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Smoke and Mirrors: The Kyoto Protocol and Beyond

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ABSTRACT

The Kyoto Protocol (KP) is considered a necessary first step towards an effective future climate accord. As argued in this paper, however, the KP will likely fail because it has too many loopholes, inadequate governance structures and insufficient compliance provisions. This view is supported by case studies of Canada, Japan and the Netherlands. These countries are unlikely to achieve their self-imposed targets, or, if they do, the costs of compliance will be unacceptably high. Consequently, the difficulty of achieving agreement to reduce global emissions by half (as required to mitigate climate change) is greatly increased.

Key words: Climate change mitigation; Kyoto Protocol and implementation; Carbon sinks

Smoke and Mirrors: The Kyoto Protocol and Beyond

INTRODUCTION

While the full extent of the potential damages from global warming remains unknown, scientists have argued that action should be taken to mitigate the potentially adverse consequences of global warming. Therefore, policy measures that the global community undertakes to address climate change are important, and any international agreements that are struck should at least achieve their outcomes. Failure in this regard may be detrimental to future attempts to negotiate meaningful reductions in emissions of greenhouse gases.

In this paper, I argue that the Kyoto Protocol (KP) is an example of an international agreement that should never have been undertaken because too many ratifying countries, let alone ones that have refused to ratify (such as the United States and Australia), will not achieve their self-assigned targets, despite the availability of Kyoto's flexibility mechanisms. Further, the KP fails to address the environmental externality because it permits countries to claim emission reduction credits that are not additional; they are ephemeral and make no contribution towards climate change mitigation (Chomitz 2000; Marland et al. 2002). Finally, because real-world mitigation relies on governance structures that are inefficient and costly, this greatly reduces the appetite for more stringent emission reductions in the future.

BACKGROUND

The Kyoto Protocol requires industrialized (Annex B) countries to reduce CO_2 emissions by an average 5.2% from the 1990 level by the commitment (measurement) period 2008-2012. It comes into effect 90 days after it is ratified by 55 states, but the Annex B countries that ratify must account for 55% of the CO_2 emitted by those countries in 1990. As of 29 September 2003, 119 countries had ratified the KP, with the industrialized countries' proportion of 1990 emissions accounted for by those that ratified equal to 44.2%. The pressure is now on Russia to ratify, because it accounts for 17.4% of 1990 CO_2 emissions and, with the United States (which accounts for 36.1% of industrial countries' emissions) having decided not to ratify, Russian ratification is required before the KP comes into effect.

Russia has to the end of 2004 to ratify the KP, but, as of October 2003, it was unclear whether it would do so soon, if at all. The EU Commissioner for the Environment, Margot Wallstrom, was quoted by *The Moscow Times* (October 9, 2003, p.8) as being confident that Russia would live up to the commitment to ratify that it made at the World Summit on Sustainable Development at Johannesburg in 2002. However, at the World Climate Change Conference in Moscow a week earlier, statements by Russian officials, particularly President Vladimir Putin, suggested otherwise. Given recent expansion of its economy, particularly its energy sector, and Putin's economic plan, Russian emissions are now forecast to exceed targeted emissions by 4% (Murray 2003). If Russia ratifies nonetheless, this development will affect both the ability of other Annex B countries to meet their targets and the costs of doing so.

The United States withdrew its support for the KP after a breakdown of negotiations during COP-6 at The Hague in late 2000, citing high costs. Kyoto's flexibility mechanisms were not considered flexible enough, and the role for terrestrial carbon sinks under the KP was considered inadequate. For example, at the Hague, the EU proposed a cap on forest and agricultural management (Article 3.4) activities of 20 Mt C, later increased to 40 Mt C, while the United States offered a cap of 221 Mt C, later reduced to 137 Mt C. At a second round of COP-6 at Bonn in July 2001, the EU relented to a much broader definition of and role for carbon sinks, mainly to appease Japan, Australia and Canada, and the U.S. in absentia. Subsequently, at COP-7 in Marrakech, Morocco in November 2001, the cap on carbon uptake in terrestrial sinks for the first commitment period (2008-12) increased from 201 Mt C per year (139 Mt C if the U.S. is left out) at Bonn to 219 Mt C. The COP-7 agreement expands what countries can claim from land use, land-use change and forestry (LULUCF) activities in lieu of CO_2-equivalent emissions reduction in meeting targets during the first commitment period, thereby avoiding politically and economically expensive controls on emissions of CO_2.

The Marrakech Accords essentially permit countries to offset any carbon released (debited) as a result of timber harvests and land conversion – at least up to 9.0 Mt C per year. In addition, some countries are able to claim automatic carbon credits from business-as-usual forest management that need not be offset against carbon released as a result of LULUCF activities. Canada can claim 12 Mt C per year, the Russian Federation 33 Mt C, Japan 13 Mt C, and other countries much lesser amounts – Germany 1.24 Mt C, Ukraine 1.11 Mt C, and remaining countries less than 1.0 Mt C. None of these activities can be considered additional in the sense that they specifically address climate change. Countries receive credit for activities that they would undertake in any event.

ECONOMIC INSTRUMENTS FOR ACHIEVING KYOTO PROTOCOL TARGETS

Economists generally identify three governance structures for mitigating environmental externalities such as rising atmospheric concentrations of CO_2: (1) command and control (C&C), or regulation and standards; (2) common values and norms; and (3) market incentives. Common values and norms are intermediary between the "extremes" of the market and C&C (Loasby 1990; Stavins 2002). Common values and norms include voluntary measures, moral suasion and education, and may be accompanied by subsidies. Common values and norms develop more easily in a homogeneous society like the Netherlands, while markets are more appropriate in a heterogeneous society such as Germany (CPB 1997, 42-44).

Market incentives include a carbon tax and a cap-and-trade scheme, where tradable emission permits (quotas) can be allocated to existing emitters of CO_2 at no cost to them (referred to as "grandfathering") or sold via an auction, thereby generating revenue for the government. Under a market scheme, an economic agent has the option of reducing emissions by paying a penalty in the form of a tax or permit purchase. The choice will depend on the agent's costs of reducing emissions. Those firms with the greatest ability to reduce emissions at lowest cost will sell (excess) emission reduction permits to those firms least able to reduce emissions, with all firms reducing emissions to the point where the marginal costs of reducing emissions further equals the tax or the price of permits. The problem with C&C is that, while in principle enabling a country to achieve its KP target, the intervention often leads to policy failure and much higher costs than with a market instrument. Market incentives are clearly more efficient (less costly) for achieving KP targets than C&C (Stavins 2002; Field and Olewiler 2002).

