POSSIBLE DOMESTIC POLICIES TO MANAGE GREENHOUSE GAS EMISSIONS

Economic and Policy Analysis Directorate
Policy Branch

March 2000

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Project leader
John C. Giraldez
Agriculture and Agri-Food Canada
GIRALDJ@em.agr.ca

Author
Erik Haites
Margaree Consultants Inc.
Contract # 01B04-8-C079

March 2000

This report was produced by the Economic and Policy Analysis Directorate, Policy Branch, Agriculture and Agri-Food Canada.

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Information Production and Promotion Unit
Economic and Policy Analysis Directorate (EPAD)
Policy Branch
Agriculture and Agri-Food Canada
Building 74, C.E.F.
Ottawa, Ontario
K1A 0C6
Tel: (613) 759-1865
Fax: (613) 759-7090
E-mail: ipp@em.agr.ca

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Publication # 2034/E

ISBN # 0-662-28734-7

Catalogue # A22-204/2000E

Project # 99056wp

Aussi disponible en français sous le titre de :
Politiques nationales possibles de gestion des émissions de gaz à effet de serre

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Foreword

This study was commissioned by Agriculture and Agri-Food Canada to assess, qualitatively, the relevance and potential impact of an international tradable permit system, the Clean Development Mechanism and Joint Implementation in the likely event that the Canadian agriculture and agri-food sector has to reduce greenhouse gas emissions. This study resulted in two reports: *"The Relevance and Potential Impact of Kyoto Protocol Mechanisms for the Canadian Agriculture and Agri-Food Sector" and "Possible Domestic Policies to Manage Greenhouse Gas Emissions."*

The Kyoto Protocol, if ratified by the Canadian Government, would require Canada to reduce its greenhouse gas emissions by 2008–2012, affecting almost every industry and consumer. With emission levels in agriculture increasing since 1990, the sector may be required to reduce its emissions as part the national strategy that is being developed. The sector would be affected by abatement costs to reduce its own emissions and by higher input and transportation costs as other sectors deal with their emissions. Regardless of future policy actions, the agriculture and agri-food sector will be affected by climate change since it is dependent on the weather which is expected to change as the concentration of greenhouse gas increases in the atmosphere.

The Kyoto Protocol has mechanisms to assist countries in achieving emission reductions. One mechanism allows for the development of international trading in greenhouse gas emission permits among Annex I (mainly industrialized) countries. Investment in emission reduction projects in other countries in return for a share of tradeable emission credits through the Clean Development Mechanism or Joint Implementation would also be permitted. These three Kyoto Protocol Mechanisms are meant to assist countries in achieving compliance with their quantified emission reduction commitments at the least cost while achieving sustainable development and contributing to the ultimate objective of the UN Framework Convention on Climate Change. Theoretically, an emission trading system would result in the adoption of least-cost abatement practices among industries and countries. Developing least-cost policy instruments to reduce greenhouse gas emissions is important as the efficiency of the policy instruments would affect the environmental standards that society is willing to accept. To date we only have limited experience with economic instruments such as tradeable permits to reduce emissions or other sources of pollution.

The debate on the use of economic instruments to reduce greenhouse gas emissions has been going on for well over a decade, largely out of public sight in highly technical international forums or within the fossil fuel and the energy sectors. With the signing of the Kyoto Protocol, this debate must now involve the public. These two reports are intended to familiarize stakeholders in the agriculture and agri-food sector, as well as other interested parties, with the concepts, issues and terms surrounding the use of economic instruments (such as tradeable permits) to reduce greenhouse gas emissions in Canada and around the world.

John C. Giraldez
Policy Branch, AAFC

Section 1: Introduction

To meet their national greenhouse gas emission commitment under the Kyoto Protocol, governments need to implement domestic policies to limit or to reduce emission by various sources. The ability of a specific source to use the Kyoto Protocol mechanisms depends upon the domestic policy adopted to limit its emissions.

Domestic policies for managing greenhouse gas emission by individual sources are grouped into four categories and described in the next four sections:

- domestic emissions trading
- emission fee or tax
- regulations
- other policies.

Section 6 examines the potential use of the Kyoto Protocol mechanisms with the different types of domestic policies.

The report concludes with a bibliography and an appendix giving a numerical example of emissions trading.

Section 2: Domestic Emissions Trading

This section[1] introduces emissions trading and classifies different types of trading systems. Emissions trading lowers the cost of achieving a specified environmental objective, such as reducing emissions of a specified pollutant, relative to traditional forms of environmental regulation.[2] Different types of emissions trading have been developed for different circumstances.

In the simplest form of emissions trading, a limit on total emissions of a pollutant by a specified set of sources is established. Allowable emissions within this total are then defined for each source. Each source must limit its actual emissions to its allowable emissions. A source whose actual emissions are below its allowable emissions can sell credits or allowances equal to the difference.[3] A source whose actual emissions are higher than its allowable emissions must buy credits or allowances from other sources to cover its excess emissions.

Participants are not obligated to trade, but they have a financial incentive to trade if it reduces compliance costs. Sources able to control their emissions at low cost can sell surplus credits or allowances at a profit. Sources facing high-cost control options can save money by purchasing credits or allowances from other sources. Trades continue until the set of emission reduction actions that meets the overall limit on emissions 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.[4] In practice the environmental objective and the type of environmental regulation are determined simultaneously.[5] Thus, the objective of an

1. This section is taken from Haites 1998.
2. Other possible objectives of emissions trading programs are to enable a more stringent objective to be achieved because the cost is lower, to enable an environmental objective to be achieved more quickly, or to enable economic growth to occur without adversely affecting the environment.
3. The differences between credits and allowances are discussed later in this section.
4. Conventional regulations require each source to reduce its own emissions to comply with its allowable emissions. This option is also available under a trading program. But with a trading program, sources also have the option to buy or to sell credits or allowances if that is financially advantageous. Thus, emissions trading reduces compliance costs relative to conventional regulations. A numerical example illustrating how cost savings are achieved through emissions trading is provided in Appendix.

emissions trading program may be faster reduction of emissions rather than cost reduction. But the faster reduction of emissions would not be acceptable without the cost savings afforded by the emissions trading program. Thus, the key benefit of a successful emissions trading program is the cost saving relative to other regulatory approaches for achieving the same environmental objective.[6]

The cost savings stem from differences in the cost of emissions control among participants. The larger the differences, the greater are the potential savings. If there is only one way to reduce emissions and it has almost the same cost for every source, emissions trading will not yield any cost savings. To achieve the full potential cost saving, the trading program should allow sources to choose from all available control options.

