NEC Scenario Analysis Report Nr. 8

Cost-effective Emission Reductions to Improve Air Quality in Europe in 2020

Analysis of Policy Options for the EU for the Revision of the Gothenburg Protocol

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International Institute for Applied Systems Analysis (IIASA)

submitted to the

European Commission, DG Environment

Contract N° 070307/2009/531887/SER/C4

FINAL REPORT

July 2011

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Executive Summary

The European Commission has developed a comprehensive approach to implementing the EU air quality policy including the preparation for a review and revision of the National Emission Ceilings (NEC) directive (CEC, 2011). As one element, this approach includes the revision of the UNECE Gothenburg Protocol aiming, inter alia, at broadening the participation and ratification of the EU's eastern neighbours and set 2020/2030 emission ceilings for the pollutants covered by the current NEC Directive.

At the same time, the Convention on Long-range Transboundary Air Pollution has embarked on the revision of its Gothenburg multi-pollutant/multi-effect protocol with the aim to finalize a revision by the end of 2011 (ECE/EB.AIR/106). In April 2011, the Centre for Integrated Assessment Modelling has presented a series of scenario calculations that illustrate cost-effective emission reductions for the European Parties of the Convention, including the eastern neighbours of the EU (Amann et al., 2011).

This report informs the European Commission on how the scenarios presented to the Convention on Long-range Transboundary Air Pollution relate to the environmental objectives that have been established by the Thematic Strategy on Air Pollution (TSAP; CEC, 2005). It explores additional emission reductions (beyond the current legislation) that would be necessary to be taken by the EU Member States to meet the environment and health objectives of the Thematic Strategy on Air Pollution and the European Parliament in 2020, under the assumptions that the non-EU Parties in Europe do not take any further measures beyond the business-as-usual case.

The report demonstrates that the least-cost portfolios of measures that would be required to meet the targets of the TSAP are critically dependent on the assumptions on the baseline developments, both for countries inside and outside the EU. For instance, additional measures in the EU-27 would involve costs of 242 million Euro/yr if the PRIMES Reference scenario (which achieves all targets of the Energy and Climate package) is assumed as a starting point and non-EU countries would reduce their emissions as suggested in the CIAM 1/2011 report for the mid-case. In contrast, if non-EU countries follow their baseline and EU countries develop along their national energy projections (with significantly higher greenhouse gas emissions), additional air pollution control costs to achieve the TSAP targets would increase to 805 million Euro/yr. The more ambitious targets of the European Parliament would increase costs by roughly a factor of two.

On a sectoral basis, the additional measures would involve highest costs for the agricultural sector for all scenarios. Measures in other sectors depend on the assumed baseline. However, total air pollution control costs (including the costs of the current legislation baseline) are significantly higher in other sectors, since stringent emission control measures are already in force at these sectors.

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Acknowledgements

The analysis presented in this paper was financially supported by the European Commission under the service contract 070307/2009/5311887/SER/C4.

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This paper reports on work of the International Institute for Applied Systems Analysis and has received only limited external review. Views or opinions expressed in this report do not necessarily represent those of the Institute, its National Member Organizations or other organizations sponsoring the work.

1 Introduction

The European Commission has developed a comprehensive approach to implementing the EU air quality policy including the preparations for a review and revision of the National Emission Ceilings (NEC) Directive (CEC, 2011). As one element, this approach includes the revision of the UNECE Gothenburg Protocol aiming, inter alia, at broadening the participation and ratification of the EU's eastern neighbours and set 2020/2030 emission ceilings for the pollutants covered by the current NEC Directive.

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The remainder of the report is organized as follows: Section 2 reviews the methodology, input data assumptions, and measures assumed in the baseline. In particular, it examines the achievement of the national emission ceilings in 2010 and explores whether additional measures could have been taken by countries that would meet the ceilings. The results of the policy scenario, i.e., emission control costs, resulting emission ceilings, marginal costs of the cost-effective solution and the environmental impacts are presented in Section 3. Conclusions are drawn in Section 4. Detailed results for all Member States are provided in the Annex.

2 Methodology, input data and assumptions

2.1 Methodology

2.1.1 The GAINS model

To identify cost-effective measures to further improve air quality in Europe, this report employs the GAINS (Greenhouse gas – Air Pollution Interactions and Synergies) model developed by the International Institute for Applied Systems Analysis (IIASA). The GAINS model explores cost-effective multi-pollutant emission control strategies that meet environmental objectives on air quality impacts (on human health and ecosystems) and greenhouse gases. GAINS brings together data on economic development, the structure, control potential and costs of emission sources, the formation and dispersion of pollutants in the atmosphere and an assessment of environmental impacts of pollution. GAINS addresses air pollution impacts on human health from fine particulate matter and ground-level ozone, vegetation damage caused by ground-level ozone, the acidification of terrestrial and aquatic ecosystems and excess nitrogen deposition to soils, in addition to the mitigation of greenhouse gas emissions. GAINS describes the interrelations between these multiple effects and the pollutants (SO_2, NO_x, PM, NMVOC, NH_3, CO_2, CH_4, N_2O, F-gases) that contribute to these effects at the European scale (Figure 2.1).

	PM (BC, OC)	SO_2	NO_x	VOC	NH_3	CO	CO_2	CH_4	N_2O	HFCs PFCs SF_6
Health impacts: PM (Loss in life expectancy)	√	√	√	√	√					
O_3 (Premature mortality)			√	√		√		√		
Vegetation damage: O_3 (AOT40/fluxes)			√	√		√		√		
Acidification (Excess of critical loads)		√	√		√					
Eutrophication (Excess of critical loads)			√		√					
Climate impacts: Long-term (GWP100)							√	√	√	√
Near-term forcing (in Europe and global mean forcing)	√	√	√	√	√	√				
Black carbon deposition to the arctic	√									

Figure 2.1: The multi-pollutant/multi-effect approach of the GAINS model to find cost-effective solutions to control air pollution and climate impacts

GAINS assesses, for each of the 43 countries in Europe, more than 2000 measures to control emissions to the atmosphere. It computes the atmospheric dispersion of pollutants and analyses the costs and environmental impacts of pollution control strategies. In its optimization mode, GAINS identifies the least-cost balance of emission control measures across pollutants, economic sectors and countries that meet user-specified air quality and climate targets. A full technical documentation of the methodology of the GAINS model is available at http://gains.iiasa.ac.at/index.php/documentation-of-model-methodology/supporting-documentation-europe.

GAINS calculates future emissions for the baseline activity data on energy use, transport, and agricultural activities that have been projected by the PRIMES, TREMOVE and CAPRI models. Together with country-specific application rates of available emission control technologies, the GAINS emission factors reproduce emissions reported by countries to the UNFCCC and the Convention on Long-range Transboundary Air Pollution. The GAINS model has been reviewed under the EC4MACS project (www.ec4macs.eu/home/review-agenda.html) and the EMEP Steering Body (ECE/EB.AIR/GE.1/2009/2).

2.2 Input data and assumptions

The analysis reported in this paper examines the need for further emission control measures that would achieve the targets of the Thematic Strategy on Air Pollution and the European Parliament for three different activity projections:

2.2.1 Activity projections

The analysis in this report employs

- The 'PRIMES Baseline' scenario: a Europe-wide coherent picture on future economic, energy and agricultural development developed with the PRIMES and CAPRI models that reflects national energy and climate policies as of 2010.
- The 'PRIMES Reference' scenario: a Europe-wide coherent picture on future economic, energy and agricultural development developed with the PRIMES and CAPRI models that achieves the targets for climate and renewable energy of the EU Energy and Climate package (CEC, 2008).
- A 'National' scenario that reflects the perspectives of individual governments, however without any guarantee for international consistency. This scenario includes the national energy and agricultural scenarios submitted by 18 countries to IIASA as well as a set of Europe-wide projections that have been compiled from various international sources (Table 2.1).

Table 2.1: Sources of activity projections

	Europe-wide PRIMES 2009 scenario	*National scenario*
Energy projections		
PRIMES 2009 baseline	EU-27, CR, MK, NO	BE, BG, CY, EE, FR, DE, HU, MK, LV, LT, LU, MT, PL, RO, SK, SI
National projections	CH	AT, CR, CZ, DK, FI, GR, IE, IT, NL, NO, PT, ES, SE, CH, UK
IEA WEO 2009	AL, BY, BA, MD, RU, RS, UA	AL, BY, BA, MD, RU, RS, UA
Agriculture		
CAPRI 2009	EU-27, AL, BA, CR, MK, NO, RS	AL, BA, BG, CY, CZ, DK, EE, FR, DE, GR, HU, LV, LT, LU, MK, MT, NO, PL, PT, RS, SL
National projections	CH	AT, BE, CR, FI, IE, IT, NL, RO, SK, ES, SE, CH, UK
FAO 2003	BY, MD, RU, UA	BY, MD, RU, UA

Two Europe-wide coherent scenarios

The analysis employs for the 27 EU countries two Europe-wide coherent scenarios that have been developed with the PRIMES model:

The 'baseline' scenario relates to the projections that have been developed with the PRIMES model in 2009 for the European Commission (i.e., updates of scenarios presented in Capros et al., 2008). It includes the effects of the financial crisis. Detailed activity projections are available at the IIASA GAINS web site (http://gains.iiasa.ac.at). Future agricultural activities are derived for the EU countries and Norway from CAPRI model calculations. Detailed data on future animal numbers and fertilizer use are available from the on-line version of the GAINS model (http://gains.iiasa.ac.at). While this scenario includes national energy and climate policies as of 2009, it does not achieve the targets on greenhouse gas emissions and renewable energy that are established by the EU Energy and Climate package.

In contrast, the 'Reference' scenario provides a picture in which these targets for renewable energy and greenhouse gas emissions were fully achieved in 2020.

A set of national activity projections

18 Parties of the Convention on Long-range Transboundary Air Pollution submitted their most recent governmental projections of future economic development, energy use and/or agricultural activities to CIAM (in some cases the national projections date back before the economic crisis). As these projections reflect perspectives of individual national governments, they are not necessarily internally consistent in their assumptions on future economic development, energy prices and climate policies. In order to arrive at a data set that covers all of Europe, projections for other countries were taken from the World Energy Outlook 2009 (IEA, 2009) and the PRIMES model (the

2009 baseline). Detailed activity data can be retrieved from the GAINS online model (http://gains.iiasa.ac.at).

2.2.2 Assumptions

This report presents, for the three alternative baseline emission projections, calculations of the resulting air quality impacts. These calculations have been carried out with IIASA's GAINS model and employ a set of exogenous assumptions that are important when interpreting results.

The quantification of excess of critical loads for eutrophication employs ecosystems-specific estimates of nitrogen deposition. As earlier calculations for the NEC directive and for TSAP have used deposition computed for the grid-average, results are not directly comparable.

For the impact assessment, the 2008 database on critical loads of the Coordination Centre for Effects (Hettelingh *et al.*, 2008) has been used. Again, this is different from earlier NEC calculations that employed the 2006 version of the database.

The calculation of years of life lost (YOLLs) that can be attributed to the exposure to fine particulate matter is based on actual population numbers for the years under consideration. This means that for the year 2000 calculations employ population numbers of 2000, while for 2020 the population size projected for that year is used. In contrast, earlier calculations for the Clean Air For Europe (CAFE) program excluded the changes in population that are assumed in the activity projections, and employed a constant population (of 2010) for the calculations of YOLLs both for the base year 2000 and the target year 2020. While this report conducts the analysis for actual population, results for constant population are presented for reference.

In this report, impact estimates for the year 2000 have been derived from atmospheric dispersion calculations with the full EMEP model. In contrast, impact estimates for the year 2000 that have been presented in CIAM report 1/2011 (Amann et al., 2011) have been derived with the approximations of source-receptor relations that are implemented in the GAINS model. As these approximations have been developed for the ranges of emissions that are relevant for the year 2020, certain differences emerge if these relationships are applied for the emissions of the year 2000. Thus, the estimates presented in the CIAM report 1/2011 for the year 2000 have to be seen as approximations, while the numbers presented in this report reflect the exact model outcome from the full EMEP Eulerian dispersion model.

For marine sources, calculations assume implementation of the recent IMO57 agreements on new fuels and engine standards.

Costs are reported in Euros of 2005, which is different to earlier NEC analyses that used Euros of 2000 as the currency unit.

Emission estimates for the year 2000 are based on activity statistics published by EUROSTAT. For some countries, this results in slight discrepancies to national emission estimates that rely on national statistics. In the GAINS online version, data for the year 2000 that are used for this report are made available as the 'GOTH_2000' scenario.

National emissions are estimated based on the amount of **fuel sold** within a country.

2.3 *Changes since the last reports*

This report relies on the GAINS data set that has been employed for the recent policy analyses for the revision of the UNECE Gothenburg Protocol (Amann et al., 2011). Compared to the NEC report #7, the following changes have been implemented:

Under the UNECE Task Force on Reactive Nitrogen (TFRN), costs of ammonia abatement options were reassessed in an expert workshop 'Costs of ammonia abatement and the climate co-benefits'. Details are covered in the chairmen's report submitted to the 48^{th} session of the WGSR in April 2011 (document ECE/EB.AIR/WG.5/2011/3), www.clrtap-tfrn.org). Based on the information on ammonia emission control costs that has emerged at that workshop and discussions with the TFRN chairs, the following changes have been implemented in the GAINS model:

- Average farm sizes were reassessed, and hobby and subsistence farms of less than 15 livestock units (LSU) were excluded. Thereby, measures that are prohibitively expensive on small farms are now considered as "not applicable", and ammonia abatement measures are only considered for farms with more than 15 LSU. As a consequence, the potential for and costs of ammonia control are more accurately estimated, particularly in countries with a large share of small "subsistence" farms (e.g., Poland, Bulgaria, Romania).
- Additional costs for low protein feed were strongly decreased to about 0.5 €/kg NH_3-N abated, based on the evidence presented at the workshop.
- Costs and efficiencies of purification of exhaust air from animal houses are now based on acid scrubbers instead of biofilters. This results in a strong cost decrease to about 10 €/kg NH_3-N saved. Other housing costs were not changed.
- Costs of manure storage options remained unchanged.
- Costs for manure spreading were reassessed based on the assumption that contractors would be able to operate much more cheaply, as their investment would pay off more readily. Reported costs are below 1 €/kg NH_3-N abated, with high efficiency measures being cheaper in abatement-related costs. Considering that any nitrogen not emitted as NH_3 would contribute to soil fertilization and save the application of mineral fertilizer, with (country-specific) fertilizer prices of about 1 €/kg N, total abated costs may become negative in some cases, i.e., it can be cost saving to prevent manure N from being lost into the atmosphere in form of NH_3.

A more comprehensive documentation is provided in Klimont & Winiwarter, 2011. Country-specific details can be extracted from the GAINS online version.

In addition to these recent modifications, CIAM report 1/2011 incorporates the following changes in comparison to NEC report #7:

- In response to comments from several EU countries who have not supplied national energy projections to CIAM, the set of national projections includes now for these countries the 2009 PRIMES energy scenario instead of the 2008 scenario that has been used before, as the 2009 version comes much closer to their national expectations than the 2008 baseline scenario did.

- For the off-road sector, the analysis considers the options of low sulfur heavy fuel oil and low sulfur diesel (compared to what was assumed in the CIAM report 1/2010). However, compared to version 1 of CIAM report 1/2011, no accelerated introduction of Euro-standards to the off-road sector is considered in this report.
- NH_3 emission factors for mineral fertilizers and applicability constraints have been updated for the UK in response to comments from national experts.

2.4 Emission control measures included in the 'Current legislation' baseline

As a reference point, the baseline projection proposes future emissions as they would emerge for 2020 from the assumed evolution of economic activities and progressive implementation of emission control legislation. These baseline projections have been described in detail in CIAM Report 1/2010.

For EU countries, the baseline projection assumes (see Box 1):

(i) the implementation of all emission control legislation as laid down in national laws,

(ii) compliance with the existing National Emission Ceilings Directive (OJ, 2001),

(iii) the newly adopted Directive on Industrial Emissions for stationary sources (OJ, 2010), and

(iv) implementation of emission control measures for heavy duty vehicles (EURO-VI, OJ, 2009a) from 2014 onwards. Emission factors for road vehicles used in GAINS are consistent with COPERT IV factors (Gkatzoflias et al., 2007), i.e., they consider for the Euro 2/II to Euro-4/IV standards the implications of real-world driving cycles. These result in significantly higher NO_x emissions for diesel vehicles than originally foreseen, e.g., in the COPERT-II model. For Euro-5/V and Euro-6/VI, calculations assume full compliance with the currently assumed emission factors (based on COPERT-IV).

At the same time, the analysis does not consider the impacts of other legislation for which the actual impacts on future activity levels cannot yet be quantified. This includes compliance with the air quality limit values for PM, NO_2 and ozone established by the new Air Quality Directive, which could require, inter alia, traffic restrictions in urban areas and thereby modifications of the traffic volumes assumed in the baseline projections. Although some other relevant directives such as the Nitrates Directive are part of current legislation, there are some uncertainties as to how their impacts can be quantified.

For the non-EU countries, the baseline scenario considers an inventory of current national legislation in the various countries. Assumptions about emission controls in the power sector have been cross-checked with detailed information from the database on world coal-fired power plants (IEACCC, 2009). The database includes information on types of control measures installed on existing plants as well as on plants under construction. Recently several non-EU countries (Albania, Bosnia and Herzegovina, Kosovo, Croatia, Macedonia, Montenegro and Serbia) signed the treaty on the European "Energy Community". Under this treaty, signatories agree to implement selected EU legislation, including the Large Combustion Plants Directive (LCPD; 2001/80/EEC) from 2018 onwards and the Directive on Sulphur Content in Liquid Fuels (1999/32/EC; OJ, 1999) from 2012 onwards. For countries that have currently only observer status within the Energy Community (Moldova, Turkey, Ukraine) only national legislation has been implemented.

The implementation schedule of measures to control emissions from mobile sources has been compiled for each country based on national information (where available) and international surveys (DieselNet, 2009). According to these surveys, emission limit values up to the Euro 4/5 standards for light-duty vehicles and Euro IV/V for heavy-duty vehicles will be implemented in non-EU countries with five to ten years delay compared with the EU.

Box 1: Legislation considered for air pollutant emissions for EU countries

SO_2:
- Directive on Industrial Emissions (OJ, 2010)
- Directive on the sulphur content in liquid fuels (OJ, 2009b)
- Directives on quality of petrol and diesel fuels (OJ, 2003), as well as the implications of the mandatory requirements for renewable fuels/energy in the transport sector
- IPPC requirements for industrial processes
- Sulphur content of gasoil used by non-road mobile machinery and inland waterway vessels (reduction from 1000 ppm to 10 ppm) according to the Directive 2009/30/EC (OJ, 2009c)
- National legislation and national practices (if stricter)

NO_x:
- Directive on Industrial Emissions
- EURO-standards, including adopted EURO-5 and EURO-6 for light duty vehicles
- EURO-standards, including adopted EURO V and EURO VI for heavy duty vehicles
- EU emission standards for motorcycles and mopeds up to Euro 3
- Legislation on non-road mobile machinery
- Higher real-life emissions of EURO-II and EURO-III for diesel heavy duty and light duty diesel vehicles compared with the test cycle
- IPPC requirements for industrial processes
- National legislation and national practices (if stricter)

NH_3:
- IPPC Directive for pigs and poultry production as interpreted in national legislation
- National legislation including elements of EU law, i.e., the nitrates and water framework directives
- Current practice including the code of good agricultural practice

VOC:
- Stage I directive (liquid fuel storage and distribution)
- Directive 96/69/EC (carbon canisters)
- EURO-standards, including adopted EURO-5 and EURO-6 for light duty vehicles
- EU emission standards for motorcycles and mopeds up to Euro 3
- Fuel directive (RVP of fuels)
- Solvents directive
- Products directive (paints)
- National legislation, e.g., Stage II (gasoline stations)

PM2.5:
- Directive on Industrial Emissions
- EURO-standards, including the adopted EURO-5 and EURO-6 standards for light duty vehicles
- EURO-standards, including adopted EURO V and EURO VI for heavy duty vehicles
- Legislation on non-road mobile machinery
- IPPC requirements for industrial processes
- National legislation and national practices (if stricter)

2.5 Compliance with national emission ceilings in 2010

In principle, the baseline projections assume for all Member States full implementation of current emission control legislation in 2020 (for details see Section 2.4). However, they exclude additional emission control measures that might become necessary to maintain compliance with the existing EU air quality limit values at the local scale, and to comply with the national emission ceilings in 2010. To the extent necessary, the 'current legislation' baseline scenario should include additional measures to comply with these pieces of existing legislation. Consequently, the costs for these extra measures should be accounted for as costs of existing legislation, and be excluded from the costs of the further measures that are required to achieve the targets of the Thematic Strategy on Air Pollution in 2010.