While market instruments are preferred, economic efficiency implications are not the same for all market instruments. When abatement costs and/or benefits are uncertain, picking a carbon tax (price) can lead to the "wrong" level of emissions reduction, while choosing a quantity can result in a mistake about the forecasted price that firms will have to pay for permits (Weitzman 1974). Such errors have social costs. If the marginal cost of abatement rises sharply with the degree of abatement while marginal damages are relatively constant over a wide range of abatement levels, and if there is uncertainty about the magnitude of both, then the costs of using marketable permits are higher than the costs of carbon taxes (Pizer 1997). Once a quantity instrument is chosen over a tax internationally, individual countries are also better off adopting a quantity instrument so long as they are able to purchase emission reduction permits abroad.

It has also been shown that taxes and auctioned permits are preferred to grandfathered permits because, if tax revenue or revenue from sale of permits is used to reduce tax distortions elsewhere in the economy as opposed to being recycled in lump sum fashion, there might be a "double-dividend" that reduces the overall cost of achieving the KP target (Parry et al. 1999; Bovenberg and Goulder 1996). However, grandfathering of permits is likely to be more politically acceptable, even though it raises costs.

The problem is that the Kyoto process began with emission reduction targets and only afterwards began to consider instruments for implementation. Rather than using a true cap-and-trade scheme that allocates emission "rights" (permits) equal to emissions cap and then allows permit trading, a credit trading scheme was adopted (Tietenberg et al. 1998). Credit trading occurs when the government mandates that firms (usually large industrial emitters) each reduce emissions by a certain amount (generally expressed as a proportion of baseline emissions) and then allows firms that reduce emissions below the required level to receive credits that can be sold to firms that cannot meet their targets. Nothing prevents emissions from growing because, for example, new firms can enter as the economy expands. But Kyoto permitted other forms of credits that could be traded (substituted) for emission reduction credits, thereby enabling countries and/or companies to achieve targets without addressing emissions per se.

Annex B countries can achieve their CO_2-reduction targets in different ways.

- Countries can simply reduce own emissions of CO_2 to the target level.
- A country can achieve part (or all) of its KP target by sequestering carbon in domestic terrestrial ecosystems. It can obtain credits (up to 9 Mt C per year) for activities that reduce carbon release from net land-use change and forestry if it had net LULUCF emissions in 1990 (Article 3.7); claim unlimited net removals by sinks as a result of afforestation and

reforestation activities that are truly additional (Article 3.3); demand unlimited net removals by changes in agronomic practices (cropland and grazing land management, and revegetation actions) under Article 3.4; and claim limited removals as a result of forest management activities (Article 3.4), as set out by COP-7 (see above).

- Joint implementation (JI) allows an Annex B country to participate in an emissions-reduction or sink activity in another Annex B country (Article 6), thereby earning "emission reduction units" (ERUs) that are credited toward the country's own commitment.
- Under the "clean development mechanism" (CDM) of Article 12, an Annex B country can earn "certified emission reductions" (CERs) by funding emissions-reducing and/or sink projects in developing (non-Annex B) countries. Only afforestation and reforestation are permitted sink activities and their use is limited (in each year of the commitment period) to 1% of the Annex B country's base-year emissions, although this constraint is likely not binding.
- Finally, Annex B countries can simply purchase excess emission credits from other Annex B countries (Article 17). Emission credits in excess of what a country needs to achieve its commitment are referred to as "assigned amount units" (AAUs) that can be purchased by other countries. These are particularly important to economies in transition (EIT) that, because of economic decline during the 1990s, are thought to be able to exceed KP targets quite easily (Figure 1), thus having "hot air" (AAUs) available for sale.

The purchase and sale of AAUs, CERs and ERUs is referred to as "international emissions trading" (IET), although no true emissions trading currently exists.

The availability of a variety of emission-reduction and carbon sequestration options for achieving targets poses greater challenges for monitoring and enforcement than is the case with simple emissions reduction. In principle, enabling emitters to purchase carbon offsets in lieu of emission credits, and allowing Annex B countries to purchase credits from developing countries via the CDM, should reduce compliance costs relative to the situation where restrictions are placed only on emissions, because it should not matter how CO_2 is removed from the atmosphere. However, it is difficult (perhaps even impossible) to determine whether a terrestrial carbon sink activity is indeed additional. Further, mixed emission-offset carbon trading requires an exchange rate – a factor that converts temporary into permanent removal of CO_2 from the atmosphere. Although temporary carbon storage can be important (Marland et al. 2001, 262), under Kyoto there is currently no effective penalty for releasing stored carbon after 2012. A country could claim carbon offset credits for each year of the commitment period, but, if the stored carbon is released immediately afterwards, climate change mitigation does not occur.

The ephemeral nature of terrestrial carbon uptake can be addressed by providing only partial credits for stored carbon according to the perceived risk that it will be released at some future date, or some assurance that the temporary activity will be followed by one that results in a permanent emissions reduction. Thus, providers of carbon offsets might be able to credit only a portion of the carbon sequestered in trees, or they have to post a bond and/or purchase an insurance contract. But this increases the transaction costs of establishing carbon sinks.

Alternatively, a conversion factor that translates years of temporary carbon storage into a permanent equivalent can be specified. For example, the IPCC (2000) has proposed the use of ton-years to address the conversion from temporary to permanent storage (with some 50-150 ton-years of storage equated to a ton of reduced emissions). Once a conversion factor has been decided upon, seamless exchange between carbon offset and emission reduction credits can occur in the marketplace. The ton-years approach reduces transaction costs of insurance and renewal contracts, and does away with the smoke and mirrors that currently characterizes the treatment of carbon sinks in the Kyoto process. However, the ton-year approach, as well as the other approaches mentioned, reduce the value of offset credits relative to emissions reductions, and will thus be opposed by countries seeking to use sinks as an "easy" means for achieving targets.

