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TABLE RONDE NATIONALE SUR L'ENVIRONNEMENT ET L'ÉCONOMIE

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Briefing Document on

Emissions Trading for Greenhouse Gases

Prepared for:

Economic Instruments Committee

of the

National Round Table on the Economy and the Environment

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Introduction

Purposes

The purposes of this briefing document are to:

- provide the Economic Instruments Committee of the National Round Table on the Economy and the Environment with an overview of activities related to emissions trading for greenhouse gases in Canada and elsewhere; and

- identify approaches the Economic Instruments Committee could pursue to contribute to a better understanding of the potential role of emissions trading to manage greenhouse gas emissions in Canada.

Scope

This briefing document discusses:

- The principal types of emissions trading programs; credit trading, allowance trading for substances, and allowance trading for emissions.

- The emissions trading and joint implementation provisions for international trading of greenhouse gas emissions in the Kyoto Protocol.

- A brief description of each of the known initiatives related to international and domestic emissions trading for greenhouse gases.

- Alternative approaches the Economic Instruments Committee could pursue to contribute to a better understanding of the potential role of emissions trading to manage greenhouse gas emissions in Canada.

These topics are discussed in successive chapters.

Principal Types of Emissions Trading Programs

The term emissions trading is applied to three generic designs: "credit trading" of documented emissions reductions, "substance trading" of compounds that are ultimately emitted as pollutants, and "emissions rights" trading by sources that discharge pollutants into the atmosphere.[1] This chapter discusses each of these designs briefly and discusses the designs best suited to different sources of greenhouse gases.

Before discussing the different designs, it is useful to provide a brief introduction to emissions trading.

Emissions Trading

Emissions trading is a form of regulation that reduces the cost of achieving a specified environmental objective, such as reducing greenhouse gas emissions. In its simplest form, a cap is established for total emissions of a pollutant by a specified set of sources. Allowances equal to the cap are given or sold to the participating sources. To achieve compliance, each source must demonstrate to the regulatory authority that it has enough allowances to cover its actual emissions. Failure to submit enough allowances leads to penalties for non-compliance.

The cap on total emissions is set by the regulatory authority to protect human health or the environment; the cap is **not** determined by the emissions trading market. Almost all trading programs give allowances to participating sources *gratis*, but they can also be sold at auction.

Participants are not obligated to trade; but they have a financial incentive to trade if it reduces compliance costs. Each source can reduce its emissions below the number of allowances it has been allocated, so it is not forced to trade. Sources able to control their emissions at low cost can sell surplus allowances at a profit. Sources facing high cost control options can save money by purchasing allowances from other sources. Trades continue until the set of emission reduction actions that meets the overall cap at the lowest total cost is implemented.

Emissions trading, then, enables a given environmental objective to be achieved at lower cost than with conventional regulations. The benefit of a successful emissions trading program is the cost saving relative to other regulatory approaches for achieving the same environmental objective.

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[1] The last two are "cap and trade" or allowance trading systems where total emissions by participating sources are limited.

A Numerical Example of Emissions Trading

The potential for cost saving is illustrated by the example in Table 1 involving two companies with different costs of emissions control. The regulator imposes a 10% emissions reduction obligation on each firm. If trading is not allowed, each company must implement the reduction internally and the total cost is $60,000. If trading is allowed, the company with low cost emissions control options (Company 1) implements a larger reduction and the company with high cost control options (Company 2) implements a smaller reduction.

Since Company 1 implements a larger emission reduction than necessary for its own compliance, it has surplus allowances or credits. To achieve compliance Company 2 implements some emission reduction measures internally and purchases surplus allowances from Company 1. The total cost of compliance is reduced to $45,000 from $60,000 and each firm shares in the financial benefits of trading.

The cost savings stem from differences in the cost of emissions control among participants. The larger the differences, the greater are the potential savings. In a competitive market, the price will equal the cost of the last measure implemented to meet the overall cap (the marginal cost). To work well, emissions trading requires a competitive market. This implies a large number of participants, none of which is large enough to influence the market.

Since allowances are valuable, companies have an incentive to under report their actual emissions. Most trading programs, therefore, have strict requirements to ensure accurate monitoring and reporting of actual emissions. An effective trading program requires penalties for non-compliance that exceed the market price of an allowance. To ensure this is the case, the penalty usually consists of allowances (to protect the environment) plus fines.

Suitability of Greenhouse Gases for Emissions Trading

Emissions trading should be used only if it is environmentally sound and it is likely to yield economic savings. Greenhouse gases meet these tests.

Emissions trading shifts the location and timing of the emissions allowed within the overall cap. A trading program must be designed to ensure that the shifts in the timing and location of emissions are environmentally beneficial or neutral. Trading programs that involve ground-level ozone precursors, for example, allow emission reductions achieved during the ozone season to be used at any time of the year but do not allow

reductions achieved outside the ozone season to be used during the ozone season. Similarly sources are generally limited to buying credits from local or upwind sources within the same airshed.

Table 1

Numerical Example of Emissions Trading

	Company 1	Company 2	Total
Current emissions	50,000 t	100,000 t	150,000 t
Emission limits	45,000 t	90,000 t	135,000 t
Emission reduction	5,000 t	10,000 t	15,000 t
Cost per ton reduced	$2,000/t	$5,000/t	
Compliance cost without trading	$10,000	$50,000	$60,000
With Emissions Trading			
Allowance allocation	45,000 t	90,000 t	135,000 t
Reductions implemented	10,000 t	5,000 t	15,000 t
Cost of reductions implemented	$20,000	$25,000	$45,000
Surplus allowances	5,000 t	-5,000 t	
Allowances purchased (sold)	(5,000 t)	5,000 t	
Assumed price per allowance	$3,500/t	$3,500/t	
Revenue from sale of allowances	$17,500		
Cost of purchasing allowances		$17,500	
Compliance cost with trading	$20,000 -$17,500 $2,500	$25,000 +$17,500 $42,500	$45,000
Savings relative to no trading	$10,000 - $2,500 $7,500	$50,000 -$42,500 $7,500	$15,000
Savings relative to no trading	75%	15%	25%

Greenhouse gas emissions have no local environmental or health impacts. And they have atmospheric lifetimes ranging from a few decades to many centuries. Thus, all reductions, regardless of their location or timing, are equally effective in mitigating climate change. In other words, greenhouse gases are suitable for emissions trading on a global scale from an environmental perspective.

Greenhouse gases are emitted by millions of sources. The costs of reducing or sequestering one tonne of emissions varies enormously across sources around the world. These cost differences suggest relatively large potential cost savings; studies suggest savings of 30 to 80% depending on the target and the scale of the trading program. The large number of sources also suggests that a competitive market can be established. Thus, greenhouse gases are economically suited to emissions trading on a global scale as well.

Experience with Emissions Trading

Experience with emissions trading is limited largely to the United States. Credit trading programs have been implemented on a regional scale for NOx, SOx, and VOCs since the 1980s. An emissions rights trading program was implemented for NOx and SOx in the greater Los Angeles area in 1994. On a national scale, substance trading programs have been used for lead in gasoline (1983-87), and ozone-depleting substances (CFCs) since 1989. A national emissions rights trading program for SO_2 emissions by electric utilities was launched in 1995.

The only international emissions trading experience to-date is limited trading of production quotas for ozone-depleting substances under the Montreal Protocol.

Credit Trading[2]

In a credit trading system a source can create "credits" by documenting emission reductions achieved. The credits can be sold to other sources to use for regulatory compliance under specified conditions. Credit creation and use are voluntary. Sources may choose to buy credits if they are less costly than alternative compliance options.

A credit trading system supplements voluntary or regulatory policies. A package of voluntary and regulatory policies and measures would be implemented to meet the national greenhouse gas emissions limitation commitment. If credit trading is allowed, some sources reduce their emissions below the level required by the applicable voluntary and regulatory policies and measures. Other sources buy credits to achieve compliance with the voluntary or regulatory policies and measures under specified conditions.

The two key issues that need to be addressed in the design of a credit trading system are:

- Ensuring that the credits represent real reductions from the emission levels that would otherwise prevail; and

[2] See Appendix A for a more extensive discussion of each of the emissions trading system designs.

- Determining the conditions under which sources can use credits for regulatory compliance.

Credits must represent real reductions from the emission levels that would otherwise prevail under the applicable voluntary and regulatory policies and measures. Trading programs establish criteria that credits must meet. Typically, credits must be real, quantifiable and surplus to all regulatory requirements. Operational interpretation of these criteria ultimately resides with the regulatory authority when it decides which credits to accept or reject for compliance purposes.

The conditions under which sources can use credits for regulatory compliance must also be determined. The ability to use credits for compliance with voluntary or regulatory policies and measures is what gives credits value.

Uses embodied in American credit trading programs for emissions other than greenhouse gases include:

- Requiring new sources locating in non-attainment areas, whose emissions exceed a specified threshold, to purchase credits created by other sources in the area at least equal to their allowed emissions.

- Allowing expanding sources to use credits to offset some of the increased emissions and so qualify for a simpler, less-costly regulatory approval process.

- Requiring sources to purchase credits as part of the penalty for violating emissions regulations or as a condition for receiving a variance from environmental regulations.

To implement credit trading as part of Canada's strategy to meet its national emissions limitation commitment, the voluntary and regulatory policies and measures would need to allow credits that meet defined criteria to be used for compliance where appropriate.