Recent reports from Member States to the European Commission indicate that some Member States might not achieve their emission ceilings in 2010. As an independent assessment, this report examines the compliance with the 2010 national emission ceilings as seen from the GAINS database that relies on internationally available statistics.

At the time of this analysis, official statistical data for energy use and agricultural activities are not yet available for 2010 at the international level. Thus, this report employs the activity data provided by the PRIMES and CAPRI baseline scenario for 2010, which are not actual statistics, but recent projections for 2010. However, differences tend to be small in general.

Based on these activity data, the recent set of emission factors held by GAINS, and the description of the temporal penetration of emission control legislation in each country, robust indications for potential compliance failures emerge only for emissions for NO_x for a number of countries. A few countries might face violations of their emission ceilings for NH_3 and VOC, depending on the actual choice of statistical information, emission factors and inclusion of source categories that will be used for the compliance assessment.

For NO_x, the latest dataset indicates serious excess of national emission ceilings for about 10 countries (Table 2.1). In many cases a significant fraction of this overshoot in emissions is caused by the differences in emission factors for diesel vehicles that have been used for the original calculations of the emission ceilings in 1999, i.e., essentially emission factors based on the COPERT-II model, and the recent estimates of emission factors provided by COPERT-IV. These new emission factors, which consider, inter alia, more representative real-world driving cycles, are significantly higher for the Euro-2/II to Euro-4/IV stages than those that have been expected a decade ago by COPERT-II. If COPERT-II emission factors were employed instead, only four countries would exceed their emission ceilings.

Table 2.1: NO_x emissions calculated for 2010 (based on PRIMES baseline energy balances for 2010), with COPERT-II and COPERT-IV emission factors for road sources, compared to the National Emission Ceilings (NEC) for 2010 (kt NO_x) – Based on fuels sold

	Stationary sources	Non-road mobile sources	Road sources using		National totals using			Excess of NEC using	
			COPERT II	COPERT IV	COPERT II	COPERT IV	NEC 2010	COPERT II	COPERT IV
Austria	51	19	54	89	124	159	103	21	56
Belgium	101	27	65	111	193	239	176	17	63
Bulgaria	51	11	37	40	98	102	247		
Cyprus	8	4	6	8	17	19	23		
Czech Rep	100	31	80	87	211	218	286		
Denmark	40	50	26	40	116	129	127		2
Estonia	12	3	8	10	24	26	60		
Finland	80	43	34	45	157	168	170		
France	283	205	285	517	773	1005	810		195
Germany	457	127	375	528	958	1112	1051		61
Greece	131	75	57	67	263	272	344		
Hungary	60	14	61	74	134	147	198		
Ireland	34	16	20	37	69	87	65	4	22
Italy	301	245	283	438	829	983	990		
Latvia	12	4	14	15	30	32	61		
Lithuania	13	5	26	27	44	45	110		
Luxembourg	2	1	19	32	23	36	11	12	25
Malta	4	0	1	3	5	6	8		
Netherlands	91	64	76	117	231	271	260		11
Poland	273	84	217	235	574	592	879		
Portugal	64	20	56	81	141	166	250		
Romania	96	29	65	69	190	194	437		
Slovakia	42	2	26	30	70	74	130		
Slovenia	18	6	10	16	35	41	45		
Spain	357	222	279	470	858	1049	847	11	202
Sweden	43	51	54	70	148	165	148		17
UK	564	295	192	326	1052	1185	1167		18
EU-27	3288	1653	2426	3583	7367	8524	9003	66	673

For a fair attribution of the emission control costs of the additional measures that are identified in this report (i) to the enhanced environmental ambition level of the TSAP, and (ii) to delayed implementation of already agreed legislation (i.e., compliance with NECs), it would be useful to hypothesize measures that would have been required to meet emission ceilings in 2010. For this purpose, an illustrative analysis explored the hypothetical potential for additional emission control measures that could have taken by Member States, (a) through further controls of stationary sources, and (b) substitution of diesel passenger cars with gasoline passenger cars (e.g., by different tax incentives). For stationary sources, the estimate makes the optimistic assumption that countries would have started implementing measures already back in 2005 (Table 2.2). Replacing diesel with gasoline cars would lead to somewhat lower emissions in the old Member States with a high share of diesel vehicles, while differences in the new Member States would be much lower due to the higher emissions of the existing fleet of gasoline cars (as the new Euro-standards affect only the newest cars).

Table 2.2: Estimated excess of the NO_x national emission ceilings in 2010 and 2015, and the hypothetical potentials from (a) further emission controls at stationary sources and (b) a substitution of all diesel vehicles by gasoline vehicles (in kt). Based on fuels sold.

	NEC 2010	Excess of NECs in 2010 estimated with COPERT-IV emission factors	Hypothetical potential from further measures at stationary sources	Hypothetical potential from a substitution of all diesel cars by gasoline cars	Hypothetical remaining excess in 2010	Excess of NECs in 2015 estimated with COPERT-IV emission factors[1])
Austria	103	56	12	17	27	22
Belgium	176	63	44	26		30
Bulgaria	247		22	0		
Cyprus	23		5	0		
Czech Rep	286		38	5		
Denmark	127	2	12	3		
Estonia	60		7	0		
Finland	170		29	5		
France	810	195	118	111		
Germany	1051	61	91	107		
Greece	344		48	3		
Hungary	198		33	0		
Ireland	65	22	19	3		12
Italy	990		141	95		
Latvia	61		5	0		
Lithuania	110		5	-1		
Luxembourg	11	25	1	3	22	16
Malta	8		2	1		
Netherlands	260	11	25	17		
Poland	879		82	2		
Portugal	250		31	11		
Romania	437		50	1		
Slovakia	130		22	1		
Slovenia	45		9	2		
Spain	847	202	216	56		93
Sweden	148	17	11	3	3	
UK	1167	18	333	92		
EU-27	9003	673	1410	563		173

1) estimated for the PRIMES baseline scenario

It turns out that, with the new COPERT-IV emission factors, Austria, Luxembourg, Sweden could not have achieved their NO_x emission ceilings in 2010 even under the assumption that countries would have started implementing maximum controls at all stationary sources in 2005 and replaced their entire diesel passenger car fleet with gasoline cars (e.g., through appropriate tax incentives). Based on this finding, and the limited flexibility to introduce tighter emission standards for mobile sources in individual Member States, it is not obvious how to define the set of additional measures whose costs could be attributed to compliance with existing legislation.

3 Policy scenarios

3.1 Environmental targets

The following analyses explore options for achieving the environmental objectives of the Thematic Strategy for Air Pollution in 2020, for a range of different boundary conditions. For reference, the environmental objectives of the Thematic Strategy for 2020 and the numerical values of the indicators calculated from the recent GAINS model version, are recalled in Table 3.1.

Table 3.1: TSAP targets used for the analysis

Effect	Health impacts from PM2.5	Acidification forest soils	Acidification water	Eutrophication all ecosystems area	Health effects from O_3
	Years of life lost	Forest area with acid deposition exceeding critical loads	Catchment area with acid deposition exceeding critical loads	Ecosystems area with nitrogen deposition exceeding critical loads[1)]	Cases of premature mortality
Unit	Million YOLLs	1000 km^2	1000 km^2	1000 km^2	Cases/yr
TSAP target relative to 2000	-47%	-74%	-39%	-31%	-10%
Indicator computed for the year 2000[2)]	200.8[2)]	280.3	53.4	1188.4	22707
Resulting TSAP target (absolute value of indicator)	106.4	72.9	32.6	820.0	20436
2020 Baseline (PRIMES)	115.9	91.2	21.7	950.3	17134
2020 Maximum technically feasible reductions in EU-27	84.3	45.2	16.1	640.8	15299

[1)] This indicator refers to calculations based on ecosystems-specific deposition. The original target of the TSAP has been computed with grid-average deposition.

[2)] Calculated for the year 2000 with the full EMEP dispersion model. Note that the indicators presented in CIAM 1/2011 were derived from approximations with the source-receptor relationships in GAINS, which do not provide fully accurate results for the year 2000.

The impact indicators listed Table 3.1 are based on the latest methodologies to calculate the years of life lost (YOLLs) due to exposure to PM2.5 and for eutrophication. These have been changed since the Thematic Strategy on Air Pollution: For YOLLs, the calculation refers now to the actual population living in the year of interest, and thus includes the demographic changes between 2000 and 2020 (for TSAP, YOLLs have been calculated for the 2010 population). For eutrophication, the calculation is now based on ecosystems-specific deposition, while for the TSAP grid-average deposition has been used to compare with ecosystems-specific critical loads.

A series of GAINS optimization analyses has been carried out to explore the additional emission reductions that would be required to meet the objectives of the TSAP in 2020, on top of the current legislation baseline(s). Calculations have been conducted for three different assumptions on baseline development: (a) the PRIMES Baseline that reflects current energy policies in the Member States, (b) the PRIMES Reference scenario that meets the targets of the EU Energy and Climate Package, and (c) a set of national activity projections that have been provided by Member States to IIASA.

As air quality within the EU is influenced also by emissions from outside the EU territory, these calculations have been carried out for two different sets of assumptions about emission development in the non-EU countries. One variant assumes no further emission control measures in the non-EU countries beyond what is currently included in the national legislations of these countries. A second case explores the required emission reductions in the EU Member States if non-EU countries implemented the emission ceilings that are laid out as the 'mid' case of the scenario analyses conducted for the revision of the Gothenburg Protocol, as of April 2011 (Amann et al., 2011).

3.2 Optimized emission reductions and associated costs

The least-cost portfolios of measures that would be required to meet the targets of the TSAP are critically dependent on the assumptions on the baseline developments, both for countries inside and outside the EU (Table 3.2). For instance, additional measures in the EU-27 would involve costs of 242 million Euro/yr if the PRIMES Reference scenario (which attains all targets of the Energy and Climate package) is adopted as a starting point and non-EU countries would reduce their emissions as suggested in the CIAM 1/2011 report for the mid-case. In contrast, if non-EU countries follow their baseline and EU countries develop along their national projections (with significantly higher greenhouse gas emissions), additional air pollution control costs to achieve the TSAP targets would increase to 805 million Euro/yr. The more ambitious targets of the European Parliament would increase costs by roughly a factor of two (Table 3.3).

Table 3.2: Emission control costs in the EU-27 for achieving the targets of the Thematic Strategy for 2020 (million Euro/yr), on top of the costs for implementing current emission control legislation, for three different activity projections

	PRIMES Baseline	PRIMES Reference	National projections
Non-EU countries at baseline			
	512.6	349.3	805.1
Non-EU countries at mid-Gothenburg ambition			
	343.0	242.8	497.6

Table 3.3: Emission control costs in the EU-27 for achieving the targets proposed by the European Parliament for 2020 (million Euro/yr), on top of the costs for implementing current emission control legislation, for three different activity projections

	PRIMES Baseline	PRIMES Reference	National projections
Non-EU countries at baseline			
	951.0	833.2	1587.8
Non-EU countries at mid-Gothenburg ambition			
	612.5	531.0	1004.0

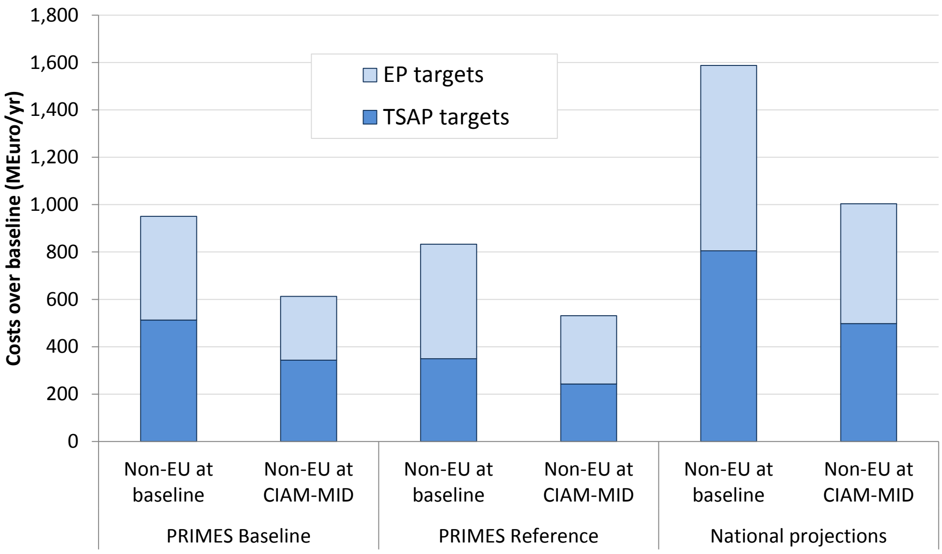

Figure 3.1: Emission control costs for the EU-27 for the optimized scenarios

On a sectoral basis, the additional measures would imply highest costs for the agricultural sector in all scenarios. Measures in other sectors depend on the assumed baseline projection (Table 3.2, Table 3.3, Figure 3.2). However, total air pollution control costs (including the costs of the current legislation baseline) are significantly higher in the non-agricultural sectors, since stringent emission control measures are already in force at these sectors. Note that the costs of the additional measures amount to 0.4% to 1.1% of the costs for implementing current legislation measures.

Table 3.4: Emission control costs (on top of current legislation) for achieving the targets of the Thematic Strategy on Air Pollution in 2020 (million Euro/year)

	Non-EU countries at baseline			Non-EU countries at CIAM-MID		
SNAP sector	PRIMES baseline	PRIMES Reference	National projections	PRIMES baseline	PRIMES Reference	National projections
1: Power generation	14.8	9.4	93.3	8.2	3.1	42.6
2: Domestic	47.5	10.6	56.0	2.3	0.1	44.8
3: Industrial combust.	49.0	35.8	143.6	27.1	10.6	54.2
4: Industrial processes	24.5	26.2	86.8	8.1	2.1	29.0
5: Fuel extraction	0.0	0.0	0.0	0.0	0.0	0.0
6: Solvents	0.0	0.0	0.0	0.0	0.0	0.0
7: Road traffic	0.0	0.0	0.0	0.0	0.0	0.0
8: Off-road sources	1.9	0.0	23.2	0.0	0.0	0.8
9: Waste management	2.0	5.4	6.1	0.7	1.4	5.1
10: Agriculture	372.9	262.0	396.2	296.5	225.6	321.1
SUM	512.6	349.3	805.1	343.0	242.8	497.6

Table 3.5: Emission control costs (on top of current legislation) for achieving the targets of the European Parliament in 2020 (million Euro/year)

SNAP sector	Non-EU countries at baseline			Non-EU countries at CIAM-MID		
	PRIMES baseline	PRIMES Reference	National projections	PRIMES baseline	PRIMES Reference	National projections
1: Power generation	46.7	41.9	219.7	29.4	18.8	109.5
2: Domestic	58.5	54.8	104.6	7.1	3.5	57.0
3: Industrial combust.	202.9	155.9	460.4	69.1	44.9	215.4
4: Industrial processes	70.8	63.0	186.1	40.8	35.0	108.6
5: Fuel extraction	0.0	0.0	0.0	0.0	0.0	0.0
6: Solvents	0.0	0.0	0.0	0.0	0.0	0.0
7: Road traffic	0.0	0.0	0.0	0.0	0.0	0.0
8: Off-road sources	30.6	27.5	41.9	0.0	0.0	23.2
9: Waste management	5.6	5.6	6.8	4.8	3.7	6.3
10: Agriculture	536.0	484.6	568.3	461.2	425.1	484.0
SUM	951.0	833.2	1587.8	612.5	531.0	1004.0

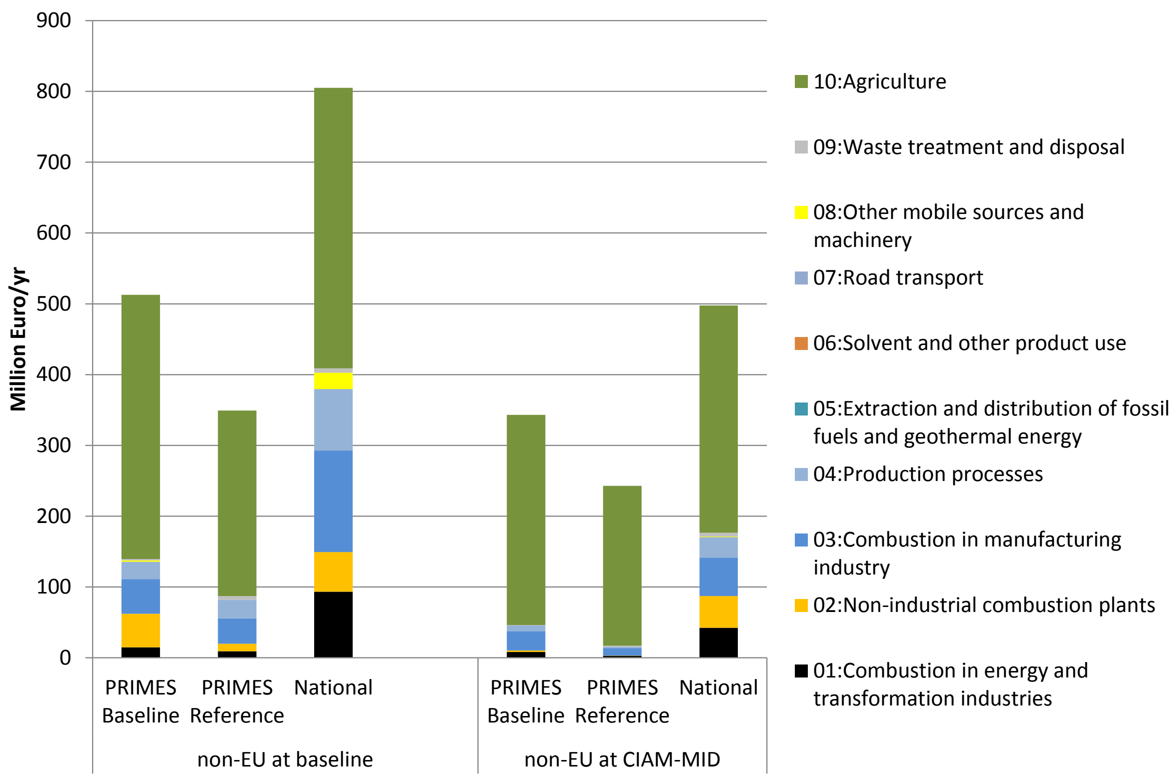

Figure 3.2: Emission control costs per SNAP sector for meeting the TSAP targets

The cost-effective portfolios of emission ceilings include largest reductions for NH_3 emissions (relative to the current legislation), followed by cuts in primary PM2.5 emissions (Table 3.6, Figure 3.3 to Figure 3.5). In all cases, the additional measures constitute only a minor share of the emission reductions that are technically feasible. Results for individual countries are presented in Table 5.4 to Table 5.18.

