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TABLE RONDE NATIONALE SUR L'ENVIRONNEMENT ET L'ÉCONOMIE

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EXTENDED DESCRIPTION OF OPTION 8: MANDATORY PERFORMANCE STANDARDS WITH CREDIT TRADING

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November 1998

EXTENDED DESCRIPTION OF OPTION 8: MANDATORY PERFORMANCE STANDARDS WITH VOLUNTARY CREDIT TRADING

INTRODUCTION

A July 1998 National Round Table on the Environment and the Economy (NRTEE) paper on *Possible Designs for a Domestic Emissions Trading Program for Greenhouse Gases* identified 14 possible designs for a domestic emissions trading program for greenhouse gases (GHGs). Six of those designs were selected for further analysis. The 14 designs and the six selected for further analysis are shown in Table 1.

This paper provides an extended description of Option 8: Mandatory Performance Standards with Credit Trading. This paper covers:

- a description of the trading program;
- descriptions of similar existing programs;
- the emissions covered by the trading program;
- the sources required to participate in the program;
- the number of sources involved;
- the share of total emissions covered by participants;
- how the trading program would be administered;
- how emissions would be measured;
- possible complementary policies;
- special issues raised by the design;
- transitional issues related to a change in the policy setting; and
- evaluation of the option using the proposed criteria.

DESCRIPTION OF THE TRADING PROGRAM

Option 8 is a program of mandatory performance standards with voluntary credit trading to meet a national commitment to limit greenhouse gas emissions.

Under this policy setting Canada is faced with meeting a national commitment to limit its greenhouse gas emissions. In Option 8 governments adopt a series of mandatory performance standards to limit these emissions. Voluntary credit trading is allowed to reduce the cost of complying with the standards.

The trading program is designed to cover a large share of Canada's total greenhouse gas emissions. The way in which energy-related emissions are covered is discussed first, separately for large energy users and small energy users. Then the other greenhouse gases/sources covered by the trading program are discussed.

Table 1 — Summary of Possible Designs and Recommended Short List

Design	Short List	Description
Prospect of future commitment to limit GHG emissions		
1	✓	Voluntary credit trading
2		Voluntary cap and trade system
No specific prospect of a commitment to limit GHG emissions		
3		Voluntary credit trading
Commitment to limit GHG emissions exists		
4	✓	Cap on carbon content of fossil fuels produced and imported with trading by producers, importers and exporters
5		Cap on carbon content of fossil fuels crossing provincial and international borders, with trading by owners of the fuels
6		Cap on the carbon content of fossil fuels implemented at the narrowest point in the distribution chain, with trading by owners of the fuels
7		Voluntary credit trading
8	✓	Voluntary credit trading with mandatory performance standards
9		Mandatory credit trading
10		Voluntary cap and trade system
11	✓	Cap on emissions by fossil fuel users, trading by large fuel users and oil companies for transportation fuels
12		Same as previous option, but excluding transportation sector
13	✓	Same as Option 11, but with no opportunity to purchase credits or allowances from sequestration or sources outside the program
14	✓	Cap on emissions by fossil fuel users, trading by large fuel users and municipalities for transportation and commercial/residential buildings

Two types of mandatory performance standards would be established to deal with energy-related emissions:

- Large energy users, including energy producers, oil refineries, natural gas processing plants, electricity generators, industries, oil and natural gas pipelines, railways and airlines, would be subject to performance standards for energy-related emissions per unit of output.

- Emissions by small energy users would be addressed through performance standards for appliances, energy-using equipment, vehicles and buildings. Manufacturers and importers of appliances, energy-using equipment, vehicles would be subject to performance standards for the products they sell in Canada. Builders likewise would be subject to a performance standard for buildings.

Large Energy Users

Large energy users would be subject to mandatory performance standards expressed in terms of emissions per unit of output; for example CO_2 equivalent emissions per tonne of steel, per automobile manufactured, per kilowatt hour (kWh) of electricity produced, or per dollar of sales.[1] The regulations that establish the standards also specify the sources to which they apply. These sources have the option of participating in a voluntary credit trading program to comply with the performance standards.