Substance Trading

An allowance trading system can be implemented for substances, such as HFCs, the carbon content of fossil fuels and the nitrogen content of fertilizers, that are ultimately emitted as greenhouse gases.[3] An annual cap on the total quantity of the substance consumed (production + imports - exports) in the country is established. All producers, importers and exporters of the substance, and products containing the substance, are required to participate in the trading system.

[3] This is analogous to the trading systems for lead in gasoline and for production and consumption of ozone-depleting substances that operated successfully in the U.S.

In general, it is important to implement an emissions cap as close as possible to the point at which emissions occur, to provide the widest possible range of mitigation options. The CO_2 emissions from combustion of fossil fuel are very closely related to the carbon content of the fuel. With few exceptions, technologies to remove CO_2 from emissions streams and to store it permanently are not economic at present.[4] So a fossil fuel carbon content trading system covers virtually all of the energy-related CO_2 emissions and does not exclude any currently viable compliance strategies. The same is true for HFCs and the N_2O emissions due to fertilizer use.

A substance trading program is essentially a quota on consumption of the regulated substance. While fertilizers vary in terms of their nitrogen content, a trading program for nitrogen used in fertilizers would limit the total amount of nitrogen available for this purpose. Similarly, a limit on total fossil-fuel carbon content would encourage a shift to less carbon-intensive fuels, but ultimately limit the use of fossil fuels. Incorporating other sources and sinks, domestic or international, into the trading system helps loosen the restriction on the regulated substances.

The main effect of a substance trading system is to change the prices of products containing the substance. Price increases for fertilizers due to a nitrogen content trading system induce farmers to change their patterns of fertilizer use. Similarly, price increases for fossil fuels due to a carbon content trading system induce customers to switch to less carbon-intensive fuels and to implement energy conservation measures. And price increases for HFCs induce a shift to substitutes.

Emissions Rights Trading

An emissions rights trading system limits aggregate emissions of a greenhouse gas by specified sources at the point of release to the atmosphere.[5] An annual cap on specified greenhouse gas emissions by the regulated sources is established. Allowances equal to the annual cap are allocated to participating sources. Each source is required to monitor its actual emissions and to remit allowances equal to its actual emissions to the regulator. Due to the cost of monitoring actual emissions, participation probably would be limited to utilities and large industrial sources.

Limiting the program to sources large enough to bear the cost of monitoring actual greenhouse gas emissions may not pose a problem for gases/sources such as CO_2 from

[4] In cases where CO_2 is recovered from an emissions stream and is permanently sequestered, the source could credited with allowances equal to the carbon sequestered in the same way as exporters of fossil fuel.

[5] This is analogous to the SO_2 allowance trading system in the U.S.and the RECLAIM trading system for SOx and NOx in the South Coast Air Quality Management District.

cement or lime manufacturing or N_2O from adipic acid production. However, a program for energy-related CO_2 emissions limited to utilities and large industrial sources would miss a significant fraction of the total emissions.

In Canada approximately 300 electric utilities and industrial firms (representing a much larger number of plants) classified by Statistics Canada as "large industrial energy users," account for at least 40% of national emissions. Thus, an energy-related CO_2 emissions trading program for large sources would need to be complemented by policies to address energy-related CO_2 emissions from transportation, commercial, residential and small industrial sources.

The participants in the program must be defined. It is relatively simple to identify the electric utility and large industrial sources that should participate in the program when it is launched. However, criteria must be established so comparable new sources, such as sources with annual emissions above a threshold level, are also required to participate in the trading program. New sources could design their facilities so that they do not qualify for the trading program, for example, by building several small plants rather than one large plant.

Existing sources may restructure their operations to facilitate compliance, for example, by purchasing components from small companies not covered by the trading program or from companies in countries without emission limitation commitments.[6] Since a trading program for greenhouse gases could remain in place for many decades it is prudent for businesses to evaluate such strategies.

Trading Program Designs Best Suited to Different Gases/Sources

There are numerous sources and sinks of greenhouse gases. Under the Kyoto Protocol the emission limitation commitments of Annex I Parties, such as Canada, cover six gases and numerous sources and sinks. Thus, domestic policies to meet the national commitment will need to address a number of gases/sources. None of the designs is well suited to all greenhouse gases/sources. This section briefly reviews a number of the principal greenhouse gases/sources to assess the most suitable program design(s) for each.

Energy-Related CO_2 Emissions

Energy-related CO_2 emissions can be regulated using:

[6] This effect is known as "leakage". Leakage is common to any agreement that involves emission reduction actions by some countries and less stringent action by other countries; it is not a problem that is unique to trading programs.

- A substance trading program for the carbon content of fossil fuels.

- An emissions rights trading program for energy-related CO_2 emissions by large sources and regulations governing energy-related CO_2 emissions by transportation, commercial, residential and small industrial sources.

- Regulations, such as energy efficiency standards, governing all sources with credit trading as a compliance option.

If all markets are perfectly competitive and the trading program for fossil-fuel users covers all users, a fossil fuel carbon content trading program and an emissions rights trading program for energy-related CO_2 emissions should lead to implementation of the same measures. However, the trading program for energy-related CO_2 emissions is likely to exclude at least the residential and transportation sectors. And there is evidence of market distortions that inhibit the adoption of energy efficiency and conservation measures. Thus, the two options are likely to produce different results in practice.

In practice, a fossil fuel carbon content trading program will cover a larger share of the total emissions with about the same number of participants as a CO_2 emissions rights trading program for large sources. A trading program should achieve a given emission limitation target at lower cost than a series of voluntary and regulatory initiatives, even when those initiatives are complemented by credit trading.

Voluntary and regulatory initiatives to enhance energy efficiency and promote non-fossil energy sources could complement a trading program by helping energy users cope with the price increases in the longer term.

Industrial CO_2 Emissions

Cement and lime production involve chemical reactions that release CO_2. Most plants that produce cement or lime are relatively large and could install monitoring equipment. Thus, process emissions from cement or lime production could be managed using either a substance trading program or an emissions rights trading program.

Since the process emissions are likely to be commingled with energy-related emissions, the trading system design selected for the process emissions is likely to be the same as the design of the trading system for the energy-related emissions. The selected design will be substance trading programs for both energy-related and process CO_2 emissions or an emissions rights trading system for total CO_2 emissions.

Regulating process emissions of CO_2 from cement and lime production is effectively the same as limiting the output since the emissions are driven by chemical reactions. This

also means that credits created by a given source mean a decline in the output of the plant. The output of other plants may increase as a result. Thus, credits need to be assessed carefully to ensure that they represent a net reduction in aggregate emissions.

Since regulation of cement and lime process emissions essentially limits output, these industries are likely to prefer to be part of an emissions trading system involving other sources of greenhouse gas emissions. This would allow production to increase as long as emissions from other sources decline.

The CO_2 emissions due to combustion of wastes by incinerators vary with the composition of the waste stream. Monitoring actual CO_2 emissions may be easier, and is certainly more accurate, than calculating emissions based on the composition of the waste stream. Thus, an emissions rights trading system is likely to be the most effective approach to regulating CO_2 emissions from incinerators.

Both emissions trading and regulatory initiatives for incinerator CO_2 emissions have the potential to divert wastes to landfills, thus increasing the emissions from those sources. Initiatives to limit such diversion may be necessary.[7] Credit creation by incinerators could be problematic because of the difficulty of establishing a baseline volume and composition of the waste stream and of ensuring that the reductions are not due to diversion of wastes. Thus, emissions rights trading may be the best option for managing CO_2 emissions by incinerators.

Industrial Emissions of Other Greenhouse Gases

Industrial emissions of other greenhouse gases, such as N_2O from adipic acid production, N_2O from fertilizer production, HFCs, perfluorocarbons and SF_6 from aluminum smelting, etc., can often be monitored or calculated reasonably accurately. The number of sources for a particular gas is often quite small.

HFCs are perhaps best suited to substance trading and/or regulation. They are used by a large number of small sources. Substance trading and regulation would limit the number of sources that use these compounds. Their chemical cousins, CFCs, were managed by substance trading and regulations in the U.S. and by regulation in Canada.

Most of the other industrial gases/sources lend themselves to emissions rights trading if emissions can be monitored or calculated with sufficient accuracy. Since the number of sources for any given gas is often small, they would need to be integrated into a larger

[7] Regulating greenhouse gas emissions from landfills by voluntary or regulatory initiatives or by including landfills in an emissions trading program would serve the purpose.

greenhouse gas trading market. Separate trading programs would not have enough participants to create competitive markets.

The other gases/sources could also be managed using voluntary or regulatory policies and measures. As part of such a regime they could be allowed to create credits for sale to participants in a greenhouse gas emissions trading program.

Non-Agricultural Methane Emissions

Landfills, coal mines, oil and gas production and wastewater treatment plants are sources of methane. Methane emissions are variable and often can not be controlled by the source. However, methane can be collected and flared or used as an energy source. Methane collection systems have been installed in newer large landfills and some wastewater treatment plants. Some underground coal mines have methane collection systems for safety purposes.

Larger sources could be included in an emissions rights trading program. However, it may be difficult for some sources to document their current emissions, which could create problems if this is the basis for allowance allocation. However, at least some of the larger sources in each category are likely to be able to document (measure or calculate) their emissions to establish a baseline.

Emissions from smaller sources could be managed using voluntary or regulatory policies and measures. Sources that could document emission reductions from actual or regulated levels could create credits for sale to sources in the trading program.

