 sectors: waste management, industrial processes, transport, energy consumption, and energy supply. The absolute annual costs identified amount to almost €371 million, with 'costs abated' (i.e. abatement costs expressed per tonne of pollutant abated, or €/tonne) ranging from €4 per tonne of NMVOC abated (for industrial processes – 'Improving the reporting/recording of Category 2.D.3.a NMVOC emissions related to the use of household/household solvents') to €26 655 per tonne of $PM_{2.5}$ abated (for energy consumption – 'Residential sector package'). Absolute annual benefits from the measures quantified exceed €584 million. Both absolute costs and benefits are greatest for the energy consumption and transport sectors in Romania, though the benefit–cost ratio (BCR) of these sectors is similar to waste management and energy supply, at 1.4 to 1.5. Industrial processes, however, have a drastically higher benefit–cost ratio than all other sectors, at 690, making this the most cost-effective sector for NECD measures by far.

Table A - 41 – Cost data provided by Member States in the PaMs database

Member State	Sector	Costs abated (abatement costs expressed per tonne of pollutant abated)		Absolute costs		Absolute benefits		BCR
		Range (€/t) across measures	# PaMs with data	Sum across measures €	# PaMs with data	Sum across measures €	# PaMs with data	
Slovakia	Energy consumption; Energy Supply	€630 to €91 000 / tonne $PM_{2.5}$ depending on measure*	5	-	-	-	-	-
	Agriculture	€716 / tonne NH_3	1	-	-	-	-	-
	Transport	€2 140/ tonne $PM_{2.5}$*	2	-	-	-	-	-
	Cross-cutting	€36 000 / tonne $PM_{2.5}$*	1	-	-	-	-	-
Cyprus	Energy Consumption; Industrial Processes	€17 000 000 / tonne $PM_{2.5}$*	1	€841 000 000	1	-	-	-
Denmark	Energy Supply	-	-	€6,170 000	1	-	-	-
	Transport	-	-	€29 200 000	5	-	-	-
	Agriculture	-	-	€63 800 000	4	-	-	-
Romania	Waste Management	€15 200/ tonne $PM_{2.5}$*	1	€386 000	1	€551 000	1	1.4
	Industrial Processes	€39 to 108 / tonne $PM_{2.5}$*	3	€37 100	3	€25 600 000	3	690.0
	Transport	€11 000/ tonne $PM_{2.5}$*	2	€87 600 000	2	€125 000000	2	1.4
	Energy Consumption	€2 650 to 26 655 / tonne $PM_{2.5}$ depending on measure*	5	€283 000 000	5	€433 000 000	5	1.5
	Energy Supply	€13 200/ tonne $PM_{2.5}$*	1	€24 800 000	1	€35 500 000	1	1.4

Notes: Blank cells represent where no data is reported in the PaMs database - only Member States that provided data are included. Absolute cost data for Cyprus for measures under 'Energy Consumption; Industrial Processes' was unclear and deemed inappropriate to aggregate – hence only data for the row that contained the highest values for costs abated and absolute costs is presented, assuming this to be a total sum. '*' In PaMs database measure is reported as addressing several pollutants and costs abated are reported separately against each pollutant – for simplicity the table above only presents costs abated per tonne of $PM_{2.5}$.

To inform the evaluation, a detailed review of **NAPCPs** and their supporting documents has been undertaken, to check again the source information underpinning the PaMs database and horizontal reports. From this review it is clear that not all information on costs is carried through to the PaMs database. While the PaMs database contains cost information for only four Member States, a review of the latest NAPCPs revealed some form of cost evidence was available for 14 countries.

The table below summarises the information found in a review of the cost information in all Member States' NAPCPs and an example of such information is provided in the following box for Hungary. However, even though further information is available from the NAPCPs themselves, the data available is still not sufficient to form an overall estimate of abatement costs. The same issues identified for the data in the PaMs database also apply to the NAPCP data, in particular that: most do not provide an estimation of total costs; data is rarely comprehensive, omitting costs for specific measures or sectors; and the metrics in which costs are expressed vary significantly between Member States. The stakeholder engagement (targeted engagement with competent authorities) highlighted that often more detailed evidence and analysis around costs and benefits has been undertaken which may not be fully reflected in the NAPCPs – see next section.

Table A - 42 – Cost information in NAPCPs across Member States (Member States only presented where cost data contained in NAPCP)

Member State	NAPCP version	Detail
Bulgaria	2019	Cost and benefit data is provided for residential heating measures, in euros per tonne of $PM_{2.5}$. A weighted average cost of heating measures is estimated at €5 954 per tonne. Investment costs (until 2030) are also captured for these measures, estimated at €426 million, as well as Net Present Value (NPV) of benefits minus costs (totalling €1 321million) and an average Benefit-Cost Ratio (BCR) of 4.6. A price year of 2018 is used. Cost information does not capture other measures included in the NAPCP (transport and agriculture).
Croatia	2019	Absolute costs and benefits per year are given in euros for three individual PaMs and packages, but costs and benefits are not provided covering all PaMs listed in the NAPCP. For the three measures for which costs are provided, the total absolute costs per year are approximately €1 125 million. The average BCR (where benefits are estimated) is 77.3:1. A price year is not given.
Cyprus	2019	The cost for energy efficiency interventions until 2030 is estimated to be at least €1 billion, which is estimated to translate to an investment of 0.33% of GDP over 2018-2030. Investment cost data is broken down between household and service sectors, but not specific measures. A price year is not given.
Czechia	2023	Specific costs are only provided for one measure ('Replacement of heat sources in the Residential Stationary Combustion sector'), estimated to be up to CZK 17 billion (approximately €673 million). Qualitative analysis of the significance of costs is included for two further measures. A price year is not given.
Denmark	2019	Quantitative data are provided on funds allocated to certain (but not all) measures, but no total investment cost is given. Examples of the measures for which cost data are provided include scrapping old wood burning stoves, scrapping diesel cars, enforcement and control of NOx

Member State	NAPCP version	Detail
		fraud with trucks, and for the committee on ammonia reducing measures in agriculture. A price year is not given.
Hungary	2019	Costs provided for agriculture measures only, expressed per ha. See following information box for details.
Italy	2019	Costs for swine and poultry housing emission reduction strategies are provided in euros per place per year (up to €305 for swine; not provided for poultry) and in euros per kilogram of ammonia nitrogen (NH_3-N) reduced per year (up to €182/kg/year for swine and €48/kg/year for poultry). No other measures have specific cost information. A price year is not given.
Latvia	2019	For three measures ('Replacement of inefficient wood boilers with more efficient boilers meeting Ecodesign requirements' in households and 'Replacement of small and medium combustion plants (0.2-50 MW) with plants complying with requirements' (natural gas and solid biomass separately)), specific costs are detailed in euros per tonne of pollutant, totalling up to €20 000/tonne $PM_{2.5}$ and €64 000/tonne NO_x. For two measures ('Replacement of small and medium combustion plants (0.2-50 MW) with plants complying with requirements' (solid biomass) and 'Increased use of alternative fuel types' in road transport), pollutant emission equivalent reduction expenditure is provided in euros per tonne, equivalent, totalling up to €103 000/tonne PM_{equ}.
Lithuania	2022	A financial projection is provided for a number of individual measures, but not all. This totals €3.1 bn over varying time periods depending on the measure. A price year is not given. Furthermore, some of these costs cover administrative costs.
Malta	2019	An assessment of two road transport action scenarios (DS1 and DS2) is provided, detailing costs, investments, and the value of benefits and savings. The economic net present values were €992 million and €2 262 million (DS1 and DS2 respectively) and the BCRs were 2.56 for DS1 and 5.0 for DS2. No other cost information is provided. A price year is not given.
Romania	2023	Cost in euros per tonne of reduced pollutant emissions, absolute annual costs (approximately €400 million) and benefits (approximately €682 million), and cost-benefit ratios (average 0.465) are provided for 8 packages (costs are not estimated for only one package – 'Industrial processes and product use'). Data is provided in the recommended format. A price year is not given.
Slovakia	2019	Quantitative estimates of costs are only provided for two measures: €10 000 for transitioning households to low-emission heat sources, and approximately €28.9 million to connect households using traditional boilers to district heating. No other cost information is provided. A price year is not given.
Slovenia	2024	Overall costs are estimated at €2.5 billion for 2021 to 2030, equivalent to between €200 million and €250 million annually. This is broken down first into building renovation, industry, e-mobility, and electricity generation, then into more detail in a table addressing specific investment needs. For additional measures addressing air pollutant emissions and air quality, costs between 2022 and 2030 are estimated to be approximately €314.3 million.
Spain	2024	In the NAPCP, Spain explains the level of financial funding that the aid programmes will supply, however the cost of the individual PaM is not detailed.

An example of the level of detail provided around costs in some NAPCPs is provided by the box below. This presents the quantitative cost data contained in Hungary's NAPCP,

selected as it presents the most detailed information regarding costs of agriculture measures.

It is important to note that the data provided by the NAPCPs represents estimates (often forward looking) of costs – it does not provide recorded outturn costs.

Comparing between the costs estimated in the NAPCPs and the IA/CAO modelling is challenging given the variance in approaches and scope. For example, the NAPCPs include costs for measures covering both EU legislation (e.g. costs of replacing domestic stoves which is likely driven by Ecodesign), national air pollution measures and may assess measures captured by wider legislation (e.g. actions associated with implementing EU climate and energy policy).

Aggregating cost estimates across NAPCPs would not result in a complete cost estimate, given several NAPCPs do not include cost estimates. Furthermore, doing so would be challenging as the approaches adopted and the way of expressing costs differ between Member State.

Member State example: Abatement costs in Hungary's NAPCP - Agricultural Subprogramme

The following table presents data captured in the Subprogramme as an illustration of the cost data available in some NAPCPs and supporting documents. This does not capture analysis of the administrative costs associated with the measures, which in the majority of cases is qualitative. Although useful cost data is available for some measures, it is not available for all agricultural measures, a total cost per measure is not estimated and it is unclear from the information contained how a total cost should be derived.

Table A - 43 - Cost data associated with measures in Hungary's agriculture subprogramme

Measure	Costs for producers
Good Agricultural Practice – GAP	Calculations are in progress
Nitrogen balance at farm and national level	The construction of a demonstration plant may represent €20,000 – 120,000 /plant. (Voluntary)
Requirements for urea-based fertilisers (mandatory ban or introduction of additional measures)	An additional € 20 - 100/ha in costs, depending on the time and method of application and incorporation
Promoting the use of organic manure	Using, drawing up the nutrient management plans of, spreading and incorporating organic fertilisers represent additional costs (on average 15 % higher than the application of artificial fertilisers); construction of manure processing plant (€20,000 – 7.2 million); cost of authorisation of a product. Additional costs of spreading and incorporating organic fertiliser and additional costs of soil protection planning, soil sampling and laboratory testing (€ 70 – 720 /ha) - cost of application of litter manure is €220 – 290 /ha on average - cost of land application of slurry is €140 – 360 /ha on average, depending on the method of application and on conditions at the place of production
Prescribing conditions for land application of organic manure	(i) laboratory analyses of soil samples, preparation of nutrient management plans (market price from €3.6 – 7.2per sample of soil, from approx. €7.2 per hectare for planning); (ii) purchase of application machines (between €10,000 – 24,000)
Mandatory cover for slurry stores	Cover with organic material is €2 – 1,200 per storage facility, Cover with plastic and other films is €240 – 40,000.
Monitoring of animal feeding	not known
Requirements concerning the feeding of animals	On the basis of an inquiry into the pig sector, a) increasing the number of feeding phases leads to a reduction in feeding costs of 5-15 % per animal compared to single-phase reference techniques, b) reducing crude protein content might result in a change in costs of ± 5-8 %, c) using benzoic acid may involve additional costs of 1-7 %.

3.2.4.2 Further evidence regarding the costs of the NECD

The targeted engagement of competent authorities for this evaluation highlighted that further evidence and analysis of the costs of air pollutant abatement measures has been developed for some Member States, and in some cases this evidence has supported the development of NAPCPs.

For example, two studies were identified exploring abatement costs in **Denmark** which supported the development of the NAPCPs. It was noted that these studies were supplemented by in house socio-economic calculations before being presented to the appropriate government committees. A 2013 study from the Ministry of the Environment of Denmark[243] explored 13 emission abatement measures (mix of technical and 'policy' measures) across four pollutants: NMVOC (including requirements for refineries and VOC reduction from paints), $PM_{2.5}$ (including improvements to wood-burning stoves and particulate filters for ships), NO_x (including a NO_x tax) and NH_3 (including tightening BAT requirements for animal housing). For each individual measure the study estimated the annual budget cost for citizens, businesses and the state, but the analysis did not present directly a cost of the NECD nor a cost of achieving ERCs.

A second study[244] explored the costs of measures that can contribute to reducing ammonia emissions in 2020 and 2030 to help meet its obligations under the NECD. The study drew up a preliminary analysis of 18 instruments which were then combined into 6 measure groups. The study identified a shortfall of approximately 4.7 kt NH_3 between the latest emission projection available and the 2030+ ERC. The total cost across all measures assessed ranged from €51m – 104m per year (2025 prices, converted from DKK in 2019 prices), although the total emission reduction across all measures was around 9.3 kt NH_3 per year. The study did not group the measures into a combined scenario to achieve the necessary emissions reductions. For illustration, drawing on the outputs of the study, if measures were taken in order of increasing cost effectiveness, emissions reductions to meet the target could be associated with a cost in the range of €26m to 33m in 2030 (2025 prices). Although challenging to compare given the difference in study objectives, scope and approach, it is notable that these costs are higher than the abatement costs estimated for Denmark under both the IA (cost of €18m per year by 2030 under Option 6C, noting that this proposed option was overall more ambitious than the NECD as implemented[245] – see Table A-33) and CAO1 (cost of €2m per year, noting that this is associated with closing a similar gap of around 4 kt of NH_3 per annum in 2030[246] – Denmark was anticipated to meet ERCs for all other pollutants in 2030 under the baseline – see Table A-39.

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243 Ministry of the Environment of Denmark (2013), Virkemiddelkatalog for NOX, PM2.5, NMVOC og NH3 - Miljøprojekt nr. 1514, 2013

244 Jacobsen, B. H., (2019). Omkostninger ved virkemidler der kan bidrage til reduktion af ammoniakemission I 2020 og 2030, 35 s., IFRO Udredning Nr. 2019/05

245 Denmark's modelled reduction of NH_3 emissions under Option 6C in 2030 was 38% - see Appendix 7.1 of the IA – in comparison to the NECD 2030+ ERC of 24%.

246 See Table 6-5 in CAO1 Overview Report which compares emissions under the baseline in 2030 to 2030+ ERCs.

In 2019 the World Bank completed a study providing technical assistance to the Slovak Ministry of Environment in preparing the Air Protection Strategy for **Slovakia**. The study undertook several analytical tasks: defining the baseline in terms of emissions and air quality, assessing the emissions and economic impact of measures proposed for inclusion in the NAPCP (across road transport, residential heating, economic instruments and agriculture sectors), before assessing the air quality impacts of a scenario (WAM+) capturing additional emission reduction measures. Together these additional measures were modelled to deliver target emissions for 2030. The fiscal analysis of the WAM+ program showed its financial burden to the state budget to reach a net €649 million (2019 prices, or €798m 2025 prices, or €73m per annum over the period) spread over the period 2020-2030, with the costliest measures being connecting homes to either gas or district heating network, net of revenues earned from tax harmonisation of petrol and diesel. Although the study explored measures to achieve ERCs under the NECD, the report highlights that these measures will also contribute to the achievement of air quality standards under the AAQ Directive. Again although challenging to compare given the differences in study objectives, scope and approach (in particular as the World Bank study assessed impacts on fiscal burden rather than societal costs, and hence included revenue from petrol and diesel tax harmonisation as a benefit), these costs are lower than the abatement costs estimated for Slovakia under the IA (cost of €131m per year by 2030 under Option 6C, noting that this proposed option was overall more ambitious than the NECD as implemented[247] – see Table A-33) and CAO1 (cost of €6m per year, noting that CAO1 and the World Bank study had quite different assessments of the potential gap to be closed in 2030 across different pollutants[248] - see Table A-33). Responses to the targeted engagement of competent authorities indicated that since the study was completed in 2019, many of the data are now outdated. Slovakia is currently in the process of updating its NAPCP and as part of this work, the competent authority is updating the numerical data and evaluation of the proposed policies and measures (but without support of the World Bank). This engagement also highlighted that in Slovakia, district offices in regional capitals prepare programs to improve air quality (PZKO) with the goal of achieving good air quality for specific zones and agglomerations. These programs include long-term measures to improve air quality and also include an estimate of the financial costs for each implemented measure. However, final documents are not yet available for all districts, not all measures are costed and the measures focus on achieving air quality standards rather than emissions targets per se.

247 Slovakia's modelled reduction of NOx, NMVOC, SO_2, NH_3 and $PM_{2.5}$ emissions under Option 6C in 2030 was 59%, 41%, 79%, 41% and 62% respectively (see Appendix 7.1 of the IA), in comparison to the NECD 2030+ ERC of 50%, 32%, 82%, 30% and 49% respectively.

248 See Tables 6-3 to 6-7 in CAO1 Overview Report which compares emissions under the baseline in 2030 to 2030+ ERCs. The World Bank report anticipated emissions in 2030 of SO_2 and NH_3 to be slightly above those required by ERCs, and emissions of NOx and $PM_{2.5}$ to be more significantly above required levels, whereas CAO1 anticipated emissions in 2030 of SO_2, NOx, NH_3 and VOC to be significantly above required levels.

In **Sweden**, the agricultural agency[249] has conducted an assessment of ammonia reduction policies and measures. In the study, the cost of some of the measures is estimated, although this presents the costs to public authorities and does not include some costs for businesses. The study does not present a defined grouping of measures and cost required to meet the 2030+ ERC for NH_3. Noting that the challenges of comparing between studies given the differences in study objectives, scope and approach, again it appears that the cost estimates in these studies are higher than those estimated in the EU-wide modelling studies under CAO. CAO1 anticipated that Sweden would have a gap to its NH_3 2030+ ERC of around 3 kt in 2030, with measures costing €2 million to close the gap (see Table A-33). In the Swedish study, it is evident that multiple (if not all) measures would be required to achieve this level of reduction, and a simple sum of the costs estimated (costs are not estimated for all measures) comes to around €166 m upfront and €21m ongoing costs.

The **targeted engagement of competent authorities** also explained in some cases why NAPCPs do not capture cost information. In the case of Belgium (Flanders region), following the implementation of the original 2001 NECD, in-depth studies were commissioned by sector exploring how 2010 NECs could be met, including developing detailed marginal cost curves. However, this exercise was not repeated for the 2016 NECD as projections signalled that 2030+ ERCs could likely be met based on current legislation and no further additional measures are required. This was also the case for Finland where the competent authority flagged there were no additional PaMs and hence no associated costs.

Two Member States explained that often measures which contribute towards achieving the ERCs are governed by different departments or ministries within a Member State, and hence gathering comprehensive cost information is challenging. In another, plans are developed by separate district offices for different regions.

The Spanish competent authority explained that most significant cost estimates were contained in the National Energy and Climate Plan (NECP) and carried through to the NAPCP. This highlights the importance of the link between energy and climate policy and air pollution policy, with the NECP indicating measures with an investment cost of €308 billion over a decade.

In some cases, competent authorities flagged that no assessment of abatement costs was available, noting either this had not been carried out or was deemed too complex. In other cases, respondents did not comment. One Member State noted through the targeted stakeholder consultation that a cost-benefit analysis was being undertaken to support the forthcoming submission of its NAPCP.

Through the **open public consultation**, abatement costs for businesses (19 of 53 responses noted ‘high cost’) and abatement costs for Member States (7 of 53 responses noted high costs) were two of the top three cost categories indicated by respondents as associated with

[249] Jordbruks verket (2024), Uppdrag att utarbeta förslag till styrmedel för att uppfylla Sveriges åtaganden enligt takdirektivet - Redovisning av regeringsuppdrag, (unpublished – shared through the targeted consultation of competent authorities).

the NECD. The majority of respondents who provided a response indicated that abatement costs for business had been 'high' (19 of 53 responses, relative to 8 for 'moderate' and 5 for 'low/minimal'). As shown in the figure below, the majority of stakeholders signalling that abatement costs for businesses were 'high' were business associations. Opinion regarding the significance of abatement costs for Member States was more mixed, with the majority of respondents who provided a response suggesting costs were 'moderate' (12 of 53 responses, relative to 7 for 'high' and 5 for 'low/minimal') – 'moderate costs' was the most common response across business associations, public authorities and EU citizens. No further insights were provided through the open-text response option to elaborate on the nature or significance of these costs.

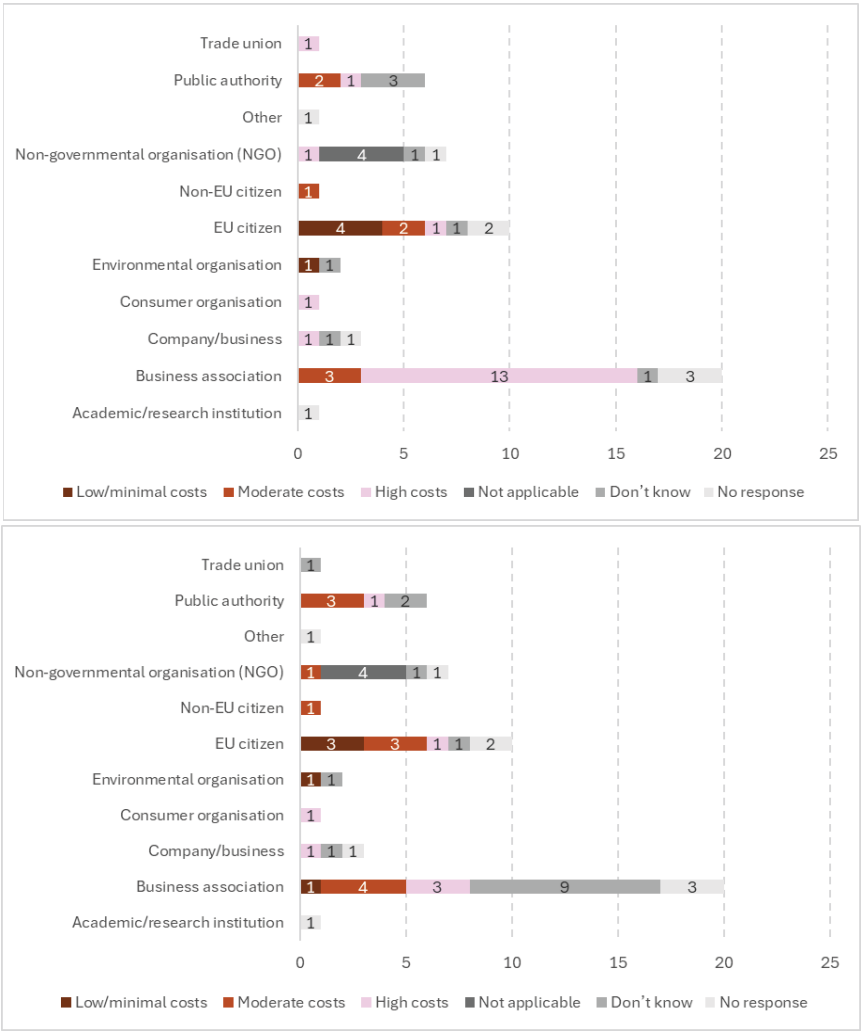

Figure A - 27 – Response to open public consultation, split by stakeholder type, for question on the significance of abatement costs (emission reduction measures) – business (top) or public authorities (bottom)

This response was mirrored in the response to the targeted stakeholder consultation, where abatement costs for businesses (14 of 41 responses noted either 'high' or 'moderate cost') and abatement costs for Member States (12 of 41) were two of the top three cost categories indicated by respondents as associated with the NECD. In this case, opinion around significance varied slightly, with the same number of respondents suggesting abatement costs for business had been either 'high' or 'moderate' (7 of 41) – as shown in the figure

below, this mix of opinions was common across both public authorities and industry association respondents. For abatement costs of Member States, more respondents suggested costs would be 'moderate' (7 of 41) than high (5 of 41), and the opinion of 'moderate costs' was predominantly provided by public authorities. Furthermore, some respondents signalled there had potentially been a cost for citizens, but that these had not been as significant as those for businesses and public authorities (6 and 2 of 41 respondents identified either 'moderate' or 'low' costs for citizens respectively).