To work well, emissions trading requires a competitive market, that is a market with a large number of participants, none of which is large enough to influence the price. Economic theory indicates that in a perfectly competitive market, the price of a credit or allowance will equal the cost of the last measure implemented to meet the overall cap (the marginal cost). In practice the price will reflect expected changes to emissions limits, anticipated growth in emissions by regulated sources, changes in the costs or effectiveness of emissions control technologies, and similar factors.

Emissions trading shifts the location and timing of the emissions allowed within the overall limit. A trading program must be designed to ensure that the shifts in the timing and location of emissions are environmentally beneficial or neutral. Greenhouse gases are very well suited to emissions trading because their impact on the global climate is the same, regardless of the date or location of the emissions.[7]

Since allowances are valuable, sources 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 a credit or allowance. To ensure this is the case, the penalty usually consists of a loss of credits or allowances (to protect the environment) plus fines.

The term "emissions trading" is applied to a variety of generic designs, including "credit trading" of documented emissions reductions and "allowance trading" of emissions rights issued by the regulatory authority. Either of these designs can be applied to the actual emissions stream, "emission rights trading,"or to a substance that is ultimately emitted as a pollutant, "substance trading."[8] These designs are discussed briefly in the following sub-sections.

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5. 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.

6. The only emissions trading program whose objective is not cost reduction is the offset requirement for major new and expanding sources in areas that have not attained the national ambient air quality standards in the U.S. The offset requirements in these non-attainment areas are designed to accommodate economic growth without hampering progress toward achievement of the air quality standards.

7. Actions to reduce greenhouse gas emissions often lower emissions of other pollutants, such as nitrogen oxides (NOx), sulphur oxides (SOx), and particulate matter as well. Thus, some reduction actions may yield larger ancillary benefits than others, even though the climate change benefits are identical. As a result, some types of actions or locations for reduction actions may be preferred for the ancillary benefits.

2.1 Credit Trading

In a credit trading system, a baseline of allowable emissions is established for each source.[9] The baseline is typically the lesser of historic or allowable emissions. The allowable emissions are determined by the regulations governing emissions of the pollutant by the given source. The regulations may define an allowable emissions rate (e.g. X kg of emissions per unit of output) or an absolute limit on emissions for a given period (e.g. Y tonnes per year).

A source can create credits by documenting that its actual emissions are below its baseline. Credit creation is voluntary. Credits can be used to meet voluntary commitments or regulatory obligations. Credit use for regulatory compliance requires that the regulations specify the conditions under which this option can be used. A source whose projected emissions are higher than its baseline may choose to buy credits if they are less costly than alternative compliance options and are allowed by the regulations.

Credits should represent real reductions from the emission levels that would otherwise prevail. Such trading programs generally specify criteria that credits must meet; typically that the emission reductions be real, measurable, surplus to regulatory requirements, and additional. To be additional, credits should represent real reductions from the emission levels that would otherwise prevail under the applicable voluntary and regulatory policies and measures.[10] Operational interpretation of the criteria ultimately resides with the regulatory authority when it decides which credits to accept or reject for compliance purposes.

Acceptance of credits for compliance with a regulatory obligation may be subject to various conditions designed to ensure that trading is neutral or beneficial to the environment. Thus, sources may be required to buy credits from upwind sources to ensure that the trade yields local benefits. In addition, seasonal restrictions are common for ozone precursors to ensure that the trade contributes to smog reduction.

Credits are measured in two different ways—as Discrete Emission Reductions or as Emission Reduction Credits:

- Discrete Emission Reductions (DERs) define the emissions reduced as a **quantity** measured in tonnes or kilograms. If the emission reduction action has a relatively short life (less than two years), DERs equal to the emissions reduced would be created after the project was completed. If the emission reduction action has a longer life, DERs are created each year for the emission reductions achieved during the year. Changes in production levels or other factors could cause the number of DERs created by a given action to vary from year to year.

- Emission Reduction Credits (ERCs) define the emissions reduced as a **stream** of pollutant emissions reduced measured in kilograms or tonnes per year. The reduction is assumed to be the same each year over the life of the emission reduction action. ERCs are usually created only by actions with a relatively long life. The reduction must be permanent and enforceable so that the reduction will be achieved every year in the future.[11]

8. Allowance trading systems are also called "cap and trade" programs.

9. The limit on total emissions is simply the sum of the baselines of all sources.

10. Credit trading programs for greenhouse gases may also require that actions which store (sequester) carbon that would otherwise be released to the atmosphere store the carbon for a long time (decades).

The main difference between the two is that DERs represent a specific quantity of emissions reduced while ERCs represent a stream of reduced emissions.[12]

ERCs are used in the U.S. to offset emissions by a major new or expanding source located in an area that has not attained the national ambient air quality standard.[13] The new or expanding source increases emissions by a permitted amount every year for the foreseeable future. To ensure that this new or expanding source does not aggravate the already unacceptable air quality, its increased emissions must be offset by reductions from existing sources in the same area. ERCs represent a stream of emission reductions from an existing source, which can be used to offset a stream of increased emissions by a new or expanding source.

2.2 Allowance Trading

In an allowance trading system, an overall cap on total emissions by a defined set of participants is established. Participation is mandatory for existing and new sources that meet the specified criteria (e.g. electricity generating units with a boiler rated at 25 MW or higher). The regulatory authority creates allowances equal to the overall cap. The allowances are distributed to the participants (or others). Each participant must monitor its actual emissions in the prescribed manner and report them to the regulatory authority. At the end of the year each participant must provide the regulatory authority allowances equal to its actual emissions to achieve compliance.

The method of distributing allowances to participants is one of the most difficult issues to resolve in the design of an allowance trading system. The simplest approach is to sell the allowances at auction. However, every existing trading program distributes the allowances free of charge to participants according to a specified allocation rule.[14] Since the allowances are valuable, devising an allocation rule that is considered fair by all participants is very difficult. Hence, some rules have numerous provisions to cover sources that have successfully argued that they warrant special treatment.

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11. The need to demonstrate permanence has meant that most ERCs have been created through shutdowns, installation of pollution control equipment, or process changes (including fuel switching). The difficulty of scheduling permanent emission reduction actions to match emission increases by new or expanding sources has led many non-attainment areas to allow banking of credits.

12. To illustrate the difference, consider a manufacturing plant that implements control technology to reduce its NOx emissions below the level required by the applicable regulations. Assume that the reduction in emissions is 85 tonnes per year if the plant is operating at normal capacity.

    If the credit trading program uses DERs, the source is required to document the emission reductions achieved each year. Based on actual operations during the year the number of DERs created might be 87 tonnes for year 1, 92 tonnes for year 2, 53 tonnes for year 3, 96 tonnes for year 4, 84 tonnes for year 5, etc. for the life of the control equipment.