Agricultural Emissions

Emissions of N_2O due to fertilizer use can be addressed through a substance trading program for the nitrogen content of fertilizers. The alternative is to adopt voluntary or regulatory policies and measures covering the nitrogen content of fertilizers and fertilizer use.

Agricultural sources of methane are very uncertain and the number of sources is very large. This combination makes them impractical to incorporate into a greenhouse gas emissions trading program at this time.

Carbon Sequestration

Credits created through carbon sequestration could be part of a greenhouse gas emissions trading market. Determining the credits created by such projects raises issues of the baseline from which to measure sequestration, monitoring procedures and calculation of

the quantity of carbon sequestered. Considerable uncertainties remain, but credible projects are being implemented.

The baseline from which to measure carbon sequestration is a critical issue -- the possibility that reforestation efforts at one site are offset by harvesting at another site (a form of leakage) is a concern. Uncertainties relating to the amount of carbon sequestered due to growth rates, disease, mortality, etc. can be addressed by issuing credits *ex post* based on monitored results. Some credits will be "destroyed" within a few years of creation by fire, disease, or harvesting of the trees which sequestered the carbon. Credits will need to be insured so that those "destroyed" within a specified period (say 40 to 60 years) are replaced.

To date, most sequestration projects have been forestry projects that store carbon in standing biomass or new forest biomass growth. Other forms of carbon sequestration, such as storage in soils and in long-term products, are not as well understood. Work is needed to allow accurate monitoring and calculation of the net amount of carbon sequestered through human initiatives for purposes of credit creation. Assuming the uncertainties related to monitoring are resolved, such sequestration options could be used to generate credits for sale to participants in an emissions trading program.

Emissions Trading and Related Provisions of the Kyoto Protocol

Under the Kyoto Protocol Canada will be expected to reduce its aggregate emissions of six greenhouse gases to 6% below the baseline level during the period 2008-2012, calculated as an average over these five years. Reductions of carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_20) will be measured from their 1990 levels. Cuts in hydrofluorocarbon (HFC), perfluorocarbon (PFC), and sulphur hexafluoride (SF_6) emissions can be measured against either a 1990 or 1995 baseline. A Party's aggregate emissions allowed for the commitment period are its "assigned amount".

The Kyoto Protocol includes provisions for three mechanisms that can be considered emissions trading:

- emissions trading between Annex I Parties;
- joint implementation between Annex I Parties; and
- a clean development mechanism.

The clean development mechanism will be able to create "certified emission reductions" in developing countries that Annex I Parties can use to help meet their commitments. Certified emission reductions created after 2000 can be counted toward commitments during the 2008 - 2012 period.

Emissions Trading between Annex I Parties

Emissions trading between Annex I Parties is covered by paragraphs 10 through 12 of Article 3 of the Protocol. These paragraphs simply state that transfer of any part of an "assigned amount" or any "emission reduction units" reduces the assigned amount of the seller and increases the assigned amount of the buyer. Certified emission reductions acquired from the clean development mechanism will also increase a Party's assigned amount. Emissions trading is required to be supplemental to domestic actions for meeting a Party's emission limitation commitment.

Article 16 bis provides that the Conference of the Parties will define the relevant principles, modalities, rules and guidelines for verification, reporting and accountability for emissions trading. It is interesting to note that it is the Conference of the Parties rather than the Meeting of the Parties to the Protocol that will establish the rules for emissions trading. Assuming this is not a drafting error, it has two implications. First, the rules could be agreed more quickly since the next Conference of the Parties will take place in November 1998 but the first Meeting of Parties to the Protocol will probably not occur until 1999 or 2000. Second, a larger number of Parties, some of which are not Parties to the Protocol, will be involved in adopting the emissions trading rules.

Joint Implementation between Annex I Parties

Joint implementation between Annex I Parties (Article 6) applies to greenhouse gas emission reductions and sink enhancements in any sector of the economy from projects that are:

- approved by the Parties involved;
- additional to what would otherwise occur;
- created in a country that is in compliance with its emissions inventory and reporting obligations; and
- used to supplement domestic actions to meet the purchaser's emission limitation commitments.

Countries may authorize legal entities to participate in the generation, transfer, or acquisition of such "emission reduction units". Guidelines for implementation of this article, including verification and reporting, are to be adopted at the first Meeting of the Parties to the Protocol or as soon as practicable thereafter.

Clean Development Mechanism

Article 12 establishes a clean development mechanism subject to the authority and guidance of the Conference of the Parties. The purposes of the clean development mechanism are to assist:

- non-Annex I Parties to achieve sustainable development;
- non-Annex I Parties to contribute to the ultimate objective of the Convention (stabilizing atmospheric concentrations of greenhouse gases); and
- Annex I Parties to achieve compliance with their emission limitation commitments.

The clean development mechanism will assist in arranging funding for projects in non-Annex I countries that reduce emissions or enhance sinks of greenhouse gases. Projects must:

- be approved by each Party involved;
- provide real, measurable and long-term benefits related to mitigation of climate change;

- yield emission reductions additional to any that would otherwise occur.

In effect the clean development mechanism becomes the institutional vehicle for joint implementation for credit between Annex I and non-Annex I Parties. The reductions resulting from each project will be certified by entities to be designated by the Meeting of the Parties to the Protocol.

Private or public entities may participate in the creation or acquisition of certified emission reductions. Proceeds from certified emission reduction credits will be used to cover administrative expenses as well as to assist developing country Parties that are particularly vulnerable to the adverse effects of climate change to meet the costs of adaptation.

Certified emission reductions obtained between 2000 and 2008 can be used by Annex I Parties for compliance purposes during the first commitment period.

The first Meeting of the Parties to the Protocol will elaborate modalities and procedures for the clean development mechanism with the objective of ensuring transparency, efficiency and accountability through independent auditing and verification of project activities.

How the clean development mechanism will operate is not very clear at the moment. It appears to be the only institution with the authority to "certify" greenhouse gas emission reductions in developing countries that can be used by Annex I Parties to comply with their commitments. It is empowered to charge a fee for this service to cover its administrative costs. But the fees must exceed the administrative costs to enable the mechanism to assist developing country Parties that are particularly vulnerable to the adverse effects of climate change to meet the costs of adaptation.

The clean development mechanism also has the authority to assist in arranging funding for projects in non-Annex I countries that reduce emissions or enhance sinks of greenhouse gases. Presumably it will be only one of many possible funding mechanisms for eligible projects, such as the World Bank's Carbon Investment Fund or the Edison Electric Institute's UtiliTree fund. This raises the question whether the mechanism will be able to compete successfully with private sector investment funds or be left with marginal projects.

International Trading of National Greenhouse Gas Emission Limitation Commitments

Emissions trading under the Kyoto Protocol means that a Party with a commitment may transfer to, or acquire from, any other Party part of its "assigned amount." A Party's actual emissions for the commitment period (2008-2012) must be less than its "assigned amount" for the period less any of its "assigned amount" transferred to other Parties, plus any "assigned amounts" acquired from other Annex I Parties with commitments, plus any

"certified emission reductions" acquired from non-Annex I countries through the clean development mechanism.

Parties must report their actual anthropogenic emissions of greenhouse gases by source and removals of greenhouse gases by sinks using approved estimation methodologies. These reports must be submitted annually and are subject to review by independent experts.

The details of the trading system remain to be developed and agreed upon by the Parties. The participants in an international emissions trading system are sovereign nations rather than firms subject to the jurisdiction of a regulator. Penalties for violation of international agreements tend to be weak and difficult to enforce, so a trading system should rely more on incentives to comply than penalties for non-compliance.

Most studies suggest that if Canada were to engage in international emissions trading, it would be an importer of "assigned amounts" from Russia and eastern European countries. If the countries with economies in transition do not participate in international emissions trading Canada would import "assigned amounts" from the United States. This is because the costs of reducing greenhouse gas emissions are estimated to be lower in these countries than in Canada.

While title to traded "assigned amounts" ultimately must be transferred from one national government to another, it is widely expected that much of the trading will be done by firms and other sub-national entities. To describe how the proposed system for international emissions trading would work, it is useful to begin with a simple transaction between two governments. The more complex situation of a trade between entities participating in domestic emissions trading programs in two countries will then be easier to understand.

Government-to-Government Transactions

In the case of a transaction between two governments, the buyer and seller Parties both notify the Climate Convention Secretariat of the agreed transfer of the agreed quantity of the seller's "assigned amount". The transfer is automatically registered unless the seller Party is not in compliance with its obligations under the Protocol. The seller's "assigned amount" for the commitment period is reduced by the amount of the transfer and the buyer's "assigned amount" is increased by the same amount for the same budget period.

The precise requirements buyers and sellers would need to meet to be in compliance with their obligations under the Protocol, and hence to engage in emissions trading have not yet been specified. Presumably a transfer that triggered non-compliance by the seller could be rejected, or the quantity transferred could be limited to the seller's surplus

emissions. Other conditions for compliance might include having submitted all reports that are due and having paid the agreed levies to support the Climate Convention Secretariat. The importing Party may also need to be in compliance with obligations such as payment of levies and submission of annual reports.

Government-to-government transactions are expected to be relatively rare. Portions of a country's "assigned amount" could, for example, be accepted in partial payment for exports of products such as wheat or coal by government agencies. Or a quantity of the "assigned amount" could be included with the government financing for a thermal generating station in another country. But governments are unlikely to spend tax revenue to purchase portions of the "assigned amounts" from other Parties to meet their national commitments when they could impose additional restrictions on domestic sources.