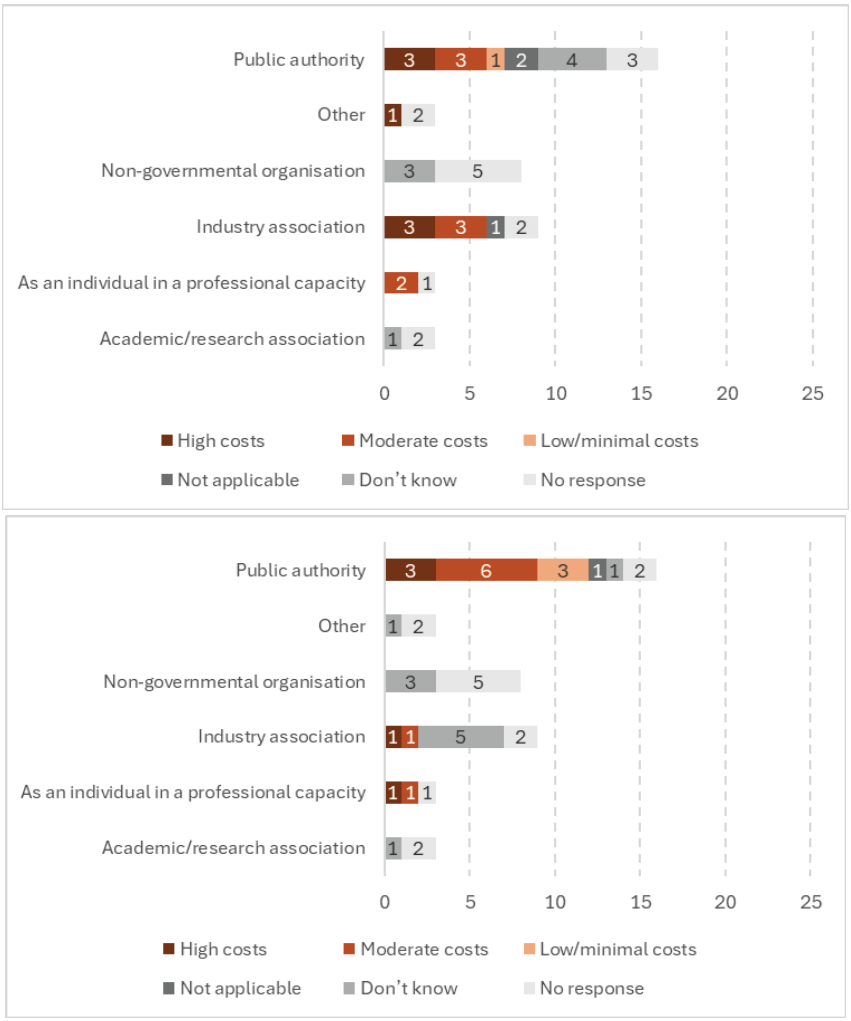

Figure A - 28 – Targeted stakeholder consultation response to questions: What have been the most significant costs associated with the NECD to date? Abatement costs (emission reduction measures) – business (top) or Member States (bottom)

Among public authorities, slightly more respondents to the targeted stakeholder consultation felt that national governments faced a more significant cost (6 of 41 respondents signalled 'high cost', with 9 identifying any level of cost), relative to local (2 of 41 respondents signalled 'high cost', with 7 identifying any level of cost) or regional administrations (3 of 41 respondents signalled 'high cost', with 5 identifying any level of cost).

3.2.5 Key conclusions

Action has been taken to meet ERCs through the deployment of a series of policies and measures to abate air pollutant emissions, triggered by different legislation at EU and national level. These actions will carry associated costs (or 'abatement costs'). **It is not possible to identify costs associated solely with the NECD**, **as measures which deliver emissions reductions are driven by a range of interacting policy (of which the NECD is one) and external factors.** This was a key challenge emphasized by stakeholders through engagement. However, studies have explored emission control costs to meet ERCs, which would all to some extent be linked to the NECD, but also to other policies and influencing factors.

Key evidence is presented in modelling studies which estimate costs for different scenarios and time periods, with 2030 as a common reference year used to present the additional annualised costs of achieving ERCs in that year, over and above the baseline. The **Impact Assessment** (IA, modelled data) published alongside the Commission's proposal for the NECD estimated costs for a range of options and provides the starting point-of-comparison. The preferred option included ERCs for 2020 which would be met under the baseline, and hence did not imply an additional cost. The preferred option also selected ERCs for the period after 2020, which carried an estimated annualised abatement cost of €5 650 million per annum in 2030 (adjusted to 2025 prices, EU27). The IA estimated that around 33% of costs would come through national air pollution control measures. Changes introduced in the co-legislative process affected the IA estimates as a point-of-comparison, in particular ERCs were made less ambitious, implying an annualised abatement costs falling in the range from €2 800 to 3 000 m per annum in 2030 (2025 prices, EU27).

The **Clean Air Outlook** (CAO, modelled data) series present forward-looking assessments of health and environmental benefits and abatement costs under various emission reduction scenarios. Changes in the scenarios assessed and the modelling methodology affect the comparability of estimates over time, and the ability to gain insight as to the 'costs of the NECD'. Additional costs (associated with emissions controls deployed over and above those in the baseline) of achieving ERCs were estimated to be **€1 405 m per annum in 2030** (2025 prices, EU27) under CAO1, lower than IA estimates mainly due to the inclusion of several EU policies in the baseline which were not included in the IA baseline. The most recent analysis under CAO4 estimates the additional costs of achieving ERCs to be **€718 m per annum in 2030** (2025 prices, EU27), reflecting an even greater level of action under EU and national air pollution control policies being captured in the baseline. For illustration, the CAO4 modelling could imply a **total (discounted) cost of €678m to meet ERCs over the evaluation period from 2016-25**, relative to the CAO4 baseline over this period.

Additional analysis undertaken using the outputs of CAO4 study estimated that **the total (discounted) costs of <u>all</u> emissions controls implemented post-2016 is estimated to be €92 billion**. These cost estimates are much greater than those presented in above as this analysis captures all emission controls adopted post 2016, whereas only the additional cost of the scenario above the baseline in a given year is considered above. Measures adopted

post 2016 are linked to air pollution control measures implemented after this date through all EU and Member State policies affecting air pollutant emissions (thus including but not limited to the NECD). **The cost of measures adopted post 2016 is equivalent to 0.08% of GDP in 2020, 0.14% of GDP in 2025 and 0.15% of GDP in 2030.** Hence, although there have been additional costs to work towards meeting ERCs, relative to GDP these costs are not significant.

The analysis sought reported information to complete the picture and to do a reality check. However, outside of the modelling studies there is limited information regarding abatement costs. These reported abatement costs also relate to different EU policy drivers, not only the NECD.

Cost information for three Member States was found – Cyprus, Denmark and Romania. Reported 'absolute costs' of measures range from €37 100 to €841 million, however caution must be taken when comparing between or aggregating across measures, as it is unclear if costs are estimated in a comparable way.

Further information on costs is available in Member State NAPCPs, with 14 Member States including some information regarding costs. For example, Bulgaria present a total cost to 2030 of residential heating measures of €426 million; Croatia report costs for three (but not all) PaMs and packages with a total annual cost of €1 125 million; Czechia report costs for replacement of heat sources in residential sector of €673 million; and Lithuania present costs for a number (but not all) measures totalling €3.1 billion. Again, caution must be exercised when comparing between Member States: costs are presented in different metrics (e.g. total or per annum), there is limited information on the underlying methodology to check consistency in approach, and costs are not estimated for all measures nor all Member States and not for the same timeframe.

Reporting costs in NAPCPs is optional and as a result, most Member States did not include cost data as in some cases costs were too challenging or complex to pull together. Other Member States do not include additional PaMs as ERCs are anticipated to be achieved without further action A limited number of wider studies have been identified which explore costs of abatement measures for some individual Member States, for example: a study assessing measures to abate ammonia in Denmark suggest a potential cost of around €26 million to €33 million per year to meet the 2030+ ERC; a study exploring abatement measures in Slovakia estimated a total cost of around €800 million to 2030 associated with a programme of additional mitigation; and a Swedish study identified additional ammonia reduction policies and measures with a combined cost of €166 million upfront and €21 million ongoing cost. Again, **it is challenging to directly compare between studies given the analysis varies in terms of metrics used and the underlying approach is not always transparent, furthermore such studies are not available for most Member States. This prevents using this information to form a reliable estimate of total costs or to confront this information with the modelled adjustment costs.**

3.3 Administrative costs and adjustment costs for businesses

3.3.1 Administrative costs for businesses

The NECD only places obligations directly on Member State competent authorities and the European Commission. The burden associated with these obligations are discussed in detail in the section on administrative costs of Member States and EU bodies above. The purpose of this section is to explore whether costs also fall elsewhere. In theory, no burden is directly placed on any other actors (including businesses). However, evidence gathered through the study suggests that some burden is passed through to businesses to assist the competent authorities in meeting their obligations.

Some Member States include information in their **Informative Inventory Reports** (or IIRs, reported data) related to private sector contributions to fulfilling obligations under the NECD. For example:

- Austria reaches out for information about activity data and emissions of the industry sector, mostly from individual plants, or in other cases, from the Association of Austrian Industries. Specifically, this includes direct information from energy and transport sectors, surveys to industrial processes and product use (IPPU) sector for companies and industry associations and distributing companies (sales data) from agricultural industry[250].
- In Finland, several industrial associations and companies provide data for the preparation of the inventory.
- Croatia asks for activity data via a questionnaire, to certain sectors such as major natural gas producers, road paving sector, pharmaceuticals and biogas facilities. Data gathered includes disaggregated energy balance, vehicle fleet information, input and output fuels and uses of specific abatement, amongst others. The IIR notes that these data are gathered under the IED and ETS.

There is also evidence that some Member States do not require specific business input. For instance, Malta's IIR did not provide any evidence of direct business input into the development of the emissions inventory.

In October of 2024, the European Commission issued the results of a survey sent to farmers which ran between March 7 and April 8, 2024. This aimed to:

- understand the burden placed on farmers by procedures and rules linked to financial support under the common agricultural policy (CAP), as well as other EU rules for food and agriculture in the EU (the answers thus covered both administrative burden and difficulties related to adjustment); and
- identify sources of concern and complexity in the way these policies and schemes are applied in the EU countries.

[250] Austria's Informative Inventory Report (IIR) 2024, page 32

26 886 responses were received, with 45% of respondents stating that compliance with rules related to the emission of air pollutants had a high complexity, 20% stated medium complexity and only 7% stated a low complexity. This reveals that air pollution measures (although not specified as NECD) are perceived as a complex task. It is important to note that compliance with other environmental and sanitary rules was also perceived as complex: 57% of respondents perceived plant health and pesticides-related rules as highly complex. The same percentage is 53% for nitrates, 48% for water, 40% for Natura2000, 33% for animal health and animal welfare.

Through the **targeted engagement with businesses** carried out under the present study, most responses provided insight on administrative effort related to agricultural businesses:

- One response was related to NH_3 emissions reporting undertaken by farmers. In one Member State, farmers are reportedly required to enter a significant amount of information (such as the number of animal places, manure management systems, growth and feeding data) into a pre-defined emissions calculator, with more data needed with more diverse production, leading to greater complexity. Completing these requires systematic data collection throughout the year, entering the data into the calculator, and then inputting the results into the administration's system, with the information then being reported to the EU. The respondent estimated that approximately 10 days are taken for each pig and poultry farm to report this information. However, the NECD was not considered to be the driver of this reporting: instead, the collection of this information was attributed to the IED and IEPR. The response also confirmed that this information is currently only reported once even though it is relevant for different pieces of legislation. The respondent expressed concern that this could change in the future. Overall, however, the response did not indicate that any additional burden on business was created by the NECD.
- Another response included feedback on a high level of administrative burden for farmers particularly in relation to detailed registration of farm activities. This includes a declaration for the production, processing, storage and/or use of fertilisers. Overall, it is estimated that 20 days of administrative effort is used to comply with these reporting requirements. The stakeholder described that this data is also used for obligations under the Nitrates Directive, IED and IEPR, and indicated that the information needed is very detailed to a level not necessary for these other obligations.
- A third response stated that administrative burden in the agricultural sector was relatively low. However, the response noted that activity data is collected (number of animal and housing systems) through a national data reporting system as part of a mandatory scheme for fertiliser plans and accounts. Since the reporting of activity data is an integrated part of the national scheme, the stakeholder noted it is difficult to isolate any additional costs related to NECD specifically.

Separately, one other response detailed information provided by businesses in the refining sector. The response explained that EU refining industries already report under the IEPR the information Member States need to calculate industrial emissions and comply with NECD obligations. As such, the stakeholder elaborated that assessing any costs associated with the NECD is extremely difficult, and administrative efforts, and reporting structures

required for NECD obligations may simultaneously be used to meet the requirements of other EU regulations. As a result, the stakeholder concluded that NECD-specific reporting costs may be concealed within broader compliance activities associated with other legislative instruments.

The **targeted engagement of competent authorities** provided further insight into where information is gathered from businesses, the type of information gathered and where this is used. Of the 16 Member State responses, 14 provided a response on the question if data is gathered from businesses to support competent authorities to meet their obligations under the NECD. Of these, 13 Member States reported data and information gathered from businesses is used in the development of emission inventories and projections. Furthermore, 3 Member States stated that they also use data gathered from businesses to support NAPCP development.

In terms of the types of information gathered and used, common responses included data or information on (in brackets we provide indications as to whether the data points are linked to other policies to indicate the likeliness that this data is already available):

- emissions of large point sources (IED),
- VOC estimations from certain sectors (IED),
- industrial production (EU industrial production statistics – PRODCOM – via Eurostat),
- all stationary source emissions data (IED, EU ETS for GHGs, MCP Directive),
- amounts of waste (Waste Framework Directive),
- projections of emissions and estimated reductions through abatement techniques (IED, NECD),
- fuel sales (Fuel Quality Directive; EU Monitoring, Reporting and Verification Regulation),
- fuel production from refineries (quality and volume of fuel via the Fuel Quality Directive, fuel combustion and production processes via the EU Emissions Trading System, pollutant release via the IED),
- vehicle sales (CO_2 emissions of vehicles),
- airport movements (Single European Sky initiative),
- fertilizer consumption (indirectly through the Nitrates Directive, CAP if benefiting from related programmes),
- number and method of keeping livestock from producers (farm structure survey via Eurostat),
- animal and crop production (farm structure survey via Eurostat, CAP),
- protein consumption (CAP via data regarding agricultural practices including feed usage).

However, the engagement also revealed that additional burden associated with the NECD is likely to be very limited, and/or burden is attributable to the NECD only in very specific cases. **In only three cases did competent authorities reveal the NECD as the primary driver for collecting certain data from businesses**:

— **Germany** noted collecting information from businesses to support **reporting of emissions of large point sources (LPS)** as per NECD Annex I Table C. This data is collected from the energy sector, the metal industry, mineral industry, chemical industry, waste and wastewater management, paper and wood industry, intensive livestock production and aquaculture, food industry and others. This data was collected from 1 374 businesses in 2021, but importantly **no data was collected from SMEs**. There was no estimation of the time it takes businesses to provide/ collect this information. Reporting of emissions of large point sources is a reporting obligation of the NECD every four years. This information is collected under the NECD as height class information is not part of the E-PRTR reporting and LPS reporting under the NECD is not limited to large point sources that are emitting above the E-PRTR threshold values for releases into the air (see ANNEX II of EC/166/2006).

— **Estonia** stated that information collected from businesses is primarily used to **develop emissions projections** under the NECD, however it is not a legal requirement to conduct such work. Affected businesses include the largest polluters subject to environmental permits, equating to ~30 installations, who report every 4 years. This would create a low burden for the NECD; whilst the competent authority does ask for more data, it is likely mostly available already (i.e. through permits).

— **Finland** gathers solvent use data from smaller companies that do not report their data to the national Compliance Monitoring Data System at the Centres for Economic Development, Transport and the Environment (solvent survey). This is requested annually from 80-100 businesses in the printing, paint and plastics industries. The data is usually collected as part of their internal processes. Some additional time is needed to compile the data to the survey response.

Overall**,** whilst three Member States mentioned that the NECD was the primary driver (at the European or national level), it is important to note that all activities to develop inventories and projections under the NECD also contribute to compliance under the GP. None are therefore attributable only to the NECD, when gathering data for the establishment of the emissions inventories (including large point sources) or projections.

The majority of Member States stated that the NECD was not the primary driver for collecting information from businesses which is used to meet obligations under the NECD. Instead, respondents reported that the information is already collected or made available under a different legislation or processes. Examples of these other mechanisms included: the Industrial Emissions Directive, the E-PRTR (and IEPR)[251], the Large Combustion Plant and Medium Combustion Plant Directives, data being available as part of permits or Corporate Social Responsibility (CSR) reporting and energy and climate

[251] According to the supporting study to the Fitness check of monitoring and reporting obligations arising from EU environmental legislation (IEEP, 2017), the majority of the burden from the EPRTR Regulation stems from internationally derived obligations through the UNECE Kiev Protocol. https://ieep.eu/wp-content/uploads/2022/12/ICFIEEP_2017_Support_fitness_check_MR_report_with-annexes.pdf.

legislation, as well as many crossovers with the Gothenburg Protocol (as reported by Finland). In more detail:

- **Denmark** uses data from the E-PRTR requirements, 'green accounts' and CSR. Data is gathered to support inventories. Whilst follow up with the competent authority directly revealed that the work required from businesses is increasing beyond mandatory submissions, no information was available in terms of number of businesses, frequency or estimations of time taken from business. It is concluded that, if any, only a very low additional burden is caused by the NECD.

- **Greece** stated that plant-specific data from the Public Power Company, as well as from the EU-ETS and E-PRTR is used. Additionally, they stated that there is ad-hoc contact with plants when clarifications on reported data are required. Further data used includes fertilizer consumption data from the Association of Fertilizer Producers & Traders. The Member State did not provide any further information in terms of number of businesses, frequency, or what businesses have to do to collate the information including a quantification of the time burden here.
- **Spain** contacts approximately 216 companies and business associations in various sectors[252] by email with a specific MS Excel file to fill out, requesting information about their activity, process descriptions, facilities, and, if available, emission data. This information is collected yearly, and businesses typically reply within 1-2 months. This information is collated in order to comply with both NECD and Governance Regulation. Thus, the burden is shared between the two policies, and data is expected to be available due to other policies (e.g. via IED-related requirements).

- **France** stated that the data collected from industrial operators for the purpose of the **inventory** are governed under French law which does not incorporate the NECD within its scope. Therefore, the competent authority did not perceive that data was collected directly from businesses to meet the NECD obligations, which had not already been collected under other legislation or obligation.

- **Croatia** states that for **inventory** purposes, some data is collected annually from legal entities via questionnaires. For example, data on solvents used is collected from pharmaceutical companies, data on the number and method of keeping livestock from producers, data on fuel production from refineries, etc. Some of the data is collected in the national PRTR, some as part of the obligations of the national statistical office. This affects 2 companies in the oil processing industry, 7 in the pharmaceutical industry,

252 Sectors within scope are aluminium manufacturing, automotives, sugar mills, cement manufacturing, lime manufacturing, coke plants, thermal power plants, calcium carbide manufacturers, railway industry, natural gas, glass industry, landfills, steel industry, refining, paper and paper pulp, extruded polystyrene manufacturers, firefighting equipment manufacturers, ceramic manufacturers, gypsum manufacturers, foundries, waste management and recovery, perfume and cosmetics, vinyl manufacturers, food and beverages, aggregates manufacturers and extraction, paints and printing inks manufacturers, wood protection, agricultural associations, water supply and sanitation, rubber manufacturers, pharmaceuticals, hydrocarbon transport and electrical equipment manufacturers.

~40 biogas plants, and ~30 farms[253] (79 businesses in total). This information is collected annually, based on data that companies already have available. It is estimated that this takes a maximum of 3-4 hours per year per business to collate and report. There is therefore a very low burden linked to the NECD.

— **Hungary** states that information already available is used for **inventory** compilation, most importantly data in the National Environmental Information System, collected already by the government from businesses. They also state that some important industrial plants are also contacted for additional information or for data validation. Clarification directly from plants about reasons of sudden changes in specific emissions may also be necessary. The inventory compilers usually contact also the European Solvents Industry Group for their VOC emission inventory. The communication is usually via email, not via formal surveys. This affects 'very few' businesses, and the data is collected annually, or less frequently. No estimation was made in terms of time taken to complete this.

— **Luxembourg** can request IED installations to annually report various administrative and thematic data under the IED and PRTR reporting obligations. Examples of data collected include activity data, energy consumption, emissions and measurements of emissions as well as updates to authorisations. The Member State simplifies submission procedures for companies, with a 'once only' principle. According to the IEPR database there are 50 relevant installations in Luxembourg[254]. The Member State reported that this information is collected under the IED and IEPR reporting obligations (i.e. there are no requirements under the NECD for businesses but the data submitted under other flows is used for inventories).

— **Netherlands** sends a survey[255] to businesses that fall under annex I of the IEPR every year, totalling about 1 000 facilities. This is required by other legislation; IED and EPRTR/IEP.

— **Portugal** noted that they send a **survey to farmers** to specifically aid the development of the **NAPCP**. Portugal also asks for information on fuel sales, vehicle sales, airport movements, vehicle inspection data, port movements, product production amounts, feedstock consumption amounts, animal and crop production, fertilizer consumption, amounts of waste, industrial production, protein consumption and burnt areas. The information is collected through email exchange and database consultation. It was not possible for the competent authority to provide an exact number of engaged businesses, as the data is collected from their associations, federations and other representative bodies. The data is collected as needed, usually once per year. The data requested for NAPCPs is already collected and reported under other legislative obligations, and the key driver for all information is the Regulation (EU) 2018/1999 on the Governance of

253 Croatia are planning inventory improvements. These are set to cover about 100 cattle farms, 200 pig farms and about fifty poultry farms.
254 Data last updated March 2025. https://doi.org/10.2909/21e758c6-a9ac-4a7d-a64a-19d2ba9eecb7
255 Survey available (in Dutch) in the Appendix I

the Energy Union and Climate Action (about 90% share of data requested). Businesses are usually requested to provide data within 30 days.

- **Romania** stated that certain activity data from main producer associations such as those in agriculture, are used for **inventories and projections** as well as the development of **NAPCPs**, however this information request is minimal and already available. Other businesses are also engaged, within all sectors targeted by the NECD (industry, agriculture, transport, waste, energy, economy etc). Hence in many cases, competent authorities are making use of data already available to them and are not requesting new or additional data and information to support compliance with the NECD.

- **Sweden** reports that data required is already available due to the E-PRTR and EU ETS obligations. This is relevant for over 1 300 facilities in the country[256].

