Air Quality Expert Group – Air Quality and Climate Change: A UK Perspective

The UK Governments asked the Air Quality Expert Group (AQEG – an independent group of UK experts) to examine linkages between mitigation policies for climate change (CC) and air quality (AQ). AQEG was asked to examine the scientific background to these interactions and to identify synergies, where measures to improve AQ can help to ameliorate CC, and trade-offs where policy measures in the two areas act in opposition. AQEG was asked to focus on the next 10 – 15 years and also to comment on the decades starting 2030 and 2050. The focus was on the UK and Europe and on likely rather than catastrophic future events.

This summary focuses on the links between mitigation policy measures. The full report will be published at the end of March 2007 and will be available at http://www.defra.gov.uk/environment/airquality/panels/aqeg/index.htm

Air quality pollutant emissions in the UK have fallen considerably over recent years and further decreases are forecast for the period up to 2020 (e.g. NO_x 45%, SO_2 64%, VOC 26%, PM_{10} 19%, for a 2002 base year). These decreases have and will be driven by legislation and by technology changes. Little or no consideration has been given in these developments to the impact of the measures on CC. Much smaller decreases are forecast over the same period for CO_2 (4%). UK projections show that future emissions of AQ pollutants will be spread over a much larger number of sectors, because of improvements in control of the previously dominant emitters. Further reductions beyond 2020, and assessments of the impact on greenhouse gas emissions, will require measures across a much larger number of sectors than was the case in 2002.

Because the projected UK decreases in CO_2 are small, even small CO_2 increases from AQ abatement technologies are significant. Many 'end-of-pipe' technologies for AQ controls result in small increases in CO_2 emissions, e.g. flue gas desulphurisation (2% increase in CO_2) and some forms of abatement of road vehicle exhaust emissions (< 5% increase in CO_2). Refinery emissions of CO_2 increase in order to meet new fuel sulphur limits and production of sulphur free (<10 ppm S) petrol and diesel leads to increased refinery CO_2 emissions of 5 – 20%. These emissions could be offset by improved technologies in petrol engines. Future diesel engines, however, are projected, on a 2010 – 2015 timeframe, to lead to increased CO_2 emissions, over Euro IV vehicles. These changes derive from the application of new pollution control technologies such as four-way catalysts, lean NO_x traps and particulate filters. Emissions of nitrous oxide, N_2O, which is a much more powerful greenhouse gas than CO_2, are also important for CC. The use of selective catalytic reduction (SCR) to reduce NO_x emissions from road vehicles could lead to increased emissions of N_2O. These emissions may more than offset the reduced CO_2 emissions resulting from the higher engine efficiency.

Fuel and life-cycle analyses must be applied to all power generation and vehicular technologies when considering policies at a national level:

- The analysis for the use of energy crops and biofuels should include fuel production and distribution, as well as end-use emissions. In addition, the management systems used to produce these crops, including the application rates of fertilisers and the land use they replace, will influence the extent to which increased production of such crops may lead to changed emissions of both AQ and GHG pollutants, e.g. NH_3, N_2O, and biogenic VOCs.

- The CC benefits of diesel over petrol are compromised if a full analysis is made that takes account of (i) the greater energy density of diesel, so that comparisons on a litre basis are inappropriate, (ii) the typically larger engine sizes of diesel compared with petrol vehicles, (iii) the rising energy intensity needed in refinery processes to meet the increased demand for diesel and the consequent fuel compositional requirements (iv) recent modelling work that indicates that black carbon emissions from diesel vehicles may offset the CO_2 benefits of diesel, resulting in greater climate warming, compared with emissions from petrol vehicles.

- The full fuel-cycle environmental implications of non-fossil fuel means of electricity generation (wind, tidal, nuclear, biomass etc) should be evaluated, as part of the development of future energy supply policies.

Some fuel-cycle analyses have been undertaken, but not necessarily on a consistent basis and always with a high level of uncertainty compared with estimates of emissions at the point of use of a fuel (e.g. vehicle tailpipe). At present, lack of information makes such assessments difficult and potentially incomplete.

Both AQ and CC generally benefit from reductions in demand and improvements in efficiency. Mode-switching, e.g. from car to train and from air to train can produce substantial benefits, as can fuel switching, from fossil fuels to hydrogen or to biofuels. In all cases, a full analysis must be made and both climate and AQ impacts assessed. Demand management, especially in the transport sector, through congestion charging and urban planning can lead to 'win-win' outcomes. Overall, behavioural change through incentives or legislation lies at the heart of such measures

A holistic approach to processes that occur in and that affect the atmosphere is essential if progress is to be made in limiting the impact of human activity on CC and AQ. This progress is currently limited by the availability of data for, e.g. fuel- cycle analyses. A further problem is the lack of common metrics that can be used to assess both AQ and CC impacts. A number of specific measures that could correct some of the deficiencies are discussed in the main report.

Key mitigations-related recommendations.

1. Impact analysis of policies or specific developments, whether for industry, transport, housing etc, should take account of the interlinkages of emissions of AQ and CC pollutants. In particular measures at the national level designed to improve local AQ or to abate greenhouse warming should not be implemented without prior consideration of all types of impact on the atmosphere and other environmental media.
2. Detailed consideration should be given to appropriate policy drivers and legislation that could be introduced to ensure that the reduction of greenhouse gas emissions is properly incorporated into regional and local government planning decisions.
3. Detailed consideration should be given to developing better means of expressing the influence of AQ pollutants on climate, and for inter-comparing the benefits of abatement strategies in respect of AQ and of CC.
4. Research is needed on the extent to which policies for large-scale tree planting within the United Kingdom and elsewhere within Europe would influence AQ in high temperature summer pollution episodes. Wider impacts of land use change upon AQ and global pollutants also need to be considered.
5. Consideration should be given to promoting measures which result in benefits both for AQ and climate. These might include incentives for domestic energy conservation, improved industrial process efficiency and measures designed to modify the behaviour of individuals so as to reduce the impact of their activities on the atmosphere. Given the significant influence of transport emissions, measures which reduced the use of road vehicles, shipping and aircraft would be highly beneficial.
6. A comprehensive life cycle analysis should be conducted comparing the environmental implications of electric and hybrid vehicles with each other and with conventionally-fuelled vehicles, to inform policy on incentivising their use.
7. The full fuel cycle environmental implications of non-fossil fuel means of electricity generation (i.e. wind, tidal, nuclear, etc) should be evaluated, as part of the development of future energy supply policies. This should include the implications of large-scale biofuel and bioenergy production for land-surface exchange of pollutants and greenhouse gases.
8. Future CC policy should consider extending the basket of radiative forcing agents included in the development of CC policies.