Table 3.6: Cost-effective emissions for the EU-27 in 2020 (kilotons)

		TSAP targets		EP targets		
	Current legislation	Non-EU at baseline	Non-EU at MID	Non-EU at baseline	Non-EU at MID	MTFR
SO_2						
PRIMES Baseline	2736	2523	2682	2397	2646	1783
PRIMES Reference	2631	2526	2627	2333	2573	1701
National scenario	2894	2441	2656	2200	2437	1828
NO_x						
PRIMES Baseline	5553	5456	5468	5257	5362	4495
PRIMES Reference	5433	5361	5373	5180	5275	4434
National scenario	5767	5566	5648	5296	5444	4639
PM2.5						
PRIMES Baseline	1059	921	1001	873	892	572
PRIMES Reference	1084	914	1007	898	920	574
National scenario	1095	895	920	879	895	580
NH_3						
PRIMES Baseline	3668	2902	2995	2748	2804	2389
PRIMES Reference	3670	3000	3086	2783	2838	2390
National scenario	3734	2893	2983	2766	2828	2434
VOC						
PRIMES Baseline	5939	5870	5897	5870	5870	4045
PRIMES Reference	6019	5950	5977	5950	5950	1701
National scenario	5941	5872	5872	5856	5872	1828

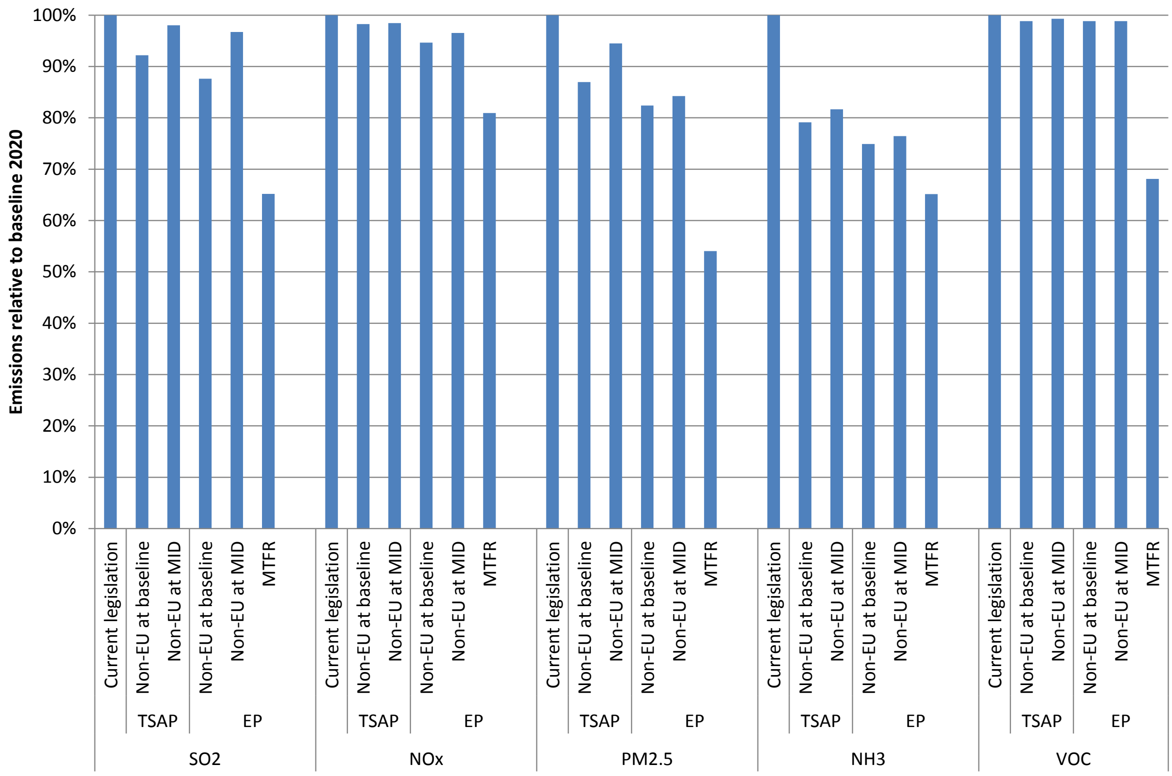

Figure 3.3: Optimized emission reductions in the EU-27 to meet the TSAP and EP targets, for the PRIMES Baseline scenario (relative to current legislation emissions)

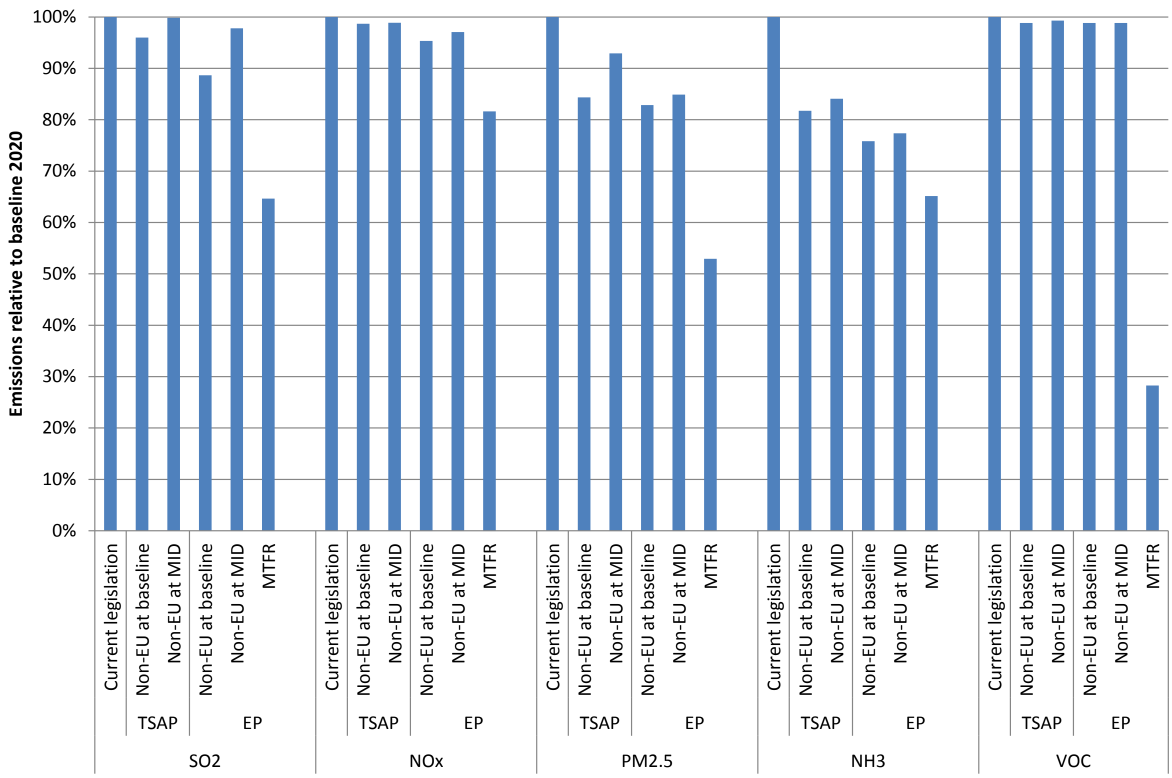

Figure 3.4: Optimized emission reductions in the EU-27 to meet the TSAP and EP targets, for the PRIMES Reference scenario (relative to current legislation emissions)

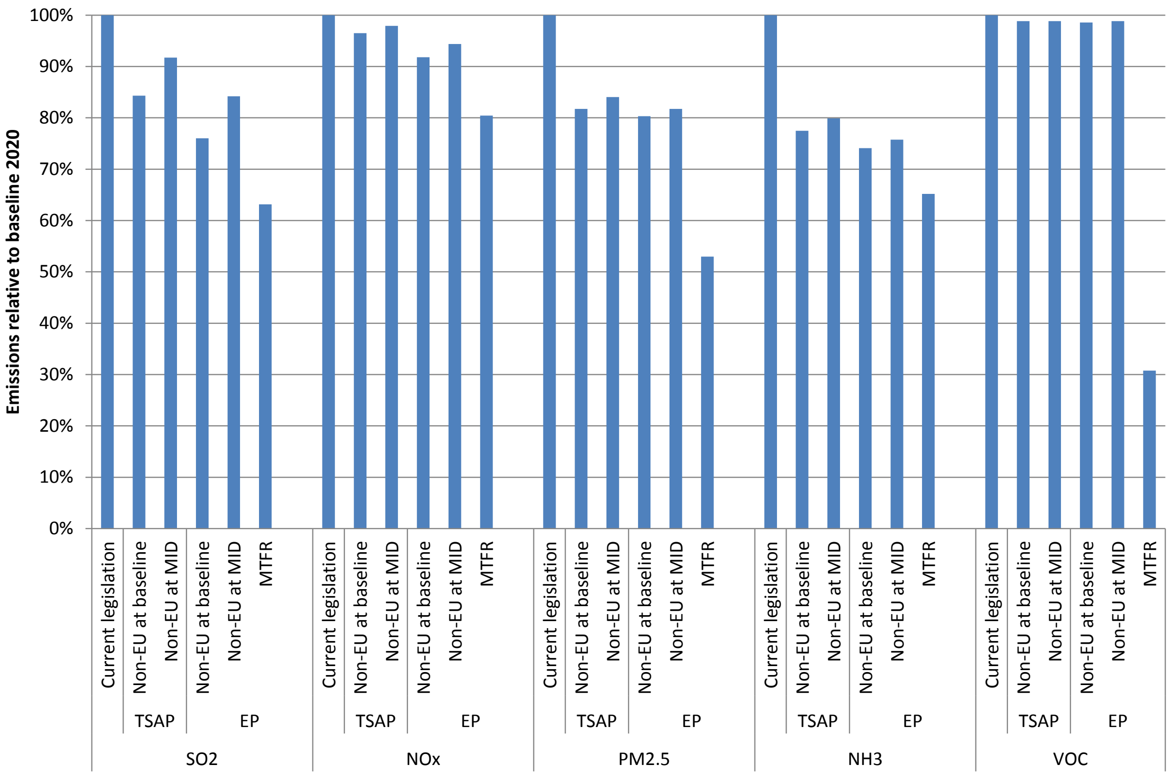

Figure 3.5: Optimized emission reductions in the EU-27 to meet the TSAP and EP targets, for the National scenario (relative to current legislation emissions)

3.3 Environmental impacts

Following the conceptual approach of this modelling study, the optimized least-cost emission control scenarios exactly meet the environmental targets as they are specified as constraints to the optimization (see Table 3.1). Thus, in general, environmental impacts of the different scenarios are very similar for each of the two sets of scenarios (i.e., for the targets of the Thematic Strategy and for the targets of the European Parliament, respectively). At a few places (countries) the optimized solutions might slightly overachieve some targets, if the corresponding emission reductions are necessary to attain more stringent targets in neighbouring regions. Table 5.19 to Table 5.48 provide detailed results for all Member States.

3.4 Sensitivity analyses

While a full quantitative uncertainty analysis of the model calculations is beyond the scope of this report, it is instructive to explore the impacts of key factors on the optimized solution. It has been pointed out that the intrinsic uncertainties about the future development of key drivers of emissions in Europe (including economic growth, energy, agricultural and climate change policies) constitute major sources of uncertainties that, however, cannot be easily reduced. To address these uncertainties, this report conducts all cost-effectiveness analyses for three different sets of exogenous economic activity projections, i.e., the PRIMES Baseline scenario, the PRIMES Reference scenario (with alternative assumptions on renewable energy policies), and the National scenarios that employ vastly different assumptions on economic development, energy prices and climate change policies in the Member States. The resulting ranges in national emission levels provide a quantitative indication of an irreducible range of uncertainties that emerges from the genuine uncertainties about future development.

In technical terms, the robustness of an optimized solution is determined by the distribution of the 'binding constraints'. If results are driven by a single constraint, the optimal solution will be very sensitive towards changes of this constraint. If, however, optimal results are determined by a large number of (spatially distributed) constraints, changes of a single constraint is unlikely to lead to substantial changes of the optimized solution, as the emission reductions will still be necessary to satisfy the other constraints. To analyse the robustness of the optimized scenarios, the 'binding constraints' that determine the cost-optimal set of emission reductions have been identified, and the distribution of marginal emission control costs across pollutants and Member States have been explored.

The cost-effectiveness analysis employs the optimization approach of the GAINS model to identify those measures that achieve the environmental targets (formulated as constraints in the optimization problem) at least costs. As described in Section 3.1, constraints have been specified for health impacts of PM, for ozone, and for eutrophication and acidification. For human health, one single constraint requests the reduction of years of life lost (YOLLs) over the entire EU, and reductions are carried out at those places where they can be achieved at least cost. For vegetation-related effects (i.e., eutrophication, acidification and ozone), constraints require equal relative improvements in each country, i.e., constraints have been specified for each country.

The optimization identifies the set of emission control measures that simultaneously satisfies all constraints. In principle, a cost-effective solution will attempt to exactly meet all constraints and avoid overachievements, as these imply higher (and unnecessary) emission control costs. Due to the transboundary transport of pollutants, however, overachievements might not always be avoided, particularly if stricter targets in neighbouring countries require measures that would not be necessary to meet the domestic constraints.

Table 3.7 lists those constraints that are exactly achieved in the optimal solution (the 'binding' constraints, i.e., for which a change of the constraint would affect the selected measures and thereby increase (or decrease) overall costs.

It turns out that for the TSAP targets the cost-optimal allocation of emission reductions is determined by set of 'binding constraints' that is evenly distributed across all Member States and environmental targets. As a consequence, relaxations of a single target (within reasonable limits) are not expected to lead to significantly different allocations of emission reductions, as the optimized set of emissions is balanced in such a way that it contributes to improvements of the environmental targets in multiple countries. In contrast, the targets specified for the European Parliament seem less balanced, as required reductions are essentially determined by the eutrophication targets in a few countries.

Table 3.7: 'Binding constraints' of the cost-optimal solution to attain the targets of the TSAP and the European Parliament.

	TSAP targets				EP targets			
	Non-EU at baseline		Non-EU at CIAM-MID		Non-EU at baseline		Non-EU at CIAM-MID	
	Acid.	Eutr.	Acid.	Eutr.	Acid.	Eutr.	Acid.	Eutr.
Austria	X	X	X	X	-	-	-	-
Belgium	X	X	X	X	-	-	-	-
Bulgaria	-	X	-	X	-	-	-	-
Cyprus	-	X	-	X	-	X	-	X
Czech Rep.	X	X	X	X	-	-	-	X
Denmark	X	X	X	X	-	X	-	X
Estonia	X	X	X	X	-	-	-	-
Finland	X	X	X	X	-	X	-	X
France	X	X	X	X	-	-	-	X
Germany	X	X	X	X	-	-	-	-
Greece	X	X	X	X	-	X	-	X
Hungary	X	X	X	X	-	-	-	-
Ireland	X	X	X	X	-	X	-	X
Italy	-	X	-	X	-	X	-	X
Latvia	X	X	X	X	-	-	-	-
Lithuania	X	X	X	X	-	X	-	X
Luxembourg	X	X	X	X	-	-	-	-
Malta	-	-	-	-	-	-	-	-
Netherlands	X	X	X	X	-	X	-	X
Poland	X	X	X	X	-	-	-	-
Portugal	X	X	X	X	-	-	-	-
Romania	X	X	X	X	-	-	-	-
Slovakia	X	X	X	X	-	-	-	-
Slovenia	X	X	X	X	-	-	-	-
Spain	X	X	X	X	-	X	-	X
Sweden	X	X	X	X	-	X	-	X
UK	X	X	X	X	-	X	-	X

The following graphs and tables provide, for each pollutant, the marginal costs of emission reductions for the cost-optimal solution to reach the environmental targets of the Thematic Strategy on Air Pollution assuming that non-EU countries maintain their emissions at the baseline level (Table 3.1 Table 3.8) and at the mid case (Table 3.9). Marginal costs for the targets of the European Parliament are provided in Table 3.10 and Table 3.11.

For SO_2, Scandinavian countries face highest marginal costs, owing to the importance of the acidification problem in this region (Figure 3.6). Marginal costs for NO_x are more evenly distributed, although they are highest in Scandinavia too (Figure 3.7). In contrast, highest marginal costs for PM2.5 reductions occur in the Mediterranean countries (Figure 3.8), while for NH_3 some countries in the northern Europe would have to take the most expensive measures (Figure 3.9). For VOC, marginal costs are generally low, with some notable exceptions (Figure 3.10).

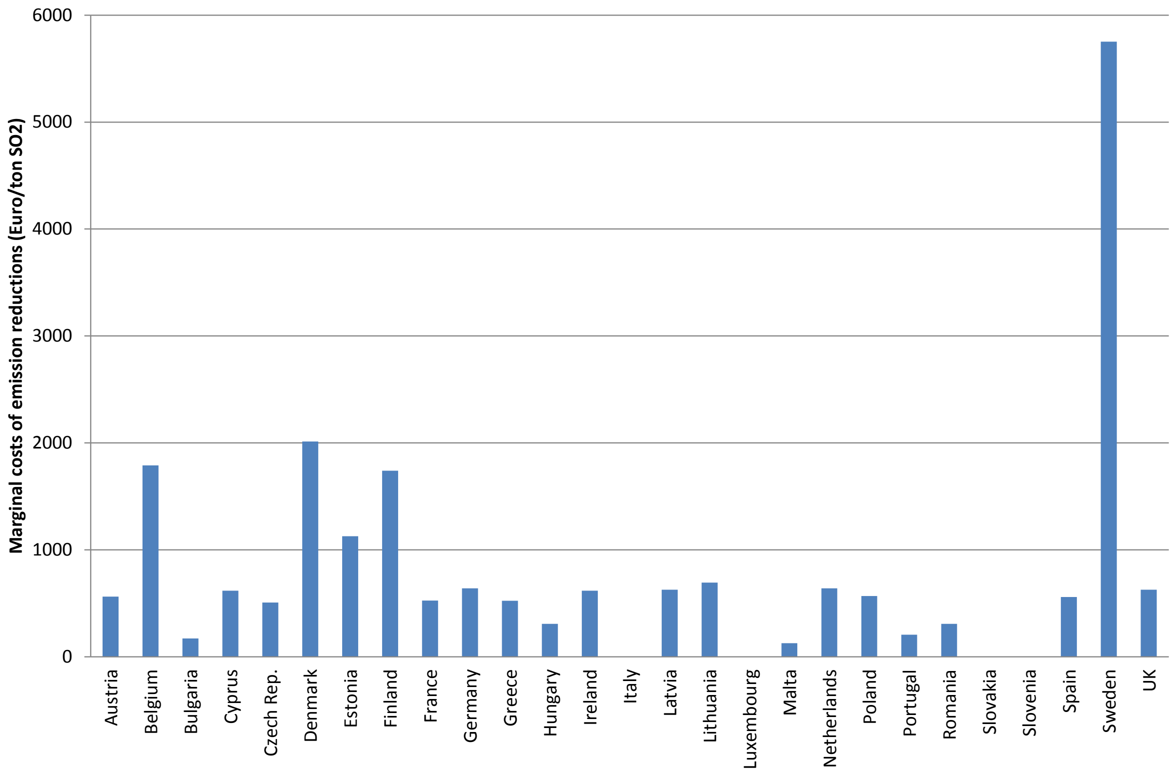

Figure 3.6: Marginal costs of the cost-optimal set of SO_2 reductions that meets the environmental targets of the Thematic Strategy on Air Pollution, non-EU countries at baseline (€/t pollutant)