- **Slovakia** reported that based on Act No. 146/2002 on air protection, operators are required, under Section 34, Paragraph 2, Letter d), to report annually, by the end of February, selected, complete, and truthful data about stationary sources, the amount of emissions, compliance with emission limits, technical requirements, and operating conditions for the previous calendar year to the National Emission Information System, in the scope specified by the implementing regulation under Section 62, Letter h), and, upon request, provide additional data about the stationary source and its operation to air protection authorities. This affects more than 8 000 operators of large and medium-sized air pollution sources annually. Operators must continuously collate this information throughout the year. In terms of time that this takes, this depends on the size of the company providing the data and how many facilities it has from which emissions originate. The respondent noted that the NECD is not the main driving force for collecting data. Directive 2010/75/EU on industrial emissions (IED) and Directive 2015/2193 on the limitation of emissions of certain pollutants into the air from medium combustion plants are also drivers.

It is also important to note that even if certain obligations are reported as solely attributed to NECD inventory development, they will, by design, contribute to the GP requirements as well.

As explained, there is quite limited evidence of costs falling on businesses that are a result of implementation of the NECD. Based on the small sample of data and insights provided through the targeted engagement of competent authorities, an illustrative **quantification of potential administrative burden on businesses in the EU** has been made as presented in the following table**.** The table also presents key steps and assumptions taken to develop the estimates – it is important to note that this table presents the outputs of analysis undertaken by the support study and does not present values provided by the competent authorities themselves.

256 https://utslappisiffror.naturvardsverket.se/sv/Sok/

The following table and analysis make quite major assumptions with proxy figures developed in order to make use of the abovementioned data provided by national competent authorities – hence this analysis cannot be relied up as robust estimates of burden but merely serve to **illustrate an approximate order of magnitude** of burden placed on businesses.

In the majority of cases Member States noted that data gathered was driven by the NECD and another EU or national legislation driver. To reflect this, the estimated costs have been adjusted to illustrate a value more 'attributable' to the NECD. Where Member States provided an illustrative quantitative split between the NECD and other drivers, this has been used. Where a quantitative split was not provided, a 50% split is applied, which in some cases might lead to quite an overestimate of the NECD related burden (e.g. where data is used that has been reported under the IED/IEPR).

Where no interaction was reported to be the case (e.g. Estonia), no split is applied. However, as mentioned above, it is still important to consider that **all activity to develop inventories and projections is expected to contribute to GP.**

Table A - 44 – Illustrative quantification of order-of-magnitude of administrative effort for businesses under the NECD – total across all businesses (where data requests are reported to be mainly driven by the NECD, cells are shaded). Results of the support study analysis based on information and insights provided by competent authorities.

Member State	Quantification (MS level, annual, 2025 prices)	Assumptions
Estonia	€75 000	• Requirement seems quite challenging. Assuming around €10 000 -15 000 per business to produce a plan in order to meet future air pollutant targets, with emissions projections calculated (equivalent to cheapest NAPCP cost). • Data given was that 30 businesses must do this every 4 years. The total was therefore divided by 4 to present an annual average. • Identified the NECD as primary driver for collecting information; no split applied.
Spain	€17 300	• Based on the information provided, the requirement does not appear onerous as it mainly concerns compiling available data. Therefore, we assume maximum of 1 day per business per year to compile. • NECD not main driver of data collection, burden shared with Governance Regulation based data request (GHG inventories). Thus, a 50% split has been applied.
Finland	€9 710	• Based on similarity of data provided, the same calculation as applied to Croatia has been applied here, using the Finnish wage rate and number of businesses affected. • NECD/GP main driver for solvent survey; no split applied
Croatia	€2 340	• Based on information provided (3-4 hours per business reported), wage rate applied hourly and multiplied by number of businesses affected. • NECD not the main driver for data collection, data already available. Even though the response from Croatia details cross-over with other policies, they do draw out an estimate made solely on collating and reporting data for the NECD. Therefore, this burden is treated as attributable to the NECD.
Hungary	€815	• Based on description of work, this is likely collating information that is already available.

Member State	Quantification (MS level, annual, 2025 prices)	Assumptions
		• Assumption is that ~10 companies (response noted 'very few') each take 1 day to fulfil this requirement annually. • NECD not the main driver for data collection, data already available. The response details additional effort related to the NECD requirements only, therefore no split is applied.
Luxembourg	€2 880	• Assuming the same requirement as Croatia. • Using calculation used for Croatia (and Finland) with the wage rate for Luxembourg based on 50 IED installations as per the most recent update to the E-PRTR (10 March 2025). • NECD not the main driver for data collection, data already available through IED. A 50% split is applied.
Netherlands	€417 000	• Based on the survey available that companies are required to fill out, assuming 3 days of work per company. Fairly intensive. • NECD not the main driver for data collection, data already available through IED. A 50% split is applied.
Portugal	€1 190	• Assuming that 50 companies spend 2-3 days fulfilling the requirement. • NECD not the main driver for data collection, key driver is the Governance Regulation (90% share). Figure reflects the 10% attributable to the NECD.
Romania	€256 000*	• Unclear based on data received what exactly is asked, however activity data should be easily available for operators. Assuming 1 day of compilation for reporting. • NECD not main driver for data collection, data already available. A 50% is applied. • Data not available on number of businesses. Thus, the analysis assumed all installations covered by the IED here. It is highly unlikely that all businesses within each sector described are involved, so this may be a significant overestimation. However, there is no data to show number of businesses that are involved.
Slovakia	€1 840 000	• Based on a large number of operators (>8 000) and assuming 5 days of work each based on complexity of requirement. • NECD not the main driver for data collection, data available via IED. A 50% split is applied.
Average business burden for activities defined by Member States, per year, Member State level	**€262 000 (range €815 - €1 840 000)**	• Estonia provides the best estimate for NECD attributable burden; however, the figure comes with key assumptions as listed above. It should also be noted again that this exercise is voluntary. • This presents a very wide range, with the average being raised significantly by 2 within the sample (Netherlands and Slovakia).
Average business burden for activities defined by Member States, per year, Member State level	**€97 700 (range €1 190 - €417 000)**	• This average leaves out the highest and lowest outlier values (HU and SK).

Note: The table uses the wage rates defined on Eurostat for industry for each Member State (excluding construction). It also assumes a working year of 230 days.

Overall, competent authorities considered the significance of the work necessary for business to collate the requested data to be very low. In most cases, businesses were reportedly gathering this information for internal purposes or for compliance with other EU or national requirements. Not many Member States could provide an estimate of the time it takes businesses to gather data, but those who provided a response suggested that the burden would be small or take only a matter of a few hours. In fact, some Member States have national policies in place aimed specifically to minimise the burden on business, such as 'ask once' principles, where businesses legally do not have to provide the same information twice. As such, the figures presented above should be used for illustrative purposes only, as they include many assumptions, primarily around effort for companies in terms of time taken. Furthermore, it is expected that for all items there is a complete overlap with the GP. Relative to other costs, these are minimal. For instance, the burden for competent authorities is around €1 million per annum, and compared with adjustment costs, estimated burden is very small.

Some further insights into the potential burden placed on businesses were provided through the **open and targeted stakeholder consultations**, some corroborating the evidence gathered through the targeted engagement of competent authorities. Seven public authorities gave insight on this topic through the TSC and revealed that business input is necessary to obtain data for emission inventories. Furthermore, some sectors can be involved in the development of emissions projections. Public authority respondents suggested this might present a small to medium burden on relevant entities.

In total (noting both surveys had limited sample sizes), 6 of 41 respondents to the targeted stakeholder consultation and 23 of 53 respondents to the open public consultation stated that there were 'high' or 'moderate' administrative costs for businesses associated with the NECD. These respondents were mainly from public authorities and industry associations, with the largest stakeholder group identifying this were business associations responding to the open public consultation (14 responses). However, the response was mixed, with a further 7 of 41 responses to the targeted stakeholder consultation and 9 of 53 respondents to the open public consultation believing there are 'low/minimal costs'. This response came mostly from those who identified as EU citizens, those from business associations and others (see figure below). Some respondents provided further insights into the nature of the burden through open questions, with one respondent elaborating that the indirect impact of the Directive on industry includes **increasing administrative burden associated with double reporting across different legislation.**

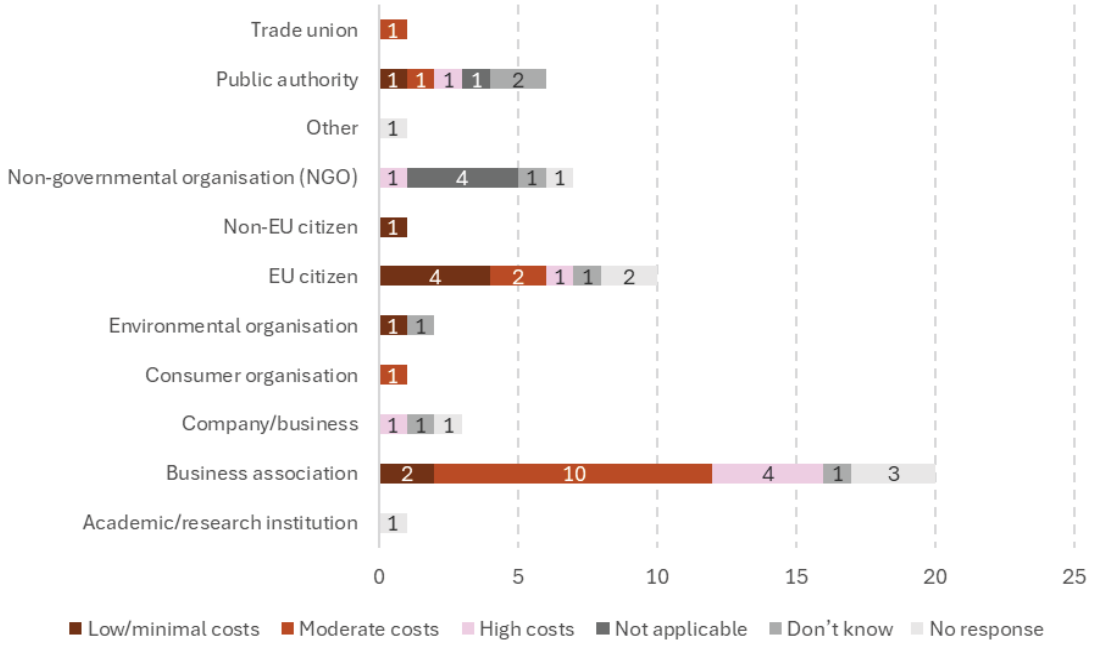

Figure A - 29 – Stakeholder response in the OPC to the question on the extent of administrative burden on business

In summary, data and information collected from businesses is used by many Member States to develop emissions inventories and projections, but data in specific cases is also used to support compliance with other obligations. However, where business data is used, the collection is often not primarily driven by the NECD, and the information is already available through reporting under other legislation or corporate processes. In specific cases, there may be a degree of additional consultation or input from business, particularly in relation to Annex III Part 2 measures for NAPCP development, albeit such cases are rare. Overall, of the Member States who stated that they do require business input, it can be concluded that all reveal either no or very low additional burden. Where extra data is asked for (such is the case for Estonia, Spain and Portugal) it is likely that businesses already have the data available. However, there is evidence to suggest that some installations, not necessarily covered by key sectoral legislation such as the IED are subject to burden. For instance, Finland's IIR details the coverage of installations which is wider than that within the IED. The Finnish database, used for reporting installation information, includes information from about 31 000 installations, of which only about 1 000 fall under the IED.

3.3.1.1 Administrative costs for small- and medium-sized enterprises (SMEs)

The IA anticipated that there would be no additional administrative burden for SMEs[257].

There is extremely limited evidence related to any NECD attributable burden for SMEs. Some Informative Inventory Reports (IIRs) touch on the topic explicitly. For instance, Finland's IIR notes that small and medium sized facilities are not requested to report to the authorities, suggesting no burden for SMEs. Furthermore, although Germany seems to

[257] https://ec.europa.eu/governance/impact/ia_carried_out/docs/ia_2013/swd_2013_0531_en.pdf: page 312.

have the most comprehensive/ burdensome national obligations for businesses that are attributable to the NECD, no SMEs are affected by the information gathering process.

Limited further insights were identified through the **targeted engagement of businesses**. The responses received focused on the potential administrative burden for farmers, a sector with proportionally high representation of SMEs. Responses noted that farmers do face a reporting burden, with one expressing concern around potential future growth in burden if companies are increasingly asked for information to meet, for example, the Corporate Sustainability Reporting Directive, and other climate-related obligations (considering NH_3 is a GHG). However, another response suggested that burden could be considered proportionate since SMEs generally have less work to do under the requested data gathering exercise. Multiple responses noted that it is not possible to attribute reporting burden for farmers solely to the NECD.

Thus, the analysis did not find any additional burden for SMEs linked to the NECD.

3.3.2 Adjustment cost for businesses

Implementing the abatement techniques required to meet ERCs will carry an associated adjustment (abatement) cost, as explored in the section dedicated to the indicator on adjustment costs. These costs could fall to varying extents on a range of different economic sectors and actors (e.g. businesses, households, public administrations, etc). Where costs have fallen will depend on how each Member State planned to meet its ERCs – in particular, this will depend on:

- which abatement measures have been identified for implementation;
- the policy mechanism chosen for delivery;
- the extent to which public funding is used to offset additional costs;
- source-specific and other EU legislation which impacts on emissions and that may also have influenced how costs have fallen across economic actors and sectors.

The implications of these costs then for the economic actors or sectors on which they fall will also depend on their response, and whether they can and have taken action to pass-on these costs – for example businesses which face an abatement cost, may raise prices for consumers to cover these additional costs.

The following section first reviews information presented in the IA on the distribution of costs as a point-of-comparison. It then summarises relevant analysis from the subsequent CAO series, before collating further information around how costs have fallen across different economic actors.

3.3.2.1 Impact assessment and CAO studies

The **IA represents** the point of comparison for estimating adjustment (abatement) costs (modelled data). The IA did not contain analysis on where costs would fall but included a split of the estimated abatement costs under each option by Selected Nomenclature for

reporting of Air Pollutants (SNAP) sector[258]. These are presented in the table below, alongside the cost split for Scenario 1 (the baseline), noting that the NECD as implemented likely sits somewhere between options 6B and 6C in 2030.

Table A - 45 – Estimated cost of modelled policy options, split by SNAP sector in 2030 (€m per annum, 2025 prices, compared to baseline) – replicates Tables 16 and 17 from the IA. Data for EU28, IA did not present SNAP sector split for EU27

SNAP Sector	1	6A	6B	6C	6D
Power generation	10 842	55	151	664	5 569
Domestic combustion	13 591	79	464	1 853	29 871
Industrial combustion	3 908	37	266	1 023	2 816
Industrial Processes	7 660	26	190	508	6 172
Fuel extraction	942	-	-	8	846
Solvent use	1 746	21	23	110	18 594
Road transport	80 125	-	-	-	-
Non-road machinery	18 681	2	8	222	4 578
Waste	2	9	11	14	14
Agriculture	2 716	93	457	1 967	8 694
TOTAL	140 212	323	1 571	6 366	77 155

The largest additional costs were modelled to fall on the domestic combustion (29% under 6C in 2030) and agriculture sectors (31%), with significant costs also falling on the industrial combustion (16%), power generation (10%) and industrial process (8%) SNAP sectors. 2025 follows the same pattern of results as 2030.

The IA noted the above costs were allocated by type of activity, but that these activities can take place in different economic sectors. The IA also presented the costs split by economic sector (for 2025 – this split was not presented for 2030) – those for options 6B and 6C are replicated in the table below.

In this case, the sector on which most costs fall are 'households' (32% under 6C in 2025) – hence a significant proportion of the costs of meeting ERCs was anticipated to be faced directly by households and associated with abatement relating to domestic combustion. Unlike businesses, households do not have the option to pass through costs to customers but may receive support through funding and other policy mechanisms. Relative to overall household consumption, the additional costs were assessed to be relatively small (0.01% under 6B and 0.02% under 6C).

Table A - 46 – Estimated cost of modelled policy options, split by economic sector in 2025 (€m per annum, adjusted to 2025 prices, replicating IA Table A7.7). Data for EU28, IA did not present SNAP sector split for EU27.

Economic sector	6B (€ m)	6B (% of total cost)	6B (% of sector output)	6C (€ m)	6C (%)	6C (% of sector output)
Agriculture	515	28%	0.07%	2 169	31%	0.27%
Chemical Products	55	3%	0.00%	265	4%	0.01%
Coal extraction	-	0%	0.00%	-	0%	0.00%
Construction	2	0%	0.00%	38	1%	0.00%

[258] The Selected Nomenclature for Air Pollution was developed in the EMEP/EEA (Air Pollutant Emission Inventory Guidebook) project and is a structure of source categories for activities resulting in emissions.

Economic sector	6B (€ m)	6B (% of total cost)	6B (% of sector output)	6C (€ m)	6C (%)	6C (% of sector output)
Consumer Goods Industries	23	1%	0.00%	149	2%	0.00%
Oil extraction	2	0%	0.00%	2	0%	0.00%
Electricity supply	116	6%	0.02%	402	6%	0.07%
Ferrous and non-ferrous metals	158	9%	0.01%	352	5%	0.02%
Market Services	37	2%	0.00%	82	1%	0.00%
Non-Market Services	3	0%	0.00%	5	0%	0.00%
Refineries	157	9%	0.04%	521	7%	0.13%
Other energy intensive	126	7%	0.01%	592	8%	0.03%
Transport	5	0%	0.00%	29	0%	0.00%
Transport equipment	-	0%	0.00%	2	0%	0.00%
Water Transport	2	0%	0.00%	155	2%	0.05%
Households	633	35%	0.01%	2 285	32%	0.02%
TOTAL	1 830	100%		7 047	100%	

The remaining costs were anticipated to fall on businesses in different economic sectors. Agriculture was anticipated to be the most affected business sector (facing 31% of total costs under 6C in 2025), followed by 'other energy intensive' (8%), refineries (7%) and electricity supply (6%). Relative to total sector output, abatement costs were anticipated to be small – those most affected were agriculture (costs equivalent to 0.27% of sector output), and refineries (cost equivalent to 0.07% of sector output).

Although the abatement costs are estimated to fall directly on these economic sectors, this does not present a complete picture. This captures the first order effects on those economic actors obligated to reduce emissions, however, investment in abatement techniques will have knock-on effects throughout the economy. Therefore, consideration of where costs ultimately fall needs to be considered:

- Which sectors benefit from expenditure in pollution control by delivering the investment goods, and which other expenditure would be crowded out;
- Price effects, and the consequences of price changes for international competitiveness and for consumers.

To capture these effects, the IA undertook Computable General Equilibrium (CGE) modelling using the GEM-E3 model. This model takes as an input the estimated additional costs placed on different economic sectors and models the subsequent knock-on effects throughout the EU economy as those directly affected respond. Overall, the estimated aggregate GDP impact was very small for Option 6C: an estimated reduction of 0.025% in GDP where health and environmental benefits achieved through improvements in air quality are not included, and a neutral effect where these benefits are included. Several of the sectors that require additional efforts in terms of pollution abatement investment, such as ferrous and non-ferrous metals, chemicals and the power sector, were observed to benefit from additional demand for the delivery of the required investment goods

throughout the economy and see an overall net output increase once these benefits are taken into account. The sectors that face net reduction in output (even after accounting for benefits) were agriculture, petroleum refining and consumer goods industry sector.

CAO1 (modelled data) also produced a disaggregation of the abatement costs split by sector, as replicated in the table below. As under the IA, agriculture was anticipated to face a significant proportion of the additional cost of meeting ERCs, estimated to be 40% under CAO1, although absolute additional costs were similar to those estimated in the IA (in the range of costs between options 6B and 6C). Both the power sector and industry sectors are anticipated to face a greater proportion of the costs relative to that anticipated in the IA, but again the absolute costs estimated for these sectors remain similar to the levels anticipated in the IA. The most significant change is the costs falling on the domestic sector, which reduced significantly under CAO1 relative to the IA both in absolute and relative terms. The key factor here is the inclusion of the Ecodesign Directive in the baseline ('2017 legislation' scenario) – this was anticipated to drive significant improvements in domestic solid fuel burning with associated costs, that under CAO1 are now captured in the baseline and are no longer additional. However, it is important to note that these costs for households remain 'real' costs that households are likely to have faced, independent of whether these are classified as 'baseline' or 'additional'.

Table A - 47 – CAO 1 - split of abatement costs by sector to 2030 under the '2017 legislation' baseline and scenario depicting cost-effective achievement of emission reduction requirements (ERRs) in 2030 (replicates Table 2 in the Economics Overview, adjusted to 2025 prices)

Sector	Unit	'2017 legislation' baseline	ERR 2030 scenario	Additional costs
Power sector	€m per annum	15,615	15,966	352
Domestic	€m per annum	6,350	6,436	87
Industry	€m per annum	15,508	15,936	428
Road transport	€m per annum	65,735	65,735	-
Non- road mobile machinery	€m per annum	14,264	14,275	9
Agriculture	€m per annum	3,227	3,813	586
Total	€m per annum	120,699	122,162	1,461
Power sector	%	13%	13%	24%
Domestic	%	5%	5%	6%
Industry	%	13%	13%	29%
Road transport	%	54%	54%	0%
Non- road mobile machinery	%	12%	12%	1%
Agriculture	%	3%	3%	40%
Total	%	100%	100%	100%

CAO1 deployed the JRC-GEM-E3 model to assess market costs (and benefits) of the clean air policy measures. This modelling sought to capture the knock-on effects throughout the wider economy leading on from the direct costs of abatement required. As noted above, approximately 40% of the additional pollution control costs to reach ERCs fall on the agricultural sector – this translated into an 0.08% output reduction for the sector. However, the benefits of avoided lost workdays and improved crop yields partially mitigates this

output loss through improvements in competitiveness, leading to increased exports and a smaller estimated reduction in output compared to the cost- only assessment. The other sectors identified to reduce output as a consequence of abatement costs are: 'Coal, oil & gas', ferrous and non-ferrous metals and consumer goods industries (all reducing output by 0.01%). However, for these and all other sectors (bar agriculture), action to meet ERCs leads to increased net output levels when the benefits in terms of avoided lost workdays are accounted for.

The **CAO2** reporting (modelled data) did not include a split of the estimated abatement costs by SNAP or economic sector. It did however repeat the macro-economic modelling of economy-wide effects using the JRC-GEM-E3 model. Under the NAPCP scenario (noting this scenario does not completely achieve ERCs across all Member States), the 'crop' sector displayed a reduction in output of -0.15%, that is only partially compensated by higher crop yields from improved air quality. The 'livestock' sector experiences a more significant reduction in output (-0.45%). Output levels in all other sectors (power sector, fossil fuels, industry and services) were estimated to be net neutral or increase in response to the scenario.

As noted under the indicator on adjustment cost, the specification of the scenarios under **CAO3** (modelled data) prevents drawing insights regarding the costs of the NECD and their distribution, as all existing action (at EU and Member State level) is captured in the baseline and cannot be isolated. The reporting presents macro-economic modelling using the JRC-GEM-E3 model but does so for scenarios where ambition goes further than meeting the ERCs under the NECD. This aside, interesting insight is provided by comparing between the CAO3 and 'REPowerEU' scenario modelled under CAO3 as an alternative baseline: REPowerEU has very slightly higher, almost similar, costs of air pollution control in 2030 compared to baseline costs. While the total costs do not differ significantly, there are some more significant shifts in the distribution of costs across sector. In particular, abatement costs in the power sector alone were modelled to increase by about 60% in REPowerEU compared to the baseline scenario (but noting that the absolute change when viewed relative to other sectors was not significant). In addition, abatement costs in transport are estimated to decline (lower number of vehicles that need expensive Euro 6 and 7 controls) compensating for higher cost of controlling larger capacity of power plants.