Firm-to-Firm Transactions

Trades involving entities participating in domestic emissions trading programs in different countries are likely to be much more common.[8] Since the commodity being traded is part of the national "assigned amount", the selling entity must apply to its national government to convert its domestic allowances into a quantity of the country's "assigned amount" for a particular commitment period. Governments that allow international emissions trading will need to create a process for such conversions. The process need not be complex -- allowances could be automatically exchanged for an equal quantity of the country's "assigned amount" provided the source is in compliance.

Upon conversion, the national government notifies the Climate Convention Secretariat of the transfer of ownership. The transfer of ownership is automatically registered unless the national government is not in compliance with its Protocol obligations. The country's "assigned amount" is reduced by the amount of the transfer. The country's "assigned amount" is reduced even though the transfer is to an entity within the country because the expectation is that it will subsequently be transferred to another Party.

A source whose emissions will exceed the allowances it holds for the domestic trading program may wish to purchase allowances from an entity in another country to achieve compliance. Assume that as a result of the excess emissions by this source the country will exceed its national emission limitation commitment. If the foreign allowances are not converted into equivalent quantities of the country's "assigned amount", the national government of the importer will not meet its commitments.

[8] Brokers and other market intermediaries may also buy and sell quantities of the "assigned amounts" of different Parties.

Thus, governments are unlikely to permit foreign allowances to be used for domestic compliance purposes unless they are valid portions of the "assigned amount" of the exporting country. Governments may impose other requirements on the use of foreign "assigned amounts" for domestic compliance purposes. For example, a source using foreign "assigned amounts" may be required to have insurance coverage in case the selling entity or Party does not comply with its commitments.

The purchasing entity buys the agreed quantity of the exporter's "assigned amount" from the seller. Both parties register the transfer of ownership with the Climate Convention Secretariat. This change of ownership should be automatic since the selling country has already been deemed to be in compliance upon transfer of this portion of the "assigned amount" to the selling entity.

Finally, the buyer transfers title to its national government when it is used for domestic compliance purposes. Again the Climate Convention Secretariat is notified of the transaction. At that time the "assigned amount" of the importing country for the current commitment period is increased. The importing country may also be required to be in compliance with specific Protocol obligations, such as reporting and payment of levies.

Implications of International Emissions Trading for a Domestic Emissions Trading System

An international emissions trading system for greenhouse gases, as currently proposed, allows national governments almost complete flexibility in the choice of domestic policies to manage greenhouse gas emissions. A country may choose to rely on voluntary and regulatory measures, emissions taxes, emissions trading, or a combination of these policies domestically to meet its commitment.

A domestic emissions trading program would probably not include all of the sources covered by the national commitment, require annual compliance and use different allowances for the following reasons:

- A domestic emissions trading program is unlikely to include all of the sources covered by the national emissions limitation commitment -- some small sources may be excluded for reasons of administrative simplicity and other sources may be too difficult to monitor. Emissions by sources that are not part of the trading program may be regulated by other means.

- Annual compliance for sources in the domestic trading program, even though the international commitment period is five years, helps the government meet its reporting obligations and allows the government to judge whether it is likely to meet

its commitment. Annual compliance is important for effective enforcement in a domestic program where sources may begin operation or cease to exist.

- Using the national "assigned amount" as the allowances in a domestic trading system creates a risk of national non-compliance due to violations of domestic obligations by firms. A firm in financial difficulty, for example, could export the "assigned amount" it owns and not have enough to cover its actual emissions. This could trigger penalties for the country with consequences for other entities.

Access to the international market is important for participants in the domestic trading system to reduce their costs of compliance. Thus, the process of exchanging domestic allowances for portions of the country's "assigned amount" and vice versa should be as simple as possible. Surplus domestic allowances could be automatically exchanged for an equal quantity of the country's "assigned amount" for export provided the source is in compliance. And imported "assigned amounts" could be automatically converted to an equal quantity of domestic allowances once evidence of insurance coverage to ensure that they are valid is provided.

Each country can have a different domestic trading program without affecting the international trading system. The only requirements are that the domestic program apply to a subset of the gases/sources covered by the national commitment and that allowances be converted to and from "assigned amounts" denominated in CO_2 equivalent tonnes using the procedures established by the Protocol.

Joint Implementation between Parties with National Emissions Limitation Commitments

Limiting joint implementation initially to Parties *with* commitments raises the issue of how it differs from international emissions trading. A successful joint implementation project reduces emissions in the host country and so leaves that Party with more surplus "assigned amount". The only "emission reduction units" that are useful to the investors are portions of the host country's "assigned amount". Thus, the investors will expect to receive some of the host country's surplus "assigned amount". A transfer of some of the host country's "assigned amount" is emissions trading.

An Annex I Party with an emissions limitation commitment will have domestic policies to meet this commitment. These policies could limit the scope for joint implementation projects. The joint implementation project must address gases/sources within the commitment, but which are not covered by a domestic emissions trading system or emissions taxes. If a source covered by a domestic emissions trading system implements a project to reduce emissions it has more surplus allowances to sell (or fewer to buy to achieve compliance). Providing joint implementation credits for the same project counts

the same reduction twice. Sources covered by regulations could implement joint implementation projects provided emissions were reduced below the regulatory requirement.

The emission reduction due to the joint implementation project automatically helps the host country meet its emission limitation commitment because it reduces net emissions in the country. Since the joint implementation project is financed, at least in part, by a foreign investor, how credit for the reduction is shared between the host country and the investor becomes an issue. It is useful to distinguish between a sharing arrangement negotiated between the host and investor entities and the "emission reduction units" the host government agrees can be exported.

In principle, the host and investor entities are free to negotiate any arrangement for sharing the "emission reduction units" created by the joint implementation project. However, the host government may not convert all of the "emission reduction units" owned by the investor entity into an equal quantity of its "assigned amount". In that case, the investor entity will own some "emission reduction units" that can only be used in the host country. This limits the investor's ability to repatriate the investment. Restrictions on the ability to repatriate funds are a risk associated with any foreign direct investment.

Converting the investor entity's joint implementation "emission reduction units" into host country "assigned amounts" could be as straightforward as in the case of a domestic emissions trading system. However, since joint implementation projects measure reductions (sequestration) from an unobservable baseline, the government would probably want to ensure that the reductions are real and additional. If the government fails to ensure that the reductions are real and additional it jeopardizes its ability to meet its own commitments. In practice, then, the estimates of the "emission reduction units" created are likely to be reviewed carefully by the host government and may be reduced (discounted) in the conversion process.

The investor entity and the host country government would report the transfer of the agreed quantity of host country "assigned amount" to the investor entity to the Climate Convention Secretariat. The transfer would be approved provided that the host country was in compliance with its Protocol obligations. The host country's "assigned amount" for the commitment period would be reduced by the amount of the transfer.

The investor entity could then sell the quantity of "assigned amount" obtained to a buyer in any other country with an emission limitation commitment or retain ownership of the commitments to meet obligations at home. The process is the same as for emissions trading -- the owner of the "assigned amounts" transfers title to the national government in return for recognition of compliance with domestic obligations. The "assigned amount" of the importing country for the current commitment period is increased by the amount of the transfer.

Initiatives Related to Emissions Trading for Greenhouse Gases

International Activities

The OECD Annex I Expert Group

The OECD established an Annex I Expert Group to advise member countries on issues related to international greenhouse gas emissions trading. The Annex I Expert Group prepared discussion papers and organized workshops on international greenhouse gas emissions trading. Experts on emissions trading from OECD and non-OECD countries reviewed the papers and participated in the workshops.

The Kyoto Protocol incorporates international emissions trading among countries with emissions limitation commitments, but leaves the details of to be agreed. It is likely that the Annex I Expert Group will continue to work on how best to implement international emissions trading until the rules have been agreed.

UNFCCC Secretariat Methodology Work on Joint Implementation

At its fifth session Subsidiary Body on Scientific and Technological Advice (SBSTA) of the United Nations Framework Convention on Climate Change (UNFCCC) requested the secretariat to develop practical options with regard to methodological issues related to activities implemented jointly. Activities implemented jointly (AIJ) is the pilot phase of joint implementation during which Annex I Parties can not receive credit for emissions reductions achieved by projects.

The Secretariat organized a workshop on the reference case (baseline) in Victoria in May and a workshop on the determination of environmental benefits in Paris in October. A number of other issues remain to be addressed. The Kyoto Protocol, in effect, provides that joint implementation for credit will be implemented through the clean development mechanism beginning in 2000. Since the modalities and procedures for the clean development mechanism remain to be elaborated, the methodology work might be refocused to this end.

The UNCTAD/Earth Council Initiative

The United Nations Conference on Trade and Development (UNCTAD) has sponsored several studies on emissions trading for greenhouse gases beginning in 1992. As an outgrowth of this work UNCTAD and the Earth Council established a Greenhouse Gas Emissions Trading Policy Forum.

The aim of the Policy Forum is to provide timely support to interested governments, corporations, and non-governmental organizations in their efforts to design and

implement an initial-phase international pilot greenhouse gas emissions trading system in accordance with the Kyoto Protocol.

The goal is to launch a pilot market for trading greenhouse gas emission allowances and reduction credits by 2000 thus contributing to early and effective implementation of the Kyoto Protocol. The Policy Forum met in Chicago in June and in Toronto in November. The latter session was devoted to discussing a draft work program aimed at establishing the pilot trading program. The work program is divided into issues related to the:

- Institutional structure -- the regulatory framework for defining the tradable commodity, accounting, monitoring, certification, reporting, non-compliance and enforcement; and

- Market operations -- trading rules, trading instruments, and supporting institutions.

