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Policies to Reduce Greenhouse Gas Emissions in Industry - Successful Approaches and Lessons Learned: Workshop Report

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FOREWORD

This document was prepared in May 2003 by the OECD Secretariat for the Annex I Expert Group on the United Nations Framework Convention on Climate Change. The Annex I Expert Group oversees development of analytical papers for the purpose of providing useful and timely input to the climate change negotiations. These papers may also be useful to national policy makers and other decision-makers. In a collaborative effort, authors work with the Annex I Expert Group to develop these papers. However, the papers do not necessarily represent the views of the OECD or the IEA, nor are they intended to prejudge the views of countries participating in the Annex I Expert Group. Rather, they are Secretariat information papers intended to inform Member countries, as well as the UNFCCC audience.

The Annex I Parties or countries referred to in this document refer to those listed in Annex I to the UNFCCC (as amended at the 3rd Conference of the Parties in December 1997): Australia, Austria, Belarus, Belgium, Bulgaria, Canada, Croatia, Czech Republic, Denmark, the European Community, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Japan, Latvia, Liechtenstein, Lithuania, Luxembourg, Monaco, Netherlands, New Zealand, Norway, Poland, Portugal, Romania, Russian Federation, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey, Ukraine, United Kingdom of Great Britain and Northern Ireland, and United States of America. Where this document refers to "countries" or "governments" it is also intended to include "regional economic organisations", if appropriate.

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Executive Summary

The industry sector is an important direct and indirect source of greenhouse gas emissions in Annex I countries. It is also a highly heterogeneous sector that has seen both rapid increases and decreases in direct emissions from different sources over the last decade. Given these trends, the remaining potential for cost-effective emission reductions in industry, and the difficulty in reducing emissions in other sectors (such as transport), emissions from the industry sector are expected to draw increasing attention by policy-makers as they look for means to reduce domestic greenhouse gas (GHG) emissions. For this reason, the Annex I Expert Group (AIXG) on the UNFCCC decided to hold a workshop in Berlin on 2-3 December 2002 to discuss the range of policies to reduce greenhouse gas emissions in industry, with a focus on voluntary approaches (VAs), taxes and trading. The overall aim of the workshop is to assess experience and identify and promote successful approaches, "good practice" and lessons learned to date.

There are two key areas of greenhouse gas emissions in the industry sector: firstly, greenhouse gas (GHG) emissions from energy use in industry; and secondly, greenhouse gas emissions from industrial processes. In Annex I countries in 2000, direct emissions from the industry sector accounted for approximately 2108 Mt CO_2 (15.4%) of total Annex I emissions from fuel combustion. Industry also accounted for a similar proportion indirectly from emissions associated with industry use of electricity[1]. Process emissions, i.e. emissions that are caused by the production process, accounted for a further 5% of total emissions in 23 Parties surveyed by the UNFCCC (UNFCCC 2002a).

A wide variation exists in the relative importance of policy instruments used to control GHG emissions in different countries. To date, VAs have dominated in terms of numbers, with almost every AIXG country having adopted a voluntary approach of one sort or another. Most VAs are energy or CO_2-related, although some also cover process emissions. A range of voluntary approaches have been adopted, varying from voluntary non-binding agreements on reporting emissions and progress to self-defined targets to negotiated agreements that are legally binding, have benchmarking and performance assessment and contain sanctions in the case of non-compliance.

The success of various approaches and policy instruments to reduce greenhouse gas emissions from industry can be measured in different ways. As well as GHG emission reductions beyond a business-as-usual scenario (brought about for example by improvements in energy efficiency), policies need to be economically efficient and minimise impacts on competitiveness. They also need to be feasible to implement, and provide encouragement to invest in a low-carbon future.

Other measures of success could include non-GHG environmental benefits as well as "soft" measures of success, such as an increased awareness within industry of climate change and potential mitigation actions. In assessing areas for possible future progress, it will be important to take a holistic view of industry emissions, which may require taking a broader look at how emissions can be reduced. Thus, the whole production chain may need to be examined, as may issues related to product modifications (rather than focusing on reducing emissions from a part of the production system).

A number of more or less formal partnerships/agreements to reduce or limit GHG emissions from industry have also been developed. These include agreements between government and industry, industry and non-governmental organisations (NGOs), within groupings of industry, or individual declarations by particular companies.

[1] Assuming a pro-rata distribution of electricity emissions to industry use of electricity.

Most countries have implemented energy taxes on fuels, some have implemented carbon or energy/carbon taxes, but only one country has implemented taxes specifically targeted at reducing domestic industry process emissions. Where energy/CO_2 taxes have been implemented, some sub-sectors in industry (particularly in energy-intensive industry) have been exempted or the tax rate significantly reduced due to competitiveness concerns where firms are exposed to international markets.

Many countries are looking specifically at emissions trading, though parts of industry are sometimes exempted from these schemes, and energy efficiency trading is also emerging as an area of interest. Other countries have implemented other forms of trading that can indirectly be used to reduce industry emissions, such as renewable energy certificate trading.

In countries where voluntary approaches, emissions trading and taxes have been implemented, there is strong potential for complementarity between the use of these instruments and they are often combined (more or less explicitly). For example, companies can often make some sort of trade-off between entering voluntary agreements and being wholly or partially exempted from energy/CO_2 taxes, or entering trading schemes with similar incentives.

It is now timely to assess the effectiveness and efficiency of the various approaches implemented to date, as well as the extent to which initiatives create incentives for additional investment in areas such as technology innovation. This paper aims to address some of the key issues relating to the implementation of good practice policy instruments to address greenhouse gas emissions in industry. Relevant policy questions include:

1. What has been the experience of countries in implementing policies to reduce greenhouse gas emissions from industry? Have some policies been particularly successful - why and under what conditions?

2. What policy mixes are emerging and why? Are some more cost-effective than others? How do the national circumstances of a country influence the mixes of policy instruments observed?

3. Do the policy instruments work best in isolation or are there significant opportunities for these instruments to complement one another? To what extent are emission reductions due to technological improvements and business as usual activities, and to what extent has additional improvements been encouraged by the policies put in place?

4. What tools can be used to help assess the effectiveness of individual measures?

1. Background

At the Annex I Expert Group meeting in March 2002, member countries agreed to hold a workshop, hosted by the German government, on "Policies to Reduce Greenhouse Gas Emissions in Industry – Successful Approaches and Lessons Learned". A workshop was then held in Berlin on 2-3 December 2002. This was a well-attended workshop with about 90 participants from industry, governments, and non-government organisations (NGOs).

The workshop had the following objectives:

- Assess the effectiveness of emissions trading, taxes and voluntary approaches to reducing greenhouse gas emissions from industry, the relationship between policy instruments and their co-ordination, the advantages and disadvantages of each instrument;
- Analyse through case studies where particular approaches have been successful at reducing GHG emissions beyond business-as-usual (BAU) practice, and how this has been determined;
- Identify conditions of and criteria for success, deficits in design and implementation of various instruments;
- Examine issues relating to international co-operation and sectoral competitiveness;
- Outline lessons learned and implications for future trends such as technology innovation.

The focus of the workshop, and this paper, is on three policy instruments (voluntary approaches, taxes and trading), their application in various OECD member countries – including their effectiveness and interaction in the policy mix, impacts on competitiveness, case studies from industry in reducing emissions, as well as partnerships between industry and other stakeholders to reduce greenhouse gas emissions. The workshop also included a discussion on competitiveness issues emerging from GHG policy. The workshop facilitated a frank exchange with industry, environmental NGOs and government in an open and constructive setting and offered a range of suggestions for improving the performance of GHG policies in reducing greenhouse gas emissions in industry.

