CO_2 is not the only gas

Most of the planned domestic and regional trading regimes for curbing emissions of greenhouse gases (GHGs) focus on carbon dioxide (CO_2). Many companies, however, see market opportunities in reducing emissions of other GHGs. **Jos Cozijnsen** explains

National inventories of greenhouse gases (GHGs) and policies for reducing emissions of global warming gases other than carbon dioxide (CO_2) are surrounded by uncertainties. But it is clear that opportunities are being missed. At two workshops organised by the author for the Netherlands government earlier this year, it was apparent that companies with non-CO_2 related production or products differ widely in their options for curbing their GHG emissions and in their marginal reduction costs.

It was also clear that most policy makers within the Netherlands administration and in research institutes focus primarily on aggregated calculation uncertainties. Based on overall national uncertainty figures for non-GHG emissions, they could not imagine that trading of reductions in these gases would be practicable.

The only mandatory GHG scheme currently in place – the Danish Utility Quota System – involves only CO_2. The UK Emissions Trading Scheme, due to be launched early next year, accepts other GHGs, but the reporting guidelines do not cover non-CO_2 process emissions. Participating companies must therefore submit their own protocols for these gases. Other planned schemes for trading GHG emissions in the Netherlands, Germany, France and Romania cover only CO_2. The Norwegian cap-and-trade proposal – planned to start in 2005 – includes a basket of four GHGs. For reasons of scale, Norway intends to link its scheme with either the proposed European Union (EU) scheme or any Baltic scheme.


Chemical plants may find it cheaper to curb GHGs other than CO_2

Getting the numbers right

The six GHGs covered by the Kyoto Protocol – CO_2, methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride (SF_6) – all trap heat in the atmosphere and therefore have global warming potential (GWP). This potential can be compared with that of CO_2 and expressed in terms of CO_2-equivalent (CO_2e), as shown in table 1.

So, while non-CO_2 GHG emissions from certain industry sectors may be small in absolute terms, their contribution to trapping heat in the atmosphere is substantial. This makes them indispensable in attempts to mitigate climate change. Moreover, studies show that the reduction of non-CO_2 gases in some sectors is very cost-effective compared to CO_2 reductions in other sectors.

Many companies are already calculating their marginal GHG reduction cost curves. Estimates range from \$5 to \$40 for each tonne of CO_2e abated. Average marginal costs for reducing non-CO_2 GHGs can be at the bottom of this range. Research done under the framework of the European Climate Change Programme (ECCP) and in the Netherlands estimates a cost of \$1–2/tonne of CO_2e avoided both for N_2O reduction from nitric acid manufacture and for cutting emissions of HFC 23 in the production of compounds used in refrigeration.

Methane savings from waste can reduce emissions for around \$5/tonne, while reductions of trace gases in the semiconductor industry, air conditioning and the manufacture of insulating foam are possible for \$10/tonne of CO_2e. In some cases, SF_6, with its huge GWP, can have a marginal reduction cost of just a few cents per tonne of CO_2e. Some individual facilities, such as fertiliser or chemical plants, prefer to reduce N_2O emissions rather than CO_2 because their marginal cost of N_2O reduction is much lower. For them, inclusion of other GHGs in trading schemes is crucial.

This issue is at the heart of discussions between Europe's chemical companies, oil industry and national governments. Current European Commission proposals for emissions trading at EU level give primary attention to CO_2 reductions. The Commission plans only to develop monitoring guidelines for non-CO_2 GHGs if, in terms of their GWP, they can "be measured as accurately as CO_2 from combustion". This decision may have been taken for valid practical or political reasons, but it disregards overall GHG reduction opportunities.

Companies take the lead

At the same time, however, several large companies, including Alcan, BP, Dupont, Pechiney and Shell already include non-CO_2 GHGs in their company-wide emissions reduction targets, using their own monitoring protocols. For example, methane represents 0.5% of Shell's absolute emissions, but 10% of its CO_2e emissions. Both the Shell and BP internal GHG trading schemes include CO_2 and CH_4. Last year, BP traded 2.7 million tonnes of CO_2e at an average price of \$7.6/tonne in its internal market. Alcan, Dupont and Pechiney are measuring CO_2 and PFCs while Dupont measures both CO_2 and N_2O.

While these companies emit trace amounts of other GHGs, these are the ones

Table 1: Global warming potentials (GWPs)

Greenhouse gas	*GWP (CO_2e)*
Carbon dioxide (CO_2)	1
Methane (CH_4)	21
Nitrous oxide (N_2O)	310
HFCs	150–11,700
PFCs (esp CF_4 and C_2F_6)	6,500–9,200
SF6	23,900

Source: IPCC, 1996

they believe it is cost-effective to measure and manage. By doing so, they are helping to reduce site-specific measurement uncertainty, even if national inventories have greater uncertainty. From a public policy perspective, this is one of the many benefits of emissions trading; it provides incentives for better measurement and inventory development.