KYOTO PROTOCOL SMOKE AND MIRRORS

Proponents of the KP stress the perhaps symbolic importance of an international agreement on climate change, even if the measures do little to forestall global warming – the current agreement can serve as a building block for more aggressive emission controls in the future. The KP can be viewed in this way only if three conditions are satisfied. First, the costs of achieving the KP targets should not be onerous; otherwise, citizens and their leaders will oppose more stringent measures, preferring to take their chances on adaptation as a lower cost alternative. And compliance costs depend on the governance structures that a country adopts.

Second, the KP can only be considered a building block for future action if most countries meet their agreed-upon targets. Failure to meet these self-imposed objectives does not bode well for future agreements, with countries then unlikely to accept a future agreement that contains meaningful emissions reductions and meaningful penalties for non-compliance.

Finally, and perhaps worst of all, if countries use smoke and mirrors to meet their obligations but make no real effort to reduce CO_2 emissions, the international community will view future participation in agreements that permit some countries to escape meaningful climate mitigation action with skepticism, making it more difficult to reach an accord at some future date. At first blush, it is difficult to accept that the KP is nothing more than smoke and mirrors. Two groups of countries, the economies in transition and the EU, currently have lower CO_2-

equivalent emissions than in 1990 (Figure 1), although the situation varies for individual EU countries (Table 1). For economies in transition, lower emissions are an artifact of economic decline, and not policies to mitigate climate change.

<Insert Figure 1 about here>

<Insert Table 1 about here>

In this section, the implementation plans of Canada, Japan and the Netherlands are examined to determine whether these countries can achieve their emission targets without some creative carbon accounting, and whether targets can be achieved at least (or at least acceptable) cost. Concern for future generations and poor people threatened by global warming played a significant role in the decision by all three countries to ratify the KP. Therefore, it is important that these countries not only achieve their KP targets, but do so in a transparent and least cost fashion. Failure to achieve targets, use of smoke and mirrors to achieve targets, and/or high economic costs will have a detrimental effect on the political feasibility of future domestic and international efforts to mitigate climate change, and not just in those countries.

Canada

Canada considers itself to be a global leader in matters of the environment and dutifully ratified the KP on December 17, 2002. Altruism is an obvious motivating factor in Canada's decision, but absent effective implementation altruism can ring hollow in the international arena, and at home. How effective is Canada's implantation plan, and, more importantly, how costly is it likely to be?

Canada committed to reduce emissions of CO_2-equivalent gases by 6% from 1990 levels, or by some 240 Mt CO_2 per year during 2008-12 (Figure 1). To achieve its targets at lowest cost, it should rely as much as possible on market incentives, but it should not rely on subsidies, for example, as these violate the "polluter-pays" principle by transferring the externality costs of CO_2 emissions from those who cause them to general taxpayers. In this sense, taxes and emissions/offset trading are preferred.

According to the federal government's implementation plan (Government of Canada 2002), C&C and voluntary action feature prominently, albeit accompanied by subsidies. Carbon taxes are hardly mentioned in the Canadian government's implementation plan, and the only example provided is a possible excise tax exemption for ethanol in gasoline. The role of emissions trading is limited to about 30% of the required reduction, with a minimum of 10 Mt CO_2 to be obtained internationally and the remainder domestically through a combination of emissions reductions and carbon offset credits (Ibid., 42-44). The plan also makes reference to covenants (e.g., contracting farmers to plant shelterbelts) and regulations/standards, with the latter used to ensure that sectors meet their KP targets. Some sectors have been exempted, most notably the automotive sector in Ontario because of its integral tie to the U.S. automotive sector. The government also announced that Canadian industry would not be required to reduce emissions below 15% of business-as-usual (projected) emissions *intensity* (CO_2 emissions per unit of output), as this objective is easily attainable.

Further, there is to be a cap on the price that is to be paid for emission reduction permits and carbon offsets of C$15 per t CO_2, based on the notion that emission reduction permits can be purchased internationally at that price or less. If costs exceed $15, the government will need to subsidize the difference – and that amount could be substantial. Estimates of the likely costs of reducing CO_2 emissions range from a low of US$7.91 (about C$12) per t CO_2 under full global trading to US$21.27 (C$32) per t CO_2 if trading is limited to Annex B countries (IPCC 2001, Table TS.4).[1] The costs of carbon credits from forest sinks are in the range of C$14-$46 per t CO_2 (Manley and van Kooten 2003). If we assume a global price of approximately C$30 per t CO_2 (trading among Annex B countries only), the subsidy to be paid by the federal government would amount to $825 million annually (=$15/t CO_2 × 55 Mt CO_2).[2] To avoid such costs, the government will likely increase reliance on international trading, placing its hope on Russian ratification and the availability of low-priced "hot air".[3]

It is difficult to determine precisely how Canada will achieve its KP targets based on the government's implementation plan, although it is possible to draw some conclusions. As indicated in Table 2, actions already underway (as a result of Action Plan 2000 and the 2001 Federal Budget) are to account for about one-third of the required emissions reduction (about 80 Mt CO_2 per year), although it is unclear whether and how the targets will be met. New actions are to account for an additional 100 Mt CO_2 reduction in emissions (or increase in carbon sequestration), while the remaining 60 Mt is to be addressed in some other (unknown) fashion at some time prior to 2008.

<Insert Table 2about here>

The government believes that individuals and all levels of government will take action to reduce emissions by driving less, setting thermostats lower, enhancing insulation of buildings, and so on (see McKitrick and Wigle 2002). Just over half of the needed emission reductions are projected to be the result of reduced fossil fuel consumption and energy efficiency improvements in the industrial sectors. The government's plan also calls for some 58-66 Mt CO_2 annually of terrestrial carbon offsets to be created, but it is not clear how (and if) this will occur given that the $15 per t CO_2 limit that firms are required to pay is less than it will cost to create offsets. Further, although it is not clear how the 60 Mt CO_2 in Step 3 will come about, this category includes the government's claim of 70 Mt CO_2 for clean energy exports (which the international community has already rejected because these credit Canada for fuel switching by U.S. firms), 7 Mt CO_2 due to the voluntary actions of Canadians (another 24 Mt CO_2 is claimed in Step 2), and 10 Mt CO_2 by one hundred communities that have plans.