    If the credit trading program uses ERCs, the regulator would review the documentation and approve the creation of ERCs. The approved quantity of ERCs might be more or less than 85 tonnes per year depending on past production levels, anticipated changes to the applicable NOx regulations, and other considerations. Assume, however, that the regulator approves ERCs of 85 tonnes per year.

13. In some jurisdictions new and expanding sources are required to purchase ERCs equal to their allowable emissions. In other jurisdictions new and expanding sources may obtain some or all of the ERCs they need, free of charge or at a discount, from ERC reserves or banks established by the municipality, the economic development agency, or the air quality regulator.

Trading is not mandatory. A participant can reduce its actual emissions below the quantity of allowances it receives or buys at auction. But sources have an economic incentive to trade as long as the marginal cost of control differs. In all existing programs, the allowances have been defined as quantities, like DERs.

2.3 Emission Rights Trading

In an emission rights trading system, a credit or allowance trading system is implemented at the point where emission is released to the atmosphere. In other words the credit or allowance represents a right to release a given quantity of a pollutant to the atmosphere. Emission rights trading programs have been implemented in the U.S. for sulphur dioxide (SO_2), nitorgen oxides (NOx), volatile organic compounds (VOCs) and carbon monoxide (CO); on a pilot basis in Ontario for these gases and carbon dioxide (CO_2); and in six other provinces for CO_2. These programs include both credit and allowance trading programs.

2.4 Substance Trading

In a substance trading system, sales (or purchases) of a substance that is ultimately discharged to the atmosphere are controlled rather that the actual emissions. Since the purpose is to limit emissions, substance trading systems are considered to be emissions trading programs. If use of the substance ultimately causes emissions, controlling the quantity of the substance effectively controls emissions of the pollutant.

Where the condition that use of the substance ultimately causes emissions is met, it may be administratively simpler to control sales of the substance rather than emissions at the point of discharge. Substance trading programs have been implemented as both credit and allowance trading programs. The credit or allowance represents the right to produce, import, or sell a given quantity of the substance rather than the right to emit the pollutant.

Substance trading programs have been implemented in the U.S. for lead in leaded gasoline and for ozone-depleting substances, and in Canada for ozone-depleting substances. It is simpler to control the quantity of lead added to gasoline at the refinery than to control lead emissions by vehicles using leaded gasoline. Similarly, it is simpler to control the use of chlorofluorocarbons (CFCs) for use in air conditioners, refrigerators, foams and other applications than to control the CFC emissions from those uses at the point of discharge.

14. It is not necessary to distribute the allowances to the participants, but almost all programs do so. The Canadian trading program for methyl bromide import allowances allocates the allowances to users rather than importers. Users are then free to choose the importer from which to purchase their supplies from. The allowances are transferred to the importer so that the methyl bromide can be imported. This arrangement was adopted to address concern over possible market power by the five methyl bromide importers, some of whom are also users competing with users who are not importers.

Section 3: Emission Fee or Tax

Under an emission fee or tax[15], sources subject to the tax must pay a fee or tax per unit of greenhouse gas emissions. The tax can be imposed on actual emissions or on substances that ultimately lead to greenhouse gas emissions. Thus, a tax on CO_2 emissions from fossil fuels could be imposed on sources that burn fossil fuels and so generate CO_2 emissions or on the carbon content of the fossil fuels. In the latter case the tax could be imposed on fossil fuel producers and importers.

To encourage implementation of the most cost-effective emission reduction measures, the tax should apply to as many sources of greenhouse gas emissions as possible and should vary directly with the CO_2 equivalent emissions generated. Thus the tax rates for emission of different greenhouse gases, such as CO_2, methane (CH_4), and nitrous oxide (N_2O), should reflect their relative impacts on climate change. This can be done by making the tax rate for each gas proportional to its internationally agreed 100-year global warming potential (GWP) values.

An emission tax should be a constant charge per unit of emissions, which means the same tax rate (adjusted for the GWP value of the gas) for all sources and no exemptions.[16] For energy-related CO_2 emissions, an emission tax would apply to the carbon content of the fuel, rather than its energy content or the value of the fuel. Taxes on the energy content or value of fossil fuels will also reduce demand for these fuels and hence reduce emissions. But in terms of achieving an emissions limitation commitment, such taxes are much less efficient than a charge per unit of emissions.[17]

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15. This section is based on material from Haites 1997.
16. Differential tax rates and exemptions are common features of most taxes. For example, the GST does not apply to all goods and services, and provincial governments are exempt. The carbon taxes implemented by European countries have different rates and exemptions for various categories of sources. Thus, they do not lead to implementation of the most cost-effective emission reduction measures.
17. Model simulations for the U.S. economy indicate that an energy tax could be between 20% and 40% more costly, and an *ad valorem* tax two to three times more costly, than a carbon tax for equivalent reductions in emissions. See Jorgenson and Wilcoxen 1992, and Scheraga and Leary 1992.

A uniform emission tax leads to implementation of the lowest cost measures available to the sources subject to the tax. A source minimizes its tax burden by implementing emission reduction measures whose marginal cost per unit of emissions reduced is less than the tax rate. Since all sources face the same tax rate, the marginal cost of control should be the same for all sources. This is the condition that minimizes the total cost of achieving the target emission reduction.

An emission tax is feasible only if it is possible to monitor or to calculate the emissions accurately. The sources subject to the tax have an obvious incentive to under-report their emissions; the lower the emissions they report, the lower their tax bill. The same incentive exists in an emissions trading program, so the monitoring requirements are similar for an emissions tax and an emissions trading system.

If the emissions can be calculated accurately, as in the case of fossil fuel CO_2 emissions, the tax can be based on records of fuel sold or consumed.[18] If actual emissions must be monitored, as in the case of CH_4 emissions from landfills, suitable equipment needs to be installed. Since monitoring equipment is relatively expensive, this expense would limit the tax (or trading system) to large sources.

Some greenhouse gas emissions can be calculated quite accurately. For example, the CO_2 emissions from combustion of fossil fuels can be determined quite accurately from the quantity of the fuel burned and an emission factor specific to the fuel. In these cases, it is possible to rely on administrative records or less costly monitoring equipment, such as fuel meters, to calculate the emissions subject to the tax.

Most fossil fuels are already taxed by one or more governments in Canada, so administrative systems to monitor the quantities of these fuels produced or consumed and to collect the appropriate taxes are already in place. This infrastructure would reduce the administrative requirements of a greenhouse gas emission tax. By relying on emission monitoring equipment for large sources and calculated emissions for smaller sources, it is possible to apply an emission tax to a relatively large share of total greenhouse gas emissions.