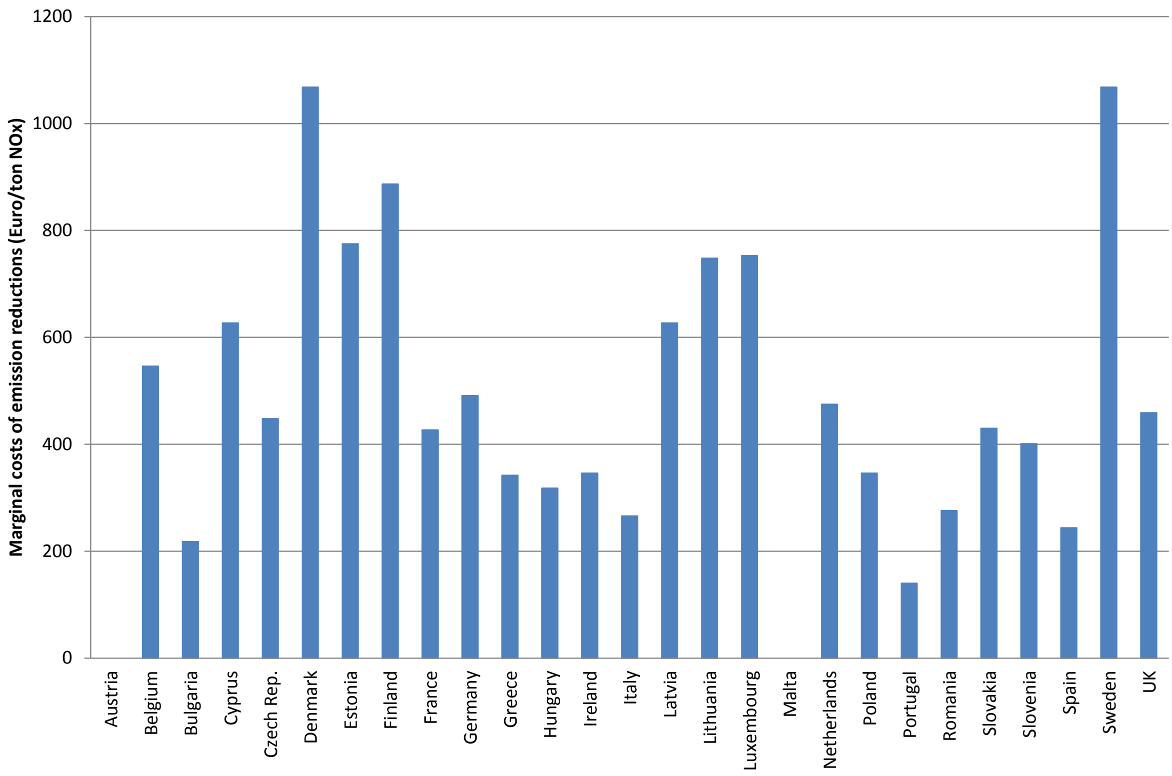

Figure 3.7: Marginal costs of the cost-optimal set of NO_x reductions that meets the environmental targets of the Thematic Strategy on Air Pollution, non-EU countries at baseline (€/t pollutant)

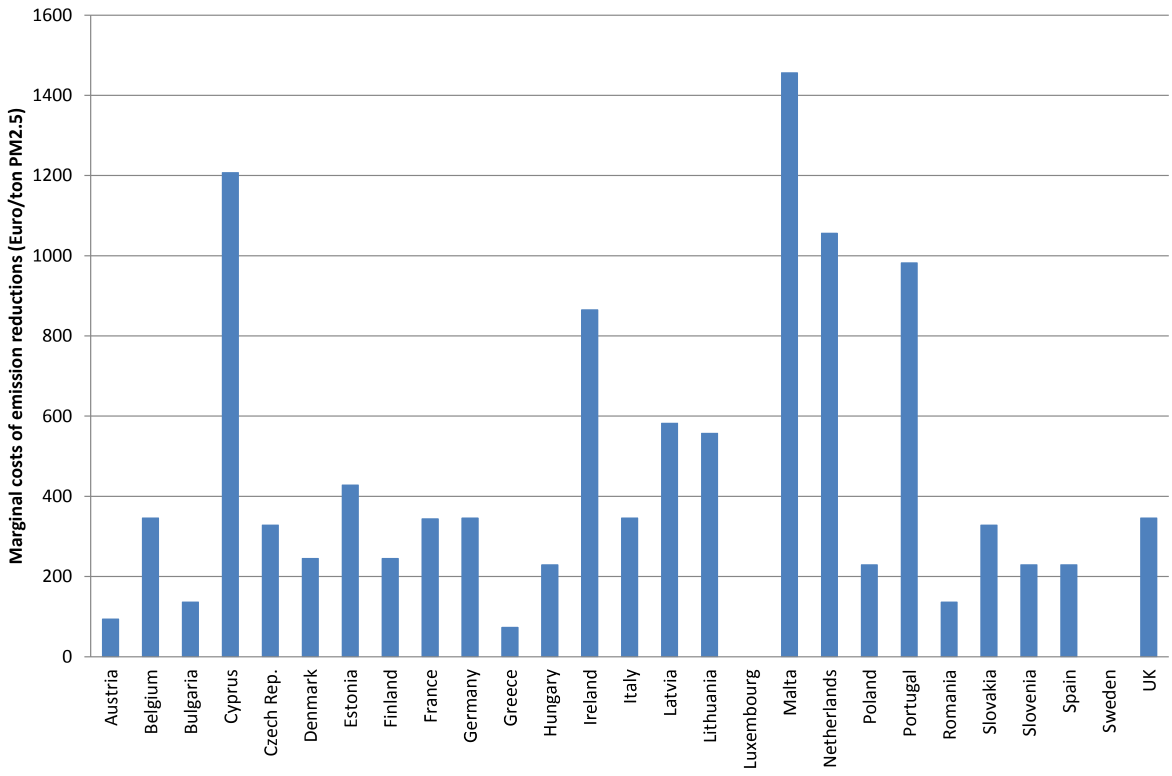

Figure 3.8: Marginal costs of the cost-optimal set of PM2.5 reductions that meets the environmental targets of the Thematic Strategy on Air Pollution, non-EU countries at baseline (€/t pollutant)

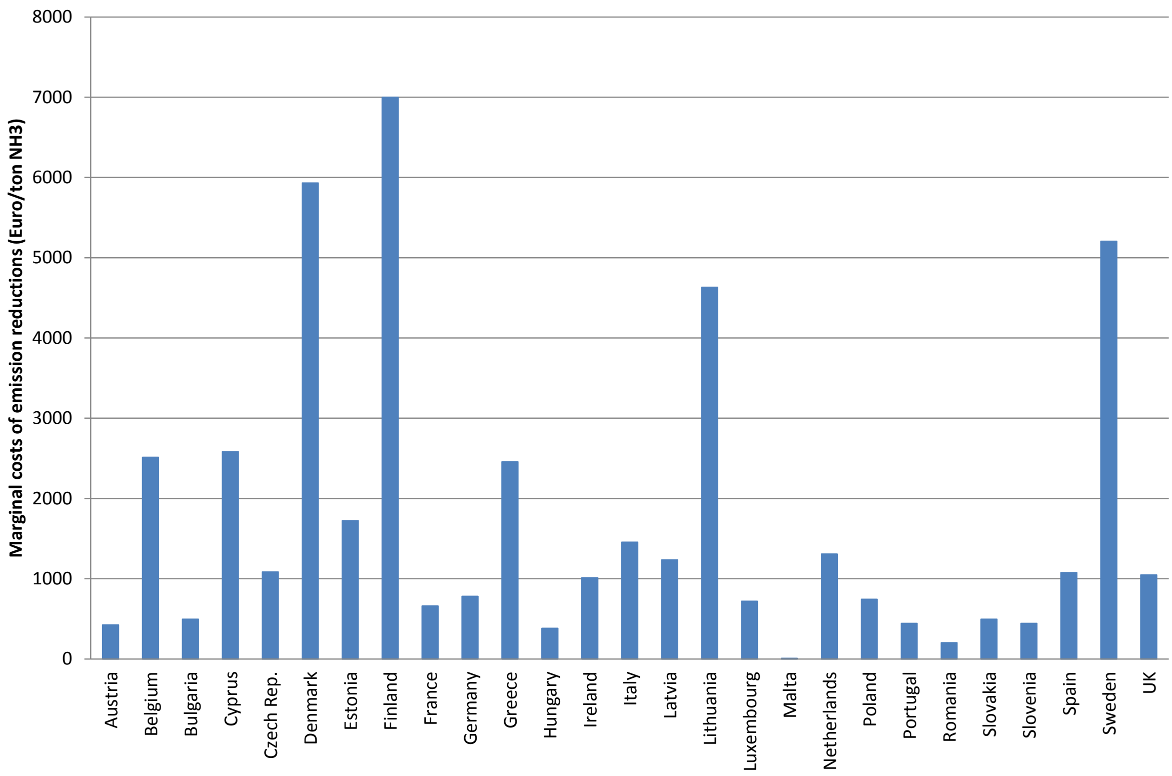

Figure 3.9: Marginal costs of the cost-optimal set of NH_3 reductions that meets the environmental targets of the Thematic Strategy on Air Pollution, non-EU countries at baseline (€/t pollutant)

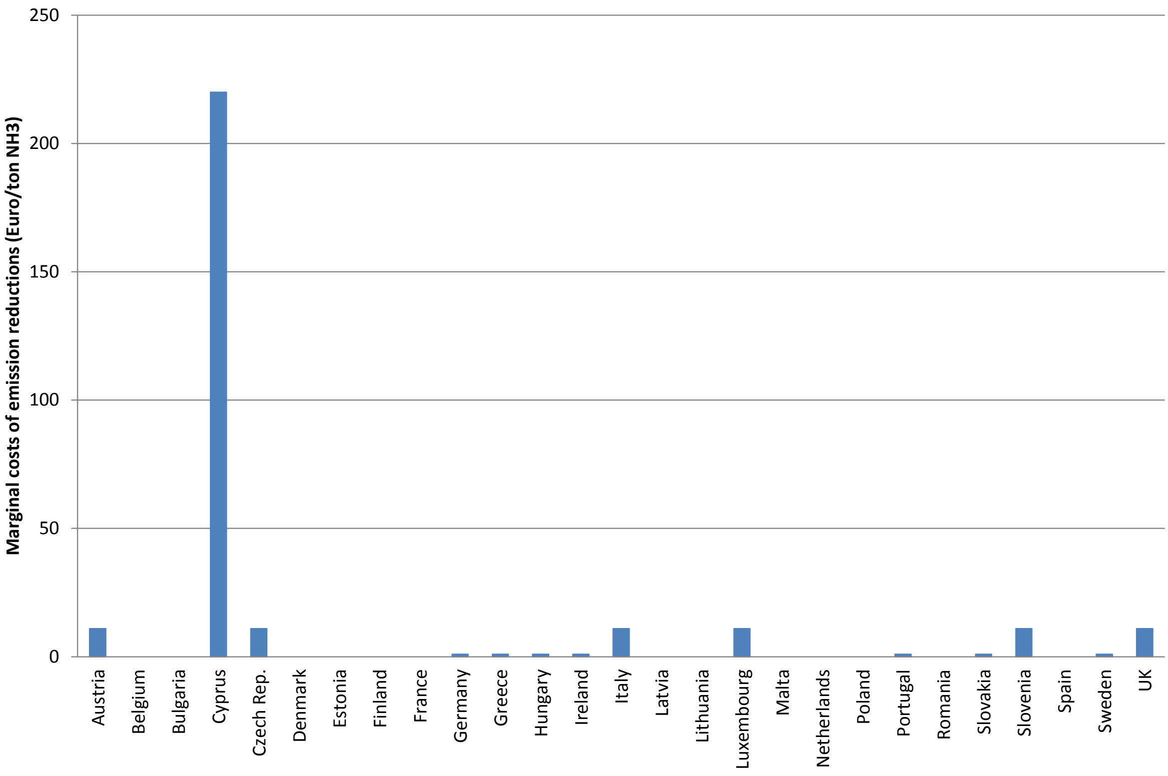

Figure 3.10: Marginal costs of the cost-optimal set of VOC reductions that meets the environmental targets of the Thematic Strategy on Air Pollution, non-EU countries at baseline (€/t pollutant)

Table 3.8: Marginal costs of the cost-optimal set of emission reductions that meets the environmental targets of the Thematic Strategy on Air Pollution, non-EU countries at baseline (€/t pollutant)

	SO_2	NO_x	PM2.5	NH_3	VOC
Austria	563	0	94	424	11
Belgium	1790	546	346	2514	0
Bulgaria	171	218	136	495	0
Cyprus	617	627	1207	2584	220
Czech Rep.	507	448	328	1084	11
Denmark	2013	1068	245	5931	0
Estonia	1126	775	428	1725	0
Finland	1739	887	245	7000	0
France	525	427	344	662	0
Germany	640	491	346	782	1
Greece	523	342	73	2458	1
Hungary	307	318	229	382	1
Ireland	617	346	865	1012	1
Italy	0	266	346	1456	11
Latvia	626	627	582	1235	0
Lithuania	693	748	557	4632	0
Luxembourg	0	753	0	720	11
Malta	126	0	1456	9	0
Netherlands	640	475	1056	1308	0
Poland	567	346	229	744	0
Portugal	205	140	982	444	1
Romania	307	276	136	203	0
Slovakia	0	430	328	495	1
Slovenia	0	401	229	444	11
Spain	558	244	229	1076	0
Sweden	5753	1068	0	5206	1
UK	626	459	346	1048	11

Table 3.9: Marginal costs of the cost-optimal set of emission reductions that meets the environmental targets of the Thematic Strategy on Air Pollution, non-EU countries at the mid-case (€/t pollutant)

	SO_2	NO_x	PM2.5	NH_3	VOC
Austria	0	860	0	424	0
Belgium	473	444	0	1773	0
Bulgaria	171	0	0	249	1
Cyprus	617	315	1207	1063	220
Czech Rep.	446	346	17	1084	0
Denmark	2013	1183	0	5931	0
Estonia	0	627	0	1341	0
Finland	1596	639	245	5297	0
France	261	268	24	447	0
Germany	562	464	0	782	1
Greece	0	261	48	1530	1
Hungary	171	66	17	312	1
Ireland	89	265	865	793	1
Italy	0	393	0	1456	11
Latvia	504	492	17	913	0
Lithuania	617	420	0	3252	0
Luxembourg	0	752	0	976	11
Malta	126	0	1456	9	0
Netherlands	0	473	85	1367	0
Poland	487	318	73	538	0
Portugal	0	140	48	389	1
Romania	174	0	17	111	1
Slovakia	0	227	17	495	1
Slovenia	0	0	0	444	67
Spain	248	329	13	1076	0
Sweden	5753	1068	0	5905	1
UK	372	459	73	878	11

Table 3.10: Marginal costs of the cost-optimal set of emission reductions that meets the environmental targets of the European Parliament, non-EU countries at baseline (€/t pollutant)

	SO_2	NO_x	PM2.5	NH_3	VOC
Austria	638	1235	2419	899	0
Belgium	713	1464	3831	2816	0
Bulgaria	171	568	1378	752	0
Cyprus	0	666	0	5286	0
Czech Rep.	744	1256	1931	1084	0
Denmark	0	2523	1015	20629	0
Estonia	0	1534	686	3579	0
Finland	31	1772	366	13958	0
France	731	860	2260	963	0
Germany	965	1464	3136	1621	0
Greece	0	665	933	3742	0
Hungary	658	1068	1589	975	0
Ireland	415	1160	1056	5109	0
Italy	658	817	2260	1456	11
Latvia	219	1068	714	2202	0
Lithuania	0	1353	670	7000	0
Luxembourg	629	775	1207	1724	0
Malta	126	111	0	361	0
Netherlands	879	1811	3598	3988	0
Poland	693	1117	1824	1504	0
Portugal	205	376	1399	1150	0
Romania	396	639	1378	382	0
Slovakia	617	860	1642	679	0
Slovenia	693	860	1477	874	0
Spain	463	648	1207	2640	0
Sweden	0	1539	346	7000	0
UK	734	1309	2419	3110	0

Table 3.11: Marginal costs of the cost-optimal set of emission reductions that meets the environmental targets of the European Parliament, non-EU countries at the mid -case (€/t pollutant)

	SO_2	NO_x	PM2.5	NH_3	VOC
Austria	563	66	1834	677	0
Belgium	713	977	2491	1897	0
Bulgaria	0	347	654	547	0
Cyprus	0	627	0	3442	0
Czech Rep.	538	820	1207	1084	0
Denmark	0	1207	629	5931	0
Estonia	0	1323	17	3327	0
Finland	31	1748	245	7000	0
France	525	696	1234	882	0
Germany	640	860	1860	974	0
Greece	0	341	766	2569	0
Hungary	313	658	1207	656	0
Ireland	89	750	0	2507	0
Italy	416	501	1207	1456	0
Latvia	171	914	582	1679	0
Lithuania	0	1068	17	7000	0
Luxembourg	595	798	1207	976	0
Malta	126	111	0	260	0
Netherlands	879	990	1994	2418	0
Poland	442	860	1207	1062	0
Portugal	205	244	982	682	0
Romania	191	400	1056	355	0
Slovakia	0	696	1056	679	0
Slovenia	0	590	1056	698	0
Spain	248	467	1056	1444	0
Sweden	0	1068	346	5905	0
UK	372	885	1364	1974	0

4 Conclusions

The European Commission has developed a comprehensive approach to implementing the EU Air Quality Policy including the preparation s for a review and revision of the National Emission Ceilings (NEC) Directive. As one element, this approach includes the revision of the UNECE Gothenburg Protocol aiming, inter alia, at broadening the participation and ratification of the EU's eastern neighbours and set 2020/2030 emission ceilings for the pollutants covered by the current NEC Directive.

At the same time, the Convention on Long-range Transboundary Air Pollution has embarked on the revision of its Gothenburg multi-pollutant/multi-effect protocol with the aim to finalize a revision by the end of 2011 (ECE/EB.AIR/106). In April 2011, the Centre for Integrated Assessment Modelling has presented a series of scenario calculations that illustrate cost-effective emission reductions for the European Parties of the Convention, including the eastern neighbours of the EU (Amann et al., 2011).

This report informs the European Commission on how the scenarios presented to the Convention on Long-range Transboundary Air Pollution relate to the environmental objectives that have been established by the Thematic Strategy on Air Pollution (TSAP; CEC, 2005). It explores additional emission reductions (beyond the current legislation) that would be necessary to be taken by the EU Member States to meet the environment and health objectives of the Thematic Strategy on Air Pollution and the European Parliament in 2020, under the assumptions that the non-EU Parties in Europe do not take any further measures beyond the business-as-usual case.

The least-cost portfolios of measures that would be required to meet the targets of the TSAP are critically dependent on the assumptions on the baseline developments, both for countries inside and outside the EU. For instance, additional measures in the EU-27 would involve costs of 242 million Euro/yr if the PRIMES Reference scenario (which achieves all targets of the Energy and Climate package) is adopted as a starting point and non-EU countries would reduce their emissions as suggested in the CIAM 1/2011 report for the mid-case. In contrast, if non-EU countries follow their baseline and EU countries develop along their national projections (with significantly higher greenhouse gas emissions), additional air pollution control costs to achieve the TSAP targets would increase to 805 million Euro/yr. The more ambitious targets of the European Parliament would increase costs by roughly a factor of two.

On a sectoral basis, the additional measures would involve highest costs for the agricultural sector for all scenarios. Measures in other sectors depend on the assumed baseline. However, total air pollution control costs (including the costs of the current legislation baseline) are significantly higher in other sectors, since stringent emission control measures are already in force at these sectors.

