Adaptive policy mechanisms

A preliminary discussion of adaptive and flexible options for environmental target setting in the context of transboundary air pollution

Interim Report

Summer 2010

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Acknowledgements and disclaimer

This note has been compiled by Andrew Kelly (AP EnvEcon) and Herman Vollebergh (Netherlands Environmental Assessment Agency). The note summarizes some preliminary ideas on the use of flexibility in air quality regulation. AP EnvEcon worked on this piece as part of the IMP Ireland project that is funded principally by the Environmental Protection Agency of Ireland. Part of the contribution is based on an ongoing joint project with Corjan Brink, Hans Eerens and Frank de Leeuw from the Netherlands Environmental Assessment Agency. This project aims to evaluate the potential usefulness of equal impact factors as a way to implement flexibility in transboundary air pollution trading in European Union. Input from Eduard Dame formerly of the European Commission and Rob Maas of PBL has been much appreciated.

Views expressed are those of the authors alone.

Introduction

This short brief presents thoughts related to potential flexible mechanisms that could be integrated into air quality policy agreements, specifically the UNECE Gothenburg Protocol (GP) emissions ceilings and the mirror European Union National Emissions Ceiling Directive 2001/81/EC (NECD)[1]. This interim document follows on from an earlier piece of work outlining a number of both 'new and known' theoretical concepts (Kelly and IMP team, 2009[2]), and precedes a new piece of work incorporating feedback from presentation of the original concepts and more rigorous analysis of possible outcomes. The piece does not represent a national position, rather it is the product of related research deemed relevant to the process.

The reasons for inclusion of flexibility are straightforward and include:

- Scenarios are illustrative. They are not predictions. Related to this, sensitivities do not actually incorporate any flexibility into the process. Thus neither of these aspects of the ceiling setting process address the potential for unforeseen events to influence the expected outcomes. Contemporary evidence highlights the potential for the unexpected across a range of issues – e.g. economic crisis, ash clouds, further EURO standard issues and so forth.
- To proceed without flexibility is to place undue confidence in long range forecasting and assumptions. This approach may limit support and restrict new participants. Specifically, this may dissuade engagement from developing economies where – in the case of the Gothenburg Protocol – ratifications could offer significant and cost-effective benefits.
- Related to this point, recently joined EU member states, and bordering countries, including EECCA, that are relevant to the transboundary pollution problem may lack capacity and expertise for the technical engagement in setting new ceilings (indeed many established countries may face this challenge). This highlights the importance of capacity, but also indicates a potential source of additional uncertainty for the future.
- Technical solutions may not offer sufficient scope for future abatement plans, this is almost certainly the case in the context of greenhouse gases. Thus abatement strategies will increasingly turn toward the use of 'non-technical' or behavioural measures. Such

[1] The NEC Directive 2001/81/EC and the Gothenburg protocol both set 'ceilings' for national emissions of pollutants with a view to controlling the effects on environment and health of transboundary air pollution.

[2] See www.impireland.ie – Outputs – Report #26

measures will introduce an added degree of uncertainty, such as temporal and spatial variability of measure effects.

- Introducing flexibility is likely to reduce the information asymmetry between regulators and firms, in particular the lack of knowledge of firm specific options to reduce emissions at low cost (compare evidence in US SO_2 emissions trading program).
- Environmental policy must be governed by principals of cost-effectiveness. Actions have opportunity costs and broader policy should always seek effective and rational allocations of resources. Where the future differs from the modelled projections, the burden of cost may rise, and the benefit may fall. Flexible mechanisms can provide a means of appropriate response.

Key Question

A key question is then how to set air quality targets and reach flexibility without sacrificing local air quality restrictions (too much)? However, the ultimate test to regulatory change is whether the benefits of change are worth the effort. Thus it should be demonstrated for a given flexibility option that the benefits for either regulator, firm or both (i.e. better information provision to the regulator or cost savings by the firms) outweigh its cost (i.e. loss in environmental targeting and administrative & compliance cost).

Cross Cutting Concepts

There are numerous 'cross-cutting' concepts that warrant consideration where seeking to design and implement a mechanism to address future uncertainty in the context of transboundary air pollution legislation. Many of these concepts should not be considered in isolation, but rather should be reviewed in conjunction with others. These have been discussed in a prior document and are therefore only touched on below.

