Technical report:

The benefits for public health in Europe of moving to a 30% target for EU climate policy

A Communication from the European Commission in May 2010 provides estimates of the additional costs of moving beyond the current 20% target for reducing EU greenhouse gas (GHG) emissions by 2020 to a reduction of 30%[16]. It also addresses some of the benefits that arise as 'side effects' of a stronger climate change policy, known as 'co-benefits', which are the focus of this report.

This paper considers the co-benefits from reduced levels of air pollution on human health. These arise through a reduction in emissions of air pollutants - fine particles (PM), nitrogen oxides (NO_x) and sulphur dioxide (SO_2) - linked to reductions in CO_2 emissions. As CO_2 emissions fall, these three pollutants, which, like CO_2, are associated primarily with energy use by sectors such as industry (including power generation) and transport, also fall. The Communication estimates the associated reduction in mortality effect at between €7.3 and €16.7 billion/year more for a 30% internal GHG cut in the EU (see Table 1) compared to a 20% cut. Two alternate scenarios are described for the 30% case. In the first, described as '30% with flexibility', there is a 25% cut in GHG emissions within the EU whilst the remaining 5% is achieved by financing equivalent cuts in other regions of the world. The second case deals with a 30% cut in GHG emissions within the EU (the '30% internal' case).

Table 1. Impacts on air pollution and air pollution control costs. Source: European Commission

Change compared to reference case	30% with flexibility	30% internal
SO_2 emissions, kilotonnes (kt)	-199	-424
NO_X emissions (kt)	-171	-350
$PM_{2.5}$ emissions (kt)	-27	-54
Air pollution reduction (sum SO_2, NO_X and $PM_{2.5}$)	4%	9%
Health co-benefit ($€_{08}$ billion/year) (mortality only)	€3.5 to 8.1	€7.3 to 16.7
Reduced air pollution control costs ($€_{08}$ billion/year)	€2.8	€5.3

16 Commission Staff Working Document accompanying the Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions, May 2010, COM (2010) 265 final. *Analysis of options to move beyond 20% greenhouse gas emission reductions and assessing the risk of carbon leakage. Background information and analysis.* Analysis of options to move beyond 20% greenhouse gas emission reductions and assessing the risk of carbon leakage.

Evidence that the health co-benefits from improved air quality are real and substantial comes from an extensive and growing literature which has been reviewed by the World Health Organization (WHO), the United States Environmental Protection Agency (US EPA) and other bodies, all of which have reached broadly similar conclusions and informed the positions taken in the current paper. Some of the clearest demonstrations of the link between health and air quality comes from 'intervention studies' in which a sudden reduction in air pollution affecting a city or region is mirrored by an improvement in health. Notable examples include studies in Dublin and Hong Kong[17]. Particularly compelling are the results of population health monitoring in Dublin after the ban on coal burning in 1990, which showed substantial reductions in respiratory ill-health. Improvements in air quality in parts of the USA during the 1980s and 1990s have been estimated to be responsible for as much as 15% of the overall increase in life expectancy observed for the studied populations[18].

The Commission's paper also shows a co-benefit to industry of the stricter target on emissions. These reduced costs for air pollution control are estimated at up to €5.3 billion per year. The estimate of reduced emissions of NO_x shown in Table 1 is also of significant policy interest as Member States are currently struggling to meet existing legislation on this pollutant. Information gathered by the European Environment Agency[19] suggests that, overall, the EU27 will overshoot the NO_x ceiling by 522 kt. The 350 kt saving seen above in the 30%-internal GHG scenario would compensate for two-thirds of this figure.

A previous report produced for HEAL in late 2008 made successful use of the earlier European Commission assessment (published in February 2008) to estimate the co-benefits to health of a 30% emissions target rather than the 20% emissions target investigated by the Commission[20]. It estimated health co-benefits of between €6 and €25 billion per year from 2020 onwards for a 30% target, additional to benefits of between €13 and €52 billion/year by adopting the 20% target. It is notable that the results from the Commission paper in May 2010 indicate that our original estimates were too cautious and, as the results below will show, underestimated the latest estimates of the change in health impacts by approximately 25%[21].

What this Technical Report provides

The Commission's new Communication covers health co-benefits of mortality but not of morbidity (diseased condition or state). Nor does it provide a breakdown of impacts by Member State.