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5 Annex: Results for Member States

5.1 Emission control costs

Table 5.1: Emission control costs by country for the PRIMES baseline scenario (million Euro/year)

	Current legislation	TSAP targets others at baseline	TSAP targets others at MID case	EP targets others at baseline	EP targets others at MID case
Austria	1849	1	1	5	3
Belgium	2321	14	6	26	16
Bulgaria	1315	1	0	7	4
Cyprus	322	1	1	2	2
Czech Rep.	2312	7	5	22	10
Denmark	1200	11	11	22	12
Estonia	366	5	4	5	4
Finland	1090	7	4	17	12
France	10762	42	29	104	62
Germany	15635	97	71	138	123
Greece	2150	7	5	13	10
Hungary	1443	3	3	18	7
Ireland	801	6	3	15	9
Italy	8975	75	61	141	99
Latvia	377	1	1	2	2
Lithuania	453	12	6	29	21
Luxembourg	418	0	0	1	0
Malta	69	0	0	0	0
Netherlands	3175	3	3	10	5
Poland	8936	69	29	106	39
Portugal	1506	7	3	14	8
Romania	2517	6	0	33	15
Slovakia	702	3	2	8	4
Slovenia	615	0	0	3	2
Spain	9462	77	51	111	83
Sweden	1993	15	16	17	14
UK	7186	41	27	82	46
EU27	87949	513	343	951	613

Table 5.2: Emission control costs by country for the PRIMES Reference scenario (million Euro/year)

	Current legislation	TSAP targets others at baseline	TSAP targets others at MID case	EP targets others at baseline	EP targets others at MID case
Austria	1837	2	1	4	2
Belgium	2270	11	3	22	11
Bulgaria	1245	2	0	7	4
Cyprus	318	0	0	2	1
Czech Rep.	2305	7	4	17	6
Denmark	1183	2	11	13	8
Estonia	351	1	2	4	4
Finland	1059	2	3	12	9
France	11461	40	24	83	53
Germany	15239	95	50	138	121
Greece	2080	3	3	11	9
Hungary	1438	5	2	17	5
Ireland	774	2	2	11	7
Italy	8748	50	47	130	89
Latvia	387	0	1	2	1
Lithuania	451	3	4	25	17
Luxembourg	412	0	0	1	0
Malta	68	0	0	0	0
Netherlands	3194	4	3	9	4
Poland	8707	29	15	88	31
Portugal	1475	8	4	13	8
Romania	2495	9	0	28	10
Slovakia	664	4	1	8	4
Slovenia	578	2	0	3	1
Spain	9251	42	37	100	76
Sweden	1952	2	6	14	11
UK	7036	21	18	71	37
EU27	86977	349	243	833	531

Table 5.3: Emission control costs by country for the National scenario (million Euro/year)

	Current legislation	TSAP targets others at baseline	TSAP targets others at MID case	EP targets others at baseline	EP targets others at MID case
Austria	1758	5	2	12	8
Belgium	2321	23	12	40	26
Bulgaria	1315	5	3	25	7
Cyprus	322	1	1	2	2
Czech Rep.	1906	15	6	33	20
Denmark	1181	5	5	21	17
Estonia	366	4	3	5	5
Finland	1317	5	4	21	19
France	10762	81	51	195	98
Germany	15635	134	113	207	138
Greece	2211	6	5	14	12
Hungary	1443	22	8	34	22
Ireland	762	3	2	12	7
Italy	10336	131	83	253	158
Latvia	377	1	1	3	2
Lithuania	453	5	4	33	24
Luxembourg	418	0	0	1	1
Malta	69	0	0	0	0
Netherlands	3994	12	5	17	13
Poland	8936	103	70	172	116
Portugal	1898	22	12	44	23
Romania	2524	39	12	77	42
Slovakia	706	13	4	21	13
Slovenia	615	4	2	5	4
Spain	8240	78	58	190	119
Sweden	1950	4	3	16	15
UK	8928	84	29	137	93
EU27	90742	805	498	1588	1004

5.2 *Emissions*

Table 5.4: Cost-effective sets of SO_2 emissions for the PRIMES Baseline scenario (kt/year)

	Current legislation	TSAP targets others at baseline	TSAP targets others at MID case	EP targets others at baseline	EP targets others at MID case	MTFR
Austria	19	19	19	18	19	16
Belgium	81	70	77	72	72	62
Bulgaria	132	132	132	129	132	80
Cyprus	5	5	5	5	5	2
Czech Rep.	106	102	106	99	100	93
Denmark	11	11	11	11	11	10
Estonia	16	14	16	16	16	12
Finland	42	41	41	41	41	37
France	199	194	199	181	193	132
Germany	329	324	328	324	324	300
Greece	114	113	113	113	113	45
Hungary	64	59	59	39	59	30
Ireland	28	25	27	27	27	20
Italy	234	234	234	184	228	117
Latvia	4	3	4	4	4	3
Lithuania	15	13	14	15	15	7
Luxembourg	1	1	1	1	1	1
Malta	3	3	3	1	1	1
Netherlands	32	32	32	32	32	30
Poland	468	372	450	354	455	299
Portugal	64	63	63	59	59	33
Romania	145	144	145	124	144	76
Slovakia	42	41	42	35	41	22
Slovenia	17	17	17	16	17	13
Spain	311	261	299	275	290	168
Sweden	29	28	28	29	29	28
UK	227	202	220	193	220	149
EU27	2736	2523	2682	2397	2646	1783

Table 5.5: Cost-effective sets of SO_2 emissions for the PRIMES Reference scenario (kt/year)

	Current legislation	TSAP targets others at baseline	TSAP targets others at MID case	EP targets others at baseline	EP targets others at MID case	MTFR
Austria	18	18	18	18	18	15
Belgium	81	72	81	72	74	62
Bulgaria	118	118	118	115	118	69
Cyprus	4	4	4	4	4	2
Czech Rep.	105	99	105	98	104	92
Denmark	11	11	11	11	11	10
Estonia	14	14	14	14	14	11
Finland	33	33	33	33	33	29
France	193	187	192	176	189	128
Germany	317	313	317	313	315	289
Greece	111	110	110	110	110	42
Hungary	63	58	63	40	58	30
Ireland	27	26	27	26	26	19
Italy	220	215	220	175	220	104
Latvia	5	5	5	5	5	4
Lithuania	15	15	15	15	15	8
Luxembourg	1	1	1	1	1	1
Malta	3	1	3	1	3	1
Netherlands	33	33	33	33	33	31
Poland	440	418	440	342	438	279
Portugal	63	58	63	58	58	33
Romania	141	141	141	130	141	73
Slovakia	40	40	40	34	40	21
Slovenia	16	16	16	15	16	12
Spain	303	281	302	273	283	163
Sweden	27	27	27	27	27	27
UK	227	212	227	193	219	148
EU27	2631	2526	2627	2333	2573	1701

Table 5.6: Cost-effective sets of SO_2 emissions for the National activity projections (kt/year)

	Current legislation	TSAP targets others at baseline	TSAP targets others at MID case	EP targets others at baseline	EP targets others at MID case	MTFR
Austria	18	18	18	18	18	16
Belgium	81	72	72	69	72	62
Bulgaria	132	129	129	97	129	80
Cyprus	5	5	5	5	5	2
Czech Rep.	101	97	98	93	97	90
Denmark	18	18	18	17	18	14
Estonia	16	16	16	16	16	12
Finland	61	60	60	60	60	53
France	199	177	182	148	177	132
Germany	329	324	324	318	324	300
Greece	104	103	103	103	103	41
Hungary	64	34	56	34	34	30
Ireland	16	15	16	14	15	12
Italy	308	208	254	194	208	127
Latvia	4	4	4	3	4	3
Lithuania	15	15	15	11	15	7
Luxembourg	1	1	1	1	1	1
Malta	3	1	1	1	1	1
Netherlands	49	49	49	48	49	42
Poland	468	340	374	321	340	299
Portugal	68	56	62	47	56	32
Romania	145	116	144	90	116	76
Slovakia	42	30	41	28	30	22
Slovenia	17	15	17	14	15	13
Spain	315	272	289	195	268	138
Sweden	29	29	29	29	29	28
UK	290	238	278	226	238	196
EU27	2894	2441	2656	2200	2437	1828

Table 5.7: Cost-effective sets of NO_x emissions for the PRIMES Baseline scenario (kt/year)

	Current legislation	TSAP targets others at baseline	TSAP targets others at MID case	EP targets others at baseline	EP targets others at MID case	MTFR
Austria	94	94	94	94	94	81
Belgium	170	165	165	155	159	142
Bulgaria	68	68	68	67	67	53
Cyprus	13	13	13	12	12	8
Czech Rep.	151	149	150	141	145	113
Denmark	85	81	81	78	80	74
Estonia	21	16	16	16	16	13
Finland	125	121	123	119	120	110
France	572	565	568	553	557	472
Germany	708	706	706	692	703	609
Greece	242	225	227	222	225	199
Hungary	86	85	85	80	81	64
Ireland	69	68	68	61	62	53
Italy	679	677	678	668	669	548
Latvia	22	21	22	21	21	19
Lithuania	29	27	27	26	26	24
Luxembourg	17	17	17	17	17	16
Malta	3	3	3	3	3	3
Netherlands	170	170	170	168	169	150
Poland	429	424	425	402	414	353
Portugal	106	102	102	101	102	87
Romania	156	155	156	139	147	104
Slovakia	57	57	57	53	54	39
Slovenia	27	27	27	26	27	25
Spain	695	689	689	641	677	553
Sweden	97	91	91	91	91	87
UK	663	640	640	610	624	499
EU27	5553	5456	5468	5257	5362	4495

Table 5.8: Cost-effective sets of NO_x emissions for the PRIMES Reference scenario (kt/year)

	Current legislation	TSAP targets others at baseline	TSAP targets others at MID case	EP targets others at baseline	EP targets others at MID case	MTFR
Austria	93	93	93	93	93	82
Belgium	162	154	157	150	153	138
Bulgaria	64	63	64	63	63	50
Cyprus	12	12	12	11	12	8
Czech Rep.	149	143	148	142	143	112
Denmark	83	83	79	77	79	73
Estonia	20	20	20	16	16	13
Finland	122	122	121	117	119	109
France	578	566	574	560	564	487
Germany	692	689	690	676	686	597
Greece	236	229	229	214	214	190
Hungary	85	82	85	80	82	64
Ireland	67	67	66	60	60	52
Italy	661	652	659	650	652	537
Latvia	22	22	22	21	21	19
Lithuania	29	28	28	26	26	23
Luxembourg	17	17	17	17	17	16
Malta	3	3	3	3	3	3
Netherlands	170	170	170	168	169	150
Poland	419	414	415	401	408	346
Portugal	102	99	100	99	99	85
Romania	154	151	154	140	150	102
Slovakia	56	53	56	51	53	38
Slovenia	26	26	26	26	26	24
Spain	677	671	671	634	666	541
Sweden	97	96	93	91	91	88
UK	640	635	624	596	609	488
EU27	5433	5361	5373	5180	5275	4434

Table 5.9: Cost-effective sets of NO_x emissions for the National activity projections (kt/year)

	Current legislation	TSAP targets others at baseline	TSAP targets others at MID case	EP targets others at baseline	EP targets others at MID case	MTFR
Austria	95	95	95	92	93	86
Belgium	170	158	162	154	155	142
Bulgaria	68	67	67	65	67	53
Cyprus	13	13	13	12	12	8
Czech Rep.	140	133	133	126	129	99
Denmark	101	94	94	89	90	82
Estonia	21	16	17	16	16	13
Finland	127	125	125	118	118	107
France	572	557	558	541	553	472
Germany	708	695	705	662	692	609
Greece	232	217	221	210	210	181
Hungary	86	80	81	78	80	64
Ireland	73	72	73	68	69	59
Italy	763	744	747	711	744	612
Latvia	22	22	22	21	21	19
Lithuania	29	27	28	26	26	24
Luxembourg	17	17	17	17	17	16
Malta	3	3	3	3	3	3
Netherlands	207	200	207	199	199	186
Poland	429	413	419	388	402	353
Portugal	117	116	116	108	115	91
Romania	156	142	153	131	138	104
Slovakia	57	53	54	49	53	39
Slovenia	27	26	27	26	26	25
Spain	708	697	704	634	641	545
Sweden	103	100	102	97	97	84
UK	723	686	706	658	676	564
EU27	5767	5566	5648	5296	5444	4639

Table 5.10: Cost-effective sets of PM2.5 emissions for the PRIMES Baseline scenario (kt/year)

	Current legislation	TSAP targets others at baseline	TSAP targets others at MID case	EP targets others at baseline	EP targets others at MID case	MTFR
Austria	13	12	13	12	12	8
Belgium	20	19	19	17	18	15
Bulgaria	33	26	33	19	20	9
Cyprus	1	1	1	1	1	1
Czech Rep.	25	23	24	23	23	13
Denmark	19	19	19	19	19	8
Estonia	7	6	7	6	6	3
Finland	21	21	21	19	20	10
France	207	192	201	186	190	107
Germany	83	79	81	77	78	63
Greece	33	26	27	25	25	16
Hungary	22	19	20	18	18	10
Ireland	8	8	8	8	8	6
Italy	81	75	80	74	74	61
Latvia	15	13	14	13	13	3
Lithuania	10	7	7	7	7	3
Luxembourg	2	2	2	2	2	2
Malta	0	0	0	0	0	0
Netherlands	16	15	16	15	15	13
Poland	96	90	91	87	88	69
Portugal	62	34	51	30	34	15
Romania	106	74	106	61	65	20
Slovakia	10	8	9	8	8	6
Slovenia	6	5	5	5	5	3
Spain	90	76	77	72	72	54
Sweden	19	19	19	19	19	15
UK	53	52	52	49	50	42
EU27	1059	921	1001	873	892	572

Table 5.11: Cost-effective sets of PM2.5 emissions for the PRIMES Reference scenario (kt/year)

	Current legislation	TSAP targets others at baseline	TSAP targets others at MID case	EP targets others at baseline	EP targets others at MID case	MTFR
Austria	13	12	13	12	12	8
Belgium	21	19	20	18	19	15
Bulgaria	34	21	31	19	21	8
Cyprus	1	1	1	1	1	1
Czech Rep.	27	25	25	25	25	14
Denmark	20	19	19	19	19	8
Estonia	8	7	7	7	7	3
Finland	22	21	21	20	21	9
France	212	193	200	190	195	108
Germany	84	79	82	78	79	63
Greece	34	27	28	27	27	16
Hungary	23	19	20	19	19	10
Ireland	7	7	7	7	7	6
Italy	83	75	78	75	76	62
Latvia	15	14	14	14	14	3
Lithuania	11	7	8	7	7	3
Luxembourg	2	2	2	2	2	2
Malta	0	0	0	0	0	0
Netherlands	16	15	16	15	15	13
Poland	99	92	94	91	92	68
Portugal	63	34	50	31	34	15
Romania	110	69	106	65	69	20
Slovakia	10	9	10	9	9	6
Slovenia	6	5	6	5	5	3
Spain	90	73	77	72	73	53
Sweden	20	19	20	19	19	15
UK	53	51	52	49	51	42
EU27	1084	914	1007	898	920	574

Table 5.12: Cost-effective sets of PM2.5 emissions for the National activity projections (kt/year)

	Current legislation	TSAP targets others at baseline	TSAP targets others at MID case	EP targets others at baseline	EP targets others at MID case	MTFR
Austria	15	14	14	14	14	9
Belgium	20	17	18	16	17	15
Bulgaria	33	19	20	18	19	9
Cyprus	1	1	1	1	1	1
Czech Rep.	19	17	17	17	17	11
Denmark	20	19	19	18	19	9
Estonia	7	6	6	6	6	3
Finland	22	20	21	20	20	12
France	207	182	187	181	182	107
Germany	83	77	78	77	77	63
Greece	33	26	26	26	26	15
Hungary	22	18	18	18	18	10
Ireland	7	7	7	7	7	6
Italy	125	116	118	112	116	72
Latvia	15	13	13	13	13	3
Lithuania	10	7	7	7	7	3
Luxembourg	2	2	2	2	2	2
Malta	0	0	0	0	0	0
Netherlands	17	16	16	16	16	14
Poland	96	87	88	86	87	69
Portugal	62	25	30	25	25	14
Romania	107	61	65	59	61	20
Slovakia	10	8	8	8	8	6
Slovenia	6	5	5	5	5	3
Spain	82	65	65	64	65	51
Sweden	20	20	20	19	20	15
UK	53	47	50	47	47	43
EU27	1095	895	920	879	895	580

Table 5.13: Cost-effective sets of NH_3 emissions for the PRIMES Baseline scenario (kt/year)

	Current legislation	TSAP targets others at baseline	TSAP targets others at MID case	EP targets others at baseline	EP targets others at MID case	MTFR
Austria	55	48	48	45	46	35
Belgium	75	70	70	69	70	67
Bulgaria	60	56	58	54	54	50
Cyprus	6	4	4	4	4	4
Czech Rep.	68	58	58	52	58	49
Denmark	52	48	48	48	48	46
Estonia	11	7	7	6	6	6
Finland	30	26	26	25	26	24
France	621	473	487	429	456	358
Germany	601	439	469	413	413	365
Greece	52	41	41	39	40	37
Hungary	70	51	51	48	49	40
Ireland	98	86	87	84	85	76
Italy	384	292	301	273	281	224
Latvia	12	9	10	9	9	9
Lithuania	45	35	36	32	33	24
Luxembourg	5	5	5	4	5	4
Malta	2	2	2	2	2	2
Netherlands	125	119	119	118	119	112
Poland	355	284	287	279	279	247
Portugal	69	56	57	54	55	42
Romania	150	127	143	111	114	90
Slovakia	24	16	17	16	16	13
Slovenia	16	15	15	13	13	11
Spain	364	270	280	258	259	208
Sweden	45	37	37	36	37	34
UK	270	230	234	227	227	214
EU27	3668	2902	2995	2748	2804	2389

Table 5.14: Cost-effective sets of NH_3 emissions for the PRIMES Reference scenario (kt/year)

	Current legislation	TSAP targets others at baseline	TSAP targets others at MID case	EP targets others at baseline	EP targets others at MID case	MTFR
Austria	55	48	48	45	48	35
Belgium	75	71	71	70	70	67
Bulgaria	60	57	58	54	55	50
Cyprus	6	4	4	4	4	3
Czech Rep.	68	60	58	52	59	49
Denmark	52	50	48	48	49	46
Estonia	11	7	7	7	7	6
Finland	30	27	26	26	26	24
France	622	488	504	452	464	359
Germany	601	443	495	413	413	365
Greece	52	42	41	40	40	37
Hungary	70	51	52	48	49	40
Ireland	98	88	88	84	85	76
Italy	385	314	311	277	285	224
Latvia	12	11	10	9	9	9
Lithuania	45	37	36	33	34	24
Luxembourg	5	5	5	4	5	4
Malta	2	2	2	2	2	2
Netherlands	125	119	119	118	119	112
Poland	356	293	300	280	281	247
Portugal	69	56	56	55	56	42
Romania	150	127	146	111	122	90
Slovakia	24	16	18	16	16	13
Slovenia	16	13	15	13	13	11
Spain	364	292	291	259	262	208
Sweden	45	40	38	37	37	34
UK	270	239	238	227	229	214
EU27	3670	3000	3086	2783	2838	2390

Table 5.15: Cost-effective sets of NH_3 emissions for the National activity projections (kt/year)

	Current legislation	TSAP targets others at baseline	TSAP targets others at MID case	EP targets others at baseline	EP targets others at MID case	MTFR
Austria	56	45	49	44	44	36
Belgium	77	71	72	70	71	68
Bulgaria	60	56	57	54	54	50
Cyprus	6	4	4	4	4	4
Czech Rep.	68	52	59	52	52	49
Denmark	52	50	50	48	48	46
Estonia	11	7	7	6	6	6
Finland	30	26	26	25	26	24
France	621	466	485	423	450	358
Germany	601	413	422	410	413	365
Greece	52	41	41	40	40	37
Hungary	70	48	49	43	48	40
Ireland	106	93	94	90	91	82
Italy	375	289	296	267	270	221
Latvia	12	9	10	9	9	9
Lithuania	45	36	36	32	33	24
Luxembourg	5	4	5	4	4	4
Malta	2	2	2	2	2	2
Netherlands	131	124	125	123	124	117
Poland	355	280	286	279	279	247
Portugal	69	56	56	48	55	42
Romania	204	151	167	141	150	122
Slovakia	28	19	19	18	18	15
Slovenia	16	13	13	13	13	11
Spain	352	260	268	247	251	200
Sweden	43	37	37	35	35	33
UK	285	239	247	238	238	223
EU27	3734	2893	2983	2766	2828	2434