- Effect protection – Are net effect/impact levels likely to change?
- Air quality limit values – Are AQ limit values respected/threatened?
- Effect distribution – Are the distribution of impacts significantly altered?
- Climate policy – How are the flexibilities likely to interact with climate policies?

- Mirrored policy – NECD and Gothenburg should be mirrored in terms of flexibility.
- Cost saving – How much cost saving is to be expected from introducing flexibility?
- Cost pass through – Is there a risk of added cost pass through under the flexibility?
- Monitoring and revision – What additional administrative burdens are imposed?
- National capacities – Are there appropriate national capacities available to operate?
- Penalties – Where non-compliance persists what are the penalty mechanisms?

Types of flexibility

An important point in respect of the flexibilities summarised in this brief, is simply that not all flexibilities address the same aspect of 'rigidity'. As an example, the '3 year average' flexibility affords some leeway with respect to spikes in emissions or the delayed, yet progressive influence of certain measures. It serves to smooth out the approach to compliance assessment in the target year. Thus where the target year is 2010, variations of a three year average compliance testing approach for emissions are possible. However, the '3 year average' does very little in respect of the general uncertainty surrounding activity projections, or failed technical abatement measures. For this and other reasons, a flexibility 'package' may be necessary to adequately provide for the different forms of rigidity in the legislative framework and to provide for mechanisms that adequately address the associated risks.

Another distinction for the type of flexibility is its scope. In some cases the flexibility will be within the international domain and engage multiple countries in an ongoing basis (e.g. International SO_2 and NO_X trading). In others the flexibility can be managed entirely on a domestic level (e.g. domestic trading, domestic gas swapping). Finally then, there are some flexibilities that are only relevant in the compliance testing phase such as three year average, split ambition targets etc. These variations are important considerations for the design, implementation and administration of a given flexibility.

As a final note, there is also rigidity inherent in setting ceilings based on any form of 'equity' basis for individual countries. This consideration is not discussed in this document, however, the decision to set aggregate EU targets versus specific country targets based on equitable considerations, will also influence the targets defined and degree of flexibility available under other mechanisms. This potential flexibility, or lack thereof, warrants independent discussion.

Exclusivity and Use

Many flexibilities are not mutually exclusive and could be introduced as a package. The interaction and freedom of flexibilities to operate in harmony is another important consideration. Whilst most could operate in parallel, the mix needs careful thought. Furthermore, it is important to define where a flexibility is an option, and where it is a defined approach. This latter point is most relevant to compliance testing flexibilities. For example, enforcing the 3 year average as the test for compliance may shift countries from a position of compliance in the target year to non-compliance.

Simplicity

As a general principal, excessive complexity will likely see a given flexibility fail. Thus, whilst accepting transboundary air pollution as a complex issue, efforts should be made to streamline proposed flexibilities to operationally feasible mechanisms. This may well require a sacrifice of some of the potential gains from a theoretical perspective (e.g. scope for cost-effective improvements in abatement decisions), but will support practical implementation.

Selected Flexibility Concepts and Associated Considerations

Under the subsequent headings a brief summary of some selected flexibility concepts are presented along with relevant questions to be addressed in respect of their potential introduction.

1. Three year average

The three year average compliance operates on the simple premise that emissions for the purpose of compliance are based not on those in a single year, but rather on a three year average. Three year average operates on a formula as follows:

(Year X - 1 plus Year X plus Year X + 2) / 3

This very simple mechanism can help with the timing of compliance testing and should smooth out the process for some who may experience emission spikes or slower abatement penetration than originally expected.

2. Domestic Gas Swaps

In this mechanism countries may offset over compliance with one pollutant against a failure to comply with another. The operation can be subject to certain constraints. The proposal would be for a simplified approach where the 'exchange rate' for domestic gas swaps is simply less favourable for the country and more favourable for the process. For example, each comparable unit of an alternative pollutant might be worth only half a fraction of 'a credit' for any other. This 'exchange rate' assumption can be tailored based on scientific input[3]. The idea is simply that offering some credit for domestic gas swapping could encourage countries to pursue additional abatement on alternative pollutants as part of their path to compliance.

One of the risks here is redistribution of effects, although with an unfavourable credit exchange rate, the net costs should be easily protected. The question arises though as to whether there is an issue with certain effects of a comparable value being swapped e.g. less health damage for more acidification.