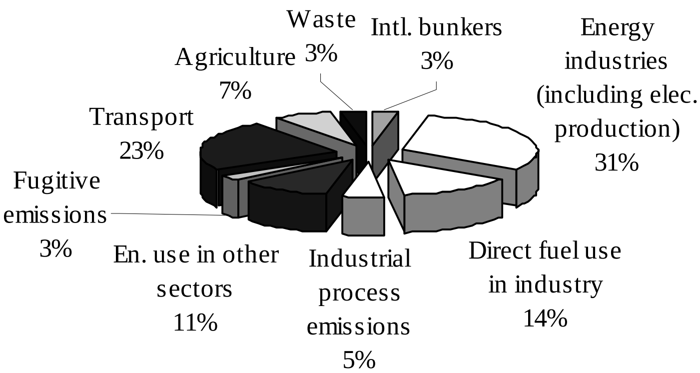
2. Industry emission and policy trends

Emissions of greenhouse gases from the industrial sector[2] are a significant proportion of emissions in Annex I countries. In 2000, industry accounted for approximately 2108 Mt CO_2 or 15.4% of direct CO_2 emissions from fuel combustion and a similar proportion indirectly[3] from emissions associated with industry use of electricity, (IEA 2002a, b, and c). Industry also generates process-related emissions of emissions of CO_2 as well as emissions of N_2O, CH_4, HFCs, PFCs and SF_6.

The "industrial sector" is highly heterogenous within and between countries, and emissions are reported in many separate places within a national inventory (emissions will appear in all white sections of figure 1). However, some general trends can be detected in emissions of different gases over the 1990-2000 period.

In general, CO_2 emissions from direct use of fuels in the industrial sector have increased between 1990 and 2000 in the OECD Pacific region, decreased slightly in North America and Europe, and decreased dramatically in countries with economies in transition (EIT)[4]. Electricity use in industry has grown in both absolute and relative terms in all OECD regions, and in relative terms in EIT countries. These trends are caused by many factors, including changes in GDP, changes in the level of industrial output, fuel switching and structural changes.

Figure 1: Shares of aggregated GHG emissions in 2000 by sector



Source: Adapted from UNFCCC 2002a.

Industrial "process emissions" are emissions generated during the production process that are not energy-related. Process emissions generally account for between 3-8% of total emissions (UNFCCC 2002a), although they can be very important in individual industry sectors, such as cement and aluminium manufacture. They can also be important in countries with low carbon-intensive electricity production such

[2] Manufacturing industries and construction only. IEA and UNFCCC 2002a figures for CO_2 emissions from fuel combustion differ slightly. See IEA 2002a for detailed explanation.

[3] Industry accounted for 40% of all electricity use in Annex I countries in 2000.

[4] IEA energy and emissions data for countries that were part of the former Soviet Union are generally only available from 1992.

as Norway and France, where process-related industry emissions accounted for 20% and 23% of emissions in 2000. In contrast to energy-related emissions, process-related emissions in Annex I countries decreased by 21% from 1990 to stand at 702 mt CO_2-eq. in 1999 (UNFCCC 2002b). However, this single figure masks sometimes widely differing trends between gases and sectors. N_2O emissions from industry (e.g. from adipic acid production in the chemical industry) have decreased sharply between 1990 and 1999 or 2000 in many countries, e.g. -95% in the UK, -88% in Japan, -60% in France and -55% in Canada (DEFRA 2001, GoJ 2002, MIES 2001, GoC 2001). These one-off reductions have helped some countries meet their aim of stabilising 2000 emissions at 1990 levels (UNFCCC 2002a).

PFC emissions have declined in many countries, including Japan (GoJ 2002), most EC countries and in the EU overall (CEC 2001). Trends in SF_6 emissions vary. HFC emissions have increased very rapidly overall, but the main driver behind this is their use in refrigeration equipment rather than in manufacturing industries. Process-related CO_2 emissions, e.g. from the production of cement and iron and steel, vary with production levels of intermediate products. For the cement industry these emissions are an integral part of the production process and cannot be reduced (although their relative importance can be diminished, e.g. through product modification to produce blended cements).

Perhaps the most rapid emission trends in industrial emissions over the 1990s were due to technology development, e.g. the ability to cost-effectively reduce N_2O emissions from adipic acid production, reductions in GDP, e.g. in EIT countries, or from demand growth, e.g. for HFCs. However, many countries have also initiated policies and/or policy packages with the aim of limiting or reducing emissions from the industrial sector. These policies have also been more or less successful in different countries and industries.

This background paper aims to summarise the policies and policy packages (focusing on voluntary approaches, taxes and tradable permits) employed in Annex I countries to limit industry emissions, to summarise the effectiveness of these policies to date, and to raise questions for discussion at the workshop. The workshop focuses on policies aiming to curb emissions from industry energy use and industry process emissions.

3. Measures of success

One of the aims of the workshop is to examine successful approaches to reducing greenhouse gas emissions from industry. This raises the issue of what defines "success"? Key criteria to define "successful" GHG mitigation policy in industry include:

- Environmental effectiveness (i.e. policies that result in real emission reductions - rather than just displacing emissions – and that help countries and entities meet short-term emission commitments).
- Economic efficiency (i.e. least cost policies that allow flexibility on where and how to mitigate emissions such that investment in abatement flows to the cheapest options first).
- Limited impact on competitiveness and addressing these effects where they do occur.

In addition, policies should be feasible to implement and sufficiently forward-looking to provide incentives to stimulate long-term technological innovation and investment in low-carbon intensity options over time.

There are also "softer" measures of success, such as increased awareness or engagement on climate change issues. Naturally, different stakeholders may have quite different perceptions of what success may be.

3.1 Environmental effectiveness

The concept of environmental effectiveness has many aspects. In order to be effective at mitigating GHG, the policy will need to reduce - rather than displace - emissions, as "leakage" of carbon or other GHG will have no global benefits[5]. Policies may also need to address the broad picture, rather than focusing on optimising the performance of individual sub-systems. For example, modifying products from (or changing inputs to) industrial processes may have more GHG mitigation potential than increasing the energy efficiency of a particular process.

A requirement to determining the environmental effectiveness of a policy is to have both a credible business-as-usual (BAU) scenario and an appropriate monitoring, reporting and verification system. Developing a BAU scenario is needed to assess whether or not an improvement in performance has happened because of policies or actions put in place or whether it is something that would have occurred anyway as part of normal business development. Whether policies quicken the rate of capital stock turnover would also be an indicator of their environmental effectiveness compared to a baseline. A recent study highlights that without significant policy signals or external market conditions, capital stocks tend to be used much beyond their stated lifetimes (Lempert et al, 2002). While new physical investment is not the only means to improve environmental outcomes, the impact of any given policy on capital stocks is probably a good indicator of environmental effectiveness.

A transparent system for monitoring, reporting and verifying (MRV) emission performance is needed to calculate actual emissions. Although there has been considerable progress on company-wide MRV practices over the past few years, the emergence of certain policy instruments, such as emissions trading, JI and CDM, require further progress be made. Additional efforts to improve entity level MRV will be needed in many Annex I countries before the first commitment period as emissions accounting becomes more complex.

[5] Leakage could occur if industries became uncompetitive as a result of an introduced policy and had to relocate.

The various effects of different policies aiming to reduce GHG emissions may also need to be disentangled from one another. However, while it may be relatively straightforward to determine the absolute energy efficiency or emissions generated in a particular industry, it is more complex to determine how much of this improvement is due to the introduction of an individual policy instrument as opposed to implementing a range of policy approaches.

3.2 Economic efficiency

A GHG reduction policy is economically efficient if it enables and encourages low-cost reduction opportunities to be taken up. Depending on how they are set up, environmental taxes, trading or VAs may all prove more economically efficient than traditional "command and control" policies. They could also be more distortionary, depending on how the issue of exemptions is dealt with. However, since VAs are not necessarily uniformly applied within a country or across a sector they may not be as economically efficient as taxes or trading, particularly if offsets from the Kyoto mechanisms cannot be used to comply with VAs. When uniformly applied across the industry sector in a country, the use of taxes or trading provides a consistent price signal to industry to reduce emissions where it is cheapest to do so. Coupled with revenue recycling, the economic efficiency of taxes or tradeable permit systems can be further improved (OECD 2001b). When applied over multi-year periods with an expectation of ratcheting up in stringency, such policies can also deliver dynamic efficiency benefits providing the incentive for continuous technological innovation to limit emissions (OECD 1993)[6].

The UNFCCC secretariat has attempted to examine the issue of cost-effectiveness when reviewing policies and measures reported by Parties in their National Communications as required under the Framework Convention on Climate Change (see UNFCCC 2002a). They observe the difficulties in assessing on the cost-effectiveness of abatement options because only a few Parties actually report on the cost of measures in their National Communications. In addition, in many cases countries do not report on the expected or actual greenhouse gas reductions associated with each of their policies and measures. It is also difficult to determine cost-effectiveness because it is a complex task to estimate expenditures by industry that were additional to what would have occurred in the absence of the measure (UNFCCC 2002a).

