CAFE CBA: Baseline Analysis 2000 to 2020






April 2005

Service Contract for Carrying out Cost-Benefit Analysis of Air Quality Related Issues, in particular in the Clean Air for Europe (CAFE) Programme

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Executive Summary

In May 2001, the European Commission launched the Clean Air for Europe (CAFE) Programme – a knowledge based approach with technical/scientific analyses and policy development that will lead to the adoption of a Thematic Strategy on Air Pollution, fulfilling the requirements of the Sixth Environmental Action Programme. Its aim is to develop a long-term, strategic and integrated policy advice for '*achieving levels of air quality that do not give rise to significant negative impacts on and risks to human health and the environment';* including '*no exceedance of critical loads and levels for acidification or eutrophication'*.

This report presents the benefits analysis for the CAFE baseline and the Thematic Strategy. The analysis takes as its starting point the pollution data generated by the EMEP and RAINS models for the baseline conditions, and uses the CAFE CBA methodology. It assesses the state of the environment in 2000 and 2020, and looks at the benefits of current policies over this period. Results are presented for the following receptors:

- Health (mortality and morbidity);
- Materials (buildings);
- Crops;
- Ecosystems (freshwater and terrestrial, including forests).

Where possible the analysis has been carried through to economic valuation, though this was not possible for ecosystems and for materials used in cultural heritage.

This analysis has used concentration data output by the RAINS model for PM health impact assessment, and pollution data from the EMEP model for other pollutants (including effects on ecosystems). The information used is taken from the latest model runs (March 2005) which include some differences to those used earlier in the benefits assessment, with the result that the information presented here cannot be compared directly with the earlier CBA baseline reports. The results given in this report are, however, consistent with other analysis for the Thematic Strategy.

An important difference to the draft final version (January 2005) of this report concerns assessment of mortality and morbidity from exposure to particulate matter. Results here are about 25% higher than before, for two reasons. Firstly, the RAINS model results used here now include an adjustment for urban PM levels, based on results of the CITY-DELTA project. This provides a more accurate analysis of urban PM concentrations. Secondly, the EMEP output parameter PM25_H2O output is included in the RAINS data (it was excluded in the previous CBA baseline). The inclusion of this metric is consistent with the analysis in other parts of the CAFE programme and in the IIASA output. The analysis has also updated the assessment for ozone based on more recent model runs.

Health Impacts across the EU

Results here estimate the total health impacts across the EU25 for the baseline from 2000 to 2020. The impacts are split into mortality (i.e. premature deaths[1]) and morbidity (i.e. illness) by pollutant (PM and ozone). The impacts reported here represent the annual number of events or new cases, rather than totals for the period under investigation (2000-2020). They

[1] Note two alternative metrics are used in assessment of chronic mortality impacts from PM, years of life lost (YOLL) and numbers of premature deaths. These two metrics are not additive.

take into account changes in the baseline environment in relation to population growth and age distribution over time, as well as changes in pollution levels. The impacts by pollutant are summarised below.

Ozone concentrations: Analysis of ozone impacts is based on use of the metric SOMO35 (sum of means over 35 ppb). Any impact of lower ozone concentrations is thus not accounted for. On this basis it is estimated that annual impacts across the EU 25 are 21 000 deaths brought forward in the year 2000. We also calculate a roughly similar number of respiratory hospital admissions linked to ozone exposure. We also estimate that ozone generates large numbers of morbidity effects, with tens of millions of minor restricted activity days and respiratory medication use days each year. These are clearly less serious at the individual level, but they affect a much greater number of people.

PM concentrations: Analysis of PM effects includes exposure to both primary and secondary aerosols, though excludes effects of exposure to naturally derived PM and secondary organic aerosols. Annual impacts across the EU 25 total an estimated 3.7 million years of life lost each year (based on the year 2000). This can also be expressed as 348 000 estimated premature deaths. Further to this, we calculate that there are 700 infant deaths each year from PM exposure (in 2000). According to the CAFE-CBA model, therefore, PM concentrations have a much more important effect than ozone with respect to mortality. PM also leads to larger numbers of annual morbidity effects than ozone. The morbidity effects of PM range from around an estimated 100 000 cases of respiratory or cardiac hospital admissions (in the year 2000) to much larger numbers of less serious effects, for example an estimated 30 million respiratory medication use days, and several hundred million restricted activity days each year.

For PM, there are significant reductions in annual impacts over the period 2000 to 2020. For ozone, the reductions are more modest.

The health effects above have been expressed in monetary terms, using the approach described in the series of reports issued on the CAFE CBA methodology. Strictly speaking, the CAFE CBA methodology is only applicable for assessing the changes between scenarios, i.e. marginal policy changes. However, we have estimated the total monetary damage from health impacts for the baseline, as an illustration of the level of economic importance. The estimated values are presented in the table below as an annual impact in billion Euro, for the whole EU 25, in the years 2000 and 2020. The analysis has also estimated the annual benefits of current policies through to 2020.

Table i: Implementing current EU legislation: Core estimates of annual health damage due to air pollution in 2000 and in 2020 in EU25, plus the difference between 2000 and 2020.

	2000 (€bn)		2020 (€bn)		Difference (€bn)	
	Low estimate	High estimate	Low estimate	High estimate	Low estimate	High estimate
O_3 mortality	1.12	2.51	1.09	2.43	0.03	0.08
O_3 morbidity	6.3	6.3	4.2	4.2	2.1	2.1
PM mortality	190.2	702.8	129.5	548.2	60.7	154.6
PM morbidity	78.3	78.3	54.1	54.1	24.2	24.2
Total	275.8	789.9	188.8	608.9	87.0	181.0

Notes.
1. A billion is a thousand million.
2. The results are based on 1997 meteorological data, so that they are comparable with the RAINS baseline results and scenario analysis. The 2020 baseline values include climate policies (Scenario 2020 CP_CLE (1997))
3. For acute mortality (O_3), two alternative values are presented, based on a range reflecting the median and mean values from the NewExt study. For chronic mortality (PM), two alternative values are presented, based on quantification using years of life lost (using the median YOLL value from NewExt) and numbers of premature deaths (using the mean VSL value from NewExt). The results of the mean YOLL value (which would be higher than the results using median YOLL value) and the median VSL value (which would be smaller than the mean VSL and also the mean VOLY) have not been shown in the interests of brevity.

The health impacts of air pollution are dominated by PM related mortality, though PM related morbidity is also significant. The importance of PM increases when the Value of Statistical Life (VSL) concept (see ‘high’ estimates in the table) is used for the valuation of chronic mortality in place of the Value of a life year (VOLY) approach (the ‘low’ estimates in the table). The most important categories (in economic terms) for PM related morbidity are restricted activity days and cases of chronic bronchitis.

The report compares total health damage with current economic indicators. EU25 GDP at market prices in 2000 was Euro 8947 billion. The estimated health damages for 2000 correspond to 3% to 10% of this value (based on the low and high estimate of damages). The estimated impact of implementing current legislation up to 2020 is valued at between €87 billion to €181 billion per year. This translates to an estimated average benefit across the EU25 of €191 and €397 per person per year.

Non-Health Impacts

The analysis has estimated some non-health impacts across the EU25 for the baseline from 2000 to 2020. Some of these have also been valued in monetary terms - damages to crops (i.e. reduced crop yield from ozone exposure) and damages to materials, mainly from acidic deposition (excluding historic buildings and cultural heritage).

These non-health impacts have been expressed in monetary terms, using the approach described in the CAFE CBA methodology. The values are presented as an annual impact in billion Euro, for the EU 25, in 2000 and 2020 in the table below. The analysis has also estimated the change in annual damage associated with current policies through to 2020. The analysis shows that these impacts are small in relation to health damages overall, though effects from ozone on crops are similar in magnitude to ozone related health impacts.

Table ii: Implementing current EU legislation: annual non-health damages due to air pollution in 2000 and in 2020 in EU25, plus the difference between 2000 and 2020

	2000 (€bn)	2020 (€bn)	Difference (€bn)
Crops (ozone)	2.8	1.5	1.3
Materials	1.1	0.7	0.4
Total	**3.9**	**2.2**	**1.7**

The results are based on 1997 meteorological data, so that they are comparable with the RAINS baseline results and scenario analysis. The 2020 baseline values include climate policies (Scenario 2020 CP_CLE (1997))

The first part of the uncertainty analysis considered the probability distribution around the mean value for estimated benefits (note: the mean value, rather than the median). This generated a 95% confidence interval equivalent to [best estimate ÷ 2.5] to [best estimate × 1.7]. Analysis of this type can be used in future to make a first estimate of the probability that benefits would exceed costs (or vice-versa).

The second part examined specific sensitivities linked to the benefit estimation methods used. This generated the following conclusions:

- Use of the VSL does lead to an increase in estimated damage compared to use of the VOLY. However, there is substantial overlap in the distributions of VSL and VOLY based estimates. This is an important conclusion as it is often assumed that the two approaches do yield results that are quite different to one another.
- Inclusion of additional impacts of PM (using what is referred to in the methodology report as the 'sensitivity functions') would not raise estimated PM damage significantly.
- Inclusion of 'sensitivity' impacts of ozone would raise estimated ozone effects significantly. Similarly, use of the VSL to value ozone related mortality would have a significant effect. However, PM damage would still dominate the baseline results.
- Alternative assumptions on the hazard posed by different chemical species of particle could have a major effect on estimated PM damage. This could be positive or negative, depending on the extent of control of each pollutant.
- Similarly, some assumptions on the lag-phase appropriate to chronic mortality assessment could have a major impact on the results shown here. However, some alternative assumptions to those used in the core analysis here, would not have a significant impact.

The third part of the uncertainty assessment considered systematic biases in the analysis. There is some overlap with issues raised above, particularly assumptions on the risk linked to each different type of particle. Other than this, the most important biases are likely to concern omission of the following types of impact from the analysis through a lack of data at some point in the impact pathway:

- Ecosystem acidification
- Ecosystem eutrophication
- Impacts of ozone on ecosystems

- Damage to cultural heritage
- Chronic health effects of exposure to ozone
- Chronic effects of PM exposure on cardio-vascular disease
- Impacts of secondary organic aerosols of anthropogenic origin

Considering information provided in the section on extended CBA, and provided that the core analysis does not lead to substantial overestimation of impacts, it is likely that the true level of damage associated with PM and ozone and their precursors is greater than indicated here, as a result of the omission of these effects. However, it is not possible to make any clear statement on the extent to which these omitted impacts would add to the quantified benefits.

Overall conclusions

This report summarises the benefits baseline for air quality in Europe from 2000 to 2020. It reveals that large benefits are predicted to occur from current policies over this time, with quantified air pollution impacts falling by €89 billion to €183 billion per year as a result of current policies by 2020. This excludes benefits from effects not included in the monetary framework - notably reductions in damage to ecosystems and cultural heritage. However, despite these improvements, the baseline damages in 2020 remain significant, with estimated damages of €191 billion to €611 billion per year.

Contents

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The RAINS team under the leadership of Markus Amann at the International Institute for Applied Systems Analysis.

The EMEP/MSC-W team providing atmospheric dispersion calculations under the leadership of Leonor Tarrason at the Norwegian Meteorological Institute

Introduction

In May 2001, the European Commission launched the Clean Air for Europe (CAFE) Programme – a knowledge based approach with technical/scientific analyses and policy development that will lead to the adoption of a Thematic Strategy on Air Pollution, fulfilling the requirements of the Sixth Environmental Action Programme. Its aim is to develop a long-term, strategic and integrated policy advice for '*achieving levels of air quality that do not give rise to significant negative impacts on and risks to human health and the environment';* including '*no exceedance of critical loads and levels for acidification or eutrophication'*.

Using results from the CAFE analysis, the European Commission will present its Thematic Strategy on Air Pollution during the first half of 2005, outlining the environmental objectives for future European air quality policy and measures to be taken to achieve these objectives.

The CAFE programme has compiled a set of baseline projections, to investigate the effects of current legislation on the future emissions, air quality and of health and environmental impacts up to the year 2020. This report presents the benefits analysis for the baseline scenarios for the *Clean Air for Europe (CAFE)* programme and thematic strategy. It has been prepared as part of the '*Service Contract for Cost-Benefit Analysis (CBA) of Air Quality Related Issues, in particular in the Clean Air for Europe (CAFE) Programme'*.

The analysis investigates expected trends in air quality, based on changes in emissions, sources and air pollution concentrations in all 25 Member States of the European Union. The analysis takes account of emission control legislation that has already been decided in the various Member States in the coming years and demographic changes (based on UN population projections). This analysis quantifies, and where possible monetises, the impacts of the baseline conditions from air quality in Europe using the methodology developed following extensive stakeholder discussions during 2003 and 2004[2].

The following scenarios have been analysed:

- Situation in 2000 (2000 BL_CLE (met year 1997)).
- Situation in 2020 assuming that current air pollution legislation is implemented in all countries of the EU25, that Member States reach their climate policy obligations under the Kyoto Protocol and carry on implementing greenhouse gas reduction policies through to 2020 (CP_CLE 2020 (met year 1997).
- The difference between these years, i.e. impact of current policies up to 2020 from 2000.

The current legislation includes the following:

[2] See http://www.cafe-cba.org

Table 1. Legislation considered in the Current Legislation (CLE) scenario

for SO_2 emissions	for NO_X emissions	for VOC emissions	for NH_3 emissions
Large combustion plant directive	Large combustion plant directive	Stage I directive	No EU-wide legislation
Directive on the sulphur content in liquid fuels	Auto/Oil EURO standards	Directive 91/441 (carbon canisters)	National legislation
Directives on quality of petrol and diesel fuels	Emission standards for motorcycles and mopeds	Auto/Oil EURO standards	Current practice
IPPC legislation on process sources	Legislation on non-road mobile machinery	Fuel directive (RVP of fuels)	
National legislation and national practices (if stricter)	Implementation failure of EURO-II and Euro-III for heavy duty vehicles	Solvents directive	
	IPPC legislation for industrial processes	Product directive (paints)	
	National legislation and national practices (if stricter)	National legislation, e.g., Stage II	

Source: The Current Legislation" cases for the CAFE baseline emission projections. Background paper for the meeting of the CAFE Working Group on Target Setting and Policy Advice. IIASA.

PM concentration data used here is taken from outputs of the RAINS model, which approximates the results of the EMEP model. A grid scale of 50x50 km is used, though data are augmented by results of the CITY-DELTA project to factor in higher urban concentrations of PM in densely populated areas. The model calculates changes in the anthropogenic contribution to ambient concentrations of $PM_{2.5}$ in Europe resulting from changes in emissions of primary $PM_{2.5}$, SO_2, NO_X, and NH_3. Note that the model does not consider the contribution from natural sources (e.g., mineral dust, organic carbon, etc.). Similarly, changes in concentrations of secondary organic aerosols (SOA) associated with anthropogenic emissions are not included in the model.

Analysis is conducted using the meteorological year of 1997. The effect of the use of this single year on exposure in each country is shown in Figure 1. For the EU25 as a whole, 1997 provides results reasonably close to the average, but results are quite variable for individual countries.

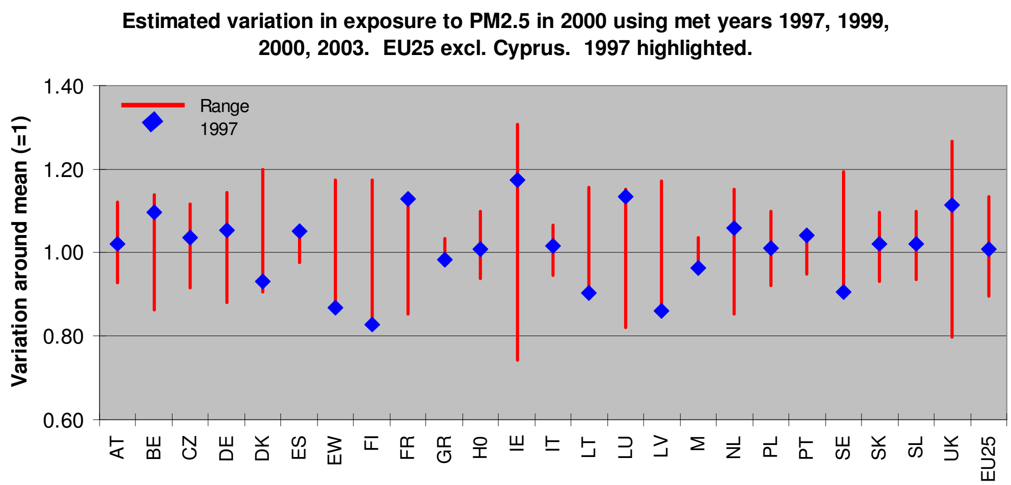

Figure 1. Variation in population weighted exposure to $PM_{2.5}$ from variation in assumed meteorological year (1997, 1999, 2000 and 2003). 1997, the year used for the analysis in this report, is highlighted.

For ozone, the study has used results from the Eulerian EMEP model directly, based on the SOMO35 exposure indicator for health assessment. Like $PM_{2.5}$, ozone is significantly influenced by inter-annual meteorological – and 1997 is not considered a typical year. Figure 2 shows variability in exposure across four different meteorological years.

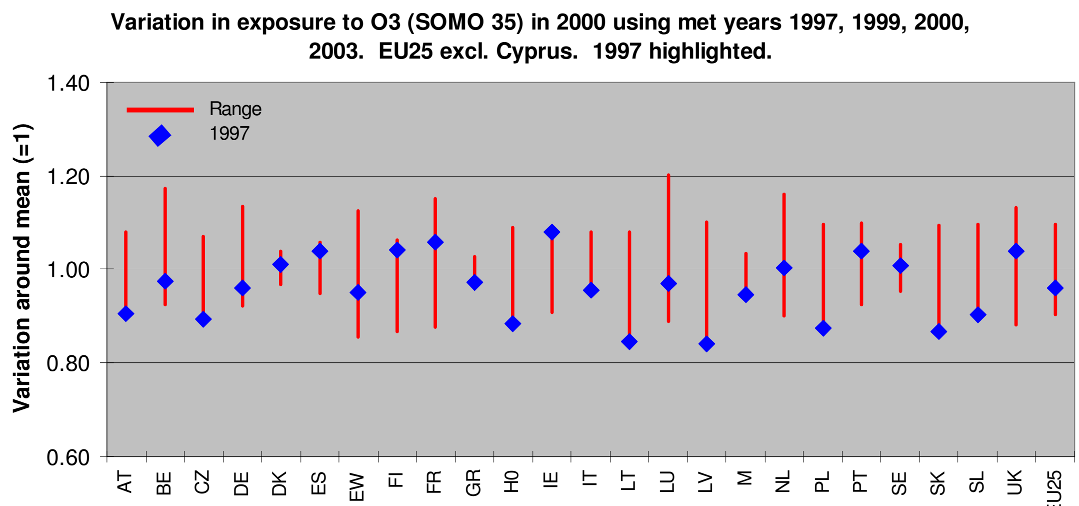

Figure 2. Variation in population weighted exposure to ozone expressed as SOMO35 from variation in assumed meteorological year (1997, 1999, 2000 and 2003). 1997, the year used for the analysis in this report, is highlighted.

The CAFE CBA methodology has been applied to the baseline data from the RAINS and EMEP models, using the CBA methodology as set out in Volumes 1 to 3 of the revised methodology[3], using the CAFE CBA modelling tool. The methodology is summarised in the next section.

The analysis cannot be compared to the earlier baseline CBA reports[4], as there are differences in the modelling. The results are, however, consistent with the updated analysis for the Thematic Strategy using the RAINS model. In the draft final version (January 2005) of this report the mortality and morbidity results of particulate matter were about 25% lower than in this final report for two reasons. Firstly, the RAINS model results used here now include an adjustment to give an urban increment, based on the outputs of the CITY-DELTA project. This provides a more accurate analysis of urban PM concentrations. Secondly, the EMEP output parameter PM25_H2O output has been included in the analysis, whereas it was previously excluded. The inclusion of this metric is consistent with the analysis in other parts of the CAFE programme and in the IIASA output. The analysis has also updated ozone impacts based on new model runs.

The report presents information on the impacts of the baseline conditions, both in terms of physical impacts and monetary valuation. It also summarises the change in impacts (i.e. the benefit) that will occur over time (from 2000 to 2020) from policies already in place, in terms of benefits and monetary valuation.

The results are presented as annual environmental and health impacts. Further the results have been aggregated – using monetary values – to have an understanding of the total damage in economic terms. This involves using different metrics to those output by the RAINS model in some areas, notably for chronic mortality effects. The annualised benefits can be compared directly with the annualised costs of pollution reduction provided by the RAINS model.

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3 Methodology for the Cost-Benefit analysis for CAFE: Volume 1: Overview of Methodology. Mike Holland, Alistair Hunt, Fintan Hurley, Stale Navrud, Paul Watkiss
Methodology for the Cost-Benefit analysis for CAFE: Volume 2: Health Impact Assessment. Fintan Hurley, Hilary Cowie, Mike Holland, Alistair Hunt, Brian Miller, Stephen Pye, Paul Watkiss
These reports are available at the project web-site.http://www.cafe-cba.org/

4 The Current Legislation" and the "Maximum Technically Feasible Reduction" cases for the CAFE baseline emission projections. Background paper for the meeting of the CAFE Working Group on Target Setting and Policy Advice, November 10, 2004. Markus Amann, Rafal Cabala, Janusz Cofala, Chris Heyes, Zbigniew Klimont, Wolfgang Schöpp. International Institute for Applied Systems Analysis (IIASA) Leonor Tarrason, David Simpson, Peter Wind, Jan-Eiof Jonson. Norwegian Meteorological Institute (MET.NO), Oslo, Norway. Version 2 (including tables of impact estimates). November 2004

Benefits Methodology

The CAFE programme focuses on the following air pollutants and effects.

Table 2. Direct and indirect impacts addressed in the CAFE CBA

	$PM_{2.5}$	SO_2	NO_x	VOCs	NH_3
Direct impacts					
Tropospheric ozone formation, leading to effects on health, crops, materials and ecosystems			✓	✓	
Health impacts from primary pollutants and secondary pollutants (ozone and aerosols)	✓	✓	✓	✓	✓
Ecosystem acidification		✓	✓		✓
Ecosystem eutrophication			✓		✓
Damage to building and other materials		✓	✓		
Indirect impacts					
Changes in greenhouse gas emissions as a result of measures employed to control CAFE pollutants	✓	✓	✓	✓	✓
Wider social and economic effects from impacts and the measures recommended for their control	✓	✓	✓	✓	✓

The relationship between the CBA and other models and activities linking to the CAFE Programme is shown below (Figure 3. The links from RAINS and CBA models to scenario development and target setting are shown with a dashed line to highlight the fact that although these processes will be influenced by model outputs, they are not direct outputs of the models.

It is important to differentiate the roles of the RAINS and CBA models. RAINS identifies a cost-effective set of measures for meeting pre-defined health and environmental quality targets. The CBA model adds to this analysis by assessing the magnitude of benefits and assesses whether overall benefits are higher or lower than the estimated costs; in other words, whether it is worth carrying out the measures identified in the RAINS model.

The development of the CAFE CBA methodology has been the subject of intense consultation in 2003 and 2004 with stakeholders from the European Union Member States, academic institutes, environment agencies, industry and non-governmental organisations. It was also subject to formal peer review by senior experts in the USA and Europe. The peer review report is available at http://europa.eu.int/comm/environment/air/cafe/activities/krupnick.pdf .

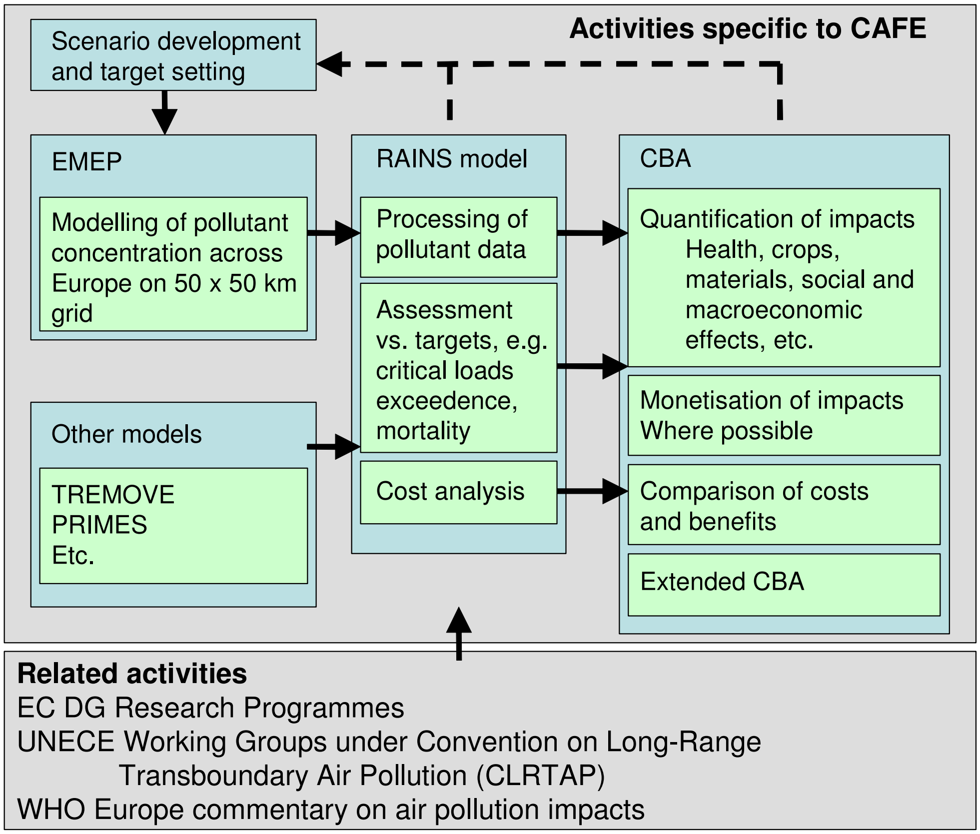

Figure 3. Position of the CBA in the analytical framework for the Thematic Strategy

Quantification of benefits and comparison with costs

The benefits listed in the table above are quantified to the extent possible using the 'impact pathway' or 'damage cost' approach. This follows the standard approach applied in all modern cost-benefit analysis of air pollution control. The methodology has been refined over the last 15 years particularly under the ExternE (and related) projects of EC DG Research. This approach follows a logical progression through the following stages:

1. Quantification of emissions (in CAFE, covered by the RAINS model);
2. Description of pollutant dispersion across Europe (in CAFE, covered by the RAINS and EMEP models);
3. Quantification of exposure of people, environment and buildings that are affected by air pollution (linking the pollution concentrations with the 'stock at risk' e.g. population data);
4. Quantification of the impacts of air pollution, using relationships linking pollution concentrations with physical impacts;
5. Valuation of the impacts; and
6. Description of uncertainties (in CAFE, with specific reference to their effect on the balance of the costs of pollution control quantified by the RAINS model and their associated benefits).

The extent of quantification of impacts varies depending on the availability of data and models:

1. For health impacts, damage to crops and damage to building materials, it is generally possible to quantify the impacts including their values. Uncertainties can be addressed using statistical methods and sensitivity analysis.
2. For damage to ecosystems and cultural heritage, it is possible to quantify the impacts relative to a measure of risk. However, it is not possible to value these impacts in the analysis in monetary terms. Examples of risk measures include:
    - The rate of deposition of acidifying pollutants relative to the critical load for acidification (as an indicator of the risk of acidification to biodiversity), and;
    - The rate of corrosion of building materials as an indicator of risks to historic monuments.
3. Other impacts may not currently be quantifiable in terms of impact or monetary value, permitting only a qualitative analysis. Examples include reduced visibility from air pollution and the social dimensions of health impacts.

Given the limits to quantification an 'extended CBA' has been developed within the project. The purpose is to provide a complete picture of whether the effects that have not been valued or quantified could have a significant effect on the balance of cost and benefits. For each impact a data sheet has been prepared containing the following types of information:

- Definition of impact
- Knowledge of the link to air pollution
- Distribution of impacts across Europe
- Contextual information on the scale of associated economic effects
- Consideration of whether the impact seems likely to be important so far as the CAFE programme is concerned, with justification for conclusions reached.

Assessing the benefits of reduced air pollution on human health

Earlier cost-benefit analysis (e.g. for the European Commission and US EPA) using similar techniques as used here has shown that health impacts generate the largest quantified monetary benefits when air pollution is reduced. The pollutants of most concern are fine particles and ground level ozone both of which occur naturally in the atmosphere. Fine particle concentration is increased close to ground level by direct emissions of 'primary' particles, and indirectly through the release of gaseous pollutants (especially SO_2, NO_x and NH_3) that react in the atmosphere to form 'secondary' particles such as ammonium sulphate and nitrate. Ozone concentrations close to ground level are increased by anthropogenic emissions, particularly of VOCs and NO_x, though the relationship between these pollutants is complex.

The quantification of health impacts addresses both long-term (chronic) and short-term (acute) exposures and deals with both mortality (i.e. deaths) and morbidity (i.e. illness). The mortality effects quantified in the CAFE cost-benefit analysis include impacts on infants as well as adults. The morbidity effects that can be quantified include major effects, such as hospital admissions and the development of chronic respiratory disease. They also include some less serious effects, affecting a much greater number of people. Examples of these are changes in the frequency of use of medicine to control asthma, and restrictions to normal activity. When the impact and the values are combined in the analysis, the most important health related issues relate to mortality, restricted activity days and chronic bronchitis.

The impacts quantified in the health analysis are presented in the table below.

Table 3. Core Health Analysis in the CAFE CBA.

End point	End point output	Pollutant
Acute Mortality	Premature deaths	O_3
Respiratory hospital admissions	Cases	O_3
Minor Restricted Activity Days (MRADs)	Days	O_3
Respiratory medication Use (Children)	Days	O_3
Respiratory medication Use (Adults)	Days	O_3
Cough and LRS (children)	Days	O_3
Chronic mortality *	Life years lost OR Premature deaths	PM
Infant mortality	Premature deaths	PM
Chronic bronchitis	Cases	PM
Respiratory hospital admissions	Cases	PM
Cardiac hospital admissions	Cases	PM
Restricted activity days (RADs)	Days	PM
Respiratory medication Use (children)	Days	PM
Respiratory medication Use (adults)	Days	PM
LRS (including cough) among children	Days	PM
LRS among adults with chronic symptoms	Days	PM

It is to be noted from the table that two approaches are used for quantifying chronic mortality impacts, generating alternate metrics of premature deaths and years of life lost (YOLL). It is stressed that they are alternative measures and hence are not additive. This is discussed further below.

Major advances have been made in health valuation in recent years. The latest European willingness to pay estimates[5] have been included in the CAFE CBA methodology. Thus, we adopt the most up-to-date information for a range of morbidity effects and mortality developed in a context relevant to air pollution.

Guidance from WHO, as adopted also for the RAINS model and consistent with our own long-established practice, recommends that chronic mortality effects be expressed principally in terms of change in longevity. Following from this, it is logical to seek to value chronic mortality impacts in terms of the change in longevity aggregated across the population, necessitating the use of the value of a life year (VOLY) concept.

For the CAFE CBA methodology, the independent external peer reviewers and several other stakeholders suggested that both the VSL and the VOLY approaches be used to show transparently the inherent uncertainty that is attached to these two approaches. For this

[5] See NexExt (2004): New Elements for the Assessment of External Costs from Energy Technologies Project Report for European Commission DG Research, Brussels, Belgium. Contract no.NNE5-2000-00045.

reason, in addition to the quantification of life years lost, we also quantify premature mortality benefits based on the cohort studies in terms of 'premature attributable deaths', valued using the Value of a Statistical Life (VSL).

The NewExt study presented both a mean and median estimates for the VSL and VOLY. Both are considered here. Altogether, this leads to the following range of starting values for mortality assessment.

Table 4. Values for use in CAFE CBA: Effects of chronic exposure on mortality.

	VSL	VOLY	Derived from:
Median (NewExt)	€980,000	€52,000	Median value
Mean (NewExt)	€2,000,000	€120,000	Mean value

In contrast, for infant mortality, we apply only the VSL.

The actual difference in mortality damage quantified using VOLY and VSL-based methods is not as great as the above table might suggest. Much of the difference between VSL and VOLY is cancelled out by the difference between the number of premature deaths quantified compared to the number of life years lost. This issue is addressed in greater depth in Volume 3 of the CBA Methodology Report. The following figure demonstrates that there is significant overlap in the damage function (combining incidence rate, response function and valuation) in the distributions derived from the VSL and VOLY methods.

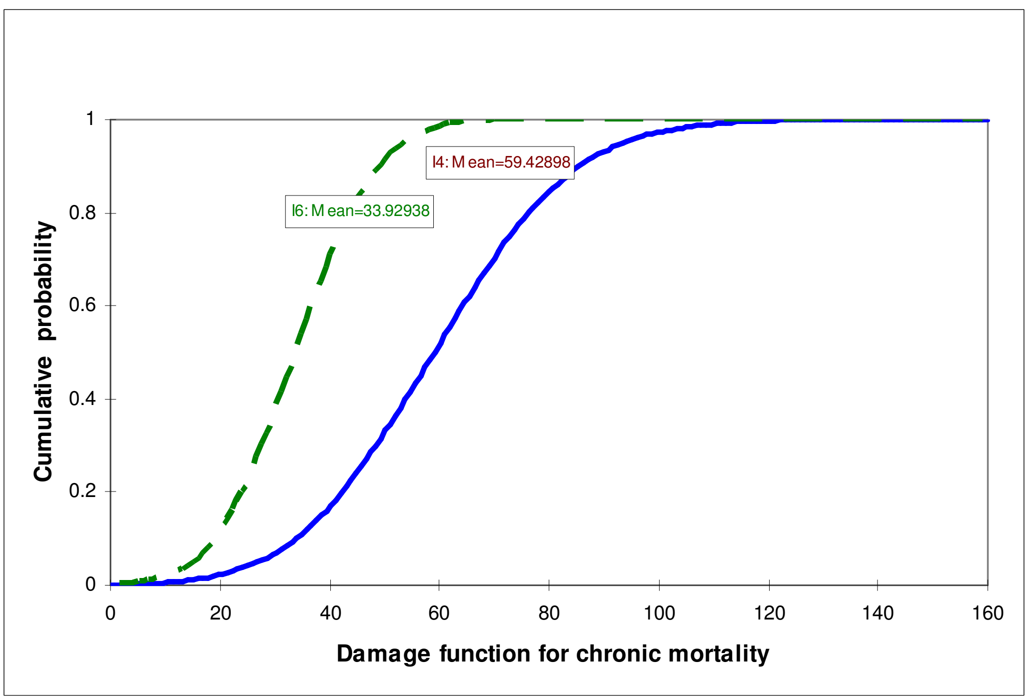

Figure 4. Probability distributions of damage factors for quantification of chronic mortality impacts of $PM_{2.5}$ using the YOLL/median VOLY approach (dashed green line) and the deaths/median VSL approach (blue line).