This Technical Report provides the added health benefits of moving from the 20% cut to the '30% with flexibility' and '30% internal' cases. It also provides additional information to that presented in the EC's new communication, as follows:

1. Estimates of health impacts including morbidity (ill health) as well as mortality
2. The economic equivalent of these effects
3. A breakdown of economic impact by Member State
4. Estimates of the cumulative health co-benefits of taking early action.

17 Dublin: Clancy L, Goodman P, Sinclair H and Dockery DW (2002). *Effect of air-pollution control on death rates in Dublin, Ireland: an intervention study.* Lancet, 360, 1210-4.

Hong Kong: Hedley AJ, Wong CM, Thach TQ, Ma SLS, Lam TH, Anderson HR (2002). *Cardio-respiratory and all-cause mortality after restrictions on sulphur content of fuel in Hong Kong: an intervention study.* Lancet 360, 1646-1652.

18 Pope CA III, Ezzati M and Dockery DW (2009). *Fine-particulate air pollution and life expectancy in the United States.* New England Journal of Medicine 360, 376-386.

19 European Environment Agency (2009). *Reporting by the Member States under Directive 2001/81/EC of the European Parliament and of the Council of 23 October 2001 on national emission ceilings for certain atmospheric pollutants.* Technical report No 11/2009. http://www.eea.europa.eu/publications/nec-directive-status-report-2008

20 HEAL, CAN Europe, WWF (2008). *The co-benefits to health of a strong EU climate change policy.* http://www.env-health.org/IMG/pdf/Co-benefits_to_health_report_-september_2008.pdf

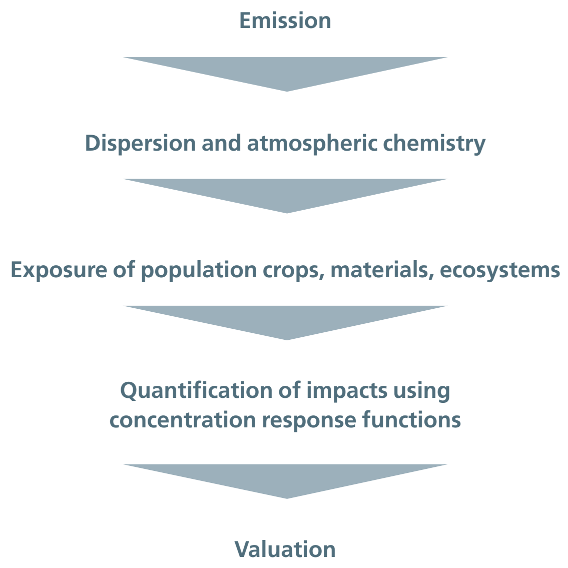
21 This underestimation is based on comparison of mortality impact estimates. For valuation we apply a broader range than the Commission (though one that better reflects the Commission's own approved methodology), so the earlier underestimation is not obvious when economic estimates of damage are compared.

Methodology: Refining and building on previous analyses

The methods that underpin this study for quantification and valuation of the impacts arising from a change in emissions of $PM_{2.5}$, NO_x and SO_2 are based on those developed under the European Commission's Clean Air For Europe (CAFE) Programme. Method development for the CAFE work was performed in partnership with WHO and various other European experts and involved extensive discussion with stakeholders and an independent peer review. The methods have since been subject to some minor revision under the EC4MACS project[22], which is funded under the European Commission's LIFE+ Programme.

The general methodology for evaluating the effects of changes in air pollutant emissions proceeds logically through the steps between emission, impact and valuation (Figure 1). This is the approach used to quantify mortality impacts in the Commission's Communication of May 2010.

Figure 1. The impact pathway approach for quantifying benefits of emission reductions, from emission to valuation



The analysis of the co-benefits through to economic valuation is more developed for health impact assessment, on which the present paper is focused, than assessment of effects on other receptors (most notably ecosystems). For the pollutants of interest here, health impacts are quantified against changes in the concentration of particulate matter accounting for:

- primary particles (particles directly emitted), and
- secondary particles (sulphate and nitrate aerosols formed in the atmosphere following release of SO_2 and NO_x respectively).