3. Split ambition targets

The split ambition target is based on the principle of splitting a target into two components a fixed value and a flexible range portion. The flexible range portion has the possibility of increasing or decreasing as initial uncertainties in the process become understood. For simplicity we assume an aggregate uncertainty to be applicable for each country's emission projection and corresponding ceiling - in this case we assume this aggregate range to be +/- 7%. In practice this component, and the fixed ceiling in particular, could be modified to support attainment of a specific minimum goal or to reflect a perceived level of uncertainty. Pollutant specific uncertainty ranges would be preferable. The parameters and sample values for this assessment are as follows:

[3] Further work on this topic of exchange rates is part of the ongoing collaborative work underway by the authors.

- Ceiling (C) : 100kt Uncertainty range (U) 7%

Calculation of the fixed and flexible portions of the ceilings are then as follows:

- Fixed ceiling (FC): FC = C - (C*U) FC = 93kt
- Flexible range (FR): FR = C*U FR = 7kt
- Upper ceiling (UC): UC = C + FR UC = 107kt
- Lower ceiling (LC): LC = FC LC = 93kt

We do not define the conditions under which the flexible range would be adjusted, although in principal these could be for community wide factors (e.g. the failure of an EU wide technology to deliver expected emission reductions), or for unforeseen national factors (e.g. underestimation of activity, overestimation of activity). Analysis of multiple scenarios suggest that the overall aggregate variability for the NO_X ceiling under such a fixed and flexible portion ceiling, would be approximately + or – 4.5%.

Key questions are how to determine the appropriate ranges, and how the decisions with respect to use or revision of the flexible range portion would be managed. In principal however, a single flexible range reflecting a broad suite of potential uncertainties may be a useful approach. We are unlikely to either get everything right or wrong. Therefore the potential uncertainty range can be smaller than the aggregate uncertainty range one might estimate through assessment of each potential source of uncertainty in the process.

4. Overcompliance pledge

The over compliance pledge would afford no penalty for a further three years on commitment of over-compliance on that new date. The objective would be to increase the annual rate of reduction on top of meeting the necessary ceiling. Failure to achieve the new pledge would be treated as non-compliance up to the present day with penalties appropriately scaled.

- C Ceiling
- EIC Emissions in compliance year
- E5 Emissions 5 years before compliance year

Overcompliance pledge is the greater reduction of:

- Pledge = C - ((E5-C)/5))*Penalty rate
- Pledge = C- ((EIC-C)/5))*Penalty rate

An advantage of the approach is that it could be a mechanism to free up funds nationally for initiatives to reduce emissions. A rational country taking this option will make significant efforts to reduce emissions. Thus even failure may have the effect of stimulating greater emission reduction effort than the original ceiling compliance level alone. However, on balance the system may yet be too complicated and challenging to warrant much support.

5. Emission Trading variant

The idea behind this mechanism is to allow countries to offset over compliance with one pollutant against a failure to comply within **another** country. This means that for a given unit of some pollutant, e.g. SO2, within one country trade options would be allowed with a comparable unit of the same pollutant in another country. These trades could be subject to some country specific 'exchange rate' – like in the case of domestic gas swaps – to account for differences in local impacts.

The choice of the exchange rate is essentially open and could be tailored to location specific environmental impacts. To account for differences in air quality impacts, for instance, the exchange rate might reflect the concept of an 'equal impact factor', i.e. trades should reflect location specificities with the location with which the trade is set. Both the dimension of the swap (which gases to be included) and its local differentiation (country, EMEP area) are essentially free to choose.

By way of an example consider the first column (S-eco) in Table 1 which shows the example of an equal impact factor on the ecosystem (acidification etc) for SO2 at the country level. Thus the exchange rate defines equal relative impact factors for different countries which for sake of comparison are standardized at 1 for the Netherlands (this choice is arbitrary as standardization is possible for each country separately).

Given this standardization the column reflects the exchange rate of trades for one unit reduction of SO2 from within the Netherlands against reductions in other countries. As one would expect the impact factor clearly reflects an increasing penalty on trades with countries the farther they are away from the Netherlands. As the Netherlands is relatively central to Europe and given the prevailing Westerly winds abating one unit emission in the Netherlands contributes relatively strongly to reducing ecosystem impacts across many borders, whereas a similar unit reduction in, for instance, Cyprus only has a very limited impact. Therefore trading with Cyprus should face a much higher exchange rate than trading with Belgium. This notion is clearly reflected in the factors with Belgium, Luxemburg and Germany reflecting a much lower exchange rate than

Cyprus (note 1: the system accounts for impacts beyond EU borders; note 2: all exchange rates are above 1 showing that the Netherlands is relatively polluting).