For acute mortality from ozone, the analysis quantifies the number of 'premature deaths' (deaths brought forward)[6]. These cases are valued using a VOLY approach, assuming that on average, each premature deaths leads to the loss of 12 months of life. The range for the VOLY is therefore applied to these impacts.

All morbidity estimates are expressed as a single estimate in the results presented in this report.

Assessing the benefits of reduced air pollution on environment

Agricultural and horticultural production
Ozone is recognised as the most serious regional air pollution problem for the agricultural sector in Europe. The development of methods for quantification in this area has been informed particularly by the Integrated Cooperative Programme (ICP) on Vegetation, and ICP/MM (Mapping and Modelling). The approach quantifies direct effects of ozone on yield. This uses information on stock at risk, in terms of the distribution of crop production, by species, across Europe, exposure-response functions for different crops, recognising the variability in response between species, and valuation data. Account has also been taken of variations in growing season across Europe and of crop height.

The response functions used here are based on the AOT40 metric. Future analysis will integrate the use of flux based functions as soon as this is possible. It is accepted that many European experts are not in favour of quantification based on AOT40 based functions. The view of the CBA-team is that the uncertainty associated with the use of AOT40 functions is less than the uncertainty associated with the alternative, which would be a lack of quantification of crop losses. It would seem likely, however, that results at the European level are more robust than those for individual Member States. [This applies to other effects also, such as health impacts, though for different reasons, for example relating to variability of background incidence rates for disease.]

Materials
The methods for quantification of damage to materials follow work carried out by the Europe-wide ICP Materials and quantification under various studies for DG Research, particularly ExternE and associated projects such as GARP (Green Accounting Research Project). The most significant impacts are those on natural stone and zinc coated materials. The 'impact pathway' approach works well for those applications that are used in every day life. This could in theory be applied to cultural and historic buildings also, though in practice there is a lack of data at several points in the impact pathway with respect to the stock at risk and valuation. As a result, effects of air pollution on cultural heritage cannot be quantified and thus are addressed qualitatively through the extended CBA framework.

Ecosystems
The effects of acidification, eutrophication and ground level ozone can be expressed in general terms as ranging from loss of species (e.g. trout and salmon from rivers and lakes in northern Europe) to more subtle effects, for example the relative abundance of different

[6] This is to signify that people whose deaths are brought forward by higher air pollution almost certainly have serious pre-existing cardio-respiratory disease and so in at least some of these cases, the actual loss of life is likely to be small – the death might have occurred within the same year and, for some, may only be brought forward by a few days.

species in grassland, moorland and other ecosystems. Stock at risk data for ecosystem impacts have been collated over a period of many years through the Coordination Center for Effects in the Netherlands. A modelling framework for describing exceedance of critical loads and levels is included within the RAINS model. Maps generated by RAINS are reproduced here to provide a comprehensive pattern of benefits. Valuation of these impacts is not yet possible because of limited research in this area that has specific relevance to reductions in air pollutant emissions. Thus, the effects of reduced air pollution on ecosystems are covered by the extended CBA.

Summary Results – Health Impacts

The first set of tables shows the totals for each of the 'core' set of health impacts for the EU25. Full listings by member state are included in the Appendix. The study has also collated values for the European Economic Area, other accession candidate countries (Bulgaria, Croatia, Romania, and Turkey), though these are not presented here.

The analysis presents estimated total health impacts across the EU25 for the years 2000 and the CAFE Baseline for 2020. All are based on 1997 meteorological data (see Figure 1 and Figure 2 for information on the variability of exposure across Member States according to the meteorological year selected for the analysis). The analysis has also presented the difference between the 2020 and 2000 baselines, i.e. the benefits of current policies.

As detailed in the previous section, the impacts are split into mortality (i.e. premature deaths) and morbidity (i.e. illness) by pollutant (PM and ozone). The quantification of health impacts addresses the impacts related to both long-term (chronic) and short-term (acute) exposures. The analysis includes impacts on $PM_{2.5}$ (anthropogenic – excluding PM from natural sources and for secondary organic aerosols) and ozone (using the metric SOMO35 – the sum of the daily maximum 8-hour mean ozone concentration with a cut-off at 35 ppb[7]).

The results show the number of events that happen in each year (i.e. the annual number of impacts or new cases[8]), or the change in the number of impacts and cases over time.

As outlined in the previous section, two alternative approaches are used for chronic mortality, to derive years of life lost and premature deaths. These two estimates should <u>not</u> be added.

Analysis of baseline results

The results are shown in Table 5. This presents the total numbers of impacts with baseline pollution concentrations in 2000 and 2020. It also shows the change in impacts between 2000 and 2020, i.e. the expected health benefits from all current legislation. All values are for the E25. The way that the change in a number of key health impacts is spread across the EU25 is shown in the maps that follow.

For the analysis here, the analysis has used the RAINS model for PM concentration data, and the EMEP model for other pollutants (including effects on ecosystems), based on the latest model runs (March 2005). Results differ to those in the earlier baseline reports because of differences in the modelling, relating to inclusion of urban PM increments based on CITY-DELTA and inclusion of the PM25_H2O component. This modelling is consistent with other information presented on the baseline scenarios under the CAFE programme.

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[7] This means that for days with ozone concentration above 35 ppb as maximum 8-hour mean, only the increment exceeding 35 ppb is used to calculate effects. No effects of ozone on health are calculated on days below 35 ppb as maximum 8-hour mean. It is likely that the overall effects of ozone on mortality are underestimated by this approach.

[8] For chronic mortality, this involves a different metric to the output from the RAINS model, which works with the change in years of life lost from sustained pollution levels over 80 years, i.e. it works with a total 'stock' concept, rather than an annualised metric.

Table 5. Implementing current EU legislation: Estimated annual health impacts due to air pollution in 2000 and in 2020 in EU25, plus the change (benefits) from current legislation (2000 to 2020)

End point	End point output	Function Group		Baseline in 2000	Current legislation in 2020 (including Climate Policy)	Difference from 2000 to 2020
Acute Mortality (All ages)	Premature deaths	Core	O_3	21,400	20,800	600
Respiratory Hospital Admissions (65yr +)	Cases	Core	O_3	14,000	20,100	-6,100
Minor Restricted Activity Days (MRADs 15-64yr)	Days	Core	O_3	53,913,600	42,415,500	11,498,100
Respiratory medication use (children 5-14yr)	Days	Core	O_3	21,355,900	12,925,900	8,430,000
Respiratory medication use (adults 20yr +)	Days	Core	O_3	8,833,600	8,171,700	661,900
Cough and LRS (children 0-14yr)	Days	Core	O_3	108,076,600	65,278,600	42,798,000
Chronic Mortality *	Life years lost	Core	PM	3,618,700	2,467,300	1,151,400
Chronic Mortality *	Premature deaths	Core	PM	347,900	271,600	76,300
Infant Mortality (0-1yr)	Premature deaths	Core	PM	677	352	325
Chronic Bronchitis (27yr +)	Cases	Core	PM	163,800	128,100	35,700
Respiratory Hospital Admissions (All ages)	Cases	Core	PM	62,000	42,300	19,700
Cardiac Hospital Admissions (All ages)	Cases	Core	PM	38,300	26,100	12,200
Restricted Activity Days (RADs 15-64yr)	Days	Core	PM	347,687,000	221,999,100	125,687,900
Respiratory medication use (children 5-14yr)	Days	Core	PM	4,218,500	1,987,700	2,230,800
Respiratory medication use (adults 20yr +)	Days	Core	PM	27,741,700	20,879,800	6,861,900
LRS symptom days (children 5-14yr)	Days	Core	PM	192,756,400	88,852,300	103,904,100
LRS in adults (15yr +) with chronic symptoms	Days	Core	PM	285,345,000	207,562,100	77,782,900

*Note two alternative metrics are used for the presentation of chronic mortality from PM. Firstly in terms of years of life lost and secondly in terms of numbers of premature deaths. These are not additive.

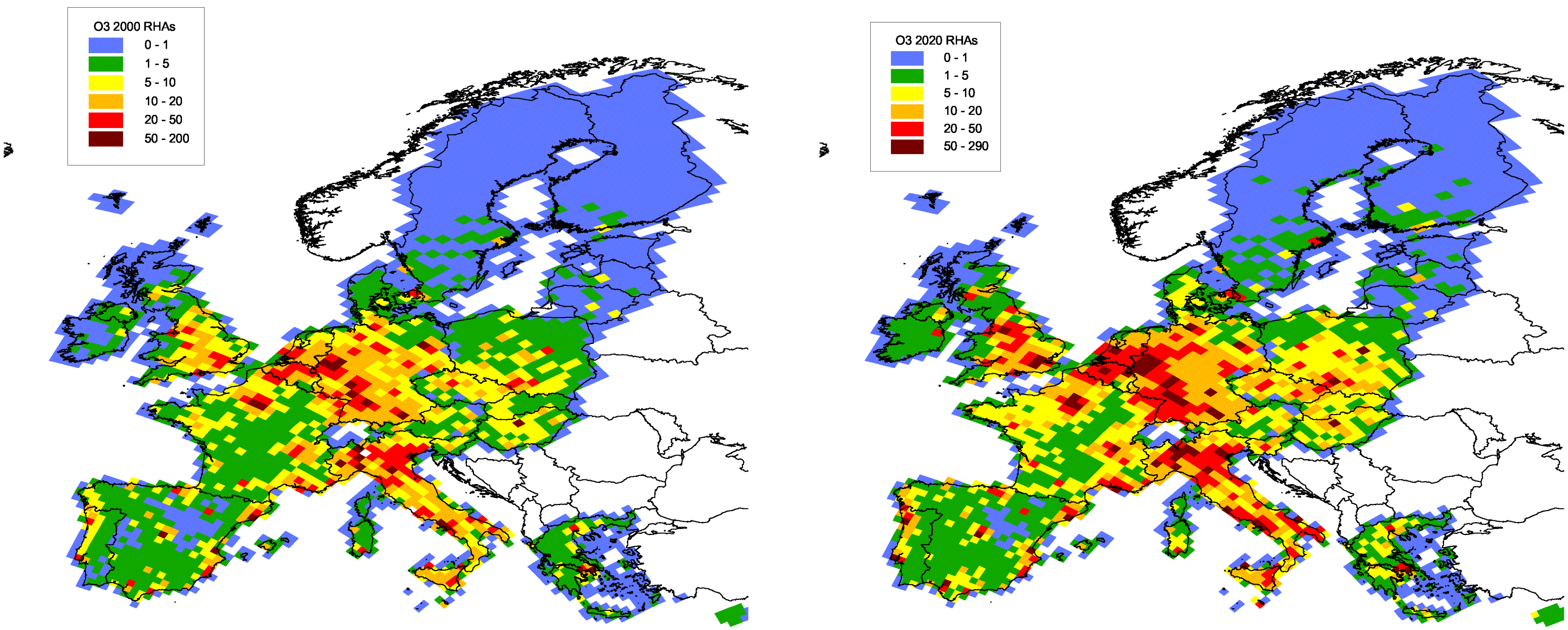


Figure 5. Estimated Numbers of Respiratory Hospital Admissions from Ozone across EU25 in 2000 and 2020.

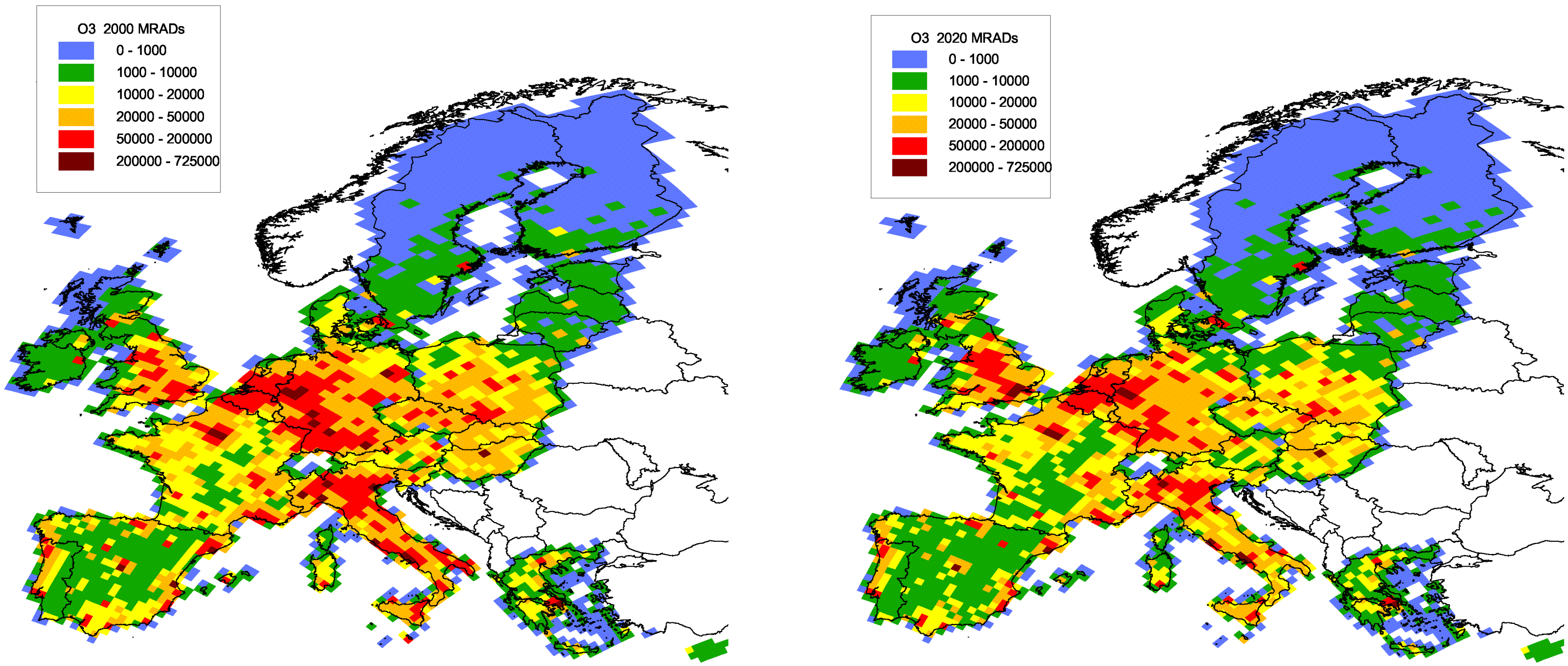


Figure 6. Estimated Numbers of Minor Restricted Activity Days from Ozone across EU25 in 2000 and 2020.

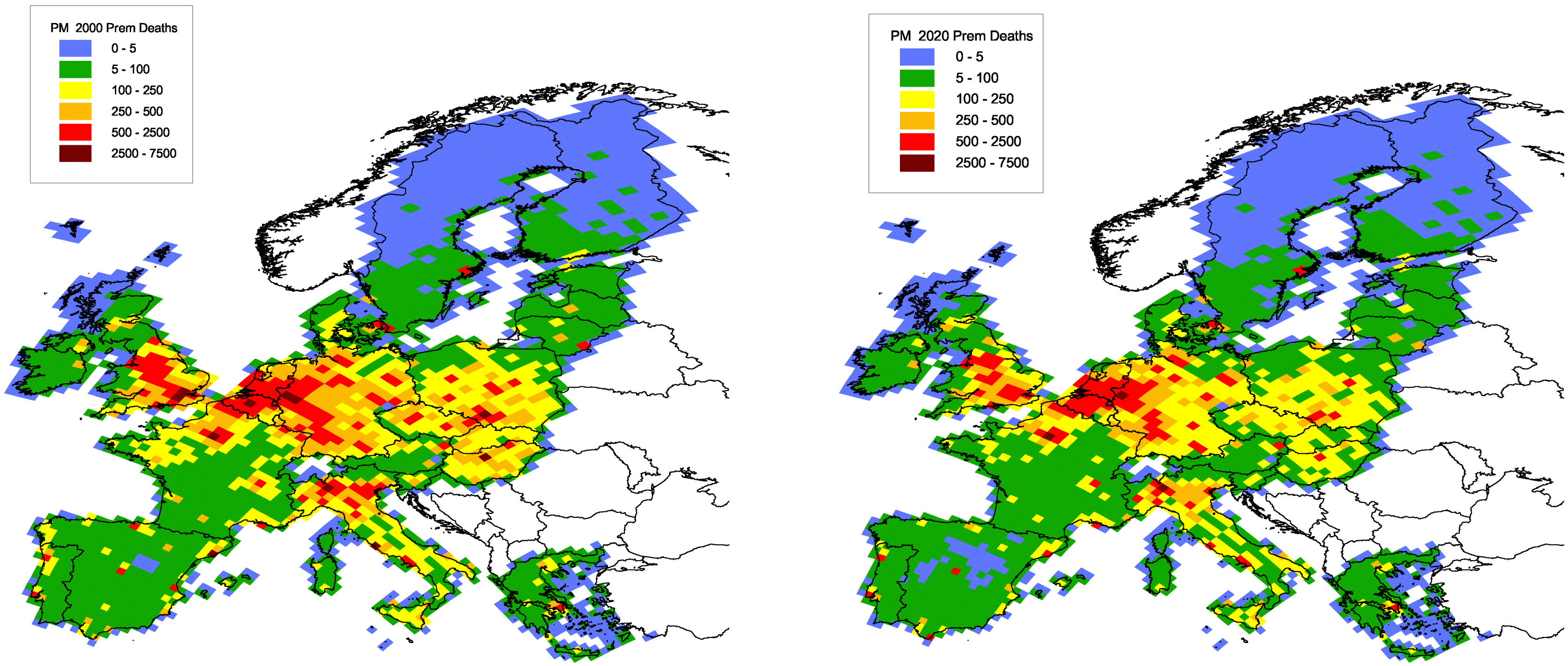


Figure 7. Estimated Numbers of Premature Deaths from PM across EU25 in 2000 and 2020.

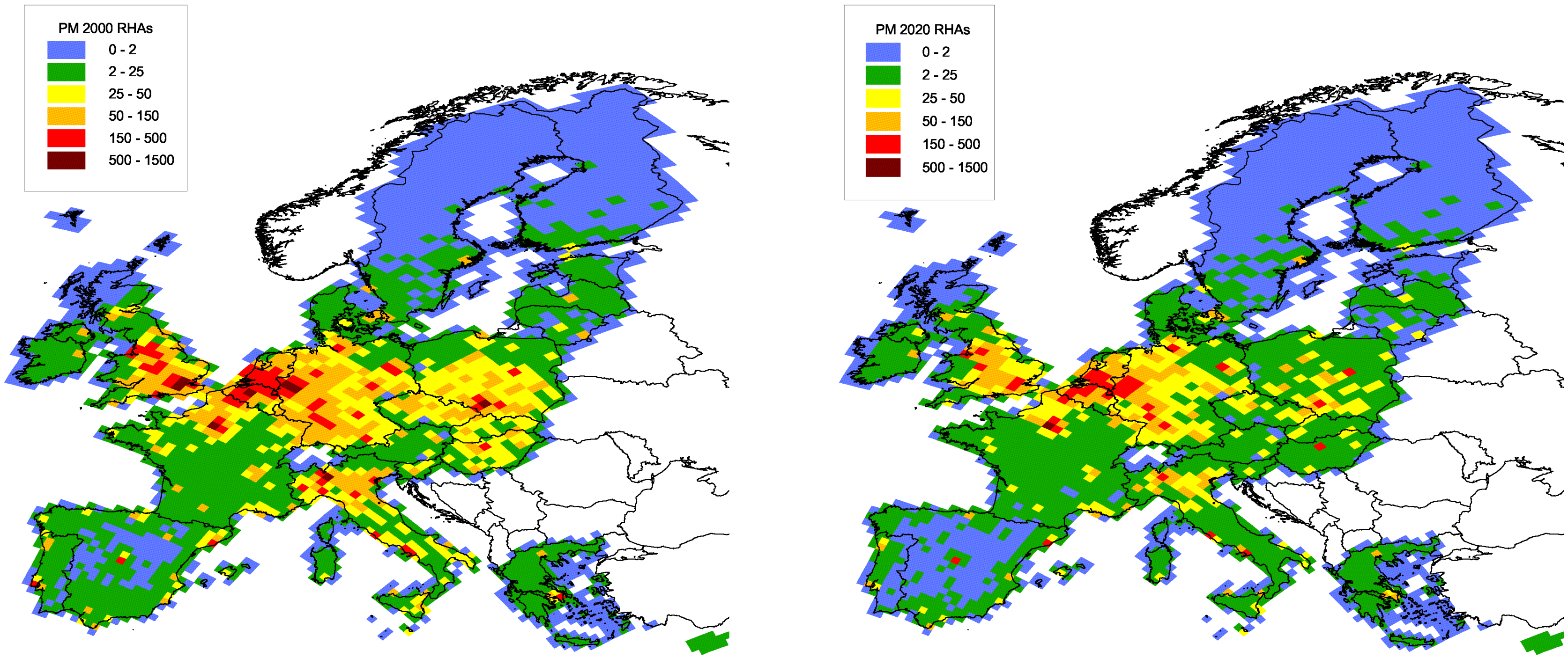


Figure 8. Estimated Numbers of Respiratory Hospital Admissions from PM across EU25 in 2000 and 2020.

Discussion of impacts

Ozone concentrations: Annual impacts across the EU 25 are estimated at some 21 000 deaths brought forward in the year 2000. However, ozone also leads to much larger numbers of estimated morbidity health impacts, with tens of millions of minor restricted activity days and respiratory medication use days each year. These are clearly less serious effects at the level of the affected individual, but they affect a much greater number of people. There are some improvements in the levels of impacts over time (from 2000 to 2020) from ozone pollution across the EU25, but this is relatively modest. The improvement seen over the time period is lower for mortality than for morbidity, due to the change in the baseline population – essentially the analysis updates population and age profiles for future years, and this leads to a significant increase in the number of older people. As the methodology considers the change in baseline death rates improvements in pollution are partially offset by an older population. This effect is also seen for respiratory hospital admissions – which actually increase over the period 2000 – 2020. Again the reason is due to the ageing population, as this impact is only quantified in those aged 65 and over.

PM concentrations: Annual impacts across the EU 25 are estimated at some 3.7 million years of life lost each year (based on the year 2000) – this can also be expressed as 348 000 estimated premature deaths. These results are consistent with the RAINS model, which calculates the total (not annual) change in life years. PM also leads to an estimated additional 700 premature deaths each year amongst infants aged between 1 month and 1 year in 2000. Clearly, these results indicate that PM concentrations have a much more important effect than ozone with respect to mortality. In addition, PM leads to larger numbers of annual morbidity effects than ozone. The estimated morbidity effects of PM range from around 100 000 cases of respiratory and cardiac hospital admissions (in the year 2000) to much larger numbers of less serious effects, for example some 30 million respiratory medication use days, and several hundred million restricted activity days each year. The values obtained have been compared against previous studies (see box below) and show consistency when the differences in methodology are taken into account. For PM, there are significant reductions in annual impacts over the period 2000 to 2020, with generally a 30 – 40% reduction in impacts over the period (the change in benefits varies according to the population group affected).

The numbers of impacts have also been compared against other risks. Data from Eurostat[9] indicates fatalities from road traffic accidents in the EU15 are 140 deaths per million population (1998), compared to a value for deaths from air pollution calculated in Table 5 (based on 375 000 deaths per year) of 830 deaths per million population (EU25). However, fatalities in transport accidents are the most common cause of death for persons aged under 40. Compared with normal life expectancy, a fatal road traffic accident represents on average 40 years of life lost[10].

[9] Eurostat. Health statistics: Key data on health 2002. Luxembourg: Office for Official Publications of the European Communities, 2002. ISBN 92-894-3730-8
[10] Corresponding losses are 10.5 years for cancer deaths and 9.7 years for deaths from cardiovascular deaths.

Comparing the baseline impacts to other studies

Lately two studies have estimated of the mortality effects of chronic exposure to fine particles. Firstly, Ezzati et al (2002), which contributed to the WHO Global Burden of Disease Project. Ezzati et al. report European impacts in 51 countries to be equal to 107,000 premature deaths and 725,000 years of life lost[11]. Secondly, Künzli et al (2000) estimated that air pollution caused 40,000 premature deaths in three countries. Künzli et al rate is double that of the Ezzati et al when expressed per capita[12] terms. The CAFE CBA health results provide a similar per capita rate Künzli et al.

The CAFE CBA team has discussed with the authors of the Ezzati et al study in order to double check the numbers and to understand the differences. There are several reasons for the CAFE CBA results being higher than Ezzati et al.:

- The population addressed by CAFE CBA consists of the total population (based on the advice of the WHO Task Force on Health Assessment), while Ezzati et al. included only urban air pollution in cities having more than 100,000 people. Thus, for example, for the WHO Region EUR-A (comprising mainly EU25), Ezzati et al. considered impacts on only 80 million people while the EU25 comprises 450 million people. Thus, there is some 4-5 fold difference due to the different populations considered.
- Both Ezzati et al and CAFE CBA use coefficients from Pope et al. (2002). CAFE CBA uses an estimate of 6% change in all-cause mortality hazards per 10µg/m^3 $PM_{2.5}$ following from the recommendations made by the working group established by WHO. On the other hand, Ezzati et al apply cause-specific results equivalent to a 4% change in all-cause mortality.
- The conversion factor of 0.5 used by Ezzati et al to convert PM_{10} to $PM_{2.5}$ also appears conservative from a European perspective. CAFE (and Ezzati et al sensitivity analysis for Europe) uses a factor of 0.65 where necessary, based on observations from various sources in Europe and North America.

There are also differences in the range over which the two studies quantify effects of particles:

- The Ezzati et al analysis only quantifies beyond 15µg/m^3 PM_{10}, taken as equivalent to 7.5µg/m^3 $PM_{2.5}$. CAFE CBA does not quantify with a cut-off point. However, the RAINS outputs include only <u>anthropogenic</u> contributions to $PM_{2.5}$ concentrations and excludes also secondary organic aerosols. The net effect of this difference on the Ezzati et al and CAFE CBA results is ambiguous.
- The use of an upper bound concentration of 50 µg/m^3 $PM_{2.5}$ by Ezzati et al probably has very little effect on the comparison of results with CAFE CBA.

[11] Ezzati et al (2002) describe the 725,000 figure in units of DALYs (Disability Adjusted Life Years), but is understood that the units for this number should be years of life lost. The corresponding DALY estimate is 849,000.

[12] Expressing results per head of population highlights differences in method, as opposed to differences in the population considered in the analysis.

Summary Results – Health Valuation

The health impacts and benefits outlined above have been expressed in monetary terms, using the approach outlined in the CAFE CBA methodology.

Strictly speaking, the CAFE CBA methodology is only applicable for assessing the changes between scenarios, i.e. marginal policy changes. However, we have estimated the total monetary damage from health impacts for the baseline, as an illustration of the level of economic importance. The methodology is described in full in Volume 2 of the Methodology reports. Values are presented for the EU25. Full listings by member state are included in the appendix.

As outlined in the earlier methodology section, there are two methods that can be used for the valuation of chronic mortality – the value of statistical life (VSL, applied to the change in number of deaths) and value of life year (VOLY, applied to changes in life expectancy). For the CAFE CBA methodology, the independent external peer reviewers and several stakeholders suggested that both the VSL and the VOLY approaches be used, to show transparently the variation in results arising from use of these two approaches. It was noted above that despite major differences in the unit valuations, there is significant overlap in the ranges of analysis based around use of the VOLY and VSL approaches.

For premature deaths from ozone, two alternative values are presented. This reflects the range in valuation for a year of life lost from the NewExt study based on the median and mean reported values. For chronic mortality, four alternative core scenarios are presented. This reflects the range from the two quantification approaches (years of life lost and VOLYs - and premature deaths and the VSL) and the range of mean and median values from the NewExt study for each of these approaches.

Analysis of baseline results

The results are shown below. Table 6 presents the total damages with baseline pollution concentration, and the change in the 2020 baseline over 2000. All values are for the EU25. Results here are about 25% higher than those given in the draft final version of this report (January 2005) for reasons described earlier.

Table 6. Implementing current EU legislation: Valuation of the annual health damage due to air pollution in 2000 and in 2020 in EU25 (€Million)

Morbidity

End point	End point	Function	Poll.	Baseline in 2000	Current legislation in 2020 (including Climate Policy)	Difference from 2000 to 2020
Respiratory hospital admissions	Cases	Core	O_3	28	40	-12
Minor Restricted Activity Days (MRADs)	Days	Core	O_3	2071	1629	442
Respiratory medication Use (Children)	Days	Core	O_3	20	12	8
Respiratory medication Use (Adults)	Days	Core	O_3	8	8	1
Cough and LRS (children)	Days	Core	O_3	4152	2508	1644
Total O_3 morbidity				**6280**	**4197**	**2082**
Chronic bronchitis	Cases	Core	PM	30687	24011	6677
Respiratory hospital admissions	Cases	Core	PM	124	85	40
Cardiac hospital admissions	Cases	Core	PM	77	52	24
Restricted activity days (RADs)	Days	Core	PM	28997	18515	10482
Respiratory medication Use (children)	Days	Core	PM	4	2	2
Respiratory medication Use (adults)	Days	Core	PM	26	20	6
LRS (including cough) among children	Days	Core	PM	7405	3413	3992
LRS in adults with chronic symptoms	Days	Core	PM	10962	7974	2988
Total PM morbidity				**78283**	**54071**	**24211**
TOTAL MORBIDITY BENEFITS				**84562**	**58269**	**26294**

Table 6. Implementing current EU legislation: Valuation of annual health damage from air pollution 2000 to 2020 in EU25 (€Million) Continued

End point MORTALITY	End point output	Function Group		Baseline in 2000	Current legislation in 2020 (inc CP.)	Difference from 2000 to 2020
Acute Mortality ***(VOLY median)****	Premature deaths	Core	O_3	1119	1085	34
Acute Mortality ***(VOLY mean*)***	Premature deaths	Core	O_3	2512	2435	77
Total Ozone Mortality						
VOLY median*				**1119**	**1085**	**34**
VOLY mean*				**2512**	**2435**	**77**
Chronic Mortality ***(VOLY median)****	Life years lost	Core	PM	189203	129000	60203
Chronic Mortality ***(VOLY mean*)***	Life years lost	Core	PM	424690	289556	135134
Chronic Mortality ***(VSL median)****	Premature deaths	Core	PM	340670	265965	74706
Chronic Mortality ***(VSL mean*)***	Premature deaths	Core	PM	700901	547200	153701
Infant Mortality (0-1yr) ***(VSL median)****	Premature deaths	Core	PM	952	495	457
Infant Mortality (0-1yr) ***(VSL mean*)***	Premature deaths	Core	PM	1903	990	914
Total PM Mortality						
VOLY median*				**190155**	**129495**	**60660**
VOLY mean*				**426593**	**290546**	**136048**
VSL median*				**341622**	**266459**	**75162**
VSL mean*				**702804**	**548190**	**154614**
TOTAL Mortality						
VOLY median*				**191274**	**130580**	**60694**
VOLY mean*				**429105**	**292981**	**136124**
VSL median*				**342741**	**267544**	**75197**
VSL mean*				**705316**	**550625**	**154691**

Note for acute mortality (O_3), two alternative values are presented, based on a range reflecting the median and mean values for VOLY from the NewExt study. For chronic mortality (PM), four alternative values are presented, based on quantification using years of life lost (using the median and mean YOLL value from NewExt) and numbers of premature deaths (using the median and mean VSL value from NewExt) . These are not additive

Table 6. Implementing current EU legislation: Valuation of annual health damage from air pollution 2000 to 2020 in EU25 (€Million) Continued

All Health

End point	End point		.	Baseline in 2000	Current legislation in 2020 (including Climate Policy)	Difference from 2000 to 2020
TOTAL OZONE						
VOLY median*				**7399**	**5282**	**2116**
VOLY mean*				**8791**	**6633**	**2159**
TOTAL PM						
VOLY median*				**268438**	**183566**	**84872**
VOLY mean*				**504876**	**344617**	**160259**
VSL median*				**419904**	**320531**	**99374**
VSL mean*				**781086**	**602261**	**178826**
TOTAL HEALTH						
VOLY median*				**275836**	**188848**	**86988**
VOLY mean*				**513667**	**351250**	**162418**
VSL median*				**427303**	**325813**	**101490**
VSL mean*				**789878**	**608893**	**180984**

Note for acute mortality (O_3), two alternative values are presented, based on a range reflecting the median and mean values for VOLY from the NewExt study. For chronic mortality (PM), four alternative values are presented, based on quantification using years of life lost (using the median and mean YOLL value from NewExt) and numbers of premature deaths (using the median and mean VSL value from NewExt) . These are not additive

The total damages, by pollutant and impact category, are summarised in the figure below. This shows that health impacts of air pollution are dominated by PM mortality, although PM related morbidity is also significant. The most important effects (in economic terms) for PM related morbidity are restricted activity days and new incidence of chronic bronchitis.

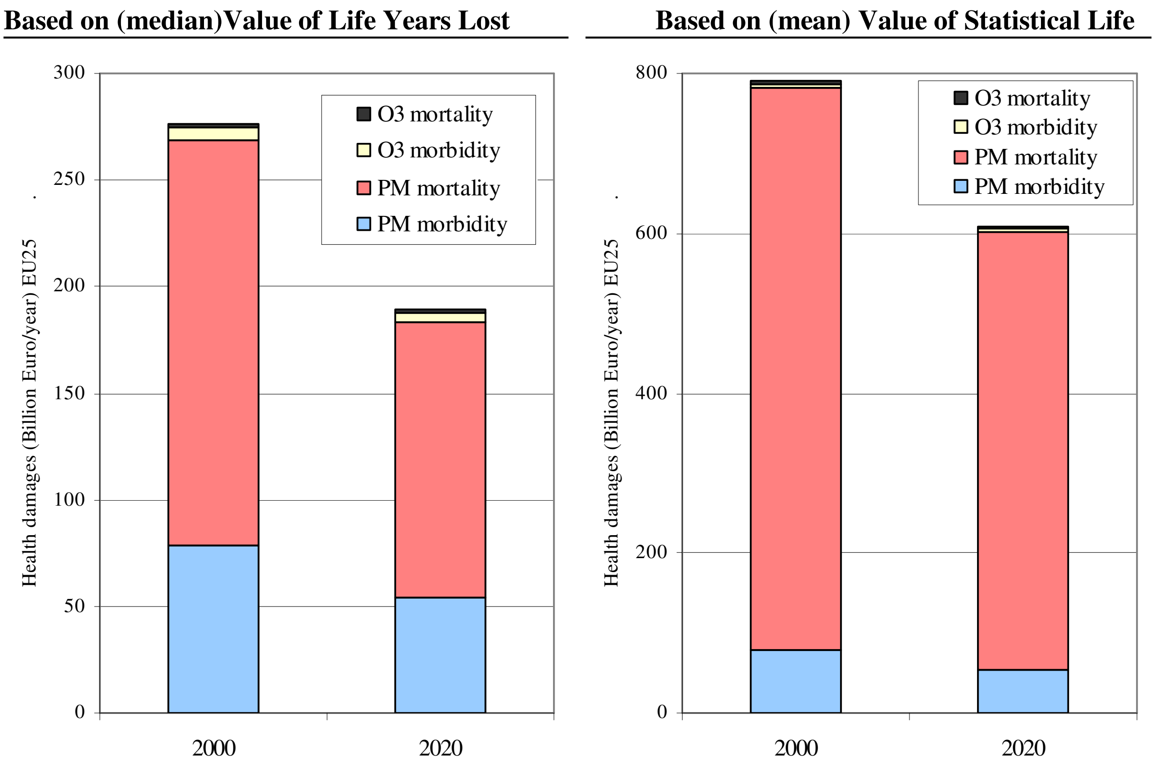


Figure 9. Estimated health damages of air pollution in EU 25 - left with VOLY – right with VSL – Note different scales

The total damage costs can be compared to current economic indicators. EU25 GDP at market prices in 2000 was Euro 8,947,008 million (~9000 billion). The estimated health damage for 2000 (in Table 6) corresponds to 3% to 9% of this value (based on the range from the low and high value).