Separate quantification of the direct effects of exposure to SO_2 and NO_2 (as distinct from the secondary sulphate and nitrate particles) is not performed as it is considered likely to double count some part of the effects attributed to particle exposure. Following WHO advice, the methodology assumes that the different types of particle are equally damaging per unit mass and that there is no threshold for impacts at the level of the population (though noting this does not preclude thresholds for individuals in good health).

To quantify an impact it is necessary to combine the following data:

1. Population exposure to the pollutant of interest, as calculated in the preceding stages from knowledge of emissions, the dispersion and chemistry of pollutants following release, and the distribution of the population across Europe.
2. A response function that links a change in air pollution to a change in the incidence of the impact under investigation.
3. The fraction of the population that the response function was derived for (e.g., children or adults).
4. The incidence rate of the impact being considered for the relevant sector of the population.
5. The impacts so quantified are then valued using European-average data on medical costs, the cost of lost productivity and estimates of willingness to pay to protect against ill-health.

22 European Consortium for Modelling of Air Pollution and Climate Strategies. http://www.ec4macs.eu/home/benefits.html?sb=12

The Commission's mortality estimates are derived using transfer matrices generated by the Unified EMEP Model for Stage 1[23], the GAINS model for quantification of years of life lost for Stages 2 to 4[24], and valuation data from the CAFE CBA work for Stage 5[25]. The results obtained by the Commission show the costs and impacts that are expected to arise first under a baseline scenario for the year 2020 that defines European conditions following implementation of all current legislation (including the 20% cut in GHG emissions agreed for 2020), and second the additional benefit that would arise from a 30% cut in GHG emissions. The analysis does not model a build-up period during which emissions are gradually reduced, but instead provides a comparison of conditions for the single year of 2020 with and without the additional 10% reduction. The Commission can therefore be seen as providing information on the effects of its climate policy at a particular point in time, rather than generating an estimate of the net present value of the changes resulting from its policy, as may be done elsewhere.

In the earlier work on the Commission's Clean Air for Europe (CAFE) Programme, stakeholders requested that mortality be valued using two approaches: one based on the loss of life expectancy and valued using the value of a life year (VOLY); the other based on the number of deaths linked to pollution exposure and valued using the value of a statistical life (VSL). These methods ascribe value by establishing the amount of money that people are willing to pay (WTP) to reduce the risk of death by a defined probability or prolong life by a given amount. This can be done by various methods, such as examining expenditure on safety equipment, using questionnaires to assess WTP to change risk by a small but policy-relevant amount, or assessing the wage premium for people in more dangerous occupations. The results do not value people's 'worth' as such but instead indicate the amount of money that they are willing to allocate for health protection. The expression of mortality in economic terms has, not surprisingly, been criticised by some as extending monetisation into areas that are beyond economics. However, this criticism ignores the fact that policy makers routinely make decisions that affect health on an economic basis, for example when setting national healthcare or international development budgets. The monetary estimates simply make the weighting of impacts more explicit than it would otherwise be.

The Commission's analysis for the move to a 30% emission cut (with or without flexibility) only includes assessment using the VOLY (low and high estimates of which are used to generate the reported ranges). This is a consequence of the method used for quantifying mortality impacts in the GAINS (Greenhouse gas-Air pollution Interactions and Synergies) model, which was used by the Commission. However, the Commission's current analysis does not fully reflect the methodology initially recommended in the CAFE study. The CAFE methodology was used for the 2008 HEAL study. For the ranges presented in this report both VOLY and VSL approaches have been used. The present author's strong preference is for the VOLY approach from the perspectives that air pollution is most likely to be a contributing factor rather than the single cause of death, and that a change in air pollution can only affect when, rather than whether, people die. However, as noted above, some stakeholders are unconvinced by these arguments and retain a preference for application of the VSL. Therefore, for full consistency with the CAFE methods, we apply both VOLY and VSL.

It is possible to use the results provided in the Commission's Communication to expand the analysis to include additional impacts without repeating all five stages of the analysis listed above. Here we have taken the Commission's mortality results and applied the factors used to quantify mortality in reverse to 'back-calculate' aggregate European exposure to pollution levels in 2020 under the current legislation baseline (including the agreed 20% GHG emission reduction), and the changes arising from the 30% cuts in GHG emissions with and without flexibility (in other words, the output of stage 1, above). Response functions, fraction of population affected and incidence data can then be applied to these exposure data to quantify morbidity effects, such as hospital admissions, lost working days, incidence of respiratory ill-health and so on, and their economic equivalent. There is some added uncertainty in making these calculations at an aggregated EU level rather than on a country by country basis (e.g., because of differences in population age structure between countries) but this is unlikely to be significant compared to other uncertainties that are present, for example in the valuation of mortality. A clear advantage in basing the analysis so closely on the Commission's is that the two sets of analysis consider exactly the same set of measures for reducing emissions.