Table 5.16: Cost-effective sets of VOC emissions for the PRIMES Baseline scenario (kt/year)

	Current legislation	TSAP targets others at baseline	TSAP targets others at MID case	EP targets others at baseline	EP targets others at MID case	MTFR
Austria	111	111	111	111	111	73
Belgium	129	128	128	128	128	108
Bulgaria	79	77	79	77	77	40
Cyprus	5	5	5	5	5	4
Czech Rep.	148	148	148	148	148	82
Denmark	74	74	74	74	74	45
Estonia	21	20	20	20	20	14
Finland	90	90	90	90	90	56
France	720	720	720	720	720	480
Germany	870	870	870	870	870	583
Greece	147	139	139	139	139	88
Hungary	104	102	102	102	102	59
Ireland	49	49	49	49	49	30
Italy	777	776	776	776	776	622
Latvia	49	48	48	48	48	18
Lithuania	53	50	50	50	50	29
Luxembourg	7	7	7	7	7	6
Malta	3	3	3	3	3	2
Netherlands	156	156	156	156	156	125
Poland	343	341	341	341	341	223
Portugal	176	170	170	170	170	115
Romania	301	277	301	277	277	129
Slovakia	56	56	56	56	56	38
Slovenia	31	30	30	30	30	17
Spain	646	630	630	630	630	468
Sweden	120	120	120	120	120	95
UK	673	673	673	673	673	494
EU27	5939	5870	5897	5870	5870	4045

Table 5.17: Cost-effective sets of VOC emissions for the PRIMES Reference scenario (kt/year)

	Current legislation	TSAP targets others at baseline	TSAP targets others at MID case	EP targets others at baseline	EP targets others at MID case	MTFR
Austria	113	113	113	113	113	74
Belgium	131	130	130	130	130	109
Bulgaria	81	78	81	78	78	40
Cyprus	5	5	5	5	5	4
Czech Rep.	151	151	151	151	151	82
Denmark	74	74	74	74	74	45
Estonia	22	21	21	21	21	14
Finland	94	94	94	94	94	58
France	740	740	740	740	740	497
Germany	871	871	871	871	871	584
Greece	150	142	142	142	142	88
Hungary	106	104	104	104	104	59
Ireland	49	49	49	49	49	30
Italy	781	780	780	780	780	623
Latvia	50	49	49	49	49	18
Lithuania	55	51	51	51	51	30
Luxembourg	7	7	7	7	7	6
Malta	3	3	3	3	3	2
Netherlands	156	156	156	156	156	125
Poland	359	358	358	358	358	224
Portugal	177	171	171	171	171	115
Romania	308	284	308	284	284	129
Slovakia	58	57	57	57	57	38
Slovenia	33	32	32	32	32	17
Spain	647	631	631	631	631	468
Sweden	121	121	121	121	121	96
UK	675	675	675	675	675	493
EU27	6019	5950	5977	5950	5950	4068

Table 5.18: Cost-effective sets of VOC emissions for the National activity projections (kt/year)

	Current legislation	TSAP targets others at baseline	TSAP targets others at MID case	EP targets others at baseline	EP targets others at MID case	MTFR
Austria	115	115	115	115	115	74
Belgium	129	128	128	128	128	108
Bulgaria	79	77	77	77	77	40
Cyprus	5	5	5	5	5	4
Czech Rep.	133	133	133	133	133	75
Denmark	75	75	75	74	75	47
Estonia	21	20	20	20	20	14
Finland	93	93	93	93	93	63
France	720	720	720	720	720	480
Germany	870	870	870	870	870	583
Greece	151	143	143	143	143	89
Hungary	104	102	102	102	102	59
Ireland	52	52	52	52	52	31
Italy	833	833	833	820	833	606
Latvia	49	48	48	48	48	18
Lithuania	53	50	50	50	50	29
Luxembourg	7	7	7	7	7	6
Malta	3	3	3	3	3	2
Netherlands	162	162	162	162	162	131
Poland	343	341	341	341	341	223
Portugal	162	156	156	156	156	104
Romania	301	277	277	276	277	129
Slovakia	56	56	56	56	56	38
Slovenia	31	30	30	30	30	17
Spain	608	592	592	592	592	436
Sweden	117	117	117	117	117	91
UK	668	667	668	667	667	495
EU27	5941	5872	5872	5856	5872	3994

5.3 Environmental impacts

5.3.1 Loss in statistical life expectancy due to exposure to PM2.5

Table 5.19: Loss in statistical life expectancy due to exposure to PM2.5, for the PRIMES baseline projection (months)

	Current legislation	TSAP targets others at baseline	TSAP targets others at MID case	EP targets others at baseline	EP targets others at MID case	MTFR others at baseline
Austria	3.65	3.40	3.37	3.26	3.25	2.70
Belgium	6.57	6.08	6.19	5.86	5.98	4.98
Bulgaria	3.90	3.69	3.45	3.45	3.20	2.99
Cyprus	3.63	3.61	3.51	3.60	3.50	3.49
Czech Rep.	4.61	4.22	4.19	4.04	4.06	3.37
Denmark	3.60	3.33	3.30	3.25	3.22	2.73
Estonia	3.07	2.87	2.52	2.83	2.47	2.53
Finland	1.94	1.85	1.62	1.81	1.59	1.60
France	3.81	3.48	3.55	3.34	3.42	2.60
Germany	4.87	4.44	4.48	4.29	4.32	3.63
Greece	4.04	3.85	3.68	3.78	3.61	3.29
Hungary	5.22	4.75	4.56	4.50	4.37	3.67
Ireland	1.92	1.78	1.81	1.74	1.76	1.50
Italy	3.98	3.76	3.76	3.60	3.64	3.06
Latvia	3.94	3.69	3.32	3.65	3.27	3.00
Lithuania	3.66	3.37	2.95	3.30	2.88	2.91
Luxembourg	4.73	4.33	4.39	4.17	4.23	3.40
Malta	4.26	4.21	4.18	4.08	4.12	3.81
Netherlands	6.17	5.77	5.83	5.59	5.66	4.86
Poland	5.15	4.69	4.57	4.52	4.45	3.87
Portugal	3.56	2.76	3.21	2.62	2.76	1.99
Romania	4.84	4.42	4.23	4.12	3.78	3.36
Slovakia	4.54	4.11	3.99	3.91	3.84	3.23
Slovenia	4.10	3.82	3.72	3.64	3.58	3.00
Spain	2.44	2.24	2.30	2.19	2.23	1.85
Sweden	2.02	1.88	1.80	1.84	1.77	1.61
UK	3.33	3.04	3.09	2.93	3.00	2.52
EU27	4.08	3.75	3.75	3.61	3.61	3.03

Table 5.20: Loss in statistical life expectancy due to exposure to PM2.5, for the PRIMES reference scenario (months)

	Current legislation	TSAP targets others at baseline	TSAP targets others at MID case	EP targets others at baseline	EP targets others at MID case	MTFR others at baseline
Austria	3.61	3.37	3.35	3.25	3.24	2.67
Belgium	6.54	6.07	6.21	5.87	6.00	4.96
Bulgaria	3.86	3.62	3.43	3.47	3.22	2.94
Cyprus	3.62	3.61	3.50	3.59	3.49	3.48
Czech Rep.	4.57	4.24	4.20	4.05	4.07	3.33
Denmark	3.58	3.36	3.31	3.25	3.22	2.71
Estonia	3.06	2.95	2.58	2.89	2.52	2.51
Finland	1.92	1.84	1.61	1.80	1.58	1.57
France	3.81	3.50	3.56	3.37	3.44	2.60
Germany	4.82	4.41	4.48	4.26	4.29	3.59
Greece	4.02	3.87	3.70	3.81	3.64	3.26
Hungary	5.18	4.74	4.55	4.51	4.38	3.63
Ireland	1.90	1.79	1.80	1.72	1.75	1.49
Italy	3.93	3.73	3.71	3.58	3.63	3.01
Latvia	3.94	3.75	3.36	3.67	3.30	2.99
Lithuania	3.65	3.42	2.97	3.32	2.90	2.89
Luxembourg	4.70	4.30	4.39	4.16	4.23	3.37
Malta	4.22	4.15	4.15	4.07	4.12	3.78
Netherlands	6.12	5.74	5.82	5.57	5.65	4.83
Poland	5.10	4.76	4.59	4.53	4.45	3.81
Portugal	3.56	2.77	3.20	2.64	2.77	1.98
Romania	4.83	4.39	4.24	4.18	3.85	3.32
Slovakia	4.50	4.13	3.99	3.90	3.84	3.18
Slovenia	4.06	3.79	3.70	3.64	3.59	2.95
Spain	2.43	2.25	2.30	2.19	2.22	1.83
Sweden	2.01	1.90	1.81	1.84	1.77	1.60
UK	3.30	3.06	3.10	2.93	3.00	2.50
EU27	4.05	3.75	3.75	3.61	3.61	3.00

Table 5.21: Loss in statistical life expectancy due to exposure to PM2.5, for the National activity projections (months)

	Current legislation	TSAP targets others at baseline	TSAP targets others at MID case	EP targets others at baseline	EP targets others at MID case	MTFR others at baseline
Austria	3.78	3.39	3.37	3.26	3.25	2.76
Belgium	6.80	6.08	6.22	5.87	6.00	5.17
Bulgaria	3.94	3.48	3.23	3.33	3.07	3.00
Cyprus	3.64	3.60	3.50	3.58	3.48	3.49
Czech Rep.	4.59	3.97	3.95	3.82	3.78	3.36
Denmark	3.71	3.39	3.35	3.28	3.26	2.82
Estonia	3.11	2.88	2.51	2.84	2.46	2.57
Finland	2.00	1.87	1.65	1.85	1.61	1.66
France	3.90	3.43	3.50	3.28	3.37	2.65
Germany	4.99	4.41	4.43	4.26	4.30	3.72
Greece	4.06	3.81	3.64	3.74	3.57	3.27
Hungary	5.30	4.54	4.39	4.36	4.16	3.71
Ireland	1.96	1.79	1.84	1.74	1.77	1.54
Italy	4.47	4.17	4.22	4.00	4.07	3.22
Latvia	3.97	3.68	3.30	3.62	3.23	3.02
Lithuania	3.69	3.35	2.91	3.26	2.83	2.93
Luxembourg	4.85	4.28	4.35	4.12	4.21	3.49
Malta	4.41	4.16	4.20	4.09	4.10	3.83
Netherlands	6.48	5.90	5.98	5.73	5.81	5.12
Poland	5.18	4.54	4.38	4.39	4.21	3.89
Portugal	3.58	2.51	2.69	2.36	2.49	1.92
Romania	4.94	4.18	3.86	3.99	3.63	3.42
Slovakia	4.61	3.93	3.83	3.78	3.63	3.26
Slovenia	4.30	3.81	3.74	3.67	3.59	3.09
Spain	2.44	2.15	2.19	2.01	2.11	1.80
Sweden	2.06	1.90	1.82	1.84	1.77	1.64
UK	3.52	3.10	3.21	3.00	3.05	2.68
EU27	4.23	3.75	3.75	3.61	3.61	3.11

5.3.2 *Years of life lost (YOLLs) due to exposure to PM2.5*

Table 5.22: Years of life lost (YOLLs) due to exposure to PM2.5, for the PRIMES baseline projection (million years), calculated with population predicted for 2020

	Current legislation	TSAP targets others at baseline	TSAP targets others at MID case	EP targets others at baseline	EP targets others at MID case	MTFR others at baseline
Austria	1.77	1.64	1.63	1.58	1.57	1.31
Belgium	3.94	3.65	3.71	3.51	3.58	2.99
Bulgaria	1.61	1.53	1.43	1.43	1.33	1.24
Cyprus	0.17	0.17	0.17	0.17	0.17	0.17
Czech Rep.	2.70	2.47	2.45	2.36	2.37	1.97
Denmark	1.08	1.00	0.98	0.97	0.96	0.82
Estonia	0.22	0.20	0.18	0.20	0.17	0.18
Finland	0.58	0.56	0.49	0.54	0.48	0.48
France	13.12	11.97	12.21	11.49	11.75	8.95
Germany	23.91	21.80	22.00	21.05	21.19	17.82
Greece	2.73	2.60	2.49	2.56	2.44	2.22
Hungary	2.91	2.65	2.54	2.51	2.44	2.05
Ireland	0.48	0.44	0.45	0.43	0.44	0.37
Italy	13.94	13.17	13.16	12.62	12.77	10.70
Latvia	0.47	0.44	0.40	0.44	0.39	0.36
Lithuania	0.65	0.60	0.53	0.59	0.51	0.52
Luxembourg	0.13	0.12	0.12	0.12	0.12	0.09
Malta	0.11	0.11	0.11	0.10	0.10	0.10
Netherlands	5.75	5.37	5.43	5.21	5.28	4.53
Poland	10.91	9.94	9.67	9.57	9.43	8.20
Portugal	2.21	1.71	1.99	1.63	1.71	1.24
Romania	5.65	5.16	4.94	4.80	4.41	3.92
Slovakia	1.37	1.24	1.20	1.17	1.16	0.97
Slovenia	0.49	0.46	0.45	0.44	0.43	0.36
Spain	6.59	6.03	6.20	5.91	6.01	4.98
Sweden	1.05	0.98	0.94	0.96	0.92	0.84
UK	11.45	10.45	10.62	10.09	10.33	8.66
EU27	115.98	106.47	106.47	102.45	102.45	86.03

Table 5.23: Years of life lost (YOLLs) due to exposure to PM2.5, for the PRIMES Reference scenario (million years), calculated with population predicted for 2020

	Current legislation	TSAP targets others at baseline	TSAP targets others at MID case	EP targets others at baseline	EP targets others at MID case	MTFR others at baseline
Austria	1.75	1.63	1.62	1.57	1.57	1.29
Belgium	3.92	3.64	3.72	3.52	3.60	2.98
Bulgaria	1.60	1.50	1.42	1.44	1.33	1.22
Cyprus	0.17	0.17	0.17	0.17	0.17	0.17
Czech Rep.	2.67	2.48	2.46	2.37	2.38	1.95
Denmark	1.07	1.00	0.99	0.97	0.96	0.81
Estonia	0.22	0.21	0.18	0.20	0.18	0.18
Finland	0.58	0.55	0.48	0.54	0.47	0.47
France	13.09	12.02	12.25	11.60	11.83	8.94
Germany	23.64	21.66	22.00	20.90	21.05	17.62
Greece	2.72	2.62	2.50	2.58	2.46	2.20
Hungary	2.89	2.64	2.54	2.52	2.44	2.03
Ireland	0.47	0.44	0.45	0.43	0.43	0.37
Italy	13.77	13.05	12.99	12.55	12.70	10.56
Latvia	0.47	0.45	0.40	0.44	0.40	0.36
Lithuania	0.65	0.61	0.53	0.59	0.52	0.52
Luxembourg	0.13	0.12	0.12	0.12	0.12	0.09
Malta	0.11	0.10	0.10	0.10	0.10	0.10
Netherlands	5.71	5.35	5.42	5.19	5.27	4.50
Poland	10.80	10.08	9.72	9.59	9.43	8.06
Portugal	2.21	1.72	1.98	1.64	1.72	1.23
Romania	5.64	5.12	4.95	4.88	4.49	3.88
Slovakia	1.35	1.24	1.20	1.17	1.16	0.96
Slovenia	0.49	0.46	0.45	0.44	0.43	0.36
Spain	6.54	6.05	6.20	5.90	5.99	4.94
Sweden	1.04	0.99	0.94	0.96	0.92	0.83
UK	11.36	10.54	10.67	10.08	10.32	8.60
EU27	115.06	106.47	106.47	102.45	102.45	85.20

Table 5.24: Years of life lost (YOLLs) due to exposure to PM2.5, for the National activity projections (million years), calculated with population predicted for 2020

	Current legislation	TSAP targets others at baseline	TSAP targets others at MID case	EP targets others at baseline	EP targets others at MID case	MTFR others at baseline
Austria	1.83	1.64	1.63	1.58	1.57	1.34
Belgium	4.08	3.65	3.73	3.52	3.60	3.10
Bulgaria	1.63	1.44	1.34	1.38	1.27	1.24
Cyprus	0.17	0.17	0.17	0.17	0.17	0.17
Czech Rep.	2.68	2.32	2.31	2.24	2.21	1.96
Denmark	1.11	1.01	1.00	0.98	0.97	0.84
Estonia	0.22	0.20	0.18	0.20	0.17	0.18
Finland	0.60	0.56	0.50	0.56	0.48	0.50
France	13.40	11.79	12.02	11.28	11.58	9.13
Germany	24.48	21.62	21.75	20.90	21.11	18.25
Greece	2.74	2.58	2.46	2.53	2.42	2.21
Hungary	2.96	2.53	2.45	2.43	2.32	2.07
Ireland	0.48	0.44	0.45	0.43	0.44	0.38
Italy	15.64	14.62	14.80	14.01	14.25	11.27
Latvia	0.48	0.44	0.40	0.44	0.39	0.36
Lithuania	0.66	0.60	0.52	0.58	0.50	0.52
Luxembourg	0.13	0.12	0.12	0.11	0.12	0.10
Malta	0.11	0.10	0.11	0.10	0.10	0.10
Netherlands	6.04	5.49	5.57	5.34	5.41	4.77
Poland	10.97	9.62	9.28	9.30	8.92	8.23
Portugal	2.22	1.56	1.67	1.46	1.55	1.19
Romania	5.77	4.88	4.51	4.66	4.23	3.98
Slovakia	1.39	1.18	1.15	1.14	1.09	0.98
Slovenia	0.52	0.46	0.45	0.44	0.43	0.37
Spain	6.58	5.79	5.91	5.42	5.69	4.86
Sweden	1.07	0.99	0.94	0.96	0.92	0.85
UK	12.11	10.65	11.05	10.32	10.51	9.21
EU27	120.08	106.47	106.46	102.45	102.45	88.18

Years of life lost (YOLLs) due to exposure to PM2.5, calculated for constant 2010 population

Table 5.25: Years of life lost (YOLLs) due to exposure to PM2.5, for the PRIMES baseline projection (million years), calculated for constant 2010 population

	Current legislation	TSAP targets others at baseline	TSAP targets others at MID case	EP targets others at baseline	EP targets others at MID case	MTFR others at baseline
Austria	1.67	1.55	1.54	1.49	1.48	1.23
Belgium	3.77	3.49	3.55	3.36	3.43	2.86
Bulgaria	1.64	1.55	1.45	1.45	1.35	1.26
Cyprus	0.14	0.14	0.14	0.14	0.14	0.14
Czech Rep.	2.60	2.38	2.37	2.28	2.29	1.90
Denmark	1.06	0.98	0.97	0.95	0.95	0.80
Estonia	0.21	0.20	0.17	0.20	0.17	0.18
Finland	0.56	0.53	0.46	0.52	0.45	0.46
France	12.32	11.25	11.47	10.80	11.04	8.41
Germany	23.17	21.13	21.33	20.40	20.53	17.27
Greece	2.59	2.47	2.36	2.42	2.31	2.11
Hungary	2.87	2.61	2.50	2.47	2.40	2.02
Ireland	0.40	0.37	0.38	0.36	0.37	0.32
Italy	13.69	12.93	12.91	12.39	12.53	10.50
Latvia	0.47	0.44	0.40	0.44	0.39	0.36
Lithuania	0.64	0.59	0.51	0.58	0.50	0.51
Luxembourg	0.12	0.11	0.11	0.11	0.11	0.09
Malta	0.09	0.09	0.09	0.09	0.09	0.08
Netherlands	5.48	5.12	5.17	4.96	5.03	4.32
Poland	10.08	9.19	8.94	8.85	8.72	7.58
Portugal	2.11	1.63	1.90	1.55	1.63	1.18
Romania	5.46	4.98	4.77	4.64	4.26	3.79
Slovakia	1.26	1.14	1.10	1.08	1.06	0.89
Slovenia	0.47	0.43	0.42	0.41	0.41	0.34
Spain	6.18	5.65	5.81	5.54	5.64	4.67
Sweden	0.99	0.92	0.89	0.91	0.87	0.79
UK	10.71	9.78	9.93	9.43	9.66	8.10
EU27	110.74	101.67	101.65	97.82	97.80	82.14