Large energy users able to reduce their emissions below the level specified by the performance standard can create credits. Consider, for example, a widget company subject to a standard of 0.1 kilograms (kg) of CO_2 per widget that produced 1,548,000 widgets during a given year. To comply with the standard, its actual emissions would need to be less than 154.8 CO_2 equivalent tonnes.[2] If its actual emissions for the year were 150.0 tonnes of CO_2 equivalent, it could claim credits of 4.8 CO_2 equivalent tonnes. The credits could be sold to another participant in the trading program, or banked for future use if this is allowed.

A source that found direct compliance with the performance standard difficult or costly could comply by purchasing credits instead. Consider, for example, an electric utility that planned to achieve compliance with its performance standard of 0.5 kg of CO_2 per kWh for a projected load of 867 megawatt hours (MWh) assuming average weather conditions.[3] If a colder winter or warmer summer increased the load to 889 MWh and increased emissions due to greater reliance on coal-fired generation, it could purchase

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[1] Participants should have an incentive to implement all cost-effective measures to reduce GHG emissions. For energy users, this means all energy-efficiency and conservation measures and all fuel switching options that reduce GHG emissions. Expressing the performance standard in terms of energy-related GHG emissions per unit of output covers all of those options. In contrast, expressing the performance standard in terms of energy-related GHG emissions per unit of energy input provides an incentive to switch to less carbon-intensive fuels, but not to implement energy-efficiency or conservation measures. Thus, an output standard is better than an input standard for energy consumers.

[2] The number of credits is calculated as follows: 1,548,000 widgets multiplied by the standard of 0.1 kg of CO_2 equivalent per widget divided by 1,000 kg per tonne of CO_2 for a total of 154.8 CO_2 equivalent tonnes.

[3] The number 0.5 kg of CO_2 per kWh is purely hypothetical. It is used simply to facilitate the discussions and should not be interpreted as a proposed standard.

credits to achieve compliance. It would need to purchase enough credits to reduce the remaining actual emissions to (889 * 0.5 =) 444.5 CO_2 equivalent tonnes.[4] Thus, the performance standard establishes the baseline for credit creation and use.[5]

The mandatory performance standards are not emissions caps, because they are expressed in terms of emissions per unit of output.[6] Total allowable emissions would change as actual output changed.

One of the biggest difficulties with this design is to set the performance standards to ensure that actual emissions are less than the national commitment. The national commitment under the Kyoto Protocol is an average 6% reduction from base year emissions over the period 2008 through 2012. This commitment does not vary with the level of output. But the allowable emissions under this design would vary with the level of output. Thus the standards must be set conservatively, or other mechanisms must be instituted, to ensure that the national commitment is met.[7]

The performance standards would also need to be adjusted periodically to reflect changes in technology, the national commitment, or other developments. The performance standards must be defined in a manner that facilitates credit creation and use; for example, CO_2 equivalent emissions per tonne of steel rather than a requirement to install best available control technology.

A definition of large energy-users is needed to determine which sources are subject to the performance standards for their operations. The definition should be related to annual annual emissions, for example annual greenhouse gas emissions in excess of 100,000 CO_2 equivalent tonnes, but could also be based on annual energy use or annual sales.[8]

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[4] Note that the standard applies to the actual sales of 889 MWh, not the projected sales of 867 MWh.

[5] A source would not need to document specific actions implemented to reduce its emissions. Rather, credits are created by documenting that actual emissions are lower than allowed by the mandatory performance standard. The sources and output covered are also specified by the performance standards.

[6] The standard is equivalent to a gratis allocation of allowances to each participant equal to the performance standard multiplied by the participant's output. The distribution of allowable emissions among participants changes each year as output changes.

[7] Some members of the Multistakeholder Expert Group suggested that one way to increase the compatibility of this design with a fixed national commitment would be to define the standards as caps on annual emissions by participants. Other felt that fluctuations in allowable emissions as a result of changes in output are an essential feature of this design.

[8] The definition of a large energy user will depend upon whether the entities subject to the mandatory performance standards are firms or individual plants. Further analysis is needed to assess the trade-offs in terms of the number of participants, administrative burden on participants and governments, and the share of total emissions covered of implementing the program for individual plants or firms.