CAO4 (modelled data) did assess the effects of a scenario to meet ERCs but did not present a cost split by economic sector. That said, the macro-economic modelling using the JRC-GEM-E3 model was replicated. Under this analysis, the 'livestock' (-0.154% reduction in output in 2030) and 'crop' (-0.037% reduction) sectors were observed to face the largest percentage reductions in output under the ERC scenario relative to the baseline, followed by 'fossil fuels' (-0.004% reduction). Under pessimistic assumptions regarding the benefits, all three sectors were observed to face a reduction in output. However, under more optimistic assumptions regarding the size of the benefits (i.e. when crop yield benefits were included and higher, more recent, estimates of productivity benefits through reduced health impacts were assumed), crop and fossil fuel sectors observed an increase in

output. The net effect on livestock sector remained negative across all sensitivities modelled (ranging from -0.152% to -0.068% net reduction in output in 2030).

3.3.2.2 Wider evidence and insight

Although the obligation to meet ERCs is placed on Member States, costs are likely to be faced by a wider range of economic actors. This is recognised by Member States themselves in the **NAPCPs** – for example, Latvia notes that *the total cost of emissions reduction will be shared between private individuals, economic operators, central and local government* (Latvian NAPCP, 2022). How costs will fall between actors will depend critically on the policies put in place to deliver the abatement techniques.

Article 7 of the NECD aimed to facilitate access to existing Union funds to support the achievement of the ERCs. In doing so, this had the potential to influence the distribution of abatement costs, in particular, shifting some of the **burden to EU funds**. According to the most recent budget contribution estimates (see table A-59), the EU budget is spending €171.4 billion (bn) over the period 2021-25 to the clean air objective (or €34.3 bn per annum over the period). This is in addition to €46.4 bn reported over the 2014-20 spending period as reported by the Commission (or €6.6 bn per annum).

The comparison of these budget figures to the abatement costs that are produced by the modelling studies varies depending on what emissions controls are considered (and hence which may be supported by budget contributions). For example, CAO4 estimated the:

- additional cost of meeting ERCs[259] relative to the baseline, in 2025 was around €101 m per annum (2025 prices, EU27), although this only captures the additional emissions controls over and above those assumed to be taken up under the baseline, which in turn captures a range of EU legislation and national air pollution policies which will deliver emissions controls.
- additional cost of meeting ERCs in 2025 relative to emission controls adopted in 2015 in the baseline was €15.7 bn per annum (2025 prices, EU27), although this only captures the cost of additional emissions controls adopted after 2015 (either under policies included in the baseline or as additional effort to reach ERCs).
- total absolute cost (i.e. not net of baseline costs) of meeting ERCs in 2025 was €103 bn (2025 prices, EU27).

However, there are reasons why the figures may not be directly comparable. The most important difference is that the modelling studies do not capture the cost of all policies and measures that abate emissions (e.g. 'climate and energy' actions are captured in the baseline or underlying activity projections), whereas EU funding going to e.g. energy efficiency improvements or roll-out of non-combustible renewable sources of energy is considered (at least partially) in clean air tracking. The majority of funding in recent years has been sourced from the Recovery and Resilience Facility (RRF). The most relevant objective for clean air initiatives under the RRF is the 'green transition'[260]. Within this

[259] Based on linear interpolation between 2020-29 and 2030+ ERCs.
[260] https://ec.europa.eu/economy_finance/recovery-and-resilience-scoreboard/green.html

objective, the policy areas receiving the most funding are energy efficiency, sustainable mobility, and renewable energy and networks. Much of expenditure in these areas comes with clean air co-benefits[261].

Other reasons (but which are expected to have less impact on the comparison) are that:

- The modelling studies focus on the costs of abatement measures implemented over the evaluation period. By contrast, EU funds may invest in innovative measures which carry costs now, but which will not be 'implemented in the modelling' until a future period. An example of this is the 2Zero Partnership, which aims to accelerate the development of zero tailpipe-emission road transport in Europe, contributing to improved air quality and mobility safety for both people and goods. The Partnership was funded under the Horizon Europe mechanism from 2021-27 and contributes to the longer-term path towards a climate-neutral European road transport system.
- The modelling studies focus on the costs of technical measures to deliver emissions reductions. By comparison, EU funds may cover the costs of a wider range of actions beyond simply the technical costs of the abatement, but which may facilitate emissions reductions (e.g. an information campaign for farmers on ammonia reduction).

Given different EU funds could support different measures across a range of different sectors, it is not possible in most cases to interpret the extent to which EU funds may have supported abatement in any one economic sector more so than any other. One exception to this is the CAP, which focuses on agriculture – in this case the CAP budget contribution amounts (estimated and with the exception of investments) are significantly smaller than the abatement costs estimated in the modelling studies: for example, CAO1 estimates an absolute cost (i.e. not net of the baseline) of EUR 3.8 bn for agriculture in 2030 to meet 2030+ ERCs (see Table A-47).

In their NAPCPs, some Member States also elaborate on proposed arrangements to finance particular measures, which in turn will impact on the proportion of adjustment costs faced by different actors. Where information is provided, it appears that there is an intention for the majority of the abatement costs associated with meeting ERCs to be covered by public sources, therefore limiting the potential costs which are placed on businesses and households. For example:

- Lithuania (Lithuanian NAPCP, 2022) detail a financial projection of €3 bn against 31 separate measures. Potential sources of funding are noted to be: the Climate Change Programme, EU and other international financial support funds, the State budget and other legitimate funds.
- Romania (Romanian NAPCP, 2023) elaborate that: For the coming period, there are several funding sources at local level that can be accessed by local authorities,

[261] Clean air coefficients aligned to EU climate coefficients for the RFF and programmes under CPR for the 2021-27 MFF; https://ec.europa.eu/economy_finance/recovery-and-resilience-scoreboard/green.html

with the most important being EU funds under the 2021-2027 ROP (2021-2027 Regional Operational Programme) or the JTOP (2021-2027 Just Transition Operational Programme), including six Romanian counties. There are also national programmes for local and regional development which can be accessed. Figures are not provided.

- Slovenia (Slovenian NAPCP, 2024) highlight that in their case, funding for additional measures to reduce emission of air pollutants (with the exception of agriculture) will mainly come from the Climate Change Fund, cohesion funds and the national budget. The funding for direct reduction of emissions on farms will be provided mainly from the European Agricultural Fund for Rural Development (EAFRD).

The **stakeholder engagement** activities provided further insight regarding the perception of the costs of the NECD. Through the open public consultation, abatement costs for businesses (19 of 53 responses noted 'high cost') was the top cost category indicated by respondents as associated with the NECD. The majority of respondents who provided a response indicated that abatement costs for business had been 'high' (19 of 53 responses, relative to 8 for 'moderate' and 5 for 'low/minimal'). The majority of stakeholders signalling that abatement costs for businesses were 'high' were business associations.

This response was mirrored in the response to the targeted stakeholder consultation, where abatement costs for businesses (14 of 41 responses noted either 'high' or 'moderate cost') were again the cost categories indicated by respondents as associated with the NECD. In this case, opinion around significance varied slightly, with the same number of respondents suggesting abatement costs for business had been either 'high' or 'moderate' (each 7 of 41).

This mix of opinions was common across both public authorities and industry association respondents. Through the targeted stakeholder consultation, a small number of respondents iterated that a cost was placed on civil society, through their role in monitoring and enforcing compliance with obligations under the NECD. One respondent also noted that some costs had likely fallen on households.

Furthermore, respondents to the targeted stakeholder consultation believed that the NECD had helped Member States deliver their obligations under the Gothenburg Protocol more efficiently. 23 of 41 respondents reported efficiency improvements in helping Member States plan and design policy to abate emissions, and 17 of 41 noting efficiency improvements in the cost of measures to abate emissions. In both cases, non-governmental organisations and public authorities were the most prominent stakeholder categories noting that the NECD has had the strongest effect in these cases.

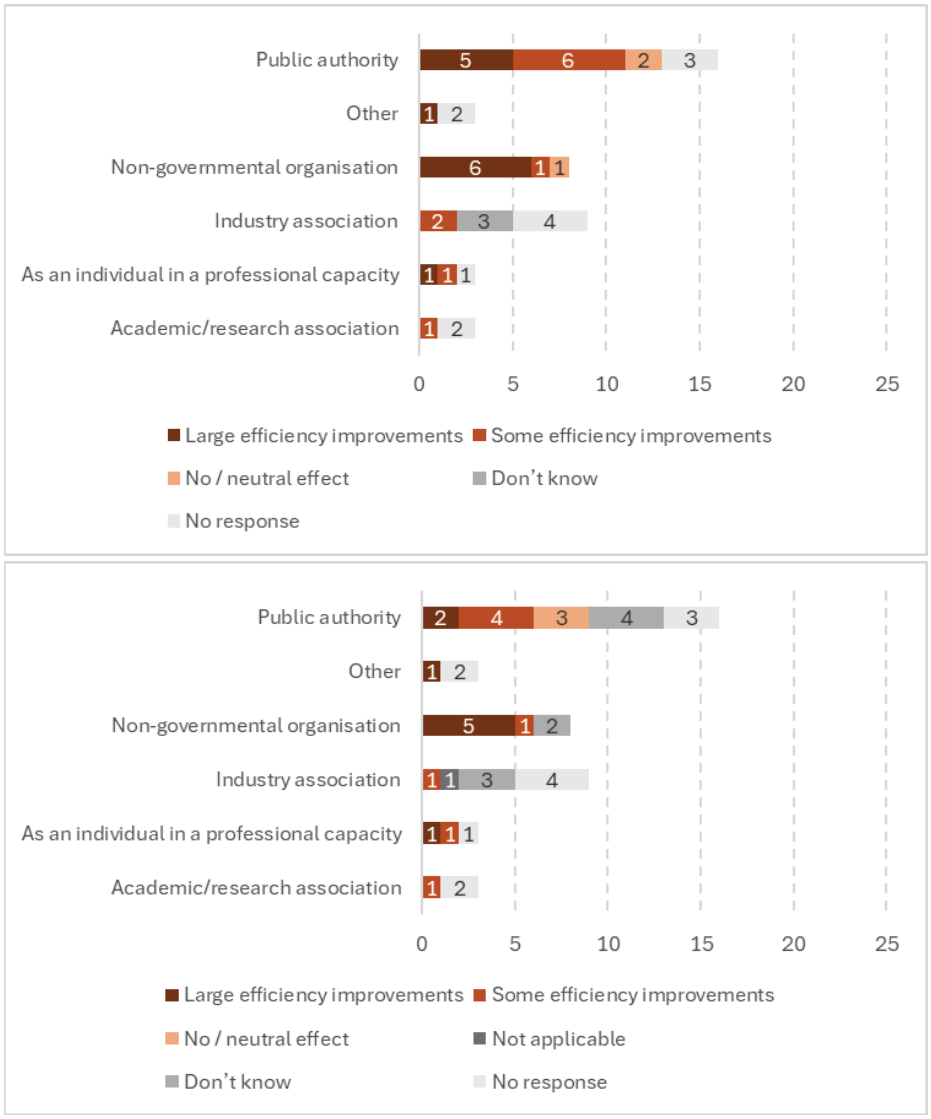

Figure A - 30 – Targeted stakeholder consultation response to question: To what extent has the NECD helped Member States to deliver on their international commitments under the Gothenburg Protocol more efficiently? Planning and design of policy to abate emissions (top) or Cost of measures to abate emissions (bottom)

In response to **the targeted engagement with businesses**, four stakeholders reported that the abatement costs for the agriculture sector had been high. One stakeholder explained that farms are required to use various emission-reducing practices and technologies (e.g., manure handling, storage, and spreading, and feeding), with some measures incurring significant costs (e.g. tightly covering a manure storage facility can double its price), elaborating that costs are specific to each farm. Another noted significant costs associated with required improvements in animal housing, noting that techniques are not available for all farm types nor possible for all existing farms, whilst installation costs are very high and do not necessarily result in higher prices for produced products. One stakeholder noted that it is impossible to separate the costs associated with various regulations as they have overlapping objectives, noting that reducing ammonia emissions from livestock is a common objective of the NEC and IED Directives.

3.3.2.3 Impacts on competitiveness and SMEs

Meeting the ERCs has and/or will place costs on a range of economic actors. As such, the NECD has the potential to have impacts on competitiveness and SMEs.

To this end the NECD included specific wording to mitigate any detrimental impacts on smaller agricultural businesses – specifically Annex III Part 2 includes the obligation that Member States shall ensure that impacts on small and micro farms are fully taken into account and may exempt small and micro farms from those measures where possible and appropriate. For other sectors, EU source-specific legislation also includes certain exemptions or allowances to prevent or minimise impacts on SMEs e.g. the IED sets activity thresholds to limit the inclusion of SMEs under its scope. Beyond EU source-specific legislation, the Member States then have flexibility to design and implement policies and measures to meet their ERCs and can prevent or minimise impacts on SMEs.

The **IA** (modelled data) provided an initial assessment of the potential effects on competitiveness and SMEs. It identified that potential impacts would concentrate in sectors that would find it more challenging to pass additional costs through to their markets and customers. This would particularly be the case where they are more exposed to international competition. The IA identified refineries, chemicals, iron & steel and agriculture as prime examples of such sectors, noting it is likely that at least a subset of users in these sectors will have difficulty in passing costs through.

Drawing on the macro-economic modelling performed, the IA also highlighted that:

- Several of the sectors that require additional efforts in terms of abatement investment, such as ferrous and non-ferrous metals, chemicals and the power sector, also benefit from additional demand for the delivery of the required investment goods throughout the economy and see a net increase in output.
- The sectors that bear a comparatively larger share of the burden were agriculture and the refinery sector, which even after accounting for health benefits, were still anticipated to face a reduction in sectoral output of 0.2% and 0.08% respectively under option 6C. However, as noted elsewhere, the NECD as implemented is likely to lie somewhere between option 6C and 6B, the latter carrying lower costs and estimated reduction in output. Furthermore, the modelled costs are very small, indicating headroom to absorb the additional costs.

As explored above, across the CAO series (modelled data) the key conclusions from the IA remained valid: i.e. only a few economic sectors (consistently including agriculture) were anticipated to observe a net reduction in output, and this reduction was likely to be very small relative to total sector output. More specifically:

- Under **CAO1**, approximately 40% of the additional pollution control costs to reach ERCs fall on the agricultural sector – this translates into an 0.05% output reduction for the sector, when benefits of avoided lost workdays and improved crop yields are included. Other sectors identified to reduce output as a consequence of abatement costs are: 'Coal, oil & gas', ferrous and non-ferrous metals and

consumer goods industries (all reducing output by 0.01%), but all these sectors observe a net increase in output when benefits are accounted for.

- In **CAO2**, the NAPCP scenario modelled a net output loss of 0.13% for the crop sector and 0.44% for the livestock sector. Output levels in all other sectors (power sector, fossil fuels, industry and services) are all neutral or observed to increase.
- **CAO4** replicated the macro-economic modelling undertaken in previous studies. Under pessimistic assumptions regarding the benefits, the livestock, crop and fossil fuel sectors were all estimated to incur a reduction in output. However, under more optimistic assumptions regarding the size of the benefits, i.e. when crop yield benefits were included or higher estimates of productivity benefits through human health, the crop and fossil fuel sectors observed an increase in output. The net effect on livestock sector output remained negative across all sensitivities modelled, but in all cases the output reduction was less than 0.15% (output reduction for livestock under most pessimistic benefit assumptions).

The response to the **targeted stakeholder consultation** did not reveal any evidence to suggest SMEs had faced a greater or disproportionate cost relative to other economic actors. A greater number of respondents believed that the most significant costs had fallen on larger businesses (8 of 41 respondents noted 'high costs', with 12 signalling any size of cost), relative to SMEs (5 of 41 respondents noted 'high costs', with 11 signalling any size of cost). That said, it is important to note the limited overall sample size of the survey, and that none of the respondents identified themselves as a SME business. The open public consultation did not ask any questions to capture any differential effect between businesses of different sizes.

In response to the **targeted engagement with businesses**, four stakeholders reported that the abatement costs for the agriculture sector had been high with all noting that costs had fallen on SMEs, as the sector is predominantly made up of small or micro farms. One stakeholder elaborated that although costs could be significant, they will always be case-specific to each farm. Another stakeholder believed that the costs placed on SMEs were disproportionate but also noted that it is impossible to separate the costs associated with the various regulations, as they have overlapping objectives. Another stakeholder noted that in their Member State, farms which produced below 500 kg NH_3 per year did not have to apply improved housing as a technique, but that this only excluded very small farms. The same stakeholder noted that techniques are only affordable for a certain size of farm, and if implemented, would have a disproportionately negative impact on smaller farms. Another highlighted the importance of achieving a level playing field across Member States and sectors, ensuring that not sector is forced to adopt highly costly solutions before more cost-effective emission reduction options are adopted elsewhere.

Separately, a **survey run by DG AGRI** in spring 2024 sought to gather insights from farmers on the burden placed on farmers by EU rules and legislation, identify sources of concern and complexity and identify areas where improvements could be made[262].

The response to the survey was mixed with respect to 'requirements related to emissions of air pollutants': one the one hand, 13% of respondents noted no particular difficulties and 33% stated they had no concern / no opinion, but on the other hand 21% stated rules are not clear and 33% noted meeting requirements is difficult. It is important to note that responses were similar regarding other requirements: 41% of respondents though that requirements related to nitrates were difficult; the same percentage was 39% for other environmental requirements, 35% for requirements related to water and 29% for requirements related to Natura 2000.

The survey also asked about difficulty in complying with GAECs. GAEC3, a ban on burning arable stubble, is directly connected to the NECD. 27% of respondents reported no particular difficulties, 8% thought that rules were not clear, 18% deemed meeting the requirements as difficult and 4% referred to other difficulties (45% did not have an opinion). In relation to other GAECs, GAEC3 seemed to call forth the least difficulties.

The survey did not split responses by farm size, hence it is unclear whether difficulties were also correlated with farm size. However, almost 50% of the response was from farms with land less than 50ha. Furthermore, the agriculture sector is predominantly represented by very small and small farms (output below €8,000 per year accounted for two-thirds (63.7 %) of all farms in the EU in 2020, whereas 99,000 farms (3.3 % of the EU total) each produced a standard output of €250,000 per year or more in 2020[263], hence any difficulties experienced are likely to fall somewhat on smaller businesses.

3.3.3 Key conclusions

Regarding administrative costs placed on businesses:

- The NECD only places obligations directly on Member State competent authorities and the European Commission. However, evidence gathered through the study suggests that most Member States use data and information gathered from businesses to feed into the development of emission inventories and projections, with some using information for other obligations too (e.g. NAPCPs).
- That said, the NECD is often not the primary driver for collecting this information from businesses. In the majority of cases, competent authorities are making use of data already available to them and are not requesting new or additional data and information to support compliance with the NECD. In the few, isolated cases where a Member State collects data for the sole purpose of the NECD, the likely burden on businesses was considered to be very small.

[262] 'Simplification – the farmers' point of view' first insights into the results of the survey running March 7-April 8, 2024.

[263] https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Farms_and_farmland_in_the_European_Union_-_statistics

Regarding adjustment costs faced by businesses:

- The IA analysis (modelled data) suggested the sectors to which most costs would fall was 'households' (32% of total costs) and 'agriculture' (31%). These were followed by 'other energy intensive' sectors (8%), refineries (7%) and electricity supply (6%). The IA also presented macro-economic modelling which captures how these first-order effects are passed through supply chains and the wider economy – accounting for this, several economic sectors that face direct costs also benefit from additional demand and see a net output increase, however two economic sectors were estimated to face a net reduction in output: agriculture and the refinery sector. The NECD had the potential to impact on competitiveness and SMEs as costs are passed onto businesses. Potential impacts concentrate in sectors that would find it more challenging to pass through costs, e.g. those more exposed to international competition. The IA identified refineries, chemicals, iron & steel and agriculture as prime examples.

- The CAO series (modelled data) replicated the analysis under the IA and found similar conclusions. In particular agriculture was repeatedly found to be the sector likely to face the greatest net reduction in output from efforts to meet ERCs, but overall impacts would likely be very small (all sector net impacts modelled under CAO4 are below 0.16% output reduction). Sensitivity modelling demonstrated that the wider policy context may have affected where costs fell – for instance under CAO3, the REPowerEU scenario shifted costs to the power sector.

- Where costs have ultimately fallen will have been driven by the policies and measures put in place by Member States and at EU level, and how they were funded. Information from funding trackers suggest the level of funding channelled to air quality improvement measures has been significant. Although it is not possible to compare directly to estimates of abatement costs, this suggests that a significant proportion of the costs of achieving ERCs will be covered by public funding, hence shifting the direct burden from businesses and households to the public sector.

- Insights from the stakeholder engagement activities suggest there is a perception that businesses may have faced the most significant abatement costs (mixed response that this was either a 'moderate' or 'high' cost). Stakeholders highlighted that farms and the agriculture sector had faced significant costs associated with emissions reductions. Four stakeholders responding to the targeted engagement of businesses suggested the agriculture sector faced significant costs, and that have fallen both on larger and smaller farms (i.e. SMEs). This is corroborated somewhat by survey evidence outside of this study suggests a reasonable proportion of farmers find the requirements related to emission of air pollutants challenging, and it is notable that this sector is predominantly made up of small farms. However, stakeholders also felt that Member States had themselves faced a significant cost,

with citizens also sharing some of the impact (noting the general caveat that this is based on surveys with low response).

- The NECD had the potential to impact on competitiveness and SMEs as costs are passed onto businesses. Potential impacts concentrate in sectors that would find it more challenging to pass through costs, e.g. those more exposed to international competition. The IA identified refineries, chemicals, iron & steel and agriculture as prime examples. Macro-economic analysis completed under the CAO series confirmed that the agriculture sector faces the greatest potential for net costs or output reductions but concluded that overall impacts would likely be very small (all sector net impacts modelled under CAO4 are below 0.16% output reduction). Two stakeholders responding to the targeted engagement of businesses suggested that the agriculture sector faced significant costs, and that have fallen both on larger and smaller farms (i.e. SMEs). This is corroborated somewhat by survey evidence outside of this study suggests a reasonable proportion of farmers find the requirements related to emission of air pollutants challenging, and it is notable that this sector is predominantly made up of small farms.

3.4 What are the benefits of the implementation of the NECD (and reversely the costs of not implementing it) and do they outweigh the costs of implementation?

The key driver of the benefits achieved under the NECD are the ERCs set for the five pollutants which each Member State must meet. These ERCs aim to deliver reduction in emissions of harmful air pollutants, which in turn should deliver reduction in exposure to these pollutants, delivering improvements in human and environmental health. Abatement measures taken to meet ERCs may also deliver wider benefits, for example in terms of energy or raw material savings, and reductions in greenhouse gas (GHG) emissions. There may also be further benefits as the direct effects cascade through wider supply chains and the economy.

The NECD is implemented as part of the wider clean air policy package. As explored under the indicator related to abatement costs, this makes it challenging to directly attribute costs to the NECD, and the same is true for benefits. For example, the achievement of the ERCs under the NECD is supported by a range of EU source-specific instruments, which impose specific requirements on individual sources of emissions. Thus, the implementation of abatement measures driven by the source-specific instruments will deliver emission savings (with associated benefits for human and environmental health) and will also contribute to meeting overall ERCs.

An additional limitation in the assessment of benefits is that it is not possible to link a human or environmental health outcome directly to a change in air pollution. The methods deployed to assess these effects consider a change in risk at population level and estimate a level of effects which can be considered statistically attributable to a given change in emissions. Furthermore, as highlighted by stakeholders at the workshop, the evidence base linking air pollution exposure to health impacts is constantly evolving, deepening the understanding around the range of health effects linked to air pollutant exposure, and the

significance of this relationship, and not all benefits of meeting ERCs can be quantified or monetised.