The analysis of the benefits of current policies (table 8) shows that the estimated benefit of implementing current legislation up to 2020 is valued at between €87 billion to €181 billion per year.

The total health effects, in monetary terms, by country, are listed in the tables below. The range reflects the approach to quantification and valuation for mortality (see above).

Table 7. Implementing current EU legislation: Valuation of estimated health impacts due to air pollution in 2000 by Member State (€million)

Year 2000 baseline

	€million/year			
	VOLY median*	**VOLY mean***	**VSL median***	**VSL mean***
Austria	4573	8477	6850	12582
Belgium	10301	19298	15726	29115
Cyprus	267	491	317	561
Czech Republic	6911	12867	11055	20505
Denmark	2334	4349	3930	7331
Estonia	405	757	740	1395
Finland	1046	1953	1568	2892
France	36733	68451	52733	96650
Germany	57741	107417	91643	169760
Greece	5513	10215	8863	16410
Hungary	7928	14784	15087	28493
Ireland	1109	2071	1485	2702
Italy	38578	71409	62183	115102
Latvia	1253	2343	1687	3073
Lithuania	1108	2074	2490	4774
Luxembourg	310	579	411	746
Malta	205	378	256	457
Netherlands	13853	25910	19443	35610
Poland	26909	50321	40442	74675
Portugal	3784	7025	6152	11418
Slovakia	3577	6669	5280	9713
Slovenia	1333	2473	1975	3625
Spain	16839	31155	25008	45838
Sweden	2506	4669	3997	7414
United Kingdom	30720	57532	47980	89040
EU-25	**275836**	**513667**	**427303**	**789878**

Note for acute mortality (O_3), two alternative values are presented, based on a range reflecting the median and mean values for VOLY from the NewExt study. For chronic mortality (PM), four alternative values are presented, based on quantification using years of life lost (using the median and mean YOLL value from NewExt) and numbers of premature deaths (using the median and mean VSL value from NewExt) . These are not additive

Table 8. Implementing current EU legislation: Valuation of estimated health impacts of air pollution in 2020 by Member State (€million)

Year 2020 baseline

	€million/year			
	VOLY median*	**VOLY mean***	**VSL median***	**VSL mean***
Austria	3317	6153	5556	10339
Belgium	7127	13347	11988	22421
Cyprus	266	489	355	638
Czech Republic	4368	8107	7707	14420
Denmark	1799	3366	3226	6068
Estonia	245	455	476	899
Finland	874	1638	1493	2798
France	26870	50115	42425	78661
Germany	40583	75805	73844	138991
Greece	4249	7853	8169	15384
Hungary	5044	9357	9853	18611
Ireland	890	1642	1237	2244
Italy	22993	42594	44629	84213
Latvia	804	1489	1154	2107
Lithuania	766	1427	1887	3634
Luxembourg	278	518	367	664
Malta	161	299	254	469
Netherlands	10421	19546	16813	31333
Poland	18019	33346	30185	56092
Portugal	2391	4401	4271	7972
Slovakia	2536	4685	4148	7683
Slovenia	855	1582	1532	2867
Spain	9957	18253	17312	32162
Sweden	1906	3560	3213	6004
United Kingdom	22129	41224	33718	62221
EU-25	**188848**	**351250**	**325813**	**608893**

Note for acute mortality (O_3), two alternative values are presented, based on a range reflecting the median and mean values for VOLY from the NewExt study. For chronic mortality (PM), four alternative values are presented, based on quantification using years of life lost (using the median and mean YOLL value from NewExt) and numbers of premature deaths (using the median and mean VSL value from NewExt) . These are not additive

Table 9. Implementing current EU legislation: Valuation of changes in health impacts due to air pollution between 2000 and 2020, by Member State (€million)

Difference between 2000 and 2020 baseline

	€million/year			
	VOLY median*	VOLY mean*	VSL median*	VSL mean*
Austria	1256	2325	1294	2243
Belgium	3174	5951	3738	6694
Cyprus	1	2	-37	-77
Czech Republic	2543	4760	3348	6086
Denmark	535	983	704	1263
Estonia	160	303	264	496
Finland	173	315	75	94
France	9863	18336	10308	17988
Germany	17158	31611	17799	30769
Greece	1264	2362	695	1026
Hungary	2885	5428	5233	9882
Ireland	219	430	248	458
Italy	15586	28815	17555	30889
Latvia	449	854	533	965
Lithuania	341	647	603	1140
Luxembourg	32	61	44	82
Malta	43	79	1	-12
Netherlands	3432	6365	2630	4277
Poland	8890	16975	10256	18582
Portugal	1392	2624	1882	3446
Slovakia	1041	1984	1132	2031
Slovenia	478	891	444	759
Spain	6882	12903	7696	13676
Sweden	600	1108	784	1410
United Kingdom	8591	16307	14262	26819
EU-25	**86988**	**162418**	**101490**	**180984**

Note for acute mortality (O_3), two alternative values are presented, based on a range reflecting the median and mean values for VOLY from the NewExt study. For chronic mortality (PM), four alternative values are presented, based on quantification using years of life lost (using the median and mean YOLL value from NewExt) and numbers of premature deaths (using the median and mean VSL value from NewExt) . These are not additive

The difference between the 2000 and 2020 baseline is plotted on the figures below, showing the distribution of benefits by member state. They show that total damage from current pollution, and the benefits from current policies, are highest (in 2000) in France, Germany, Italy, the Netherlands, Poland and the UK. These countries stand out partly because of the high population in these countries and partly because of the size of the change in pollution levels in them.

An analysis has also been made of the damage per head of population, and the benefits from current policies (i.e. based on the change in impacts between 2000 and 2020), by member state. This is presented in the tables below, and in the subsequent figures. It shows a much more even distribution of benefits across member states, though there tend to be larger benefits in central European countries, and less in Scandinavia countries, reflecting the pollution concentrations experienced.

Across the EU25, the analysis shows that current policies from 2000 to 2020 are expected to lead to estimated health benefits of €191 and €397 per person per year (low and high estimate).

Table 10. Implementing current EU legislation: Valuation of estimated health impacts due to air pollution in 2000 by Member State (€ per person)

Year 2000 baseline

	€ per person per year			
	VOLY median*	**VOLY mean***	**VSL median***	**VSL mean***
Austria	564	1046	846	1553
Belgium	1005	1882	1534	2840
Cyprus	342	627	405	716
Czech Republic	673	1253	1077	1997
Denmark	439	817	738	1377
Estonia	296	554	542	1021
Finland	202	377	303	559
France	619	1154	889	1630
Germany	702	1305	1114	2063
Greece	506	937	813	1505
Hungary	792	1477	1507	2846
Ireland	290	542	389	707
Italy	671	1241	1081	2001
Latvia	528	988	711	1296
Lithuania	316	592	711	1363
Luxembourg	712	1327	943	1710
Malta	526	971	657	1175
Netherlands	872	1630	1223	2240
Poland	696	1301	1046	1931
Portugal	378	701	614	1140
Slovakia	664	1237	980	1802
Slovenia	670	1243	993	1822
Spain	413	764	614	1125
Sweden	283	527	451	837
United Kingdom	523	980	818	1517
EU-25	**610**	**1136**	**945**	**1747**

Note for acute mortality (O_3), two alternative values are presented, based on a range reflecting the median and mean values for VOLY from the NewExt study. For chronic mortality (PM), four alternative values are presented, based on quantification using years of life lost (using the median and mean YOLL value from NewExt) and numbers of premature deaths (using the median and mean VSL value from NewExt) . These are not additive

Table 11. Implementing current EU legislation: Valuation of estimated health impacts due to air pollution in 2020 by Member State (€ per person)

Year 2020 baseline

	€ per person per year			
	VOLY median*	**VOLY mean***	**VSL median***	**VSL mean***
Austria	413	767	692	1288
Belgium	679	1271	1142	2135
Cyprus	303	557	404	727
Czech Republic	439	814	774	1448
Denmark	329	617	591	1111
Estonia	224	417	436	824
Finland	165	309	282	528
France	423	788	667	1237
Germany	493	921	897	1689
Greece	392	724	754	1419
Hungary	555	1029	1084	2048
Ireland	196	361	272	493
Italy	424	785	822	1552
Latvia	410	759	588	1075
Lithuania	245	456	603	1161
Luxembourg	505	938	665	1203
Malta	388	718	611	1127
Netherlands	614	1152	991	1846
Poland	476	881	798	1482
Portugal	241	443	430	802
Slovakia	467	863	764	1415
Slovenia	451	834	808	1512
Spain	244	447	424	788
Sweden	211	394	356	665
United Kingdom	355	662	541	999
EU-25	**414**	**770**	**714**	**1335**

Note for acute mortality (O_3), two alternative values are presented, based on a range reflecting the median and mean values for VOLY from the NewExt study. For chronic mortality (PM), four alternative values are presented, based on quantification using years of life lost (using the median and mean YOLL value from NewExt) and numbers of premature deaths (using the median and mean VSL value from NewExt) . These are not additive

Table 12. Implementing current EU legislation: Valuation of annual health impacts of air pollution for the change from 2000 to 2020 by Member State (€ per person)

Difference between 2000 and 2020 baseline – benefits of current legislation

	€ per person per year			
	VOLY median*	**VOLY mean***	**VSL median***	**VSL mean***
Austria	156	290	161	280
Belgium	302	567	356	637
Cyprus	1	3	-43	-88
Czech Republic	255	478	336	611
Denmark	98	180	129	231
Estonia	147	278	242	454
Finland	33	60	14	18
France	155	288	162	283
Germany	208	384	216	374
Greece	117	218	64	95
Hungary	317	597	576	1087
Ireland	48	94	55	101
Italy	287	531	324	569
Latvia	229	436	272	492
Lithuania	109	207	193	364
Luxembourg	58	111	80	148
Malta	104	190	4	-29
Netherlands	202	375	155	252
Poland	235	449	271	491
Portugal	140	264	189	347
Slovakia	192	365	209	374
Slovenia	252	470	234	400
Spain	169	316	189	335
Sweden	66	123	87	156
United Kingdom	138	262	229	431
EU-25	**191**	**356**	**223**	**397**

Note for acute mortality (O_3), two alternative values are presented, based on a range reflecting the median and mean values for VOLY from the NewExt study. For chronic mortality (PM), four alternative values are presented, based on quantification using years of life lost (using the median and mean YOLL value from NewExt) and numbers of premature deaths (using the median and mean VSL value from NewExt) . These are not additive

Note the numbers take account of the change in population in each country over time.

Figure 10. Estimated impact of current legislation on health up to 2020 in Member States – Change from 2000 baseline to 2020 baseline (<u>LOW</u> – VOLY (Value of Life Years Lost – Median Value)) (€ million)

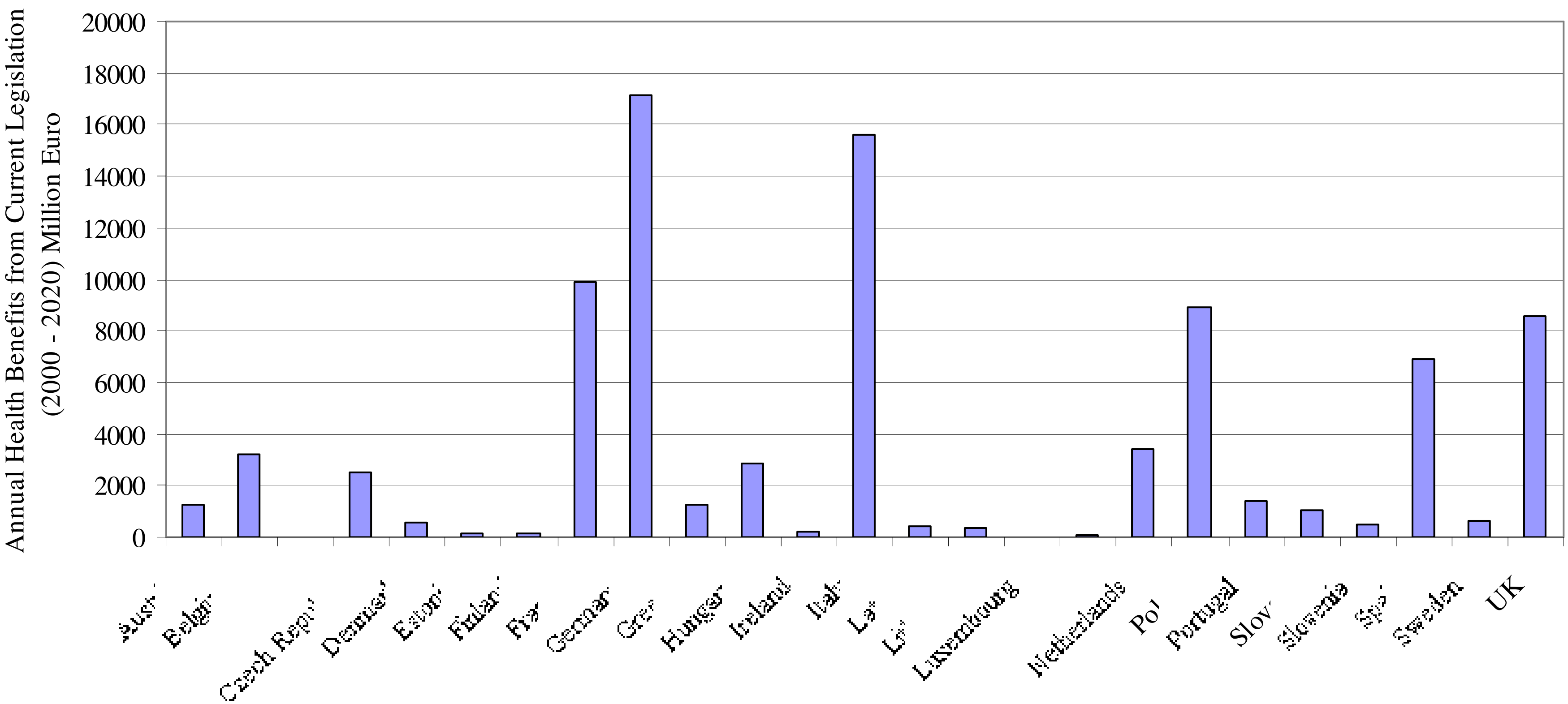


Figure 11. Estimated impact of current legislation on health up to 2020 in Member States – Change from 2000 baseline to 2020 baseline (<u>HIGH</u> – VSL (Value of Statistical Life – Mean Value)) (€ million)

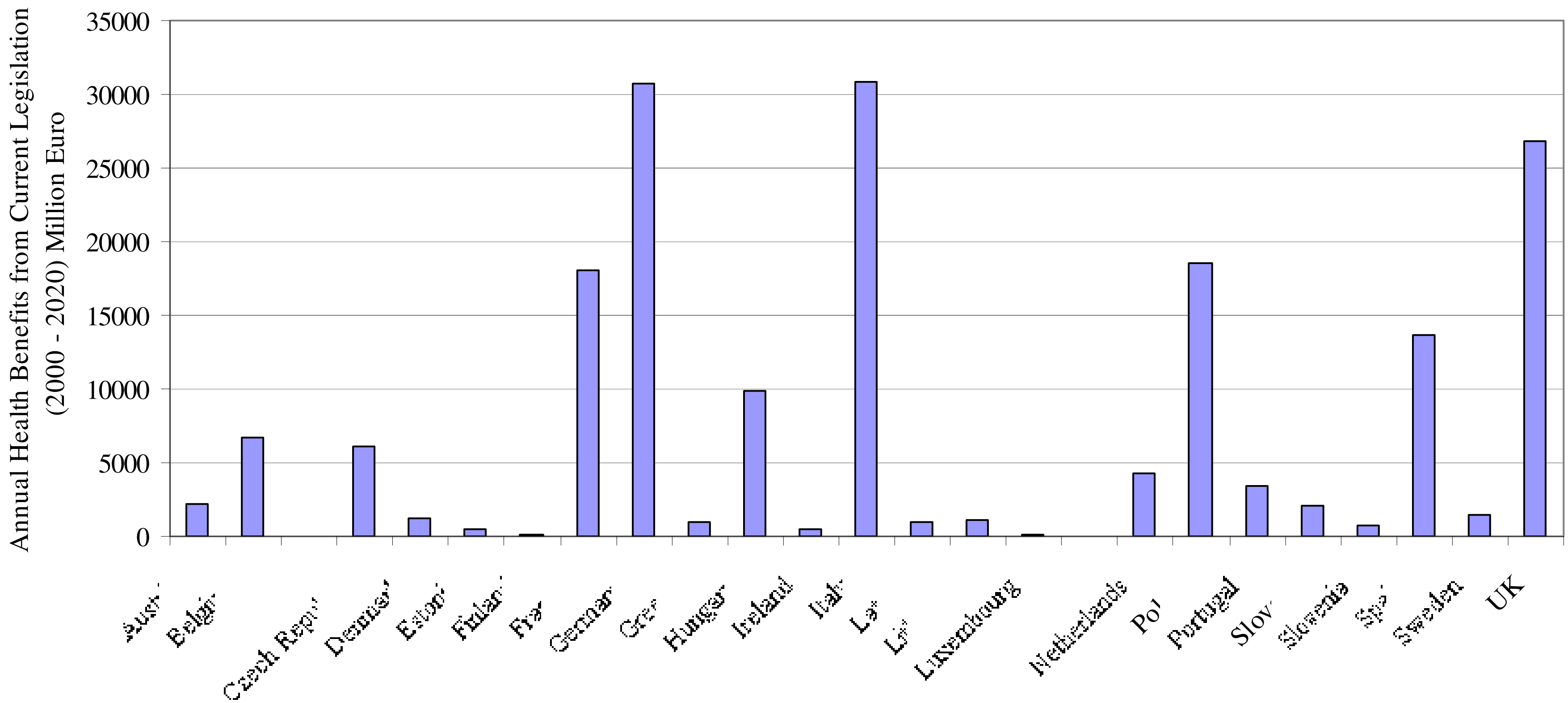


Figure 12. Estimated health benefits (Euro per person of country population) of policies from 2020 to 2000 by Member State- Change from 2000 baseline to 2020 baseline (LOW – VOLY (Value of Life Years Lost – Median Value))

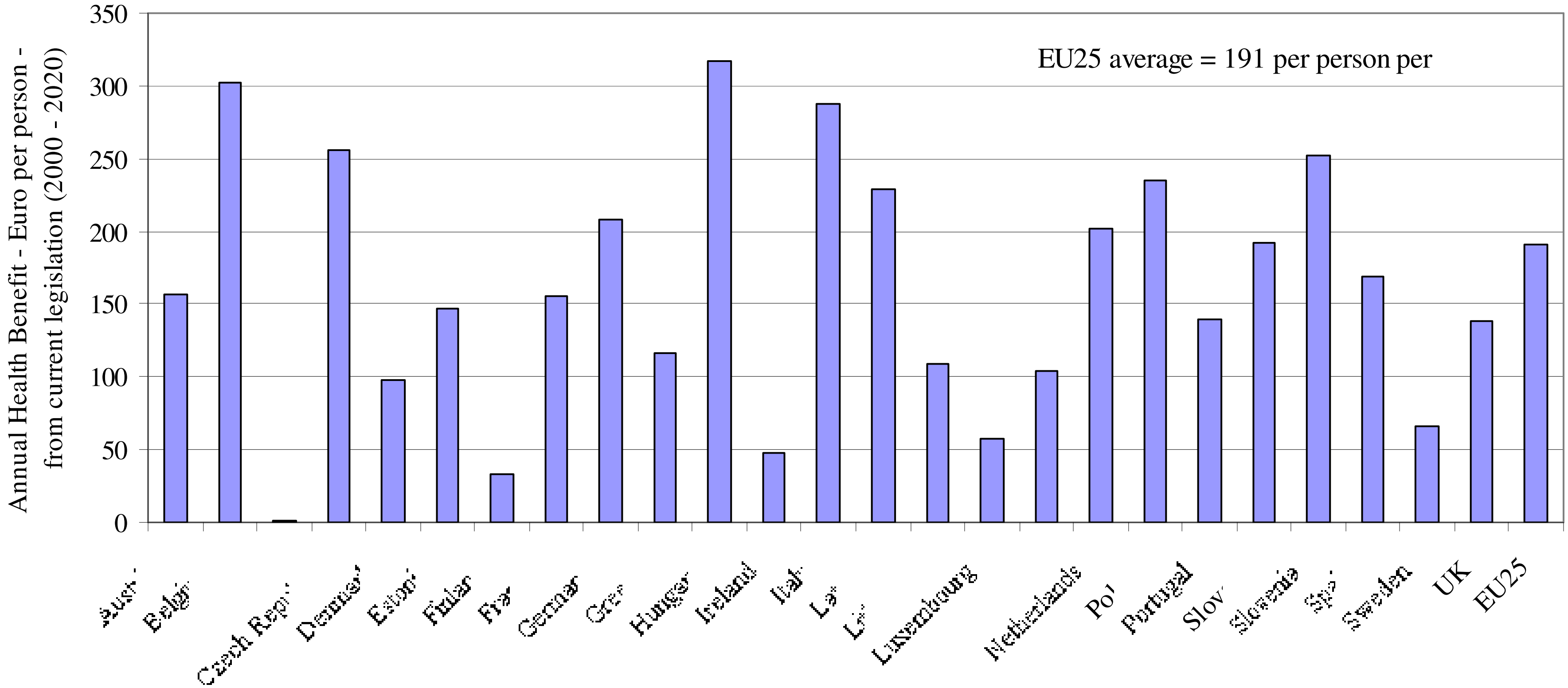
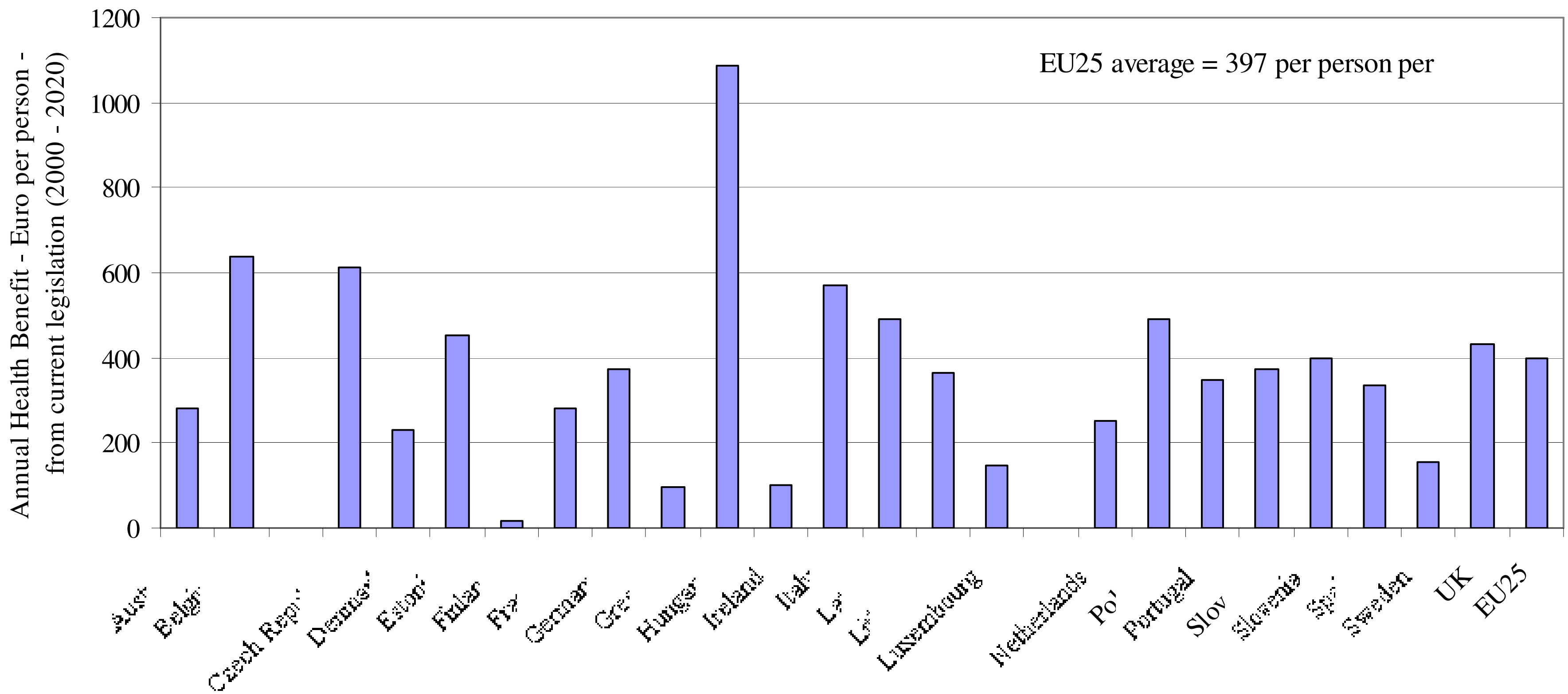


Figure 13. Estimated health benefits (Euro per person of country population) of policies from 2020 to 2000 by Member State - Change from 2000 baseline to 2020 baseline ((<u>HIGH</u> – VSL (Value of Statistical Life – Mean Value))



Non-Health Impacts (Crops and Materials)

Crops

The approach used for assessing damage to crops was summarised in the methodology section earlier and also in the methodology report, volume 1. Account has been taken of the work of ICP Vegetation, though it is noted that they express concerns about the use (as here) of AOT40 as a metric for crop damage assessment. Analysis will shift to flux based methods as soon as these become available.

Table 13 presents the total crop yield loss from ozone exposure for the EU25 with baseline ozone pollution concentrations in 2000 and 2020 by Member State, and the change from 2000 to 2020 (the benefits of current legislation). The total damages in the year 2000 are estimated at just under €3 billion/year, falling to just under €1.5 billion/year by 2020 – with estimated benefits of current legislation of €1.3 billion/year. The distribution of impacts varies by crop and by country. For illustration, an example for the damage to wheat is shown in the maps given in Figure 14.

Table 13. Estimated annual crop damage due to air pollution (ozone) in 2000 and 2020 in EU25, and benefits of implementing current EU legislation (2000 to 2020) (€Million)

Country	Baseline in 2000	Current legislation In 2020	Difference 2000 to 2020
Austria	54.7	22.9	31.8
Belgium	52.7	33.3	19.4
Czech Republic	76.5	30.6	45.9
Denmark	32.4	18.4	14
Estonia	0.8	0.4	0.4
Finland	3	1.5	1.5
France	573.9	292.5	281.4
Germany	465.5	220	245.5
Greece	281.9	198.9	83
Hungary	120.9	57.6	63.3
Ireland	8.1	4.7	3.4
Italy	413.4	247.2	166.2
Latvia	2.6	1.5	1.1
Lithuania	8.7	5.2	3.5
Luxembourg	1	0.6	0.4
Malta	0	0	0
Netherlands	77	46.2	30.8
Poland	232.8	104.8	128
Portugal	13.5	9.6	3.9
Slovakia	36.5	14.6	21.9
Slovenia	7.1	3.4	3.7
Spain	183	108.6	74.4
Sweden	11.7	6.4	5.3
United Kingdom	121.5	82.6	38.9
Total	2779.2	1511.5	1267.7

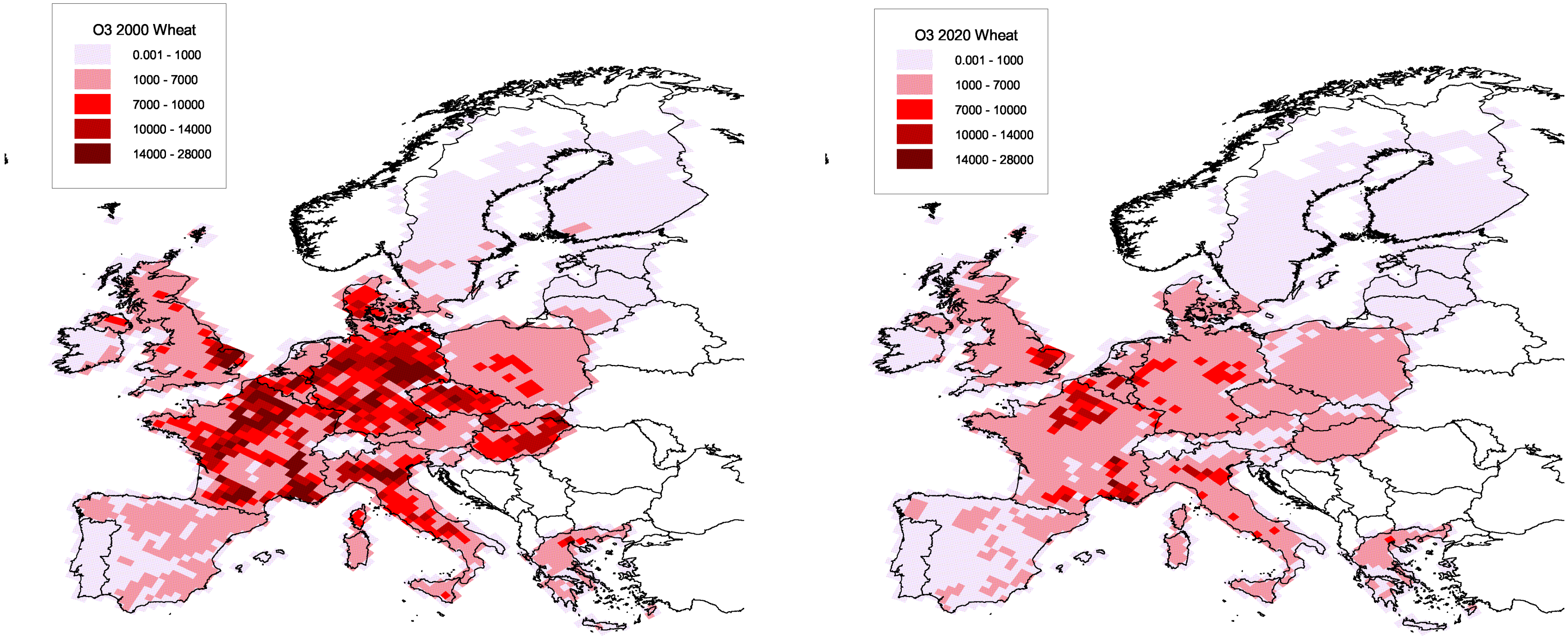


Figure 14. Estimated Reduction in Wheat Yield from Ozone across EU25 in 2000 and 2020.

The analysis of crop damages shows that these effects are small in economic terms in relation to health effects overall (i.e. including PM effects), though effects from ozone on crops are similar in magnitude to ozone related health damage.

Materials

The approach used for assessing damage to materials was summarised in the methodology section earlier. The approach has been discussed extensively over the years with the International Cooperative Programme (ICP) on Materials, and uses response functions based on their work. The methodology is described in full in the methodology report, volume 1.

Table 14 presents the total annual quantified damage to materials for the EU25 with baseline pollution concentrations in 2000 and 2020, and the change from 2000 to 2020. The damage mostly arises from SO_2. The total damage in the year 2000 is estimated at €1.1 billion/year, falling to €0.8 billion/year by 2020 – the benefits of current legislation are therefore just under €0.4 billion/year.

Table 14. Estimated material damage due to air pollution in 2000 and 2020 in EU25, and benefits of implementing current EU legislation (2000 to 2020) (€billion)

Country	Baseline in 2000	Current legislation In 2020	Difference from 2000 to 2020
EU25	1.13	0.74	0.39

The analysis of material impacts shows that these effects are small in economic terms in relation to health damage.

Extended Cost-Benefit Analysis

The objective of the 'extended-CBA' is to draw attention to those effects that are not quantified in monetary terms, and would thus, ordinarily, be omitted from the comparison of costs and benefits.

The intention of providing information in this way is to prompt stakeholders to consider whether the impacts that have not been quantified are likely to be important enough to change the balance of costs and benefits.

Table 15. Ratings for the extended CBA. Effects considered likely to be negligible are omitted from this table.

Effect	Rating
Forests	
Effects of O_3, acidification and eutrophication	★★★
Freshwaters	
Acidification and loss of invertebrates, fish, etc.	★★★
Other ecosystems	
Effects of O_3, acidification and eutrophication on biodiversity	★★★
Materials	
Effects on cultural assets	★★
Health	
Ozone: chronic effects on mortality and morbidity	★★
PM: chronic effects on cardiovascular disease	★★
SO_2: chronic effects on morbidity	★
Direct effects of VOCs	★
Social impacts of air pollution on health	★★
Altruistic effects	★★
Crops	
Indirect air pollution effects on livestock	★
Visible injury to leaf crops following ozone exposure	★
Changes in the taste and nutritional quality of crops following ozone exposure	★★
Interactions between pollutants, with pests and pathogens, climate...	★★
Visibility	
Change in amenity	★
Groundwater quality and supply of drinking water	
Effects of acidification	★

Key

★★★	Impacts likely to be significant at the European level
★★	Impacts that may be significant at the European level
★	Impacts unlikely to be important at the European level, but of local significance

Based on this table and the information that underpins it, the views of the CBA team are that:

- Inclusion of impacts on forests, freshwaters and other ecosystems could add significantly to the benefits quantified for emission reductions.
- Inclusion of the effects of chronic exposure to ozone on health and to PM on cardiovascular disease, social impacts of air pollution on health, altruistic effects, damage to cultural assets and some impacts on crops via interactions with pests and pathogens may be important, but there is inadequate evidence available to make a firm conclusion at this point in time.

- The other effects listed in the table are unlikely to make a substantial difference to quantified benefits at the European scale, but may be significant in some areas.

The most important of these: ecosystems, is discussed below. The ratings provided in Table 15 are simply intended as flags to highlight issues that are, or are not, likely to be important to the economic assessment of pollution impacts under the CAFE programme. The omission of a number of potentially significant effects from the monetised benefits analysis demonstrates a bias to underestimation of damage.