23 The Unified EMEP Model: http://www.emep.int/OpenSource/index.html

24 The GAINS Model: http://gains.iiasa.ac.at/index.php/home-page

25 Health Impact Assessment report from CAFE-CBA: http://www.cafe-cba.org/assets/volume_2_methodology_overview_02-05.pdf

For consistency with the Commission's analysis, the ranges that are presented here account for uncertainty only in the valuation of mortality. The full CAFE methodology provides a much more thorough methodology for assessing uncertainties, which accounts for variation in response functions, data on the incidence of ill health and so on in more detail. This permits, for example, a probabilistic assessment of the likelihood of the benefits of an air pollution control policy exceeding the costs. We also note that whilst WHO Europe have approved use of the CAFE methods, other expert bodies, such as COMEAP in the United Kingdom and the US Environmental Protection Agency[26], have different views on some parts of the analysis, which would change both the best estimates and surrounding distributions of impacts and benefits. However, it is also important to note that there is much agreement between the bodies mentioned with respect to:

- air pollution expressed through exposure to particles and ozone being damaging to health;
- effects across the population being significant in Europe and North America as well as in areas of the world where pollution levels are higher; and
- the selection of response functions for the most significant effects.

Having quantified impacts at the EU level, we go further to seek to define impacts at the national level. The Commission's analysis does not provide a breakdown of the types of measures implemented or the extent of controls in each country. However, it is possible that the resulting uncertainties are not too severe for the purposes of the present analysis because of the long-range, transboundary nature of the air pollutants of interest here, which reduces to a significant extent the specificity of damage according to the precise site of emission.

To assess the consistency in the share of benefits for each country for various scenarios of air pollutant and greenhouse gas controls, results of the following studies have been reviewed:

- The European Commission's Communication of May 2010
- Policy studies by IIASA for the European Commission using the GAINS model[27]
- Policy studies by AEA Technology and EMRC for the Commission, particularly the CAFE-CBA work, using the ALPHA (Atmospheric Long-range Pollution Health Environment Assessment) model[28].

It was found that the geographic distribution of emission reduction benefits across the different scenarios reviewed, including those for the original Climate and Energy Package, is broadly consistent for most countries. On this basis, it is reasonable to extrapolate the share of total damage occurring in each country to the new scenarios. However, results for countries at the edges of the EU (e.g., the United Kingdom, Estonia, Finland, Ireland, Latvia and Malta) were found to be more sensitive to the geographic distribution of emission reductions than those for countries towards the centre. This added uncertainty for geographically peripheral countries needs to be considered when inspecting the results of the study.

26 COMEAP – Committee on the Medical Effects of Air Pollutants: http://www.dh.gov.uk/ab/comeap/index.htm. USEPA (ongoing) Second Prospective Study on the Benefits and Costs of the Clean Air Act: http://www.epa.gov/air/sect812/prospective2.html

27 http://gains.iiasa.ac.at/index.php/policyapplications/gothenburg-protocol-revision

28 http://www.cafe-cba.org/reports/

Results

Results are provided in the following tables and figures. The baseline scenario describes the total impact on health of improved air pollution (due to reductions in SO_2, NO_x and fine particles) for European Union Member States 2020 assuming full implementation of current legislation including the 20% reduction in GHGs under the existing Climate and Energy Package of the EU.

Table 2 describes the health impacts avoided by moving to the '30% with flexibility' and '30% internal' cuts in GHG emissions across the EU27 by 2020. The units vary between the impacts - for example, they relate to the loss of life expectancy, cases of bronchitis, or days of ill health. The rationale for selecting these endpoints from the epidemiological literature is provided in the Health Impact Assessment Methodology volume of the CAFE-CBA reports[29].

Estimated benefits arising from the current target of a 20% emission cut, which are taken from the earlier HEAL report[30], are shown for comparison.