This section first presents the analysis in the IA as the point of comparison. It then reviews relevant material from the CAO series, before summarising relevant information on the benefits from other sources.

3.4.1 Benefits identified in the 2013 impact assessment

The **IA** (modelled data) represents the starting point for developing a point of comparison. As noted under the indicator analysing adjustment costs, the IA identified option 6C as the preferred option for the period 2025-30. The IA quantified a range of anticipated benefits associated with achieving the ERCs relative to the baseline in 2030:

- Health benefits of 61 000 fewer premature deaths from long-term exposure to $PM_{2.5}$ (reduction of 20%) and 1,200 from acute exposure to ozone (reduction of 7%), as well as 80 million fewer sick days.
- Environmental benefits of 144 000 additional km^2 of ecosystems protected from eutrophication (reduction of 17%), 73 000 of which are in Natura 2000 areas; and 21 000 additional km^2 of forest ecosystems protected from acidification (50% reduction).
- Direct economic benefits of €3 bn (representing reduced workdays lost, healthcare cost savings, improved crop yields and reduced damage to the built environment, adjusted to 2025 prices).
- No net GDP impact when labour productivity benefits accruing from improved health are included. Positive net GDP impact for the majority of economic sectors (with the exception of agriculture, consumer goods industries and petroleum refining)[264].
- Increased employment of 113 000 jobs overall across EU28 (i.e. including UK, no figure was provided for EU27 or split by Member States) once health benefits are captured, and positive improvements for all economic sectors (except agriculture and petroleum refining).
- Overall human health benefits in the range of €63 bn – 223 bn per annum (adjusted to 2025 prices, EU28)[265], 10 to 35 times the compliance costs (without considering the ecosystem benefits – range is driven by the method to value mortality effects).

The figures above will not capture all benefits achieved by meeting ERCs, as not all are disaggregated or included in the modelling. For example, any operating cost savings are not presented separately and would be included in the 'costs' estimated by the GAINS

[264] Indicators presented in the IA for 2025 only but noted that relative changes do not differ significantly for 2025 and 2030.

[265] Captures a range of human health impacts, including: Acute Mortality (All ages), Respiratory hospital admissions (>64), Cardiovascular hospital admissions (>64), Minor Restricted Activity Days (MRADs all ages), Chronic Mortality (All ages) LYL, Chronic Mortality (30yr +) deaths, Infant Mortality (0-1yr), Chronic Bronchitis (27yr +), Bronchitis in children aged 6 to 12, Respiratory Hospital Admissions (All ages), Cardiac Hospital Admissions (>18 years), Restricted Activity Days (all ages), Asthma symptom days (children 5-19yr), and Lost working days (15-64 years).

modelling (these will be included as negative costs, netted against any implementation costs also associated with a given technique). Furthermore, benefits in terms of GHG emission savings were not captured and only benefits of reductions in $PM_{2.5}$ and O_3 were included in the final aggregate total benefits to avoid potential double counting of effects (notably between $PM_{2.5}$ and NO_2).

In addition (as for the abatement costs presented in Annex III section 3.2), IA estimates must be treated with caution given the preferred option identified was different to the NECD finally adopted (primarily due to changes made in the co-legislative process). Two key changes will affect the benefits as they did the costs:

- ERCs were defined for the period 2030+, and as such the benefits of the IA options assessed for 2030 are more relevant[266]. As such the quantitative estimates presented above reflect only those for 2030.
- ERCs for all pollutants were reduced during the negotiations, i.e. the emission reductions required relative to 2005 were less. As a consequence, the benefits of the NECD are likely to be less than those presented for the IA option 6C above. As discussed with respect to abatement costs, the $PM_{2.5}$ emissions reductions required by the NECD lie between option 6B and 6C – i.e. monetised health benefits will lie between the ranges of €42 bn – 149 bn and €63 bn – 223 bn.

However, no sensitivity modelling was performed with respect to the benefits to model the trend in benefits achieved between these two options. Therefore, it is not possible to judge where in this range the benefits of the NECD, as implemented, would lie.

3.4.2 Benefits appraised in the CAO series

Following the IA and the adoption of the NECD, the Commission has published a series of **Clean Air Outlook (CAO)** reports (modelled data) which, alongside costs, estimated the benefits of various emission reduction scenarios. As for the IA, these modelling studies are not able to isolate the benefits attributable solely to the NECD given interactions with the wider policies affecting air pollution but are able to provide insights as to the total benefits associated with achieving the ERCs. It is important to note that, although the broad approach to assessing benefits was consistent with the IA, across the CAO series it also evolved to reflect advances in the underlying evidence base. This included expanding the range of human and environmental health effects considered, and the methodologies to assess them. This will have an influence on the comparison of estimates between the studies.

CAO1 considered a revised '2017 legislation' baseline (capturing three key EU legislations introduced post-2014), and a scenario simulating cost-effective achievement of the ERCs. The analysis was extended relative to the IA to include non-health environmental effects on building materials in some applications (though excluding cultural heritage), forests, crops and ecosystems, and also provided additional detail on issues such as productivity losses and healthcare costs. Relative to the 2017 legislation

[266] The IA also assessed the benefits should ERCs be implemented in 2025.

baseline, the scenario meeting ERCs was anticipated to achieve the following benefits in 2030:

- Health benefits of 24 000 fewer premature deaths from long-term exposure to PM2.5 and 1 000 from acute exposure to ozone.
- Overall monetised human health benefits (including reduced mortality and morbidity) in the range of €25 bn - €89 bn per annum (range is driven by the method to value mortality effects, adjusted 2025 prices). In addition, non-health environmental benefits of €633 m per annum by 2030.
- Net GDP impact of positive 0.006% when labour productivity benefits accruing from improved health are included. Positive net GDP impact for the majority of economic sectors (with the exception of agriculture).
- Increased employment of 39 000 jobs overall across EU once health benefits are captured, and positive improvements for all economic sectors (except agriculture).

In comparison with the IA, the benefits (as per the costs) of achieving the ERCs are lower. This is driven by: amendments made to the baseline to include the three key EU policies introduced post-2014 which have brought the baseline closer to the ERCs, and the amendment of the ERCs in the co-legislative process which have brought these closer to the baseline.

The construction of the scenarios under **CAO2** make it more challenging to disaggregate costs and identify the effects of the NECD specifically. This is because the CAO2 baseline captures national air pollution control policies and measures based on a review in 2020, post-adoption of the NECD. The study did consider an NAPCP scenario incorporating additional national level policies and measures which had been announced, but these were not modelled as sufficient for all Member States to achieve ERCs for each of the five pollutants. CAO2 assessed that the NAPCP scenario would deliver in 2030:

- Health benefits of 7 000 fewer premature deaths from long-term exposure to PM2.5 and 30 from acute exposure to ozone.
- Overall monetised human health benefits (including reduced mortality and morbidity) in the range of €10.7 bn – €41.2 bn per annum (range is driven by the method to value mortality effects, adjusted to 2025 prices). Where additional health impacts are included (that were not deemed robust enough to include in the central estimation), the estimated benefits increased to €15.2 bn – €55 bn per annum).
- Reduction in ecosystems area with nitrogen disposition exceeding critical loads for eutrophication of 57 600 km^2, and a reduction in forest area with acid disposition exceeding critical loads for acidification of 11,500 km^2.
- Monetised environmental benefits of €396 m – 1 104 m per annum by 2030 (adjusted to 2025 prices).
- Net GDP impact of negative 0.004% when labour productivity benefits accruing from improved health are included. Positive net GDP impact for the majority of economic sectors (with the exception of agriculture – crops and livestock).

Comparing these estimates to CAO1, the benefits are smaller. This is likely as more measures implemented to achieve ERCs have been implemented as part of the baseline (bringing the baseline closer to ERCs), and also given the NAPCP scenario does not achieve all ERCs.

CAO3 did estimate benefits associated with emissions reductions, however it did not explore a scenario which came close to replicating the impact of achieving ERCs. All existing action (at EU and Member State level) was captured in the baseline and cannot be isolated[267].

CAO4 modelled a scenario which meets ERCs relative to the baseline. However, this does not capture all additional efforts made to meet ERCs following the implementation of the NECD, as many policies and measures are now captured in the CAO4 baseline. This caveat aside, the study estimated a range of benefits associated with meeting 2030+ ERCs relative to the baseline:

- Health benefits of 7 000 fewer premature deaths from long-term exposure to PM2.5, 600 from acute exposure to ozone and 1 200 fewer from exposure to NO_2[268].
- Overall monetised human health benefits (including mortality and morbidity effects) in the range of €9.9 bn – €55.9 bn (including NO_2 functions only for adult asthma and child acute lower respiratory symptoms, ranges are driven by the method to value mortality effects included, adjusted to 2025 prices).
- Reduction in ecosystems area with nitrogen disposition exceeding critical loads for eutrophication of 34 600 km^2, and a reduction in ecosystem area with acid disposition exceeding critical loads for acidification of 7 800 km^2.
- Monetised environmental benefits of €430 m – €870 m per annum by 2030 (adjusted to 2025 prices).
- Net GDP impact of ranging from -0.002% to +0.053% depending on the sensitivity around the benefits included. Positive net GDP impact for the majority of economic sectors under most or all of the benefit sensitivities (with the exception of agriculture livestock).

Between CAOs, it appears that the estimated benefits associated with meeting ERCs has reduced from CAO1 to CAO2 but then is fairly consistent between CAO2 and 4. However, it is challenging to compare between CAOs given the changes made between studies. Over time, evidence linking air pollution exposure and health impacts has strengthened, which

[267] Aside from the direct effects on the five pollutants for which ERCs have been defined, CAO3 also explored the impacts of the emission reduction scenarios on black carbon. The study notes that black carbon and methane have been significantly reduced in recent decades, as illustrated in the baseline scenario. For black carbon, the key contributing policies were reported to have been: introduction of diesel particulate filters for vehicles, reduction of coal use in residential sector and eco-design requirements for solid fuel boilers. These are all measures which also work towards achieving the ERCs under the NECD and hence are direct co-benefits.

[268] The CAO studies note the potential for double counting when analysis combines response functions for more than one pollutant. It is considered appropriate to combine estimates associated with $PM_{2.5}$ and O_3, given differences in the sources of the two pollutants and the mechanisms for pollutant formation, but the benefits from $PM_{2.5}$ and NO_2 are not directly combined.

has allowed a wider range of impacts to be captured and has increased the significance of impacts per unit of exposure – both would increase the benefits estimated under the later CAOs relative to the earlier studies (all other things being equal). More importantly however, the reduction in estimated benefits between CAO1 and CAO2 and 4 is driven by an increasing proportion of abatement being captured in the baseline, leaving a smaller proportion of effort (and hence a smaller proportion of the benefits) to be captured under the ERC scenario (the same mechanism as affecting the abatement costs as discussed in Annex III section 3.2).

3.4.3 Further analysis of benefits – comparison to the 2015 baseline

As explored in the costs section above, further analysis has been performed on the costs and benefits assessed under CAO4 to provide a different perspective on the impacts of the NECD. The IA and CAO summary presented above only considers the impacts of the scenarios over and above the baseline in a given modelling year (2030). This makes it challenging to understand the impacts of the NECD as: (a) increasing amounts of abatement efforts are captured in the baseline between CAOs; and (b) this considers a modelling year outside of the evaluation period. This further analysis instead compares the benefits assessed in different modelling years over the evaluation period to those quantified in the baseline in 2015.

Estimates of the benefits were taken from the support study to CAO4 (modelled data) [269]. This study only presents estimates of the effects under the baseline for 2020 and 2025 – estimates for 2015 were provided directly from the CAO4 study team. Benefit estimates are based on a value mortality effects as value of life year (VOLY) and value per statistical life (VSL).

BOX 8. Different approaches to valuing mortality – VOLY vs. VSL

Health impact assessments typically apply two different approaches to monetising mortality effects, either using a value of a life year (VOLY) or value of statistical life (VSL) approach. Opinion amongst economists is divided as to whether mortality valuation is better represented by using VOLY or VSL. It has therefore been standard practice in clean air related policy assessments to present both, as a range. **VOLY** represents an estimate of damage costs based on the potential years of life lost (YOLL) from a specific risk, based on an estimated life expectancy. Therefore, the result is affected by the age at which deaths occur. VOLY is used in contexts where it is important to evaluate the benefits of life extension, such as healthcare interventions, chronic disease management, or any scenario where the goal is to increase the duration of life. **VSL** is independent of life expectancy and represents the value a given population places ex ante on avoiding the death of an individual. VSL is typically used in policy assessments where the focus is on reducing the probability of death due to specific risks, such as environmental policies that aim to decrease pollution, road safety measures, or workplace safety regulations. It helps in allocating resources toward interventions that can save lives. Both concepts are defined by OECD[270]. VSL values tend to be higher than VOLY values as VOLY reflects the value of extending life expectancy by a single year (per-year valuation), whilst VSL

[269] IIASA, EMRC, MET Norway, TNO, e-misia, RIVM, Logika Group (2025), Support to the development of the fourth Clean Air Outlook.

[270] OECD, 2012, Mortality risk valuation in Environment, Health and Transport Policies.

represents the monetary value that individuals place on reducing overall risk of death (thus the value of reducing the probability of death for all remaining life years collectively)[271].

The adult VSL estimate of EUR 3.6 million from OECD (2012) was updated in 2025 to EUR 7.4 million[272] (see also Annex III 5.1.2).

The changes between years will reflect both the change in the take up of emissions controls, and the influence of underlying changes in activity which change the volume of emissions sources (to which emissions controls are applied). This is different to the costs, where only the costs of emissions controls are seen in the outputs from the GAINS model (changes in activity will also carry a cost, but these are not reflected in the results). This creates a challenge when comparing costs and benefits as the benefits capture the effects of two changes (activity and emissions controls), whereas the costs only capture one (emissions controls).

As an additional comparison to the modelled results using GAINS, the benefits can also be calculated using emissions inventory data (reported data). Emissions data up to 2023 (reported by Member States in 2025) were shared by the EEA. The difference in emissions relative to 2016 was combined with damage costs for each pollutant, which capture a range of impact pathways in an aggregated impact-per-tonne metric[273]. For simplicity and in adopting a conservative approach, only the damage costs estimating mortality effects using VOLY were used.

These analyses are presented in the following table. Again, alongside the estimates for particular years, a total present value is presented, aggregating the impacts between 2016-2025 (or between 2016-2023 for the estimates based on inventory data), and discounting these effects back to 2016 using a 3% discount rate.

Using inventory emissions data instead to estimate the benefits, the total present value is lower at around €506 billion over the period from 2016 to 2023. This is for two reasons: (a) it is estimated over a shorter time period, to 2023 rather than 2025, and (b) as emissions in the inventory have not followed a linear reduction over time, as is assumed in the interpolation of the GAINS modelled emissions data. Instead, emissions have followed a non-linear trend, lagging the reductions of the assumed linear trend. However, the estimates are broadly comparable to the CAO4 unadjusted baseline results.

271 Econometric model derived from meta-analysis to estimate VSL and VOLY associated to air pollution at a global level - ScienceDirect.

272 OECD (2012) Mortality Risk Valuation in Environment, Health and Transport Policies and OECD (2025), Mortality Risk Valuation in Policy Assessment: A Global Meta-Analysis of Value of Statistical Life Studies.

273 Damage costs are taken from the study 'Update of the costs of not implementing EU environmental law', which were updated as part of that study to mimic the approaches to estimating benefits deployed under CAO4.

Table A - 48 – Estimated benefits combining emissions changes and damage costs (VOLY) (2025 prices, €m, total present value discounts to 2016)

Study	Valuation method	Absolute Damage			Benefits relative to 2015 (reduction in damage)		Total present value of net benefits, over period from 2016
		2015	2020	2025	2020	2025	
CAO4 - baseline	VOLY	733 000	604 000	479 000	129 000	254 000	954 000
	VSL	2 140 000	1 970 000	1 500 000	167 000	637 000	1 970 000
Inventory emissions	VOLY	640 000	511 000	457 000*	130 000	184 000*	506 000**
	VSL	1 990 000	1 580 000	1 420 000*	407 000	570 000*	1 580 000**

Notes: '*' value for 2023, last year for which inventory data is available, '**' estimated over period to 2023, rather than 2025 as other estimates in this column.

Over the period from 2016 to 2025, emission reductions implemented since the adoption of the NECD have delivered significant benefits, with a (discounted) value of around €954 billion.

Using **inventory emissions** data instead to estimate the benefits, the total present value is lower, at around **€506 billion over the period from 2016 to 2023.** This is for two reasons: (a) it is estimated over a shorter time period, to 2023 rather than 2025, and (b) as emissions in the inventory have not followed a linear reduction over time, as is assumed in the interpolation of the GAINS modelled emissions data. Instead, emissions have followed a non-linear trend, lagging the reductions of the assumed linear trend. However, the estimates are broadly comparable to the CAO4 unadjusted baseline results.

The estimated benefits in the above analysis comparing to the baseline in 2015 capture the impact on emissions of both changes in emissions controls and underlying activity data. As such, this will **significantly overstate the benefits** which can be associated with policies affecting air quality.

Similarly to adjustment costs, benefits can also be estimated based on the additional modelling undertaken under CAO4 which defines a **counterfactual** that holds emissions controls constant at 2015 levels to isolate their effect on emissions (modelled data). This analysis isolates the impact of emissions controls over the period, which are more closely attributable to the to the effects of clean air related policies, including the NECD. Changes in emissions are combined with the damage costs to monetise the effects, as described for the inventory emissions above.

Comparing between the CAO4 baseline and the counterfactual, and monetising the emissions using the damage costs, the estimated benefit:

- in 2020 is valued at €55.9 billion (2025 prices, VOLY) and in 2025 of €92.5 billion (2025 prices, VOLY). When a VSL approach is taken, the estimated benefits increase to €177 billion in 2020 and €293 billion in 2025 (2025 prices).
- adopting the linear interpolation of impacts from 2015, the total (discounted) benefit over the period from 2016 to 2025 is estimated to be around €372 billion (VOLY). Using the VSL approach, the estimated total (discounted) benefit over the period from 2016 to 2025 increases to 1,180 billion (2025 prices).

As for the costs, the impacts associated with emissions controls are just less than half those estimated looking at the overall change relative to 2015 estimated to be €954 billion for the CAO4 baseline over the period – see Table A-48). This is to be expected, as changes in underlying activity have also delivered emission reductions over this period.

3.4.4 Further evidence regarding benefits

In the literature, many studies have been published assessing and monetising the benefits of reducing emission of air pollutants. For example, the EEA[274] has published reports estimating the external costs of industrial air pollution, which define damage costs per tonne for several air pollutants capturing the human and environmental health effects associated with exposure per tonne of emission. In some cases, similar studies have replicated this analysis at Member State level, for example work by Ineris[275] to define damage costs for France for PM, NOx, SO_2, NH_3 and NMVOC. Such studies do not provide estimates of the total benefits of the NECD or of achieving ERCs, but these reference costs have been noted (e.g. during targeted engagement with competent authorities) to be useful as a decision support tool, to provide an indication of the economic acceptability of abatement measures.

More generally, there is increasing evidence linking reduced exposure to air pollutants with human health benefits, and subsequent reductions in demand for health and social care services and improved productivity. For example, a recent study by Vranken et al (2023) investigated associations between concentrations of $PM_{2.5}$ and General Practitioner and emergency room visits for young people and adults. The study found a statistically significant association between in-hours and out-of-hours General Practitioner visits with $PM_{2.5}$ concentrations – assuming causality, reducing $PM_{2.5}$ levels observed in the lowest quartile of recordings to the whole of Belgium, the authors estimated this could save €43 m in General Practitioner and emergency hospital visits in 2019. Hence this not only benefits public health but also helps ensure the financial stability of the social security system.

A detailed review of the latest evidence was undertaken as part of CAO4 (see section 2.3 of the CAO4 report) noting in particular the conclusion of two major projects exploring

[274] See: EEA in collaboration with the European Topic Centre on Human Health and the Environment (ETC-HE) (2024), Technical note. Estimating the external costs of industrial air pollution-Trends 2012-2021v2Page | 1Estimating the external costs of industrial air pollution: Trends 2012-2021; https://www.eea.europa.eu/publications/the-cost-to-health-and-the/technical-note_estimating-the-external-costs/view.

[275] Ineris (2024), Coûts de référence pour 5 polluants atmosphériques (PM, NOx, SO2, NH3, COVNM) - Version 1, (unpublished – shared through targeted engagement with competent authorities).

the quantification of health impacts. The EMAPEC (Estimating the Morbidity from Air Pollution and its Economic Costs) study coordinated by WHO concluded in summer 2024. This provided updated concentration response functions for ischaemic heart disease, chronic obstructive pulmonary disease (COPD), stroke, diabetes, acute lower respiratory infections and new incidence of asthma, and an additional function for dementia. In October 2024, a second study coordinated by WHO, HRAPIE2 (Health Response to Air Pollutants in Europe 2) released papers considering mortality functions for $PM_{2.5}$, NO_2 and O_3.

The **stakeholder engagement activities** for this evaluation also provided further insight regarding the perception of the costs of the NECD. Through the open public consultation, the benefit considered most significant amongst respondents was 'protecting human health' (44 of 53 respondents suggesting the NECD had delivered this either 'to a large' or 'to some extent'). This is followed by (in decreasing order of significance) benefits to 'protecting the environment (e.g. ecosystems)' (43 of 53 respondents), 'reducing economic costs linked to air pollution' (34 of 53 respondents), 'reduction in emissions of greenhouse gases' (26 of 53 respondents) and 'energy or fuel cost savings' (19 of 53 respondents). For all benefits considered as part of the OPC, the most common response was that the NECD had delivered these benefits 'to some extent'. As shown in the figure below, there was corroboration around protection of human health and the environment being the most important benefits across stakeholder types, in particular business associations, public authorities, non-governmental organisations and EU citizens.