In Table 3, I indicate how actions are likely to be allocated. The government plans to employ subsidies to bring about a 35% reduction in required emissions, terrestrial carbon sinks are to account for 25%, voluntary action is projected to reduce emissions by 20% of the amount needed, and other actions are to account for the remainder. Clean energy exports act as a fudge factor that will enable Canada to undershoot its target by nearly 30% and still claim to be in compliance. According to the implementation plan, domestic and international emissions trading are to account for 10% of the KP target (with any sink carbon in excess of 38 Mt CO_2 to come from domestic emissions trading), but international emissions trading could play a larger role for reasons indicated above. Overall, the 2002 plan is dominated by inefficient instruments, many of which have a dubious effect on CO_2 emissions and/or lack a means (tax, subsidy, standard) for bringing them about.

<Insert Table 3 about here>

My estimates of the potential cost to Canada of the current implementation plan are provided in the last column of Table 3. These ignore the distorting effects of government subsidies, sector exemptions and the possible costs of providing carbon credits for extant forest management practices. Under the KP, Canada can automatically claim any difference between what grows on a managed forest and what is harvested, up to 44 Mt CO_2 although it has so far only claimed a 20 Mt CO_2 credit. This can hardly be considered additional and a contribution to mitigation of climate change. Canada can increase the credit to the maximum allowable amount of 44 Mt CO_2 simply by declaring a larger forest area to be managed, but the downside is the risk that some of the forest will succumb to fire resulting in carbon debits.

The opportunity cost of unharvested timber might be considered an estimate of the costs of this component of terrestrial carbon sinks; after all, if carbon offsets can be claimed on unharvested timber, this same timber constitutes the opportunity cost of the claim. Assuming that logs are worth \$60-\$120 per m^3 and that each m^3 of timber removes 735 kg of CO_2 from the atmosphere, the foregone resource rent by neglecting to harvest 27.2 million m^3 of available timber amounts to \$1.6-\$3.3 billion. This seems an expensive means for creating carbon sink credits and probably does not reflect true costs because of the regulated nature of Canadian forestry – logging companies would not be permitted to harvest any or all of the 27.2 million m^3 of "extra" growth. In this sense, there is no cost to claiming this terrestrial carbon credit, but then there is no real increase in the amount of carbon stored in terrestrial carbon sinks either.

What about the other components of ongoing terrestrial activities? There is no automatic claim for them under the KP as there is with ongoing forest management activities, so it makes sense to estimate their costs. The costs of creating carbon credits are some \$35 to over \$100 per t CO_2 for Canadian agricultural sinks (Manley et al. 2003), implying an annual cost of some \$630 million for such ongoing sink activities.

Direct subsidies of some \$500 million annually are being set aside to fund programs and measures to reduce CO_2 emissions, although this likely underestimates the amount required (Government of Canada 2001, p.55; 2002, p.12). The government claims that 50 Mt of CO_2 will be reduced this way, but careful examination of the implementation plan suggests that some 85 Mt of CO_2 are to be eliminated annually using subsidies. Thus, the needed subsidy would be $850 million per year instead of $500 million, which firms and individuals would spend on mitigating activities (see Table 3).

Carbon offset trading is expected to account for about half of the 55 Mt CO_2 to be addressed by market instruments. Given that this will be in addition to the terrestrial carbon sinks already underway (or planned for), costs of creating these additional credits will be significantly higher (due to higher marginal costs). Costs of creating offset credits are estimated to be some $963 million to $2,750 million per year. It is necessary to compare these costs against the least-cost alternative – buying emission reduction credits. Using IPCC (2001) data, the estimated cost of purchasing the same amount of emission reduction credits would be $410-$765 million per year, although this would be even lower if international trading could be exploited to a greater degree. In order for carbon offsets to be traded, however, the government will have to subsidize their creation, with the subsidy equal to the difference between purchase of emission reduction credits and the cost of creating carbon sink offsets, or some $0.6-$2.3 billion annually.

Finally, voluntary initiatives and clean energy export credits are assumed to be costless means of achieving emissions reductions, although this is unlikely to be the case in practice. Firms and individuals will incur costs in order to purchase goodwill or utility from having done what is "right", but it is a cost nonetheless.

Overall, the costs to Canada of the government's implementation plan are here estimated to range conservatively from $2.9 billion to about $6.2 billion per year, or some $41 billion to $89 billion in discounted terms (using a 7% rate of discount).[4] This is somewhat higher than the $30 billion estimated by Kennedy (2002, p.31), but he assumed that market instruments and not regulations would be used to achieve Kyoto targets. The reason for the wide range of estimates is related to the uncertainty about the costs of creating terrestrial carbon sinks and the future price of tradable emission permits.

Suppose that the government relied solely on emissions trading to achieve the aforementioned reductions of 158 Mt CO_2 (excluding the 20 Mt CO_2 credit for ongoing forest management). The remainder is to be attained through voluntary measures and credits for clean energy exports. Assume that trading occurs at some $15-$30 per t CO_2 and that 75% of emissions are purchased domestically. In that case, the cost to Canada amounts to some $1.481-$2.963 billion annually,[5] still a significant sum but $1.4-$3.2 billion less than what it would be under the government's implementation plan. That is, reliance on emissions trading will reduce costs by at least half. The reason is that the government plan does not give firms and individuals the incentive to seek out the least cost means of reducing greenhouse gas emissions.

Japan

Like Canada, Japan is committed to reducing its CO_2-equivalent GHG emissions by 6% from 1990 levels. It ratified the KP on June 4, 2002, just ahead of the Johannesburg Environmental Summit. According to the UN FCCC (2003) database, baseline 1990 Japanese emissions were 1,212 Mt of CO_2 equivalent, implying that Japan's KP target is 1,139 Mt CO_2 per year (Figure 1). However, Japanese emissions are expected to decline somewhat by 2010 as a result of voluntary measures already implemented.