The UNFCCC document also notes that the implementation of measures to reduce greenhouse gas emissions in industry is often driven by economic rather than environmental concerns. For example, reductions in input costs provide a significant incentive for industry to take actions to increase the energy efficiency of operations. In many cases, reductions will be due to technological improvements or industry restructuring, as in some of the Economies in Transition (EITs). Also, there may be some overlap between emission reductions through requirements to replace ozone-depleting substances under the Montreal Protocol.

3.3 Other measures of success

As well as being efficient from a GHG reduction and economic point of view, there are other possible measures of success for GHG reduction policies in industry. For example, a policy will need to be feasible enough, and have enough support amongst stakeholders, to be implemented. A forward-looking policy capable of delivering increasing environmental performance over time would also be an advantage, given that the climate regime may change within the lifetime of equipment investments. But which policy types,

[6] Sectors where international competition is direct and where options to mitigate GHG emissions are costly or non-existent, may be more prone to carbon leakage than sectors where there are cost efficient alternatives and sector specific reasons (eg. transport, nature of the product, raw material) for production being more locally oriented.

or policy mixes best encourage research and development and/or technical innovation? Economic instruments generally offer flexibility to stimulate long term investment in technological innovation (dynamic efficiency), as well as contribute to cost-effective emission reductions over the short term (static efficiency) (OECD 1993).

Policies that increase awareness and/or engagement of industry in climate change issues may also lead to more climate-friendly investments in the longer term. Increased stakeholder awareness and participation in policy development could also be a measure of success, as it would increase the likelihood that policies are both credible and feasible to implement.

Success could also be assessed as the environmental effectiveness of policy instruments from both a climate change and wider environmental perspective, such as whether they promote “co- or ancillary benefits,” such as improvements in local air and water quality. Significant potential exists for ancillary environmental benefits when using policy instruments to reduce greenhouse gas emissions. For example, a regulation requiring industry to reduce SO_x and NOx emissions has the potential to reduce air pollution, increase health benefits, as well as reduce greenhouse gas emissions (OECD 2002c, Davis et al. 2000). Ancillary benefits of reducing emissions in the aluminium sector include reduction of air and water pollution and enhanced productivity in aluminium production (UNFCCC 2002a).

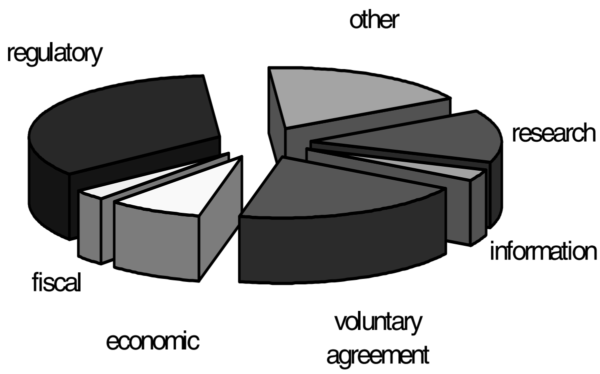
Policies may also be seen as successful if they result in social and economic benefits such as increased employment and welfare. Policies may also result in a reduction in resource inputs and input costs or an increase in health and safety (UNFCCC 2002a).

4. Policy context

Given emission commitments under the UNFCCC and the Kyoto Protocol, many AIXG countries are using different policy types to reduce GHG emissions from industry. The policy aim and range is generally wider in Annex II countries than EIT countries, as emissions from most EIT countries have dropped sharply since 1990 (particularly in the industry sector) due to profound structural change in their economies during this period.

The full range of instruments includes, but is not restricted to, performance and technology-based regulations and standards; research and development; information-based tools; economic and fiscal instruments such as taxes, subsidies and trading; and voluntary approaches. Figure 2 illustrates the types of instruments used to address greenhouse gas reduction in the industry sector of 23 Annex I Parties, as outlined in their 3rd National Communications to the UNFCCC, and indicates the relative proportions (in terms of numbers of policies) in which these are applied. This illustrates the importance of voluntary agreements, regulation and economic instruments (taxes and trading) relative to other instruments used such as information, research and fiscal mechanisms. The Annex I Expert Group workshop and this paper focus only on three instruments: voluntary approaches (VAs); taxes; and trading.

Figure 2: Types of policy instruments to address greenhouse gas emissions in industry and the frequency with which they are used



Source: UNFCCC (2002c)

4.1 Developing policy packages

The application of each of these instruments in individual countries will reflect a number of factors, including a country’s national circumstances, industry structure, and exposure of these industries to competition in international markets. Customized policies suitable for each country’s specific circumstances are often required (Aiba 2002). The relative importance of different policy types varies by country, as does the interaction between the policies.

Of the three policy types examined here, VAs are the most widely used (Table 1). To date, most countries examined have implemented voluntary agreements with industry, focusing on key sub-sectors, and some Annex I countries have had voluntary agreements in place since the early 1990s. Carbon or carbon/energy taxes (i.e. taxes introduced with the aim of reducing energy use and/or fuel-related GHG emissions) are quite common in European countries. Taxes aimed at reducing emissions of process gases or fugitive emissions are much rarer. The use of various types of trading schemes is also growing rapidly. For example, Denmark and the United Kingdom have implemented emissions trading schemes, and it is expected that the European Union will introduce an emissions trading scheme from 2005. Some countries (e.g. Australia, Austria, Denmark, Italy, the Netherlands, UK, some States in the US) have implemented other trading instruments, including tradable renewable energy certificates, and energy efficiency trading, and other countries (Canada, Japan) are actively considering establishing trading schemes. However, these instruments often have the objective of promoting development of renewable energy and energy efficiency technologies rather than specifically reducing greenhouse gas emissions.

Table 1: Summary table of range of policy instruments either implemented or planned in selected AIXG countries

		Taxes		Trading	
	Voluntary Approach	Energy[7] or CO_2	Industry specific	Emissions	Renewable energy or energy efficiency
Australia	✓			✓*	✓
Austria	✓	✓			✓
Belgium	✓	✓			✓
Canada	✓			✓	
Czech Republic	✓			✓	
Denmark	✓	✓		✓	✓
Estonia	✓	✓			
Finland	✓	✓			
France	✓	✓**	✓	✓	
Germany	✓	✓		✓	
Italy	✓	✓			✓
Japan	✓				
Netherlands	✓	✓		✓	✓
New Zealand	✓				
Norway	✓	✓	✓	✓	
Slovakia				✓	
Sweden	✓	✓			✓
Switzerland	✓	✓		✓	
United Kingdom	✓	✓		✓	✓
United States	✓			✓*	✓*

* At State level only
** Plans currently suspended

Source: UNFCCC (2002a, 2002c), Baron and Serrett (2002), Costyn (2002), Malaman and Pavan (2002).

Table 1 also illustrates that countries generally use a mix of policies, rather than relying solely on one policy type. Braathen (2002) and Torvanger (2002) also advise that governments rely on other instruments than VAs alone to achieve policy objectives. However, little work has been done to assess what combinations of policy instruments are likely to be the most effective and efficient complements. The complementarity issue is discussed briefly in section 5.4 of this paper.

[7] This table does not include excise taxes on fuels – most countries have implemented these.

Policies can have different results depending on how they are designed and applied. For example, voluntary agreements that are considered most effective are those negotiated within a framework that exerts pressure on companies to join the agreement and achieve their stated targets (UNFCCC 2002a). Thus, the framework within which a policy operates is a crucial determinant of success. In addition, life-cycle analysis could be a useful tool in the future design and application of policies, and in determining at which stage in the life-cycle to place a carbon constraint (see Aiba 2002, Gagnier 2002).

4.2 Competitiveness issues

There are many factors that can affect the competitiveness of a country or sector in both the short and long-term. These include exchange rates, political stability, skill of the labour force, tax policies, both environmental and non-environmental legislation, levels of R&D and access to markets (Raynolds et al. 2002, Barker and Johnstone 1998). Some of these factors are more subject to uncertainty than others. Thus, while actions that increase the marginal costs of production can impact the competitiveness of the firm, region or country that is affected by the increase they are only one of several possible factors that can impact competitiveness.