Ecosystems

Valuation of ecosystem impacts is not yet possible because of limited research in this area that has specific relevance to reductions in air pollutant emissions. This, in turn, reflects the difficulty of carrying out a meaningful analysis of the economics of biodiversity changes.

This section reproduces the text and figures for ecosystems given in the RAINS baseline[13] to supplement the rating expressed by the extended CBA, demonstrating why we conclude that impacts are sufficiently serious that they would add significantly to the quantified monetary damage estimates given in this report. The RAINS data provide information on the state of ecosystems with respect to exceedance of critical loads and levels for acidification, eutrophication and ground level ozone. The RAINS analysis addresses risks from:

- Vegetation impacts from ground level ozone (excess ozone that is considered harmful for forest trees, using the AOT40 (accumulated ozone over a threshold of 40 ppb));
- Acid deposition to forest ecosystems (area/percentage of forest area receiving acid deposition above the critical loads);
- Acid deposition to semi-natural ecosystems (area/percentage of semi-natural ecosystems receiving acid deposition above the critical loads);
- Acid deposition to freshwater bodies (catchments) (area/percentage of freshwater ecosystems area receiving acid deposition above the critical loads);
- Excess nitrogen deposition (eutrophication) (area/percentage of total ecosystems area receiving nitrogen deposition above the critical loads for eutrophication).

Vegetation damage from ground-level ozone

The RAINS model has applied the concept of critical levels to quantify progress towards the environmental long-term target of full protection of vegetation from ozone damage. The most appropriate approach for setting future ozone critical levels for forest trees is to look at the effective ozone dose, based on the flux of ozone into the leaves through the stomata. However, uncertainties in the development and application of flux-based approaches to setting critical levels for forest trees prevent their application as a standard risk assessment method at a European scale. Instead, the AOT40 (accumulated ozone over a threshold of 40 ppb) has been used for integrated risk assessment for forest trees.

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[13] The Current Legislation" and the "Maximum Technically Feasible Reduction" cases for the CAFE baseline emission projections. Background paper for the meeting of the CAFE Working Group on Target Setting and Policy Advice, November 10, 2004. Markus Amann, Rafal Cabala, Janusz Cofala, Chris Heyes, Zbigniew Klimont, Wolfgang Schöpp. International Institute for Applied Systems Analysis (IIASA) Leonor Tarrason, David Simpson, Peter Wind, Jan-Eiof Jonson. Norwegian Meteorological Institute (MET.NO), Oslo, Norway. Version 2 (including tables of impact estimates). November 2004

The Working Group on Effects Mapping Manual defines critical levels for crops, forests and semi-natural vegetation in terms of different levels of AOT40, measured over different time spans. From earlier analysis of ozone time series for various parts of Europe, the critical level for forest trees (5 ppm.hours over the full vegetation period, April 1- September 30 is recommended as default) appears as the most stringent constraint. For most parts of Europe, the other critical levels will be automatically achieved if the 5 ppm.hours over six months condition is satisfied. Thus, if used for setting environmental targets for emission reduction strategies, the critical levels for forest trees would imply protection of the other receptors.

The figure below presents the levels of excess ozone for forest trees, based on the AOT40 metric. There is a clear improvement in the years to 2020, though there is still widespread exceedance of the critical level.

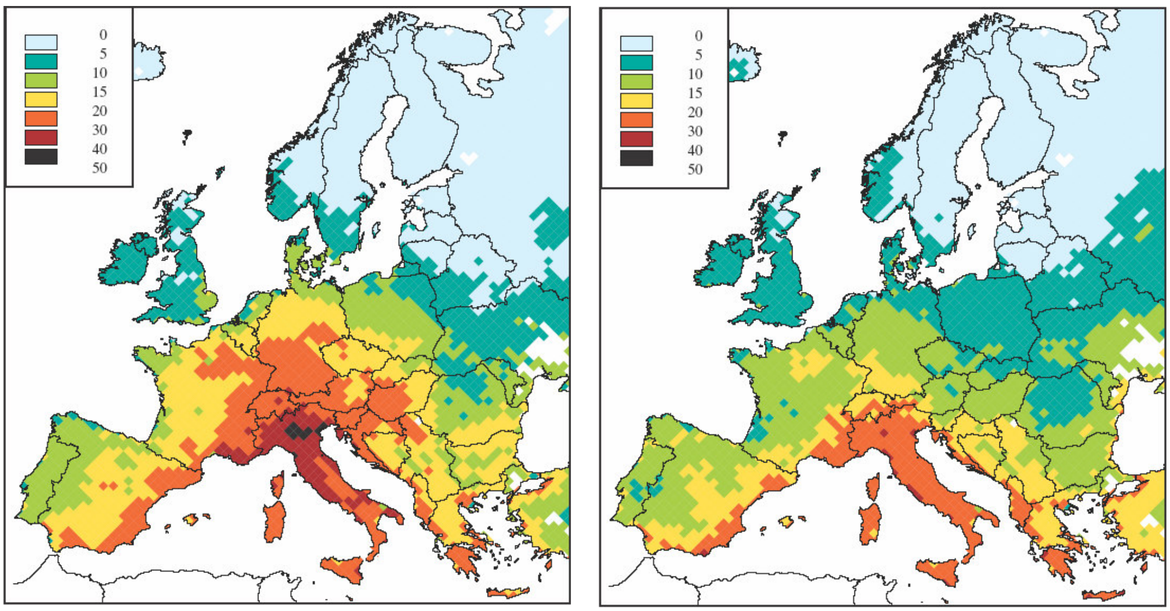

Figure 15. AOT40 for the year 2000 (left panel), the current legislation case of the “Climate policy” scenario in 2020 (panel), in ppm.hours.

Note: Calculation results for the meteorological conditions of 1997. The critical level for forests is set at 5 ppm.hours.

Acid deposition to forest ecosystems

RAINS has used the concept of critical loads as a quantitative indicator for sustainable levels of sulphur and nitrogen deposition. The analysis is based on the critical loads databases compiled by the Coordination Centre on Effects under the UNECE Working Group on Effects. For most ecosystem types (e.g., forests), critical loads are calculated for both acidity and eutrophication. Other receptor types, such as streams and lakes, have only critical loads for acidity, on the assumption that airborne nitrogen does not contribute significantly to eutrophication in these ecosystems. The RAINS analysis groups ecosystems into three classes (forests, semi-natural vegetation such as nature protection areas and freshwater bodies) and performs separate analyses for each class. The RAINS analysis has assessed the deposition to these ecosystems with the critical loads and thus provides an indication to what extent the various types of ecosystems are still at risk of acidification under different baseline conditions. This indicator cannot be directly interpreted as the actual damage occurring at such ecosystems. To derive damage estimates, the historic rate of acid deposition as well as dynamic chemical processes in soils and lakes need to be considered, which can lead to substantial delays in the occurrence of acidification as well as in the recovery from acidification.

Table 16. Percentage of forest area receiving acid deposition above the critical loads for baseline emissions (2000) and current legislation of the "Climate policy" scenario in 2020.

	2000	2020CLE
Austria	15.2	5.0
Belgium	55.4	31.6
Denmark	31.8	8.5
Finland	1.6	1.5
France	12.4	4.8
Germany	72.3	41.6
Greece	0.6	0.0
Ireland	47.0	19.2
Italy	2.3	1.0
Luxembourg	35.1	11.6
Netherlands	88.3	80.4
Portugal	2.6	0.2
Spain	1.0	0.0
Sweden	23.7	18.7
UK	49.0	17.6
Total EU-15	17.7	10.5
Czech Rep.	80.8	42.0
Estonia	0.3	0.0
Hungary	3.9	1.5
Latvia	0.6	0.5
Lithuania	2.9	1.0
Poland	59.0	21.8
Slovakia	22.7	7.7
Slovenia	2.8	0.1
Total NMS	35.7	14.2
Total EU-25	20.8	11.1

Calculation results for the meteorological conditions of 1997, using ecosystem-specific deposition for forests. Critical loads data base of 2004.

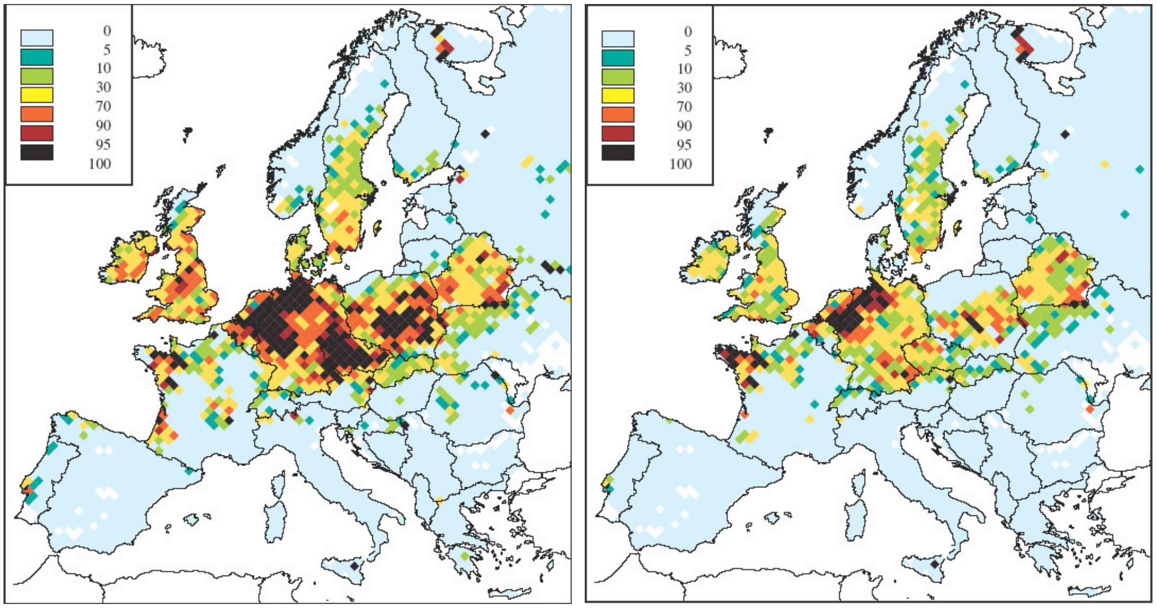

Figure 16. Percentage of forest area receiving acid deposition above the critical loads for the baseline emissions for 2000 (left panel) and current legislation "Climate policy" scenario in 2020 (right panel).

Calculation results for the meteorological conditions of 1997, using ecosystem-specific deposition for forests. Critical loads data base of 2004.

Acid deposition to semi-natural ecosystems

A number of countries have provided estimates of critical loads for semi-natural ecosystems. This group typically contains nature and landscape protection areas, many of them designated as Natura2000 areas under the EU Habitats Directive. While this group of ecosystems includes open land and forest areas, RAINS uses a conservative estimate grid-average deposition rate for comparison with critical loads, which systematically underestimates deposition for forested land.

Table 17. Area of semi-natural ecosystems with acid deposition above critical loads (in km^2). The analysis reflects average meteorological conditions of 1997

Semi-natural ecosystems area with acid deposition above critical loads				
	2000	CLE 2020	2000	CLE 2010
France	37.6	9.0	376032	90328
Germany	68.1	40.9	268750	161487
Ireland	10.3	2.3	47429	10786
Italy	0.0	0.0	261	0
Netherlands	63.0	47.8	81711	61970
UK	30.8	9.3	1528760	459721
Total	24.1	8.2	2302941	784291

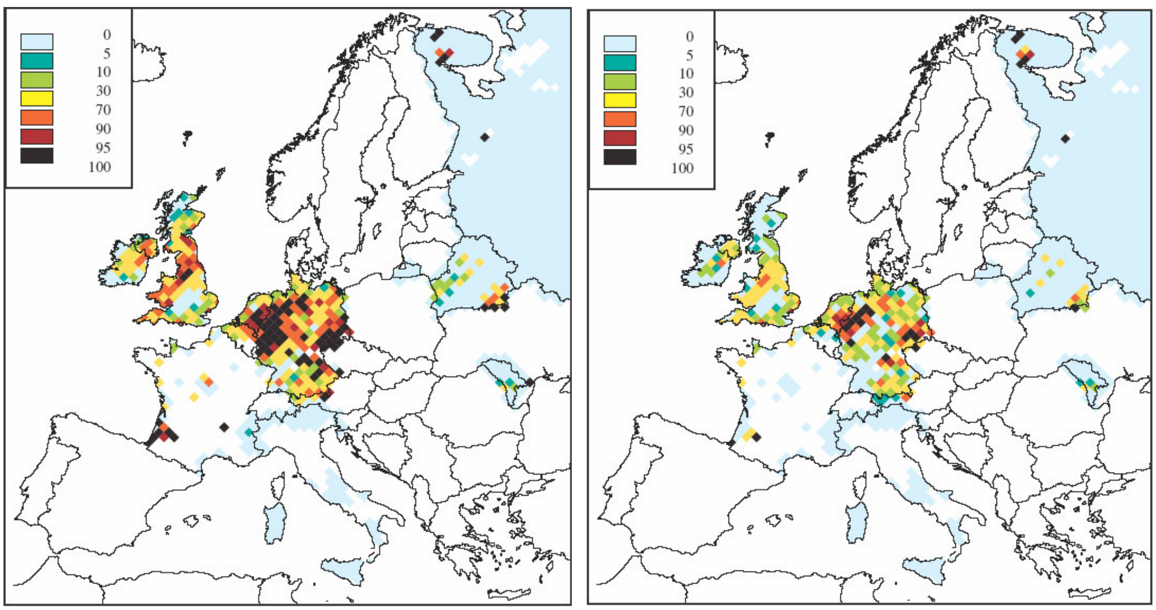

Figure 17. Percentage of the area of semi-natural ecosystems receiving acid deposition above the critical loads, for the baseline emissions for 2000 (left panel), the current legislation case of the "Climate policy" scenario in 2020 (right panel). White areas represent regions for which critical loads data are unavailable.

Calculation results for the meteorological conditions of 1997, using grid-average deposition. Critical loads data base of 2004. For areas shown in white no critical loads estimates have been provided.

Acid deposition to freshwater bodies

The RAINS analysis has estimated exceedance of critical loads for the catchments of freshwater bodies (lakes and streams) in Finland, Norway, Sweden and the UK only. The baseline emission projections suggest a significant fall in acid deposition across this region, in many cases even below their critical loads. As indicated above, recovery from acidification requires acid deposition to stay below the critical loads for some time.

Table 18. Percentage of freshwater ecosystems area receiving acid deposition above the critical loads for the baseline emissions for 2000, the current legislation case of the "Climate policy" scenario in 2020.

	2000	CLE 2020
Finland	0.7	0.7
Sweden	14.9	10.5
UK	8.1	3.7

Calculation results for the meteorological conditions of 1997, using grid-average deposition. Critical loads data base of 2004.

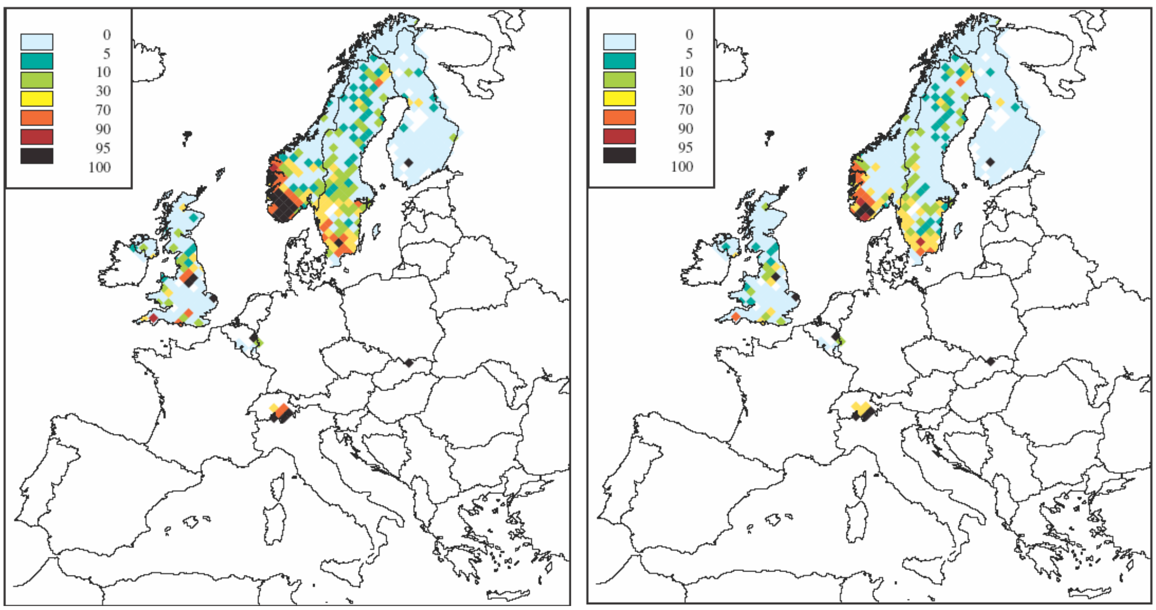

Figure 18. Percentage of freshwater ecosystems area receiving acid deposition above the critical loads for the baseline emissions for 2000 (left panel), the current legislation case of the "Climate policy" scenario in 2020 (right panel).

Calculation results for the meteorological conditions of 1997, using grid-average deposition. Critical loads data base of 2004. For areas shown in white no critical loads estimates have been provided.

Excess nitrogen deposition (eutrophication)

Excess nitrogen deposition poses a threat to plant communities in a wide range of ecosystems. The RAINS analysis has estimated exceedance of critical loads across Europe. Using a conservative approach based on grid-average deposition for all ecosystems, it gives a systematic underestimate of nitrogen deposition to forests.

Table 19. Percentage of total ecosystems area receiving nitrogen deposition above the critical loads for eutrophication for the baseline emissions for 2000, the current legislation case of the "Climate policy" scenario in 2020.

	2020	CLE 2020
Austria	96.0	86.4
Belgium	92.7	60.8
Denmark	52.7	37.2
Finland	25.1	14.4
France	95.8	79.1
Germany	96.2	94.4
Greece	75.8	72.9
Ireland	11.6	3.3
Italy	62.3	47.7
Luxembourg	96.4	82.1
Netherlands	66.5	60.8
Portugal	29.7	12.0
Spain	64.6	50.1
Sweden	26.1	16.1
UK	13.3	5.5
Total EU-15	54.3	43.0
Czech Rep.	95.2	76.6
Estonia	11.7	5.8
Hungary	30.7	24.4
Latvia	54.3	38.0
Lithuania	85.0	80.8
Poland	86.0	78.8
Slovakia	88.8	60.2
Slovenia	94.3	88.0
Total NMS	71.2	60.3
Total EU-25	57.1	45.9

Calculation results for the meteorological conditions of 1997, using grid-average deposition. Critical loads data base of 2004.

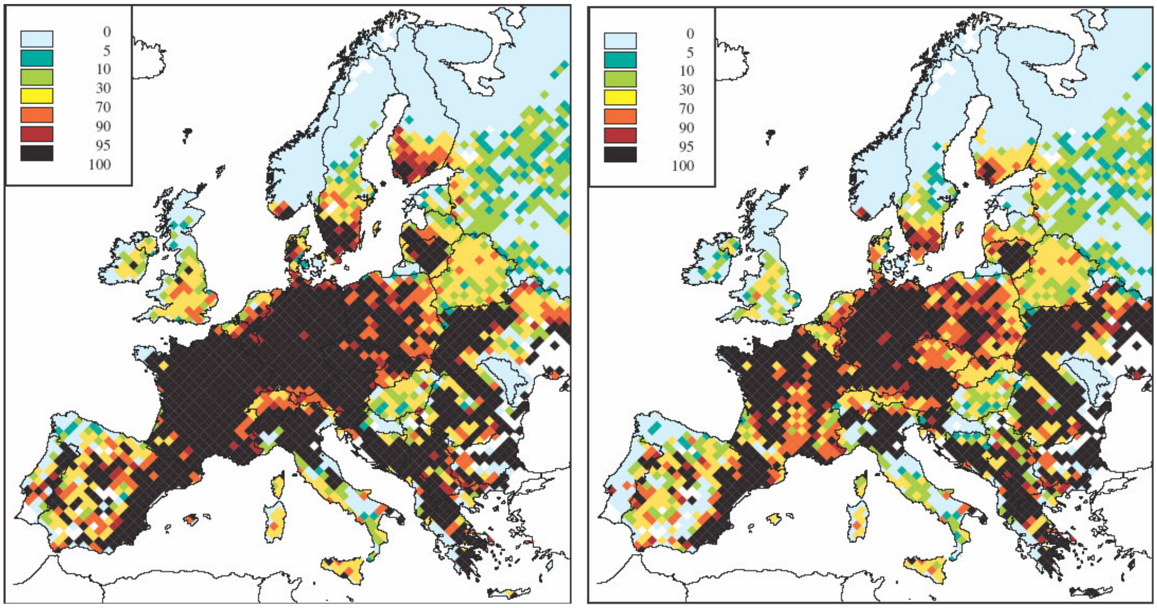

Figure 19. Percentage of total ecosystems area receiving nitrogen deposition above the critical loads for eutrophication for the baseline emissions for 2000 (left panel), the current legislation case of the "Climate policy" scenario in 2020 (right panel).

Calculation results for the meteorological conditions of 1997, using grid-average deposition. Critical loads data base of 2004. For areas shown in white no critical loads estimates have been provided.

Uncertainty / Sensitivity Analysis

Volume 3 of the methodology reports describes the uncertainties associated with the CAFE analysis and methods for dealing with them. Some reference has already been made to the findings of that report (see, for example, Figure 1, Figure 2 and Figure 4). In this report the uncertainty assessment is focused solely on the quantification of the benefits of the reduction in exposure of people, ecosystems, etc., to air pollutants as a result of emission reductions between 2000 and 2020. No account is made here of uncertainty in dispersion modelling using the EMEP and RAINS models, or of the quantification of abatement costs made by RAINS, though both are considered in Volume 3 of the CAFE-CBA Methodology Report.

Methods for describing uncertainties

Three methods are identified for dealing with uncertainties:

- Statistical assessment, for dealing quantitatively with uncertainties that are amenable to this type of analysis.
- Sensitivity analysis, for dealing quantitatively with specific parameters for which alternative positions are available (e.g. VSL vs. VOLY).
- Bias assessment, for dealing semi-quantitatively with uncertainties that are likely to drive the balance of benefits and costs in a particular direction. It is often possible to define the direction of bias (e.g., the omission of impacts will lead to underestimation of damage, whilst the omission of abatement measures will direct towards overestimation of costs), but not its magnitude.

No method used in isolation can capture all elements of uncertainty. For that reason, analysis is carried out in a sequential manner, considering the information obtained from each approach.

Although assessment of uncertainty is complex, it is simplified to an extent by the fact that a small number of issues are likely to dominate any consideration of uncertainty in the assessment being made here. These are:

1. Quantification of the mortality impact of exposure to fine particles;
2. Valuation of mortality impacts from particles and other pollutants;
3. Assessment of effects of chronic exposure to particles on the prevalence of bronchitis;
4. Attribution of effects to individual species of particle or other pollutant;
5. Failure to quantify monetary benefits with respect to ecosystem and some other types of damage.

Whilst the analysis presented here is not constrained by this list, it is useful to refer back to it to ensure that assessment is focused on the parts of the analysis that are likely to matter most.

Statistical analysis

Volume 3 of the CAFE-CBA methodology report quantifies the spread of monetised damage around estimated health impacts of ozone and PM exposure – readers should consult that report for information on the precise methodology used, assumed probability distributions, etc. The analysis presented there accounts for uncertainty at three stages of the analysis, quantification of background incidence rates for death or ill-health, concentration-response functions, and monetary valuation. The results presented in this report deal only with the spread around the mean for PM health impacts arising from these three stages of analysis for the following reasons:

1. The impacts of ozone described in this report are very small compared to the effects of PM. Uncertainty in ozone quantification would not, therefore, have a substantial effect on the results reported here.
2. Quantified impacts on crops and materials are also small compared to quantified PM health impacts.
3. Although exposure estimates based on dispersion model results are prone to uncertainty, this is likely to be less important at the aggregate level of interest to this report, than variability in the stages of analysis that are accounted for.

It is concluded that consideration of the quantifiable statistical uncertainty in the results for PM health effects will provide reasonable guidance on the overall level of statistical uncertainty in the benefits results.

Table 20 shows the results of this analysis in terms of the mean of the aggregated PM health damage factor and the 95% confidence interval surrounding it. Several issues need explanation or comment:

1. The 'aggregated damage factor' is the sum of products of background incidence, concentration-response function and valuation for each end-point considered in the PM health analysis.
2. The total damage attributable to PM can be calculated by multiplying the aggregated PM damage factor by the sum of products of population and PM concentration across the gridded domain.
3. Distributions have been calculated using the @RISK model. The model was run for 10,000 iterations using a Monte-Carlo sampling procedure.
4. The increase in the damage factor when the PM health sensitivity functions are added in is small, indicating that they are relatively unimportant to the analysis.
5. Whilst the analysis considers results separately for VOLY and VSL based approaches to mortality valuation, it does not provide separate results for mean and median estimates of VOLY and VSL. The median and mean are of course accounted for within the analysis through the distribution taken for mortality valuation data.
6. The use of VSL or VOLY approaches to mortality valuation clearly makes a difference to the results, but there is substantial overlap in the probabilised distributions, as noted above.

Table 20. Summary statistics, mean and 95% confidence interval (2.5% to 97.5%) for assessment of aggregated PM functions including effects on mortality and morbidity, showing differences arising from approach to mortality assessment, adoption of median or mean values as the preferred measure of population WTP, and inclusion of core functions only, or core + sensitivity functions.

Mortality valuation method	Mean or median	Sensitivity functions included?	2.5%-ile	Mean	97.5%-ile
VOLY	median	✗	24	48	72
VOLY	median	✓	26	50	74
VOLY	mean	✗	39	91	149
VOLY	mean	✓	41	94	151
VSL	median	✗	34	73	115
VSL	median	✓	36	75	117
VSL	mean	✗	55	135	225
VSL	mean	✓	57	137	228

Table 21 takes the information presented in Table 20 and expresses the results relative to the mean value. This shows the mean to be roughly a factor 2.5 greater than the lower limit of the 95% confidence interval and a factor 1.7 less than the upper limit of the 95% confidence interval. The distributions given here may seem tightly constrained, but this arises in part from the separate consideration of mean and median estimates for mortality valuation.

Table 21. 95% confidence interval for aggregated PM functions including effects on mortality and morbidity, accounting for factors listed for Table 20.

Mortality valuation method	Mean or median	Sensitivity functions included?	Mean / 2.5%-ile	97.5%-ile / mean
VOLY	median	✗	2.00	1.50
VOLY	median	✓	1.92	1.48
VOLY	mean	✗	2.33	1.64
VOLY	mean	✓	2.29	1.61
VSL	median	✗	2.15	1.58
VSL	median	✓	2.08	1.56
VSL	mean	✗	2.45	1.67
VSL	mean	✓	2.40	1.66

The results given here can be used with results from the analysis of scenarios to define probability distributions – simply divide values by a factor 2.5 to obtain the lower end of the 95% confidence interval and multiply by 1.7 to obtain the upper end. Results are shown in Table 22 for the extreme situations based around use of the median VOLY and the mean VSL. Of course, an alternative would be to run the @RISK model for each scenario, but this is not likely to add much to the information presented.

Table 22. Implementing current EU legislation: health damage (core functions only) due to air pollution in 2000 and 2020 in the EU25. Units: €billion.

VOLY (median) based analysis	2.5%	Mean	97.5%
2000	110.4	276	469
2020	75.2	188	320
Difference	35.2	88	149

VSL (mean) based analysis	2.5%	Mean	97.5%
2000	316	790	1343
2020	244	609	1035
Difference	72	181	308

The analysis can be extended once cost data are considered to describe the probability that estimated benefits will exceed estimated costs. This will be done in future reports.

The statistical analysis describes one part of the uncertainty in the analysis. It does not, however, deal with uncertainties linked to specific choices made in the methodology. These are best addressed using sensitivity analysis, as shown in the next section.

Sensitivity analysis

A number of sensitivity tests have been undertaken for the baseline, focused on the key issues listed towards the start of this chapter. These include:

- Comparison of results based on VOLY and VSL based assessment of PM damages (this sensitivity is explored throughout the report);
- An analysis of some additional potential health impacts for PM;
- An analysis of some additional potential health impacts for ozone;
- An analysis of alternative valuation of acute mortality from ozone;
- A number of sensitivities on the PM mortality effects, in relation to the PM mixture and lag phases.

Additional health impacts from PM and ozone

Volume 2 of the CAFE-CBA Methodology report identifies a number of health impacts which, for various reasons, it is not felt appropriate to include in the core analysis. Sensitivity analysis has been undertaken on these effects to assess their importance.. In some cases the sensitivity analysis represents additional categories of impacts, in some cases it is an alternative impact analysis or valuation. For example, Restricted activity days (RADs) – ext. days = additional days due to application of function to ALL AGES, not just ADULTS OF WORKING AGE.   Chronic Bronchitis – additional cases = additional case due to use of a higher C-R function.   Full details are presented in Volume 2 of the methodology report.

In terms of the number of additional health impacts for PM, the sensitivity analysis shows these additional impacts are important, with hundreds of millions of additional potential cases or days of illness. However, for the additional health endpoints, the economic impacts are not large in relation to those quantified in the 'core analysis' (i.e. they do not represent a major additional benefit).

In terms of the number of additional health impacts for ozone, the sensitivity analysis shows these additional impacts are important, in the region of hundreds of millions of additional cases or days of illness, and also important in relation to economic damages. The sensitivity analysis on respiratory symptoms in adults for ozone (note this is an alternatives to the core analysis), is important and would significant increase the economic damage from ozone, over and above the 'core' analysis above). However, inclusion of these effects would not raise ozone damage to a level similar to that of PM impacts.

Table 23. EU25 Estimated Health Impacts Sensitivity Analysis (number of events or new cases)

End point	End point output	Function Group		Baseline in 2000	Current legislation in 2020 (+ CP)	Difference 2000 to 2020
Allergic rhinitis consultations (adults 15-64yr)	Consultations	Sensitivity	O3	750,100	590,100	160,000
Allergic rhinitis consultations (children 0-14yr)	Consultations	Sensitivity	O3	347,100	209,600	137,500
Respiratory symptoms (adults 15yr +)	Days	Sensitivity	O3	199,280,000	178,491,700	20,788,300
Restricted Activity Days (RADs All ages) - ext. days	Days	Sensitivity	PM	169,285,600	130,475,700	38,809,900
Asthma Consultations (0-14yr)	Consultations	Sensitivity	PM	177,100	85,600	91,500
Asthma Consultations (15-64yr)	Consultations	Sensitivity	PM	302,400	193,100	109,300
Asthma Consultations (65yr +)	Consultations	Sensitivity	PM	131,700	155,300	-23,600
Consultations for URDs (0-14yr)	Consultations	Sensitivity	PM	600,400	290,000	310,400
Consultations for URDs (15-64yr)	Consultations	Sensitivity	PM	1,897,700	1,211,700	686,000
Consultations for URDs (65yr +)	Consultations	Sensitivity	PM	651,600	768,600	-117,000
Chronic Bronchitis - additional cases (27yr +)	Cases	Sensitivity	PM	165,600	129,600	36,000

Table 24. EU25 Estimated Health Impacts Sensitivity Analysis (Valuation (€ Million))

End point	End point output	Function Group		Baseline in 2000	Current legislation in 2020 (+ CP)	Difference 2000 to 2020
Allergic rhinitis consultations (adults 15-64yr)	Consultations	Sensitivity	O3	56	44	12
Allergic rhinitis consultations (children 0-14yr)	Consultations	Sensitivity	O3	26	16	10
Respiratory symptoms (adults 15yr +)	Days	Sensitivity	O3	25955	23247	2708
Restricted Activity Days (RADs All ages) - ext. days	Days	Sensitivity	PM	14118	10882	3237
Asthma Consultations (0-14yr)	Consultations	Sensitivity	PM	9	5	5
Asthma Consultations (15-64yr)	Consultations	Sensitivity	PM	16	10	6
Asthma Consultations (65yr +)	Consultations	Sensitivity	PM	7	8	-1
Consultations for URDs (0-14yr)	Consultations	Sensitivity	PM	45	22	23
Consultations for URDs (15-64yr)	Consultations	Sensitivity	PM	142	91	51
Consultations for URDs (65yr +)	Consultations	Sensitivity	PM	49	58	-9
Alternative approach for Chronic Bronchitis - additional cases (27yr +)	Cases	Sensitivity	PM	31035	24282	6752

Valuation of ozone mortality

For the core analysis of acute mortality from ozone, the analysis quantifies the number of 'premature deaths' (deaths brought forward). These cases are valued using a VOLY approach, assuming that on average, each premature deaths leads to the loss of 12 months of life. Results presented earlier show total ozone mortality damage of €1 billion (from use of the median VOLY) to €2.5 billion (from use of the mean VOLY). To further examine sensitivity to the approach used, the baseline has considered the potential effect of using a full Value of Statistical Life (0.98 million Euro) for these premature deaths. Table 25 shows that this would significantly add to ozone related damage, though it would still be significantly less important than PM for which damage is an order of magnitude greater.

Table 25. EU25 estimated ozone acute mortality with a full VSL.

End point	Pollutant	2000 CLE Baseline	2020 CLE (CP)
Acute Mortality. Core function, but VSL 0.98 million (median value)	O_3	21 090	20 447

Sensitivity on PM and chronic mortality

A number of potential issues were raised in the methodology report.

The first and most important is to discuss qualitatively the potential effects of different toxicities for the components of the PM mixture, i.e. primary $PM_{2.5}$, sulphates and nitrates. We recognise that any attempt at quantification will be speculative. The Health Effects Task Force of WHO considered this issue in 2003, and again in the CAFE follow-up questions. The latter noted that:

- Toxicological studies have highlighted that primary, combustion-derived particles have a high toxic potency; and that
- Several other components of the PM mix – including sulphates and nitrates – are lower in toxic potency.

Unfortunately there is a lack of any established risk estimates for the different components. We agree with the WHO (2004) evaluation that it is currently not possible to precisely quantify the contributions from different sources and different PM components to health effects. However, we believe there is value in exploring this as a sensitivity analysis, for example to differentiate between policies that reduce primary rather than secondary particles from combustion. The baseline analysis has therefore considered the potential particle attribution based on the baseline data. This is shown by member state in the table below (note this is based on the EMEP model output).