The official KP target is based on actual emissions as reported by the UN FCCC (2003), but policy analysis has been based on a higher target of 1,155 Mt CO_2. Whatever target is employed, it is clear that the Kyoto gap is substantial and will not easily be attained. What is important is how Japan intends to implement its Kyoto commitment and whether it can realistically expect to achieve the required reductions, whether these are 165 Mt CO_2 after existing measures are taken into account or 196 Mt CO_2.[6]

Japan's 1998 implementation plan was revised in March 2002. Japan's strategy is to reduce CO_2 emissions related to energy use (by far the largest source of emissions) back to the 1990 level by 2010, and then rely on reductions in other greenhouse gases, technological innovations, domestic terrestrial carbon sinks, and Kyoto's flexibility mechanisms for the remainder (Table 4). Domestic action is to account for 88% of Japan's emissions reductions, with the remainder coming from abroad.

What governance structures will be employed? To what extent will Japan rely on market instruments to keep compliance costs down? Consider action *only to stabilize CO_2 emissions*. As is the case for Canada, Japan's implementation plan relies principally on C&C, voluntary initiatives (common values and norms) and subsidies. This is illustrated in Table 5. Compulsory measures (mainly efficiency standards on automobiles, household electric appliances such as air conditioners, and business machines such as photocopiers) are to account for 27.8% of emissions reductions, voluntary action for 31.4%, subsidies for 28.9%, and other actions for the remainder. Twelve percent of the targeted overall emissions reduction, or approximately 29 Mt CO_2, will come from Kyoto's flexibility mechanisms, while the remainder (4 Mt CO_2) appear to be coming from domestic emissions trading.

<Insert Tables 4, 5 and 6 about here>

A summary of the importance of various governance structures in achieving Japan's KP target is provided in Table 6. Carbon taxes have been eschewed to maintain international competitiveness, and will not be implemented until there is international coordination of such taxes (Hayami et al. 2003). Among market instruments subsidies play a dominant role, while command and control is also important. Although Japan's mix of governance structures is similar to that employed by Canada, common values and norms are likely to be more effective in Japan because it is a more homogeneous society.

Not evident from Table 5 is how the Japanese intend to reduce reliance on fossil fuels by expanding nuclear generating capacity. The 1998 implementation plan called for the construction of 20 nuclear power plants by 2008, and these would reduce emissions by a projected 107.9 Mt CO_2 annually. Overall, greater reliance on nuclear power is expected to reduce emissions by 139 Mt CO_2 per year, energy conservation by 22 Mt CO_2, new energy (photovoltaic, solar, wind, waste and biomass burning, etc.) by 34 Mt CO_2, and fuel switching (e.g., coal to natural gas) by 18 Mt CO_2.

Two questions remain: First, will Japan succeed in meeting its Kyoto target? Second, what will it cost? In response to the first question, it is important to note that, despite a sluggish economy, total and per capita emissions have grown between 1990 and 2000. Without the economic incentives provided by carbon taxes or domestic emissions trading, it will be difficult to reduce per capita energy consumption and total CO_2 emissions. It is also unlikely that Japan will succeed in building twenty nuclear power plants by 2008. Indeed, this is the same conclusion reached by the Advisory Committee for Natural Resources and Energy and the Central Environmental Council in separate studies in mid 2001. The studies examined what would happen to emissions in the energy sector if the government's plan was implemented, but with various assumptions about the number of nuclear power plants to be built. The Advisory Committee found that, even if 10-13 additional nuclear power plants were built, energy sector CO_2 emissions would still be 7% (or 73.4 Mt CO_2) higher in 2010 than in 1990. The Central Environmental Council found that, if seven nuclear facilities were built, emissions would be 8% (93 Mt CO_2) higher in 2010 than 1990, and if 13 nuclear plants were built they would be 5% (61 Mt CO_2) higher. Nonetheless, Japan ratified the KP despite knowing this.

No studies have examined the actual costs of Japan's implementation plan. However, crude estimates can be made using information from the IPCC (2001, Table TS.4). Information averaged over a number of economic models (reported in IPCC, Table TS.4) indicate that, if Japan relies only on domestic instruments for achieving its KP target, the cost will be some $US 82.64 per t CO_2 ($303 per tC). With emissions trading among Annex B countries only, the cost will be significantly lower at $21.27 per t CO_2, while full global emissions trading reduces the cost to $7.91 per t CO_2. As argued earlier, full global trading is an unlikely prospect; assume, rather, that external trading of emissions, including terrestrial carbon credits, costs $15 per t CO_2 (about half way between the figures for Annex B trading and full global trading). Further, if 14% of Japan's required target is the result of offshore emissions trading and the remainder from domestic trading (at $82.64 per t CO_2), then the total cost to Japan will be some $17.5 billion per year. However, if voluntary measures are indeed successful (and there is more chance of their success in Japan than Canada for reasons already mentioned), costs would only be $12.2 billion annually. This is $2.3 billion less than if Japan were to rely solely on domestic measures (i.e., not rely on Kyoto's flexibility mechanism).

Although the annual cost of achieving the KP target appears to be quite high, the $12.2 billion per year estimate must be considered a lower bound estimate. The reasons are that, as argued for Canada, voluntary measures are unlikely to come about without social costs and, more importantly, the estimated annual cost assumes that market instruments are used to achieve the target. Again recall that regulations are more costly than market instruments for correcting environmental spillovers.

Japan is unlikely to meet its Kyoto obligation because any serious attempt to meet its KP obligation will result in costs that are unlikely to be politically acceptable (viz., building 20 nuclear power plants). Unfortunately, failure to achieve the required target or failure to control costs, or both, will lead to a negative Japanese attitude towards future climate negotiations, particularly if such negotiations attempt to implement emissions reductions on the scale called for by climate scientists.

The Netherlands

Although individual EU countries may have difficulty achieving their KP targets, the EU as a whole appears to be on course for meeting its KP obligations. This is the result of, among other things, aggressive energy pricing policies and sheer luck that has to do as much with the choice of base year as with policy: Inefficient coal mines and power generating facilities in Britain have closed down since 1990, while inefficient manufacturing industries in eastern Germany closed as a result of reunification. Thus, Britain and Germany have agreed to bear the greatest burden in achieving EU reductions (Table 1). Since the Netherlands is a country that has experienced neither a large increase in CO_2-equivalent greenhouse gas emissions since 1990 nor an opportunistic drop in emissions, it makes an interesting case study: If the Netherlands cannot achieve its KP target in straightforward and transparent fashion, it does not bode well for the current agreement or future ones.

The Netherlands ratified the Kyoto Protocol as a member of the EU on May 31, 2002.