In some cases the emission tax would be a tax on a product, such as a tax on hydrofluorocarbons (HFCs), the nitrogen content of fertilizers, or the carbon content of fossil fuels. If the tax constitutes a relatively large share of the product price and other jurisdictions regulate these products with other policies, it could lead to smuggling to avoid the tax. Canada's experience with cigarette and alcohol smuggling and cross-border purchases of gasoline and the U.S. experience with CFCs are examples of such tax evasion.

3.1 Setting the Appropriate Tax Rate

To meet Canada's emissions limitation commitment, the tax rate must be set to achieve a target emission reduction by the affected sources. If the tax rate is too low, emissions by the affected sources will be higher than the target and the national commitment will not be met. If the tax rate is too high, emissions by the affected sources will be below the target and they will have incurred higher costs than necessary to meet the commitment.[19]

18. The calculated emissions, supported by appropriate records and audits, could also be used as the actual emissions for an emissions trading program.

The appropriate tax rate can only be determined by trial and error. The five-year budget period of the Kyoto Protocol may not allow enough time to find the correct tax rate and to have sources implement the emissions control measures corresponding to that rate.[20] To avoid a trial and error search for the appropriate tax rate, implement an emissions trading system for the gases/sources subject to the tax with allowances equal to the overall emissions target for these sources with one of two options:

- an auction of the allowances where the auction replaces the tax.[21]
- free distribution of the allowances, where a tax is imposed equal to the market price on the allowances.[22]

3.2 Revenue Recycling

An emission fee or tax raises revenue.[23] Depending on the emissions target, the amount of revenue raised can be large. The economic impacts of an emission tax depend on how the revenue is used. Five options for the use of emission tax revenue, each with its advantages and disadvantages, have been suggested:

- rebates to taxed sources—distributing the revenue to the taxed sources minimizes the economic burden of the tax. However, the formula for distributing the revenue must give sources an incentive to reduce emissions.[24]
- exemptions for selected sources—some categories of sources could be exempted from the tax, or taxed at a lower rate, due to concerns about the effect of the tax on their competitiveness. Such exemptions and reductions lead to inefficient implementation of emission reduction measures, which increases the cost of achieving the objective.[25]
- restructuring personal income or consumption taxes—an emission tax is shifted to customers, employees, suppliers, and shareholders. Most studies of emission taxes

19. Canada's actual emissions would be less than its assigned amount, so it could sell the surplus assigned amount to other countries. However, there is no mechanism to ensure that the revenue from such a sale is returned to the sources subject to the tax.
20. Economic models can estimate the appropriate tax rate, but the impact of the tax on emissions can only be determined from the behaviour of sources subject to the tax.
21. The market clearing price for the auction is the tax rate that would achieve the emissions target for the affected sources.
22. The market price for the allowances is equal to the tax rate that would achieve the emissions target for the affected sources. If a tax equal to the market price is then imposed on recipients of allowances, the result is equivalent to imposing the correct emission tax.
23. Revenue recycling applies equally to revenue raised from the sale of allowances for an emissions trading program at auction.
24. Revenues from some emission taxes in Scandinavian countries are redistributed to the taxed sources. The distribution formula must provide sources with an incentive to reduce their emissions. Distributing the revenue on the basis of output creates an incentive to minimize emissions per unit of output. Sources with lower than average emissions per unit of output receive rebates, while sources with above average emissions per unit of output have a net tax liability.
25. Bohringer and Rutherford 1997 conclude that tax exemptions for energy- and export-intensive industries to save jobs are costly. A uniform carbon tax (no exemptions) with a wage subsidy achieves the same national emissions reduction and employment creation at a fraction of the cost.

suggest that the net effect is regressive for the lowest income groups. Using emission tax revenue to offset the impact on low-income groups corrects this distributional effect.

- purchases of assigned amount, emission reduction units, or certified emission reduction credits from other countries—such purchases reduce the emission reductions needed domestically. As a result the tax rate is lower and competitiveness is improved, at least in the short run. In the long run, the measures implemented by sources in other countries to reduce their emissions below their commitments may make them more competitive.
- reducing existing, more distortionary taxes. Any tax creates a disincentive to engage in the taxed activity and so reduces economic activity. Existing taxes discourage investment, employment creation, and work. Using emission tax revenue to reduce such taxes can stimulate economic activity and so reduce the economic impact of the tax.[26]

A tax on greenhouse gas emissions could raise a large amount of revenue. How the revenue is recycled has a significant impact on the cost of the emissions limitation policy, economic growth, the competitiveness of sources subject to the tax, and the distribution of income. Trade-offs among these impacts, and hence how emission tax revenue should be recycled, are policy decisions.

26. Some analysts argue that a lump sum distribution of the emission tax revenue should be used to analyse the economic impact of an emission tax since such a distribution has a neutral impact on economic activity. Others argue that since the emission tax generates the revenue, using the revenue to reduce existing, more distortionary taxes and so minimize the economic impact of the emission tax is valid. Analysts that favour the lump sum distribution argue that the economic benefits of reducing existing taxes suggest an opportunity for tax reform, not a need for an emission tax. But tax reform is possible only if the government has a new source of tax revenue, such as an emission tax, to replace the revenue lost by reducing existing taxes.

    Bohm 1997 notes that analyses of the economic impact of an emission tax compare it to a baseline with no environmental policy. A fair comparison requires that the emissions tax be compared to a baseline that uses other policies to achieve the same environmental goal. In that situation Goulder, Parry and Burtraw 1997 show that for a given environmental goal using non-revenue raising policies is more costly than using revenue raising policies with revenue recycling.

    The following analogy may help. Assume that the advertised price of a product is $100, but a manufacturer's rebate of $25 is available to every customer. Is the real price $100 or $75? The price (assuming lump sum distribution) is $100, but the net cost of purchasing the product (reducing existing, more distortionary taxes) is $75. It is not possible to collect the rebate (reform existing taxes) unless the product is purchased (another source of revenue is found). One can argue that the price is $100 or $75, but the cost is $75 in either case.

Section 4: Regulations

Regulations require sources of greenhouse gas emissions to install specific controls or equipment or to meet mandated performance standards. Regulations are a useful tool for assigning responsibility for actions to reduce greenhouse gas emissions to various sources, but they do not control aggregate emissions very precisely and are unlikely to lead to implementation of the most cost-effective measures to meet the national commitment.

Energy-related CO_2 emissions dominate Canada's greenhouse gas emissions. Regulations establishing energy efficiency standards for new buildings, building retrofits, equipment, appliances and vehicles could reduce these emissions. Other regulations could be implemented to address greenhouse gas emissions from manure, landfills, use of HFCs and other emission sources covered by Canada's national commitment.