The draft work plan will be revised based on the discussions at the November workshop. Small task forces (2-3 persons each) will be formed in early 1998 to work on specific issues. These task forces will report to the next session of the Policy Forum, which is tentatively scheduled for February in London.

The World Bank's Carbon Investment Fund

The World Bank proposes to establish a Carbon Investment Fund (CIF) to supply high quality offsets at a competitive price and to ensure that suppliers and buyers receive a fair share of the value added. The CIF will invest in carbon emission reduction actions in developing countries and countries with economies in transition. It is expected that many of the actions financed by the CIF would be enhancements to regular World Bank or International Finance Corporation (IFC) projects to reduce the greenhouse gas emissions.

The fund will be similar to a closed-end mutual fund. Private sector and government investors in the CIF would receive greenhouse gas emission reduction credits created through the actions financed by the fund. An independent body would verify the emission reductions achieved and certify that they met the internationally agreed criteria for credits from joint implementation projects. These credits could be used to meet national emission limitation commitments. Risks are reduced by pooling funds to finance a portfolio of projects.

The World Bank's target capitalization for the CIF is $100 million by 2000. The Bank estimates that the market for joint implementation credits could be $1 billion by 2000 and $10 to $60 billion by 2020 depending on the strength and scope of future greenhouse gas emission limitation commitments.

The activities of the CIF in developing countries could complement, or be subsumed by, the clean development mechanism established by the Kyoto Protocol. The CIF could function as planned in Annex I Parties with economies in transition.

The North American Commission for Environmental Cooperation

The Commission for Environmental Cooperation commissioned an "Analysis of the Potential for a Greenhouse Gas Trading System for North America". The study examined the economic and policy context for greenhouse gas emissions trading in Canada, the United States and Mexico; alternative emissions trading program designs on a North American scale; criteria for assessing emissions trading program designs; and institutional considerations affecting the choice of trading program design. The study was completed in May 1997.

A second phase is planned but has not yet been initiated.

American Activity Related to Domestic Greenhouse Gas Emissions Trading

Center for Clean Air Policy

The Center for Clean Air Policy has a project underway to analyse alternative designs for a domestic greenhouse gas emissions trading system in the United States. Representatives of industry, environmental groups, and the federal government participate in the project. However, the report will be the responsibility of the Center, not a collaborative report.

The Center for Clean Air Policy is also planning a project on joint implementation. This could be refocused on the clean development mechanism.

Heinz Center

The Heinz Center is examining alternative designs for incorporating emissions trading into a potential U.S. program to limit emissions of greenhouse gases. The will identify those design and implementation issues that are likely to be most contentious, construct alternative options, and examine the strengths and weaknesses of each alternative. It focuses primarily on the mechanics of a domestic program, but includes international aspects that are relevant to the design of a domestic program.

The study will examine:

- the *initial design* of a domestic program (e.g., whether it is modeled after the SO_2 allowance trading program or its more limited predecessors; if an allowance trading scheme is chosen, who receives or is required to hold permits; and designs for possible hybrids with traditional regulatory approaches);

- the *reach* of the program (e.g., whether and how and how to account for reductions of non carbon greenhouse gases, offsets from carbon sequestration, and reductions outside US borders); and

- the *mechanics* of a domestic trading program (e.g., needed institutional infrastructure for efficient trading and monitoring and enforcement issues).

The study has been underway since the fall of 1997. A series of alternative designs have been formulated for energy-related CO_2 emissions. Selection of three designs for detailed analysis and integration of other sources/gases into the design is currently underway.

Federal Government (EPA and DOE)

Work on design of a domestic greenhouse gas emissions trading program is known to be underway in the Environmental Protection Agency and the Department of Energy. No information on the schedule for the work or the designs being considered is publicly available. Representatives of these agencies are participating in the Center for Clean Air Policy and Heinz Center projects.

NESCAUM GHG Emissions Trading Demonstration Project

The North East States for Coordinated Air Use Management (NESCAUM), a body for coordinating state regulatory activity related to air quality among eight states in the U.S. northeast, is launching a greenhouse gas trading demonstration project. The demonstration project will be launched in late January or early February1998.

The project will have two major components. It will:

- enlist companies to voluntarily undertake a strategic planning process demonstrating how it would comply with a carbon budget while pursuing traditional business objectives (allowance trading).

- Develop case studies of innovative measures to reduce greenhouse gas emissions (credit trading).

The former component would be the first demonstration of a voluntary allowance trading program. The credit trading component will be modelled on the NESCAUM demonstration project for NOx and VOC trading, which ran from 1993 through 1996 and developed the discrete emission reduction form of credit trading. This demonstration project might provide insight into issues surrounding the coexistence of allowance and credit trading.

The demonstration project will include participants from state and federal agencies, the private sector and environmental advocacy organizations. It will be a consensus-based process to clarify key issues involved in the design of a greenhouse gas emissions trading program. The demonstration project is expected to last two years.

Canadian Activity Related to Domestic Greenhouse Gas Emissions Trading

Pilot Emission Reduction Trading (PERT) Project

The Pilot Emission Reduction Trading (PERT) project was launched in 1996 to demonstrate the feasibility of using emissions reduction trading for NOx and VOC emissions in southern Ontario. The project was modelled on the NESCAUM demonstration program. However, the design can accommodate other gases and participants are requested to track changes in emissions of all pollutants as a result of actions under PERT. Ontario Hydro plans to register its recent purchase of CO_2 reductions from Southern California Edison with PERT.

The PERT project involves the creation, trade and proposed use of real, surplus emission reductions created in the ozone seasons since 1994. Rules governing the creation of emission reduction credits have been extensively discussed and largely agreed. The rules are intended to be simple enough to encourage trade while maintaining environmental integrity. A number of credit creation actions have been reviewed. The project does not formally approve credit creation or use actions; this authority remains with the provincial Ministry of the Environment.

Although the focus of activity is southern Ontario, the first US-Canada NOx trade took place within the project (Detroit Edison, Clean Air Action Corporation, and Ontario Hydro - August 1996). A stationary-source/mobile-source trade, where 140 high-emitting motor vehicles were permanently retired (ProtectAir and Ontario Hydro) also occurred within PERT. A number of other innovative emission reduction creation actions were also implemented.

The PERT project involves participants from governments, industry and environmental and public health groups in both the Executive Committee and the Working Group. PERT is negotiating a letter of understanding with the provincial Ministry of the Environment that would enable actions under the pilot project to be used to meet future regulatory obligations. This is essential to stimulate trade and use of credits. To-date all credit creation actions and purchases are voluntary commitments.

The PERT project is expected to continue through 1999.

B.C. GHG Pilot Trading Program

In 1996 British Columbia, along with Environment Canada and the Greater Vancouver Regional District, funded a design study for an offsets pilot. The study "Requirements for a Pilot Greenhouse Gas Offsets Program in British Columbia: A Discussion Paper" was released in March 1997.

Since the release of the report, the British Columbia Ministries of Employment and Investment and Environment, Lands and Parks have been working with representatives from the federal government, the GVRD, industry and environmental groups to develop the framework for the pilot. The pilot is expected to be formally launched in January 1998 and to run through 1999.

The objectives of the Greenhouse Gas Emission Reduction Trading Pilot are:

- to assess the environmental and economic benefits of emission reduction trading as a tool to meet GHG reduction objectives;
- to test and evaluate the legal and administrative elements of an emission reduction trading system in support of a possible future emission reduction trading market;
- to maximize the involvement of industry by developing an infrastructure that uses market mechanisms to achieve economic and environmental objectives;
- to encourage the identification and implementation of voluntary emission reduction trades aimed at reducing, avoiding or sequestering GHG emissions; and
- to provide all participants with practical experience in the area of emission reduction trading.

Industry participants agree to bring forward, for review by the pilot Technical Committee, emission reduction projects and trades, which result in emissions reduction, avoidance or sequestration and to share detailed information on these projects and trades.

Participating governments agree to recognize emission reduction trades accepted by the pilot (registered emission reductions or RERs) as early progress towards future greenhouse gas emission compliance requirements. Several other provinces have expressed interest in, and may join, the pilot.

All participants agree to work co-operatively to develop standard measurement, verification and documentation procedures and standard contractual language. For all participants, the pilot will provide experience with emission reduction trading and the opportunity to participate in the development of a GHG emission reduction trading market. The pilot will only consider projects where a trade occurs.

Greenhouse Emissions Management Consortium (GEMCo)

GEMCo is a consortium of Canadian energy companies formed to establish industrial leadership in, and solutions to, the issue of managing greenhouse gas emissions. Its current members include: BC Hydro, Canadian Utilities Ltd., EPCOR, NOVA Corporation of Alberta, Nova Scotia Power, Ontario Hydro, SaskPower, TransAlta Corporation, and Westcoast Energy Inc. GEMCo was created in 1995.

On December 10, 1997 GEMCo and Northeast Utilities System (NUL) of Connecticut signed a Memorandum of Understanding in which it was agreed that GEMCo members will purchase a ten year stream of GHG emission reductions, starting in 1998, that will be created by the construction of a commercial greenhouse which will derive most of its heat and electricity and all of its CO_2 (to enhance plant growth) requirements from an IFC fuel

cell. The fuel cell is fueled by methane recovered from Groton's recently closed landfill. The project will generate up to 13,000 tonnes (carbon equivalent) in carbon reductions annually, but GEMCo will acquire only a portion of the reduction stream. The official seller of the emission reduction credits is a new corporate entity which is a commercial partnership of NUL, the US EPA, and the Town of Groton.