While the EU's overall target is to reduce emissions by 7%, the Dutch negotiated a reduction of 6% within the EU (Table 1). Baseline emissions of CO_2-equivalent greenhouse gases are some 206 Mt per year, but they had increased by 3.4% to 213 Mt by 2000, while targeted emissions are 193 Mt. In the absence of any policies, some of which are already in place, emissions were projected to be about 243 Mt CO_2. According to the Dutch implementation plan (VROM 2003), an annual reduction of 50 Mt CO_2-equivalent is required by 2010. This amount is about one-quarter to one-fifth of the reduction required of each of Canada and Japan.

The Dutch implementation plan calls for 50% of the required reduction to be met internally, with the remainder to be achieved using Kyoto's flexibility mechanisms. For the Netherlands, this implies relying mainly on the CDM. In early 2003, the Dutch had already announced the first of 18 CDM projects they proposed to undertake in China (a wind farm in Inner Mongolia announced on March 13, 2003), Bolivia, Brazil, Costa Rica, El Salvador, India, Indonesia, Jamaica and Panama (World Environmental News 2003). These projects would cut carbon dioxide emissions by more than 16 Mt annually, thus already achieving some two-thirds of the required emissions reductions planned to occur outside the country.

Within the Netherlands, three "packages" have been proposed. The basic package is designed to reduce emissions by 25 Mt of CO_2-equivalent greenhouse gases per year. A reserve package has been identified in case the basic package cannot achieve its goals, and an innovation package was developed with a focus on the future. The innovation package is designed to permit experimenting with emissions trading and, at the same time, encourage innovations that lead to the development of climate neutral energy carriers. For meeting the KP target, however, it is the basic package and the reserve package that are important.

The basic package involves a 70-30 split between measures aimed at reducing CO_2

emissions and those aimed at other greenhouse gases, including primarily non-CO_2 emissions from industrial sources and agriculture. CO_2-equivalent reductions by sector are provided in Table 7.

<Insert Table 7 about here>

Unlike Canada and Japan, the Dutch implementation plan calls for greater reliance on markets as a governance structure, even though common values and norms are probably more effective in Holland than in more heterogeneous countries, such as Canada (CPB 1997). To reduce emissions in the transportation sector, the government intends to rely on tax measures that raise the costs of fuel, thereby inducing increased fuel efficiency and less driving, although greater enforcement of speed limits (higher speeds increase fuel use) will also be employed. However, it appears that, given already high prices due to a variety of taxes, fuel demand may be quite price inelastic, thus reducing the ability of the government to increase efficiency in this sector. Carbon taxes on energy used for heating have also been implemented, but, again, their effectiveness may be limited due to existing efficiencies. Hence, regulation of industry output of non-CO_2 greenhouse gases, as well as CO_2, continue to feature prominently. Further, the Dutch plan to reduce reliance on coal-generated power and even natural gas, intending instead to purchase hydropower from Norway and nuclear power from France.

Despite a basic package that is designed to reduce CO_2 emissions by the required amount, the Dutch have a backup plan. The main element in this plan is a measure to reduce N_2O emissions in the chemical industry using a yet-to-be developed technology. This would result in annual reductions of CO_2-equivalent N_2O of 10 Mt, or 20% of the total required reduction. In this sense, it behaves much like Canada's claim for clean energy exports – a type of "ace in the hole". However, the backup plan (reserve package) also calls for higher energy taxes, excise duties on motor fuels, and the underground storage of CO_2.

It is difficult to estimate the costs of attaining the Dutch KP target. If it is assumed that external reductions cost $US 15 per t CO_2 (as above), then half of required Dutch emissions reductions come at a cost of $375 million. The remainder could be achieved through domestic emissions trading and/or taxes at an average cost of $US82.64 per t CO_2, or total annual cost of $2,066 million (see IPCC, Table TS.4). The total cost would then be $2.44 billion per year. However, some of the domestic emission reductions will come about at higher cost because regulatory (C&C) measures will be used. Suppose that half of the domestic reduction comes at a cost that is double what it would be if markets (taxes and/or emissions trading) were employed. The domestic cost would then be $3,099 million and the total cost would be $3.47 billion, or about a billion U.S. dollars higher than if taxes and/or emissions trading alone were used to achieve the domestic target.

If trading occurs among Annex B countries (or even within Europe itself), and the Netherlands were to rely solely on taxes and emissions trading, then the annual domestic costs would be $532 million (=$21.27/t CO_2 × 25 Mt CO_2) and yearly total costs would amount to $907 million, resulting in a saving of about $2.5 billion per year compared to the current plan.

It is not clear that the Netherlands can attain its KP target. Emissions have risen despite very high fuel and other taxes, and despite various regulations, restrictions and investments in efficiency improvements, most of which were pursued for reasons related to water and air pollution and congestion on roads rather than to mitigate climate change. Economic growth has resulted in greater demand for environmental amenities, but it has also enabled the Dutch to "afford" higher carbon taxes. The dilemma is that, while higher prices have shifted people into smaller and more efficient vehicles, for example, the income effect has caused them to demand larger, less fuel efficient ones that are then driven farther as well. Hence, it is quite possible that the basic package may not succeed in getting the Dutch to meet their KP target. In the end, unless the economy stagnates, the target may only be met by relying more and more on nuclear and hydro energy, and implementing projects such as the high-cost "Betuwe" rail line that is dedicated to the transport of goods from the Port of Rotterdam to Germany, thus reducing truck traffic (addressing both congestion and pollution). More desperately, the Dutch recognize that they may need to find ways of reducing industry's N_2O emissions if they are to meet their KP target.

While the Dutch have a well-thought out implementation plan, one that includes a reserve package in case of failure, it relies almost entirely on emission reductions occurring elsewhere, either via the CDM or through the purchase of hydro and nuclear power from other European countries. While permitted under Kyoto, the purchase of hydro and nuclear power hastens the day when Norway and France will need to build more energy generating capacity, which will be difficult to do given environmental opposition to the types of development required. In that sense, the program is a stop-gap, temporary measure, and perhaps even another form of smoke and mirrors. Nonetheless, the Dutch plan appears to be on much firmer ground than those of Canada and Japan.