Table 2. Health benefits to the EU Member States of cutting EU27 GHG emissions by more than 20% for 2020

Units: life years lost, cases, days lost to ill-health (as appropriate) per year.

Impact assessment, all figures per year	**Baseline in 2020** Takes into account the current 20% emissions cut	**Benefit from agreed 20% cut**	**Additional annual health benefit in 2020 of moving from 20%-30% emissions reduction**	
Health impacts - cases attributed to change in air pollution exposure			Cut of 30% with flexibility	30% internal cuts
Mortality - Life years lost, people aged >29	2,361,000	218,182	67,308	**140,385**
Deaths in infants (1 to 11 months)	376	36	11	**23**
Chronic bronchitis, cases	119,361	11,078	2,949	**6,151**
Cardiac and respiratory hospital admissions	63,456	5,869	1,811	**3,776**
Restricted activity days (RADs), working age population	207,539,966	19,194,869	6,270,471	**13,078,412**
Of which, working days lost	47,526,656	4,395,625	1,435,938	**2,994,956**
Days with respiratory medication use by adults and children	21,204,130	1,960,163	595,725	**1,242,512**
Days with lower respiratory symptoms among adults and children	275,334,406	25,362,686	8,372,396	**17,462,427**
Consultations for asthma and upper respiratory symptoms	2,374,300	218,711	68,302	**142,458**

Two comments relating to the quantification of mortality in the population aged over 29 years are necessary. First, the omission of effects in those aged under 29 (who were not covered in the original epidemiological study from which the response function used was derived) is unlikely to add greatly to the results because of the low mortality rate of the population aged under 30 in Europe. Second, additional calculations estimated the number of deaths attributable to the change in pollution levels, a result that is used below to quantify the upper bound valuation of impacts following application of the VSL. The estimated number of deaths brought forward is not shown in Table 2 as it could imply that results were additive to the estimate of lost life years, which they are not. The results for infant mortality are, however, not covered in other estimates shown in the table.

29 HEAL, CAN Europe, WWF (2008). The co-benefits to health of a strong EU climate change policy. http://www.env-health.org/IMG/pdf/Co-benefits_to_health_report_-september_2008.pdf

30 European Commission Communication, May 2010, COM (2010) 265 final. Analysis of options to move beyond 20% greenhouse gas emission reductions and assessing the risk of carbon leakage . http://ec.europa.eu/environment/climat/pdf/2010-05-26communication.pdf

EU health co-benefits

Results are converted to economic value in Table 3 based on a price year of 2005 (consistent with the European Commission's analysis). Economic value is here an aggregate of the costs to health services, productivity of the economy and willingness to pay to avoid ill health and the pain, suffering and loss of life expectancy that goes with it.

Total health co-benefits of moving from a 20% to a '30% internal' cut in EU27 GHG emissions by 2020 are estimated to be between €10.6 and €30.5 billion per year (the range showing sensitivity to use of a lower bound estimate of the VOLY and an upper bound estimate of the VSL). The effects that contribute most to this are: premature death, chronic bronchitis, restricted activity days, and lower respiratory symptoms.

The benefits shown in Table 3 are in addition to those associated with achieving the 20% emission reductions target, estimated in HEAL's previous report at €13 to €52 billion per year in 2020.

Table 3. Economic value of the co-benefits described in Table 2. €millions/year

Economic assessment, €millions	Added benefit from 30% with flexibility by 2020	Added benefit from 30% internal cut by 2020
Mortality (range: lower bound VOLY, upper bound VSL) €million	€3,516 – 13,062	**€7,334 – 27,245**
Morbidity €million	€1,545	**€3,222**
Total health benefit, €million, low	€5,061	**€10,556**
Total health benefit, €million, high	€14,607	**€30,466**

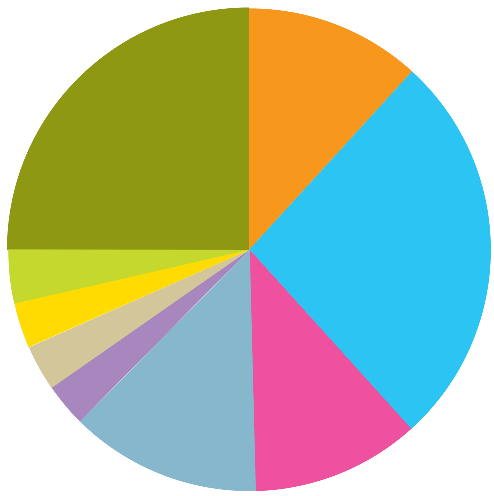
Benefits for individual EU Member States

