3 - Science and Policy interface: role of integrated assessment modelling (IAM) and cost-benefit analysis (CBA)

Integrated Assessment Modelling (IAM) has been at the heart of European air quality policy development for more than two decades[3]. Such tools provide a useful framework for policy makers to connect the increasingly complex science dealing with multiple pollutants and multiple effects to practical and cost-effective policy.

Given that the complexity of the underlying science is embedded (often deeply embedded) within the IAM, the development and use of such tools places significant responsibility on the scientific community involved. First they need to ensure that 'good science' is incorporated into the model and that uncertainties in the science are made transparent and their policy relevance explored. Second, they need to ensure that the exogenous or endogenous data driving the model accounts for uncertainties (e.g. alternative 'future worlds'). Complex science connected to practical policy 'at the push of a button' is alluring since it no longer requires stakeholders (especially hard pressed policy makers) to invest in understanding the science or its limitations. The danger is that all this complexity becomes a black box where only the inputs and outputs are visible.

This said, in the ever complex 'multi-pollutant', 'multi-issue' world of air quality, IAMs are vital to the development of practical policy but must be appropriately deployed. In principle such tools enable the full 'policy envelope' to be explored and provide an ideal framework to explore the influence of 'uncertainties' and express them in policy terms.

In this Review we have brought together the results of a comprehensive range of such uncertainty or sensitivity scenarios to illustrate how vital it is to fully utilize the capabilities of IAM tools to ensure policies are robust.

We extend our Review to the topic of Cost Benefit Analysis (CBA). Whether appropriate or not, CBA has increasingly been used by policy makers to 'justify' the proposed ambition level of air quality policies in Europe. Therefore, as for IAM, CBA needs to be based on sound science which accounts for alternative views and for the uncertainties both in the valuation of external costs and in the impacts that are being valued. This is well illustrated in the range of valuations that result from Willingness To Pay (WPT) surveys used as the main 'valuation input' for determining the external cost for long term PM impacts on human health. Survey data shows some three orders of magnitude variations in individual responses (discounting the zero/close to zero responses). The distribution is also highly skewed to the low end valuations.

The use of survey data to value the external costs also brings with it an inherent difficulty since, unlike market surveys which seek to provide data on willingness to pay for a new product launched onto the market, the actual willingness to pay is never tested. This, in itself, suggests reliance on a single WTP for policy development is far from robust.

In addition, it is important to note that policy is rightly shaped by many factors. CBA is by its nature 'single issue' focused. What it does not tell the policy maker is whether the expenditure on this 'societal risk' if spent on another 'risk' would return a greater societal benefit. This need to spend proportionally across a range of risks is often lost in CBA. This is particularly relevant for the case of air pollution control since health benefits can be generated on the basis of a range of different policies and a CBA of air pollution control policies does not identify which of the options promoting better health is the most cost-effective.

In this Review we explore these concerns and their implications in the development of a robust policy. We also set forth what we believe might be a better approach. In addition, recognizing the growing body of work around valuing ecosystem services, we provide what we hope are some first thoughts that are relevant in considering ecosystem impacts in air policy assessments.

[3] The significant shift to an effects based approach to European air quality policy took place in the early part of the 90's and was first deployed (including IAM) in the technical work underpinning the UN-ECE second sulphur (Oslo) Protocol. The availability of robust European Scale air quality models such as EMEP together with the comprehensive mapping of critical loads for ecosystems paved the way for IAM. Here simplified emission-impact relationships based on the results of European scale air quality modelling are integrated in a framework with emission control measures and their costs to enable optimum, cost-effective policies to be explored. The IAM studies have been centered on the RAINS/GAINS model developed and maintained by IIASA.

Gothenburg Protocol (GP):

The Convention on Long-range Trans-boundary Air Pollution (CLTAP) was adopted in November 1979 within the framework of the Economic Commission for Europe on the Protection of the Environment. There are currently 32 Signatory countries to the Convention including most western European countries, Canada, the Russian Federation, Ukraine and the USA. A total of 51 countries are party to the Convention. The Convention includes eight protocols that identify specific obligations to be taken up by the signatory parties. The Gothenburg Protocol was signed in 1999 in Gothenburg and entered into force in 2005. It sets emissions ceilings for sulphur dioxide, nitrogen oxides, volatile organic compounds and ammonia in order to reduce acidification, eutrophication and ground-level ozone. In the EU, the Gothenburg Protocol has been implemented through the National Emission Ceilings (NEC) directive. In the Gothenburg Protocol, emission limits are set for each participating country.

Substantial amendments to the Gothenburg Protocol were agreed in May 2012. These amendments included new commitments for the reduction of $PM_{2.5}$, specific attention for black carbon as driver for both air pollution and climate change, and new commitments to reduce the emissions of sulphur dioxide, nitrogen oxides, ammonia, and volatile organic compounds. In addition, a number of new countries signed up for the Gothenburg Protocol, or indicated their interest in becoming signatories, including Russia and Belarus. Substantial improvements in air quality can be expected as result of the implementation of the revised Gothenburg Protocol.

Thematic Strategy on Air Pollution (TSAP)

The Thematic Strategy on Air Pollution (TSAP) (September 2005) is one of the seven thematic strategies in the Sixth Environmental Action Programme adopted by the EU in 2002. It supplements national and preceding EU legislation by establishing objectives for air pollution and proposing air pollution control measures. The TSAP covers a wide range of air quality issues and potential pollutants, with a focus on Particulate Matter.

Basic concepts in IAM language

CLE: Current legislation. Usually used to refer to the emissions that result from current legislation (no further measures are applied)

MTFR: Maximum Technically Feasible Reduction refers to the emission levels achieved by applying all further abatement measures

Gap Closure percentage: reduction of health and environmental impacts, expressed as a percentage, of the maximum further impact reduction achievable in moving from CLE to MTFR.