An uneven application of GHG reduction policies such as taxes, or an uneven allocation of emission permits, can affect the competitiveness of individual firms or sectors within a particular country when compared with similar industrial activities in another country. This is particularly important for industries – such as chemicals, iron and steel - whose goods are: 1) very GHG-intensive; and, 2) widely traded. Competitiveness impacts and carbon "leakage" may be of particular concern to countries such as Japan and Australia whose major trading partners are developing countries without GHG commitments and therefore unlikely to impose similar regulations (Aiba 2002). For this reason, industry has strongly opposed the introduction of environmentally-related taxes (OECD 2001b) and is liasing with governments in providing industry views on the quantity of emissions permits allocated under a domestic emissions trading scheme as well as on allocation modes. For example, the Japanese industry association Keidanren argues that taxes undermine competitiveness and discourage investment in technology (Aoyama 2002).

While taxes have nevertheless been introduced, mostly in European countries, competitiveness concerns have been taken into account in their design. Different governments have chosen different means to soften the effect of taxes on industry competitiveness. This can involve either providing full or partial exemptions for certain industries. A recent study by Morgenstern et al (2002) show that a carbon tax – or a similar price signal through emissions trading – would have a significant effect only on a small number of manufacturing sectors in the United States in the near-term, i.e. before any technology improvements can take place. Any exemption policy may be fairly limited in scope in order to offset the most negative competitiveness impacts.

Governments can also consider phasing-in tax increases/permit decreases over a period of time that allows investment in more energy-efficient or GHG-friendly technologies. For example, German tax rates for manufacturing industry/electricity are phased in: they will double between 1999 and 2003: to 0.41 EUR/1000 kWh in 2003. Tax rates in Denmark's "Green Tax Package" tax rates are also differentiated over time (tax rates rise yearly) and by industry type (energy intensive industries are subject to lower tax rates than less energy-intensive industries). Moreover, revenue from the tax is recycled to the sectors affected by the tax (Hansen 2001). This tax package is nevertheless expected to reduce industry emissions by 4% in 2005 compared to 1988 levels (Hansen 2001). This effect is largely due to the structure of the tax package: companies that have entered into an energy-efficiency agreement with the Danish Energy Agency pay much lower rates of tax, e.g. 0.4 €/t CO_2 in 2000 instead of 3.3 €/t for energy-intensive industries.

Industry is also exempt in some of the greenhouse gas emissions trading schemes being implemented, and in others DET systems work very closely with energy and carbon taxes (see section 5.4 below). The issue of exemptions in EU countries has been discussed as part of the development of the EU emissions trading Directive. The primary reason for this discussion is the exposure of some industry sectors to international markets, and the potential for a loss of competitiveness for those industries liable under any trading scheme. Some have examined this issue in more detail for specific industry sectors – for example Quirion (2002) has examined the impact of the EU trading Directive on the iron and steel sector, and has concluded that the impacts of the Directive on this sector would not be significant. Quirion also maintains that the proposed amendments to the Directive to protect competitiveness with an opt-out clause would have some repercussions on the competitiveness of activities covered by the Directive[8].

Although VAs are generally thought of as not having competitiveness impacts, there may nevertheless be costs associated with their design and implementation, although they are likely to be less visible than a straight price signal on GHG emissions. This could be the case for VAs that have sanctions in the case of non-compliance and/or are costly to negotiate, monitor and report on.

Environmental leadership drives firms to be more innovative and create additional value for its customers and shareholders, and seek new business opportunities (Raynolds et. al., 2002). Action can also lead to direct gain over competitors through first mover advantage (Boyd 2002) and indirect gains through an improved or "greener" reputation (Gagnier 2002).

[8] O'Brien and Vourc'h (2001) also note the inefficiencies related to applying exemptions when using environmental taxes.

5. Specific policy instruments and experience to date in implementation

The following section examines the implementation of taxes, voluntary approaches, and trading instruments applied in Annex I countries, and the experience in various countries to date. The section only focuses on the application of these instruments in the industry sector, and on particularly innovative approaches, or on situations where one or more instruments have been adopted in a unique way. The final part to this section examines the interaction of policy instruments where more than one instrument has been used, reasons why different instruments may have been implemented, and the potential for different instruments to be complementary to each other when working together in the policy mix.

5.1 Taxes

Taxes are part of the policy mix used by some Annex I countries to reduce GHG emissions[9]. These include carbon taxes, carbon/energy taxes as well as taxes on process emissions such as N_2O (although the latter are very rare).

5.1.1 Carbon/energy taxes

Carbon taxes were first introduced in the early 1990s in a handful of northern European countries. Carbon or carbon/energy taxes are becoming increasingly used by countries to reduce CO_2 emissions, despite significant concerns raised by industry. Recent carbon/energy taxes that have been introduced include the UK's "climate change levy" and Estonia's CO_2 tax (5 EEK or 0.32 Euro) per t CO_2. Poland is also planning to introduce a CO_2 tax.

In most countries, when a carbon or carbon/energy tax has been established, it is often done as part of a "green tax reform" where environmental taxes are used to reduce existing, more distortionary taxes (OECD 2001b). The carbon or carbon/energy taxes introduced in different countries can have somewhat varying aims, e.g. to increase energy efficiency (e.g. in Denmark), or to raise revenue as well as increasing energy efficiency or environmental performance (e.g. in the Netherlands).

When setting individual tax rates, governments need to ensure that rates are high enough to be effective and provide sufficient incentive for action while ensuring that they are not so high that industries close down or relocate, which could just result in carbon "leakage" rather than reduction (see e.g. Gielen and Moriguchi 2002). Governments have approached this issue in various ways. For example, some governments have decided, for competitiveness reasons, to allow industry complete or partial exemptions from carbon or carbon/energy taxes applied elsewhere in the economy. Tax rates/exemptions have often been revised frequently. For example, Sweden's energy tax rates were changed substantially in 1991, 1993 (where tax rates for industry were reduced for competitiveness reasons), and 1995. Of course, exempting industry from carbon taxes will severely affect the effectiveness of these taxes (Norwegian Ministry of Environment 2002, Torvanger 2002).

[9] This section focuses on environmental taxes and does not deal with excise taxes, which are widespread.

Table 2: Energy/CO_2 taxes and their use in industry in selected countries

Country	Status	Tax applied to:	Industry exempted?
Austria	Updated 2000	Energy	Partial - tax paid on electricity consumption by manufacturing industry subject to upper limits (absolute payments and in terms of value added).
Belgium	Planned	Energy	Planned.
Denmark	Updated 1996	CO_2	Yes, if signed agreement on energy efficiency.
Estonia	Implemented 2000	CO_2	No, but the tax rate is very low.
Finland	Updated 1998	Energy/CO_2	Yes, for energy sources not used as fuels. For fuels, an exemption of 85% of the portion of tax exceeding 3.7% of value added.
France	Suspended	Energy/CO_2	NA
Germany	Implemented 1999	"Eco-tax"	80% discount on fuel and electricity component for manufacturing industries, further exemptions for energy-intensive industry*
Italy	Implemented 1998, revised 1999 then suspended.	CO_2	No, but tax applies to fossil fuel combustion only (i.e. fossil fuels not used as energy sources are exempt).
Netherlands	Implemented 1996	Energy ("regulatory energy tax")	No, there is however a ceiling on the amount of energy on which tax must be paid: 10 million kWh and 1 million m^3 of natural gas (except when it is used to generate electricity).
Norway	Updated 1999	CO_2	Yes (but industry will not be exempt from emissions trading scheme which may start in 2005).
Sweden	Updated 2001	CO_2	Yes: 65% refunds are given for energy sources used as non-fuel inputs to manufacturing industries. Upper limit on payments.
Switzerland	Planned for 2004	CO_2	Yes, if have made and kept to voluntary agreements on CO_2 emissions.
UK	Implemented 2001	Energy	80% discount for industries who have taken on an emissions or energy efficiency target.

* The new German government has proposed reducing the rebate to 40% (ENDS 2002).

Tax exemptions in some countries are tied to the environmental performance of industries. For example, the large exemptions for energy-intensive industries in Denmark will be rescinded and the company liable for taxes if the energy-efficiency agreement with the government is broken.