Experience suggests that efficiency standards can be an effective policy instrument to improve energy efficiency. For example, the fuel efficiency of new cars roughly doubled from the time the U.S. introduced Corporate Average Fuel Efficiency (CAFE) standards (the equivalent of Canadian CAFC standards) in 1978 until they reached their present level in 1985. The fuel efficiency of new vehicles in the U.S. has not improved significantly since 1985.[27] Nor did fuel efficiency improve in Europe where no standards were in force.[28]

Experience with energy efficiency standards suggests that in addition to being environmentally beneficial, they can be cost-effective and produce savings for consumers. For example, American energy efficiency standards for refrigerators have lowered energy use as much as 60% and the total costs of the standards, including administrative overhead, are estimated as being under half the cost of energy saved.[29] The cost of refrigerators has also dropped since the standards came into effect. Further energy savings are estimated to be possible at a net cost saving for the consumer.[30]

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27. Natural Resources Canada 1995a. Statistical analysis of fuel efficiency patterns strongly suggests that CAFE standards, not increased fuel prices, were the prime motivator of better fuel efficiency.
28. Swisher 1996, p. 37.
29. The price of refrigerators in real terms (inflation adjusted dollars) has dropped. The estimated total cost of the standards is three cents per kilowatt hour saved (compared to a retail price for electricity of at least seven cents per kilowatt hour). See Swisher 1996, p. 29.
30. Swisher 1996, p. 29.

Energy efficiency standards do have some inherent limitations. Minimum performance standards (such as those for appliances) tend to eliminate the least efficient products, but do not encourage improvements in the most efficient products. In contrast, average performance standards, such as the CAFE standard for motor vehicles, encourage a shift to energy efficiency across the entire market. Corporate sales average standards provide an incentive to improve all models, but are complex to enforce. They require efficiency tests for all models and data on sales volumes by model. It is also true that if standards significantly raise new product prices, they may slow capital stock turnover to more energy efficient capital. Energy efficiency improvements may also give rise to a "rebound effect." For instance, for every 10% decrease in the price of driving due to improved fuel efficiency, car use will increase about 1.0% to 1.5% due to reduced costs per kilometre traveled.[31] Efficiency standards will thus be most effective where the demand for the energy-using services is relatively price-inelastic.

As the primary means of meeting a national commitment to limit greenhouse gas emissions, standards in general have three drawbacks:

- the large number of standards required creates a substantial administrative workload
- the emission reductions achieved cannot be determined very accurately
- standards do not lead to implementation of the lowest cost measures needed to achieve the target.

The use of regulations to meet a national emissions limitation commitment will involve a large number of initiatives (at least 80) because of the large number of diverse sources of greenhouse gases. In 1995 the National Air Issues Coordinating Mechanism identified and analysed over 80 measures to reduce greenhouse gas emissions in Canada. In negotiations leading to the Kyoto Protocol, the European Union proposed a list of over 80 policies and measures for adoption by each Annex I Party as appropriate to national circumstances. Neither of these lists covered all greenhouse gas sources and sinks. Developing, updating and enforcing compliance with that many regulations creates a substantial administrative workload.

The emission reductions that will result from the implementation of proposed regulations are difficult to forecast accurately. It is also difficult to determine whether the proposed regulations are sufficient to achieve the national commitment.[32]Regulations often focus on new buildings, equipment, appliances and vehicles. The impact of the regulations will depend upon how quickly existing stocks are replaced. Emissions also depend significantly on how the buildings, equipment, appliances and vehicles are used. The regulations generally do not control use, and hence emissions, directly. But regulations do change behaviour and hence emissions.[33]

Regulations are unlikely to lead to implementation of the lowest cost measures to achieve the national commitment. To minimize the cost of meeting a commitment, the marginal cost of

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31. Greene 1991.
32. The Forecast Working Group (FWG) of the National Air Issues Coordinating Mechanism 1995 grouped most of the 80 odd measures identified into five modelling scenarios that included progressively more, and more stringent measures. Only the most stringent scenario came close to stabilizing emissions in 2000 at 1990 levels. The FWG estimates had an uncertainty range of 30% due to uncertainty about penetration rates, costs, discount rates and government financing.

emissions control must be the same for all sources. With over 80 different policies and measures affecting millions of sources, it is impossible to meet this condition, thus the cost of meeting the commitment will be higher than if economic instruments are used.

Regulations can sometimes be formulated to allow credit trading and so improve cost-effectiveness. Assume that automobile manufacturers and importers were subject to corporate fleet efficiency standards for the vehicles sold in Canada. The standard could be formulated so that a company whose vehicles were more efficient than required by the standard could receive a credit for the difference. A company whose vehicles were less efficient than the standard could comply by purchasing credits to offset the extra emissions.[34] Such a standard improves efficiency by encouraging reductions to be implemented by the sources able to make them at the lowest cost.

In short, the use of regulatory policies alone to achieve a national emissions limitation commitment is unlikely to meet the commitment precisely and will be more costly than using economic instruments, such as emissions trading and an emission taxes.

33. Fuel efficiency standards for vehicles, for example, increase the costs of new vehicles and reduce operating costs. Thus the standards delay turnover of the vehicle stock and induce additional travel. These effects are small relative to the impact of the standards, but they increase the uncertainty about the effect of the standards.

34. Such a system is used by the U.S. Environmental Protection Agency for compliance with standards for heavy-duty engine emissions.

Section 5: Other Policies

A variety of other types of policies[35] can help reduce greenhouse gas emissions. They address barriers to implementation of measures to reduce greenhouse gas emissions, such as information on options to reduce emissions. Most of these policies could be implemented on their own or in conjunction with emissions trading, emissions taxes, or regulations.

5.1 Information, Education and Outreach

Firms and individuals often do not invest in greenhouse gas emissions reduction because they are unaware of the options, their costs and their performance. Information, education and outreach programs seek to correct this problem. They can also help to change behaviour and so reduce emissions directly.