Table 2: Uncertainties in the Netherlands' GHG measurements

1. Greenhouse gas	*2. National uncertainty Netherlands inventory**	*3. Bottom-up uncertainty figures in some sub-sectors or facilities***
CO_2	3%	Fossil fuel combustion (n/a)
Methane (CH_4)	25%	35% agriculture; 20% gas production; 20% landfills; 10–15% for newer landfills; negligible for waste incineration for energy use, when professionally metered
Nitrous oxide (N_2O)	35%	75% agricultural soil management; 35% transportation; 35% industry; 12% nitric acid manufacture
HFCs	50%	negligible for small cooling and air-conditioning applications if control and filling is done professionally
PFCs (CF_4 and C_2F_6)	50%	10% certain individual aluminium smelters
SF_6	–10%/+100%	20% power transmission

*RIVM, 2001 ** Individual sources

Narrowing uncertainties in the Netherlands

For national GHG inventories, governments use the revised 1996 Guidelines for National Greenhouse Gas Inventories produced by the Intergovernmental Panel on Climate Change (IPCC) and the Good Practice Guidance issued in May 2000. These give default methodologies (default values and their uncertainty ranges) for estimating national emissions. Many companies, governments and international institutes are working together to develop accurate and practical protocols for monitoring and verification of GHG inventories in companies and even in individual facilities. Based on this work, the Netherlands National Institute for Environment and Public Health (RIVM) calculated uncertainty numbers in its national GHG inventory earlier this year (see table 2, column 2).

Non-CO_2 GHGs represent a third of Dutch GHGs in terms of their global warming potential. Uncertainties in measuring emissions of these gases have a variety of causes including, sometimes, poor monitoring protocols. Nevertheless, bottom-up inventories based on GHGs of individual facilities and analysis for the National Programme for the Reduction of Non-CO_2 GHG emissions, carried out in the framework of the ECCP, proves that uncertainties in emissions totals are smaller for specific sectors and, especially, for some individual facilities (see table 2, column 3).

Industrial sources of non-CO_2 GHGs, in particular, can deliver much lower inventory uncertainties than can be achieved at the national level. From diffuse GHG sources such as transport and agriculture, less accurate data are reported and expected.

Treatment of uncertainties

For practical and meaningful inclusion of sources of non-CO_2 GHGs in emissions trading regimes, several provisions exist to treat the uncertainties involved. Governments and companies need to continue developing standardised protocols for compiling GHG emissions inventories. Including such sources of GHGs in corporate inventories would help develop emission inventory standards. Hence, GHG trading promotes transparency in where the emissions come from and how reductions are generated and encourages credibility and market discipline. This is because emissions reductions represent market assets. Participants in a trading scheme want to be sure that each tonne of CO_2e bought or sold really is a tonne of CO_2e. So, for environmental credibility, inventories should be conservative.

In practice, inclusion of non-CO_2 GHGs in trading regimes could proceed as follows, in advance of international standardised protocols:

- Companies with GHGs, starting with those with the lowest uncertainties, could opt for inclusion of these gases in domestic trading schemes or register their GHG reductions, under the condition of notifying the market authorities of their monitoring protocols. Once standards for non-CO_2 inventories are set, companies will need to have their own protocols approved.
- In the national registry, the default uncertainty should be added to the emissions calculated by each source, as the government needs to be 'on the safe side' in its estimates. For example, if a nitric acid factory in the Netherlands wants to register its N_2O emissions under a trading regime, the company must accept the Netherlands' guidelines and uncertainty default, unless it can 'prove' its own measurements have a lower level of uncertainty. Otherwise, the national uncertainty of 12% should be factored into the reported emission reductions.

Trading on a sectoral basis

It can be attractive to include non-CO_2 GHGs from diffuse sectors and small sources in GHG trading schemes. Examples include agriculture, transport and the catering industry. Although emissions from individual sources in these sectors may be modest, at a national level they can add up to a substantial amount of CO_2e. To facilitate inclusion of these sources, one could choose to allocate GHG emission quotas to such facilities on a sectoral or 'mid-stream' basis (ie half-way between a downstream scheme based on individual companies and an upstream scheme targetting power sources). Sectoral GHG trading could involve activities such as the dairy industry, meat industry, automobiles, air-conditioning and restaurant industries. They represent the ultimate GHG emissions of farms, car drivers, kitchens etc.

Companies in such schemes would be able to internalise and distribute the costs of their emission quotas to their customers. In this way, GHGs would not be counted where they are actually emitted, but 'mid-stream' at the location best able to handle the counting and also able to encourage innovations that would reduce ultimate emissions. Such an approach also invites the mid-stream operations to encourage those upstream (suppliers) and downstream (consumers/end users) to take steps to reduce emissions.

In this way, more non-CO_2 GHG emissions could be included and could be avoided or compensated for, using market mechanisms. In general, small sources are not included because the transaction costs would be high. But, with mid-stream allocation of emissions quotas and sectoral emissions trading, those sources are indirectly included. Also, this approach would allow more companies to participate in the GHG market.

Conclusions

Inclusion of non-CO_2 GHGs in emissions trading creates an incentive for companies to enhance their inventory discipline and increase the accuracy of GHG calculations. It can present business opportunities for companies in the carbon market and lead to better national GHG inventories.

By excluding non-CO_2 gases from trading regimes – as many governments currently do – opportunities for reductions, private sector involvement and cost effectiveness and efficiency are being missed. As a result, GHG emissions trading markets will be less optimal and liquid, which might contribute to further delay in implementation of the Kyoto Protocol.

Aggregated non-CO_2 GHG emissions inventories show large uncertainties. But, when broken down into specific industry sectors or facilities, these uncertainties can be reduced.

Governments and companies need to further develop standardised and practical protocols for building GHG emissions inventories. In advance of these protocols, concrete ways to treat GHG inventory uncertainty problems are available. Opt-in provisions for non-CO_2 sources in emissions trading regimes are helpful for companies that want to participate.

Sectoral or mid-stream emissions trading is one of the design options available to facilitate inclusion of diffuse and small sources with non-CO_2 gases in GHG trading.

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