Table 26. $PM_{2.5}$ speciation (%) by Member State for the Baseline (2000)

	Primary $PM_{2.5}$	Nitrate in the fine fraction (NO_3^-)	Sulphate (SO_4^{--})	Ammonium (NH_4^+)	$PM_{2.5}$ _unattributed
Austria	19.3	31.5	18.6	16.1	14.5
Belgium	20.6	33.6	12.7	14.5	18.7
Cyprus	15.7	0.2	45.4	14.6	24.3
Czech Republic	17.8	31.8	18.6	16.2	15.6
Denmark	19.3	31.1	18.4	15.8	15.4
Estonia	21.1	17.4	29.7	14.8	17.0
Finland	17.2	5.8	37.0	9.4	31.0
France	19.4	26.3	20.8	15.1	18.3
Germany	17.2	34.7	15.3	15.8	17.1
Greece	16.4	4.1	42.6	12.2	25.0
Hungary	17.0	28.6	21.1	16.2	16.9
Ireland	19.2	27.5	20.8	15.3	17.2
Italy	17.2	15.2	32.2	14.2	21.3
Latvia	18.1	24.1	25.8	16.2	15.9
Lithuania	18.2	27.3	22.7	16.3	15.5
Luxembourg	17.8	35.2	13.4	15.3	18.3
Malta	19.9	0.3	43.7	6.6	29.5
Netherlands	20.2	33.4	13.4	14.6	18.4
Poland	18.7	29.3	20.3	16.1	15.7
Portugal	28.0	7.3	32.7	13.3	20.0
Slovakia	17.7	27.7	22.3	16.3	16.0
Slovenia	20.2	29.0	20.2	15.9	14.7
Spain	21.5	10.5	32.7	14.6	20.9
Sweden	19.1	11.4	33.1	11.9	24.7
United Kingdom	18.9	27.1	20.9	15.1	17.9

Some scoping sensitivity analysis has shown that different assumptions about the causality (toxicities) of different components on the $PM_{2.5}$ mixture do lead to very different damages by member state when compared to the existing baseline – even if the overall causality from $PM_{2.5}$ across the EU is constant. Interestingly, the % of the PM mixture that is primary $PM_{2.5}$ is remarkable constant across all countries – it is the other components such as sulphates and nitrates that differ dramatically by member state. For example if nitrates are assigned a lower causality, and primary $PM_{2.5}$ a higher causality, then the very high damages seen in many central countries (e.g. Germany, France, Netherlands – which have very high nitrate concentrations) would be reduced in relation to other countries. A different pattern of countries would be affected if the causality of sulphates is reduced (i.e. Greece and Cyprus).

Given the different proportion of components of the PM mixture by member state, it is also clear that future policies will lead to significantly different damage and benefit numbers, if there are different assumptions made about the causality of the PM mixture. This is therefore considered an important issue for sensitivity analysis in relation to future scenarios.

The second major aspect raised in the methodology report was in relation to chronic mortality is the issue of lag phases. The current methodology assumes that there is a short time between changes in ambient PM and consequent reductions in the risk of mortality (i.e. it assumes there is no lag).

If, alternatively, it were judged that there was a possibly substantial time-lag between changes in ambient PM and changes in risks of mortality, then mortality impacts would differ, because these effects would occur in the future and would be subject to economic discounting.

A scoping analysis has been undertaken for the baseline on various time-lags between changes in pollution and changes in death rates. This includes the use of no lag phase (as in the core analysis), a 40 year lag phase, and an intermediate analysis similar to the recent discussions informing the US EPA's analysis of the costs and benefits of the US Clean Air Act (where, for example, it is assumed that 30% of the effect of reduced pollution on deaths rates occurs immediately (year1); 50% of the effect is distributed over years 2-5; and the remaining 20% is distributed over years 6-20). This analysis has shown that a 40 year lag phase would significantly affect the damage costs/benefits downwards (perhaps reducing the economic damage by half), but that the EPA type lag scheme would have only a modest effect in reducing the values, of around 10%.

Bias analysis

Having investigated statistical uncertainty and sensitivity to specific parameters, the next part of the uncertainty analysis considers systematic bias in the benefits analysis. These biases will lead either to overestimation or underestimation of benefits. In some cases (e.g. the omission of impact categories), the direction of bias is clear. In others, for example issues concerning particle speciation, it is not, and may well vary from scenario to scenario. However, for any particular scenario, biases have a systematic effect rather than a random one.

Table 27 is taken from Volume 3 of the Methodology Report. The central column in the Table shows the likely effect of each bias. A negative sign indicates that benefits would be underestimated as a result of the bias in question, a positive sign indicates that benefits would be overestimated. A single sign indicates that the CAFE-CBA team believe that effects seem likely to be negligible, a triple sign ('---' or '+++') that effects seem likely to be significant. A double sign indicates that effects may or may not be significant. The most important biases according to this table are associated with the omission of various impacts and possibly with the lack of differentiation of particles by chemical species. Both issues have been discussed above.

Analysis of specific policy scenarios beyond the baseline, requiring comparison of costs and benefits would require consideration to be given also to biases and other uncertainties in the cost data generated by the RAINS model.

Table 27. Biases in the benefits analysis

Source of bias	**Likely effect on benefit:cost ratio**	**Comment**
Unquantified impacts: • Ecosystem acidification • Ecosystem eutrophication • Impacts of ozone on ecosystems • Damage to cultural heritage • Chronic health effects of exposure to ozone • Chronic effects of PM exposure on cardio-vascular disease • Impacts of secondary organic aerosols of anthropogenic origin • Effects on crop quality (as opposed to yield)	 --- --- --- -- ---? ---? -- --	These impacts were discussed above in the chapter on the extended CBA..
Lack of differentiation of particles by species for health impact assessment	+++/---	Effect on quantified benefits will depend on the level of control for each type of particle.
Use of health functions from the US and western Europe	++/--	Further research is needed to test whether there are systematic differences between regions.
Quantification of deaths from chronic exposure to PM using techniques not based on life tables.	++	Some potential for double counting of deaths, depending on the time horizon used for the analysis.
Use of uniform incidence data for the whole of Europe for most morbidity effects	++/--	Again, further research is needed to test whether there are systematic differences between regions. The identification of consistent sets of incidence data is recognised as a problem for transferability of health response functions generally.
Use of AOT40 based relationships to quantify impacts of ozone on crops	+	Likely to cause overestimation of impacts amongst un-irrigated crops in drier parts of Europe. Overall effect unclear. Should be resolved in 2005 by a switch to flux-based modelling.

Overview of the uncertainty analysis

An overview of the uncertainty analysis is provided in the next chapter.

Conclusions

The analysis has calculated impacts to health, crops, materials and ecosystems across the EU25 for the baseline from 2000 to 2020.

Based on use of the SOMO35 exposure metric, it is estimated that ozone was responsible for an estimated 21 000 deaths brought forward in the year 2000 across the EU 25. However, ozone also leads to much larger numbers of estimated morbidity health impacts, with tens of millions of minor restricted activity days and respiratory medication use days each year. These are clearly less serious effects at the level of the individual, but they affect a much greater number of people.

For PM, annual impacts across the EU 25 total an estimated 3.7 million years of life lost each year (based on the year 2000) – this can be alternatively expressed as 348 000 premature deaths. PM is also estimated to generate 700 infant deaths each year (in 2000). According to these estimates, PM exposure has, therefore, a much more important effect than ozone on mortality. In addition, PM leads to larger numbers of annual morbidity effects than ozone. The estimated morbidity effects of PM ranges from around 100 000 series cases of hospital or cardiac hospital admissions (in the year 2000) to much larger numbers of less serious effects, for example some 30 million respiratory medication use days, and several hundred million restricted activity days each year.

For PM, there are significant reductions in annual impacts over the period 2000 to 2020. For ozone, the reductions are more modest.

The health effects above have been expressed in monetary terms, using the approach outlined in the CAFE CBA methodology. This shows that the health impacts of air pollution are dominated by PM and mortality, though PM related morbidity is also significant.

The estimated impact of implementing current legislation up to 2020 is valued at between €87 billion to €181 billion per year[14]. This translates to an average estimated benefit across the EU25 of €191 and €397 per person per year.

The analysis has estimated the non-health impacts across EU25 for the baseline from 2000 to 2020. A number of these impacts have also been valued in monetary terms, damages to crops (in terms of reduced crop yield) and damages to materials (excluding historic buildings and cultural heritage). The analysis shows that these impacts are small in relation to health damages overall, though effects from ozone on crops are similar in magnitude to ozone related health impacts.

The first part of the uncertainty analysis considered the probability distribution around estimated benefits. This generated a 95% confidence interval equivalent to [best estimate ÷ 2.5] to [best estimate × 1.7]. Analysis of this type can be used in future to make a first estimate of the probability that benefits would exceed costs (or vice-versa).

The second part examined specific sensitivities linked to the benefit estimation methods used. This generated the following conclusions:

[14] The statistical analysis suggests a broad range around these figures, from around €35 billion to €310 billion.

- Use of the VSL does lead to an increase in estimated damage compared to use of the VOLY. However, there is substantial overlap in the distributions of VSL and VOLY based estimates. This is an important conclusion as it is often assumed that the two approaches do yield results that are quite different to one another.
- Inclusion of additional ('sensitivity') impacts of PM would not raise estimated PM damage significantly.
- Inclusion of additional impacts of ozone would raise estimated ozone effects significantly. Similarly, use of the VSL to value ozone related mortality would have a significant effect. However, PM damage would still dominate the baseline results.
- Alternative assumptions on the hazard posed by different chemical species of particle could have a major effect on estimated PM damage. This could be positive or negative, depending on the extent of control of each pollutant.
- Similarly, some assumptions on the lag-phase appropriate to chronic mortality assessment could have a major impact on the results shown here. However, some alternative assumptions to those used in the core analysis here, would not have a significant impact.

The third part of the uncertainty assessment considered systematic biases in the analysis. There is some overlap with issues raised above, particularly assumptions on the risk linked to each different type of particle. Other than this, the most important biases are likely to concern omission of the following types of impact from the analysis through a lack of data at some point in the impact pathway:

- Ecosystem acidification
- Ecosystem eutrophication
- Impacts of ozone on ecosystems
- Damage to cultural heritage
- Chronic health effects of exposure to ozone
- Chronic effects of PM exposure on cardio-vascular disease
- Impacts of secondary organic aerosols of anthropogenic origin

Considering information provided in the section on extended CBA, and provided that the core analysis does not lead to substantial overestimation of impacts, it is likely that the true level of damage associated with PM and ozone and their precursors is greater than indicated here, as a result of the omission of these effects. However, it is not possible here to make any clear statement on the extent to which these omitted impacts would add to the quantified benefits.

Taken together, the baseline analysis has shown that large benefits are predicted to occur from current policies to improve air pollution from 2000 to 2020 this time, with potential benefits estimated at €89 billion to €183 billion each year from current policies by 2020 (as well as further benefits from effects not included in the monetary framework - notably ecosystem). However, despite these improvements, the baseline damages in 2020 remain significant, with estimated damage of €191 to €611 billion per year.

Appendix: Country Health Results

COUNTRY RESULTS: TOTAL IMPACTS AND TOTAL DAMAGES

Austria

Implementing current EU legislation: Estimated Health damage due to air pollution in 2000 and 2020

End point	End point output	Function Group		Baseline in 2000	Current legislation in 2020 (including Climate Policy)	Change 2000 to 2020
Acute Mortality (All ages)	Premature deaths	Core	O_3	435	369	66
Respiratory Hospital Admissions (65yr +)	Cases	Core	O_3	284	382	-98
Minor Restricted Activity Days (MRADs 15-64yr)	Days	Core	O_3	1,143,900	828,970	314,930
Respiratory medication use (children 5-14yr)	Days	Core	O_3	527,480	188,250	339,230
Respiratory medication use (adults 20yr +)	Days	Core	O_3	186,360	160,240	26,120
Cough and LRS (children 0-14yr)	Days	Core	O_3	2,304,020	914,140	1,389,880
Chronic Mortality *	Life years lost	Core	PM	59,400	43,100	16,300
Chronic Mortality *	Premature deaths	Core	PM	5,500	4,590	910
Infant Mortality (0-1yr)	Premature deaths	Core	PM	8	5	3
Chronic Bronchitis (27yr +)	Cases	Core	PM	2,750	2,340	410
Respiratory Hospital Admissions (All ages)	Cases	Core	PM	1,020	740	280
Cardiac Hospital Admissions (All ages)	Cases	Core	PM	630	460	170
Restricted Activity Days (RADs 15-64yr)	Days	Core	PM	5,756,330	4,070,600	1,685,730
Respiratory medication use (children 5-14yr)	Days	Core	PM	75,580	26,320	49,260
Respiratory medication use (adults 20yr +)	Days	Core	PM	459,620	385,640	73,980
LRS symptom days (children 5-14yr)	Days	Core	PM	3,123,910	1,087,870	2,036,040
LRS in adults (15yr +) with chronic symptoms	Days	Core	PM	4,704,950	3,791,720	913,230

*Note two alternative metrics are used for the presentation of chronic mortality from PM. Firstly in terms of years of life lost and secondly in terms of numbers of premature deaths. These are not additive.

Implementing current EU legislation: Estimated Valuation of the health damage due to air pollution in 2000 and in 2020 in EU25 (€000)

End point	End point output	Function Group		Baseline in 2000	Current legislation in 2020 (+ Clim. Pol.)	Change 2000 to 2020
Acute Mortality ***(VOLY median)****	Premature deaths	Core	O_3	22,760	19,318	3,442
Acute Mortality *(VOLY* ***mean*)***	Premature deaths	Core	O_3	51,087	43,362	7,725
Respiratory Hospital Admissions (65yr +)	Cases	Core	O_3	570	767	-197
Minor Restricted Activity Days (MRADs 15-64yr)	Days	Core	O_3	43,945	31,846	12,099
Respiratory medication use (children 5-14yr)	Days	Core	O_3	494	176	318
Respiratory medication use (adults 20yr +)	Days	Core	O_3	175	150	24
Cough and LRS (children 0-14yr)	Days	Core	O_3	88,513	35,118	53,395
Chronic Mortality ***(VOLY median)****	Life years lost	Core	PM	3,105,832	2,253,702	852,130
Chronic Mortality ***(VOLY mean*)***	Life years lost	Core	PM	6,971,424	5,058,714	1,912,711
Chronic Mortality ***(VSL median)****	Premature deaths	Core	PM	5,383,315	4,493,338	889,977
Chronic Mortality ***(VSL mean*)***	Premature deaths	Core	PM	11,075,719	9,244,667	1,831,052
Infant Mortality (0-1yr) ***(VSL median)****	Premature deaths	Core	PM	10,792	6,700	4,092
Infant Mortality (0-1yr) ***(VSL mean*)***	Premature deaths	Core	PM	21,584	13,400	8,184
Chronic Bronchitis (27yr +)	Cases	Core	PM	514,815	439,304	75,512
Respiratory Hospital Admissions (All ages)	Cases	Core	PM	2,042	1,482	560
Cardiac Hospital Admissions (All ages)	Cases	Core	PM	1,260	914	346
Restricted Activity Days (RADs 15-64yr)	Days	Core	PM	480,078	339,488	140,590
Respiratory medication use (children 5-14yr)	Days	Core	PM	71	25	46
Respiratory medication use (adults 20yr +)	Days	Core	PM	431	361	69
LRS symptom days (children 5-14yr)	Days	Core	PM	120,011	41,793	78,219
LRS in adults (15yr +) with chronic symptoms	Days	Core	PM	180,750	145,666	35,084
Total with Mortality – VOLY – low (median)				**4,572,540**	**3,316,811**	**1,255,728**
Total with Mortality – VOLY – high (mean)				**8,477,251**	**6,152,566**	**2,324,685**
Total with Mortality – VSL – low (median)				**6,850,022**	**5,556,447**	**1,293,575**
Total with Mortality – VSL – high (mean)				**12,581,546**	**10,338,519**	**2,243,027**

*Note two alternative metrics are used for the presentation of chronic mortality from PM. Firstly in terms of years of life lost and secondly in terms of numbers of premature deaths. There are also two alternative valuations for each, based on a median or mean value from NewExt. These individual valuations are not additive.

Belgium

Implementing current EU legislation: Estimated Health damage due to air pollution in 2000 and in 2020

End point	End point output	Function Group		Baseline in 2000	Current legislation in 2020 (including Climate Policy)	Change 2000 to 2020
Acute Mortality (All ages)	Premature deaths	Core	O_3	364	381	-17
Respiratory Hospital Admissions (65yr +)	Cases	Core	O_3	258	369	-111
Minor Restricted Activity Days (MRADs 15-64yr)	Days	Core	O_3	914,320	807,850	106,470
Respiratory medication use (children 5-14yr)	Days	Core	O_3	447,090	303,300	143,790
Respiratory medication use (adults 20yr +)	Days	Core	O_3	152,660	153,280	-620
Cough and LRS (children 0-14yr)	Days	Core	O_3	1,994,830	1,415,070	579,760
Chronic Mortality *	Life years lost	Core	PM	137,370	94,900	42,470
Chronic Mortality *	Premature deaths	Core	PM	12,880	10,030	2,850
Infant Mortality (0-1yr)	Premature deaths	Core	PM	24	14	10
Chronic Bronchitis (27yr +)	Cases	Core	PM	6,260	4,730	1,530
Respiratory Hospital Admissions (All ages)	Cases	Core	PM	2,350	1,630	720
Cardiac Hospital Admissions (All ages)	Cases	Core	PM	1,450	1,000	450
Restricted Activity Days (RADs 15-64yr)	Days	Core	PM	12,863,530	8,403,130	4,460,400
Respiratory medication use (children 5-14yr)	Days	Core	PM	179,100	89,830	89,270
Respiratory medication use (adults 20yr +)	Days	Core	PM	1,052,640	781,390	271,250
LRS symptom days (children 5-14yr)	Days	Core	PM	7,402,660	3,712,890	3,689,770
LRS in adults (15yr +) with chronic symptoms	Days	Core	PM	10,778,600	7,856,330	2,922,270

*Note two alternative metrics are used for the presentation of chronic mortality from PM. Firstly in terms of years of life lost and secondly in terms of numbers of premature deaths. These are not additive.

Implementing current EU legislation: Estimated Valuation of the health damage due to air pollution in 2000 and in 2020 in EU25 (€000)

End point	End point output	Function Group		Baseline in 2000	Current legislation in 2020 (+ Clim. Pol.)	Change 2000 to 2020
Acute Mortality ***(VOLY median)****	Premature deaths	Core	O_3	19,016	19,900	-884
Acute Mortality *(VOLY* ***mean*)***	Premature deaths	Core	O_3	42,683	44,668	-1,985
Respiratory Hospital Admissions (65yr +)	Cases	Core	O_3	517	740	-223
Minor Restricted Activity Days (MRADs 15-64yr)	Days	Core	O_3	35,125	31,035	4,090
Respiratory medication use (children 5-14yr)	Days	Core	O_3	419	284	135
Respiratory medication use (adults 20yr +)	Days	Core	O_3	143	144	-1
Cough and LRS (children 0-14yr)	Days	Core	O_3	76,635	54,363	22,273
Chronic Mortality ***(VOLY median)****	Life years lost	Core	PM	7,182,252	4,961,758	2,220,494
Chronic Mortality ***(VOLY mean*)***	Life years lost	Core	PM	16,121,454	11,137,279	4,984,174
Chronic Mortality ***(VSL median)****	Premature deaths	Core	PM	12,607,189	9,823,193	2,783,996
Chronic Mortality ***(VSL mean*)***	Premature deaths	Core	PM	25,938,236	20,210,398	5,727,839
Infant Mortality (0-1yr) ***(VSL median)****	Premature deaths	Core	PM	34,218	20,126	14,092
Infant Mortality (0-1yr) ***(VSL mean*)***	Premature deaths	Core	PM	68,437	40,253	28,184
Chronic Bronchitis (27yr +)	Cases	Core	PM	1,172,748	887,294	285,454
Respiratory Hospital Admissions (All ages)	Cases	Core	PM	4,723	3,263	1,460
Cardiac Hospital Admissions (All ages)	Cases	Core	PM	2,913	2,012	901
Restricted Activity Days (RADs 15-64yr)	Days	Core	PM	1,072,818	700,821	371,997
Respiratory medication use (children 5-14yr)	Days	Core	PM	168	84	84
Respiratory medication use (adults 20yr +)	Days	Core	PM	986	732	254
LRS symptom days (children 5-14yr)	Days	Core	PM	284,388	142,638	141,750
LRS in adults (15yr +) with chronic symptoms	Days	Core	PM	414,082	301,817	112,265
Total with Mortality – VOLY – low (median)				**10,301,152**	**7,127,011**	**3,174,141**
Total with Mortality – VOLY – high (mean)				**19,298,239**	**13,347,427**	**5,950,812**
Total with Mortality – VSL – low (median)				**15,726,089**	**11,988,446**	**3,737,642**
Total with Mortality – VSL – high (mean)				**29,115,022**	**22,420,545**	**6,694,476**

*Note two alternative metrics are used for the presentation of chronic mortality from PM. Firstly in terms of years of life lost and secondly in terms of numbers of premature deaths. There are also two alternative valuations for each, based on a median or mean value from NewExt. These individual valuations are not additive.

Cyprus

Implementing current EU legislation: Estimated Health damage due to air pollution in 2000 and in 2020

End point	End point output	Function Group		Baseline in 2000	Current legislation in 2020 (including Climate Policy)	Change 2000 to 2020
Acute Mortality (All ages)	Premature deaths	Core	O_3	33	42	-9
Respiratory Hospital Admissions (65yr +)	Cases	Core	O_3	21	49	-28
Minor Restricted Activity Days (MRADs 15-64yr)	Days	Core	O_3	110,140	119,410	-9,270
Respiratory medication use (children 5-14yr)	Days	Core	O_3	29,630	19,350	10,280
Respiratory medication use (adults 20yr +)	Days	Core	O_3	16,530	21,920	-5,390
Cough and LRS (children 0-14yr)	Days	Core	O_3	318,830	234,320	84,510
Chronic Mortality *	Life years lost	Core	PM	3,380	3,360	20
Chronic Mortality *	Premature deaths	Core	PM	230	270	-40
Infant Mortality (0-1yr)	Premature deaths	Core	PM	1	1	0
Chronic Bronchitis (27yr +)	Cases	Core	PM	134	169	-35
Respiratory Hospital Admissions (All ages)	Cases	Core	PM	58	58	0
Cardiac Hospital Admissions (All ages)	Cases	Core	PM	36	36	0
Restricted Activity Days (RADs 15-64yr)	Days	Core	PM	316,390	306,730	9,660
Respiratory medication use (children 5-14yr)	Days	Core	PM	3,640	2,120	1,520
Respiratory medication use (adults 20yr +)	Days	Core	PM	23,270	27,590	-4,320
LRS symptom days (children 5-14yr)	Days	Core	PM	250,440	146,270	104,170
LRS in adults (15yr +) with chronic symptoms	Days	Core	PM	246,970	273,970	-27,000

*Note two alternative metrics are used for the presentation of chronic mortality from PM. Firstly in terms of years of life lost and secondly in terms of numbers of premature deaths. These are not additive.

Implementing current EU legislation: Estimated Valuation of the health damage due to air pollution in 2000 and in 2020 in EU25 (€000)

End point	End point output	Function Group		Baseline in 2000	Current legislation in 2020 (+ Clim. Pol.)	Change 2000 to 2020
Acute Mortality ***(VOLY median)****	Premature deaths	Core	O_3	1,712	2,202	-490
Acute Mortality *(VOLY* ***mean*)***	Premature deaths	Core	O_3	3,843	4,943	-1,101
Respiratory Hospital Admissions (65yr +)	Cases	Core	O_3	42	98	-56
Minor Restricted Activity Days (MRADs 15-64yr)	Days	Core	O_3	4,231	4,587	-356
Respiratory medication use (children 5-14yr)	Days	Core	O_3	28	18	10
Respiratory medication use (adults 20yr +)	Days	Core	O_3	15	21	-5
Cough and LRS (children 0-14yr)	Days	Core	O_3	12,248	9,002	3,247
Chronic Mortality ***(VOLY median)****	Life years lost	Core	PM	176,736	175,739	997
Chronic Mortality ***(VOLY mean*)***	Life years lost	Core	PM	396,706	394,469	2,237
Chronic Mortality ***(VSL median)****	Premature deaths	Core	PM	226,708	264,279	-37,571
Chronic Mortality ***(VSL mean*)***	Premature deaths	Core	PM	466,432	543,732	-77,300
Infant Mortality (0-1yr) ***(VSL median)****	Premature deaths	Core	PM	1,648	1,122	527
Infant Mortality (0-1yr) ***(VSL mean*)***	Premature deaths	Core	PM	3,297	2,244	1,053
Chronic Bronchitis (27yr +)	Cases	Core	PM	25,127	31,645	-6,518
Respiratory Hospital Admissions (All ages)	Cases	Core	PM	116	116	1
Cardiac Hospital Admissions (All ages)	Cases	Core	PM	72	71	0
Restricted Activity Days (RADs 15-64yr)	Days	Core	PM	26,387	25,581	805
Respiratory medication use (children 5-14yr)	Days	Core	PM	3	2	1
Respiratory medication use (adults 20yr +)	Days	Core	PM	22	26	-4
LRS symptom days (children 5-14yr)	Days	Core	PM	9,621	5,619	4,002
LRS in adults (15yr +) with chronic symptoms	Days	Core	PM	9,488	10,525	-1,037
Total with Mortality – VOLY – low (median)				**267,497**	**266,375**	**1,122**
Total with Mortality – VOLY – high (mean)				**491,246**	**488,967**	**2,279**
Total with Mortality – VSL – low (median)				**317,469**	**354,914**	**-37,446**
Total with Mortality – VSL – high (mean)				**560,973**	**638,230**	**-77,258**

*Note two alternative metrics are used for the presentation of chronic mortality from PM. Firstly in terms of years of life lost and secondly in terms of numbers of premature deaths. There are also two alternative valuations for each, based on a median or mean value from NewExt. These individual valuations are not additive.

Czech Republic

Implementing current EU legislation: Estimated Health damage due to air pollution in 2000 and in 2020

End point	End point output	Function Group		Baseline in 2000	Current legislation in 2020 (including Climate Policy)	Change 2000 to 2020
Acute Mortality (All ages)	Premature deaths	Core	O_3	521	414	106
Respiratory Hospital Admissions (65yr +)	Cases	Core	O_3	277	468	-191
Minor Restricted Activity Days (MRADs 15-64yr)	Days	Core	O_3	1,289,930	813,540	476,390
Respiratory medication use (children 5-14yr)	Days	Core	O_3	239,840	92,560	147,280
Respiratory medication use (adults 20yr +)	Days	Core	O_3	202,910	166,040	36,870
Cough and LRS (children 0-14yr)	Days	Core	O_3	2,492,870	1,102,190	1,390,680
Chronic Mortality *	Life years lost	Core	PM	90,640	56,890	33,750
Chronic Mortality *	Premature deaths	Core	PM	9,070	6,450	2,620
Infant Mortality (0-1yr)	Premature deaths	Core	PM	16	7	9
Chronic Bronchitis (27yr +)	Cases	Core	PM	4,000	3,260	740
Respiratory Hospital Admissions (All ages)	Cases	Core	PM	1,550	970	580
Cardiac Hospital Admissions (All ages)	Cases	Core	PM	960	600	360
Restricted Activity Days (RADs 15-64yr)	Days	Core	PM	9,033,130	5,035,390	3,997,740
Respiratory medication use (children 5-14yr)	Days	Core	PM	71,730	24,470	47,260
Respiratory medication use (adults 20yr +)	Days	Core	PM	696,400	503,660	192,740
LRS symptom days (children 5-14yr)	Days	Core	PM	4,941,560	1,685,630	3,255,930
LRS in adults (15yr +) with chronic symptoms	Days	Core	PM	7,198,400	4,900,160	2,298,240

*Note two alternative metrics are used for the presentation of chronic mortality from PM. Firstly in terms of years of life lost and secondly in terms of numbers of premature deaths. These are not additive.

Implementing current EU legislation: Estimated Valuation of the health damage due to air pollution in 2000 and in 2020 in EU25 (€000)

End point	End point output	Function Group		Baseline in 2000	Current legislation in 2020 (+ Clim. Pol.)	Change 2000 to 2020
Acute Mortality ***(VOLY median)****	Premature deaths	Core	O_3	27,225	21,659	5,566
Acute Mortality *(VOLY **mean*)***	Premature deaths	Core	O_3	61,110	48,616	12,494
Respiratory Hospital Admissions (65yr +)	Cases	Core	O_3	556	938	-382
Minor Restricted Activity Days (MRADs 15-64yr)	Days	Core	O_3	49,555	31,254	18,301
Respiratory medication use (children 5-14yr)	Days	Core	O_3	225	87	138
Respiratory medication use (adults 20yr +)	Days	Core	O_3	190	156	35
Cough and LRS (children 0-14yr)	Days	Core	O_3	95,768	42,343	53,426
Chronic Mortality ***(VOLY median)****	Life years lost	Core	PM	4,739,240	2,974,336	1,764,904
Chronic Mortality ***(VOLY mean*)***	Life years lost	Core	PM	10,637,810	6,676,264	3,961,546
Chronic Mortality ***(VSL median)****	Premature deaths	Core	PM	8,883,275	6,313,359	2,569,916
Chronic Mortality ***(VSL mean*)***	Premature deaths	Core	PM	18,276,594	12,989,207	5,287,388
Infant Mortality (0-1yr) ***(VSL median)****	Premature deaths	Core	PM	23,097	9,840	13,257
Infant Mortality (0-1yr) ***(VSL mean*)***	Premature deaths	Core	PM	46,193	19,680	26,513
Chronic Bronchitis (27yr +)	Cases	Core	PM	749,637	610,659	138,978
Respiratory Hospital Admissions (All ages)	Cases	Core	PM	3,117	1,956	1,161
Cardiac Hospital Admissions (All ages)	Cases	Core	PM	1,922	1,206	716
Restricted Activity Days (RADs 15-64yr)	Days	Core	PM	753,363	419,951	333,412
Respiratory medication use (children 5-14yr)	Days	Core	PM	67	23	44
Respiratory medication use (adults 20yr +)	Days	Core	PM	653	472	181
LRS symptom days (children 5-14yr)	Days	Core	PM	189,840	64,757	125,083
LRS in adults (15yr +) with chronic symptoms	Days	Core	PM	276,541	188,249	88,292
Total with Mortality – VOLY – low (median)				**6,910,995**	**4,367,885**	**2,543,110**
Total with Mortality – VOLY – high (mean)				**12,866,547**	**8,106,611**	**4,759,936**
Total with Mortality – VSL – low (median)				**11,055,030**	**7,706,908**	**3,348,122**
Total with Mortality – VSL – high (mean)				**20,505,331**	**14,419,554**	**6,085,778**

*Note two alternative metrics are used for the presentation of chronic mortality from PM. Firstly in terms of years of life lost and secondly in terms of numbers of premature deaths. There are also two alternative valuations for each, based on a median or mean value from NewExt. These individual valuations are not additive.

Denmark

Implementing current EU legislation: Estimated Health damage due to air pollution in 2000 and in 2020

End point	End point output	Function Group		Baseline in 2000	Current legislation in 2020 (including Climate Policy)	Change 2000 to 2020
Acute Mortality (All ages)	Premature deaths	Core	O_3	178	175	2
Respiratory Hospital Admissions (65yr +)	Cases	Core	O_3	98	172	-74
Minor Restricted Activity Days (MRADs 15-64yr)	Days	Core	O_3	402,310	339,110	63,200
Respiratory medication use (children 5-14yr)	Days	Core	O_3	196,680	135,470	61,210
Respiratory medication use (adults 20yr +)	Days	Core	O_3	65,920	63,980	1,940
Cough and LRS (children 0-14yr)	Days	Core	O_3	905,370	601,270	304,100
Chronic Mortality *	Life years lost	Core	PM	30,690	23,850	6,840
Chronic Mortality *	Premature deaths	Core	PM	3,270	2,730	540
Infant Mortality (0-1yr)	Premature deaths	Core	PM	4	2	2
Chronic Bronchitis (27yr +)	Cases	Core	PM	1,400	1,140	260
Respiratory Hospital Admissions (All ages)	Cases	Core	PM	530	410	120
Cardiac Hospital Admissions (All ages)	Cases	Core	PM	320	250	70
Restricted Activity Days (RADs 15-64yr)	Days	Core	PM	2,925,110	2,078,580	846,530
Respiratory medication use (children 5-14yr)	Days	Core	PM	40,720	23,640	17,080
Respiratory medication use (adults 20yr +)	Days	Core	PM	234,910	192,210	42,700
LRS symptom days (children 5-14yr)	Days	Core	PM	1,682,950	977,210	705,740
LRS in adults (15yr +) with chronic symptoms	Days	Core	PM	2,383,010	1,979,450	403,560

*Note two alternative metrics are used for the presentation of chronic mortality from PM. Firstly in terms of years of life lost and secondly in terms of numbers of premature deaths. These are not additive.

Implementing current EU legislation: Estimated Valuation of the health damage due to air pollution in 2000 and in 2020 in EU25 (€000)

End point	End point output	Function Group		Baseline in 2000	Current legislation in 2020 (+ Clim. Pol.)	Change 2000 to 2020
Acute Mortality ***(VOLY median)****	Premature deaths	Core	O_3	9,290	9,170	120
Acute Mortality *(VOLY **mean*)***	Premature deaths	Core	O_3	20,853	20,583	270
Respiratory Hospital Admissions (65yr +)	Cases	Core	O_3	197	345	-148
Minor Restricted Activity Days (MRADs 15-64yr)	Days	Core	O_3	15,456	13,027	2,428
Respiratory medication use (children 5-14yr)	Days	Core	O_3	184	127	57
Respiratory medication use (adults 20yr +)	Days	Core	O_3	62	60	2
Cough and LRS (children 0-14yr)	Days	Core	O_3	34,782	23,099	11,683
Chronic Mortality ***(VOLY median)****	Life years lost	Core	PM	1,604,759	1,247,096	357,663
Chronic Mortality ***(VOLY mean*)***	Life years lost	Core	PM	3,602,081	2,799,261	802,819
Chronic Mortality ***(VSL median)****	Premature deaths	Core	PM	3,200,032	2,673,748	526,284
Chronic Mortality ***(VSL mean*)***	Premature deaths	Core	PM	6,583,797	5,501,013	1,082,785
Infant Mortality (0-1yr) ***(VSL median)****	Premature deaths	Core	PM	5,912	3,464	2,448
Infant Mortality (0-1yr) ***(VSL mean*)***	Premature deaths	Core	PM	11,824	6,928	4,897
Chronic Bronchitis (27yr +)	Cases	Core	PM	261,509	214,210	47,299
Respiratory Hospital Admissions (All ages)	Cases	Core	PM	1,055	820	235
Cardiac Hospital Admissions (All ages)	Cases	Core	PM	651	506	145
Restricted Activity Days (RADs 15-64yr)	Days	Core	PM	243,955	173,353	70,601
Respiratory medication use (children 5-14yr)	Days	Core	PM	38	22	16
Respiratory medication use (adults 20yr +)	Days	Core	PM	220	180	40
LRS symptom days (children 5-14yr)	Days	Core	PM	64,654	37,542	27,112
LRS in adults (15yr +) with chronic symptoms	Days	Core	PM	91,548	76,044	15,504
Total with Mortality – VOLY – low (median)				**2,334,272**	**1,799,066**	**535,206**
Total with Mortality – VOLY – high (mean)				**4,349,069**	**3,366,108**	**982,960**
Total with Mortality – VSL – low (median)				**3,929,545**	**3,225,718**	**703,827**
Total with Mortality – VSL – high (mean)				**7,330,785**	**6,067,860**	**1,262,926**

*Note two alternative metrics are used for the presentation of chronic mortality from PM. Firstly in terms of years of life lost and secondly in terms of numbers of premature deaths. There are also two alternative valuations for each, based on a median or mean value from NewExt. These individual valuations are not additive.