Natural Resources Canada has focused much of its effort on education and information programs targeted at the residential and passenger transportation sectors. Although there have been some notable success stories in these sectors,[36] information programs by themselves generally do not stimulate significant changes in technology or practices.[37] They may, however, complement other approaches and they tend to work better where energy prices are higher.[38]

The environmental effectiveness of information, education and outreach programs is difficult to assess, especially due to limited information.[39] Early reviews of Canada's appliance labeling program showed that few consumers read the labels.[40] Similarly, most of the public appear to be unaffected by a Natural Resources Canada program intended to encourage the driving public to consider fuel efficiency in driving, maintaining and purchasing vehicles.[41] In some cases, the effectiveness of programs was reduced by poor cooperation of essential

35. This section is based on material from Rolfe, Haites and Hornung 1998.
36. Stern 1992, p. 1228.
37. Swisher 1996.
38. Kempton, Darley and Stern 1992, p. 1217.
39. Nadel, Pye and Jordan 1994.
40. Stern 1992, p. 1228.

players. For instance, surveys indicated that car dealers were removing most of the labels under Natural Resources Canada's voluntary vehicle fuel efficiency labeling program.[42] Education and information may be more effective in the industrial sector.[43]

5.2 Energy Auditing and Pollution Prevention Plans

Energy auditing, or pollution prevention planning with an energy component, can be effective in reducing both informational and institutional barriers to greenhouse gas emissions reduction. Energy audits and pollution prevention plans involve a detailed review of the processes used by facilities (inputs, outputs and operating practices), as well as a detailed evaluation of measures for decreasing energy use and/or the creation of polluting substances. Mandatory pollution prevention planning laws in 20 American states are intended to force companies to rethink processes and products.[44] Other states provide regulatory incentives to firms that conduct pollution prevention planning or auditing. Several Canadian provinces have pollution prevention planning initiatives.

Canadian and American experiences suggest that companies which audit their energy use find savings that they did not expect. For instance, TransAlta Corporation encouraged energy audits of all its operations by applying an internal $2 per tonne carbon tax.[45] This motivation to find energy efficiency led to over a million tonnes of emission reductions, most of them profitable in the absence of the internal carbon tax. Early analyses of the American pollution prevention planning experience suggest that despite an initially steep learning curve for industry and regulators, planning produces significant net savings.[46] Eighty percent of the energy saving lighting upgrades under the Environmental Protection Agency's Green Lights Program (essentially a program of energy audits for lighting) had payback periods of two years or less.[47]

5.3 Utility Demand-Side Management Programs

Much of our experience with efforts to address barriers and cure market failures comes from utility demand-side management (DSM) programs. DSM refers to a broad range of policies that are based on the philosophy that one can meet projected increases in demand for utility services through specific policies that seek to decrease demand rather than increase supply. Examples of DSM policies for utility customers include subsidies for the purchase of energy

41. Natural Resources Canada 1995b reports that a 1994 survey on the awareness of the motoring public indicated that nearly 70% of respondents stated they had not heard any information on how to improve road transportation and fuel efficiency.
42. Natural Resources Canada, 1995a, p. 5 reports that close to 75% of automobile dealerships received between 85% and 100% of vehicles from manufacturers with labels affixed. But close to 39% of dealerships surveyed had no labels on the vehicles in their car lot and only 21% of the dealerships had labels on all vehicles.
43. A comparison of scenarios for improving efficiency in British Columbia found that, for educational programs, the ratio of cost to energy savings was far higher in the industrial sector than other sectors; Collaborative Committee, 1994, Table II-2, page II-5.
44. Waste Reduction Institute for Training and Applications Research, Inc. 1992.
45. Chris Rolfe's personal communication with John Hastie, TransAlta Corporation, Calgary, October 1998.
46. Geiser 1992.
47. Porter and van der Linde 1995, p. 120.

efficient equipment, information and education programs related to energy efficiency, more finely-tuned pricing strategies (e.g. tied to time of day), and programs that purchase and retire energy inefficient equipment.

Over the past decade, more than 500 utilities have offered more than 2,000 DSM programs.[48] These programs have been mandated by utility commissions seeking to ensure that customers needs for heat, light and other energy services are met at the lowest financial cost and least environmental damage. The costs of North American electric DSM programs have ranged from $0.001 per kilowatt hour saved to $0.25 per kilowatt hour saved.[49] Competitive bids for reducing electricity demand suggest that the cost for improving energy efficiency is in the range of $0.04 to $0.07 per kilowatt hour, decreasing over time.[50] This cost compares to consumer prices for electricity of around $0.07 per kilowatt hour.

5.4 Land Use Planning and Transportation Infrastructure

Today's investments in the capital stock of transportation infrastructure and today's decisions regarding land use planning will affect greenhouse gas emissions for the next 50–100 years or more. Once these investments are made, they are difficult to reverse except through the natural retirement of the capital stock. Prematurely retiring capital stock such as freeways is enormously expensive.[51]

5.5 Procurement Programs

Technology procurement programs can be an effective means of reducing barriers to the introduction of new efficient or low emission technologies and products. In particular, they reduce manufacturers' and distributors' risks associated with the introduction of such products.

In some programs, the government commits to purchase a certain number of new products. In other programs, the government or other organizations organize buyers to purchase new technologies at costs that would be impossible without large orders. Often the products purchased under procurement programs enter the market with a price premium, but sufficiently-sized procurement plans have been successful in reducing the premium to near zero.[52]

One of the best examples of procurement programs is the "Greenfreeze" program in Europe. In the early 1990s, European refrigerator manufacturers were reluctant to change to energy-efficient, non-ozone-depleting refrigeration technologies. Greenpeace was able to get one company to commit to the new technology if it received a sufficient number of pre-orders. Greenpeace then campaigned to get tens of thousands of pre-orders for the refrigerator. Since then, the alternative technology has become the norm among all European manufacturers. Other examples of successful procurement programs include programs for lighting ballasts, computers and windows.[53]

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48. Nadel, Pye and Jordan 1994.
49. Ibid.
50. Swisher 1996, p. 37.
51. Jaccard 1997.
52. Swisher 1996, p. 32.

Procurement programs may be less successful where manufacturers are reluctant to prove a new technology's cost-effectiveness (for instance, because of the precedent it may set for regulation)[54] or where the new technology has higher initial costs and there is little appetite for increased capital expenditures.

5.6 Financial Incentives

Some cost-effective actions to reduce greenhouse gases will not be implemented because sources do not have access to sufficient capital, or there is resistance to investing scarce capital for long-term energy cost savings. Financially-strapped consumers, for example, are usually unwilling to go into debt for energy efficiency investments even when the return on their investment may be higher than the interest they pay. Also, different consumers have dramatically different requirements as to reasonable payback periods. It has been shown that individual consumers demand payback on energy efficiency investments of less than one year, commercial operations two to three years, and industrial consumers three to five years.[55]

Three financial incentives have been identified or used to overcome these barriers: mortgage rates which reflect decreased energy costs, accelerated capital cost allowances for energy efficiency investments, and rebates for energy efficient products.[56] Both loan programs and rebates can make energy efficient equipment more attractive by lowering capital costs. Rebate programs appear to be more effective, especially among residential customers who are generally unwilling to assume debt to save energy.[57]

5.7 Removing Subsidies

Policies to reduce greenhouse gas emissions will be less effective if activities that generate such emissions are subsidized directly or through the tax system. Subsidies for fossil fuel production, for example, reduce the effectiveness of policies to reduce energy-related CO_2 emissions. Removing such subsidies can lower greenhouse gas emissions and make emissions control policies more effective.