5.1.2 Taxes on other gases

Emissions of non-CO_2 gases from industry are more commonly limited by non-tax policies such as regulations or voluntary approaches. However, France has put in place a tax on emissions of non-CO_2 gases: N_2O emissions in industrial facilities are taxed at 0.125 €/t CO_2-eq. This very low tax rate is planned to be increased (Government of France 2002).

Norway put in place a tax of 180 NOK/t CO_2eq. on the bulk import of HFCs and PFCs from the beginning of 2003 (Weidemann 2003). The level of this tax reflects that on CO_2 emissions. There are no exemptions to the tax, although there are plans to make the tax refundable if HFCs and PFCs are destructed as wastes (Weidemann 2003).

5.2 Voluntary approaches

The use of voluntary approaches (VAs) as a tool to reduce emissions from industry is widespread, and has been used as a tool to reduce GHG emissions since the early 1990s in some countries.

VAs can be classified into one of four types (OECD 1999): unilateral commitments by industry; private agreements between industry and stakeholders; environmental agreements negotiated between industry and government; voluntary programmes developed by government that individual firms can join. VAs with national and/or regional governments can, and are, being entered into at the company, industry association or sector-wide level.

5.2.1 Voluntary approaches involving government and industry

The move towards policy instruments such as voluntary agreements and trading, and concerns that taxes should not adversely affect the competitiveness of domestic industries, has meant that governments are increasingly involving industry partners when developing or revising emission mitigation policies for the industry sector. Thus, for example, the Swiss government developed its guidelines on voluntary agreements in close consultation with business (Mörikofer 2001).

Energy-related VAs (i.e. covering either energy-efficiency or energy-related CO_2 emissions) between governments and industry have been in place for many years, and there is extensive experience with, and analysis of, the effectiveness of such agreements (e.g. OECD 2002b, ten Brink 2002, Karup and Ramesohl 2000). VAs covering process emissions have also been developed, e.g. in Germany, the Netherlands, Japan and the UK (EFCTC 2000).

Many different types of VAs have been used to reduce greenhouse gas emissions from industry. VAs can vary significantly from one another in terms of their design, e.g. in whether or not they are legally binding, include sanctions for non-compliance, or allow companies to use offsets such as from clean development mechanism projects or emissions trading. The administrative and transaction costs of VAs also differ.

Voluntary programmes developed by government that individual firms can join often involve setting emission reduction targets and monitoring and reporting a company’s emissions inventory (e.g. in the US climate leaders partnership). These voluntary programmes are typically not linked directly to other policy types (e.g. environmental taxes).

Voluntary environmental agreements negotiated by government and industry where industry aims to meet a specific energy-efficiency or emissions performance standard can have very different characteristics. For example, these VAs may be binding once entered into, and may also involve regulatory or fiscal sanctions in the case of non-compliance, e.g. in the Danish agreement on industrial energy efficiency. This issue is addressed further in section 5.4 of this paper.

The role and importance of VAs in the policy mix can also vary from country to country, and is often linked to the proportion of industry covered by VAs. Governments in countries such as Australia, Canada, Germany, Japan and the United States have placed a strong emphasis on the importance of voluntary approaches to develop emission-reducing partnerships with industry.

VAs, in combination with fiscal incentives and environmental permits, are the main policy tool used to limit industry GHG emissions in the Netherlands, and companies that account for almost all (96%) of Dutch industrial energy use have subscribed to an energy efficiency "benchmarking covenant" (ENDS 2002). The "long-term agreements" between the Dutch government and different industry sectors are legally binding once entered into. The German 3rd National Communication to the UNFCCC also indicates that VAs in industry are expected to have a greater GHG impact than any other policy instrument in reducing GHG emissions to 2010 (Government of Germany 2002).

Coverage can vary greatly between countries. For example, 100% of aluminium and cement producers, 98% of electricity generation and distribution and 98% of oil and gas extraction have signed up to the Australian "Greenhouse Challenge" (AGO 2002, Shevlin 2002). However, less than 40% of industrial energy consumption is covered by VAs in France (Karup and Ramesohl 2000) and the third French National Communication indicated that the then government did "not feel that voluntary commitments … should be given priority" as part of a new GHG reduction programme (Government of France 2002).

5.2.2 Other partnerships

Because of the sheer scale of company-wide emissions and the increased awareness and involvement of the business community in climate change issues, partnerships are becoming increasingly important in the policy packages developed to limit greenhouse gas emissions from the industrial sector. These can also include industry/NGO partnerships and industry/industry partnerships as well as government/industry partnerships described above.

Many innovative industry/NGO partnerships have been developed. For example, WWF has set up a "Climate Savers" programme where it works with individual businesses to set targets for GHG reduction strategies. Six companies have entered this programme, including Lafarge, whose target includes aims to reduce energy-related emissions, increase the proportion of renewable energy sources and use materials substitution to reduce the GHG intensity of final products (WWF 2002). Credits from the Kyoto mechanisms will not be able to be used against such a target. Other forms of partnership are groupings of industries and NGOs. These include the "Partnerships for climate action" (Petsonk 2002), where eight energy, energy producing or energy-intensive companies partnered with Environmental Defense (a US-based NGO) and have committed to set environmental targets and track progress to these targets with the possibility to trade reductions when available.

Voluntary GHG mitigation activities have also been initiated by individual companies, industry associations or groupings. For example, both BP and Shell have committed to specific greenhouse gas reduction targets, with Shell committing in 1998 to reducing its 1990 emission levels by 10% in 2002. The Japanese industry group -Keidanren- initiated a "global environmental charter" and many of their industry branches have subsequently drafted their own voluntary action plans under this umbrella. Many of these have targets that include either absolute or relative GHG targets. Ten global cement companies have developed "The Cement Sustainability Initiative" for 2002-2007 under the umbrella of the World Business Council for Sustainable Development. This initiative outlines individual or joint actions to set emissions targets and monitor and report emissions.

Other industry/industry partnerships have been established to provide a forum for discussion of issues relating to greenhouse gas emissions in industry and to develop a coordinated industry response and work with government to meet their needs. For example, in Australia an industry group called the Australian

Industry Greenhouse Network commonly participates in consultative steering groups in the development and implementation of government policy. This situation is not unique to Australia.

However, although they represent a new and innovative policy direction, and show positive initiatives by industry to self-regulate, partnerships that do not involve government or non-industry third parties raise some questions. Unlike some VAs, there is no direct legal or regulatory come-back should any pledges made not be met, so how much should governments rely on independent partnerships to meet an emissions commitment? Does the development of these partnerships delay useful regulatory action on the part of government without delivering real emission reductions? Or do they deliver real reductions that justify such a delay? How can it be ensured that the monitoring and reporting from such partnerships is credible, and does not result in double-counting or gaps with national emission accounting efforts?

5.2.3 Experience to date in VA design and effectiveness

VAs are popular instruments, and are becoming increasingly so, because they are voluntary, flexible and do not negatively affect competitiveness.

Unsurprisingly, the structure of the VA (e.g. how it is developed, what the measures of success are, the independence of any follow-up evaluation or monitoring, whether or not there are any sanctions for non-compliance) can influence how effective it is at reducing emissions beyond business-as-usual levels[10]. Thus, more detailed and targeted voluntary approaches are likely to be more environmentally effective (Braathen 2002) and more cost-effective (Phylipsen and Blok 2002), although they also require a greater up-front government involvement. Indeed, although VAs are "cheaper" to implement than subsidies, the Dutch voluntary agreements have been estimated to cost 10-15 €/t CO_2 (Phylipsen 2002).

It is difficult to compare the "stringency" or otherwise of different targets in the same sector, as different VAs are measured using different units, timeframes and/or boundaries. For example, the German VA on the steel industry is to reduce emissions of CO_2 per ton of rolled steel by 16-17% by 2005 compared to 1990. The Japanese target for the same sector is to reduce total energy consumption by 10% in 2010 compared to 1990 levels.

However, there are widely differing views as to the environmental effectiveness of VAs. Some governments, as well as industry, are of the opinion that VAs are highly effective in reducing GHG emissions (e.g. Sullivan and Rand 2001, CEC 2001, IAI 2002). This was echoed by some presentations by industry representatives at the workshop (e.g. Gagnier 2002, Boyd 2002). Some governments indicate that VAs have played a part in achieving reductions in industry emissions: for example, the Dutch government indicates that the energy efficiency improvement in industry sectors with long-term energy-efficiency agreements was 2.2%p.a. whereas the autonomous energy efficiency improvement expected over the same period was 1.3%.