The landfill gas recovery and stationary fuel cell systems have been operating on a test basis for a little under a year. Integration of the commercial greenhouse with the landfill/fuel cell changes the project from being "commercially not viable" to one that is expected to generate a modest economic return. In the absence of the addition of the commercial greenhouse operation, the methane recovery and fuel cell electricity generation activities would have been terminated early in 1998.

Most of the emissions reduction credits relate to the conversion--by the fuel cell--of landfill methane, which would otherwise be released freely to the atmosphere to electricity, heat and waste CO_2. . The greenhouse will use all of the electricity and heat produced by the fuel cell, as well as the fuel cell's waste CO_2. Commercial greenhouses typically purchase bottled CO_2 to enrich interior air to enhance plant growth rates. The five-acre commercial greenhouse will produce tomatoes for New England, a market which currently imports all of its tomatoes.

GEMCo members are expected to purchase additional greenhouse gas emissions reduction credits in 1998, possibly as part of the B.C. GHG Pilot Trading Program.

Ontario Hydro-Southern California Edison Trade

On December 9 Ontario Hydro announced that it had purchased 10,000 tons of CO_2 credits from Southern California Edison for $30,000 (US). The trade is the first in a modest portfolio of trades Ontario Hydro plans next year to help meet its voluntary commitment to stabilize CO_2 emissions at 1990 levels by 2000. Southern California Edison created the credits by improving the efficiency of its Mohave Power Plant.

Ontario Hydro will need to offset about 4 million tons of CO_2 emissions in 2000 to meet its commitment. Most of the reductions Ontario Hydro needs to meet this commitment will come from within its own operations. Increased use of fossil fuel during the shutdown of several nuclear units has increased Ontario Hydro's projected CO_2 emissions, requiring it to look for additional reductions and offsets. The timing of the trade was intended to encourage negotiators to include emissions trading in the Kyoto Protocol.

Federal Greenhouse Gas Emissions Trading Working Group

The federal government has established an interdepartmental Working Group on GHG Trading to study the options for greenhouse gas emissions trading to meet Canada's commitments under the Kyoto Protocol. The Working Group is led by Finance and Natural Resources and also includes representatives from Environment, Industry, and

Transport. The Working Group is reviewing the literature on emissions trading, American experience with emissions trading, different types of emissions trading that could be applied to greenhouse gases, and the legislative requirements for implementation of emissions trading for greenhouse gases in Canada.

Members of the Working Group have very different knowledge levels relative to emissions trading, so the initial tasks are designed to provide them with a common, comprehensive knowledge base. The Working Group was established in November 1997 and has no schedule for completing its work.

National Air Issues Coordinating Committee Study

A study of the implications for Canada of international emissions trading for greenhouse gases was commissioned for the Climate Change Working Group of the National Air Issues Coordinating Committee. The study was completed in October 1997 but has not yet been released to the public.

Alberta Offset Policy Development Workshop

The Canadian Energy Research Institute is organizing an *Alberta Offset Policy Development Workshop* to be held in Calgary on February 2-3, 1998. The workshop is intended to clarify the opportunities and risks associated with crediting greenhouse gas offset measures in Alberta. It is intended that the workshop will have an important bearing on the overall strategy to reduce Alberta's greenhouse gas emissions. The workshop, for example, could generate stakeholder support for Alberta participation in the B.C. GHG Pilot Trading Program.

Alternative Approaches the Economic Instruments Committee could Pursue

Canada has no experience with emissions trading other than the PERT Pilot project. Despite this Canada appears to be the world leader in experimenting with greenhouse gas emissions trading. The B.C. GHG Pilot Trading Program and the PERT project will provide experience with credit trading. Governments, industries and environmental organizations are involved in both pilot programs. The only other pilot program currently contemplated is the NESCAUM Demonstration Project.

The recent trades involving Ontario Hydro and GEMCo are the second and third greenhouse gas trades announced and are both international in scope.[9] More trades are contemplated in 1998 both by Ontario Hydro and by other GEMCo members. Thus, emissions trading is beginning even before the regulatory programs have been designed.

Virtually no work has been done in Canada on the detailed design of an emissions trading system for managing greenhouse gases. Managing the range of gases/sources covered by the Kyoto Protocol will probably require a mix of regulatory policies, including emissions trading. As noted earlier, different gases/sources are better suited to particular emissions trading program designs.

Canada can not simply adopt a trading program designed in the U.S. because the mix of sources is different and the regulatory jurisdictions differ. Thus, Canada will need to design an emissions trading system suited to Canadian circumstances. And this trading system will be only part of the regulatory structure needed to manage the gases/sources covered by the Kyoto Protocol commitment.

The National Round Table on the Environment and the Economy provides a forum where stakeholders can discuss issues related to the environment and the economy. Efficient regulatory policies for meeting Canada's greenhouse gas commitment, such as emissions trading, match this mandate very well.

Among the approaches the Economic Instruments Committee could pursue are:

1. Prepare a State of the Debate report. The Round Table has produced a number of these reports. A State of the Debate report can be prepared relatively quickly at modest cost and does not require stakeholder consensus. A State of the Debate report would not be able to discuss alternative designs in any detail because the number of options becomes too large. Thus, a State of the Debate report would be a rather general report on emissions trading and would probably serve primarily a public information function.

[9] The first trade involved the transfer of SO_2 allowances from Niagara Mohawk to Arizona Public service in return for CO_2 reductions.

2. Organize a collaborative to design a domestic emissions trading program for greenhouse gases. This could be seen as a follow-up to the 1993 Economic Instruments Collaborative, which dealt with SOx, NOx and greenhouse gases. This requires consensus among participating stakeholders, which may not be possible to achieve. A collaborative involves more work and is likely to take longer than a State of the Debate report. If consensus is achieved, (perhaps even without consensus) the result is likely to be more useful for policy makers than a State of the Debate report.

3. Undertake a study to design a domestic emissions trading program for greenhouse gases with stakeholder participation. However, the result is a Round Table report that is not endorsed by the participating stakeholders. This is the approach being used by the Center for Clean Air Policy and the Heinz Center.[10] This involves the same scale of effort as a collaborative, but there is no requirement for consensus. Stakeholders can contribute to the study and learn about the issues in the process, but do not need to support the results. The Round Table would, of course, be responsible for the results. The result is likely to be more useful for policy makers than as a tool for public education.

4. Form a group of organizations to undertake a study to design a domestic emissions trading program for greenhouse gases with stakeholder participation. This is the same as option 3 except that the work is sponsored jointly by several organizations including the Round Table. Other organizations that might be interested in such a project might include the Canadian Energy Research Institute, the Canadian Global Change Program, and the Conference Board of Canada.

The above options are not all mutually exclusive. A State of the Debate report could be an early product of either option 3 or 4, for example.

[10] These projects are scheduled to run for one to two years and appear to have budgets on the order of $200,000 to $500,000 (US).

Appendix A

Emissions Trading System Designs

Emissions Trading System Designs

Credit Trading

In a credit trading system a source can create "credits" by documenting emission reductions achieved.[11] The credits can be sold to other sources to use for regulatory compliance under specified conditions. Credit creation and use are voluntary. Sources may choose to buy credits if they are less costly than alternative compliance options.

A credit trading system supplements voluntary or regulatory policies. A package of voluntary and regulatory policies and measures would be implemented to meet the national emissions limitation commitment. If credit trading is allowed, some sources reduce their emissions below the level required by the applicable voluntary and regulatory policies and measures. Other sources buy credits to achieve compliance with the voluntary or regulatory policies and measures under specified conditions.

The two key issues that need to be addressed in the design of a credit trading system are:

- Ensuring that the credits represent real reductions from the emission levels that would otherwise prevail; and

- Determining the conditions under which sources can use credits for regulatory compliance.

Credit Creation

Credits must represent real reductions from the emission levels that would otherwise prevail under the applicable voluntary and regulatory policies and measures. Trading programs establish criteria that credits must meet. Typically, credits must be real, quantifiable and surplus to all regulatory requirements.[12] Operational interpretation of these criteria ultimately resides with the regulatory authority when it decides which credits to accept or reject for compliance purposes.

In some cases the voluntary and regulatory policies define the emission levels that would prevail in the absence of the actions to create credits. For example, if the applicable policies and measures limit emissions by a source to a maximum of a specified level after

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[11] Credit trading is similar to joint implementation for credit and "open market trading" as proposed by the U.S. Environmental Protection Agency.

[12] The U.S. Environmental Protection Agency's criteria for creation of emission reduction credits, which are measured in tonnes per year, are that they be: real, surplus, quantifiable, enforceable and permanent. For credits measured in tonnes, rather than tonnes per year, the last two criteria are not necessary if the credits are created after the reductions have been achieved.

a given date and current emissions exceed this maximum, then this regulated limit might be used as an estimate of the future emissions in the absence of credit creation actions.