DISCUSSION

The Kyoto Protocol is a first attempt by nations to agree to and implement a far-reaching agreement to address a global environmental problem. That an agreement was somehow hammered out is rather amazing, but it came at a cost. Rather than tackle the problem of greenhouse gas emissions in a meaningful way, the KP contains provisions that can best be described as smoke and mirrors. Countries can obtain credit for activities that do not reduce atmospheric concentrations of greenhouse gases. These include the potential purchase of "hot air", carbon offset credits for business-as-usual forest management, and temporary carbon sinks, but can be extended to CO_2 emission reductions arising from "fortunate" choice of a base year. Further, countries are free not to achieve targets because the KP failed to include effective compliance penalties.

What can be learned from the implementation plans of three quite different countries that have ratified the Kyoto Protocol? First, it will be difficult for each of these countries to achieve their target of reducing CO_2 emissions by six percent. This is particularly true of Canada and Japan whose emissions in 2000 were significantly above what they were in 1990, so much so that, when compared to the U.S. and Australia, one might question whether they should have even ratified the Kyoto Protocol. With emissions in 2000 only some three percent above base year emissions, the Netherlands has a chance of delivering on its commitment, but it will not be a cakewalk.

Japan will be unable to meet its target without significant investments in nuclear facilities, which will raise the ire of the environmental movement and draw opposition from many citizens. Serious emissions reduction by Canada will likely be nothing more than smoke and mirrors, because of specious claims for terrestrial carbon uptake and dubious credits for clean energy exports. Both countries have implementation plans that lack the transparency needed to instill confidence in processes that make a serious attempt to address anthropogenic emissions of greenhouse gases. Only the Netherlands appears to have a solid strategy for attaining its KP target, although one that calls for most of the emissions reductions to take place outside the country via the Clean Development Mechanism and increased imports of nuclear and hydropower from elsewhere in Europe. While the Dutch bear the burden, these emissions reductions will likely be unavailable in the future, to be claimed instead by the host country. Unless technological innovations are forthcoming, the Dutch will be hard pressed to commit to future reductions in greenhouse gas emissions without importing them from abroad.

Of course, if in the end a reasonably functioning market in emission reduction credits and carbon offsets is available and there is enough "hot air" to go around, all countries have the potential to meet their Kyoto obligations. However, the obstacles to such a scenario are many. First off, such a market may not develop because the institutional barriers are too great (Tietenberg et al. 1998). For example, not all countries have legal systems in place that will facilitate permit trading. Further, if hot air is plentiful, countries may chose not to purchase it, because, after all, it constitutes nothing more than a large income transfer that does not affect CO_2 emissions whatsoever. If hot air is not available, the costs of emission/offset trading could be unacceptably high. This is a very probable outcome, given that Russia has embarked on a program of economic development that could bring emissions close to their KP target. Finally, there remains the real possibility that Russia will not ratify Kyoto, in which case the international community will need to begin again to negotiate a climate accord.

On the basis of what was negotiated by the international community and the three case studies, one cannot be optimistic about the chances that the KP will succeed. Whether it does or not, striking a future climate accord will be even more difficult. To mitigate climate change, it will be necessary for countries to reduce global greenhouse gas emissions by some one-half of what they were in 1990. Emission reductions on that scale are simply unrealistic, while the ability and will of countries actually to make such significant cuts is likely weak.

ENDNOTES

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1. Values are converted from units of C to CO_2 (1 tC = 3.667 t CO_2), and then to Canadian dollars.
2. This might be a conservative estimate, especially given the great reliance on terrestrial sinks. Using sinks as a guide, a more realistic cost might be \$40 per t CO_2, which would entail annual costs to the government of \$1,375 million.
3. One reviewer suggested that the above estimates are likely on the high side because Canada can purchase emission reduction credits on the international market at prices as low as US\$5 per t CO2 (e.g., see Böhringer and Vogt 2003). I am not as confident because Russia may not have hot air to sell (see Background section) and U.S. firms may well be in the market as a result of actions being undertaken at the state level.
4. Seven percent is the historical average real rate of return to large U.S. companies over the period 1926-1990 and is the rate used by the U.S. Office of Management and Budget for standard cost-benefit analysis (Newell and Pizer 2003).

5. Note that Kennedy's (2002) estimate of \$2.1 billion annually (=\$30 billion×0.07) falls in this range, but that the annual estimates reported by Wigle (2001, pp.6-7) (\$9-\$22 billion when there is no global emissions trading and \$2-\$6 billion with global trading) are generally much larger.
6. The gap of 196 Mt CO_2 is derived from the UN FCCC (2003) plus the assumption that 2010 emissions will be lower than those of 2000 by 12 Mt CO_2 – the projected reduction reported by Yamaguchi (2003).

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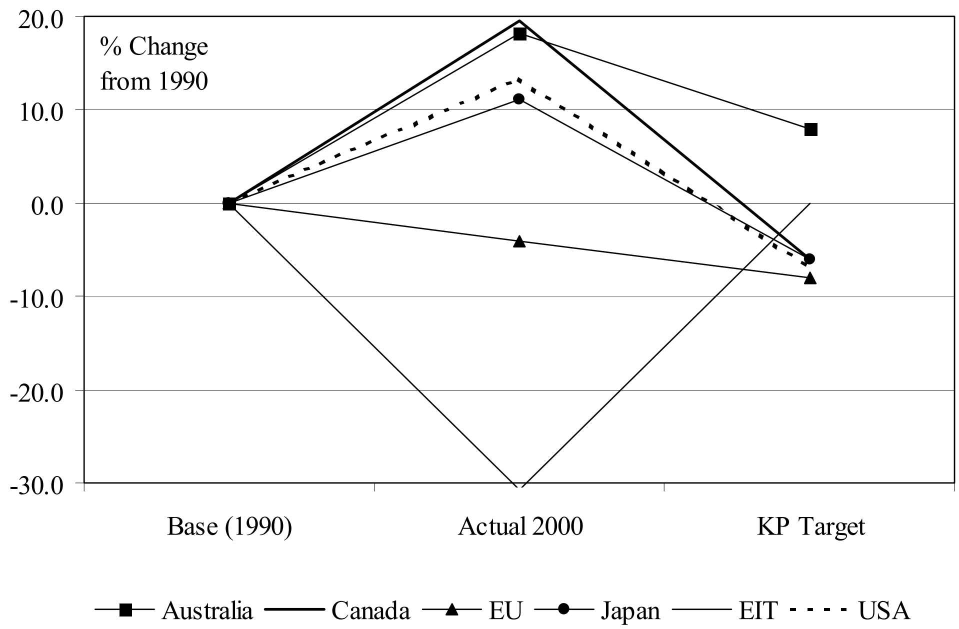