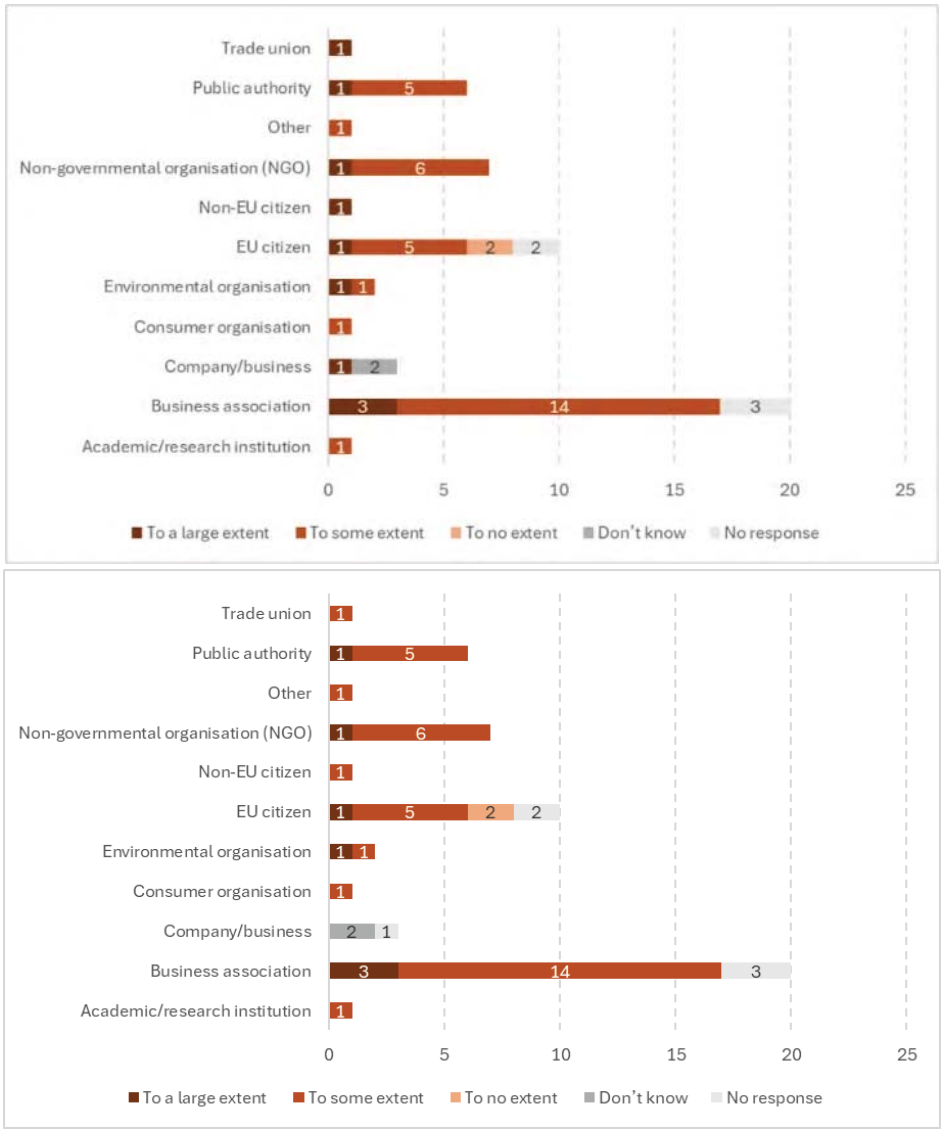

Figure A - 31 – Open public consultation response to question: To what extent has the NECD delivered the following benefits? Protecting human health (top) and Protecting the environment (e.g. ecosystems) (bottom)

This result was mirrored in the response to the targeted stakeholder consultation, where the benefit considered most significant amongst respondents was 'protecting human health' (28 of 41 respondents suggesting the NECD had delivered this either 'to a large' or 'to some extent'). This is followed by (in decreasing order of significance) benefits to 'protecting the environment (e.g. ecosystems)' (27 of 41 respondents), 'reducing economic costs linked to air pollution' (22 of 41 respondents), 'reduction in emissions of greenhouse gases' (20 of 41 respondents) and 'energy or fuel cost savings' (13 of 41 respondents). For all benefits considered as part of the Targeted stakeholder consultation, the most common response was that the NECD had delivered these benefits 'to some extent'. As shown in the figure below, again there was corroboration around the key benefits and their likely significance across stakeholder types, including public authorities, non-governmental organisations and industry associations.

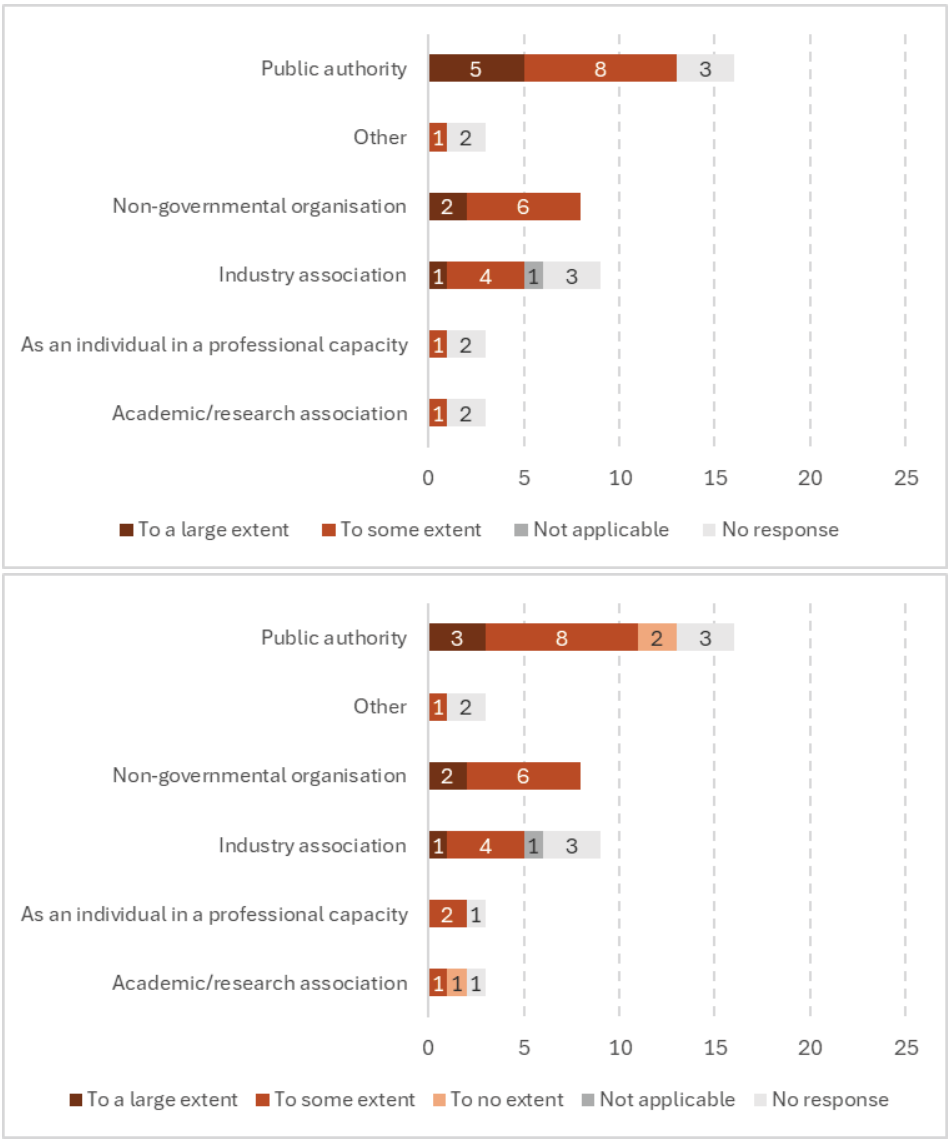

Figure A - 32 – Targeted stakeholder consultation response to question: To what extent has the NECD delivered the following benefits? Protecting human health (LEFT) and Protecting the environment (e.g. ecosystems) (RIGHT)

The respondents to the targeted stakeholder consultation suggested these benefits had been shared equitably between different groups, with 26 of 41 respondents noting that all citizens had either 'greatly' or 'somewhat' benefited. The result was similar for vulnerable citizens (26 of 41 respondents noted some level of benefit), citizens living in urban areas (28 of 41) and citizens living in rural areas (24 of 41).

3.4.5 Costs of non-implementation

A 2025 European Commission study[276] developed updated estimates of the costs and foregone benefits of the lack of implementation of EU environmental law in the EU-27 Member States. Estimates of the cost of the 'implementation gap' were made across eight policy areas, including for clean air. The 'implementation gap' is defined as the difference

[276] DG Environment, EMRC, Logika Group and RPA Europe (2025), Update of the costs of not implementing EU environmental law.

between actual environmental status and the respective environmental target(s). For the NECD, the analysis compared 2022 air pollutant inventory emissions (reported in 2024)[277] to Member State ERCs for 2020-29 and 2030+. The emissions gap (i.e. emissions in excess of the maximum allowed levels set by the ERCs) was then monetised using damage costs per tonne, calculated adjusting those reported by EEA (2023)[278] with updated assumptions from the CAO4 analysis.

The costs of the implementation gap to 2020-29 ERCs are shown in the table below. The total damage associated with not achieving the ERCs in 2022 was estimated to be between €2.3 billion to €7.6 billion per year (taking the low valuation estimates which exclude $PM_{2.5}$ morbidity functions in CAO4 confidence group 3 covering dementia and diabetes and adjusting original estimates to 2025 prices). The range is driven by different approaches to monetising mortality effects, either using a Value-Of-Life-Year (VOLY) or Value-of-Statistical-Life (VSL) approach. The largest damage estimates for individual pollutants are associated with Romania: $PM_{2.5}$, Hungary: $PM_{2.5}$ and NH_3, Lithuania: NOx and NH_3, and Austria, Bulgaria, Ireland and Portugal: NH_3.

The gap to the achievement of the 2020-29 ERCs (and linear interpolation between 2020-29 and 2030+ ERCs to define a target for 2025) is explored further in Appendix 3 of the support study. In particular, further modelling has been undertaken using the GAINS model to explore the abatement options available to close the gap between emissions and ERCs. The analysis shows the abatement options Member States could have taken to meet the ERCs and demonstrates that the set ERCs were feasible. For example, for NH_3 the model identifies further abatement through manure management in cattle and poultry farms, and improved fertiliser management (the later in particular for Ireland and Lithuania); for $PM_{2.5}$ additional abatement could have been achieved through improved residential stoves (in Romania and Lithuania), and for NO_x further primary abatement in cement (in Lithuania) and better inspection and management of road transport (in Portugal and Lithuania) could have supported achievement of the ERCs.

Table A - 49 – Damage estimates for the gap between 2022 emissions (reported in 2024 inventory) and 2020-2029 ERCs (€ million/year) aggregated across pollutants. Only countries with excess emissions are shown (replicates Table 2-6 of the original study, adjusted to 2025 prices)

	Low VOLY	High VOLY	Low VSL	High VSL
Austria	84	136	245	297
Bulgaria	114	165	336	374
Cyprus	45	73	58	73
Hungary	206	310	674	766
Ireland	45	65	129	156
Latvia	-	1	1	2
Lithuania	169	224	626	671
Portugal	26	47	84	104
Romania	1 726	2 513	5 684	6 398
Sweden	25	44	75	96

277 Aether (2024): Final horizontal review report - Review of National Air Pollutant Emission Inventory Data 2024 under Directive 2016/2284 (NECD);

278 EEA (2023) Estimating the external costs of industrial air pollution: Trends 2012-2021. Technical note on the methodology and additional results from the EEA briefing 24/2023..

	Low VOLY	High VOLY	Low VSL	High VSL
Total (across countries with excess emissions)	2 441	3 580	7 909	8 935

Notes: 'Low' valuation estimates which exclude $PM_{2.5}$ morbidity functions in CAO4 confidence group 3 covering dementia and diabetes, whereas 'high' valuation includes these impact pathways.

The costs of the implementation gap (i.e. foregone benefits) to the 2030+ ERCs is shown in the table below. Many more countries have emissions above the 2030+ ERCs than for the period 2022-29, and hence there is a substantial increase in damage to between a range of €89 billion to 279 billion per year (adjusting original estimates to 2025 prices). Three countries (Germany, Italy and Poland) each account for more than 15% of estimated total damage. This presents the gap to the 2030+ ERCs based on emissions as of 2022, the implementation gap in 2030 (when the ERCs will apply) is anticipated to look very different. Emissions are likely to continue to fall to 2030, reducing the implementation gap. Hence the damage presented in this section overstates what the gap is expected to be in 2030, presenting a pessimistic scenario where there are no further reductions in emissions.

Table A - 50 – Damage estimates for gap between 2022 emissions (reported in 2024 inventory) and for 2030+ ERCs (€ million/year) aggregated across pollutants. Only countries with excess emissions are shown (only Belgium and Finland are not shown) (replicates Table 2-8 of the cost of non-implementation study, adjusted to 2025 prices)

	Low VOLY	High VOLY	Low VSL	High VSL	% of total
Austria	1 848	2 749	5 753	6 662	2.0%
Bulgaria	801	1 131	2 531	2 779	0.9%
Croatia	801	1 232	2 679	3 050	0.9%
Cyprus	94	150	119	151	0.1%
Czechia	5 008	7 472	14 504	16 676	5.2%
Denmark	231	312	693	769	0.2%
Estonia	2	3	4	5	0.0%
France	7 233	10 751	21 958	25 291	7.8%
Germany	21 798	36 640	70 177	82 572	25.2%
Greece	321	499	1 204	1 371	0.4%
Hungary	3 484	5 041	11 740	13 144	4.0%
Ireland	410	547	1 160	1 343	0.4%
Italy	14 432	26 678	48 371	59 266	17.8%
Latvia	65	103	222	253	0.1%
Lithuania	210	281	769	828	0.2%
Luxembourg	75	104	193	225	0.1%
Malta	26	27	23	25	0.0%
Netherlands	383	507	1 230	1 354	0.4%
Poland	18 090	27 235	50 476	58 215	18.4%
Portugal	2 192	3 855	7 389	8 891	2.7%
Romania	5 870	8 328	19 588	21 811	6.6%
Slovakia	99	140	312	355	0.1%
Slovenia	465	728	1 750	2 062	0.6%
Spain	4 837	7 747	14 910	17 807	5.4%
Sweden	462	590	1 509	1 654	0.5%
Total	89 239	142 851	279 264	326 559	100%

A separate study (albeit one similar in nature to the European Commission report summarised above)[279] estimated that air pollution still causes €600 billion (2024 prices) in losses each year in the EU, equal to 4% of its annual GDP. These losses stem from detrimental effects on human health, resulting in absenteeism and a reduction in productivity at work, and detrimental effects on the environment. Furthermore, the study noted that promoting clean air can boost economic growth by between €50 billion – 60 billion every year. Relative to the European Commission study, Mejino-Lopez and Oliu-Barton assess the burden associated with total exposure to air pollution (rather than the gap between current emissions and concentrations and targets set in EU legislation), and deploy a methodology based on an OECD study which estimated that a 1 $\mu g/m^3$ reduction in the annual concentrations of $PM_{2.5}$ resulted in a 0.8 percent increase of GDP in Europe throughout the period 2000-2015 (Dechezleprêtre et al, 2019) (whereas the European Commission study monetises the impacts based on damage costs which aggregate impacts across a range of pathways, valued based on willingness-to-pay estimates).

3.4.6 Comparison of costs and benefits

The NECD is implemented as part of the wider clean air policy package which, as discussed above, makes it challenging to isolate costs and benefits solely and directly attributable to the NECD. The IA and subsequent modelling studies have instead estimated the total costs and benefits of achieving the ERCs put in place by the NECD, but to which other legislation (in particular EU source-specific legislation and climate legislation) will contribute. In doing so, these studies also provide an illustration of the balance between costs and benefits, and given this is presented as a ratio, this somewhat overcomes changes in underlying methodologies between studies providing a more comparable metric.

The **IA** (modelled data) again provides the starting point for forming the points-of-comparison. The IA identified option 6C as the preferred option for the period 2025-30, although given subsequent changes in the co-legislation process, the actual costs and benefits are likely to lie somewhere between those estimated for options 6B and 6C for 2030. As can be seen from Figure A-33 below, both of these options are deemed to deliver benefits in excess of the costs. This is the case under both low and high sensitivity around the valuation of benefits (range driven by alternative approaches to the monetisation of mortality impacts). In fact, even option 6D where all available abatement is taken up under the MTFR scenario is still anticipated to deliver a net benefit.

CAO1 (modelled data) considered a revised '2017 legislation' baseline (capturing three key EU legislations introduced post-2014), and a scenario simulating cost-effective achievement of the ERCs, offering some comparability to the IA modelling (although an MTFR scenario was noted as modelled, the results were not presented in the reporting). The scenario achieving ERCs was modelled to again provide a significant net benefit, with the benefit-cost ratio (BCR) ranging between 16.9 and 60.8. The benefit-cost ratio (BCR) also lies in the range between options 6B and 6C as modelled in the IA, suggesting limited

[279] Mejino-Lopez, J. and M. Oliu-Barton (2024), 'How much does Europe pay for clean air?'

change between the expected balance between benefits and costs in the IA to those presented in CAO1.

CAO2 (modelled data) developed an updated baseline which captured national air pollution control policies and measures based on a review in 2020, post adoption of the NECD. Hence this construction makes it more challenging to disaggregate costs and identify the effects of the NECD and/or the ERCs specifically. CAO2 did consider an NAPCP scenario incorporating additional national level policies and measures which had been announced and also modelled an MTFR scenario. The BCR of the NAPCP scenario ranges from 6.4 – 24.3, suggesting additional announced measures would deliver a large net benefit. The estimated BCR range for the NAPCP scenario is below that of options 6B and 6C from the IA. This reflects that CAO2 captured additional abatement in the baseline, and given abatement is taken up in order of cost-effectiveness, leaves relatively less cost-effective abatement to be captured in the NAPCP scenario. Furthermore, the benefits continue to outweigh costs under the much more ambitious MTFR scenario.

The specification of the scenarios under **CAO3** (modelled data) is challenging to draw out insights on the costs of the NECD as all existing action (at EU and Member State level) is captured in the baseline and cannot be isolated. CAO3 did model a range of alternative scenarios which may provide insights into the comparison of benefits and costs in the baseline. Specifically, CAO3 modelled scenarios: reflecting the targets in the Zero Pollution Action Plan (ZPAP); achieving the (at the time) proposed ambient air quality standard of 10 $\mu g/m^3$; and an MTFR scenario. All scenarios, which implement additional abatement measures over and above the baseline, are anticipated to deliver a net benefit and a BCR above 1. Furthermore, sensitivity analysis under CAO3 suggested that these conclusions were robust against various uncertainties in the analysis, including: the choice of metric for mortality valuation, the range over which benefits are quantified (full exposure vs exposure to air pollutant concentrations in excess of the WHO Guidelines), and potential double counting of impacts when estimates for $PM_{2.5}$ and NO_2 health impacts are combined).

Under **CAO4** (modelled data) the BCR of scenarios to meet ERCs and MTFR both return a net benefit (ranging from 15 to 58, and 2 to 8 respectively).

In summary**, across all modelling studies, from the IA through the CAO series, the benefits of meeting the ERCs are anticipated to outweigh the costs, and significantly so.** A summary of the abatement costs, benefits and net benefit estimated are presented in the following figure.

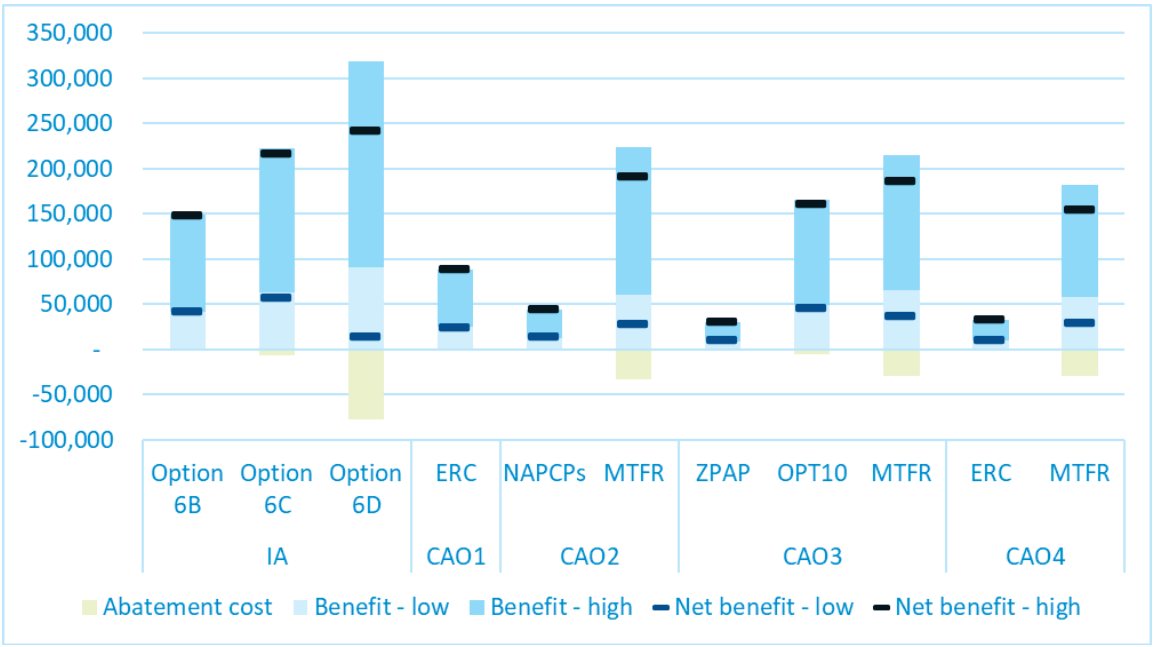

Figure A - 33 – Abatement costs, benefits and net benefits across modelling studies and relevant scenarios (€ million, 2025 prices), all impacts in 2030

Under CAO1 and CAO4, scenarios designed to achieve ERCs both show a net benefit. Although this assessment relates to meeting ERCs, and cannot be attributed solely to the NECD, the Directive plays a key part alongside source-specific legislation in driving the achievement of ERCs. In addition, although the NAPCP scenario under CAO2 does not achieve ERCs in all cases, it isolates additional measures which were planned by Member States at national level to work towards achieving ERCs. This scenario is also shown to deliver a significant net benefit and is arguably a more direct assessment of the potential impacts attributable to the NECD. Furthermore, the BCR remains above 1 (i.e. benefits outweigh costs) even under much more ambitious scenarios which deliver emissions reductions beyond the ERCs (i.e. the MTFR scenario). This provides additional weight to the conclusion that the benefits of achieving the ERCs are likely to have outweighed the costs.

A key assumption across all these modelling studies is that abatement is taken up in order of cost-effectiveness, which may not necessarily be the case in practice as Member States operate without perfect information. This means that the costs in practice may not be as low as those modelled here. That said, not all benefits are captured and monetised in the modelling studies (in particular GHG emission reductions as a co-benefit from air pollution abatement) associated with the measures, suggesting the benefits are also likely to be understated. The range of benefit-cost ratios of the different scenarios is shown in the following figure.

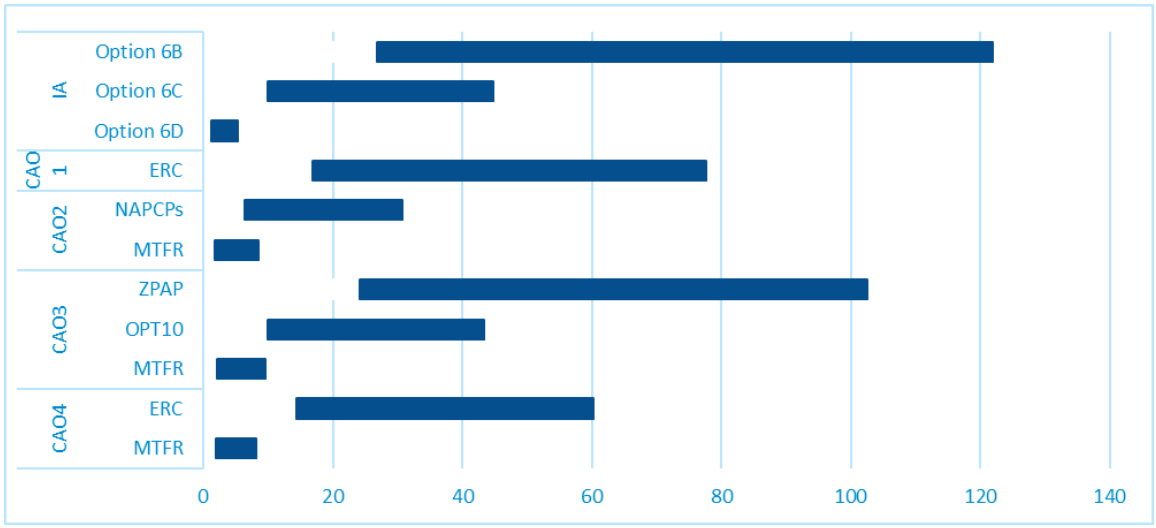

Figure A - 34 – Benefit-cost ratios across modelling studies and relevant scenarios, all impacts in 2030

3.4.6.1 Further analysis of impacts – comparison to the 2015 baseline and the counterfactual

In the analysis above and across the IA and CAOs, increasing amounts of abatement are captured in the baseline. Only an undefinable share of this abatement taken up after implementation of the NECD could (to varying degrees) be associated with the NECD, and as such this limits the insights that the analysis can provide as to the effects of the NECD itself. Furthermore, this often focuses on 2030 as a modelled year of impact, which falls outside of the evaluation period.