Others are much more skeptical about the effect of VAs in reducing emissions over what would have happened anyway (e.g. Government of France 2002). Notably, some independent assessments of voluntary approaches - while acknowledging that there have been absolute emission improvements brought about by investments in cleaner technologies - have indicated that there is little improvement over BAU scenarios as these investments would have probably happened anyway (e.g. Rietbergen and Blok 2000, Kågeström et. al. 2000, OECD 2002b). In other cases, the fact that some targets set by VAs are met well ahead of schedule has led to questions about the validity of such targets (Buttermann and Hillebrand 2000). Thus,

[10] The economic efficiency of VAs can be low, as they seldom incorporate mechanisms to equalise marginal abatement costs between different emitters (Braathen 2002).

Braathen (2002) notes that if VAs are not sufficient to stimulate lower GHG emissions than would have happened in a business as usual scenario, their environmental effectiveness is questionable.

However, it is difficult to assess the environmental effectiveness of VAs, particularly if a business-as-usual scenario has not been developed at the commencement of the initiative (which may often be the case for voluntary programmes where the main aim is to monitor and report absolute emissions rather than determining emission reductions compared to a BAU scenario).

The UNFCCC (UNFCCC 2002a) indicate that those VAs which have a target that has been negotiated between governments and industry, i.e. voluntary environmental agreements, appear to be most effective. However, some negotiated agreements have not been very successful in reducing GHG emissions, even when regulatory incentives are present (Mörikofer 2001). Other analysis has indicated that VAs work best as part of a policy package, rather than as a stand-alone instrument (Torvanger 2002, Krarup and Ramesohl, 2002 - see also section 5.4). Braathen (2002) indicates that the performance of many VAs would be improved if there were a real threat of other instruments being used if targets are not met.

However, there are other (non-environmental) “soft” benefits that can be derived from the process of developing, as well as implementing, VAs. For example, the negotiations needed to develop VAs can help to some extent raise awareness of climate change issues and potential mitigative actions within industry (e.g. Kågeström et. al. 2000) – both at management and operational levels. This can therefore help to move industries towards best practice. They can also help establish an arena for industry/government (or industry/NGO) dialogue. An evaluation of VAs in the Netherlands also found that implementing VAs can improve companies’ systematic approach to and technical knowledge of energy conservation activities (Rietbergen and Blok 2000).

Some analyses (e.g. OECD 1999, WWF 2000) recommend design characteristics that would help to improve the environmental effectiveness of voluntary approaches. These include setting clearly defined targets, developing a business-as-usual (baseline) scenario, having incentives in the case of non-compliance (e.g. sanctions or regulatory threats), putting in place an effective monitoring mechanism (including through an independent agency); and including third-party participation in the design of the VA.

However, setting up VAs that meet these characteristics requires considering compliance incentives and penalties. It also requires real engagement and commitment by industry stakeholders to develop meaningful VAs, to allow independent monitoring, and to disclose information on GHG mitigation measures taken. The willingness of parties to undertake such actions can vary greatly (Buttermann and Hillebrand 2000). Defining the role, scope and functioning of VAs also requires time (e.g. for negotiations between government and industry) and money on both sides. For example, early Danish VAs were estimated to cost 17,000-33,000 Euro per firm and annual monitoring costs for Dutch VAs were estimated at 50,000 Euro per sector (Karup and Ramesohl 2000). This has led to a restructuring of the Danish scheme in order to reduce costs, and an indication by the Dutch government that the new round of “long-term agreements” will be aimed at larger energy consumers only (van Luyt 2000).

5.3 Trading

Various trading instruments have been applied to address greenhouse gas emissions in industry in Annex I countries, including greenhouse gas emissions trading renewable energy certificate or green electricity trading and energy efficiency trading. Whereas the primary objective of domestic emissions trading schemes is to reduce greenhouse gas emissions, the primary objective of renewable energy certificate trading schemes is to promote the development and diffusion of cost-effective renewable energy sources, with a reduction in greenhouse gas emissions being a secondary objective.

Table 3: Status of Domestic Emissions Trading Schemes

Country	Coverage	Initial Permit Allocation	Interface with other instruments
Canada	Not yet certain. Both narrow and "broad as practical" coverage considered.	Both grandfathering and auctioning considered.	Transitional voluntary credit-trading scheme (for reduction beyond what is required by regulation) considered prior to mandatory cap-and-trade scheme.
Denmark	CO_2 from electricity production only, about 30% of 1997 CO_2 emissions.	Grandfathering	Trading covers electricity generation, supplementing the tax covering others.
EU	Initially CO_2 only (from 2005), then eventually all Kyoto gases after 2008. Approx. 46% of EU's estimated CO_2 emissions, covering 4,000 – 5,000 sites. Sectors include electricity and heat; iron and steel; refining, glass and building material; and pulp and paper. The chemical sector is not included for the most part.	During 2005-7, grandfathering of allowances by Member states, which will be required to apply common criteria for their national allocation.	Some discussion on the possibility to exempt certain sectors / companies from the Directive until 2007. Synergies with the IPPC Directive intended. Anticipated that future revisions or new directives will establish links with JI/CDM mechanisms.
France	Large industrial sources. All Kyoto gases. Possibly as early as 2003.	Based on voluntary agreements.	Linking to EC system and Kyoto mechanisms explicitly envisioned.
Norway	All Kyoto gases and all sectors possible; over 80% to be captured. Startup in 2005.	To be determined, partial auctioning, partial grandfathering.	In parallel with carbon tax from 2005, eventually to replace it after 2008.
Slovakia	Both mandatory and voluntary participants. Sources emitting CO_2. Expected start-up in 2006	To be determined.	
Switzerland	Large emitters, companies and energy intensive producers can exempt themselves from the CO_2 law by adopting absolute CO_2 limit, with possibility to trade. Pilot phase 2005 – 2007.	Based on voluntary agreements. Free allocation.	Tax on fossil fuels will be imposed from 2004 if voluntary measures insufficient.
UK	Emission Trading Scheme (ETS) on voluntary basis for any firms that commit to binding targets, with the choice of CO_2 only or all Kyoto gases. ETS launched in April 2002, and will run from 2002 until the end of 2006.	Free allocation of allowances. Direct participants bid for reduction commitments in an auction for incentive monies.	Firms that negotiate Climate Change Agreements qualify for 80% discount on Climate Change Levy and eligibility for baseline and credit trading. This is integrated into cap-and-trading by the direct participants in the ETS.

Source: Baron and Bygrave (2002), Kitamori (2002).

5.3.1 Greenhouse gas emissions trading

Emissions trading is an economic instrument that has been used since the 1980s to address non-greenhouse gas emissions. Recently, trading has been an instrument of choice to address GHG emissions, with domestic schemes being introduced in Denmark in 2001 and the United Kingdom in April 2002, and several other countries planning to do so well before 2008. Many of these schemes cover industry emissions - to a greater or lesser extent.

The emissions trading scheme in the United Kingdom will involve more than 4,000 companies while the proposed scheme in Norway will cover sectors currently exempt from the carbon tax, such as energy- and emissions-intensive manufacturing industries (for example metals and chemicals). The proposed EU scheme would cover energy combustion installations greater than 20MW, as well as oil refineries, coke ovens, metal production and processing, as well as producers of cement, glass, ceramics, pulp from timber and paper products, and include 4,000 – 5,000 installations (European Commission 2001). As the emissions trading scheme in Denmark targets CO_2 from electricity production only, it is only relevant for the industry sector to the extent that firms may generate their own electricity and export this electricity to other users.

Several other European countries (France, Slovakia, Switzerland, and Norway) are developing their own domestic emissions trading schemes (DETs), with expected start-up of the French system as early as 2003 (see Table 3). The European Union is expected to introduce a European Directive on emissions trading commencing in 2005. Each of these systems have varying designs, cover different sectors and gases and have different methods of allocation, resulting in issues relating to their compatibility, the extent to which they can be linked and technical design solutions that can be implemented[11]. Table 3 outlines the status of various DETs, and in particular various design elements associated with them. The last column in Table 3 also indicates where and how the trading schemes interact with other policy instruments, and this topic is further addressed in section 5.4.