Figure 1: Emissions Growth and KP Targets, Main Annex B Regions

Table 1: Change from 1990 Emissions in EU Member States, Year 200 and Kyoto Protocol Target

Member State	Year 2000 (%)	Kyoto Protocol commitment (%)	Member State	Year 2000 (%)	Kyoto Protocol commitment (%)
Austria	+1.73	-13.00	Italy	+4.75	-6.50
Belgium	+6.17	-7.50	Luxembourg	-55.60	-28.00
Denmark	-2.29	-21.00	Netherlands	+3.44	-6.00
Finland	-4.72	0.00	Portugal	+30.41	+27.00
France	-2.52	0.00	Spain	+32.42	+15.00
Germany	-19.40	-21.00	Sweden	-2.23	+4.00
Greece	+20.98	+25.00	United Kingdom	-12.49	-12.50
Ireland	+24.41	+13.00	**Total EU**	**-4.07**	**-8.00**

Source: http://www.environment.fgov.be/Root/tasks/atmosphere/klim/pub/int/unfccc/kyoto/protocolsyn_en.htm

Table 2: Canada's Implementation Plan (Mt CO_2)

Item	*Step 1:* Actions Underway	*Step 2:* New Actions	*Step 3:* The Remainder
Actions by Canadians & governments: transportation & buildings	13	15-20	
Large industrial emitters	} 25	55	
Other industrial emissions: Technology, infrastructure & efficiency gains		16	
Agriculture, forestry & landfills: Sinks and offsets	38	20-28[a]	
International markets	2	10+	
TOTAL	**About 80**	**About 100**	**About 60**

[a] It is estimated that 20-28 Mt CO_2 will be attained by private sale of carbon sink offset credits.
Source: Government of Canada (2002, p.11)

Table 3: Canada's Implementation Strategy and Estimated Costs: A Summary

Item	Projected contribution to KP target (Mt CO_2)	Estimated Costs $ millions
Terrestrial Carbon Sinks[a]	***38***	***630-1,800***
- current forest management practices (max. 44 Mt CO_2)	20	0
- agricultural and other sink activities since 1991	18	630-1,800
Subsidies to transportation, housing and industry	***85***	***850***
- Transportation (R&D, ethanol, public transit systems, etc.)	14	
- Housing (e.g., upgrading of insulation)	11	
- Industry R&D, innovation, adoption of new technology, etc.)	60	
Voluntary initiatives	***49***	***0***
- by individuals (each person to reduce emissions by 1t CO_2)	31	
- by local communities	10	
- by industry	8	
Emissions and carbon offset trading	***55***	***1,373-3,515***
- Carbon sink offsets sold in markets (e.g., via afforestation)[a]	20-28	963-2,750
- Domestic trading of CO_2 emissions (excluding carbon offsets)	≥12[c]	180-300
- International emission markets (priority given to CDM and JI)	≥20[c]	230-465
Clean energy exports credit[b]	***±70***[c]	***0***
TOTAL	**240**	**2,853-6,165**

[a] These are ongoing activities; not included are afforestation and other sink projects that the government assumes will be funded by trading of carbon credits.
[b] The federal government is using this credit to support the 240 Mt CO_2 annual reduction target in the event it is not achieved.
[c] Minimum targets
[d] Sum of numbers in bold and italics is 297 Mt CO_2, including clean energy export credit.
Source: Author's calculations

Table 4: Japan's Strategy for Achieving it Kyoto Protocol Target of a 6% Reduction in Greenhouse Gases

Item	Planned Change
CO_2 emissions due to energy consumption	0.0%
Other CO_2, methane, etc. emissions	-0.5%
Technological advances	-2.0%
HFC, PFC, SF6	+2.0%
Domestic terrestrial carbon sinks (mainly forest management)	-3.9%
Kyoto's flexible mechanisms (CDM, JI, emissions trading)	-1.6%
TOTAL	-6.0%

Source: Yamaguchi (2003)

Table 5: Governance Mechanisms for Stabilizing Japan's CO_2 Emissions from Energy Consumption, 1998 Implementation Plan

Mechanism	Industry	Commercial & residential	Transportation	TOTAL
Proportion of total emissions	40.0%	25.7%	20.7%	86.4%
		Mt CO_2 per annum		
1. Compulsory measures related to energy efficiency	11.0	35.6	11.0	57.6
2. Voluntary action[a]	41.5	18.4	5.1	65.0
3. Subsidies and indirect measures to induce adoption of energy efficient technologies[b]	8.1	46.6	5.1	59.8
4. Regulation (traffic control, etc)	–	–	24.6	24.6
TOTAL	**60.6**	**100.6**	**45.8**	**207.0**

[a] In the original source, this category is divided into voluntary action by industry and "drastic change in lifestyle", which includes voluntary action in the transportation sector and adjusting climate-control settings in buildings.

[b] Also included are provision of information and moral suasion to make the transportation sector more efficient, for example.

Source: Yamaguchi (2003)

Table 6: Role of Various Governance Structures in Achieving Japan's Kyoto Target

Governance Structure	Proportion of Targeted Reduction
Regulation (C&C)	34.3%
Common values & norms	27.1%
Subsidies	24.9%
Emissions trading & purchase of carbon offsets	13.7%
TOTAL (240 Mt CO_2)	**100%**

Table 7: Distribution of CO_2-equivalent Emissions and Planned Reductions across Sectors, The Netherlands

	Emissions in 2010		Reduction in 2010	
Sector	Mt CO_2	% of Total	Mt CO_2	%
Industry (including refining)	89	33	10.0	11.2
Energy	61	24	8.0	13.1
Agriculture	28	11	2.0	7.1
Transportation	40	15	3.0	7.4
Households	23	9	2.3	10.0
Trade, services, government	12	5	1.0	8.3
Other	6	3		
TOTAL	**259**	**100**	**26.3**	

Source: VROM (2003)