Estonia

Implementing current EU legislation: Estimated Health damage due to air pollution in 2000 and in 2020

End point	End point output	Function Group		Baseline in 2000	Current legislation in 2020 (including Climate Policy)	Change 2000 to 2020
Acute Mortality (All ages)	Premature deaths	Core	O_3	22	20	2
Respiratory Hospital Admissions (65yr +)	Cases	Core	O_3	10	15	-4
Minor Restricted Activity Days (MRADs 15-64yr)	Days	Core	O_3	42,010	33,620	8,390
Respiratory medication use (children 5-14yr)	Days	Core	O_3	9,220	4,040	5,180
Respiratory medication use (adults 20yr +)	Days	Core	O_3	6,670	6,540	130
Cough and LRS (children 0-14yr)	Days	Core	O_3	92,760	50,390	42,370
Chronic Mortality *	Life years lost	Core	PM	5,370	3,200	2,170
Chronic Mortality *	Premature deaths	Core	PM	630	410	220
Infant Mortality (0-1yr)	Premature deaths	Core	PM	1	0	1
Chronic Bronchitis (27yr +)	Cases	Core	PM	234	178	56
Respiratory Hospital Admissions (All ages)	Cases	Core	PM	92	55	37
Cardiac Hospital Admissions (All ages)	Cases	Core	PM	57	34	23
Restricted Activity Days (RADs 15-64yr)	Days	Core	PM	513,360	294,740	218,620
Respiratory medication use (children 5-14yr)	Days	Core	PM	4,810	1,510	3,300
Respiratory medication use (adults 20yr +)	Days	Core	PM	39,940	28,090	11,850
LRS symptom days (children 5-14yr)	Days	Core	PM	331,420	104,250	227,170
LRS in adults (15yr +) with chronic symptoms	Days	Core	PM	418,440	270,340	148,100

*Note two alternative metrics are used for the presentation of chronic mortality from PM. Firstly in terms of years of life lost and secondly in terms of numbers of premature deaths. These are not additive.

Implementing current EU legislation: Estimated Valuation of the health damage due to air pollution in 2000 and in 2020 in EU25 (€000)

End point	End point output	Function Group		Baseline in 2000	Current legislation in 2020 (+ Clim. Pol.)	Change 2000 to 2020
Acute Mortality ***(VOLY median)****	Premature deaths	Core	O_3	1,164	1,037	127
Acute Mortality *(VOLY* ***mean*)***	Premature deaths	Core	O_3	2,613	2,327	286
Respiratory Hospital Admissions (65yr +)	Cases	Core	O_3	21	29	-9
Minor Restricted Activity Days (MRADs 15-64yr)	Days	Core	O_3	1,614	1,291	322
Respiratory medication use (children 5-14yr)	Days	Core	O_3	9	4	5
Respiratory medication use (adults 20yr +)	Days	Core	O_3	6	6	0
Cough and LRS (children 0-14yr)	Days	Core	O_3	3,564	1,936	1,628
Chronic Mortality ***(VOLY median)****	Life years lost	Core	PM	280,792	167,111	113,680
Chronic Mortality ***(VOLY mean*)***	Life years lost	Core	PM	630,271	375,102	255,170
Chronic Mortality ***(VSL median)****	Premature deaths	Core	PM	616,310	398,547	217,763
Chronic Mortality ***(VSL mean*)***	Premature deaths	Core	PM	1,268,006	819,977	448,029
Infant Mortality (0-1yr) ***(VSL median)****	Premature deaths	Core	PM	1,754	688	1,066
Infant Mortality (0-1yr) ***(VSL mean*)***	Premature deaths	Core	PM	3,509	1,377	2,132
Chronic Bronchitis (27yr +)	Cases	Core	PM	43,863	33,324	10,539
Respiratory Hospital Admissions (All ages)	Cases	Core	PM	185	110	75
Cardiac Hospital Admissions (All ages)	Cases	Core	PM	114	68	46
Restricted Activity Days (RADs 15-64yr)	Days	Core	PM	42,814	24,581	18,233
Respiratory medication use (children 5-14yr)	Days	Core	PM	5	1	3
Respiratory medication use (adults 20yr +)	Days	Core	PM	37	26	11
LRS symptom days (children 5-14yr)	Days	Core	PM	12,732	4,005	8,727
LRS in adults (15yr +) with chronic symptoms	Days	Core	PM	16,075	10,385	5,690
Total with Mortality – VOLY – low (median)				**404,748**	**244,604**	**160,144**
Total with Mortality – VOLY – high (mean)				**757,431**	**454,573**	**302,858**
Total with Mortality – VSL – low (median)				**740,266**	**476,040**	**264,226**
Total with Mortality – VSL – high (mean)				**1,395,165**	**899,448**	**495,717**

*Note two alternative metrics are used for the presentation of chronic mortality from PM. Firstly in terms of years of life lost and secondly in terms of numbers of premature deaths. There are also two alternative valuations for each, based on a median or mean value from NewExt. These individual valuations are not additive.

Finland

Implementing current EU legislation: Estimated Health damage due to air pollution in 2000 and in 2020

End point	End point output	Function Group		Baseline in 2000	Current legislation in 2020 (including Climate Policy)	Change 2000 to 2020
Acute Mortality (All ages)	Premature deaths	Core	O_3	58	71	-14
Respiratory Hospital Admissions (65yr +)	Cases	Core	O_3	36	89	-53
Minor Restricted Activity Days (MRADs 15-64yr)	Days	Core	O_3	150,830	135,690	15,140
Respiratory medication use (children 5-14yr)	Days	Core	O_3	30,170	22,840	7,330
Respiratory medication use (adults 20yr +)	Days	Core	O_3	24,290	28,210	-3,920
Cough and LRS (children 0-14yr)	Days	Core	O_3	334,900	268,430	66,470
Chronic Mortality *	Life years lost	Core	PM	13,840	11,640	2,200
Chronic Mortality *	Premature deaths	Core	PM	1,270	1,250	20
Infant Mortality (0-1yr)	Premature deaths	Core	PM	2	1	1
Chronic Bronchitis (27yr +)	Cases	Core	PM	620	580	40
Respiratory Hospital Admissions (All ages)	Cases	Core	PM	237	200	38
Cardiac Hospital Admissions (All ages)	Cases	Core	PM	146	123	23
Restricted Activity Days (RADs 15-64yr)	Days	Core	PM	1,323,390	942,660	380,730
Respiratory medication use (children 5-14yr)	Days	Core	PM	11,310	6,780	4,530
Respiratory medication use (adults 20yr +)	Days	Core	PM	104,450	96,060	8,390
LRS symptom days (children 5-14yr)	Days	Core	PM	778,870	466,930	311,940
LRS in adults (15yr +) with chronic symptoms	Days	Core	PM	1,076,630	959,460	117,170

*Note two alternative metrics are used for the presentation of chronic mortality from PM. Firstly in terms of years of life lost and secondly in terms of numbers of premature deaths. These are not additive.

Implementing current EU legislation: Estimated Valuation of the health damage due to air pollution in 2000 and in 2020 in EU25 (€000)

End point	End point output	Function Group		Baseline in 2000	Current legislation in 2020 (+ Clim. Pol.)	Change 2000 to 2020
Acute Mortality ___(VOLY median)*___	Premature deaths	Core	O_3	3,010	3,721	-711
Acute Mortality ___(VOLY mean*)___	Premature deaths	Core	O_3	6,756	8,352	-1,596
Respiratory Hospital Admissions (65yr +)	Cases	Core	O_3	73	179	-106
Minor Restricted Activity Days (MRADs 15-64yr)	Days	Core	O_3	5,794	5,213	582
Respiratory medication use (children 5-14yr)	Days	Core	O_3	28	21	7
Respiratory medication use (adults 20yr +)	Days	Core	O_3	23	26	-4
Cough and LRS (children 0-14yr)	Days	Core	O_3	12,866	10,312	2,554
Chronic Mortality ___(VOLY median)*___	Life years lost	Core	PM	723,434	608,740	114,694
Chronic Mortality ___(VOLY mean*)___	Life years lost	Core	PM	1,623,837	1,366,393	257,444
Chronic Mortality ___(VSL median)*___	Premature deaths	Core	PM	1,245,308	1,227,871	17,436
Chronic Mortality ___(VSL mean*)___	Premature deaths	Core	PM	2,562,116	2,526,242	35,874
Infant Mortality (0-1yr) ___(VSL median)*___	Premature deaths	Core	PM	2,792	1,918	874
Infant Mortality (0-1yr) ___(VSL mean*)___	Premature deaths	Core	PM	5,584	3,836	1,748
Chronic Bronchitis (27yr +)	Cases	Core	PM	115,781	109,435	6,346
Respiratory Hospital Admissions (All ages)	Cases	Core	PM	476	400	75
Cardiac Hospital Admissions (All ages)	Cases	Core	PM	293	247	47
Restricted Activity Days (RADs 15-64yr)	Days	Core	PM	110,371	78,618	31,753
Respiratory medication use (children 5-14yr)	Days	Core	PM	11	6	4
Respiratory medication use (adults 20yr +)	Days	Core	PM	98	90	8
LRS symptom days (children 5-14yr)	Days	Core	PM	29,922	17,938	11,984
LRS in adults (15yr +) with chronic symptoms	Days	Core	PM	41,361	36,860	4,501
Total with Mortality – VOLY – low (median)				**1,046,333**	**873,726**	**172,607**
Total with Mortality – VOLY – high (mean)				**1,953,275**	**1,637,928**	**315,347**
Total with Mortality – VSL – low (median)				**1,568,207**	**1,492,857**	**75,350**
Total with Mortality – VSL – high (mean)				**2,891,553**	**2,797,777**	**93,777**

*Note two alternative metrics are used for the presentation of chronic mortality from PM. Firstly in terms of years of life lost and secondly in terms of numbers of premature deaths. There are also two alternative valuations for each, based on a median or mean value from NewExt. These individual valuations are not additive.

France

Implementing current EU legislation: Estimated Health damage due to air pollution in 2000 and in 2020

End point	End point output	Function Group		Baseline in 2000	Current legislation in 2020 (including Climate Policy)	Change 2000 to 2020
Acute Mortality (All ages)	Premature deaths	Core	O_3	2,780	2,750	30
Respiratory Hospital Admissions (65yr +)	Cases	Core	O_3	1,980	2,840	-860
Minor Restricted Activity Days (MRADs 15-64yr)	Days	Core	O_3	7,479,670	6,081,680	1,397,990
Respiratory medication use (children 5-14yr)	Days	Core	O_3	3,891,440	2,926,000	965,440
Respiratory medication use (adults 20yr +)	Days	Core	O_3	1,221,610	1,143,170	78,440
Cough and LRS (children 0-14yr)	Days	Core	O_3	17,701,870	13,053,260	4,648,610
Chronic Mortality *	Life years lost	Core	PM	482,210	353,160	129,050
Chronic Mortality *	Premature deaths	Core	PM	42,090	34,740	7,350
Infant Mortality (0-1yr)	Premature deaths	Core	PM	112	60	52
Chronic Bronchitis (27yr +)	Cases	Core	PM	21,220	16,760	4,460
Respiratory Hospital Admissions (All ages)	Cases	Core	PM	8,260	6,050	2,210
Cardiac Hospital Admissions (All ages)	Cases	Core	PM	5,100	3,730	1,370
Restricted Activity Days (RADs 15-64yr)	Days	Core	PM	44,935,660	30,238,370	14,697,290
Respiratory medication use (children 5-14yr)	Days	Core	PM	665,660	414,230	251,430
Respiratory medication use (adults 20yr +)	Days	Core	PM	3,596,850	2,785,660	811,190
LRS symptom days (children 5-14yr)	Days	Core	PM	27,513,760	17,121,430	10,392,330
LRS in adults (15yr +) with chronic symptoms	Days	Core	PM	37,202,230	28,357,730	8,844,500

*Note two alternative metrics are used for the presentation of chronic mortality from PM. Firstly in terms of years of life lost and secondly in terms of numbers of premature deaths. These are not additive.

Implementing current EU legislation: Estimated Valuation of the health damage due to air pollution in 2000 and in 2020 in EU25 (€000)

End point	End point output	Function Group		Baseline in 2000	Current legislation in 2020 (+ Clim. Pol.)	Change 2000 to 2020
Acute Mortality ***(VOLY median)****	Premature deaths	Core	O_3	145,379	143,866	1,513
Acute Mortality *(VOLY* ***mean*)***	Premature deaths	Core	O_3	326,321	322,924	3,396
Respiratory Hospital Admissions (65yr +)	Cases	Core	O_3	3,982	5,703	-1,721
Minor Restricted Activity Days (MRADs 15-64yr)	Days	Core	O_3	287,346	233,640	53,707
Respiratory medication use (children 5-14yr)	Days	Core	O_3	3,646	2,742	905
Respiratory medication use (adults 20yr +)	Days	Core	O_3	1,145	1,071	73
Cough and LRS (children 0-14yr)	Days	Core	O_3	680,053	501,467	178,586
Chronic Mortality ***(VOLY median)****	Life years lost	Core	PM	25,212,377	18,464,856	6,747,522
Chronic Mortality ***(VOLY mean*)***	Life years lost	Core	PM	56,592,298	41,446,652	15,145,647
Chronic Mortality ***(VSL median)****	Premature deaths	Core	PM	41,212,538	34,020,003	7,192,535
Chronic Mortality ***(VSL mean*)***	Premature deaths	Core	PM	84,791,346	69,993,307	14,798,039
Infant Mortality (0-1yr) ***(VSL median)****	Premature deaths	Core	PM	156,933	84,001	72,932
Infant Mortality (0-1yr) ***(VSL mean*)***	Premature deaths	Core	PM	313,866	168,002	145,864
Chronic Bronchitis (27yr +)	Cases	Core	PM	3,977,384	3,140,948	836,436
Respiratory Hospital Admissions (All ages)	Cases	Core	PM	16,580	12,143	4,437
Cardiac Hospital Admissions (All ages)	Cases	Core	PM	10,225	7,489	2,737
Restricted Activity Days (RADs 15-64yr)	Days	Core	PM	3,747,634	2,521,880	1,225,754
Respiratory medication use (children 5-14yr)	Days	Core	PM	624	388	236
Respiratory medication use (adults 20yr +)	Days	Core	PM	3,370	2,610	760
LRS symptom days (children 5-14yr)	Days	Core	PM	1,056,996	657,754	399,242
LRS in adults (15yr +) with chronic symptoms	Days	Core	PM	1,429,198	1,089,419	339,779
Total with Mortality – VOLY – low (median)				**36,732,873**	**26,869,976**	**9,862,897**
Total with Mortality – VOLY – high (mean)				**68,450,669**	**50,114,832**	**18,335,837**
Total with Mortality – VSL – low (median)				**52,733,034**	**42,425,123**	**10,307,910**
Total with Mortality – VSL – high (mean)				**96,649,716**	**78,661,487**	**17,988,229**

*Note two alternative metrics are used for the presentation of chronic mortality from PM. Firstly in terms of years of life lost and secondly in terms of numbers of premature deaths. There are also two alternative valuations for each, based on a median or mean value from NewExt. These individual valuations are not additive.

Germany

Implementing current EU legislation: Estimated Health damage due to air pollution in 2000 and in 2020

End point	End point output	Function Group		Baseline in 2000	Current legislation in 2020 (including Climate Policy)	Change 2000 to 2020
Acute Mortality (All ages)	Premature deaths	Core	O_3	4,150	3,790	360
Respiratory Hospital Admissions (65yr +)	Cases	Core	O_3	2,660	3,810	-1,150
Minor Restricted Activity Days (MRADs 15-64yr)	Days	Core	O_3	10,215,160	7,194,260	3,020,900
Respiratory medication use (children 5-14yr)	Days	Core	O_3	4,390,910	2,262,890	2,128,020
Respiratory medication use (adults 20yr +)	Days	Core	O_3	1,687,020	1,427,450	259,570
Cough and LRS (children 0-14yr)	Days	Core	O_3	19,245,810	10,770,780	8,475,030
Chronic Mortality *	Life years lost	Core	PM	756,850	535,940	220,910
Chronic Mortality *	Premature deaths	Core	PM	75,040	62,590	12,450
Infant Mortality (0-1yr)	Premature deaths	Core	PM	110	71	39
Chronic Bronchitis (27yr +)	Cases	Core	PM	35,800	27,700	8,100
Respiratory Hospital Admissions (All ages)	Cases	Core	PM	12,970	9,190	3,780
Cardiac Hospital Admissions (All ages)	Cases	Core	PM	8,000	5,660	2,340
Restricted Activity Days (RADs 15-64yr)	Days	Core	PM	73,588,300	47,030,800	26,557,500
Respiratory medication use (children 5-14yr)	Days	Core	PM	900,640	421,200	479,440
Respiratory medication use (adults 20yr +)	Days	Core	PM	5,956,160	4,573,400	1,382,760
LRS symptom days (children 5-14yr)	Days	Core	PM	37,226,290	17,409,700	19,816,590
LRS in adults (15yr +) with chronic symptoms	Days	Core	PM	60,681,960	45,442,200	15,239,760

*Note two alternative metrics are used for the presentation of chronic mortality from PM. Firstly in terms of years of life lost and secondly in terms of numbers of premature deaths. These are not additive.

Implementing current EU legislation: Estimated Valuation of the health damage due to air pollution in 2000 and in 2020 in EU25 (€000)

End point	End point output	Function Group		Baseline in 2000	Current legislation in 2020 (+ Clim. Pol.)	Change 2000 to 2020
Acute Mortality ***(VOLY median)****	Premature deaths	Core	O_3	216,889	197,982	18,907
Acute Mortality *(VOLY **mean*)***	Premature deaths	Core	O_3	486,834	444,395	42,439
Respiratory Hospital Admissions (65yr +)	Cases	Core	O_3	5,329	7,637	-2,308
Minor Restricted Activity Days (MRADs 15-64yr)	Days	Core	O_3	392,436	276,382	116,054
Respiratory medication use (children 5-14yr)	Days	Core	O_3	4,114	2,120	1,994
Respiratory medication use (adults 20yr +)	Days	Core	O_3	1,581	1,338	243
Cough and LRS (children 0-14yr)	Days	Core	O_3	739,366	413,781	325,585
Chronic Mortality ***(VOLY median)****	Life years lost	Core	PM	39,571,443	28,021,241	11,550,203
Chronic Mortality ***(VOLY mean*)***	Life years lost	Core	PM	88,822,998	62,897,140	25,925,858
Chronic Mortality ***(VSL median)****	Premature deaths	Core	PM	73,473,843	61,282,146	12,191,697
Chronic Mortality ***(VSL mean*)***	Premature deaths	Core	PM	151,166,279	126,082,883	25,083,396
Infant Mortality (0-1yr) ***(VSL median)****	Premature deaths	Core	PM	154,365	99,859	54,506
Infant Mortality (0-1yr) ***(VSL mean*)***	Premature deaths	Core	PM	308,730	199,718	109,013
Chronic Bronchitis (27yr +)	Cases	Core	PM	6,708,027	5,191,153	1,516,874
Respiratory Hospital Admissions (All ages)	Cases	Core	PM	26,022	18,427	7,595
Cardiac Hospital Admissions (All ages)	Cases	Core	PM	16,049	11,365	4,684
Restricted Activity Days (RADs 15-64yr)	Days	Core	PM	6,137,264	3,922,369	2,214,896
Respiratory medication use (children 5-14yr)	Days	Core	PM	844	395	449
Respiratory medication use (adults 20yr +)	Days	Core	PM	5,581	4,285	1,296
LRS symptom days (children 5-14yr)	Days	Core	PM	1,430,122	668,828	761,294
LRS in adults (15yr +) with chronic symptoms	Days	Core	PM	2,331,219	1,745,753	585,466
Total with Mortality – VOLY – low (median)				**57,740,652**	**40,582,914**	**17,157,738**
Total with Mortality – VOLY – high (mean)				**107,416,517**	**75,805,085**	**31,611,432**
Total with Mortality – VSL – low (median)				**91,643,051**	**73,843,819**	**17,799,232**
Total with Mortality – VSL – high (mean)				**169,759,798**	**138,990,829**	**30,768,969**

*Note two alternative metrics are used for the presentation of chronic mortality from PM. Firstly in terms of years of life lost and secondly in terms of numbers of premature deaths. There are also two alternative valuations for each, based on a median or mean value from NewExt. These individual valuations are not additive.

Greece

Implementing current EU legislation: Estimated Health damage due to air pollution in 2000 and in 2020

End point	End point output	Function Group		Baseline in 2000	Current legislation in 2020 (including Climate Policy)	Change 2000 to 2020
Acute Mortality (All ages)	Premature deaths	Core	O_3	711	789	-77
Respiratory Hospital Admissions (65yr +)	Cases	Core	O_3	493	716	-222
Minor Restricted Activity Days (MRADs 15-64yr)	Days	Core	O_3	1,751,840	1,458,310	293,530
Respiratory medication use (children 5-14yr)	Days	Core	O_3	290,190	186,460	103,730
Respiratory medication use (adults 20yr +)	Days	Core	O_3	290,960	288,470	2,490
Cough and LRS (children 0-14yr)	Days	Core	O_3	3,217,250	2,050,400	1,166,850
Chronic Mortality *	Life years lost	Core	PM	71,280	54,450	16,830
Chronic Mortality *	Premature deaths	Core	PM	7,230	6,910	320
Infant Mortality (0-1yr)	Premature deaths	Core	PM	12	6	6
Chronic Bronchitis (27yr +)	Cases	Core	PM	3,270	2,970	300
Respiratory Hospital Admissions (All ages)	Cases	Core	PM	1,220	930	290
Cardiac Hospital Admissions (All ages)	Cases	Core	PM	750	580	170
Restricted Activity Days (RADs 15-64yr)	Days	Core	PM	6,864,590	4,875,280	1,989,310
Respiratory medication use (children 5-14yr)	Days	Core	PM	48,570	26,620	21,950
Respiratory medication use (adults 20yr +)	Days	Core	PM	558,770	472,650	86,120
LRS symptom days (children 5-14yr)	Days	Core	PM	3,345,600	1,834,010	1,511,590
LRS in adults (15yr +) with chronic symptoms	Days	Core	PM	5,751,150	4,641,370	1,109,780

*Note two alternative metrics are used for the presentation of chronic mortality from PM. Firstly in terms of years of life lost and secondly in terms of numbers of premature deaths. These are not additive.

Implementing current EU legislation: Estimated Valuation of the health damage due to air pollution in 2000 and in 2020 in EU25 (€000)

End point	End point output	Function Group		Baseline in 2000	Current legislation in 2020 (+ Clim. Pol.)	Change 2000 to 2020
Acute Mortality ***(VOLY median)****	Premature deaths	Core	O_3	37,196	41,238	-4,043
Acute Mortality *(VOLY* ***mean*)***	Premature deaths	Core	O_3	83,491	92,565	-9,074
Respiratory Hospital Admissions (65yr +)	Cases	Core	O_3	989	1,436	-446
Minor Restricted Activity Days (MRADs 15-64yr)	Days	Core	O_3	67,300	56,024	11,276
Respiratory medication use (children 5-14yr)	Days	Core	O_3	272	175	97
Respiratory medication use (adults 20yr +)	Days	Core	O_3	273	270	2
Cough and LRS (children 0-14yr)	Days	Core	O_3	123,597	78,770	44,827
Chronic Mortality ***(VOLY median)****	Life years lost	Core	PM	3,726,611	2,847,053	879,558
Chronic Mortality ***(VOLY mean*)***	Life years lost	Core	PM	8,364,840	6,390,564	1,974,277
Chronic Mortality ***(VSL median)****	Premature deaths	Core	PM	7,076,729	6,766,543	310,186
Chronic Mortality ***(VSL mean*)***	Premature deaths	Core	PM	14,559,777	13,921,595	638,181
Infant Mortality (0-1yr) ***(VSL median)****	Premature deaths	Core	PM	17,368	9,107	8,261
Infant Mortality (0-1yr) ***(VSL mean*)***	Premature deaths	Core	PM	34,736	18,214	16,522
Chronic Bronchitis (27yr +)	Cases	Core	PM	613,174	556,405	56,769
Respiratory Hospital Admissions (All ages)	Cases	Core	PM	2,451	1,872	578
Cardiac Hospital Admissions (All ages)	Cases	Core	PM	1,511	1,155	357
Restricted Activity Days (RADs 15-64yr)	Days	Core	PM	572,507	406,598	165,909
Respiratory medication use (children 5-14yr)	Days	Core	PM	46	25	21
Respiratory medication use (adults 20yr +)	Days	Core	PM	524	443	81
LRS symptom days (children 5-14yr)	Days	Core	PM	128,528	70,457	58,071
LRS in adults (15yr +) with chronic symptoms	Days	Core	PM	220,942	178,307	42,635
Total with Mortality – VOLY – low (median)				**5,513,289**	**4,249,336**	**1,263,953**
Total with Mortality – VOLY – high (mean)				**10,215,181**	**7,853,280**	**2,361,901**
Total with Mortality – VSL – low (median)				**8,863,406**	**8,168,826**	**694,580**
Total with Mortality – VSL – high (mean)				**16,410,118**	**15,384,312**	**1,025,806**

*Note two alternative metrics are used for the presentation of chronic mortality from PM. Firstly in terms of years of life lost and secondly in terms of numbers of premature deaths. There are also two alternative valuations for each, based on a median or mean value from NewExt. These individual valuations are not additive.

Hungary

Implementing current EU legislation: Estimated Health damage due to air pollution in 2000 and in 2020

End point	End point output	Function Group		Baseline in 2000	Current legislation in 2020 (including Climate Policy)	Change 2000 to 2020
Acute Mortality (All ages)	Premature deaths	Core	O_3	720	515	206
Respiratory Hospital Admissions (65yr +)	Cases	Core	O_3	324	410	-85
Minor Restricted Activity Days (MRADs 15-64yr)	Days	Core	O_3	1,399,830	934,530	465,300
Respiratory medication use (children 5-14yr)	Days	Core	O_3	265,590	100,510	165,080
Respiratory medication use (adults 20yr +)	Days	Core	O_3	223,810	178,330	45,480
Cough and LRS (children 0-14yr)	Days	Core	O_3	2,851,120	1,191,670	1,659,450
Chronic Mortality *	Life years lost	Core	PM	104,090	65,520	38,570
Chronic Mortality *	Premature deaths	Core	PM	12,870	8,410	4,460
Infant Mortality (0-1yr)	Premature deaths	Core	PM	25	11	14
Chronic Bronchitis (27yr +)	Cases	Core	PM	4,590	3,640	950
Respiratory Hospital Admissions (All ages)	Cases	Core	PM	1,780	1,120	660
Cardiac Hospital Admissions (All ages)	Cases	Core	PM	1,100	690	410
Restricted Activity Days (RADs 15-64yr)	Days	Core	PM	10,171,930	6,161,890	4,010,040
Respiratory medication use (children 5-14yr)	Days	Core	PM	82,430	28,300	54,130
Respiratory medication use (adults 20yr +)	Days	Core	PM	797,070	576,290	220,780
LRS symptom days (children 5-14yr)	Days	Core	PM	5,678,320	1,949,800	3,728,520
LRS in adults (15yr +) with chronic symptoms	Days	Core	PM	8,211,780	5,653,480	2,558,300

*Note two alternative metrics are used for the presentation of chronic mortality from PM. Firstly in terms of years of life lost and secondly in terms of numbers of premature deaths. These are not additive.

Implementing current EU legislation: Estimated Valuation of the health damage due to air pollution in 2000 and in 2020 in EU25 (€000)

End point	End point output	Function Group		Baseline in 2000	Current legislation in 2020 (+ Clim. Pol.)	Change 2000 to 2020
Acute Mortality ***(VOLY median)****	Premature deaths	Core	O_3	37,662	26,902	10,760
Acute Mortality *(VOLY* ***mean*)***	Premature deaths	Core	O_3	84,536	60,385	24,151
Respiratory Hospital Admissions (65yr +)	Cases	Core	O_3	651	822	-171
Minor Restricted Activity Days (MRADs 15-64yr)	Days	Core	O_3	53,777	35,902	17,876
Respiratory medication use (children 5-14yr)	Days	Core	O_3	249	94	155
Respiratory medication use (adults 20yr +)	Days	Core	O_3	210	167	43
Cough and LRS (children 0-14yr)	Days	Core	O_3	109,531	45,780	63,751
Chronic Mortality ***(VOLY median)****	Life years lost	Core	PM	5,442,245	3,425,915	2,016,330
Chronic Mortality ***(VOLY mean*)***	Life years lost	Core	PM	12,215,793	7,689,891	4,525,902
Chronic Mortality ***(VSL median)****	Premature deaths	Core	PM	12,600,302	8,235,699	4,364,603
Chronic Mortality ***(VSL mean*)***	Premature deaths	Core	PM	25,924,067	16,944,262	8,979,805
Infant Mortality (0-1yr) ***(VSL median)****	Premature deaths	Core	PM	35,526	15,759	19,767
Infant Mortality (0-1yr) ***(VSL mean*)***	Premature deaths	Core	PM	71,053	31,518	39,535
Chronic Bronchitis (27yr +)	Cases	Core	PM	860,076	682,058	178,019
Respiratory Hospital Admissions (All ages)	Cases	Core	PM	3,579	2,253	1,326
Cardiac Hospital Admissions (All ages)	Cases	Core	PM	2,207	1,389	818
Restricted Activity Days (RADs 15-64yr)	Days	Core	PM	848,339	513,902	334,437
Respiratory medication use (children 5-14yr)	Days	Core	PM	77	27	51
Respiratory medication use (adults 20yr +)	Days	Core	PM	747	540	207
LRS symptom days (children 5-14yr)	Days	Core	PM	218,144	74,905	143,238
LRS in adults (15yr +) with chronic symptoms	Days	Core	PM	315,472	217,190	98,282
Total with Mortality – VOLY – low (median)				**7,928,492**	**5,043,605**	**2,884,887**
Total with Mortality – VOLY – high (mean)				**14,784,441**	**9,356,822**	**5,427,619**
Total with Mortality – VSL – low (median)				**15,086,549**	**9,853,389**	**5,233,160**
Total with Mortality – VSL – high (mean)				**28,492,715**	**18,611,193**	**9,881,521**

*Note two alternative metrics are used for the presentation of chronic mortality from PM. Firstly in terms of years of life lost and secondly in terms of numbers of premature deaths. There are also two alternative valuations for each, based on a median or mean value from NewExt. These individual valuations are not additive.

Ireland

Implementing current EU legislation: Estimated Health damage due to air pollution in 2000 and in 2020

End point	End point output	Function Group		Baseline in 2000	Current legislation in 2020 (including Climate Policy)	Change 2000 to 2020
Acute Mortality (All ages)	Premature deaths	Core	O_3	71	96	-25
Respiratory Hospital Admissions (65yr +)	Cases	Core	O_3	40	89	-49
Minor Restricted Activity Days (MRADs 15-64yr)	Days	Core	O_3	219,580	269,790	-50,210
Respiratory medication use (children 5-14yr)	Days	Core	O_3	128,940	138,960	-10,020
Respiratory medication use (adults 20yr +)	Days	Core	O_3	32,460	47,330	-14,870
Cough and LRS (children 0-14yr)	Days	Core	O_3	577,100	624,660	-47,560
Chronic Mortality *	Life years lost	Core	PM	14,630	11,410	3,220
Chronic Mortality *	Premature deaths	Core	PM	1,170	960	210
Infant Mortality (0-1yr)	Premature deaths	Core	PM	4	2	2
Chronic Bronchitis (27yr +)	Cases	Core	PM	570	560	10
Respiratory Hospital Admissions (All ages)	Cases	Core	PM	251	196	55
Cardiac Hospital Admissions (All ages)	Cases	Core	PM	155	121	34
Restricted Activity Days (RADs 15-64yr)	Days	Core	PM	1,403,960	1,041,170	362,790
Respiratory medication use (children 5-14yr)	Days	Core	PM	23,470	15,270	8,200
Respiratory medication use (adults 20yr +)	Days	Core	PM	101,720	89,510	12,210
LRS symptom days (children 5-14yr)	Days	Core	PM	970,300	631,150	339,150
LRS in adults (15yr +) with chronic symptoms	Days	Core	PM	1,091,130	891,240	199,890

*Note two alternative metrics are used for the presentation of chronic mortality from PM. Firstly in terms of years of life lost and secondly in terms of numbers of premature deaths. These are not additive.

Implementing current EU legislation: Estimated Valuation of the health damage due to air pollution in 2000 and in 2020 in EU25 (€000)

End point	End point output	Function Group		Baseline in 2000	Current legislation in 2020 (+ Clim. Pol.)	Change 2000 to 2020
Acute Mortality ***(VOLY median)****	Premature deaths	Core	O_3	3,699	5,011	-1,312
Acute Mortality *(VOLY **mean*)***	Premature deaths	Core	O_3	8,302	11,247	-2,945
Respiratory Hospital Admissions (65yr +)	Cases	Core	O_3	80	178	-98
Minor Restricted Activity Days (MRADs 15-64yr)	Days	Core	O_3	8,435	10,364	-1,929
Respiratory medication use (children 5-14yr)	Days	Core	O_3	121	130	-9
Respiratory medication use (adults 20yr +)	Days	Core	O_3	30	44	-14
Cough and LRS (children 0-14yr)	Days	Core	O_3	22,171	23,998	-1,827
Chronic Mortality ***(VOLY median)****	Life years lost	Core	PM	764,933	596,714	168,219
Chronic Mortality ***(VOLY mean*)***	Life years lost	Core	PM	1,716,987	1,339,398	377,589
Chronic Mortality ***(VSL median)****	Premature deaths	Core	PM	1,140,779	943,635	197,145
Chronic Mortality ***(VSL mean*)***	Premature deaths	Core	PM	2,347,058	1,941,450	405,609
Infant Mortality (0-1yr) ***(VSL median)****	Premature deaths	Core	PM	5,569	2,800	2,769
Infant Mortality (0-1yr) ***(VSL mean*)***	Premature deaths	Core	PM	11,139	5,600	5,538
Chronic Bronchitis (27yr +)	Cases	Core	PM	107,009	104,829	2,179
Respiratory Hospital Admissions (All ages)	Cases	Core	PM	503	392	111
Cardiac Hospital Admissions (All ages)	Cases	Core	PM	310	242	68
Restricted Activity Days (RADs 15-64yr)	Days	Core	PM	117,091	86,834	30,257
Respiratory medication use (children 5-14yr)	Days	Core	PM	22	14	8
Respiratory medication use (adults 20yr +)	Days	Core	PM	95	84	11
LRS symptom days (children 5-14yr)	Days	Core	PM	37,276	24,247	13,029
LRS in adults (15yr +) with chronic symptoms	Days	Core	PM	41,918	34,239	7,679
Total with Mortality – VOLY – low (median)				**1,109,263**	**890,121**	**219,141**
Total with Mortality – VOLY – high (mean)				**2,071,490**	**1,641,842**	**429,647**
Total with Mortality – VSL – low (median)				**1,485,109**	**1,237,042**	**248,067**
Total with Mortality – VSL – high (mean)				**2,701,560**	**2,243,893**	**457,667**

*Note two alternative metrics are used for the presentation of chronic mortality from PM. Firstly in terms of years of life lost and secondly in terms of numbers of premature deaths. There are also two alternative valuations for each, based on a median or mean value from NewExt. These individual valuations are not additive.