Table 5.26: Years of life lost (YOLLs) due to exposure to PM2.5, for the PRIMES Reference scenario (million years), calculated for constant 2010 population)

	Current legislation	TSAP targets others at baseline	TSAP targets others at MID case	EP targets others at baseline	EP targets others at MID case	MTFR others at baseline
Austria	1.65	1.54	1.53	1.48	1.48	1.22
Belgium	3.75	3.48	3.56	3.37	3.44	2.85
Bulgaria	1.63	1.53	1.44	1.46	1.36	1.24
Cyprus	0.14	0.14	0.14	0.14	0.14	0.14
Czech Rep.	2.58	2.39	2.37	2.28	2.30	1.88
Denmark	1.05	0.99	0.97	0.95	0.95	0.80
Estonia	0.21	0.20	0.18	0.20	0.18	0.17
Finland	0.55	0.53	0.46	0.52	0.45	0.45
France	12.30	11.29	11.51	10.90	11.12	8.40
Germany	22.91	21.00	21.32	20.26	20.40	17.08
Greece	2.58	2.48	2.37	2.44	2.33	2.09
Hungary	2.84	2.60	2.50	2.48	2.40	1.99
Ireland	0.40	0.38	0.38	0.36	0.37	0.31
Italy	13.51	12.81	12.75	12.32	12.46	10.36
Latvia	0.47	0.45	0.40	0.44	0.39	0.36
Lithuania	0.63	0.60	0.52	0.58	0.50	0.50
Luxembourg	0.12	0.11	0.11	0.11	0.11	0.09
Malta	0.09	0.09	0.09	0.09	0.09	0.08
Netherlands	5.44	5.10	5.17	4.95	5.02	4.29
Poland	9.99	9.32	8.98	8.86	8.72	7.45
Portugal	2.11	1.64	1.89	1.56	1.64	1.17
Romania	5.45	4.95	4.78	4.71	4.34	3.75
Slovakia	1.24	1.14	1.10	1.08	1.06	0.88
Slovenia	0.46	0.43	0.42	0.41	0.41	0.34
Spain	6.13	5.67	5.82	5.53	5.62	4.63
Sweden	0.99	0.93	0.89	0.91	0.87	0.79
UK	10.63	9.86	9.98	9.42	9.65	8.05
EU27	109.86	101.65	101.64	97.82	97.80	81.35

Table 5.27: Years of life lost (YOLLs) due to exposure to PM2.5, for the National activity projections (million years), calculated for constant 2010 population)

	Current legislation	TSAP targets others at baseline	TSAP targets others at MID case	EP targets others at baseline	EP targets others at MID case	MTFR others at baseline
Austria	1.73	1.55	1.54	1.49	1.48	1.26
Belgium	3.90	3.49	3.57	3.37	3.44	2.97
Bulgaria	1.66	1.47	1.36	1.40	1.29	1.27
Cyprus	0.14	0.14	0.14	0.14	0.14	0.14
Czech Rep.	2.59	2.24	2.23	2.16	2.14	1.90
Denmark	1.09	0.99	0.98	0.96	0.96	0.83
Estonia	0.22	0.20	0.17	0.20	0.17	0.18
Finland	0.57	0.54	0.47	0.53	0.46	0.48
France	12.59	11.07	11.30	10.59	10.88	8.58
Germany	23.72	20.95	21.08	20.25	20.46	17.69
Greece	2.60	2.44	2.33	2.40	2.29	2.10
Hungary	2.91	2.50	2.41	2.40	2.29	2.04
Ireland	0.41	0.38	0.39	0.36	0.37	0.32
Italy	15.35	14.35	14.52	13.75	13.99	11.06
Latvia	0.48	0.44	0.39	0.43	0.39	0.36
Lithuania	0.64	0.58	0.51	0.57	0.49	0.51
Luxembourg	0.12	0.11	0.11	0.10	0.11	0.09
Malta	0.10	0.09	0.09	0.09	0.09	0.08
Netherlands	5.75	5.24	5.31	5.08	5.16	4.54
Poland	10.14	8.89	8.58	8.59	8.25	7.61
Portugal	2.12	1.49	1.59	1.39	1.48	1.14
Romania	5.57	4.71	4.35	4.50	4.09	3.85
Slovakia	1.27	1.09	1.06	1.04	1.00	0.90
Slovenia	0.49	0.43	0.43	0.42	0.41	0.35
Spain	6.17	5.43	5.54	5.08	5.34	4.55
Sweden	1.02	0.93	0.89	0.90	0.87	0.81
UK	11.33	9.96	10.33	9.65	9.83	8.62
EU27	114.69	101.70	101.69	97.86	97.85	84.20

5.3.3 *Cases of premature deaths attributable to the exposure to ground level ozone*

Table 5.28: Cases of premature deaths attributable to the exposure to ground level ozone, for the PRIMES baseline scenario (cases/year)

	Current legislation	TSAP targets others at baseline	TSAP targets others at MID case	EP targets others at baseline	EP targets others at MID case	MTFR others at baseline
Austria	280	279	276	276	274	245
Belgium	336	335	333	333	332	296
Bulgaria	365	362	352	357	348	321
Cyprus	26	26	26	26	26	26
Czech Rep.	367	365	361	357	356	308
Denmark	150	149	147	148	147	136
Estonia	18	18	18	18	18	17
Finland	46	46	45	46	45	43
France	1846	1838	1833	1821	1822	1655
Germany	2959	2949	2934	2926	2922	2617
Greece	501	494	488	491	485	456
Hungary	510	507	496	496	488	434
Ireland	79	79	79	79	79	75
Italy	3331	3320	3296	3295	3279	2999
Latvia	42	42	41	41	40	39
Lithuania	62	61	59	61	59	57
Luxembourg	22	22	22	22	22	19
Malta	19	19	19	19	19	17
Netherlands	333	331	330	329	328	289
Poland	1008	1001	983	982	972	875
Portugal	447	443	443	439	442	408
Romania	790	785	762	767	749	679
Slovakia	163	162	159	157	156	134
Slovenia	73	73	71	72	71	63
Spain	1538	1531	1529	1507	1521	1410
Sweden	159	158	156	157	156	148
UK	1664	1661	1656	1656	1653	1533
EU27	17134	17057	16915	16877	16809	15299

Table 5.29: Cases of premature deaths attributable to the exposure to ground level ozone, for the PRIMES Reference scenario (cases/year)

	Current legislation	TSAP targets others at baseline	TSAP targets others at MID case	EP targets others at baseline	EP targets others at MID case	MTFR others at baseline
Austria	278	276	275	274	273	244
Belgium	337	336	334	334	333	297
Bulgaria	362	359	350	355	346	319
Cyprus	26	26	26	26	26	26
Czech Rep.	364	360	359	356	355	307
Denmark	149	149	147	148	147	136
Estonia	18	18	18	18	18	17
Finland	46	46	45	46	45	43
France	1847	1837	1835	1824	1825	1663
Germany	2951	2940	2927	2921	2916	2614
Greece	498	494	487	489	482	453
Hungary	506	500	493	494	488	433
Ireland	79	79	79	79	79	75
Italy	3314	3296	3279	3282	3265	2991
Latvia	42	42	41	41	40	39
Lithuania	62	61	59	61	59	57
Luxembourg	22	22	22	22	22	19
Malta	19	19	19	19	19	17
Netherlands	333	332	330	330	329	289
Poland	1001	993	977	980	968	870
Portugal	444	441	441	438	440	406
Romania	786	779	758	766	750	675
Slovakia	162	159	157	157	155	133
Slovenia	72	72	70	71	70	62
Spain	1529	1522	1521	1504	1516	1405
Sweden	159	158	156	157	156	147
UK	1666	1663	1658	1659	1655	1535
EU27	17073	16982	16864	16850	16776	15272

Table 5.30: Cases of premature deaths attributable to the exposure to ground level ozone, for the National activity projections (cases/year)

	Current legislation	TSAP targets others at baseline	TSAP targets others at MID case	EP targets others at baseline	EP targets others at MID case	MTFR others at baseline
Austria	283	280	278	274	275	247
Belgium	338	336	335	333	333	297
Bulgaria	366	360	352	353	347	321
Cyprus	26	26	26	26	26	26
Czech Rep.	366	358	356	349	351	305
Denmark	152	150	149	148	148	137
Estonia	19	18	18	18	18	17
Finland	47	46	45	46	45	44
France	1855	1839	1836	1815	1822	1660
Germany	2972	2948	2940	2910	2921	2624
Greece	501	494	488	488	483	453
Hungary	513	502	493	490	487	436
Ireland	80	79	79	79	79	75
Italy	3423	3389	3370	3335	3351	3048
Latvia	42	42	41	41	40	39
Lithuania	62	61	60	61	59	57
Luxembourg	23	22	22	22	22	19
Malta	20	20	19	19	19	18
Netherlands	335	333	332	330	330	291
Poland	1011	993	980	968	965	876
Portugal	447	444	444	436	439	406
Romania	794	775	758	759	743	680
Slovakia	164	159	157	154	154	134
Slovenia	75	74	72	72	72	64
Spain	1544	1533	1535	1501	1505	1405
Sweden	161	159	158	158	157	148
UK	1666	1662	1657	1656	1653	1536
EU27	17285	17103	17001	16841	16843	15365

5.3.4 Ecosystems area with nitrogen deposition exceeding critical loads for eutrophication

Table 5.31 Ecosystems area with nitrogen deposition exceeding critical loads [1000 km^2], for the PRIMES baseline scenario

	Current legislation	TSAP targets others at baseline	TSAP targets others at MID case	EP targets others at baseline	EP targets others at MID case	MTFR others at baseline
Austria	27.7	16.8	16.9	12.7	13.1	4.7
Belgium	5.2	4.5	4.6	4.0	4.2	3.0
Bulgaria	28.6	19.4	18.2	18.3	16.6	14.2
Cyprus	1.6	1.4	1.4	1.4	1.4	1.4
Czech Rep.	27.6	27.6	27.6	27.5	27.5	27.5
Denmark	3.6	3.6	3.6	3.6	3.6	3.6
Estonia	8.0	5.5	4.9	5.1	4.6	4.4
Finland	63.4	53.4	49.7	51.1	46.2	42.3
France	154.9	129.2	132.0	116.3	122.2	89.2
Germany	65.9	51.1	53.2	47.2	47.5	37.6
Greece	51.8	50.4	49.9	49.9	49.2	47.6
Hungary	20.5	17.6	17.4	17.3	16.3	13.9
Ireland	1.9	1.8	1.8	1.8	1.8	1.7
Italy	61.5	44.3	44.7	40.2	40.3	27.4
Latvia	32.9	30.5	29.2	29.9	28.6	27.2
Lithuania	19.0	18.8	18.7	18.8	18.7	18.5
Luxembourg	1.0	1.0	1.0	1.0	1.0	1.0
Malta						
Netherlands	3.8	3.7	3.7	3.7	3.7	3.6
Poland	88.9	85.3	85.0	84.2	83.9	80.2
Portugal	19.1	11.6	12.0	10.4	11.1	3.7
Romania	1.6	0.5	0.5	0.2	0.2	0.1
Slovakia	20.5	20.1	20.0	20.0	20.0	19.9
Slovenia	6.3	3.8	2.7	2.1	1.0	0.4
Spain	165.5	152.0	153.9	145.7	148.8	114.8
Sweden	55.3	49.9	48.4	48.5	47.1	43.5
UK	14.3	12.1	12.4	11.4	11.8	9.4
EU27	950.3	816.1	813.2	772.2	770.2	640.8

Table 5.32: Ecosystems area with nitrogen deposition exceeding critical loads [1000 km^2], for the PRIMES Reference scenario

	Current legislation	TSAP targets others at baseline	TSAP targets others at MID case	EP targets others at baseline	EP targets others at MID case	MTFR others at baseline
Austria	27.4	17.1	17.7	12.6	13.6	4.6
Belgium	5.2	4.6	4.7	4.1	4.2	3.0
Bulgaria	27.4	19.4	18.2	17.9	15.9	13.9
Cyprus	1.6	1.5	1.5	1.4	1.4	1.3
Czech Rep.	27.6	27.6	27.6	27.5	27.5	27.5
Denmark	3.6	3.6	3.6	3.6	3.6	3.6
Estonia	7.9	5.9	4.9	5.1	4.7	4.3
Finland	62.3	54.7	50.2	51.1	45.9	41.9
France	154.4	132.2	134.0	120.2	122.9	89.2
Germany	65.5	51.4	55.2	47.1	47.2	37.3
Greece	51.7	50.5	49.8	49.7	49.0	47.3
Hungary	20.5	17.5	17.4	17.3	16.3	13.9
Ireland	1.9	1.8	1.8	1.8	1.8	1.7
Italy	61.3	47.0	46.3	40.1	40.4	27.4
Latvia	32.9	31.1	29.6	29.9	28.6	27.1
Lithuania	19.0	18.9	18.7	18.8	18.7	18.5
Luxembourg	1.0	1.0	1.0	1.0	1.0	1.0
Malta						
Netherlands	3.8	3.7	3.7	3.7	3.7	3.6
Poland	88.8	85.7	85.6	84.2	83.9	80.0
Portugal	18.9	11.8	11.9	10.6	11.2	3.6
Romania	1.5	0.5	0.5	0.2	0.2	0.1
Slovakia	20.5	20.1	20.1	20.0	20.0	19.9
Slovenia	6.1	3.1	2.8	2.0	1.0	0.3
Spain	165.1	154.7	154.7	146.2	149.0	113.5
Sweden	55.0	50.7	48.8	48.5	47.1	43.4
UK	13.8	12.5	12.4	11.4	11.7	9.3
EU27	944.5	828.5	822.8	775.8	770.4	637.4

Table 5.33: Ecosystems area with nitrogen deposition exceeding critical loads [1000 km^2], for the National activity projections

	Current legislation	TSAP targets others at baseline	TSAP targets others at MID case	EP targets others at baseline	EP targets others at MID case	MTFR others at baseline
Austria	28.3	14.7	16.3	11.8	12.0	5.1
Belgium	5.4	4.5	4.7	4.1	4.4	3.2
Bulgaria	28.6	19.4	18.5	18.1	17.7	14.2
Cyprus	1.6	1.4	1.4	1.4	1.4	1.4
Czech Rep.	27.6	27.5	27.6	27.5	27.5	27.5
Denmark	3.6	3.6	3.6	3.6	3.6	3.6
Estonia	8.3	5.6	5.0	5.2	4.7	4.4
Finland	64.9	54.5	50.7	51.4	46.6	42.8
France	155.2	127.2	132.2	115.6	122.0	90.5
Germany	66.5	48.8	49.9	46.9	47.6	38.4
Greece	51.9	50.5	50.0	49.7	49.1	47.5
Hungary	20.7	17.7	17.4	16.2	16.2	14.4
Ireland	1.9	1.8	1.9	1.8	1.8	1.8
Italy	63.0	45.9	46.7	40.7	41.8	29.2
Latvia	33.0	30.6	29.6	30.0	28.6	27.4
Lithuania	19.0	18.8	18.7	18.8	18.7	18.6
Luxembourg	1.0	1.0	1.0	1.0	1.0	1.0
Malta						
Netherlands	3.9	3.7	3.8	3.7	3.7	3.6
Poland	89.2	85.0	84.9	84.1	83.9	80.6
Portugal	19.4	11.8	12.2	8.6	11.2	3.7
Romania	9.6	0.7	0.8	0.5	0.5	0.2
Slovakia	20.5	20.1	20.1	20.0	20.0	19.9
Slovenia	6.8	3.0	2.1	2.1	1.0	0.4
Spain	165.2	151.0	153.0	141.2	145.7	111.5
Sweden	56.2	50.6	49.4	48.8	47.5	44.1
UK	15.6	12.7	13.3	12.4	12.6	10.4
EU27	966.8	812.4	814.6	765.2	770.9	645.5

5.3.5 Average accumulated excess deposition of nitrogen loads

Table 5.34: Average accumulated excess deposition of nitrogen loads [eq/ha/yr], for the PRIMES baseline scenario

	Current legislation	TSAP targets others at baseline	TSAP targets others at MID case	EP targets others at baseline	EP targets others at MID case	MTFR others at baseline
Austria	121.0	48.8	50.4	34.0	34.9	11.5
Belgium	396.2	277.3	288.9	251.2	263.0	189.8
Bulgaria	67.2	50.2	44.4	42.0	35.5	26.3
Cyprus	121.1	105.9	105.6	103.0	102.6	94.3
Czech Rep.	652.5	523.4	529.0	480.8	498.0	394.4
Denmark	630.9	558.2	560.4	540.8	543.0	485.7
Estonia	26.4	15.9	13.3	14.5	12.1	10.5
Finland	18.5	13.4	11.9	12.4	10.9	9.3
France	272.4	165.6	173.1	136.1	149.9	82.1
Germany	299.4	165.5	182.0	142.9	144.5	95.7
Greece	187.6	152.6	143.5	144.4	135.4	119.1
Hungary	301.0	206.3	189.0	184.5	168.8	129.6
Ireland	332.8	261.9	268.3	245.3	251.6	193.9
Italy	160.1	84.6	88.0	70.5	73.7	34.0
Latvia	151.3	113.7	100.2	105.6	92.5	81.8
Lithuania	380.8	299.6	275.5	280.3	256.3	219.5
Luxembourg	660.4	508.9	522.0	470.7	486.0	378.7
Malta						
Netherlands	893.3	747.7	760.4	713.3	726.0	605.2
Poland	492.3	361.5	355.6	339.0	332.5	259.6
Portugal	50.4	21.3	22.9	17.0	19.1	4.0
Romania	0.9	0.3	0.3	0.1	0.1	0.1
Slovakia	367.8	271.1	264.3	247.7	240.8	176.6
Slovenia	65.4	21.9	12.6	10.2	5.8	1.5
Spain	185.4	119.8	125.8	105.1	110.8	63.9
Sweden	62.0	49.3	47.8	46.4	45.4	37.8
UK	46.7	32.0	33.2	28.8	30.0	19.7
EU27	168.7	112.7	113.7	100.3	101.2	70.1

Table 5.35: Average accumulated excess deposition of nitrogen loads [eq/ha/yr], for the PRIMES Reference scenario

	Current legislation	TSAP targets others at baseline	TSAP targets others at MID case	EP targets others at baseline	EP targets others at MID case	MTFR others at baseline
Austria	118.2	50.2	54.8	33.7	36.5	11.3
Belgium	390.4	282.9	296.2	254.4	264.8	188.7
Bulgaria	64.5	50.5	43.8	40.9	35.4	25.2
Cyprus	120.3	107.9	106.3	102.9	102.4	93.8
Czech Rep.	647.6	528.6	537.9	479.4	499.6	392.0
Denmark	625.8	568.8	563.7	540.3	542.3	483.4
Estonia	25.9	17.1	13.9	14.4	12.2	10.3
Finland	18.1	14.2	12.1	12.3	10.8	9.2
France	270.7	174.7	182.6	146.3	153.3	82.5
Germany	295.6	167.7	197.8	141.8	143.1	94.6
Greece	184.4	156.4	143.7	142.6	133.6	115.9
Hungary	297.8	203.6	191.8	183.8	169.9	128.7
Ireland	329.5	273.4	272.8	245.9	252.1	192.4
Italy	157.5	96.1	93.0	71.6	74.7	33.4
Latvia	149.7	120.8	103.0	105.8	92.7	81.2
Lithuania	378.6	314.0	281.8	281.9	257.9	218.4
Luxembourg	656.3	513.6	536.8	476.7	487.6	377.8
Malta						
Netherlands	889.0	752.2	771.8	716.6	729.2	604.0
Poland	487.8	370.9	372.5	338.1	331.9	257.3
Portugal	48.5	22.3	22.3	17.6	19.4	3.8
Romania	0.8	0.3	0.3	0.1	0.1	0.1
Slovakia	363.7	269.5	270.5	246.4	241.0	174.4
Slovenia	62.2	17.3	13.8	9.8	5.8	1.4
Spain	182.6	130.4	130.0	105.6	111.4	62.8
Sweden	61.2	51.2	48.9	46.5	45.4	37.6
UK	45.6	34.0	33.8	28.7	29.8	19.3
EU27	166.7	117.5	118.3	101.3	101.7	69.4