Documenting the emissions reduced or sequestered by joint implementation projects is the same as creating credits. A baseline must be defined, specific emission reduction (or sequestration) actions implemented, and the results documented. The current pilot phase of activities implemented jointly is intended to help Parties better understand issues, such as baselines, monitoring, verification, additionality and leakage due to shifting activities, that affect the reductions actually achieved by joint implementation projects. During the pilot phase, participants can not receive credit for the emission reductions achieved by joint implementation projects.[13]

Actions registered with the Voluntary Challenge and Registry (VCR) also represent emission reductions relative to a baseline. But participants do not need to demonstrate that the reductions are real, quantifiable and surplus to regulatory requirements to register them with the Voluntary Challenge and Registry.[14]

Credit Use

The conditions under which sources can use credits for regulatory compliance must also be determined. The ability to use credits for compliance with voluntary or regulatory policies and measures is what gives credits value.

Current programs do not provide an incentive to buy credits.[15] The principal domestic initiative, the Voluntary Challenge and Registry (VCR), is voluntary, and regulatory measures, such as energy efficiency standards, do not allow the use of credits for compliance. Canadian entities that invest in domestic emission reduction or sequestration projects or in joint implementation projects can register the reductions with the VCR.

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[13] Since investors can not receive credit for the emissions reductions achieved, the incentive to invest is weak. Joint implementation projects provide opportunities to enter new markets and to enhance a company's public image. However, many of the projects can be undertaken at lower cost simply by not seeking joint implementation status. See John Palmisano, *Establishing a Market in Emissions Credits: A Business Perspective*, The Institute for Economic Affairs, London, July 1996, pages 34, 63 and 66 for a discussion of the reasons for the tepid business interest in Joint Implementation. See also ECON, *Domestic Climate Regimes and Incentives for Private Sector Involvement in JI*, report 15/97, Oslo, August 1997.

[14] At present there are no regulations that govern emissions of greenhouse gases directly, but many regulations, such as those relating to energy efficiency, affect emissions of greenhouse gases indirectly. Creation of credits could be affected by those regulations.

[15] The Pilot Emission Reduction Trading (PERT) program in southern Ontario and the B.C. Pilot Greenhouse Gas trading program feature agreements with the respective provincial governments to recognize credit creation actions or credit purchases during the pilot program toward future voluntary or regulatory commitments.

Uses embodied in American credit trading programs for emissions other than greenhouse gases include:

- Requiring new sources locating in non-attainment areas, whose emissions exceed a specified threshold, to purchase credits created by other sources in the area at least equal to their allowed emissions.[16]

- Allowing expanding sources to use credits to offset some of the increased emissions and so qualify for a simpler, less-costly regulatory approval process.

- Requiring sources to purchase credits as part of the penalty for violating emissions regulations or as a condition for receiving a variance from environmental regulations.

To implement credit trading as part of Canada's strategy to meet its national emissions limitation commitment, the voluntary and regulatory policies and measures must allow credits that meet defined criteria to be used for compliance where appropriate. Otherwise there is no incentive to buy credits. Since greenhouse gas emissions cause no local health or environmental damage, sources might be permitted to use credits for compliance with a wide range of voluntary or regulatory policies and measures over a wide geographic area.

Applicable regulations might require retrofit installation of equipment that meets particular energy-efficiency standards by a specified date. Installing the new equipment several years later may be preferable for a given source due to renovation plans for its facility. Purchase of credits equivalent to the extra emissions for the intervening years may be a less costly compliance option. This is but one example of a potential use of credits.

Transactions Costs

Each credit creation action is unique and must be assessed relative to the established criteria. Thus, credit trading involves relatively high transactions costs per unit traded compared with programs which deal in homogeneous, government-issued allowances. On the other hand, the volume of trades is typically higher for an allowance program than for a credit program. In a credit trading program sources may choose to comply with the applicable regulations rather than buy credits. But the only compliance option available

[16] Under the U.S. Clean Air Act a non-attainment area is a region that exceeds the established ambient air quality standard for one of the specified criteria air pollutants -- ozone, CO, PM_{10}, SO_x, NO_x and lead. To ensure that a new source locating in a non-attainment area does not make the ambient air quality worse, it is required to purchase offsets at least equal to its authorized emissions from existing sources that have reduced their emissions beyond their regulatory requirements. Although offsets are measured in terms of tons per year for an indefinite period, rather than tons, the principle is the same.

in an allowance trading program is to hold allowances equal to actual emissions. Which type of trading program has the highest total transactions cost is not clear.

Estimating total transactions costs for a credit trading program is complex because it is part of a larger regulatory structure. The administrative costs associated with the regulations can be attributed to the trading program or to the regulations. Compliance may, for example, require changes to an operating permit. If compliance is achieved through purchase of credits, is the cost of the permit change part of the transaction cost for the trade or simply part of the administrative cost of the regulations? In short, trying to separate the transactions costs for credit trading from those of the underlying regulatory system is not very meaningful.

Several approaches to reducing the (unit) transactions costs for credit trading, such as consortia and investment pools, are being tested.[17] These institutions become skilled at dealing with the complexities of emission reduction and sequestration projects. They also have access to a larger pool of capital and so spread the administrative burden over a larger base. Firms that invest in these institutions also reduce the risks associated with poor performance or failure of a single project by investing in a variety of projects.

Advantages of Credit Trading

The principal advantage of credit trading is that it improves the economic efficiency of regulatory policies and so lowers the cost of meeting the environmental objectives.

It is impossible for the large number of voluntary and regulatory policies and measures to lead to the same marginal cost of control for the millions of sources affected. Credit trading helps equalize marginal control costs. Sources with relatively low control costs reduce their emissions more than required to create credits. Sources with relatively high control costs purchase credits to achieve compliance rather than implement high cost controls.

Disadvantages of Credit Trading

The principal disadvantages of credit trading are that:

- Total emissions are not controlled very accurately. While this is sometimes alleged to be a disadvantage of credit trading program, it is really a function of the regulations. The trading program simply enables the regulatory requirements to be met at lower total cost.

[17] The investment funds established by the electric utility industry in the U.S. and the offset projects that the Greenhouse Emissions Management Consortium (GEMCo) plans to initiate are examples of approaches to reduce the administrative costs associated with credit creation. If an active market for credits existed, these institutions could distribute credits equal to the carbon reduced or sequestered each year to their investors to sell or use for regulatory compliance.

- Unit transactions costs are relatively high.

In summary, credit trading supplements a set of voluntary and regulatory policies and measures. Total emissions are determined by the voluntary and regulatory policies and measures, not by the trading program. Credit trading enables the emissions limitation commitment to be met at lower total cost than by relying on voluntary and regulatory policies and measures alone.

Substance Trading

An allowance trading system can be implemented for substances, such as HFCs, the carbon content of fossil fuels and the nitrogen content of fertilizers, that are ultimately emitted as greenhouse gases.[18] An annual cap on the total quantity of the substance consumed (production + imports - exports) in the country is established. All producers, importers and exporters of the substance, and products containing the substance, are required to participate in the trading system.

For example, fossil fuel producers and importers would be allocated allowances by the regulatory authority.[19] And they would be required to provide the regulator with allowances equal to the carbon content of the coal, oil, synthetic crude, natural gas and refined petroleum products they produce or import. Exporters would receive permits equal to the carbon content of the fossil fuels exported.

For administrative reasons it might be difficult to achieve the emissions target each year. Allowances would be allocated to fossil fuel producers and importers at the beginning of the year, but the allowances credited to exporters would not be known exactly until after the end of the year. Thus, the carbon content of the fossil fuels consumed (the energy-related CO2 emissions) during the year would not be known until after the end of the year. However, the difference between target and actual carbon content is likely to be relatively small and appropriate adjustments can be made the following year.[20]

In general, it is important to implement an emissions cap as close as possible to the point at which emissions occur, to provide the widest possible range of mitigation options. The

[18] This is analogous to the trading systems for lead in gasoline and for production and consumption of ozone-depleting substances that operated successfully in the U.S.

[19] Allowances can be auctioned or allocated *gratis* according to any number of different formulae. It is assumed here that they are allocated *gratis*. The specific formula for allocating the permits does not affect the design of the program. Exporters would receive permits equal to the carbon content of the fuels actually exported and so are unaffected by the allocation rule. If petrochemical producers are awarded permits equal to the carbon content of fossil fuel used as feedstock they would also be unaffected by the allocation rule.

[20] Historic data suggest that the carbon content of fossil fuel consumption in Canada rarely varies by more than 3% from one year to the next. If the actual carbon content in a particular year exceeded the target, the target for the following year could be reduced by the amount of the surplus and vice versa.

CO_2 emissions from combustion of fossil fuel are very closely related to the carbon content of the fuel. With few exceptions, technologies to remove CO_2 from emissions streams and to store it permanently are not economic at present.[21] So a fossil fuel carbon content trading system covers virtually all of the energy-related CO_2 emissions and does not exclude any currently viable compliance strategies. The same is true for HFCs and the N_2O emissions due to fertilizer use.

A substance trading program is essentially a quota on consumption of the regulated substance.[22] While fertilizers vary in terms of their nitrogen content, a trading program for nitrogen used in fertilizers would limit the total amount of nitrogen available for this purpose. Similarly, a limit on total fossil-fuel carbon content would encourage a shift to less carbon-intensive fuels, but ultimately limit the use of fossil fuels. Incorporating other sources and sinks, domestic or international, into the trading system helps loosen the restriction on the regulated substances.

The main effect of a substance trading system is to change the prices of products containing the substance. Price increases for fertilizers due to a nitrogen content trading system induce farmers to change their patterns of fertilizer use. Similarly, price increases for fossil fuels due to a carbon content trading system induce customers to switch to less carbon-intensive fuels and to implement energy conservation measures. And price increases for HFCs induce a shift to substitutes.