Italy

Implementing current EU legislation: Estimated Health damage due to air pollution in 2000 and in 2020

End point	End point output	Function Group		Baseline in 2000	Current legislation in 2020 (including Climate Policy)	Change 2000 to 2020
Acute Mortality (All ages)	Premature deaths	Core	O_3	5,030	4,710	320
Respiratory Hospital Admissions (65yr +)	Cases	Core	O_3	3,470	4,480	-1,010
Minor Restricted Activity Days (MRADs 15-64yr)	Days	Core	O_3	11,978,610	8,200,710	3,777,900
Respiratory medication use (children 5-14yr)	Days	Core	O_3	4,643,200	2,346,900	2,296,300
Respiratory medication use (adults 20yr +)	Days	Core	O_3	2,033,710	1,650,130	383,580
Cough and LRS (children 0-14yr)	Days	Core	O_3	20,766,430	10,351,480	10,414,950
Chronic Mortality *	Life years lost	Core	PM	497,840	295,790	202,050
Chronic Mortality *	Premature deaths	Core	PM	50,690	37,890	12,800
Infant Mortality (0-1yr)	Premature deaths	Core	PM	76	33	43
Chronic Bronchitis (27yr +)	Cases	Core	PM	23,820	15,970	7,850
Respiratory Hospital Admissions (All ages)	Cases	Core	PM	8,530	5,070	3,460
Cardiac Hospital Admissions (All ages)	Cases	Core	PM	5,260	3,130	2,130
Restricted Activity Days (RADs 15-64yr)	Days	Core	PM	48,105,300	26,096,340	22,008,960
Respiratory medication use (children 5-14yr)	Days	Core	PM	530,930	212,640	318,290
Respiratory medication use (adults 20yr +)	Days	Core	PM	4,002,740	2,573,530	1,429,210
LRS symptom days (children 5-14yr)	Days	Core	PM	21,944,990	8,789,290	13,155,700
LRS in adults (15yr +) with chronic symptoms	Days	Core	PM	40,548,130	25,597,890	14,950,240

*Note two alternative metrics are used for the presentation of chronic mortality from PM. Firstly in terms of years of life lost and secondly in terms of numbers of premature deaths. These are not additive.

Implementing current EU legislation: Estimated Valuation of the health damage due to air pollution in 2000 and in 2020 in EU25 (€000)

End point	End point output	Function Group		Baseline in 2000	Current legislation in 2020 (+ Clim. Pol.)	Change 2000 to 2020
Acute Mortality ***(VOLY median)****	Premature deaths	Core	O_3	263,159	246,197	16,963
Acute Mortality *(VOLY* ***mean*)***	Premature deaths	Core	O_3	590,693	552,619	38,075
Respiratory Hospital Admissions (65yr +)	Cases	Core	O_3	6,965	8,996	-2,031
Minor Restricted Activity Days (MRADs 15-64yr)	Days	Core	O_3	460,182	315,047	145,135
Respiratory medication use (children 5-14yr)	Days	Core	O_3	4,351	2,199	2,152
Respiratory medication use (adults 20yr +)	Days	Core	O_3	1,906	1,546	359
Cough and LRS (children 0-14yr)	Days	Core	O_3	797,784	397,673	400,111
Chronic Mortality ***(VOLY median)****	Life years lost	Core	PM	26,029,488	15,465,294	10,564,195
Chronic Mortality ***(VOLY mean*)***	Life years lost	Core	PM	58,426,405	34,713,764	23,712,642
Chronic Mortality ***(VSL median)****	Premature deaths	Core	PM	49,634,564	37,101,257	12,533,306
Chronic Mortality ***(VSL mean*)***	Premature deaths	Core	PM	102,118,958	76,332,730	25,786,228
Infant Mortality (0-1yr) ***(VSL median)****	Premature deaths	Core	PM	106,416	46,335	60,081
Infant Mortality (0-1yr) ***(VSL mean*)***	Premature deaths	Core	PM	212,831	92,670	120,162
Chronic Bronchitis (27yr +)	Cases	Core	PM	4,463,187	2,992,746	1,470,440
Respiratory Hospital Admissions (All ages)	Cases	Core	PM	17,117	10,170	6,947
Cardiac Hospital Admissions (All ages)	Cases	Core	PM	10,557	6,272	4,285
Restricted Activity Days (RADs 15-64yr)	Days	Core	PM	4,011,982	2,176,435	1,835,547
Respiratory medication use (children 5-14yr)	Days	Core	PM	497	199	298
Respiratory medication use (adults 20yr +)	Days	Core	PM	3,751	2,411	1,339
LRS symptom days (children 5-14yr)	Days	Core	PM	843,061	337,658	505,403
LRS in adults (15yr +) with chronic symptoms	Days	Core	PM	1,557,738	983,394	574,344
Total with Mortality – VOLY – low (median)				**38,578,140**	**22,992,572**	**15,585,568**
Total with Mortality – VOLY – high (mean)				**71,409,007**	**42,593,799**	**28,815,208**
Total with Mortality – VSL – low (median)				**62,183,215**	**44,628,536**	**17,554,679**
Total with Mortality – VSL – high (mean)				**115,101,560**	**84,212,766**	**30,888,794**

*Note two alternative metrics are used for the presentation of chronic mortality from PM. Firstly in terms of years of life lost and secondly in terms of numbers of premature deaths. There are also two alternative valuations for each, based on a median or mean value from NewExt. These individual valuations are not additive.

Latvia

Implementing current EU legislation: Estimated Health damage due to air pollution in 2000 and in 2020

End point	End point output	Function Group		Baseline in 2000	Current legislation in 2020 (including Climate Policy)	Change 2000 to 2020
Acute Mortality (All ages)	Premature deaths	Core	O_3	74	67	7
Respiratory Hospital Admissions (65yr +)	Cases	Core	O_3	34	48	-14
Minor Restricted Activity Days (MRADs 15-64yr)	Days	Core	O_3	138,820	117,090	21,730
Respiratory medication use (children 5-14yr)	Days	Core	O_3	31,140	11,390	19,750
Respiratory medication use (adults 20yr +)	Days	Core	O_3	22,080	22,660	-580
Cough and LRS (children 0-14yr)	Days	Core	O_3	306,630	144,030	162,600
Chronic Mortality *	Life years lost	Core	PM	16,590	10,430	6,160
Chronic Mortality *	Premature deaths	Core	PM	1,330	910	420
Infant Mortality (0-1yr)	Premature deaths	Core	PM	4	2	2
Chronic Bronchitis (27yr +)	Cases	Core	PM	730	600	130
Respiratory Hospital Admissions (All ages)	Cases	Core	PM	284	179	106
Cardiac Hospital Admissions (All ages)	Cases	Core	PM	175	110	65
Restricted Activity Days (RADs 15-64yr)	Days	Core	PM	1,584,910	999,690	585,220
Respiratory medication use (children 5-14yr)	Days	Core	PM	15,190	4,150	11,040
Respiratory medication use (adults 20yr +)	Days	Core	PM	123,530	94,820	28,710
LRS symptom days (children 5-14yr)	Days	Core	PM	1,046,190	286,020	760,170
LRS in adults (15yr +) with chronic symptoms	Days	Core	PM	1,292,240	904,880	387,360

*Note two alternative metrics are used for the presentation of chronic mortality from PM. Firstly in terms of years of life lost and secondly in terms of numbers of premature deaths. These are not additive.

Implementing current EU legislation: Estimated Valuation of the health damage due to air pollution in 2000 and in 2020 in EU25 (€000)

End point	End point output	Function Group		Baseline in 2000	Current legislation in 2020 (+ Clim. Pol.)	Change 2000 to 2020
Acute Mortality ***(VOLY median)****	Premature deaths	Core	O_3	3,848	3,496	352
Acute Mortality *(VOLY* ***mean*)***	Premature deaths	Core	O_3	8,636	7,847	790
Respiratory Hospital Admissions (65yr +)	Cases	Core	O_3	68	96	-28
Minor Restricted Activity Days (MRADs 15-64yr)	Days	Core	O_3	5,333	4,498	835
Respiratory medication use (children 5-14yr)	Days	Core	O_3	29	11	19
Respiratory medication use (adults 20yr +)	Days	Core	O_3	21	21	-1
Cough and LRS (children 0-14yr)	Days	Core	O_3	11,780	5,533	6,247
Chronic Mortality ***(VOLY median)****	Life years lost	Core	PM	867,150	545,082	322,069
Chronic Mortality ***(VOLY mean*)***	Life years lost	Core	PM	1,946,426	1,223,503	722,923
Chronic Mortality ***(VSL median)****	Premature deaths	Core	PM	1,300,726	895,307	405,419
Chronic Mortality ***(VSL mean*)***	Premature deaths	Core	PM	2,676,134	1,842,019	834,115
Infant Mortality (0-1yr) ***(VSL median)****	Premature deaths	Core	PM	5,818	2,439	3,379
Infant Mortality (0-1yr) ***(VSL mean*)***	Premature deaths	Core	PM	11,637	4,879	6,758
Chronic Bronchitis (27yr +)	Cases	Core	PM	135,939	112,633	23,305
Respiratory Hospital Admissions (All ages)	Cases	Core	PM	570	358	212
Cardiac Hospital Admissions (All ages)	Cases	Core	PM	352	221	131
Restricted Activity Days (RADs 15-64yr)	Days	Core	PM	132,182	83,374	48,808
Respiratory medication use (children 5-14yr)	Days	Core	PM	14	4	10
Respiratory medication use (adults 20yr +)	Days	Core	PM	116	89	27
LRS symptom days (children 5-14yr)	Days	Core	PM	40,191	10,988	29,203
LRS in adults (15yr +) with chronic symptoms	Days	Core	PM	49,644	34,763	14,881
Total with Mortality – VOLY – low (median)				**1,253,054**	**803,606**	**449,448**
Total with Mortality – VOLY – high (mean)				**2,342,937**	**1,488,818**	**854,119**
Total with Mortality – VSL – low (median)				**1,686,630**	**1,153,832**	**532,798**
Total with Mortality – VSL – high (mean)				**3,072,645**	**2,107,334**	**965,311**

*Note two alternative metrics are used for the presentation of chronic mortality from PM. Firstly in terms of years of life lost and secondly in terms of numbers of premature deaths. There are also two alternative valuations for each, based on a median or mean value from NewExt. These individual valuations are not additive.

Lithuania

Implementing current EU legislation: Estimated Health damage due to air pollution in 2000 and in 2020

End point	End point output	Function Group		Baseline in 2000	Current legislation in 2020 (including Climate Policy)	Change 2000 to 2020
Acute Mortality (All ages)	Premature deaths	Core	O_3	55	53	2
Respiratory Hospital Admissions (65yr +)	Cases	Core	O_3	28	37	-9
Minor Restricted Activity Days (MRADs 15-64yr)	Days	Core	O_3	119,670	105,880	13,790
Respiratory medication use (children 5-14yr)	Days	Core	O_3	28,900	14,010	14,890
Respiratory medication use (adults 20yr +)	Days	Core	O_3	18,780	19,090	-310
Cough and LRS (children 0-14yr)	Days	Core	O_3	299,060	169,960	129,100
Chronic Mortality *	Life years lost	Core	PM	14,650	10,020	4,630
Chronic Mortality *	Premature deaths	Core	PM	2,190	1,680	510
Infant Mortality (0-1yr)	Premature deaths	Core	PM	7	4	3
Chronic Bronchitis (27yr +)	Cases	Core	PM	620	520	100
Respiratory Hospital Admissions (All ages)	Cases	Core	PM	251	172	79
Cardiac Hospital Admissions (All ages)	Cases	Core	PM	155	106	49
Restricted Activity Days (RADs 15-64yr)	Days	Core	PM	1,379,450	959,580	419,870
Respiratory medication use (children 5-14yr)	Days	Core	PM	14,230	5,420	8,810
Respiratory medication use (adults 20yr +)	Days	Core	PM	106,100	84,800	21,300
LRS symptom days (children 5-14yr)	Days	Core	PM	980,290	373,520	606,770
LRS in adults (15yr +) with chronic symptoms	Days	Core	PM	1,112,800	836,200	276,600

*Note two alternative metrics are used for the presentation of chronic mortality from PM. Firstly in terms of years of life lost and secondly in terms of numbers of premature deaths. These are not additive.

Implementing current EU legislation: Estimated Valuation of the health damage due to air pollution in 2000 and in 2020 in EU25 (€000)

End point	End point output	Function Group		Baseline in 2000	Current legislation in 2020 (+ Clim. Pol.)	Change 2000 to 2020
Acute Mortality ***(VOLY median)****	Premature deaths	Core	O_3	2,871	2,756	115
Acute Mortality *(VOLY* ***mean*)***	Premature deaths	Core	O_3	6,445	6,187	258
Respiratory Hospital Admissions (65yr +)	Cases	Core	O_3	55	73	-18
Minor Restricted Activity Days (MRADs 15-64yr)	Days	Core	O_3	4,597	4,068	530
Respiratory medication use (children 5-14yr)	Days	Core	O_3	27	13	14
Respiratory medication use (adults 20yr +)	Days	Core	O_3	18	18	0
Cough and LRS (children 0-14yr)	Days	Core	O_3	11,489	6,529	4,960
Chronic Mortality ***(VOLY median)****	Life years lost	Core	PM	766,035	523,941	242,094
Chronic Mortality ***(VOLY mean*)***	Life years lost	Core	PM	1,719,460	1,176,051	543,409
Chronic Mortality ***(VSL median)****	Premature deaths	Core	PM	2,147,982	1,644,319	503,663
Chronic Mortality ***(VSL mean*)***	Premature deaths	Core	PM	4,419,293	3,383,049	1,036,245
Infant Mortality (0-1yr) ***(VSL median)****	Premature deaths	Core	PM	9,340	4,983	4,358
Infant Mortality (0-1yr) ***(VSL mean*)***	Premature deaths	Core	PM	18,680	9,965	8,715
Chronic Bronchitis (27yr +)	Cases	Core	PM	116,742	96,882	19,860
Respiratory Hospital Admissions (All ages)	Cases	Core	PM	504	345	159
Cardiac Hospital Admissions (All ages)	Cases	Core	PM	311	212	98
Restricted Activity Days (RADs 15-64yr)	Days	Core	PM	115,046	80,029	35,018
Respiratory medication use (children 5-14yr)	Days	Core	PM	13	5	8
Respiratory medication use (adults 20yr +)	Days	Core	PM	99	79	20
LRS symptom days (children 5-14yr)	Days	Core	PM	37,660	14,349	23,310
LRS in adults (15yr +) with chronic symptoms	Days	Core	PM	42,751	32,124	10,626
Total with Mortality – VOLY – low (median)				**1,107,559**	**766,408**	**341,151**
Total with Mortality – VOLY – high (mean)				**2,073,898**	**1,426,931**	**646,967**
Total with Mortality – VSL – low (median)				**2,489,506**	**1,886,785**	**602,721**
Total with Mortality – VSL – high (mean)				**4,773,731**	**3,633,928**	**1,139,803**

*Note two alternative metrics are used for the presentation of chronic mortality from PM. Firstly in terms of years of life lost and secondly in terms of numbers of premature deaths. There are also two alternative valuations for each, based on a median or mean value from NewExt. These individual valuations are not additive.

Luxembourg

Implementing current EU legislation: Estimated Health damage due to air pollution in 2000 and in 2020

End point	End point output	Function Group		Baseline in 2000	Current legislation in 2020 (including Climate Policy)	Change 2000 to 2020
Acute Mortality (All ages)	Premature deaths	Core	O_3	16	16	-1
Respiratory Hospital Admissions (65yr +)	Cases	Core	O_3	11	14	-3
Minor Restricted Activity Days (MRADs 15-64yr)	Days	Core	O_3	49,420	52,800	-3,380
Respiratory medication use (children 5-14yr)	Days	Core	O_3	24,550	21,920	2,630
Respiratory medication use (adults 20yr +)	Days	Core	O_3	7,930	8,710	-780
Cough and LRS (children 0-14yr)	Days	Core	O_3	113,470	97,790	15,680
Chronic Mortality *	Life years lost	Core	PM	4,090	3,650	440
Chronic Mortality *	Premature deaths	Core	PM	320	290	30
Infant Mortality (0-1yr)	Premature deaths	Core	PM	1	0	0
Chronic Bronchitis (27yr +)	Cases	Core	PM	184	174	10
Respiratory Hospital Admissions (All ages)	Cases	Core	PM	70	63	8
Cardiac Hospital Admissions (All ages)	Cases	Core	PM	43	39	5
Restricted Activity Days (RADs 15-64yr)	Days	Core	PM	392,680	355,960	36,720
Respiratory medication use (children 5-14yr)	Days	Core	PM	5,550	4,210	1,340
Respiratory medication use (adults 20yr +)	Days	Core	PM	30,860	28,790	2,070
LRS symptom days (children 5-14yr)	Days	Core	PM	229,600	173,860	55,740
LRS in adults (15yr +) with chronic symptoms	Days	Core	PM	315,590	293,900	21,690

*Note two alternative metrics are used for the presentation of chronic mortality from PM. Firstly in terms of years of life lost and secondly in terms of numbers of premature deaths. These are not additive.

Implementing current EU legislation: Estimated Valuation of the health damage due to air pollution in 2000 and in 2020 in EU25 (€000)

End point	End point output	Function Group		Baseline in 2000	Current legislation in 2020 (+ Clim. Pol.)	Change 2000 to 2020
Acute Mortality ***(VOLY median)****	Premature deaths	Core	O_3	822	854	-32
Acute Mortality *(VOLY* ***mean*)***	Premature deaths	Core	O_3	1,845	1,916	-71
Respiratory Hospital Admissions (65yr +)	Cases	Core	O_3	22	28	-5
Minor Restricted Activity Days (MRADs 15-64yr)	Days	Core	O_3	1,898	2,029	-130
Respiratory medication use (children 5-14yr)	Days	Core	O_3	23	21	2
Respiratory medication use (adults 20yr +)	Days	Core	O_3	7	8	-1
Cough and LRS (children 0-14yr)	Days	Core	O_3	4,359	3,757	602
Chronic Mortality ***(VOLY median)****	Life years lost	Core	PM	213,857	190,711	23,146
Chronic Mortality ***(VOLY mean*)***	Life years lost	Core	PM	480,029	428,076	51,954
Chronic Mortality ***(VSL median)****	Premature deaths	Core	PM	314,496	279,131	35,365
Chronic Mortality ***(VSL mean*)***	Premature deaths	Core	PM	647,049	574,288	72,760
Infant Mortality (0-1yr) ***(VSL median)****	Premature deaths	Core	PM	1,041	665	376
Infant Mortality (0-1yr) ***(VSL mean*)***	Premature deaths	Core	PM	2,082	1,331	751
Chronic Bronchitis (27yr +)	Cases	Core	PM	34,397	32,522	1,875
Respiratory Hospital Admissions (All ages)	Cases	Core	PM	141	125	15
Cardiac Hospital Admissions (All ages)	Cases	Core	PM	87	77	9
Restricted Activity Days (RADs 15-64yr)	Days	Core	PM	32,750	29,687	3,063
Respiratory medication use (children 5-14yr)	Days	Core	PM	5	4	1
Respiratory medication use (adults 20yr +)	Days	Core	PM	29	27	2
LRS symptom days (children 5-14yr)	Days	Core	PM	8,820	6,679	2,141
LRS in adults (15yr +) with chronic symptoms	Days	Core	PM	12,124	11,291	833
Total with Mortality – VOLY – low (median)				**310,383**	**278,484**	**31,899**
Total with Mortality – VOLY – high (mean)				**578,619**	**517,576**	**61,043**
Total with Mortality – VSL – low (median)				**411,021**	**366,904**	**44,118**
Total with Mortality – VSL – high (mean)				**745,638**	**663,789**	**81,849**

*Note two alternative metrics are used for the presentation of chronic mortality from PM. Firstly in terms of years of life lost and secondly in terms of numbers of premature deaths. There are also two alternative valuations for each, based on a median or mean value from NewExt. These individual valuations are not additive.

Malta

Implementing current EU legislation: Estimated Health damage due to air pollution in 2000 and in 2020

End point	End point output	Function Group		Baseline in 2000	Current legislation in 2020 (including Climate Policy)	Change 2000 to 2020
Acute Mortality (All ages)	Premature deaths	Core	O_3	21	25	-4
Respiratory Hospital Admissions (65yr +)	Cases	Core	O_3	14	35	-21
Minor Restricted Activity Days (MRADs 15-64yr)	Days	Core	O_3	70,020	56,540	13,480
Respiratory medication use (children 5-14yr)	Days	Core	O_3	15,500	9,560	5,940
Respiratory medication use (adults 20yr +)	Days	Core	O_3	10,720	11,450	-730
Cough and LRS (children 0-14yr)	Days	Core	O_3	170,380	111,660	58,720
Chronic Mortality *	Life years lost	Core	PM	2,630	2,080	550
Chronic Mortality *	Premature deaths	Core	PM	192	206	-13
Infant Mortality (0-1yr)	Premature deaths	Core	PM	1	0	0
Chronic Bronchitis (27yr +)	Cases	Core	PM	110	107	4
Respiratory Hospital Admissions (All ages)	Cases	Core	PM	45	36	9
Cardiac Hospital Admissions (All ages)	Cases	Core	PM	28	22	6
Restricted Activity Days (RADs 15-64yr)	Days	Core	PM	253,550	174,040	79,510
Respiratory medication use (children 5-14yr)	Days	Core	PM	2,400	1,260	1,140
Respiratory medication use (adults 20yr +)	Days	Core	PM	19,030	17,270	1,760
LRS symptom days (children 5-14yr)	Days	Core	PM	165,160	86,540	78,620
LRS in adults (15yr +) with chronic symptoms	Days	Core	PM	199,440	170,740	28,700

*Note two alternative metrics are used for the presentation of chronic mortality from PM. Firstly in terms of years of life lost and secondly in terms of numbers of premature deaths. These are not additive.

Implementing current EU legislation: Estimated Valuation of the health damage due to air pollution in 2000 and in 2020 in EU25 (€000)

End point	End point output	Function Group		Baseline in 2000	Current legislation in 2020 (+ Clim. Pol.)	Change 2000 to 2020
Acute Mortality ***(VOLY median)****	Premature deaths	Core	O_3	1,115	1,314	-198
Acute Mortality *(VOLY* ***mean*)***	Premature deaths	Core	O_3	2,504	2,949	-445
Respiratory Hospital Admissions (65yr +)	Cases	Core	O_3	28	69	-41
Minor Restricted Activity Days (MRADs 15-64yr)	Days	Core	O_3	2,690	2,172	518
Respiratory medication use (children 5-14yr)	Days	Core	O_3	15	9	6
Respiratory medication use (adults 20yr +)	Days	Core	O_3	10	11	-1
Cough and LRS (children 0-14yr)	Days	Core	O_3	6,545	4,289	2,256
Chronic Mortality ***(VOLY median)****	Life years lost	Core	PM	137,253	108,568	28,684
Chronic Mortality ***(VOLY mean*)***	Life years lost	Core	PM	308,081	243,695	64,385
Chronic Mortality ***(VSL median)****	Premature deaths	Core	PM	188,249	201,299	-13,051
Chronic Mortality ***(VSL mean*)***	Premature deaths	Core	PM	387,306	414,156	-26,850
Infant Mortality (0-1yr) ***(VSL median)****	Premature deaths	Core	PM	908	416	492
Infant Mortality (0-1yr) ***(VSL mean*)***	Premature deaths	Core	PM	1,816	832	984
Chronic Bronchitis (27yr +)	Cases	Core	PM	20,660	19,958	702
Respiratory Hospital Admissions (All ages)	Cases	Core	PM	90	71	19
Cardiac Hospital Admissions (All ages)	Cases	Core	PM	56	44	12
Restricted Activity Days (RADs 15-64yr)	Days	Core	PM	21,146	14,515	6,631
Respiratory medication use (children 5-14yr)	Days	Core	PM	2	1	1
Respiratory medication use (adults 20yr +)	Days	Core	PM	18	16	2
LRS symptom days (children 5-14yr)	Days	Core	PM	6,345	3,324	3,020
LRS in adults (15yr +) with chronic symptoms	Days	Core	PM	7,662	6,559	1,103
Total with Mortality – VOLY – low (median)				**204,543**	**161,339**	**43,203**
Total with Mortality – VOLY – high (mean)				**377,667**	**298,518**	**79,149**
Total with Mortality – VSL – low (median)				**255,539**	**254,070**	**1,469**
Total with Mortality – VSL – high (mean)				**456,892**	**468,978**	**-12,086**

*Note two alternative metrics are used for the presentation of chronic mortality from PM. Firstly in terms of years of life lost and secondly in terms of numbers of premature deaths. There are also two alternative valuations for each, based on a median or mean value from NewExt. These individual valuations are not additive.

Netherlands

Implementing current EU legislation: Estimated Health damage due to air pollution in 2000 and in 2020

End point	End point output	Function Group		Baseline in 2000	Current legislation in 2010	Current legislation in 2020 (including Climate Policy)
Acute Mortality (All ages)	Premature deaths	Core	O_3	415	460	-45
Respiratory Hospital Admissions (65yr +)	Cases	Core	O_3	264	497	-233
Minor Restricted Activity Days (MRADs 15-64yr)	Days	Core	O_3	1,215,090	1,050,770	164,320
Respiratory medication use (children 5-14yr)	Days	Core	O_3	595,860	402,820	193,040
Respiratory medication use (adults 20yr +)	Days	Core	O_3	193,610	195,100	-1,490
Cough and LRS (children 0-14yr)	Days	Core	O_3	2,710,230	1,819,750	890,480
Chronic Mortality *	Life years lost	Core	PM	184,160	139,330	44,830
Chronic Mortality *	Premature deaths	Core	PM	15,540	13,970	1,570
Infant Mortality (0-1yr)	Premature deaths	Core	PM	33	20	13
Chronic Bronchitis (27yr +)	Cases	Core	PM	8,310	6,760	1,550
Respiratory Hospital Admissions (All ages)	Cases	Core	PM	3,160	2,390	770
Cardiac Hospital Admissions (All ages)	Cases	Core	PM	1,950	1,470	480
Restricted Activity Days (RADs 15-64yr)	Days	Core	PM	17,869,290	12,436,060	5,433,230
Respiratory medication use (children 5-14yr)	Days	Core	PM	249,500	135,740	113,760
Respiratory medication use (adults 20yr +)	Days	Core	PM	1,395,410	1,131,640	263,770
LRS symptom days (children 5-14yr)	Days	Core	PM	10,312,850	5,610,760	4,702,090
LRS in adults (15yr +) with chronic symptoms	Days	Core	PM	14,269,020	11,566,260	2,702,760

*Note two alternative metrics are used for the presentation of chronic mortality from PM. Firstly in terms of years of life lost and secondly in terms of numbers of premature deaths. These are not additive.

Implementing current EU legislation: Estimated Valuation of the health damage due to air pollution in 2000 and in 2020 in EU25 (€000)

End point	End point output	Function Group		Baseline in 2000	Current legislation in 2020 (+ Clim. Pol.)	Change 2000 to 2020
Acute Mortality ***(VOLY median)****	Premature deaths	Core	O_3	21,705	24,074	-2,368
Acute Mortality *(VOLY* ***mean*)***	Premature deaths	Core	O_3	48,721	54,037	-5,316
Respiratory Hospital Admissions (65yr +)	Cases	Core	O_3	530	997	-467
Minor Restricted Activity Days (MRADs 15-64yr)	Days	Core	O_3	46,680	40,367	6,313
Respiratory medication use (children 5-14yr)	Days	Core	O_3	558	377	181
Respiratory medication use (adults 20yr +)	Days	Core	O_3	181	183	-1
Cough and LRS (children 0-14yr)	Days	Core	O_3	104,119	69,909	34,210
Chronic Mortality ***(VOLY median)****	Life years lost	Core	PM	9,628,666	7,284,836	2,343,830
Chronic Mortality ***(VOLY mean*)***	Life years lost	Core	PM	21,612,732	16,351,716	5,261,016
Chronic Mortality ***(VSL median)****	Premature deaths	Core	PM	15,219,310	13,676,896	1,542,414
Chronic Mortality ***(VSL mean*)***	Premature deaths	Core	PM	31,312,457	28,139,069	3,173,388
Infant Mortality (0-1yr) ***(VSL median)****	Premature deaths	Core	PM	46,428	27,815	18,613
Infant Mortality (0-1yr) ***(VSL mean*)***	Premature deaths	Core	PM	92,856	55,630	37,226
Chronic Bronchitis (27yr +)	Cases	Core	PM	1,557,453	1,266,439	291,014
Respiratory Hospital Admissions (All ages)	Cases	Core	PM	6,332	4,791	1,541
Cardiac Hospital Admissions (All ages)	Cases	Core	PM	3,905	2,955	951
Restricted Activity Days (RADs 15-64yr)	Days	Core	PM	1,490,299	1,037,167	453,132
Respiratory medication use (children 5-14yr)	Days	Core	PM	234	127	107
Respiratory medication use (adults 20yr +)	Days	Core	PM	1,308	1,060	247
LRS symptom days (children 5-14yr)	Days	Core	PM	396,189	215,549	180,640
LRS in adults (15yr +) with chronic symptoms	Days	Core	PM	548,173	444,341	103,832
Total with Mortality – VOLY – low (median)				**13,852,760**	**10,420,987**	**3,431,773**
Total with Mortality – VOLY – high (mean)				**25,910,269**	**19,545,645**	**6,364,624**
Total with Mortality – VSL – low (median)				**19,443,404**	**16,813,047**	**2,630,357**
Total with Mortality – VSL – high (mean)				**35,609,993**	**31,332,997**	**4,276,996**

*Note two alternative metrics are used for the presentation of chronic mortality from PM. Firstly in terms of years of life lost and secondly in terms of numbers of premature deaths. There are also two alternative valuations for each, based on a median or mean value from NewExt. These individual valuations are not additive.

Poland

Implementing current EU legislation: Estimated Health damage due to air pollution in 2000 and in 2020

End point	End point output	Function Group		Baseline in 2000	Current legislation in 2020 (including Climate Policy)	Change 2000 to 2020
Acute Mortality (All ages)	Premature deaths	Core	O_3	1,390	1,240	150
Respiratory Hospital Admissions (65yr +)	Cases	Core	O_3	700	1,150	-450
Minor Restricted Activity Days (MRADs 15-64yr)	Days	Core	O_3	3,666,560	2,790,450	876,110
Respiratory medication use (children 5-14yr)	Days	Core	O_3	805,140	315,820	489,320
Respiratory medication use (adults 20yr +)	Days	Core	O_3	549,880	536,730	13,150
Cough and LRS (children 0-14yr)	Days	Core	O_3	8,422,380	3,830,110	4,592,270
Chronic Mortality *	Life years lost	Core	PM	356,350	233,410	122,940
Chronic Mortality *	Premature deaths	Core	PM	32,850	24,890	7,960
Infant Mortality (0-1yr)	Premature deaths	Core	PM	94	41	53
Chronic Bronchitis (27yr +)	Cases	Core	PM	14,680	13,390	1,290
Respiratory Hospital Admissions (All ages)	Cases	Core	PM	6,110	4,000	2,110
Cardiac Hospital Admissions (All ages)	Cases	Core	PM	3,770	2,470	1,300
Restricted Activity Days (RADs 15-64yr)	Days	Core	PM	34,944,700	22,294,280	12,650,420
Respiratory medication use (children 5-14yr)	Days	Core	PM	327,730	107,760	219,970
Respiratory medication use (adults 20yr +)	Days	Core	PM	2,568,440	2,101,630	466,810
LRS symptom days (children 5-14yr)	Days	Core	PM	22,577,080	7,423,790	15,153,290
LRS in adults (15yr +) with chronic symptoms	Days	Core	PM	27,355,240	19,996,180	7,359,060

*Note two alternative metrics are used for the presentation of chronic mortality from PM. Firstly in terms of years of life lost and secondly in terms of numbers of premature deaths. These are not additive.

Implementing current EU legislation: Estimated Valuation of the health damage due to air pollution in 2000 and in 2020 in EU25 (€000)

End point	End point output	Function Group		Baseline in 2000	Current legislation in 2020 (+ Clim. Pol.)	Change 2000 to 2020
Acute Mortality ***(VOLY median)****	Premature deaths	Core	O_3	72,817	64,861	7,956
Acute Mortality *(VOLY* ***mean*)***	Premature deaths	Core	O_3	163,448	145,589	17,858
Respiratory Hospital Admissions (65yr +)	Cases	Core	O_3	1,411	2,316	-905
Minor Restricted Activity Days (MRADs 15-64yr)	Days	Core	O_3	140,858	107,201	33,657
Respiratory medication use (children 5-14yr)	Days	Core	O_3	754	296	458
Respiratory medication use (adults 20yr +)	Days	Core	O_3	515	503	12
Cough and LRS (children 0-14yr)	Days	Core	O_3	323,563	147,141	176,421
Chronic Mortality ***(VOLY median)****	Life years lost	Core	PM	18,631,391	12,203,592	6,427,799
Chronic Mortality ***(VOLY mean*)***	Life years lost	Core	PM	41,820,461	27,392,472	14,427,989
Chronic Mortality ***(VSL median)****	Premature deaths	Core	PM	32,163,841	24,369,661	7,794,180
Chronic Mortality ***(VSL mean*)***	Premature deaths	Core	PM	66,174,410	50,138,538	16,035,872
Infant Mortality (0-1yr) ***(VSL median)****	Premature deaths	Core	PM	131,566	57,170	74,396
Infant Mortality (0-1yr) ***(VSL mean*)***	Premature deaths	Core	PM	263,131	114,340	148,791
Chronic Bronchitis (27yr +)	Cases	Core	PM	2,751,385	2,508,482	242,903
Respiratory Hospital Admissions (All ages)	Cases	Core	PM	12,252	8,025	4,227
Cardiac Hospital Admissions (All ages)	Cases	Core	PM	7,556	4,949	2,607
Restricted Activity Days (RADs 15-64yr)	Days	Core	PM	2,914,388	1,859,343	1,055,045
Respiratory medication use (children 5-14yr)	Days	Core	PM	307	101	206
Respiratory medication use (adults 20yr +)	Days	Core	PM	2,407	1,969	437
LRS symptom days (children 5-14yr)	Days	Core	PM	867,344	285,200	582,144
LRS in adults (15yr +) with chronic symptoms	Days	Core	PM	1,050,906	768,193	282,713
Total with Mortality – VOLY – low (median)				**26,909,421**	**18,019,343**	**8,890,077**
Total with Mortality – VOLY – high (mean)				**50,320,687**	**33,346,121**	**16,974,565**
Total with Mortality – VSL – low (median)				**40,441,871**	**30,185,412**	**10,256,458**
Total with Mortality – VSL – high (mean)				**74,674,635**	**56,092,187**	**18,582,449**

*Note two alternative metrics are used for the presentation of chronic mortality from PM. Firstly in terms of years of life lost and secondly in terms of numbers of premature deaths. There are also two alternative valuations for each, based on a median or mean value from NewExt. These individual valuations are not additive.