Table 5.36: Average accumulated excess deposition of nitrogen loads [eq/ha/yr], for the National activity projections

	Current legislation	TSAP targets others at baseline	TSAP targets others at MID case	EP targets others at baseline	EP targets others at MID case	MTFR others at baseline
Austria	127.2	39.6	45.8	31.4	31.6	12.5
Belgium	423.1	284.9	302.7	263.0	275.7	205.6
Bulgaria	75.9	51.6	45.4	43.2	37.0	28.8
Cyprus	121.4	106.0	105.7	102.2	101.9	94.2
Czech Rep.	656.0	489.1	517.6	470.5	475.0	395.8
Denmark	648.9	574.5	576.9	552.2	554.6	500.3
Estonia	27.7	16.4	13.9	14.7	12.3	10.8
Finland	19.2	14.0	12.4	12.5	11.0	9.5
France	277.1	162.6	173.6	133.4	147.9	84.7
Germany	307.3	151.7	158.9	141.6	146.0	99.9
Greece	190.2	153.5	144.5	142.6	133.8	118.0
Hungary	319.8	200.4	187.1	175.8	171.5	137.1
Ireland	378.8	301.1	308.2	278.3	285.2	226.0
Italy	162.8	87.6	90.9	70.0	72.9	36.3
Latvia	155.4	115.4	102.7	106.0	93.1	83.9
Lithuania	386.1	304.0	280.0	279.5	255.6	222.8
Luxembourg	674.4	501.3	518.4	471.2	489.3	390.7
Malta						
Netherlands	965.0	789.8	807.9	769.3	782.3	666.4
Poland	499.5	351.6	353.1	335.8	330.3	263.6
Portugal	52.7	22.8	23.8	12.4	19.5	4.0
Romania	6.3	0.5	0.5	0.3	0.3	0.1
Slovakia	392.1	269.9	268.2	249.0	246.4	188.8
Slovenia	73.4	16.6	10.2	10.1	6.1	1.9
Spain	181.2	115.8	121.7	97.7	103.2	60.6
Sweden	63.9	50.8	49.8	47.2	46.1	39.0
UK	54.5	36.2	39.3	33.4	34.8	24.0
EU27	172.8	110.7	112.7	99.0	100.3	71.8

5.3.6 Forest area with deposition exceeding critical loads for acidification

Table 5.37: Forest area with deposition exceeding critical loads for acidification [1000 km^2], for the PRIMES baseline scenario

	Current legislation	TSAP targets others at baseline	TSAP targets others at MID case	EP targets others at baseline	EP targets others at MID case	MTFR others at baseline
Austria	0.0	0.0	0.0	0.0	0.0	0.0
Belgium	0.9	0.7	0.8	0.7	0.7	0.5
Bulgaria	0.0	0.0	0.0	0.0	0.0	0.0
Cyprus	0.0	0.0	0.0	0.0	0.0	0.0
Czech Rep.	5.0	4.4	4.4	3.6	4.1	3.2
Denmark	0.3	0.2	0.2	0.2	0.2	0.2
Estonia	0.0	0.0	0.0	0.0	0.0	0.0
Finland	1.8	1.5	1.5	1.5	1.5	1.4
France	4.6	3.3	3.5	2.1	2.6	0.9
Germany	20.6	12.6	13.8	11.2	11.6	6.5
Greece	0.2	0.1	0.1	0.1	0.1	0.0
Hungary	0.9	0.6	0.5	0.4	0.5	0.1
Ireland	0.4	0.3	0.4	0.3	0.3	0.2
Italy	0.0	0.0	0.0	0.0	0.0	0.0
Latvia	1.2	1.0	0.8	1.0	0.8	0.8
Lithuania	5.7	5.4	5.1	5.2	5.0	4.8
Luxembourg	0.1	0.1	0.1	0.1	0.1	0.0
Malta						
Netherlands	4.4	4.3	4.3	4.2	4.3	4.1
Poland	33.6	26.1	27.2	24.7	26.2	18.9
Portugal	0.9	0.6	0.6	0.6	0.6	0.1
Romania	4.2	3.7	2.8	2.7	2.7	0.9
Slovakia	1.4	0.9	0.9	0.4	0.6	0.0
Slovenia	0.0	0.0	0.0	0.0	0.0	0.0
Spain	0.0	0.0	0.0	0.0	0.0	0.0
Sweden	2.2	1.7	1.6	1.5	1.5	1.1
UK	2.6	2.0	2.1	1.9	2.0	1.4
EU27	91.2	69.6	70.5	62.6	65.3	45.2

Table 5.38: Forest area with deposition exceeding critical loads for acidification [1000 km^2], for the PRIMES Reference scenario

	Current legislation	TSAP targets others at baseline	TSAP targets others at MID case	EP targets others at baseline	EP targets others at MID case	MTFR others at baseline
Austria	0.0	0.0	0.0	0.0	0.0	0.0
Belgium	0.9	0.7	0.8	0.7	0.7	0.5
Bulgaria	0.0	0.0	0.0	0.0	0.0	0.0
Cyprus	0.0	0.0	0.0	0.0	0.0	0.0
Czech Rep.	5.0	4.4	4.4	3.6	4.1	3.1
Denmark	0.3	0.3	0.2	0.2	0.2	0.2
Estonia	0.0	0.0	0.0	0.0	0.0	0.0
Finland	1.7	1.5	1.5	1.5	1.5	1.4
France	4.6	3.5	3.6	2.3	3.1	0.9
Germany	19.8	12.4	14.2	10.8	11.3	6.1
Greece	0.2	0.1	0.1	0.1	0.1	0.0
Hungary	0.7	0.5	0.5	0.4	0.4	0.1
Ireland	0.4	0.4	0.4	0.3	0.3	0.2
Italy	0.0	0.0	0.0	0.0	0.0	0.0
Latvia	1.2	1.1	0.8	1.0	0.8	0.8
Lithuania	5.7	5.4	5.2	5.2	5.0	4.8
Luxembourg	0.1	0.1	0.1	0.1	0.1	0.0
Malta						
Netherlands	4.4	4.3	4.3	4.2	4.3	4.1
Poland	32.7	27.4	27.6	24.3	25.8	18.2
Portugal	0.8	0.6	0.6	0.6	0.6	0.1
Romania	3.9	3.5	2.6	2.8	2.6	0.8
Slovakia	1.4	0.9	0.9	0.4	0.6	0.0
Slovenia	0.0	0.0	0.0	0.0	0.0	0.0
Spain	0.0	0.0	0.0	0.0	0.0	0.0
Sweden	2.1	1.7	1.6	1.5	1.4	1.1
UK	2.6	2.1	2.2	1.9	2.0	1.4
EU27	88.3	70.9	71.5	62.0	64.7	43.8

Table 5.39: Forest area with deposition exceeding critical loads for acidification [1000 km^2], for the National activity projections

	Current legislation	TSAP targets others at baseline	TSAP targets others at MID case	EP targets others at baseline	EP targets others at MID case	MTFR others at baseline
Austria	0.0	0.0	0.0	0.0	0.0	0.0
Belgium	1.0	0.8	0.8	0.7	0.8	0.6
Bulgaria	0.0	0.0	0.0	0.0	0.0	0.0
Cyprus	0.0	0.0	0.0	0.0	0.0	0.0
Czech Rep.	5.0	3.7	4.2	3.6	3.6	3.2
Denmark	0.5	0.3	0.3	0.2	0.3	0.2
Estonia	0.0	0.0	0.0	0.0	0.0	0.0
Finland	2.0	1.7	1.5	1.6	1.5	1.5
France	4.7	3.3	3.5	2.0	2.5	1.1
Germany	21.5	12.1	12.6	10.8	11.6	7.0
Greece	0.2	0.1	0.1	0.1	0.1	0.0
Hungary	1.1	0.5	0.5	0.3	0.3	0.1
Ireland	0.4	0.3	0.3	0.3	0.3	0.2
Italy	0.0	0.0	0.0	0.0	0.0	0.0
Latvia	1.3	1.0	0.8	1.0	0.7	0.8
Lithuania	5.7	5.4	5.1	5.1	5.0	4.9
Luxembourg	0.1	0.1	0.1	0.1	0.1	0.0
Malta						
Netherlands	4.4	4.3	4.3	4.3	4.3	4.2
Poland	34.0	24.8	25.2	23.5	23.2	19.1
Portugal	0.9	0.6	0.6	0.5	0.6	0.1
Romania	5.3	2.4	2.6	1.5	1.5	0.9
Slovakia	1.5	0.5	0.7	0.3	0.2	0.0
Slovenia	0.0	0.0	0.0	0.0	0.0	0.0
Spain	0.0	0.0	0.0	0.0	0.0	0.0
Sweden	2.3	1.7	1.6	1.6	1.4	1.2
UK	3.1	2.3	2.5	2.1	2.2	1.7
EU27	95.1	65.7	67.5	59.7	60.2	46.8

5.3.7 *Average accumulated excess deposition for acidification in forests [eq/ha/yr]*

Table 5.40: Average accumulated excess deposition for acidification in forests [eq/ha/yr], for the PRIMES baseline scenario

	Current legislation	TSAP targets others at baseline	TSAP targets others at MID case	EP targets others at baseline	EP targets others at MID case	MTFR others at baseline
Austria	0.0	0.0	0.0	0.0	0.0	0.0
Belgium	98.1	68.4	77.4	65.0	68.7	40.7
Bulgaria	0.0	0.0	0.0	0.0	0.0	0.0
Cyprus	0.0	0.0	0.0	0.0	0.0	0.0
Czech Rep.	94.1	62.2	66.1	52.5	58.2	34.2
Denmark	30.6	20.4	21.1	18.3	18.9	11.9
Estonia	0.0	0.0	0.0	0.0	0.0	0.0
Finland	0.8	0.7	0.6	0.6	0.6	0.5
France	9.0	3.5	4.0	2.3	3.0	0.7
Germany	67.5	32.0	37.2	26.5	27.8	13.1
Greece	1.0	0.6	0.5	0.5	0.4	0.2
Hungary	9.5	4.2	3.1	2.1	2.2	0.1
Ireland	18.9	11.8	13.2	11.2	12.0	5.7
Italy	0.0	0.0	0.0	0.0	0.0	0.0
Latvia	5.9	3.8	1.6	3.3	1.4	1.8
Lithuania	105.7	72.5	55.4	65.6	50.3	39.0
Luxembourg	54.8	23.3	26.9	14.4	19.2	0.2
Malta						
Netherlands	1116.6	942.1	970.4	905.0	924.9	740.7
Poland	159.9	93.3	105.7	81.4	99.4	47.1
Portugal	7.8	5.5	5.7	4.1	4.3	0.3
Romania	2.6	2.1	1.6	1.2	1.5	0.3
Slovakia	11.7	3.1	3.0	1.1	1.9	0.0
Slovenia	0.0	0.0	0.0	0.0	0.0	0.0
Spain	0.3	0.2	0.3	0.2	0.2	0.1
Sweden	1.2	0.8	0.8	0.8	0.7	0.5
UK	51.6	35.6	38.6	32.2	35.7	20.7
EU27	27.2	16.7	18.0	14.7	16.2	9.2

Table 5.41: Average accumulated excess deposition for acidification in forests [eq/ha/yr], for the PRIMES Reference scenario

	Current legislation	TSAP targets others at baseline	TSAP targets others at MID case	EP targets others at baseline	EP targets others at MID case	MTFR others at baseline
Austria	0.0	0.0	0.0	0.0	0.0	0.0
Belgium	96.2	70.7	81.3	64.8	70.4	40.4
Bulgaria	0.0	0.0	0.0	0.0	0.0	0.0
Cyprus	0.0	0.0	0.0	0.0	0.0	0.0
Czech Rep.	90.8	62.9	66.6	51.2	58.5	32.9
Denmark	29.3	21.4	21.5	17.9	18.4	11.4
Estonia	0.0	0.0	0.0	0.0	0.0	0.0
Finland	0.7	0.6	0.5	0.6	0.5	0.5
France	8.8	3.9	4.5	2.6	3.1	0.7
Germany	64.1	31.4	39.5	25.1	26.7	12.3
Greece	0.8	0.5	0.4	0.4	0.3	0.1
Hungary	9.0	3.9	3.2	2.0	2.1	0.1
Ireland	18.2	13.1	13.6	10.9	11.7	5.4
Italy	0.0	0.0	0.0	0.0	0.0	0.0
Latvia	5.7	4.3	1.7	3.3	1.3	1.7
Lithuania	103.1	80.1	57.3	65.3	49.7	37.5
Luxembourg	52.9	23.1	29.2	14.7	18.9	0.2
Malta						
Netherlands	1111.3	951.1	988.1	908.3	932.0	739.2
Poland	149.9	105.9	108.0	78.2	95.1	42.7
Portugal	7.3	4.3	5.4	4.0	4.1	0.3
Romania	2.3	2.0	1.4	1.3	1.3	0.3
Slovakia	10.4	3.3	3.1	0.9	1.7	0.0
Slovenia	0.0	0.0	0.0	0.0	0.0	0.0
Spain	0.3	0.2	0.3	0.2	0.2	0.0
Sweden	1.2	0.9	0.8	0.7	0.7	0.5
UK	50.4	38.3	39.9	32.0	35.5	20.3
EU27	26.0	17.7	18.5	14.4	15.8	8.8

Table 5.42: Average accumulated excess deposition for acidification in forests [eq/ha/yr], for the National activity projections

	Current legislation	TSAP targets others at baseline	TSAP targets others at MID case	EP targets others at baseline	EP targets others at MID case	MTFR others at baseline
Austria	0.0	0.0	0.0	0.0	0.0	0.0
Belgium	112.0	77.0	81.6	66.9	75.5	47.7
Bulgaria	0.0	0.0	0.0	0.0	0.0	0.0
Cyprus	0.0	0.0	0.0	0.0	0.0	0.0
Czech Rep.	94.1	53.3	59.8	48.0	50.4	33.7
Denmark	37.5	22.8	23.3	20.0	20.3	13.8
Estonia	0.0	0.0	0.0	0.0	0.0	0.0
Finland	0.9	0.7	0.6	0.7	0.6	0.6
France	9.3	3.2	4.0	2.0	2.8	0.7
Germany	72.5	30.2	32.6	26.0	28.8	14.8
Greece	1.0	0.5	0.4	0.4	0.3	0.2
Hungary	11.9	2.4	2.6	1.2	0.9	0.2
Ireland	19.0	11.5	12.7	9.4	10.4	5.6
Italy	0.0	0.0	0.0	0.0	0.0	0.0
Latvia	6.3	3.8	1.6	3.1	1.1	1.9
Lithuania	108.4	72.5	53.7	61.6	43.7	40.3
Luxembourg	58.4	20.4	24.5	9.6	17.8	0.3
Malta						
Netherlands	1278.4	1065.0	1090.6	1023.4	1056.1	863.1
Poland	162.7	81.6	87.3	72.1	72.0	48.0
Portugal	9.8	4.3	5.9	1.1	4.0	0.3
Romania	4.1	1.1	1.5	0.6	0.6	0.3
Slovakia	13.8	1.4	2.3	0.6	0.6	0.0
Slovenia	0.0	0.0	0.0	0.0	0.0	0.0
Spain	0.3	0.2	0.2	0.1	0.2	0.0
Sweden	1.4	0.9	0.8	0.8	0.7	0.5
UK	67.7	42.8	50.6	38.7	41.6	27.7
EU27	29.1	16.1	17.0	14.3	14.7	10.1

5.3.8 *Catchment area with deposition exceeding critical loads for acidification [km^2]*

Table 5.43: Catchment area with deposition exceeding critical loads for acidification [km^2], for the PRIMES baseline scenario

	Current legislation	TSAP targets others at baseline	TSAP targets others at MID case	EP targets others at baseline	EP targets others at MID case	MTFR others at baseline
Finland	827	748	522	748	522	607
Sweden	14822	13691	11659	12650	11522	11131
UK	6090	6050	6052	6032	6050	4362
EU27	21738	20489	18233	19429	18094	16100

Table 5.44: Catchment area with deposition exceeding critical loads for acidification [km^2], for the PRIMES Reference scenario

	Current legislation	TSAP targets others at baseline	TSAP targets others at MID case	EP targets others at baseline	EP targets others at MID case	MTFR others at baseline
Finland	773	748	522	654	522	562
Italy	0	0	0	0	0	0
Sweden	14489	14108	11541	11681	11103	10689
UK	6068	6052	6052	6032	6050	4359
EU27	21331	20907	18115	18367	17675	15610

Table 5.45: Catchment area with deposition exceeding critical loads for acidification [km^2], for the National activity projections

	Current legislation	TSAP targets others at baseline	TSAP targets others at MID case	EP targets others at baseline	EP targets others at MID case	MTFR others at baseline
Finland	827	780	595	773	569	701
Italy	0	0	0	0	0	0
Sweden	14954	13975	11749	12423	11194	12212
UK	6122	6058	6086	6050	6057	6013
EU27	21903	20813	18431	19246	17821	18926

5.3.9 Average accumulated excess deposition of acidifying substances for freshwater ecosystems [eq/ha/yr]

Table 5.46: Average accumulated excess deposition of acidifying substances for freshwater ecosystems [eq/ha/yr],for the PRIMES baseline scenario

	Current legislation	TSAP targets others at baseline	TSAP targets others at MID case	EP targets others at baseline	EP targets others at MID case	MTFR others at baseline
Finland	1.2	1.0	0.7	0.9	0.6	0.8
Italy	0.0	0.0	0.0	0.0	0.0	0.0
Sweden	2.5	2.1	2.1	2.1	2.1	1.8
UK	89.4	64.6	70.5	59.5	66.9	40.4
EU27	6.2	4.8	5.0	4.5	4.8	3.4

Table 5.47 Average accumulated excess deposition of acidifying substances for freshwater ecosystems [eq/ha/yr], for the PRIMES Reference scenario

	Current legislation	TSAP targets others at baseline	TSAP targets others at MID case	EP targets others at baseline	EP targets others at MID case	MTFR others at baseline
Finland	1.1	1.0	0.6	0.9	0.6	0.7
Italy	0.0	0.0	0.0	0.0	0.0	0.0
Sweden	2.4	2.2	2.1	2.0	2.0	1.7
UK	88.0	69.6	73.3	59.1	66.8	39.8
EU27	6.0	5.0	5.0	4.4	4.7	3.3

Table 5.48: Average accumulated excess deposition of acidifying substances for freshwater ecosystems [eq/ha/yr], for the National activity projections

	Current legislation	TSAP targets others at baseline	TSAP targets others at MID case	EP targets others at baseline	EP targets others at MID case	MTFR others at baseline
Finland	1.4	1.1	0.8	1.1	0.7	0.9
Italy	0.0	0.0	0.0	0.0	0.0	0.0
Sweden	2.8	2.2	2.1	2.1	2.0	1.9
UK	114.5	77.6	91.0	71.5	76.1	54.0
EU27	7.5	5.4	5.9	5.1	5.1	4.1