5.3.2 Other trading instruments

Various Annex I countries have also designed and implemented a number of other trading schemes in addition to greenhouse gas emissions trading. These include tradeable renewable energy certificate trading schemes and the emerging energy efficiency trading schemes.

Reducing greenhouse gas emissions is not the primary objective of renewable energy certificate trading or energy efficiency trading. However, they are relevant to industries that generate their own electricity (as in some pulp and paper plants using black liquor) or that are energy-intensive. Renewable energy certificate trading has been initiated in several countries (table 4).

Energy efficiency trading is being considered in Italy through the Energy Efficiency Certificate Market and in the UK through the Energy Efficiency Commitment (see Costyn 2002, Malaman and Pavan 2002). Such systems target a fixed amount of energy savings (Baron 2002); entities can trade surplus energy efficiency certificates. Industrial electricity users could benefit from these mechanisms if they can generate significant savings that liable entities (electricity suppliers and distributors) could use to comply.

[11] For further discussion see Baron and Bygrave (2002).

Table 4: Summary of Tradable Renewable Energy Certificate Schemes

Country	Target	Implemented/being considered
Australia	Mandatory Renewable Energy Target	Commenced April 2001
Austria		Implemented
Belgium		Implemented
Denmark		Proposed
Italy	Green Certificates System	Implemented
Netherlands	Green Certificates Scheme	Implemented – voluntary
Sweden		Proposed
United Kingdom	Renewables Obligation commences April 2001	Implemented
United States	Renewable Portfolio Standards in New Jersey, Texas and Wisconsin	Implemented

Source: Baron and Serrett (2002).

There are potential linkages between energy certificate trading schemes and greenhouse gas emission trading schemes, e.g. if renewable energy or energy efficiency certificates can be traded in greenhouse gas emissions trading systems. For example, under the UK scheme, entities can trade carbon savings into the UK Emissions Trading Scheme (Costyn 2002).

5.4 Interaction of instruments in the policy mix and complementarities

A key consideration for Annex I countries is how to design policy instruments to address greenhouse gas emissions so they are complementary and work together efficiently and effectively in the policy mix. Important issues include how to provide the right incentives for different stakeholders to reduce GHG emissions at minimum cost and how to target stakeholders with different requirements such as exposure to international markets. This section briefly examines these issues.

Very little work has been done on the conditions under which the use of multiple environmental policy instruments is likely to be preferable to the application of a single policy instrument. Moreover, little work has been done on examining the combinations of policy instruments which are likely to serve as effective and efficient complements (OECD 2002d).

As shown in Table 1, many countries use multiple policies and measures to target reduced emissions from the industry sector. However, these policies are used in different ways in different countries. For example, policies can operate at the same time in a "complementary" way, often as a result of bargaining between governments and target sectors. Alternatively, there can be a clear policy "evolution" where one policy follows another. Sometimes, complementary policies are used to hit the same target more than once, e.g. in the UK where individual companies may be subject to both taxes and trading. Other complementary policies can be targeted to work in parallel, targeting different entities. This is the case for Norway's proposed emissions trading scheme, which has been designed to work in parallel with the carbon tax: when the trading scheme starts in 2005, it will include emissions sources that are exempt from the tax (Government of Norway 2002b). In other countries, both taxes and emissions trading have been applied to target the same entities. For example, in Denmark the tax and permit regime will co-exist for a period of time, before the former is discontinued. Hartridge (2002) refers to the interaction between various policy instruments such as the Climate Change Levy, emissions trading scheme and the Climate Change Agreements in the UK.

An evolutionary approach to policy mixes has been used in other countries, e.g. Switzerland, where taxes will be applied if VAs have not delivered the results hoped for. Alternatively, two or more policy types can be used to target different actors in the same sector, with the policy used depending on, for example marginal abatement costs or company size (smaller companies may not be able to absorb transaction costs associated with VA development or participating in emissions trading). In examining the use of policy instruments to address greenhouse gas emissions in industry in Norway, Torvanger (2002) suggests using only one instrument per emission source.

The choice of policy instrument will be determined by what the main aim of the policy is and who it is targeting. Taxes can fix marginal abatement costs and be relatively easily applied to small users. Taxes can also be used to "cap" potential permit prices where there is uncertainty about abatement costs, e.g. in Denmark where the government has explicitly used a "safety-valve" in setting the penalty at 40 DKK ($US 4.78)/ ton of CO_2 in its trading scheme[12]. Emissions trading schemes can fix the environmental objective (if absolute, rather than relative, caps are used) and can thus ensure that an absolute emissions target is met. There may also be links between different types of trading schemes. For example, the possibility of linkages between renewable energy certificate trading schemes and greenhouse gas emission trading schemes is also envisioned in the literature, but could undermine the environmental integrity of GHG trading systems (see Baron and Serret 2002).

The effectiveness of taxes or trading will depend on the shape of marginal abatement cost curves (O’Brien and Vourc’h 2001). In addition, the number of market players will influence the selection of a tax versus a trading scheme. A trading scheme will not succeed with few players as it may not have sufficient liquidity whereas a taxation scheme can easily address a more limited number of players in an equitable manner (O’Brien and Vourc’h 2001). Naturally, the popularity of a particular instrument with key stakeholders will be an important influencing factor. However, compared to regulations, both taxes and trading can have dynamic efficiency benefits by providing on-going incentives to innovate. Tax exemptions can also be used as an incentive to participate either in a trading scheme, as in the UK.

As well as being applied in a complementary way, tradable permits and pollution taxes can also be applied jointly. There are three potential motivations for the introduction of taxes in the presence of tradeable permits:

- As a means to reduce compliance cost uncertainty;
- As a means to penalise non-compliance; and
- As a means to capture windfall rents from grandfathered permit allocation (OECD 2002d).

The choice between the application of taxes or emissions trading schemes will also depend on equity, competitiveness concerns and leakage concerns. The application of a trading system targeting the same sectors across a number of countries in the same region, as proposed in the European Directive on emissions trading, could have fewer equity concerns relative to the application of a variety of taxes with different tax rates being applied to different sectors in different countries.

[12] The penalty does not always play this role: if a source is both subject to a financial penalty and the obligation to offset emissions above target in the next commitment period, the financial penalty will not set a price cap, as the cost of non-compliance is obviously more than the penalty. The US SO_2 allowances programme follows this approach – but prices have never come close to the penalty level.

Voluntary approaches are nearly always used in conjunction with other policy instruments, and can be a useful complement to other instruments, especially in providing flexibility for entities (O'Brien and Vourc'h 2001).

There are three ways in which voluntary approaches may be integrated with tradable permits:

- Where the adherence to tradable permit systems is voluntary;
- Where tradable permits are used as a means of allocating responsibilities within an industry-wide negotiated agreement; and
- Where emission reductions agreed to under VAs are used as a means to allocate permits in a grandfathered tradable permit scheme (OECD 2002d).

There are also links between energy efficiency trading and voluntary agreements in Italy (Malaman and Pavan 2002), as well as between energy efficiency and renewable energy certificate trading and emissions trading in the UK (Costyn 2002). In addition, some VAs, e.g. those in Germany, allow participants to use offsets from ET, JI or CDM in meeting their agreed targets. Nevertheless, there can be some inconsistencies between voluntary measures and emissions trading schemes (eg. see de Groot 2002). Some questions have been raised about the effectiveness and potential overlap of emissions trading when other energy savings and renewable energy targets are imposed (Honkatukia 2002).

Taxes and voluntary agreements can also be used together in either a complementary or evolutionary way. For example, taxes are being used in Switzerland in association with voluntary approaches as an instrument to apply in the case of non-performance: a tax may be imposed on fossil fuels from 2004 if the voluntary measures are found to be insufficient (Government of Switzerland 2002).

Entering into a voluntary agreement can also lead to tax exemptions in some countries, e.g. Denmark where there is a reduction in the energy tax rate from 2 to 0.4 € /t CO_2 for entities participating in voluntary agreement (Danish Energy Agency 2000). This exemption has to be repaid in the VA has not been met.

Differences in national circumstances will influence policy choice, though some stakeholders express a clear preference for trading over taxes and regulations (eg. see Boyd 2002).

6. Workshop conclusions

The presentations and discussions held at the workshop led to some general conclusions. These are outlined below.