Allocation of these benefits to various EU Member States is shown in Figure 2. Benefits are partly a function of the size of each country and are partly a function of their location within the EU, with countries towards the centre having larger benefits than those at the edges. The country with the greatest benefits is Germany, with particularly large total benefits also observed for France, Italy and Poland because of their location relative to other EU Member States and high populations. Whilst acknowledging the uncertainty inherent in the method for allocating benefits to each country, particularly in cases where, for example, power plant emissions may diverge significantly from the European average, we are confident that the figures given are a broadly reasonable reflection of the distribution across different countries.

Figure 2. Allocation of benefits for the EU27 to countries

Total benefit of moving from a 20% to a 30% cut by 2020 = €10.5 to - €30.5 bn/yr

Scenario: 30% internal cut in EU GHG emissions



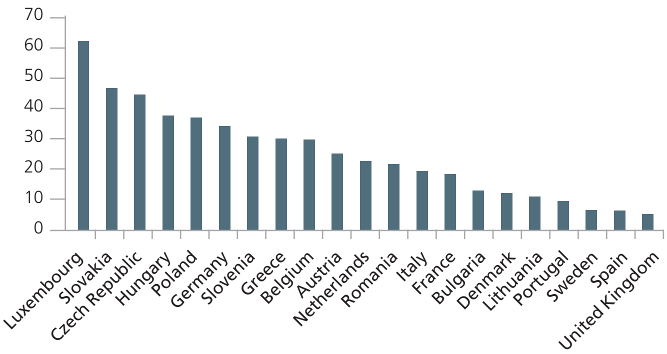
Germany	€2.8 - € 8.1bn/yr
Poland	€1.4 - €4bn/yr
France	€1.2 - €3.5bn/yr
Italy	€1.2 - €3.4bn/yr
Netherlands	€0.4 - €1.1bn/yr
Belgium	€0.3 - €0.9bn/yr
Spain	€0.3 - €0.9bn/yr
United Kingdom	€0.3 - €0.9bn/yr
Other countries	€2.6 - €7.7bn/yr

Benefits for smaller EU countries

Another way to consider the allocation between countries is to quantify health benefits per head of population (See Figure 3. NB The results are based on the lower bound for mortality valuation: results for the upper bound would be nearly a factor of 3 times greater).

This has the advantage of demonstrating how some smaller countries stand to benefit from strong climate policies. For example, Luxembourg is estimated to have the highest benefits per head of population of any country as it would gain from emission reductions in the industrial countries that surround it, such as France, Belgium, the Netherlands and Germany. Other smaller countries with high benefits per head of population are Slovakia, Czech Republic and Hungary. Note that some of the smaller countries at the edges of the EU27 have been omitted from the figure (Cyprus, Estonia, Finland, Ireland, Latvia and Malta) because of uncertainty in the way that total benefits would be distributed between countries.

Figure 3. Health benefit per capita for a '30% internal' reduction in GHG emissions relative to a 20% cut by 2020



Cumulative benefits

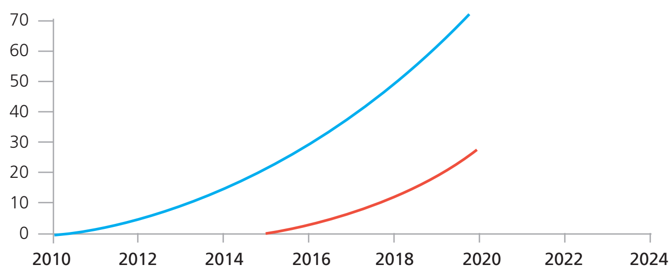
It is also appropriate to consider how co-benefits may accumulate over time. A key issue here concerns when controls are brought in. This is illustrated in Figure 4, again taking the case with the lower bound mortality valuation. The upper line shows how benefits of moving to the new 30% target would accumulate assuming that action commences in 2010 and is phased in linearly through to complete implementation by 2020. This generates a total benefit of €58 billion over the 10 year period.