Additional analyses have been performed presenting an alternative view on costs and benefits based on modelled data. Two calculations have been performed:

- Comparing the impacts in future years relative to those in 2015 in the baseline.
- Developing a new counterfactual which projects to 2030 whilst holding emissions controls constant at 2015 levels, before comparing the impacts in future years relative to those in 2015 in the baseline.

As discussed in the sections above, the second analysis arguably presents a closer reflection of the effects of the NECD (although it will still overstate these effects). The first analysis will capture changes in both emissions controls and activity over the period and their influence on costs and benefits. By controlling for changes in activity, the second analysis focuses on the effects of changes in emissions controls which are more closely associated with the NECD. That said, neither analysis can provide a direct estimate of the impacts of the NECD, given that the implementation of emissions controls will be influenced by a wide range of policy and external factors.

The main results of this analysis are presented in the table below. In summary:

- Over the period from 2016-25 the additional uptake of emissions controls has carried an estimated cost of €92 billion (2025 prices, discounted to 2016).

- Over the same period, the emissions reductions delivered by these additional controls has an estimated benefit of €372 billion (VOLY) or €1 180 billion (VSL) (2025 prices, discounted to 2016).
- The benefit-to-cost ratio of these additional emissions controls implemented over the period since adoption of the NECD is estimated to be 4:1 (VOLY) or 13:1 (VSL)).
- The benefits (and costs) could have been higher had ERCs (linearly interpolated between 2020-29 and 2030+ ERCs) been met in 2025.

Given this controls for changes in underlying activity, this analysis presents a clearer indication of the costs and benefits of emissions controls implemented since the adoption of the NECD, with the key result being that the benefits of these controls significantly outweigh the costs.

The results of this analysis can be compared to those of the analysis which simply compares the results of the modelling to 2015 in the baseline. As can be seen from the table, the estimated costs are higher and the benefits lower in the 'new counterfactual' analysis relative to other analysis using 2015 as a benchmark. This is to be expected as: (a) the changes in activity post-2015 have reduced the need for emissions controls, hence reducing the costs, and (b) have delivered additional emissions reductions and associated benefits. As such, the resulting benefit-to-cost ratio of 25:1 is artificially high as a reflection of the impacts of the NECD. The table also includes a comparison to the monetised benefit estimate using emissions inventory data. These emission changes will capture the influence of changes in emissions controls and activity and hence are aligned with those based on the 'overall comparison to 2015'. The estimated benefits are smaller because (as described in the benefits section above), the timeframe over which benefits are monetised is shorter by two years, and emission in practice have not followed the linear trend as assumed in the extrapolation of the modelling results.

That said, this analysis highlights that the benefits (and costs) could have been higher had ERCs (linearly interpolated between 2020-29 and 2030+ ERCs) been met in 2025.

A tentative comparison can also be made to the BCRs from the IA. The BCR of Option 6B was 27:1 (VOLY) or 95:1 (VSL), and for Option 6C 10:1 (VOLY) or 35:1 (VSL) – as discussed above, the NECD as implemented is anticipated to lie somewhere between the two. It is important to note that: (a) the IA BCRs were calculated for the 2030 modelling year only, and not for the present values of costs and benefits over the evaluation period and (b) this will capture the influence of changes in both emissions controls and activity and hence are more directly comparable to those produced from the 'Comparison to 2015' and emissions inventory analyses. These caveats aside, the BCR values for both the 'Comparison to 2015' and emissions inventory analyses sit within the ranges for Option 6B and 6C from the IA (the range for the emissions inventory analysis sits towards the lower end, noting that this only captures benefits over a shorter time period) – hence the BCR assessed over the evaluation period remains comparable to that anticipated in the IA. The BCR range for the 'new counterfactual' analysis overlaps with the bottom end of the BCR range for Options 6B and 6C from the IA, hence the BCRs still remain broadly

comparable, however as noted the 'new counterfactual' does not capture the impact that changes in activity levels have on reducing costs and increasing benefits over the appraisal period.

Table A - 51 – Estimated total impacts of additional emissions controls deployed over NECD implementation period – from 2016 to 2025 (2025 prices, €m, present values discounted to 2016).

Analysis	Valuation method	CAO4 Scenario	Present value costs	Present value benefits	Benefit to cost ratio
'New counterfactual'	VOLY	Baseline	92 100	372 000	4
	VSL		92 100	1,180 000	13
Comparison to 2015	VOLY	Baseline	37 800	953 000	25
	VSL		37 800	1 970 000	52
Baseline (inventory emissions 2016-23)	VOLY	n/a	37 800	506 000	13
	VSL		37 800	1 580 000	42

3.4.6.2 Further analysis – comparing costs and benefits at Member State level

Available studies were reviewed to further explore available evidence on comparing costs and benefits beyond modelling. It is very challenging to compare estimates of costs and benefits at Member State level across different studies. Often between studies costs are presented in different ways (e.g. total or annual costs), most appear to capture only some (and not all) abatement measures adopted, and there is uncertainty regarding the comparability of approaches. This section presents a very indicative comparison of costs and benefits for particular Member States, but the results should be interpreted with extreme caution given these limitations. Example Member States have been selected where the cost data presented appears most complete (i.e. covers the majority of measures in the NAPCP) and costs appear likely to have been incurred over the evaluation period.

For **Slovakia,** a 2019 World Bank study assessed the emissions and economic impact of measures proposed for inclusion in the NAPCP (across road transport, residential heating, economic instruments and agriculture sectors), before assessing the air quality impacts of a scenario (WAM+) capturing additional emission reduction measures. Together these additional measures were modelled to deliver target emissions for 2030. The fiscal analysis of the WAM+ program showed its financial burden to the state budget to reach a net €649 million (2019 prices, or €798m 2025 prices, or €73m per annum over the period) spread over the period 2020-2030. For illustration, this equates to a cost of around €292m over the 4-year period from 2020-2023 (assuming measures start to be deployed in 2020 and are deployed linearly). For comparison, emissions reductions over this period (using latest inventory emissions to 2023) have delivered a monetised benefit of around €5,800 m. This is significantly higher than the costs. Caution must be taken in this comparison, as the

estimates of costs were developed several years ago and may not capture all policies and measures which reduce emissions.

Romania's NAPCP presents absolute annual costs of approximately €400 million covering 8 packages of policies and measures (costs are not estimated for only one package – 'Industrial processes and product use'). Assuming these apply in each year from 2021-2023, this implies a total cost of around €1,200 million. Over the same period, emissions reductions observed in the inventory carry a monetised benefit of around €7,500 million. However, given Romania's NAPCP was published in 2023 it is unclear to what extent these measures incurred costs before this date.

Slovenia's NAPCP presents overall costs of €2.5 billion for 2021 to 2030, equivalent to between €200 million and €250 million annually. This is broken down first into building renovation, industry, e-mobility, and electricity generation, then into more detail in a table addressing specific investment needs. For additional measures addressing air pollutant emissions and air quality, costs between 2022 and 2030 are estimated to be approximately €314.3 million. Together these present a total annual cost of around €289 million, which if assumed to apply over the period from 2021-2023 produces a total cost of €870 million. By contrast, the emissions reductions observed in the inventory over the same period are estimated to provide a monetised benefit of around €2,450 million.

In conclusion, **due to the high uncertainties, this analysis can be only taken as an indication that measures to reduce air pollution should produce a net benefit at Member State level**.

More confidence can be placed in the comparison between costs and benefits where these are derived from the same study. Using the outputs of the **CAO4 modelling**, a comparison between costs and benefits can be made at Member State level, as presented for the EU as a whole in the sections above. The same caveat applies in that these are modelled, rather than observed costs, and offer only an illustration of the potential trade-off of impacts at Member State level. The outputs of the 'new counterfactual' analysis, extrapolating impacts over the evaluation period using a simple linear interpolation, are presented in the following table.

The ratio of benefits to costs can be seen to vary somewhat by Member State. This will be driven by a range of factors, including the size of emissions reductions delivered and the cost of available actions, and the benefit per unit of emission reduction, which in turn will be influenced by population density, underlying population health, income per capita and other factors. One of the reasons for the variation may be that some Member States are assumed to take significant action under the baseline to abate emissions and/or are closer to their ERCs, and as such adopt increasingly costly emissions controls which reduces their benefit-to-cost ratio. Alternatively, some Member States may face larger issues associated with solid fuel burning, and emissions abatement in this sector translates into more significant health improvements given the proximity of emissions to residential areas.

For the vast majority of Member States, the benefit-to-cost ratio of this illustrative analysis is above 1 (the point at which costs and benefits are in parity), and significantly so. For only three Member States, Cyprus, Finland and Malta, does the benefit-to-cost ratio dip below 1. This result is driven by the relatively low damage cost per tonne of emission reduction. For these countries, the cost of emissions controls relative to GDP is well within the range defined by the rest of the EU27, likewise the emission reductions (in percentage terms) are also well within the range defined by the rest of the EU27. However, when monetised, the valued benefits are significantly lower, due to the lower damage costs. This in turn likely reflects the relatively lower exposure to changes in air pollution, due to lower population densities and their location as islands separate to the European mainland. That said, it is important to note that the benefits here are valued using the VOLY approach, which typically derives a lower, conservative estimate of benefits – health impacts are also usually valued using a VSL approach, which generates a higher bound estimate.

Table A - 52 – Illustrative of costs and benefits over evaluation period using the outputs of the 'new counterfactual' analysis (VOLY approach, 2025 prices, €m, discounted to 2016)

Member State	Total present value cost	Total present value benefits (VOLY)	Benefit-cost ratio	Member State	Total present value cost	Total present value benefits (VOLY)	Benefit-cost ratio
Austria	2 510	12 000	4.8	Italy	15 700	58 400	3.7
Belgium	2 710	13 900	5.1	Latvia	360	923	2.6
Bulgaria	1 040	6 310	6.1	Lithuania	1 010	1 420	1.4
Croatia	917	3 990	4.4	Luxemburg	223	1 170	5.3
Cyprus	150	67	0.4	Malta	150	42	0.3
Czech Republic	2 590	13 400	5.2	Netherlands	1 710	15 300	9.0
Denmark	1 670	3 470	2.1	Poland	10 800	51 300	4.7
Estonia	309	367	1.2	Portugal	2 060	3 640	1.8
Finland	2 380	2 100	0.9	Romania	3 190	9 340	2.9
France	12 700	58 200	4.6	Slovakia	923	4 080	4.4
Germany	12 400	73 500	5.9	Slovenia	552	1 900	3.4
Greece	1 660	3 150	1.9	Spain	10 200	22 500	2.2
Hungary	1 540	6 370	4.1	Sweden	1 250	2 180	1.7
Ireland	1 380	2 860	2.1				

3.4.6.3 Further evidence on the balance of costs and benefits

The balance of costs and benefits was also explored with **stakeholders**. In the targeted engagement of competent authorities, one stakeholder noted that cost-benefit analyses were undertaken at national level on a regular basis. From these studies the broad conclusion was that the benefits of meeting ERCs outweighed the costs, with very few individual projects showing a net cost.

As part of the open public consultation, 21 of 53 respondents suggested the benefits of the NECD had outweighed the costs, with 14 respondents reporting the benefits 'greatly' outweighed the costs. This contrasted to 8 of 53 respondents noting the reverse, that costs had outweighed the benefits (remaining respondents either noted they were in balance – 5 respondents – or reported 'did not know' or left the question blank). As shown in the figure

below, this opinion varied somewhat between stakeholder types, with public authorities and non-governmental organisations suggesting more strongly that benefits outweighed costs, EU citizens also predominantly thought benefits outweighed costs (although the response was more mixed), whereas a more common response amongst business associations were that costs and benefits were in balance or even costs outweighed the benefits.

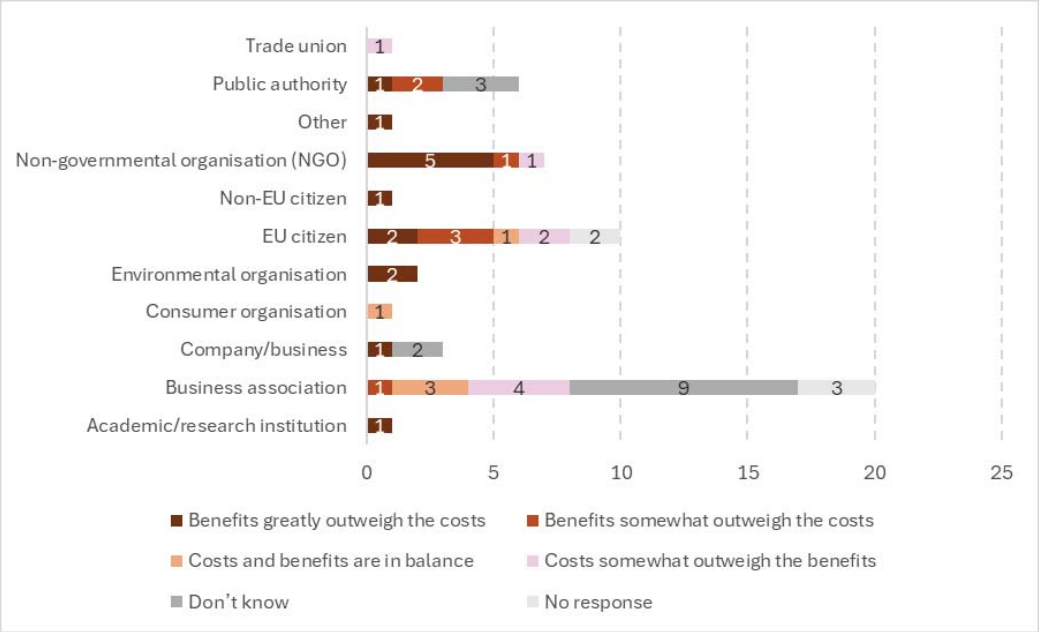

Figure A - 35 – Open public consultation response to question: Overall, how have the benefits of the NECD compared to the costs of its implementation?

A similar response was observed to the targeted stakeholder consultation, where the most common response was that the 'Benefits greatly outweigh the costs' (12 of 41 responses), with the second most common being 'benefits somewhat outweigh the costs' (6 of 41). In contrast, 5 of 41 respondents believed the costs had somewhat outweighed the benefits. Looking forward, respondents took a similar view of the net impact of achieving the 2030+ ERCs, with the most common response again that the benefits will greatly outweigh the costs (13 of 41 responses). As shown in the figure below, opinions varied across stakeholder types, with public authorities and non-governmental organisations more commonly considering benefits to outweigh costs, whereas amongst business associations the most prominent response was that costs somewhat outweighed the benefits.

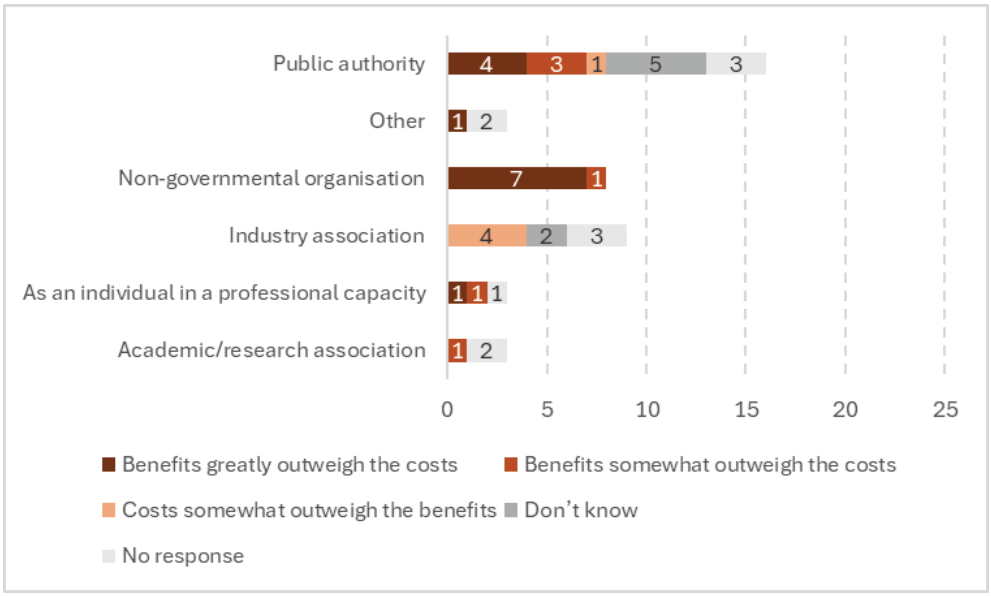

Figure A - 36 – Targeted stakeholder consultation response to question: Overall, how have the benefits of the NECD compared to the costs of its implementation to date?

3.4.7 Key conclusions

Evidence linking exposure to air pollution to detrimental health impacts continues to grow, as demonstrated by two recent key WHO research studies: EMAPEC (Estimating the Morbidity from Air Pollution and its Economic Costs) and HRAPIE2 (Health Response to Air Pollutants in Europe 2). Meeting ERCs will reduce exposure to harmful air pollutants, **delivering improvements in human and environmental health**. As for the costs, it is not possible to isolate benefits solely attributable to the NECD, but studies have estimated the total benefits of achieving ERCs.

The IA (modelled data) presents the starting point for the points-of-comparison and identified a range of benefits, including **monetised human health benefits in the of €63 bn (VOLY) or 223 bn (VSL) per annum in 2030** (adjusted to 2025 prices). Changes during the co-legislative process were likely to significantly reduce the benefits delivered respectively to the IA figures. The CAO series (modelled data) implemented similar methods to estimate benefits of its emission reduction scenarios. Throughout the reports **estimates of the additional benefits of achieving ERCs relative to the baseline remain significant** but have decreased in absolute terms (alongside costs) as more and more policies limiting emissions are included in the baseline. Stakeholder engagement also highlights that the NECD has also delivered other associated benefits (to varying degrees), specifically: protecting the environment (e.g. ecosystems), reducing economic costs linked to air pollution, reduction in emissions of greenhouse gases and energy or fuel cost savings.

Further analysis has been undertaken using the outputs of CAO4 considering the benefits of all emissions controls taken up after the adoption of the NECD over the evaluation period. This overcomes the challenge of the CAO series where increasing amounts of abatement action is captured in the baseline and hence does not appear in the net benefit of the scenarios assessed relative to the baseline. The analysis estimates that **emission reductions associated with additional controls taken up over the evaluation period**

have delivered significant benefits, with a (discounted) value of around €372 billion. The benefits delivered could have been higher had ERCs been met.

A recent European Commission study developed updated estimates of the costs and foregone benefits of the lack of full implementation of EU environmental law in the EU. The **total damage associated with not achieving the 2020-29 ERCs in 2022 was estimated to be between €2.4 billion to €7.9 billion per annum**. Further modelling work under this study has demonstrated that abatement options are available to close the implementation gap across Member States and pollutants. The costs of the implementation gap from 2022 to the 2030+ ERCs is much higher as many more countries have emissions above the 2030+ ERCs than for the period 2022-29, and hence there is a substantial increase in damage (a range of €89 billion to 279 billion per year). However, this presents the gap based on emissions as of 2022, and the implementation gap in 2030 (when the ERCs will apply) is anticipated to be smaller as emissions are likely to continue to fall.

Across all modelling studies, from the IA through the CAO series, **the benefits of meeting the ERCs are shown to significantly and consistently outweigh the costs**. For example, in CAO4, the benefits of achieving ERCs with additional mitigation over and above the baseline were estimated to be 14 to 46 times higher than costs (range driven by approach to valuing mortality effects). In these modelling studies, benefits remain greater than costs even under much more ambitious scenarios delivering emissions reductions beyond the ERCs.

This conclusion also holds in the additional analysis undertaken which compares the costs and benefits of all additional emissions controls taken up since adoption of the NECD in 2016**: The benefit-to-cost ratio of additional emissions controls implemented over the period from 2016-2025 is 4:1 (VOLY) or 13:1 (VSL).** Applying the counterfactual analysis at Member State level, the VOLY-based BCR for this illustrative analysis ranges between 0.3 (MT) and 9 (NL). Only three Member States show a BCR below one. In these three cases the lower benefits are due to lower damage costs, driven by lower exposure to changes in air pollution.

The majority of stakeholders who responded to the consultation activities also believe that the benefits of the NECD have outweighed the costs.

3.5 Have inefficiencies been identified and is there potential for simplification and reduction of administrative costs?

Under this indicator, we examined

- the actions (and where possible, value of costs) assessed to be unnecessary or disproportionate; and
- overlapping requirements in reporting or other actions, where removing or changing these would lead to simplification and cost reduction (where possible, we identified the value of costs).

This section focuses on inefficiencies and simplification opportunities tied to administrative costs. The analysis draws on a literature review of reports published since the adoption of the NECD, and stakeholder opinion gathered through the various engagement activities.

3.5.1 NAPCP development – synergies with the AAQD

There are clear synergies between these two pillars of clean air legislation, and their reporting instruments, the NAPCPs and AAQD air quality plans.

A 2022 report[280] found that there is room for guidance to **strengthen the links between emission reduction policies in the NAPCPs and those required under the AAQ Directives' air quality plans**. During the workshop held in October 2024 under this service request, one stakeholder raised that a disadvantage under the current reporting approach is that there is a fractioning of efforts due to uncoordinated reporting and assessment and raised the potential to coordinate these in the future to ensure better coherence with the AAQ Directives'. Off the back of this, another stakeholder agreed that whilst potentially beneficial, this coordination should not be at the expense of proper enforcement of the AAQ Directives and any other legislation. At the same time, results from the OPC and TSC indicate that coherence between the NECD and the AAQDs is thought as the highest across all instruments (19 OPC and 13 TSC respondents thought that they were highly coherent; 16 OPC and 17 TSC respondents indicated that they were somewhat coherent; 7 OPC and 2 TSC respondents though they were somewhat incoherent and 3 OPC respondents and no TSC respondents indicated that they are highly incoherent.

Cross-references between the two pieces of legislation are in place. The mandatory NAPCP format requires Member States to explicitly describe progress against air quality objectives; and to show the progress made by PaMs in improving air quality and the degree of compliance with national and EU air quality obligations.

The extent to which the links are established vary across NAPCPs. According to the 2024 Horizontal review report, nine Member states referred to priority air pollutants, linking them clearly to air quality objectives. Member States generally provided information on the progress triggered by PaMs in improving air quality. This has been done through

[280] EC (2022), *Strengthening of air quality monitoring, modelling and plans under the Ambient Air Quality Directives*.

reporting on historical trends in ambient air pollutant concentrations and reporting on compliance with EU limit values. The projected improvement in air quality as a result of additional PaMs was reported by a minority of Member States, with only a few providing maps of air pollutant concentrations provided under a WAM scenario. Two Member States selected additional PaMs for adoption specifically to improve air quality or to meet AAQD objectives.

The AAQD (as currently in force) requires Member States to ensure that the NAPCP is implemented to achieve ozone target values where it is exceeded, and to ensure to the extent possible that the air quality plans established in application of that Directive are consistent with programmes required under the NECD. Similar requirements apply also in the revised AAQD, specifying that NAPCPs need to address ozone precursors where ozone target values are exceeded, and that consistency is also required between air quality roadmaps and NAPCPs.

Considering the above, **the NECD and the AAQD and their reporting instruments are designed to exploit the complementarities, thus opportunities to strengthen synergies could stem from improving the practice of reporting, rather than changing reporting cycles or content**.