Canada subsidizes fossil fuels through the tax treatment of energy-related investments. In 1996, the federal Departments of Finance and Natural Resources published a joint study comparing the tax treatment of various energy-related investments and expenditures.[58] The value of each expenditure or investment under our current system was compared to its value

53. Swisher 1996, p. 32.
54. Some commentators have suggested that procurement programs for alternate technology vehicles have been less effective because the automobile industries steadfastly oppose alternative technology mandates.
55. Robinson et al.,1993, p. 11 and Swisher 1996, p. 33.
56. Nadel, Pye and Jordan 1994. p. 35.
57. Swisher 1996 reports that BC Hydro's Industrial Motors Program cost only $0.010/kWh saved and its refrigerator rebate program cost only $0.013 per kilowatt hour saved. The program increased the market share of efficient motors from 4% to 64% in four years, allowing BC Hydro to reduce rebate payments and impose even higher standards for qualifying motors(p. 34).
58. Natural Resources Canada and the Department of Finance, 1996 measured the "uplift" given by the tax system. The uplift is equal to [(net present value of tax paid under neutral system – net present value of taxes paid under Canadian system) x 100]/net present value of capital investment.

under a neutral tax system that has no tax credits, tax exemptions or preferential tax rates. The report identified three ways in which fossil fuels are subsidized relative to energy efficiency investments:

- Investments in energy efficiency for commercial buildings, for instance district heating, solar space heating or building retrofits, were less attractive (up to 10% less attractive in the case of retrofits) than in a neutral tax system.
- Conventional oil and gas investments were 5–10% more attractive under the current system than a neutral system. In addition, oil and gas companies can transfer exploration expense write-offs to shareholders. This transfermade a conventional oil and gas project up to 20% more attractive than in a tax neutral system.
- Large oil investments such as oil sands projects and the Hibernia offshore development were up to 21% more attractive by the current tax system.

Eliminating the preferential tax treatment of fossil fuel investments would reduce greenhouse gas emissions and increase welfare.[59] Elimination of Canadian subsidies is complicated by the fact that the U.S. and other jurisdictions offer similar subsidies to fossil fuel investments,[60] and regions dependent on fossil fuel exploration and development fear transfer of oil and gas development elsewhere.

5.8 Coordination with Other Environmental Policies

Actions to reduce greenhouse gas emissions often yield other environmental benefits. Measures to reduce energy-related CO_2 emissions generally reduce emissions of other pollutants produced by fossil fuel combustion, such as NOx, VOCs, SOx, particulate matter, lead, and other toxins. On the other hand, actions to reduce emissions of these pollutants may not reduce greenhouse gas emissions and may even increase them.

Designing policies to address multiple environmental objectives can improve cost-effectiveness. The Intergovernmental Panel on Climate Change stated that "policies to reduce net greenhouse gas emissions appear more easily implemented when they are designed to address other concerns that impede sustainable development (e.g. air pollution and soil erosion)."[61]

Such policies might include emission fees or emissions trading for local and regional pollutants. They could also include cost-effective prescriptive policies. Some policies that are routinely advocated to address other environmental problems but that also address climate change include vehicle inspection and maintenance programs, vehicle scrappage programs, increasing transit ridership, full-cost road pricing, integrated resource planning, landfill gas recovery, improved manure storage and use, no-till agriculture, and increased perennial forage.

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59. Since 1996, some changes were made in the tax system that begin to address the concerns raised by the Level Playing Field study. For example, a new category of expenses for certain types of energy projects that can be fully deducted or used with flow-through shares (Canadian Renewable and Conservation Expense) was introduced. These changes, however, have been modest and more could be done to eliminate the preferential treatment of fossil fuels.

60. de Moor and Calamai 1996.

61. Watson, et al. 1995, p. 18.

Section 6: Potential Use of Kyoto Protocol Mechanisms with Different Types of Domestic Policies

The Kyoto Protocol establishes emissions limitation or reduction commitments for 38 wealthier countries, including Canada. The emissions limitation or reduction commitments apply to each country's aggregate emissions of six greenhouse gases during the period 2008–2012. Canada's commitment is to limit its average annual emissions during the period 2008–2012 to 94% of its baseline emissions, a reduction of 6% from the baseline and of 20–30% from projected emissions in 2010.

The Kyoto Protocol includes three mechanisms a country can use to help meet its commitment:

- International emissions trading (IET) between Annex I parties (Article 17) involves transfers of *assigned amount* between Annex I countries.
- Joint implementation (JI) between Annex I parties (Article 6) involves transfers of *emission reduction units* created by emission reduction or sequestration actions in one Annex I country with financial assistance from another Annex I country.
- Clean development mechanism (CDM) (Article 12) involves transfers to Annex I parties of *certified emission reduction credits* created through emission mitigation projects implemented in developing countries with financial and other assistance from Annex I countries.

The Government of Canada can use the Kyoto Protocol mechanisms to help achieve the national commitment regardless of the policies implemented domestically. But the ability of individual sources of greenhouse gas emissions to use the Kyoto Protocol mechanisms depends upon the nature of the domestic policies with which they must comply.

6.1 Potential Use by the Government of Canada

The Government of Canada could buy the assigned amount or JI emission reduction units from other Annex I Parties. It could also purchase certified emission reduction credits created by CDM projects in developing countries. The purchases of these instruments[62] and their use to help achieve compliance with the national commitment would, of course, be subject to the rules adopted for the mechanisms.

The Government of Canada could also sell surplus assigned amount or approve JI projects that reduce emissions in Canada. Some of the emission reductions achieved by such projects would be exported and reduce Canada's assigned amount accordingly. Such purchases and sales are possible regardless of the policies implemented domestically.

6.2 Potential Use by Individual Emission Sources in Canada

To meet its national commitment Canada needs to adopt policies to limit greenhouse gas emissions by individual sources. The ability of a specific source of greenhouse gas emissions to use the Kyoto Protocol mechanisms depends on the domestic policies with which it must comply. Possible domestic policies to manage greenhouse gas emissions fall into four categories: domestic emissions trading, emission fee or tax, regulations and other policies.

A Canadian source might wish to purchase assigned amount, JI emission reduction units, or certified CDM credits to help achieve compliance with its domestic obligations. This purchase could occur in three circumstances:

- If the source is a participant in a domestic emissions trading program, it should be allowed to purchase such instruments and to use them toward compliance with its domestic obligations. Thus, a source could provide the regulator with a combination of domestic allowances or credits and Kyoto Protocol instruments equal to its actual emissions to achieve compliance. Title to the Kyoto Protocol instruments would be transferred to the Government of Canada so that it could use them toward compliance with its national commitment.