A Fossil Fuel Carbon Content Trading Program

A fossil fuel carbon content trading program involving producers, importers and exporters provides essentially complete coverage of energy-related CO_2 emissions. In Canada, a fossil fuel carbon content trading program would involve 350 to 750 firms.[23] To cover as large a share of total energy-related CO_2 emissions as possible, it is important to implement the program as close as possible to the wellhead and mine mouth.

The carbon content of fossil fuel produced, imported or exported can be calculated reasonably accurately by multiplying the quantity of fuel by an appropriate emissions coefficient. The federal and provincial governments currently have relatively good systems in place to monitor fossil fuel production, imports and exports for regulatory and fiscal purposes such as royalties and taxes. Quantities of oil and natural gas can also be obtained from pipeline records. However, the existing systems would need to be expanded to cover oil and gas imports and coal exports.

At the provincial level a fossil fuel carbon content trading program that involved the natural gas distribution utilities, petroleum product distributors, and large industries and

[21] In cases where CO_2 is recovered from an emissions stream and is permanently sequestered, the source could credited with allowances equal to the carbon sequestered in the same way as exporters of fossil fuel.

electric utilities that use coal would cover most of the energy-related CO_2 emissions. Provinces with oil and natural gas production might implement the trading system at the well head so that the upstream emissions are covered as well.

Treatment of energy-intensive industries needs to be resolved. Fossil fuel prices rise downstream of the fuel producers and importers. Large price increases could have adverse impacts on energy-intensive industries, particularly if competing firms in other countries are not faced with similar cost increases. A simple way to deal with this problem is to award energy-intensive firms allowances equal to a fraction of the carbon content of the fossil fuel they use. They can then sell these allowances to fuel producers and importers to recover some of the price premium.

Some analysts criticize fossil fuel carbon content trading for its reliance on price signals to achieve the emissions reductions. They argue that this is inefficient given the market barriers and imperfect information that inhibit adoption of energy-efficient technologies.[24] Higher gasoline prices, for example, have only a limited effect on the fuel efficiency of new vehicles purchases. Adopting energy efficiency standards, initiatives to encourage development and adoption of more energy-efficient buildings, equipment, appliances and vehicles, and measures to stimulate development of non-fossil energy sources would help address this concern.

Advantages of Substance Trading

The principal advantages of a substance trading system are that:

- Transactions costs are low since homogeneous, government-issued allowances are traded.

- Total greenhouse gas emissions due to use of the substance by specified sources can be controlled relatively precisely.

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[22] Any initiative to limit greenhouse gas emissions will limit consumption of substances responsible for such emissions. In a substance trading program, the cap makes that limit more precise than for most other policies and measures. But allowing participants to use allowances from other domestic trading programs, credits created by regulated sources, and imported "assigned amounts" to achieve compliance makes the limit on actual use of the substance much more flexible.

[23] There are approximately 20 licensed natural gas exporters, 20 licensed natural gas importers, about 100 firms with oil export orders, nine coal producers and 25 coal importers, and 190 companies (excluding subsidiaries) active oil and natural gas exploration and production in Canada. Statistics Canada reports approximately 30 establishments in the coal industry and about 670 establishments in the oil and natural gas industry.

[24] See, for example, Joel N. Swisher, "Regulatory and Mixed Policy Options for Reducing Energy Use and Carbon Emissions," *Mitigation and Adaptation Strategies for Global Change*, vol. 1, 1996.

In the specific case of a fossil fuel carbon content trading program:

- Virtually all energy-related CO_2 emissions can be covered by a trading program that involves a relatively small number of participants.

- A good foundation for the administrative system needed to monitor the carbon content of fossil fuel production, imports and exports already exists.

- Administrative costs are likely to be low since additional monitoring equipment is probably not needed and compliance verification can be shared with energy regulatory and taxation agencies.

- Reasonably good historic information on production, imports and exports is available as input to allocation rule calculations.

Disadvantages of Substance Trading

The principal disadvantages of a substance trading system are:

- The potential adverse reaction to the price increases for products, such as gasoline, containing or made with the substance.

- The inefficiency of relying on price signals to reduce induce consumers to reduce their demand for products containing or made with the substance and so reduce the associated greenhouse gas emissions.

- The difficulty of negotiating an allocation of allowances.

Emissions Rights Trading

An emissions rights trading system limits aggregate emissions of a greenhouse gas by specified sources at the point of release to the atmosphere.[25] An annual cap on specified greenhouse gas emissions by the regulated sources is established. Allowances equal to the annual cap are allocated to participating sources.[26] Each source is required to monitor its actual emissions and to remit allowances equal to its actual emissions to the regulator.

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[25] This is analogous to the SO_2 allowance trading system in the U.S. except that it would include a wider range of sources.

[26] Although allowances could be auctioned, it is assumed here that they are allocated *gratis*.

Due to the cost of monitoring actual emissions, participation probably would be limited to utilities and large industrial sources.

Limiting the program to sources large enough to bear the cost of monitoring actual greenhouse gas emissions may not pose a problem for gases/sources such as CO_2 from cement or lime manufacturing or N_2O from adipic acid production. However, a program for energy-related CO_2 emissions limited to utilities and large industrial sources would miss a significant fraction of the total emissions.

In Canada approximately 300 electric utilities and industrial firms (representing a much larger number of plants) classified by Statistics Canada as "large industrial energy users," account for at least 40% of national emissions.[27] Thus, an energy-related CO_2 emissions trading program for large sources would need to be complemented by policies to address energy-related CO_2 emissions from transportation, commercial, residential and small industrial sources. Assuming these other sources are governed by regulations, they may be able to create credits for sale to firms participating in the trading program.[28] Firms in the emissions rights trading program could also use imported "assigned amounts" for compliance purposes.

The participants in the program must be defined. It is relatively simple to identify the electric utility and large industrial sources that should participate in the program when it is launched. However, criteria must be established so comparable new sources, such as sources with annual emissions above a threshold level, are also required to participate in the trading program. New sources could design their facilities so that they do not qualify for the trading program, for example, by building several small plants rather than one large plant.[29]

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[27] See Merete Heggelund, *Emissions Permit Trading: A Policy Tool to Reduce the Atmospheric Concentration of Greenhouse Gases*, Study 36, Canadian Energy Research Institute, Calgary, January 1991, p. 79.

[28] Energy-related CO_2 emissions from these sources could be managed through regulations (such as energy efficiency standards for buildings and equipment), taxes (such as a carbon tax on transportation fuels) or other measures (such as road pricing). These emissions could also be managed using other trading programs. For example, the transportation sector could be included by making automobile manufacturers responsible for the emissions of the vehicles they sell or making the oil companies responsible for the carbon content of the fuels they sell. Similarly, energy distributors could be made responsible for the carbon content of fuels sold to the residential, commercial and small industrial sectors.

[29] The strength of the incentive to design new facilities to avoid participation in the trading program depends on the allocation rule (whether allowances are allocated *gratis* to new sources), allowance prices (assuming that a new source would need to buy at least some allowances) and the cost of compliance with the regulations governing small industrial sources.

Existing sources may restructure their operations to facilitate compliance, for example, by purchasing components from small companies not covered by the trading program or from companies in countries without emission limitation commitments.[30] Since a trading program for greenhouse gases could remain in place for many decades it is prudent for businesses to evaluate such strategies.

Under a trading program that includes energy-related CO_2 emissions, industrial sources could shift part of their compliance burden to the utilities.[31] Switching from fossil fuels to electricity makes the electric utility responsible for the emissions. Increases in the price of electricity due to the cost of complying with the emissions trading program would tend to inhibit such shifts. Electric utilities may welcome the added sales despite the added compliance burden, so it may not be a concern. On the other hand, some utilities may be uneasy about such shifts because they could affect their competitiveness as the electricity industry restructures.

The administrative structure needed to implement an emissions rights trading program for electric utility and large industrial sources would need to be established. Many industrial sources are required to monitor their emissions of various pollutants. But they are not required to report their greenhouse gas emissions and it is not clear whether these emissions could be monitored with sufficient accuracy using the existing equipment.[32]

Advantages of Emissions Rights Trading

The principal advantages of an emissions rights trading system for large sources are that:

- Transactions costs are likely to be low since homogeneous government-issued allowances are being traded.

- A significant fraction of total greenhouse gas emissions from some sources can be covered with relatively small number of participants.[33]

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[30] This effect is known as "leakage". Leakage is common to any agreement that involves emission reduction actions by some countries and less stringent action by other countries; it is not a problem that is unique to trading programs.

[31] Assuming that residential, commercial and small industrial sources are subject to voluntary or regulatory policies and measures, they could also shift some of their compliance burden to electric utilities by switching to electric technologies.

[32] If the only greenhouse gas emissions by a given source is due to combustion of fossil fuels, the emissions could be calculated from fuel use.

[33] Energy-related CO_2 emissions are an exception, an emissions rights trading system involving large sources would cover 40% to 60% of total emissions while a substance trading program for the carbon content of fossil fuels would cover virtually all of these emissions with roughly the same number of

Disadvantages of Emissions Rights Trading

The principal disadvantages of an emissions rights trading program for large sources are:

- The potential to shift emissions to small sources outside the trading program by purchasing components and designing new facilities so that they do not qualify for the program.

- The difficulty of negotiating an allocation of allowances.

In the case of energy-related CO_2 emissions, the regulatory structure is more complex than with a fossil fuel carbon content trading program because small sources not covered by the emissions trading program need to be regulated by other means.

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participants.