3.5.2 NAPCP development – synergies with NECPs

The report from the European Commission to the European Parliament and Council on the Review of the Regulation on the Governance of the Energy Union and Climate Action found that there is scope to enhance coherence and synergies with other policy areas, including related to air quality.

Commission guidance on developing NAPCPs invites Member States to consider the policies and measures planned in light of climate and energy obligations. Guidance on drafting NECPs encourages Member States to align NECP updates with NAPCP updates, however there are different legal deadlines in submitting NAPCPs and NECPs, so submission dates may not align in practice.

It is not possible to quantify the potential savings of this option with high robustness at this stage. For illustration, the option could deliver a potential minor administrative saving, if efficiency gains are realised between the reporting requirements. Whilst it may not be feasible to have one database for reporting both NECPs and NAPCPs at the same time, closer alignment could make the process more streamlined (and enable greater consideration of each set of PaMs in the two plans). **This, if realised, could result in a yearly saving competent authorities of €3,400 on average per Member State** (assumes 10% saving of average annual ongoing cost to Member States of developing NAPCPs estimated to be €34,200 per annum).

An NAPCP capacity building workshop held in January 2022 highlighted that examples had been identified where Member States managed to integrate the NAPCP with the NECP despite the challenging differences in legal deadlines. However, only three Member States clearly state in their most recent PaMs submission at the time of drafting this evaluation,

that all PaMs have been developed in line with their NECP. The workshop slides go onto note that: *Examples shared show that the NAPCPs often built on what was already included in the NECPs and were then used to rectify some of the measures which were unfavourable for air quality e.g. concerning the use of biomass.* A 2024 Staff Working Document on the review of the Regulation on the Governance of the Energy Union and Climate Action found that: *over half of the draft plans do not include the required information on the impact of policies on projected emissions of the main air pollutants regulated under the National Emissions Reduction Commitments nor on the alignment of National Air Pollution Control Programme (NAPCP) with energy and climate programmes*[281]. The final assessment[282] encourages Member States to further consider synergies and trade-offs of the planned measures with air pollution when implementing their updated NECPs.

Through the **targeted engagement of competent authorities**, several Member States revealed that improvements could be made through greater alignment of NECP and NAPCP reporting. Two Member States commented that it might be desirable to better align the reporting dates between the NECP and NAPCP, with one explaining that the disconformity in the deadlines prevents the timely adoption of the NAPCP. The Member States elaborated that the deadlines for NECP and NAPCP preparation should not be the same as this would increase burden, rather than spread the workload. Some Member States suggested a delay of a month would be sufficient to spread the effort.

The issue of inconsistency between the NAPCP and NECP timelines was also mentioned by two individuals responding in a professional capacity and one public authority during the **targeted stakeholder consultation** as an element that hinders the NAPCPs' ability to achieve the objectives of the NECD.

Other suggestions for simplification around NAPCPs and NECPs offered through the targeted engagement of competent authorities were to combine the reporting of PaMs databases between energy and climate and air quality reporting, and allow the NAPCP to cross-reference the NECP, and/or have a sub-chapter in the NECP on air quality.

3.5.3 NAPCP development – the common NAPCP template

According to six public authorities and two individuals in a professional capacity responding to the TSC, the NAPCP templates have somewhat helped with standardising reporting across Member States. The requirement of listing measures that would reduce emissions was thought to be useful to attain NECD objectives.

During the stakeholder workshop conducted in October 2024 as part of this evaluation, one participant stated that the amount of detail needed in NAPCP reporting is in some instances very high and is not always productive. One example raised by one Member State related to concentrations, noting that whilst the NAPCP template asks for these, it is unclear why

[281] Staff Working Document on the review of the Regulation on the Governance of the Energy Union and Climate Action, SWD(2024) 200 final: page 44.
[282] COM(2025) 274 final.

they are needed (see stakeholder opinions highlighting the need for connections between AAQD air quality plans and NAPCPs above). Connected to this, another stakeholder (through the targeted engagement of competent authorities) noted that the common reporting template could be made more suitable for NAPCP updates (noting that the current template was more appropriate for the first NAPCPs submitted in 2019).

Public administrations responding to the TSC mentioned several points regarding the format: that a single template was a rigid format that was not adaptable to differences in Member State administrative systems; that the template was technical, and filling it was time-consuming; that, as a consequence it was not appropriate for public engagement.

One respondent from a public entity noted that although reporting around PaMs is important, there are inherent difficulties in the quantitative assessment of impacts, action by action. This is because each would require its own assessment as they may not all be equally complex and, in some cases, may be impossible to determine. The respondent elaborated that knowing the reduction potential of certain actions is valuable for developing the action plan, but a detailed assessment, measure by measure, for each Member State, generates significant and unnecessary costs. Therefore, it is considered that an overall assessment of the plan is sufficient to monitor compliance with the trajectory, particularly when this assessment shows compliance with the objectives is sufficient. On this topic, the NAPCP reviewers' analysis (see further details below) recommended to provide additional guidance to Member States.

An assessment[283] of the common format identified possibilities for reducing he overall burden of reporting NAPCPs.

- Eliminate unnecessary repetition (e.g. information on implementation years and responsible authorities for PaMs considered for adoption and PaMs considered and selected for adoption).
- Reduce optional reporting content (e.g. executive summary, reporting costs of PaMs considered but not selected for adoption).
- Make the NAPCP format more suitable for updates.

3.5.4 NAPCPs – frequency of updates

Some public authorities mentioned through the targeted engagement of competent authorities that it does not seem necessary to update the NAPCP every 4 years, particularly for those Member States who are meeting (or are anticipated to meet under baseline projections) their ERCs. Two Member States suggested that the PaMs and NAPCP should only be updated in case the emission projections indicate non-compliance for any pollutant.

It is not possible to quantify the potential savings of this option with high robustness at this stage. For illustration, this option could provide a potential annual administrative cost saving of ~20% primarily due to the adapted format for reporting**. This could result in an annual saving, for each Member State, of ~€7k on average (saving relative to average**

[283] Ricardo (2024) Assessment on the suitability of the NAPCP common format and EEA-PaM tool.

annual ongoing cost per Member State of NAPCP development, estimated to be €34 200). However, the key caveat here would be that the actual reduction potential would depend on how detailed – and how aligned with the template – each MS would report. As seen throughout Annex III section 3.1, the quality of, and price of developing, NAPCPs currently widely varies between Member States.

3.5.5 Emissions inventories and projections

A questionnaire issued under the 2023 Task force on Emission Inventories and Projections (TFEIP)[284] of the GP previously found that **no significant component of the existing emissions reporting requirements was considered unnecessary** by the vast majority of respondents. It was also noted that using a simple consensus to decide the scope of reporting is not an appropriate approach. For example, the researchers and scientists who use the emissions of persistent organic pollutants may be very small in number, but the reported emissions are essential to their work. Stakeholder feedback from the emissions inventory community concluded that reducing the number of pollutants reported would result in only a very small reduction in required effort.

Targeted engagement of Competent Authorities revealed that whilst some Member State consider the **frequency of reporting** to be appropriate (this was corroborated by another stakeholder through the Targeted stakeholder consultation), this is not consistent across all countries. Another Member State suggested the frequency of reporting (of emissions, projections, adjusted data, gridded and LPS data) should be reviewed to ensure this provides opportunity to maximise the quality of the reporting. A further Member State suggested that reducing projections reporting frequency to every 4 years would be beneficial as it is a very costly element of the obligation, noting that projections are reported less frequently under the GP.

It is not possible to quantify the potential savings of this option with high robustness at this stage. For illustration, these synergies could result in a 25% administrative saving, per year. This is because significant man-time would be saved if preparation of reports only had to occur at half the current frequency. Where realised, **this could deliver a potential yearly saving of €187 000 per Member State, on average** (relative to annual average ongoing costs of inventory and projection development, estimated to be €749 000 per year per Member State)[285]. However, this is likely to be offset by innovation / R&D related costs which are not quantified. These costs would relate to the 'higher quality data' point within the option. This is described further, with additional caveats to consider, in section 2.6 of the support study.

Through the targeted engagement of competent authorities, some Member States made suggestions around the **timeline for reporting**. One noted that since it is a pre-requisite to align climate and energy scenarios with the NAPCP, it could be useful to align the timeframes for developing GHG and air (NECD) projections. Another mentioned that the

[284] The future of emissions reporting (recent TFEIP questionnaire)

[285] This will vary greatly between Member States, in line with the variability shown between Member States within Annex III section 3.1.1. This figure is merely illustrative.

same mid-March reporting deadline can be difficult to juggle if the same organisations are responsible for both the air pollutant and the GHG inventory, and a somewhat later deadline then might ease some burden and improve the quality of the IIR reports (although recognising that the current deadlines are in line with the Reporting Guidelines under the CLRTAP). Another three Member States suggested that delaying the reporting of projections by at least one month after March 15th would allow for the incorporation of the latest edition of the inventory. Through the targeted stakeholder consultation one competent authority raised concerns relating to the deadline for reporting the spatial inventory which requires producing and validating an up-to-date spatial inventory within 2 and a half months and suggested to extend this deadline.

A particular inefficiency identified by emissions inventory experts and compilers in the 2023 European Commission study relates to the lack of a robust system that **ensures new knowledge is shared quickly** and introduced to the EMEP/EEA guidebook in a timely manner[286]. The same report identified that workloads and time efficiency are key barriers to improvement of NECD emissions inventories and datasets and that this is because *inventory experts are committed to other reporting requirements beyond the NECD"*[287].

One Member State (through the targeted engagement of competent authorities) suggested taking the opportunity to review **Article 5 on flexibilities** (although the Member State also stated that this was not a key obligation that had resulted in additional administrative effort to undertake). The Member State perceived that flexibilities specified in paragraphs 2, 3 and 4 have not been used, nor have the Commission adopted any implementing acts (in line with paragraph 7 of article 5). Other Member States highlighted that the flexibilities permitted by Article 5 for the adjustment of national emissions inventories are necessary. This is because the flexibility permitted by paragraph 1 makes it possible to have up-to-date emissions inventories, based on the latest knowledge (methodology, data), and does not require Member States to set up dual accounting consisting of a methodologically up-to-date inventory and an inventory intended for European reporting.

3.5.6 Electronic reporting

Electronic submission has been used for the purposes of reporting under the NECD since its adoption.

Member States upload their PaMs via the **EEA PaM tool**. The EEA provided several trainings to Member States on the use of the tool.

When responding to the **TSC** question on whether the PaM tool had an influence on the cost or effort of providing information on policies and measures, most respondents from public administrations – who are the main users of the tool – thought that it had no effect on costs (5). Two thought that it somewhat reduced the burden, whilst 3 thought that it

[286] European Commission, Directorate-General for Environment, (2023) Analysis of and recommendations for the inventory reporting requirements under Directive (EU) 2016/2284 not linked to emission reduction commitments: final report. Publications Office of the European Union.

[287] Ibid: page 26.

somewhat increased the burden, and 2 that it increased the burden greatly. The two respondents in a personal capacity thought that it somewhat increased the burden.

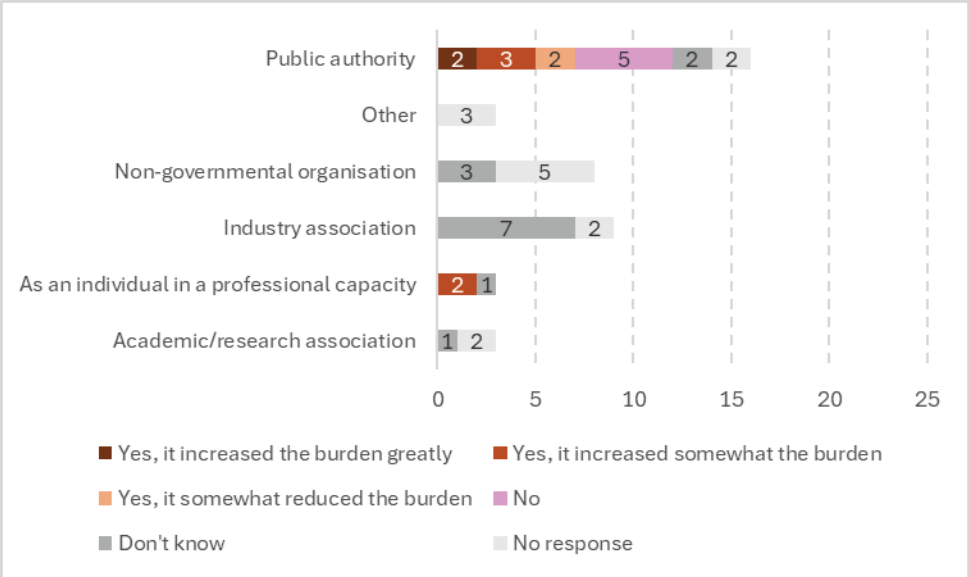

Figure A - 37 – Replies to the question "Did the PaM tool have an influence on the cost/ effort of providing information on policies and measures?" through the targeted stakeholder consultation (2024).

Through the **targeted engagement**, competent authorities suggested to provide a more user-friendly template for reporting PaMs that would allow users to download and complete it offline, make modifications as needed without errors or data loss, and include prefilled data where possible. Although no quantification could be made, it was suggested that this simplification could lead to significant time savings.

EEA Reportnet2 was used for the NECD during the evaluation period. One of the suggestions of competent authorities through the targeted engagement was to rely on the more user-friendly Reportnet3 as a tool for simplifying reporting. The migration from Reportnet2 to Reportnet3 was already foreseen and is underway at the time of writing this evaluation.

At the moment, artificial intelligence (AI) techniques would not be capable to take over the inventory reporting or review process in a credible manner. The methodology is well established and requires a lot of technical expertise, which cannot be implemented by machines yet. At the same time, AI could be ready for assisting data processing, anomaly detection and data verification under expert supervision.

3.5.7 Ecosystems monitoring

There have been challenges in ecosystems monitoring that have led to issues around the usability of the data reported, and hence the effectiveness of the obligation (as explored under Annex III section 3.1 above). The evidence gathered through this evaluation suggests that these challenges which impact on the effectiveness of the reporting are also leading to inefficiency.

A recent report on ecosystem data reported by Member States under the NECD summarised that the current dataset is highly heterogeneous (i.e. variable in terms of the site types, measurement protocols and parameters measured), both spatially and temporally, which means that it is difficult in all cases to ascertain whether sites in all Member States are representative in line with the requirement of the Directive[288]. The report recommended that Member States should be provided with a standardised means to explain how their submission of monitoring data fulfils their NECD obligation and to explain this in terms of cost-effectiveness[289].

Stakeholder feedback corroborates the current challenges observed in the ecosystems monitoring and reporting. In the stakeholder workshop, one participant (competent authority) stated that ecosystem reporting seems irrelevant as it is. Targeted engagement of competent authorities revealed a perception that ecosystems monitoring was ineffective largely due to the voluntary design and implementation of national programs for data monitoring. One Member State went on to suggest that the requirement as it stands does not generate data as intended and should either be removed or have more specific requirements or guidance developed to ensure the data produced is more comparable across Member States. Through the OPC, one public authority stakeholder suggested that ecosystem monitoring should be reformulated in such a way to allow for conclusions to be drawn, making better use of existing monitoring data for entire territories.

In the workshop, one stakeholder noted that **closer alignment with the Air Convention** regarding ecosystems reporting would be very cost-effective and efficient (in particular making use of the existing monitoring). This was corroborated through the targeted engagement of competent authorities, where a few Member States suggested that the information and format for reporting to International Cooperative Programmes (ICPs) under the CLRTAP could be used for reporting under the NECD. This view was also raised by a competent authority through the targeted stakeholder consultation who considered that the format and requirements of ecosystems reporting could be improved as it is not sufficiently consistent with the reporting format carried out under the GP, particularly the different indicators required, which degrade the level of information provided. The Member State suggested that stronger links should be established with biodiversity conservation stakeholders. However, using existing monitoring data from other legislation and programmes relies on this data being available, and at this point not all Member States are part of the ICPs. Although data may be available for Member States currently part of ICPs, for this to be effective, the Member States not currently part of the ICPs would need to establish new monitoring networks and for these Member States this would represent an additional burden (being part of ICPs and reporting ecosystem impacts is not mandatory under the Gothenburg Protocol).

It is very difficult to quantify potential administrative savings with any certainty because Member States take different approaches to ecosystems monitoring. Some Member States raised that whilst they did not have to set up new sites, additional parameters or further

[288] Williamson, T et al. (2024). Ecosystem data reported by Member States under Directive 2016/2284.
[289] Ibid.

calculations were needed on top of what is required by other legislation. In some cases, it was indicated that the potential savings stemming from this streamlining process are likely to be minimal; whereas in others savings could be significant bearing in mind the administrative effort for reporting under this obligation currently.

It is not possible to quantify the potential savings of this option with high robustness at this stage. For illustration, we use a potential administrative saving of 40%, if all reporting is streamlined under the GP requirements, in the same template. This is based on Member State accounts of either not utilising the existing templates or taking a reasonable amount of effort to harmonise. This would, however, vary significantly at the Member State level, where some Member States could face significant one-off costs associated with reporting to the ICP under the GP, if they do not participate already. If these efficiency gains are realised, **they could deliver an average annual €115 000 saving per Member State** (relative to annual average ongoing cost of ecosystems monitoring, estimated to be €288,000 per year per Member State)[290].

Several Member States noted through the targeted engagement of competent authorities the potential for **greater harmonisation and reduction of duplication between different EU obligations**. One Member State suggested potential synergies with WFD and biodiversity programmes should be explored, in particular whether the frequency of reporting could be aligned or all requirements combined in a common programme (noting that within the Member State, complexity arises in that one team is responsible for WFD monitoring, but not NECD requirements). In order to better streamline the requirements under Article 9, another Member State suggested that the list of ecosystem types should be reviewed, with the intention of specifying the most vulnerable types on which to target the monitoring. Whilst the list of key ecosystem impacts is still relevant, the monitored variables should be re-evaluated and harmonized (NECD Annex V).

3.5.8 Reporting on pollutants not covered by ERCs and other types of data

Work commissioned by DG ENV[291] has analysed the relevance of the range of the 'non-ERC' pollutants, i.e. pollutants covered by reporting obligation, as well as other types of data (LPS and gridded data). Annex III section 5.3 provides a more ample summary of the results. It points towards reporting items that may be considered unnecessary, including:

- Heavy metals and POPs, often considered of little use because the data is thought to be unnecessary or not used by modellers and users of national emissions data.
- TSP is identified as a pollutant that could be further evaluated for removal from NECD reporting requirements given it is not much used.
- The role of LPS data submitted under NECD reporting was questioned by stakeholders, particularly against the more frequently updated E-PRTR data.

[290] This will vary greatly between Member States, in line with the variability shown between Member States within section 2.2.1. This figure is merely illustrative.

[291] Analysis prepared by Aether, CITEPA and Ricardo, published as: European Commission: Directorate-General for Environment, *Analysis of and recommendations for the inventory reporting requirements under Directive (EU) 2016/2284 not linked to emission reduction commitments – Final report*, Publications Office of the European Union, 2023.

However, inventory compilers consulted as part of that work have indicated that **removing several pollutants would not significantly reduce the resources needed for reporting**. The reason for this is that the quantification of these emissions is based on the same activity data as other data points, requiring primarily additional application of emission factors.

The study also indicated that reporting higher quality data less frequently would be preferable to annual reporting for all pollutants.

3.5.9 Overlaps between the NECD and IED reporting

The IED requires that large point sources (LPS) report their pollutant emissions (including into air) every year. The NECD requires LPS emissions of the five main air pollutants, via Member State reporting, every four years. Considering this overlap, stakeholders questioned the added value of including LPS reporting under the NECD, stating in the TSC that it did not have an impact on improving information and data available around air pollution. However, stakeholder feedback from the emissions inventory community did not indicate a strong consensus to remove any data reporting.

It is also important to note that this item is required by the GP, therefore any changes to requirements would have an effect on alignment with the GP; and Member States would continue to be required to report these data to the GP as signatories to the Air Convention.

3.5.10 Overlaps between NECD and GP reporting

Member States provide the same reports using the same methods and templates for inventories and projections reporting under the NECD and the GP. Two Member States responding to the targeted engagement of competent authorities volunteered the suggestion of combining the data entry for NECD and Gothenburg Protocol, such that the data only needs to be submitted once in one place.

There is a limited set of differences between reporting under the two instruments (see a detailed analysis of the coherence between the NECD and GP under Annex III section **Error! Reference source not found.**). The key differences are related to the additional 2030+ ERCs in the NECD and the requirement to follow a linear trajectory towards these ERCs in 2025; the exclusion some agricultural sources from the inventories under the NECD (see a detailed analysis in Annex III **Error! Reference source not found.**); and some additional flexibilities in the NECD respectively to the GP. The two submissions use the same EEA platform.

As a consequence, the additional effort to comply with NECD requirements is due to policy choices that do not overlap with the GP (e.g. the 2030+ ERCs). Where differences could be eliminated, the potential cost reduction tied to this simplification would be very limited.

One Member State responding to the targeted engagement noted that the further **alignment of the review activities** around emissions inventory data carried out under the Air Convention with similar activities carried out under the NECD and seeking co-operation

on these activities would result in a reduced burden. It was noted that a proposal was presented to the EMEP Steering Body in September 2017.

3.5.11 Deriving data from earth observation

CAMS applications are already supporting the analysis of potential impacts of sectoral policy measures and help check conditions for applying for flexibility under Article 5(2).

In the future and based on additional research and development, more enhanced use of earth observation data such as from Copernicus could simplify compilation of air pollutant inventories and inform clean air policies more widely. Since 2014, Copernicus through its Copernicus Atmosphere Monitoring Service (CAMS) provides continuous data and information describing air quality levels and trends at national and European level. CAMS re-analysis and inversion analysis has the potential to be used to improve emission inventories by combining earth observation and in situ measurements. The current tools are particularly suited for identifying large sources of air pollution and capacity for the verification of diffuse sources is also increasing. For example, combining Sentinel-5P with the American Cross-track Infrared Sounder (CrIS) now yields regional estimates of NH_3 emissions, allowing checks on agricultural reporting. Commercial high-resolution Earth Observation constellations also demonstrate potential for targeted audits of large emitters, subject to validation and data-policy alignment.

The use of CAMS data could not be used to replace the current inventories, but there is potential to explore its use for quality control and verification of emission estimates for certain sectors:

- The Copernicus Atmosphere Monitoring Service (CAMS) delivers reanalyses and inversion products suitable for top-down checks of sectoral trends. The Copernicus Sentinel-5P satellite provides NO_2 , SO_2 , CO and other pollutant data used to identify emission hotspots and verify spatial consistency in national inventories. The newly launched Sentinel-4 mission (July 2025) is designed to provide hourly atmospheric composition data over Europe, facilitating near real-time profiling of emission events. Sentinel-5, launched in August 2025, and hosted on a MetOp-SG A satellite, will provide daily, global measurements of air quality, climate, ozone, and UV radiation. It will monitor trace gases like nitrogen dioxide, methane, and aerosols with high spatio-temporal resolution to support public health, climate science, and environmental applications.
- Other Copernicus missions and services – Sentinel-2/3, Copernicus Land Monitoring Service (CLMS), and Copernicus Climate Change Service (C3S) – enhance land-use mapping and meteorology-adjusted trend analysis.
- The CO2M constellation of 3 satellites to be launched in the coming years (first satellite in 2027) will form the backbone of a new European CO_2 monitoring and verification support capacity (CO2MVS) for monitoring global anthropogenic (human-made) CO_2 and CH_4 emissions and also associated components such as NO_2 for enhanced emission plume detection. CO2MVS is being developed as part of the EU's Copernicus Atmosphere Monitoring Service.