Portugal

Implementing current EU legislation: Estimated Health damage due to air pollution in 2000 and in 2020

End point	End point output	Function Group		Baseline in 2000	Current legislation in 2020 (including Climate Policy)	Change 2000 to 2020
Acute Mortality (All ages)	Premature deaths	Core	O_3	439	485	-46
Respiratory Hospital Admissions (65yr +)	Cases	Core	O_3	264	397	-133
Minor Restricted Activity Days (MRADs 15-64yr)	Days	Core	O_3	1,056,250	1,000,720	55,530
Respiratory medication use (children 5-14yr)	Days	Core	O_3	466,430	364,130	102,300
Respiratory medication use (adults 20yr +)	Days	Core	O_3	170,900	183,460	-12,560
Cough and LRS (children 0-14yr)	Days	Core	O_3	2,136,490	1,558,260	578,230
Chronic Mortality *	Life years lost	Core	PM	49,100	30,300	18,800
Chronic Mortality *	Premature deaths	Core	PM	5,040	3,540	1,500
Infant Mortality (0-1yr)	Premature deaths	Core	PM	13	5	8
Chronic Bronchitis (27yr +)	Cases	Core	PM	2,180	1,570	610
Respiratory Hospital Admissions (All ages)	Cases	Core	PM	840	520	320
Cardiac Hospital Admissions (All ages)	Cases	Core	PM	520	320	200
Restricted Activity Days (RADs 15-64yr)	Days	Core	PM	4,748,890	2,816,190	1,932,700
Respiratory medication use (children 5-14yr)	Days	Core	PM	59,710	29,180	30,530
Respiratory medication use (adults 20yr +)	Days	Core	PM	376,580	253,030	123,550
LRS symptom days (children 5-14yr)	Days	Core	PM	2,467,980	1,205,990	1,261,990
LRS in adults (15yr +) with chronic symptoms	Days	Core	PM	3,886,920	2,535,190	1,351,730

*Note two alternative metrics are used for the presentation of chronic mortality from PM. Firstly in terms of years of life lost and secondly in terms of numbers of premature deaths. These are not additive.

Implementing current EU legislation: Estimated Valuation of the health damage due to air pollution in 2000 and in 2020 in EU25 (€000)

End point	End point output	Function Group		Baseline in 2000	Current legislation in 2020 (+ Clim. Pol.)	Change 2000 to 2020
Acute Mortality ***(VOLY median)****	Premature deaths	Core	O_3	22,969	25,373	-2,404
Acute Mortality *(VOLY* ***mean*)***	Premature deaths	Core	O_3	51,557	56,953	-5,395
Respiratory Hospital Admissions (65yr +)	Cases	Core	O_3	530	797	-267
Minor Restricted Activity Days (MRADs 15-64yr)	Days	Core	O_3	40,578	38,445	2,134
Respiratory medication use (children 5-14yr)	Days	Core	O_3	437	341	96
Respiratory medication use (adults 20yr +)	Days	Core	O_3	160	172	-12
Cough and LRS (children 0-14yr)	Days	Core	O_3	82,077	59,864	22,214
Chronic Mortality ***(VOLY median)****	Life years lost	Core	PM	2,567,042	1,584,247	982,795
Chronic Mortality ***(VOLY mean*)***	Life years lost	Core	PM	5,762,043	3,556,039	2,206,005
Chronic Mortality ***(VSL median)****	Premature deaths	Core	PM	4,935,769	3,463,912	1,471,857
Chronic Mortality ***(VSL mean*)***	Premature deaths	Core	PM	10,154,931	7,126,709	3,028,222
Infant Mortality (0-1yr) ***(VSL median)****	Premature deaths	Core	PM	17,895	6,943	10,952
Infant Mortality (0-1yr) ***(VSL mean*)***	Premature deaths	Core	PM	35,791	13,886	21,904
Chronic Bronchitis (27yr +)	Cases	Core	PM	408,588	294,444	114,145
Respiratory Hospital Admissions (All ages)	Cases	Core	PM	1,688	1,042	646
Cardiac Hospital Admissions (All ages)	Cases	Core	PM	1,041	643	399
Restricted Activity Days (RADs 15-64yr)	Days	Core	PM	396,057	234,870	161,187
Respiratory medication use (children 5-14yr)	Days	Core	PM	56	27	29
Respiratory medication use (adults 20yr +)	Days	Core	PM	353	237	116
LRS symptom days (children 5-14yr)	Days	Core	PM	94,812	46,331	48,482
LRS in adults (15yr +) with chronic symptoms	Days	Core	PM	149,324	97,394	51,929
Total with Mortality – VOLY – low (median)				**3,783,609**	**2,391,169**	**1,392,439**
Total with Mortality – VOLY – high (mean)				**7,025,093**	**4,401,484**	**2,623,610**
Total with Mortality – VSL – low (median)				**6,152,335**	**4,270,834**	**1,881,501**
Total with Mortality – VSL – high (mean)				**11,417,981**	**7,972,154**	**3,445,827**

*Note two alternative metrics are used for the presentation of chronic mortality from PM. Firstly in terms of years of life lost and secondly in terms of numbers of premature deaths. There are also two alternative valuations for each, based on a median or mean value from NewExt. These individual valuations are not additive.

Slovakia

Implementing current EU legislation: Estimated Health damage due to air pollution in 2000 and in 2020

End point	End point output	Function Group		Baseline in 2000	Current legislation in 2020 (including Climate Policy)	Change 2000 to 2020
Acute Mortality (All ages)	Premature deaths	Core	O_3	248	209	38
Respiratory Hospital Admissions (65yr +)	Cases	Core	O_3	119	179	-60
Minor Restricted Activity Days (MRADs 15-64yr)	Days	Core	O_3	670,110	492,470	177,640
Respiratory medication use (children 5-14yr)	Days	Core	O_3	148,310	59,370	88,940
Respiratory medication use (adults 20yr +)	Days	Core	O_3	99,920	90,710	9,210
Cough and LRS (children 0-14yr)	Days	Core	O_3	1,553,350	717,650	835,700
Chronic Mortality *	Life years lost	Core	PM	46,940	32,660	14,280
Chronic Mortality *	Premature deaths	Core	PM	4,250	3,390	860
Infant Mortality (0-1yr)	Premature deaths	Core	PM	15	7	8
Chronic Bronchitis (27yr +)	Cases	Core	PM	1,920	1,840	80
Respiratory Hospital Admissions (All ages)	Cases	Core	PM	800	560	240
Cardiac Hospital Admissions (All ages)	Cases	Core	PM	500	350	150
Restricted Activity Days (RADs 15-64yr)	Days	Core	PM	4,636,610	3,174,550	1,462,060
Respiratory medication use (children 5-14yr)	Days	Core	PM	43,830	16,350	27,480
Respiratory medication use (adults 20yr +)	Days	Core	PM	338,840	286,580	52,260
LRS symptom days (children 5-14yr)	Days	Core	PM	3,019,230	1,126,020	1,893,210
LRS in adults (15yr +) with chronic symptoms	Days	Core	PM	3,589,020	2,763,070	825,950

*Note two alternative metrics are used for the presentation of chronic mortality from PM. Firstly in terms of years of life lost and secondly in terms of numbers of premature deaths. These are not additive.

Implementing current EU legislation: Estimated Valuation of the health damage due to air pollution in 2000 and in 2020 in EU25 (€000)

End point	End point output	Function Group		Baseline in 2000	Current legislation in 2020 (+ Clim. Pol.)	Change 2000 to 2020
Acute Mortality ***(VOLY median)****	Premature deaths	Core	O_3	12,947	10,953	1,994
Acute Mortality *(VOLY* ***mean*)***	Premature deaths	Core	O_3	29,062	24,586	4,475
Respiratory Hospital Admissions (65yr +)	Cases	Core	O_3	239	358	-120
Minor Restricted Activity Days (MRADs 15-64yr)	Days	Core	O_3	25,744	18,919	6,824
Respiratory medication use (children 5-14yr)	Days	Core	O_3	139	56	83
Respiratory medication use (adults 20yr +)	Days	Core	O_3	94	85	9
Cough and LRS (children 0-14yr)	Days	Core	O_3	59,675	27,570	32,105
Chronic Mortality ***(VOLY median)****	Life years lost	Core	PM	2,454,095	1,707,684	746,411
Chronic Mortality ***(VOLY mean*)***	Life years lost	Core	PM	5,508,519	3,833,107	1,675,412
Chronic Mortality ***(VSL median)****	Premature deaths	Core	PM	4,157,132	3,319,958	837,174
Chronic Mortality ***(VSL mean*)***	Premature deaths	Core	PM	8,552,951	6,830,535	1,722,415
Infant Mortality (0-1yr) ***(VSL median)****	Premature deaths	Core	PM	20,982	10,109	10,873
Infant Mortality (0-1yr) ***(VSL mean*)***	Premature deaths	Core	PM	41,964	20,219	21,746
Chronic Bronchitis (27yr +)	Cases	Core	PM	359,960	343,921	16,039
Respiratory Hospital Admissions (All ages)	Cases	Core	PM	1,614	1,123	491
Cardiac Hospital Admissions (All ages)	Cases	Core	PM	995	693	303
Restricted Activity Days (RADs 15-64yr)	Days	Core	PM	386,693	264,757	121,936
Respiratory medication use (children 5-14yr)	Days	Core	PM	41	15	26
Respiratory medication use (adults 20yr +)	Days	Core	PM	317	269	49
LRS symptom days (children 5-14yr)	Days	Core	PM	115,990	43,258	72,731
LRS in adults (15yr +) with chronic symptoms	Days	Core	PM	137,879	106,149	31,730
Total with Mortality – VOLY – low (median)				**3,577,404**	**2,535,920**	**1,041,484**
Total with Mortality – VOLY – high (mean)				**6,668,925**	**4,685,085**	**1,983,840**
Total with Mortality – VSL – low (median)				**5,280,441**	**4,148,194**	**1,132,247**
Total with Mortality – VSL – high (mean)				**9,713,357**	**7,682,513**	**2,030,843**

*Note two alternative metrics are used for the presentation of chronic mortality from PM. Firstly in terms of years of life lost and secondly in terms of numbers of premature deaths. There are also two alternative valuations for each, based on a median or mean value from NewExt. These individual valuations are not additive.

Slovenia

Implementing current EU legislation: Estimated Health damage due to air pollution in 2000 and in 2020

End point	End point output	Function Group		Baseline in 2000	Current legislation in 2020 (including Climate Policy)	Change 2000 to 2020
Acute Mortality (All ages)	Premature deaths	Core	O_3	119	105	14
Respiratory Hospital Admissions (65yr +)	Cases	Core	O_3	71	118	-47
Minor Restricted Activity Days (MRADs 15-64yr)	Days	Core	O_3	326,680	207,650	119,030
Respiratory medication use (children 5-14yr)	Days	Core	O_3	57,070	19,690	37,380
Respiratory medication use (adults 20yr +)	Days	Core	O_3	51,270	42,690	8,580
Cough and LRS (children 0-14yr)	Days	Core	O_3	609,050	232,980	376,070
Chronic Mortality *	Life years lost	Core	PM	17,360	11,050	6,310
Chronic Mortality *	Premature deaths	Core	PM	1,580	1,280	300
Infant Mortality (0-1yr)	Premature deaths	Core	PM	2	1	1
Chronic Bronchitis (27yr +)	Cases	Core	PM	780	640	140
Respiratory Hospital Admissions (All ages)	Cases	Core	PM	298	189	108
Cardiac Hospital Admissions (All ages)	Cases	Core	PM	184	117	67
Restricted Activity Days (RADs 15-64yr)	Days	Core	PM	1,738,820	1,002,670	736,150
Respiratory medication use (children 5-14yr)	Days	Core	PM	12,970	4,060	8,910
Respiratory medication use (adults 20yr +)	Days	Core	PM	133,760	101,030	32,730
LRS symptom days (children 5-14yr)	Days	Core	PM	893,680	279,760	613,920
LRS in adults (15yr +) with chronic symptoms	Days	Core	PM	1,387,140	972,730	414,410

*Note two alternative metrics are used for the presentation of chronic mortality from PM. Firstly in terms of years of life lost and secondly in terms of numbers of premature deaths. These are not additive.

Implementing current EU legislation: Estimated Valuation of the health damage due to air pollution in 2000 and in 2020 in EU25 (€000)

End point	End point output	Function Group		Baseline in 2000	Current legislation in 2020 (+ Clim. Pol.)	Change 2000 to 2020
Acute Mortality ***(VOLY median)****	Premature deaths	Core	O_3	6,226	5,483	743
Acute Mortality *(VOLY **mean*)***	Premature deaths	Core	O_3	13,975	12,307	1,667
Respiratory Hospital Admissions (65yr +)	Cases	Core	O_3	142	236	-94
Minor Restricted Activity Days (MRADs 15-64yr)	Days	Core	O_3	12,550	7,977	4,573
Respiratory medication use (children 5-14yr)	Days	Core	O_3	53	18	35
Respiratory medication use (adults 20yr +)	Days	Core	O_3	48	40	8
Cough and LRS (children 0-14yr)	Days	Core	O_3	23,398	8,951	14,448
Chronic Mortality ***(VOLY median)****	Life years lost	Core	PM	907,811	577,879	329,932
Chronic Mortality ***(VOLY mean*)***	Life years lost	Core	PM	2,037,694	1,297,121	740,573
Chronic Mortality ***(VSL median)****	Premature deaths	Core	PM	1,550,465	1,254,805	295,660
Chronic Mortality ***(VSL mean*)***	Premature deaths	Core	PM	3,189,951	2,581,656	608,295
Infant Mortality (0-1yr) ***(VSL median)****	Premature deaths	Core	PM	2,841	1,359	1,482
Infant Mortality (0-1yr) ***(VSL mean*)***	Premature deaths	Core	PM	5,681	2,717	2,964
Chronic Bronchitis (27yr +)	Cases	Core	PM	145,910	120,377	25,533
Respiratory Hospital Admissions (All ages)	Cases	Core	PM	597	380	217
Cardiac Hospital Admissions (All ages)	Cases	Core	PM	368	234	134
Restricted Activity Days (RADs 15-64yr)	Days	Core	PM	145,018	83,623	61,395
Respiratory medication use (children 5-14yr)	Days	Core	PM	12	4	8
Respiratory medication use (adults 20yr +)	Days	Core	PM	125	95	31
LRS symptom days (children 5-14yr)	Days	Core	PM	34,333	10,748	23,585
LRS in adults (15yr +) with chronic symptoms	Days	Core	PM	53,290	37,369	15,921
Total with Mortality – VOLY – low (median)				**1,332,722**	**854,773**	**477,949**
Total with Mortality – VOLY – high (mean)				**2,473,194**	**1,582,197**	**890,997**
Total with Mortality – VSL – low (median)				**1,975,375**	**1,531,698**	**443,677**
Total with Mortality – VSL – high (mean)				**3,625,451**	**2,866,732**	**758,719**

*Note two alternative metrics are used for the presentation of chronic mortality from PM. Firstly in terms of years of life lost and secondly in terms of numbers of premature deaths. There are also two alternative valuations for each, based on a median or mean value from NewExt. These individual valuations are not additive.

Spain

Implementing current EU legislation: Estimated Health damage due to air pollution in 2000 and in 2020

End point	End point output	Function Group		Baseline in 2000	Current legislation in 2020 (including Climate Policy)	Change 2000 to 2020
Acute Mortality (All ages)	Premature deaths	Core	O_3	2,030	2,120	-90
Respiratory Hospital Admissions (65yr +)	Cases	Core	O_3	1,560	1,990	-430
Minor Restricted Activity Days (MRADs 15-64yr)	Days	Core	O_3	5,880,340	4,794,480	1,085,860
Respiratory medication use (children 5-14yr)	Days	Core	O_3	2,280,180	1,497,950	782,230
Respiratory medication use (adults 20yr +)	Days	Core	O_3	966,860	906,750	60,110
Cough and LRS (children 0-14yr)	Days	Core	O_3	10,265,080	6,404,020	3,861,060
Chronic Mortality *	Life years lost	Core	PM	217,190	125,050	92,140
Chronic Mortality *	Premature deaths	Core	PM	19,940	14,190	5,750
Infant Mortality (0-1yr)	Premature deaths	Core	PM	36	14	22
Chronic Bronchitis (27yr +)	Cases	Core	PM	9,920	6,900	3,020
Respiratory Hospital Admissions (All ages)	Cases	Core	PM	3,720	2,140	1,580
Cardiac Hospital Admissions (All ages)	Cases	Core	PM	2,300	1,320	980
Restricted Activity Days (RADs 15-64yr)	Days	Core	PM	21,287,840	11,695,930	9,591,910
Respiratory medication use (children 5-14yr)	Days	Core	PM	235,030	104,050	130,980
Respiratory medication use (adults 20yr +)	Days	Core	PM	1,715,440	1,084,080	631,360
LRS symptom days (children 5-14yr)	Days	Core	PM	9,714,700	4,300,540	5,414,160
LRS in adults (15yr +) with chronic symptoms	Days	Core	PM	17,626,590	10,659,620	6,966,970

*Note two alternative metrics are used for the presentation of chronic mortality from PM. Firstly in terms of years of life lost and secondly in terms of numbers of premature deaths. These are not additive.

Implementing current EU legislation: Estimated Valuation of the health damage due to air pollution in 2000 and in 2020 in EU25 (€000)

End point	End point output	Function Group		Baseline in 2000	Current legislation in 2020 (+ Clim. Pol.)	Change 2000 to 2020
Acute Mortality ***(VOLY median)****	Premature deaths	Core	O_3	106,326	110,814	-4,487
Acute Mortality *(VOLY* ***mean*)***	Premature deaths	Core	O_3	238,662	248,735	-10,072
Respiratory Hospital Admissions (65yr +)	Cases	Core	O_3	3,133	3,991	-858
Minor Restricted Activity Days (MRADs 15-64yr)	Days	Core	O_3	225,905	184,190	41,715
Respiratory medication use (children 5-14yr)	Days	Core	O_3	2,137	1,404	733
Respiratory medication use (adults 20yr +)	Days	Core	O_3	906	850	56
Cough and LRS (children 0-14yr)	Days	Core	O_3	394,354	246,023	148,331
Chronic Mortality ***(VOLY median)****	Life years lost	Core	PM	11,355,733	6,538,080	4,817,653
Chronic Mortality ***(VOLY mean*)***	Life years lost	Core	PM	25,489,347	14,675,529	10,813,819
Chronic Mortality ***(VSL median)****	Premature deaths	Core	PM	19,525,457	13,893,497	5,631,960
Chronic Mortality ***(VSL mean*)***	Premature deaths	Core	PM	40,171,993	28,584,707	11,587,286
Infant Mortality (0-1yr) ***(VSL median)****	Premature deaths	Core	PM	50,628	20,221	30,407
Infant Mortality (0-1yr) ***(VSL mean*)***	Premature deaths	Core	PM	101,255	40,441	60,814
Chronic Bronchitis (27yr +)	Cases	Core	PM	1,859,817	1,293,181	566,635
Respiratory Hospital Admissions (All ages)	Cases	Core	PM	7,468	4,299	3,168
Cardiac Hospital Admissions (All ages)	Cases	Core	PM	4,606	2,652	1,954
Restricted Activity Days (RADs 15-64yr)	Days	Core	PM	1,775,406	975,441	799,965
Respiratory medication use (children 5-14yr)	Days	Core	PM	220	97	123
Respiratory medication use (adults 20yr +)	Days	Core	PM	1,607	1,016	592
LRS symptom days (children 5-14yr)	Days	Core	PM	373,210	165,214	207,996
LRS in adults (15yr +) with chronic symptoms	Days	Core	PM	677,161	409,511	267,650
Total with Mortality – VOLY – low (median)				**16,838,614**	**9,956,981**	**6,881,633**
Total with Mortality – VOLY – high (mean)				**31,155,192**	**18,252,572**	**12,902,621**
Total with Mortality – VSL – low (median)				**25,008,338**	**17,312,398**	**7,695,940**
Total with Mortality – VSL – high (mean)				**45,837,838**	**32,161,750**	**13,676,088**

*Note two alternative metrics are used for the presentation of chronic mortality from PM. Firstly in terms of years of life lost and secondly in terms of numbers of premature deaths. There are also two alternative valuations for each, based on a median or mean value from NewExt. These individual valuations are not additive.

Sweden

Implementing current EU legislation: Estimated Health damage due to air pollution in 2000 and in 2020

End point	End point output	Function Group		Baseline in 2000	Current legislation in 2020 (including Climate Policy)	Change 2000 to 2020
Acute Mortality (All ages)	Premature deaths	Core	O_3	196	206	-10
Respiratory Hospital Admissions (65yr +)	Cases	Core	O_3	134	225	-91
Minor Restricted Activity Days (MRADs 15-64yr)	Days	Core	O_3	456,570	408,420	48,150
Respiratory medication use (children 5-14yr)	Days	Core	O_3	101,000	64,100	36,900
Respiratory medication use (adults 20yr +)	Days	Core	O_3	77,090	81,720	-4,630
Cough and LRS (children 0-14yr)	Days	Core	O_3	1,067,260	801,340	265,920
Chronic Mortality *	Life years lost	Core	PM	32,960	25,160	7,800
Chronic Mortality *	Premature deaths	Core	PM	3,280	2,680	600
Infant Mortality (0-1yr)	Premature deaths	Core	PM	4	3	1
Chronic Bronchitis (27yr +)	Cases	Core	PM	1,490	1,260	230
Respiratory Hospital Admissions (All ages)	Cases	Core	PM	560	430	130
Cardiac Hospital Admissions (All ages)	Cases	Core	PM	350	270	80
Restricted Activity Days (RADs 15-64yr)	Days	Core	PM	3,027,120	2,099,860	927,260
Respiratory medication use (children 5-14yr)	Days	Core	PM	28,600	14,080	14,520
Respiratory medication use (adults 20yr +)	Days	Core	PM	250,490	205,910	44,580
LRS symptom days (children 5-14yr)	Days	Core	PM	1,970,260	969,690	1,000,570
LRS in adults (15yr +) with chronic symptoms	Days	Core	PM	2,558,300	2,065,730	492,570

*Note two alternative metrics are used for the presentation of chronic mortality from PM. Firstly in terms of years of life lost and secondly in terms of numbers of premature deaths. These are not additive.

Implementing current EU legislation: Estimated Valuation of the health damage due to air pollution in 2000 and in 2020 in EU25 (€000)

End point	End point output	Function Group		Baseline in 2000	Current legislation in 2020 (+ Clim. Pol.)	Change 2000 to 2020
Acute Mortality ***(VOLY median)****	Premature deaths	Core	O_3	10,262	10,770	-508
Acute Mortality *(VOLY **mean*)***	Premature deaths	Core	O_3	23,034	24,175	-1,141
Respiratory Hospital Admissions (65yr +)	Cases	Core	O_3	269	452	-183
Minor Restricted Activity Days (MRADs 15-64yr)	Days	Core	O_3	17,540	15,690	1,850
Respiratory medication use (children 5-14yr)	Days	Core	O_3	95	60	35
Respiratory medication use (adults 20yr +)	Days	Core	O_3	72	77	-4
Cough and LRS (children 0-14yr)	Days	Core	O_3	41,001	30,785	10,216
Chronic Mortality ***(VOLY median)****	Life years lost	Core	PM	1,723,208	1,315,606	407,602
Chronic Mortality ***(VOLY mean*)***	Life years lost	Core	PM	3,867,953	2,953,040	914,913
Chronic Mortality ***(VSL median)****	Premature deaths	Core	PM	3,214,241	2,622,904	591,337
Chronic Mortality ***(VSL mean*)***	Premature deaths	Core	PM	6,613,032	5,396,406	1,216,627
Infant Mortality (0-1yr) ***(VSL median)****	Premature deaths	Core	PM	5,063	3,564	1,499
Infant Mortality (0-1yr) ***(VSL mean*)***	Premature deaths	Core	PM	10,127	7,128	2,998
Chronic Bronchitis (27yr +)	Cases	Core	PM	280,094	235,634	44,460
Respiratory Hospital Admissions (All ages)	Cases	Core	PM	1,133	865	268
Cardiac Hospital Admissions (All ages)	Cases	Core	PM	699	534	165
Restricted Activity Days (RADs 15-64yr)	Days	Core	PM	252,461	175,128	77,334
Respiratory medication use (children 5-14yr)	Days	Core	PM	27	13	14
Respiratory medication use (adults 20yr +)	Days	Core	PM	235	193	42
LRS symptom days (children 5-14yr)	Days	Core	PM	75,692	37,253	38,439
LRS in adults (15yr +) with chronic symptoms	Days	Core	PM	98,282	79,359	18,923
Total with Mortality – VOLY – low (median)				**2,506,132**	**1,905,982**	**600,150**
Total with Mortality – VOLY – high (mean)				**4,668,713**	**3,560,385**	**1,108,328**
Total with Mortality – VSL – low (median)				**3,997,166**	**3,213,280**	**783,885**
Total with Mortality – VSL – high (mean)				**7,413,793**	**6,003,751**	**1,410,041**

*Note two alternative metrics are used for the presentation of chronic mortality from PM. Firstly in terms of years of life lost and secondly in terms of numbers of premature deaths. There are also two alternative valuations for each, based on a median or mean value from NewExt. These individual valuations are not additive.

United Kingdom

Implementing current EU legislation: Estimated Health damage due to air pollution in 2000 and in 2020

End point	End point output	Function Group		Baseline in 2000	Current legislation in 2020 (including Climate Policy)	Change 2000 to 2020
Acute Mortality (All ages)	Premature deaths	Core	O_3	1,320	1,650	-330
Respiratory Hospital Admissions (65yr +)	Cases	Core	O_3	840	1,480	-640
Minor Restricted Activity Days (MRADs 15-64yr)	Days	Core	O_3	3,165,990	4,120,790	-954,800
Respiratory medication use (children 5-14yr)	Days	Core	O_3	1,711,390	1,417,640	293,750
Respiratory medication use (adults 20yr +)	Days	Core	O_3	519,670	737,490	-217,820
Cough and LRS (children 0-14yr)	Days	Core	O_3	7,620,030	6,762,980	857,050
Chronic Mortality *	Life years lost	Core	PM	409,120	290,910	118,210
Chronic Mortality *	Premature deaths	Core	PM	39,470	27,370	12,100
Infant Mortality (0-1yr)	Premature deaths	Core	PM	73	41	32
Chronic Bronchitis (27yr +)	Cases	Core	PM	18,160	14,370	3,790
Respiratory Hospital Admissions (All ages)	Cases	Core	PM	7,010	4,990	2,020
Cardiac Hospital Admissions (All ages)	Cases	Core	PM	4,320	3,070	1,250
Restricted Activity Days (RADs 15-64yr)	Days	Core	PM	38,022,110	27,414,650	10,607,460
Respiratory medication use (children 5-14yr)	Days	Core	PM	585,200	268,530	316,670
Respiratory medication use (adults 20yr +)	Days	Core	PM	3,058,690	2,404,590	654,100
LRS symptom days (children 5-14yr)	Days	Core	PM	24,188,370	11,099,410	13,088,960
LRS in adults (15yr +) with chronic symptoms	Days	Core	PM	31,459,330	24,182,220	7,277,110

*Note two alternative metrics are used for the presentation of chronic mortality from PM. Firstly in terms of years of life lost and secondly in terms of numbers of premature deaths. These are not additive.

Implementing current EU legislation: Estimated Valuation of the health damage due to air pollution in 2000 and in 2020 in EU25 (€000)

End point	End point output	Function Group		Baseline in 2000	Current legislation in 2020 (+ Clim. Pol.)	Change 2000 to 2020
Acute Mortality ***(VOLY median)****	Premature deaths	Core	O_3	69,000	86,013	-17,013
Acute Mortality *(VOLY* ***mean*)***	Premature deaths	Core	O_3	154,879	193,067	-38,188
Respiratory Hospital Admissions (65yr +)	Cases	Core	O_3	1,680	2,973	-1,293
Minor Restricted Activity Days (MRADs 15-64yr)	Days	Core	O_3	121,628	158,308	-36,681
Respiratory medication use (children 5-14yr)	Days	Core	O_3	1,604	1,328	275
Respiratory medication use (adults 20yr +)	Days	Core	O_3	487	691	-204
Cough and LRS (children 0-14yr)	Days	Core	O_3	292,739	259,813	32,925
Chronic Mortality ***(VOLY median)****	Life years lost	Core	PM	21,390,928	15,210,121	6,180,807
Chronic Mortality ***(VOLY mean*)***	Life years lost	Core	PM	48,014,583	34,140,996	13,873,586
Chronic Mortality ***(VSL median)****	Premature deaths	Core	PM	38,651,698	26,799,343	11,852,355
Chronic Mortality ***(VSL mean*)***	Premature deaths	Core	PM	79,522,632	55,137,403	24,385,229
Infant Mortality (0-1yr) ***(VSL median)****	Premature deaths	Core	PM	102,643	57,349	45,294
Infant Mortality (0-1yr) ***(VSL mean*)***	Premature deaths	Core	PM	205,286	114,697	90,589
Chronic Bronchitis (27yr +)	Cases	Core	PM	3,403,949	2,692,059	711,891
Respiratory Hospital Admissions (All ages)	Cases	Core	PM	14,067	10,002	4,065
Cardiac Hospital Admissions (All ages)	Cases	Core	PM	8,675	6,169	2,507
Restricted Activity Days (RADs 15-64yr)	Days	Core	PM	3,171,044	2,286,381	884,663
Respiratory medication use (children 5-14yr)	Days	Core	PM	548	252	297
Respiratory medication use (adults 20yr +)	Days	Core	PM	2,866	2,253	613
LRS symptom days (children 5-14yr)	Days	Core	PM	929,245	426,406	502,839
LRS in adults (15yr +) with chronic symptoms	Days	Core	PM	1,208,573	929,008	279,564
Total with Mortality – VOLY – low (median)				**30,719,676**	**22,129,127**	**8,590,549**
Total with Mortality – VOLY – high (mean)				**57,531,853**	**41,224,405**	**16,307,447**
Total with Mortality – VSL – low (median)				**47,980,446**	**33,718,349**	**14,262,097**
Total with Mortality – VSL – high (mean)				**89,039,902**	**62,220,812**	**26,819,090**

*Note two alternative metrics are used for the presentation of chronic mortality from PM. Firstly in terms of years of life lost and secondly in terms of numbers of premature deaths. There are also two alternative valuations for each, based on a median or mean value from NewExt. These individual valuations are not additive.

ANNEX 2: UPDATE OF VALUES FROM VERSION 1

An earlier version of this report, circulated in January, included lower results for PM impacts and values, as illustrated below for EU25 impacts.

End point	End point output	Function Group	Pollutant	Baseline in 2000	Current legislation in 2020 (including Climate Policy)
Chronic mortality *	Life years lost	Core	PM	3 001 000	1 900 000
Chronic mortality *	Premature deaths	Core	PM	288 300	208 000
Infant mortality	Premature deaths	Core	PM	562	271
Chronic bronchitis	Cases	Core	PM	135 700	98 400
Respiratory hospital admissions	Cases	Core	PM	51 400	32 600
Cardiac hospital admissions	Cases	Core	PM	31 700	20 100
Restricted activity days (RADs)	Days	Core	PM	288 292 000	170 955 700
Respiratory medication Use (children)	Days	Core	PM	3 510 000	1 548 700
Respiratory medication Use (adults)	Days	Core	PM	22 990 000	16 055 000
LRS (including cough) among children	Days	Core	PM	160 349 000	68 819 000
LRS among adults with chronic symptoms	Days	Core	PM	236 498 000	159 724 000

Compared to the results in this report.

End point	End point output	Function Group		Baseline in 2000	Current legislation in 2020 (including Climate Policy)
Chronic Mortality	Life years lost	Core	PM	3,618,700	2,467,300
Chronic Mortality	Premature deaths	Core	PM	347,900	271,600
Infant Mortality (0-1yr)	Premature deaths	Core	PM	677	352
Chronic Bronchitis (27yr +)	Cases	Core	PM	163,800	128,100
Respiratory Hospital Admissions (All ages)	Cases	Core	PM	62,000	42,300
Cardiac Hospital Admissions (All ages)	Cases	Core	PM	38,300	26,100
Restricted Activity Days (RADs 15-64yr)	Days	Core	PM	347,687,000	221,999,100
Respiratory medication use (children 5-14yr)	Days	Core	PM	4,218,500	1,987,700
Respiratory medication use (adults 20yr +)	Days	Core	PM	27,741,700	20,879,800
LRS symptom days (children 5-14yr)	Days	Core	PM	192,756,400	88,852,300
LRS in adults (15yr +) with chronic symptoms	Days	Core	PM	285,345,000	207,562,100

The reason for difference is because of two reasons. Firstly, the EMEP model runs here have been adjusted to give an urban increment, based on the CITY-DELTA project results. This provides a more accurate analysis of urban PM concentrations. Secondly, the EMEP output parameter

PM25_H2O output[15] has been included in this set of analysis (it was excluded in the previous CBA baseline). The inclusion of this metric is consistent with the analysis in other parts of the CAFE programme and in the IIASA output.

[15] The output from the EMEP model for PM25_H2O is calculated for the actual chemical composition of PM2.5 and at temperature 20C and relative humidity 50% (which are conditions required for the same equilibration when PM mass is determined by gravimetric methods). Particle water is calculated with the model to close a gap between calculated and measured PM mass because gravimetrically measured PM2.5 mass always contains some water (10-25% on average), PM2.5 = PM2.5_dry + PM25_H2O should better represent the gravimetrically measured PM2.5.