- Industry would like clarity and foresight from government about the policy environment to assist their response to the greenhouse issue. Some, but not all, businesses/industries are taking proactive actions to reduce or limit GHG emissions, with the expectation that these efforts will be rewarded when regulation is established. Where companies have implemented voluntary approaches (VAs), there have been positive experiences and cultural changes in organisations to increase efficiencies and generally "do better".

- The policy mix used by governments to address industry emissions is changing in response to lessons learned from experience in implementing policy instruments to date. Mitigation policies becoming more common include VAs or "negotiated agreements" with both "carrots" (i.e. subsidies for GHG abatement) and "sticks" (i.e. with targets, timeframes and penalties), emissions trading, and taxes. Many countries have at least tried to implement VAs of one sort of another, and there was considerable discussion at the workshop about the need to go further and implement either more rigorous VAs or tougher measures. Those countries with taxes will continue this path but may decrease the number of exemptions and increase tax rates. Many countries are now looking at how to add emissions trading into the existing policy mix, sometimes at the request of industry (United Kingdom, France).

- There is a range of policy responses in individual AIXG countries, which reflects a number of factors. National circumstances and culture are an important determining factor in policy choice and design. For example, many northern European countries have used similar approaches (taxes combined with negotiated agreements and, more recently, trading). Non-European countries (Australia, US, Canada, Japan) are focusing more on VAs, with little or no implementation of taxes or trading (aside from SO_2 and renewable certificate trading, and other trading systems at the State level in Australia and the US. However, both Canada and Japan are now actively looking at developing trading systems. National circumstances can also affect the number of programmes as well as the complexity (or otherwise) of monitoring how effective programmes are in reducing emissions.

- No matter what instrument is used, there is a strong need for monitoring and verification (most workshop participants supported independent third party verification). There is still generally very little data to support work on establishing baselines to determine what reductions are beyond business-as-usual (BAU) activities. In some instances, NGOs and industry have created partnerships where NGOs provide an objective and independent evaluation of companies' voluntary climate change objectives.

- As is the case for other sectors, there is still a long way to go in implementing effective policy instruments to address emissions from industry. For example, where taxes have been implemented, there have been many exemptions or reduced tax rates so that it is very difficult to assess how effective these have been. Also, VAs have not always achieved the promised reductions.

- Since countries use many policy instruments to reduce GHG emissions, it is often difficult to assess the effectiveness of individual policy instruments. Although there is strong potential for linking different policy types, there is not much detailed work being done on linking/harmonisation of policy instruments in the policy mix. Several speakers indicated that although trading is becoming more and more popular, there are potential incompatibilities between different policy instruments (e.g. trading and taxes, or trading and VAs, if absolute caps are not defined). Examples (e.g. UK) show that policy combinations can be worked out, if this can bring broader industry participation without undermining environmental effectiveness. The compatibility, cost and effectiveness of instruments will largely be influenced by how individual policies are designed.

- Another point that was highlighted was the need to take a wider view: policies that focus on product/behavioural change may be able to deliver more reductions than focusing on energy efficiency. Further work on life-cycle emissions could be useful in this context, and in determining at which stage in the life-cycle to place a carbon constraint.

- Energy/GHG-related costs are not the only important factors in considering competitiveness issues, especially since competitiveness effects are context specific (national, industry, product). Moreover, the impact of GHG reduction policies on competitiveness may change over time e.g. if the international climate regime becomes more inclusive. A key for business is to have the ability to adapt products and production processes to changing markets. Providing businesses with foresight and clarity about the future directions and nature GHG policy can assist this transition to lower GHG pathways. Policy can also be designed to address competitiveness issues directly, e.g. through transitional compensation mechanisms for sensitive sectors or industries.

7. References

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8. Glossary

Annex I	Countries included in Annex I to the United Nations' Framework Convention on Climate Change
Annex II	Industrialised countries included in Annex II to the United Nations' Framework Convention on Climate Change
BAU	Business as usual
CDM	Clean Development Mechanism
CH_4	Methane
CO_2	Carbon dioxide
EIT	Countries with economies in transition
ET	Emissions Trading
GHG	Greenhouse gas
IEA	International Energy Agency
JI	Joint Implementation
N_2O	Nitrous oxide
NGO	Non-governmental organisation
OECD	Organisation for Economic Co-operation and Development
UNFCCC	United Nations' Framework Convention on Climate Change
VAs	Voluntary approaches

Annex 1: WORKSHOP AGENDA

Policies to Reduce Greenhouse Gas Emissions in Industry – Successful Approaches and Lessons Learned

Policies and Measures Workshop
2-3 December 2002

Building of the Representation of the Lands Brandenburg and Mecklenburg-Vorpommern to the Federation
In den Ministergärten 3, 10117 Berlin

Workshop Chair: Doug Russell, Managing Director, Global Change Strategies International

Day 1: 2 December 2002

9:00 – 10:00 Welcome / Introduction to workshop

- Introduction to workshop by chair of Annex I Expert Group, *Enno Harders*
- Official opening by *Margareta Wolf*, Parliamentary Secretary of State, Ministry for the Environment, Nature Conservation and Nuclear Safety, Germany
- Welcome by the State Secretary of the government of Mecklenburg-Vorpommern, Germany, *Thomas Freund*
- Welcome by chair of workshop, *Doug Russell*
- Keynote presentation, *Dave Findlay*, DuPont

10:00 – 12:45 Identifying policy options and packages – which approaches have been adopted and why?

<u>Presentations from national government representatives</u>

- *Franz-Josef Schafhausen*, Ministry for Environment, Nature Conservation and Nuclear Safety, Germany
- *Jim Sullivan*, Environmental Protection Agency, United States
- *Ivan Mojik*, Ministry of the Environment, Slovakia
- *Juha Honkatukia*, Government Institute for Economic Research, Finland
- *Olivia Hartridge*, Department for Environment, Food and Rural Affairs, United Kingdom

11:00 - 11:30 Break

12:45 – 13:45 Lunch

AGENDA (continued)

Day 1: 2 December 2002 (continued)

13:45 – 15:30 **Developing partnerships – implementation of various approaches to reduce greenhouse gas emissions from industry**

- *Frits de Groot*, Confederation of Netherlands Industry and Employers VNO-NCW
- Government/industry partnerships in Germany: experience and effectiveness, *Bernhard Hillebrand*, Rhine-Westphalia Institute for Economic Research (RWI)
- The role of partnerships in reducing emissions from the aluminium industry, *Eirik Nordheim*, European Aluminium Association (EAA)
- Developing meaningful voluntary agreements, *Chris Boyd*, Lafarge
- Approaches to reduce industry emissions - NGO commentary, *Annie Petsonk*, Environmental Defense Fund
- The Keidanren and voluntary approaches, *Meguri Aoyama*, Keidanren, Japan Business Federation
- Australia's approach to reducing greenhouse gas emissions from industry, *James Shevlin*, Australian Greenhouse Office

15:30 – 16:00 **Break**

16:00 – 17:45 **Developing partnerships – implementation of various approaches to reduce greenhouse gas emissions from industry (continued)**

- Presentations continued and Discussion

Day 2: 3 December 2002

9:00 – 10:30 **Competitiveness, leakage and other multinational issues**

Presentations from industry, NGO/government discussants

- *Dan Gagnier*, Alcan
- *Takao Aiba*, Development Bank of Japan (DBJ)
- GHG reduction policies: what impact on competitiveness? *Marlo Raynolds*, Pembina Institute

10:30 - 11:00 **Break**

11:00 - 12:30 **Assessing environmental and economic performance**

- *Asbjørn Torvanger*, Center for International Climate and Environmental Research - Oslo (CICERO)
- *Dian Phylipsen*, Ecofys
- *Nils-Axel Braathen*, OECD

12:30 – 13:30 **Lunch**

AGENDA (continued)

Day 2: 3 December 2002 (continued)

13:30 – 15:30 Panel discussion – lessons learned

- *Katia Simeonova*, UNFCCC Secretariat
- *Jan Corfee-Morlot*, OECD
- *Christophe Bourrillon*, Pechiney
- *Stephan Singer*, World Wide Fund International (WWF)
- *Philippe Tulkens*, Belgian Federal Planning Bureau
- *Tim Karlsson*, Department of Industry, Canada

15:30 – 16:00 Break

16:00 – 17:00 Conclusions and wrap up

17:00 Workshop close

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