The lower line, in contrast, assumes that no action occurs before 2015, but that the same level of control is reached by 2020 generating a total benefit of only €22 billion.

Accumulated co-benefits are more than twice as high in the first case compared with the second (€58 billion as compared with €22 billion). In the case of the upper bound mortality valuation, the cumulative benefit would be €63 billion if action starts in 2015 as against €163 billion if action is started in 2010.

Of course, were action to be delayed to the end of the period all of the potential co-benefits in the years prior to 2020 shown would be lost.

Figure 4. Consequences of delaying the start of action for the '30% internal' case



A further factor to consider is the added benefit of starting early in terms of bringing forward the date of compliance with existing air quality legislation. Air quality standards on NO_2 and PM, and national emission ceilings for NO_x otherwise appear unlikely to be met for sometime. These co-benefits are considered below.

Other co-benefits of a strong EU climate policy

The analysis presented in this report covers only one element of the benefits of climate policy, namely the impacts on health in the European Union of reducing several air pollutants (fine particles, NO_x and SO_2). These indirect effects linked to the reduction of air pollutants are not covered under the Kyoto Protocol. Nevertheless, even in addressing this limited set of indirect effects, the following have not been considered:

- Unquantified health effects of the pollutants listed, noting that quantification in epidemiological studies is focused on those elements that are relatively easy to measure.
- Impacts on the natural environment, including rivers and lakes, forests and other terrestrial ecosystems.

Small increases in the productivity of EU and national workforces are quantified in the study and included in the estimates of health benefits. Figures are shown in Table 2 and in Appendix I which shows results by country.

As mentioned above, early action on moving to the 30% target would help speed up the date of compliance with existing air quality legislation, easing the regulatory burden on national authorities. Industry involved in air pollution control would also benefit. The 2010 European Commission Communication highlights the co-benefits to industry of the reductions in these three air pollutants. They are estimated at €5.3 billion on the basis of the 30% cut in internal emissions. (See Table 1, though it is unclear to what extent these savings are additional to the health benefits quantified in this report.)

Wider benefits of action to control climate change

On top of these, of course, should be considered the added benefits of avoided climate change. These include health effects such as reduced temperature stress and limiting the spread of infectious disease to reduced flooding and landslides. It also includes economic effects, such as the creation of new job opportunities in green energy and reductions in oil and gas imports, and improved energy security for the EU Member States.

Conclusions

This study has assessed the co-benefits to public health across the EU of a move to a 30% GHG emission reduction target rather than 20% (as currently agreed) by 2020.

The main findings are:

- The achievement of a 30% rather than a 20% reduction in GHG emissions across the EU27 by 2020 would result in better health and lower health costs.
- Health benefits would be higher if a 30% internal (domestic) target on emissions were adopted rather than 30% with flexibility. (In the latter case, there would be a 25% cut in GHG emissions within the EU whilst the remaining 5% is achieved by financing equivalent cuts in other regions of the world.)
- The co-benefits to health quantified in this report are expected to be particularly large (>€100 million/year, extending to several billion €/year) in eight Member States. Appendix I gives a detailed breakdown of the health benefits for Belgium, France, Germany, Italy, the Netherlands, Poland, Spain and United Kingdom. Benefits tend to be lower in some of the smaller Member States, largely on account of population size, though some of these (Luxembourg being a prime example) have very high benefits per head of population (see Figure 3).
- Benefits are reduced the longer action is delayed.
- Cleaner air resulting from the achievement of a 30% rather than 20% reduction in emissions would result in a more productive workforce. This is highlighted in the estimates of the health benefits to EU Member States (Table 2). It shows the reduction in days of restricted activity (due to better health) among the working population and the proportion of those days which are 'working days' in paid employment.
- The analysis presented here shows that our previous report on this theme did not exaggerate health co-benefits. On the contrary, the recent European Commission report on which this study is based suggest that our previous figures underestimated the EU health co-benefits of moving to the 30% internal target.
- Finally, it is stressed that the study assesses only a small proportion of overall health benefits arising from climate policies. Most obviously, we have not considered the direct benefits of reducing climate change. We have also not quantified some of the co-benefits of the non-GHG pollutants addressed in this report, of which impacts on ecosystems may be especially important.