  The government would want to ensure that there is no risk of disallowance of some of the Kyoto Protocol instruments due to the liability provisions adopted.[63] The government might also impose limits on the use of such instruments to ensure compliance with the supplementarity provisions in the rules.[64] Otherwise there is no reason why the government should not accept Kyoto Protocol instruments toward compliance in a domestic emissions trading program.

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62. The term "instruments" or "Kyoto Protocol instruments" is used to refer to assigned amount, JI emission reduction units, or certified emission reduction credits created by CDM projects when the distinction among the mechanisms does not matter.

63. The rules for IET might establish buyer liability, which would reduce the assigned amount purchased by some or all of the buyers from a party whose emissions exceed its remaining assigned amount to bring the seller into compliance. Buyer liability helps keep sellers in compliance with their commitments. But it creates a risk that some of the assigned amount purchased will be discounted or disallowed.

64. The Kyoto Protocol specifies that use of each of the mechanisms must be supplemental to domestic action as a means of meeting a country's commitment. Thus, the ability of Canada to use purchased instruments may be limited. Operational interpretation of the supplementarity provision remains to be agreed.

- If the source is subject to an emission tax, it could in principle, be allowed to use the Kyoto Protocol mechanisms to reduce its tax liability. Instead of paying tax on some (or all) of its actual emissions, the source would transfer title to Kyoto Protocol instruments to the Government of Canada for that quantity of emissions. If the tax rate is less than the international market price for Kyoto Protocol instruments, there is no incentive to buy the instruments—paying the tax is less expensive.[65]

  If the tax rate is above the international market price, a source subject to tax can reduce its compliance cost by buying Kyoto Protocol instruments equal to its actual emissions. Then it would pay no tax. If the government depends on the emission tax for revenue, it may restrict the use of Kyoto Protocol instruments to meet its revenue targets.

- If the source is subject to regulations or other policies designed to limit its greenhouse gas emissions, it can use Kyoto Protocol mechanisms for compliance only under specific conditions. The regulation must be formulated in such a way that the quantity of instruments needed to achieve compliance can be calculated. Thus, a regulation that establishes a minimum energy-efficiency standard for refrigerators or acceptable manure handling practices would not allow the use of Kyoto Protocol instruments.

  On the other hand, a regulation that established a corporate average fleet efficiency standard could be structured to allow the use of Kyoto Protocol instruments to achieve compliance. The excess emissions associated with non-compliance with the regulation can be calculated. Transfer of an equivalent quantity of Kyoto Protocol instruments to the Government of Canada would allow it to meet the national commitment despite not meeting the standard required by the regulation.

Now consider a Canadian source that wishes to sell the assigned amount to a source in another Annex I country. Such a sale would be allowed by the Government of Canada only if the seller could demonstrate that it was in compliance with its domestic obligations and hence that the sale would not contribute to non-compliance with the national commitment. Again, there are three circumstances:

- If the source is a participant in a domestic emissions trading program, it should be able to demonstrate whether it is in compliance with its domestic obligations. The quantity of surplus allowances or credits it owns will also be known. Thus it should be possible to allow participants in a domestic emissions trading program to exchange domestic allowances or credits for assigned amount to sell on the international market.

- If the source is subject to an emission tax, it is not possible to define the surplus allowances or credits it owns. Thus it is not possible for a source subject to an emission tax to earn Kyoto Protocol instruments for sale on the export market.

- If the source is subject to regulations or other policies, it can only sell Kyoto Protocol instruments if the regulations are structured so that it is possible to calculate the surplus reductions the source has achieved.

65. For convenience it is assumed that there is a single market price for all instruments. In practice, there may be different prices for different instruments and for a given instrument from different countries.

A Canadian source unable to sell the assigned amount through the IET could seek to structure its emission reduction or sequestration actions as a JI project and so transfer some of the emission reduction units to the foreign partners. A JI project would need to be approved by the Government of Canada. The Government of Canada is likely to approve such projects only for sources not covered, directly or indirectly, by any domestic policy to reduce greenhouse gas emissions. Failure to do this would likely lead to double counting and so risk non-compliance with the national commitment.

The risk of double-counting reductions from sources whose emissions are covered directly by domestic policies is illustrated by the following example. Assume that manufacturers and importers of combines must meet minimum energy efficiency standards to reduce CO_2 emissions from the fuel used. All combines sold in Canada will meet or exceed the standard. Now assume that a farm cooperative wished to launch a JI project that provided incentives to farmers to buy combines whose energy efficiency was better than the average for new models. It is likely that some of the participants would have purchased the more efficient models in the absence of the JI project. Thus such a project would count some reductions achieved by the energy efficiency standard. The risk of double counting—reductions due to the regulation being claimed by the JI project—is so high that the project probably would not be approved.

This risk of double counting is even higher for sources whose emissions are regulated indirectly. Assume that a domestic emissions trading program is implemented for the carbon content of fossil fuels sold in Canada by producers and importers. The actual emissions reductions are achieved as a result of energy efficiency and fuel switching measures implemented be energy users in response to the price increases caused by the trading program. A JI project to improve the energy efficiency of buildings runs a significant risk of double counting because it is difficult to determine how much would have been implemented in response to the price increases and how much is due to the JI project.

Assuming that domestic policies apply, directly or indirectly, to most sources of greenhouse gas emissions for efficiency and equity reasons, the potential to host JI projects will be limited.

In summary, the opportunity to use the Kyoto Protocol mechanisms for compliance with domestic policy obligations is greatest for sources covered by a domestic emissions trading program. Access to the Kyoto Protocol mechanisms for compliance purposes is possible under some circumstances for sources subject to an emission tax or to specific types of regulations. The opportunity to sell the assigned amount to sources in other Annex I countries is limited to sources covered by a domestic emissions trading program or specific types of regulations. Assuming that domestic policies cover most sources directly or indirectly, the opportunity to host a JI project is likely to be very limited.

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Appendix: A Numerical Example of Emissions Trading

The potential for cost saving is shown in Table A-1. The example involves 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.

With trading, the total cost of compliance is reduced to $45,000 from $60,000 and each firm shares in the financial benefits of trading.

Table A.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	
	$20,000	$25,000	
	-$17,500	+$17,500	
Compliance cost with trading	$2,500	$42,500	$45,000
Savings Relative to No Trading			
Compliance cost without trading	$10,000	$50,000	
Compliance cost with trading	- $2,500	-$42,500	
Savings relative to no trading	$7,500	$7,500	$15,000
Savings relative to no trading	75%	15%	25%