Other and even more sophisticated 'equal impact factors' can be applied too. Like domestic gas swaps trades could allow for swaps between emissions such as SO2 and NOx (Column SN swap). Impact factors could also account for health impacts from PM 2,5 and ozone (Column S- and N-health). Furthermore, exchange rates could also be adapted to the EMEP grid to account for links between the location of specific installations within countries and their local impacts.

Table 1: Equal impact factors – Interim results

	Ecosystem effects			Health impacts		
Kolom1	**S-eco**	**N-eco**	**SN swap**	**N-health**	**S-health**	**SN swap**
AT	3.0	0.8	0.2	0.5	0.9	1.4
BE	1.2	0.9	0.6	1.3	1.0	3.6
BG	11.3	1.1	0.1	1.1	2.1	1.4
CY	41.6	2.9	0.1	0.6	0.8	2.0
CZ	1.2	0.8	0.5	0.8	1.1	2.0
DE	1.3	0.8	0.5	0.6	0.9	1.8
DK	2.2	1.3	0.5	1.7	1.7	2.6
EE	8.5	1.6	0.2	3.4	5.0	1.8
ES	8.7	1.1	0.1	1.7	1.5	2.9
FI	8.8	1.9	0.2	4.7	6.5	1.9
FR	2.6	1.0	0.3	0.7	1.2	1.6
GB	2.1	1.5	0.6	1.9	1.7	3.1
GR	11.9	1.2	0.1	2.1	2.6	2.2
HU	3.2	0.8	0.2	0.8	1.2	1.7
IE	3.3	1.9	0.5	1.4	1.9	2.0
IT	13.2	1.2	0.1	0.6	0.9	1.8
LT	1.8	1.1	0.5	1.6	2.6	1.6
LU	1.4	0.8	0.5	0.6	0.8	1.9
LV	5.2	1.2	0.2	2.1	3.2	1.7
MT	29.2	4.3	0.1	35.1	4.2	22.7
NL	1.0	1.0	0.8	1.0	1.0	2.7
PL	1.3	0.8	0.5	1.4	1.5	2.6
PT	2.8	1.1	0.3	2.4	1.5	4.3
RO	7.0	1.0	0.1	0.7	1.4	1.3
SE	3.3	1.6	0.4	2.2	3.7	1.6
SI	5.3	0.9	0.1	0.5	1.0	1.5
SK	2.5	0.8	0.3	0.7	1.2	1.6

Thoughts and Recommendations

These are only a handful of possibilities and it must be remembered that many of the potential flexibilities can be designed or modified to provide additional scope for flexibility with limited risk to effects. However, if the necessary constraints complicate the process too much, or the benefits are not shown to outweigh the costs, then the particular flexibility fails.

What seems clear is that some provision of flexibility to facilitate cost effective abatement and allow for the risks posed by uncertainty is sensible for future processes. It may be the case that with increased expertise and engagement, strong climate policies, moderate economic growth and stable populations the chance of major deviations for transboundary air pollution emissions will be more restricted for 2020 than the past. However, even this is just an informed guess. Whatever the future holds, flexibility remains important. It is not a question of choosing between the environment and the economy. It is a question of acknowledging the uncertainty inherent in the future and setting in place appropriate mechanisms with the aim of balancing our use of economic and natural resources effectively and equitably.

To investigate whether the benefits of regulatory change really outweigh its cost more research is necessary. Currently a project team from the Netherlands Environmental Assessment Agency aims to contribute in answering this question using the (global) CGE model Worldscan. The project analyses potential gains of the trading option in particular in a setting with international trade in goods and which also allows for interaction with (global and/or 'local') climate policy. As a first step the maximum gains from air quality emission trading will be assessed as well as the environmental impacts of such a policy using the GAINS model. These results will be compared with better targeted options such as those mentioned in the emission trading section.

By way of an interim recommendation, at this stage it may be sufficient to appropriately word the legislation to make the necessary provision for the potential package of flexibilities, as well as defining the desired constraints that would ultimately govern their operation.