Some large energy-users, such as automobile manufacturers, could be subject to performance standards for their operations as well as their products.

Product Related Emissions

Energy-related emissions by residential, commercial, institutional, small industrial and motor vehicle sources would be controlled indirectly through mandatory product-relate emissions standards for buildings, appliances, energy-using equipment and vehicles. New vehicles sold in Canada would be subject to mandatory corporate average fuel efficiency (CAFE) standards applied to all manufacturers and importers of cars and trucks. Similarly, manufacturers and importers of appliances and energy-using equipment would be subject to mandatory emissions standards for the products sold in Canada. The product-related emissions standards would specify energy-related greenhouse gas emissions for each model under specified test conditions. Builders likewise would be subject to an emissions standard for buildings.

The product-related emissions standards do not restrict sales of the appliances, equipment or vehicles or construction of new buildings during a given year. Actual emissions will be determined by the use of the existing stock of buildings, appliances, equipment and vehicles, so the product-related emissions standards also do not cap emissions.

Exceeding the emissions standard would create a stream of credits measured in CO_2 equivalent tonnes. Assume that a motor vehicle manufacturer sold 100,000 new vehicles in Canada during a given year and that the emissions standard for the vehicles of that type was 0.3 tonnes per year based on a specified test procedure and assumed use profile.[9] If the vehicles actually sold beat the standard by 10%, the manufacturer could claim credit for 3,000 CO_2 equivalent tonnes. Those credits would be assigned to the current and future years based on the expected life and use profile of the vehicle.[10]

An appliance manufacturer whose sales in Canada did not meet the product-related emissions standard would need to purchase a stream of credits for the current and future years based on the expected life and use profile of the appliance for the excess emissions.

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[9] The test procedure might measure emissions during urban and highway driving cycles. And the use profile might assume an average of 12,000 km per year, of which 60% is urban driving and 40% is highway driving.

[10] The credits would be distributed over time, based on the scrappage profile and usage pattern for vehicles. Thus, of the 3,000 CO_2 equivalent tonnes of credits over the life of the vehicle, 350 tonnes might be assigned to the current year because new vehicles are heavily used and the scrappage rate is low, while 20 tonnes might be assigned to the 15th year of the expected vehicle life because most of the vehicles will have been scrapped and the remaining old vehicles will tend to be used less than the fleet average. A standard profile would be used to allocate the stream of credits for each type of appliance, equipment, vehicle and building over time.

Thus the product-related emissions standards for appliances, equipment, vehicles and buildings also define the baseline for credit creation and use.

The credits created by appliances, equipment, vehicles and buildings must be distributed over the lives of the items that generated them if they are to be tradable.[11] Otherwise, compliance with the national commitment is compromised. Assume that all of the 3,000 credits earned by the automobile manufacturer could be used immediately by large energy users. Emissions by the energy users that purchased the credits would rise well before the reductions anticipated from the more efficient vehicles are realized.

It is not feasible to apply product-related emissions standards to existing appliances, vehicles and equipment. Thus, the impact of the product-related emissions standards will only be felt gradually as the existing stocks are replaced. Unless mandatory standards are imposed well before the national commitment comes into force, the impact of the product-related emissions standards during the commitment period will be relatively small. The consequence might be a requirement for larger initial reductions from other sources.

The product-related emissions standards would limit the energy-related emissions by residential, commercial, institutional, small industrial and motor vehicle sources. These sources would not be subject to the mandatory performance standards for large energy users discussed above.[12] However, small firms that manufacture or import appliances, energy-using equipment or vehicles would be required to meet the product-related emissions standards for their products.

Other Greenhouse Gas Emissions

Where feasible emissions of other gases/sources would be covered by mandatory performance standards with voluntary credit trading. Those gases/sources are identified in Table 2. Greenhouse gases other than CO_2 would be converted to CO_2 equivalents using

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[11] An alternative to converting the appliance, equipment, vehicle and building standards into a stream of credits over the life of the product is to establish a series of separate trading programs, each limited to the performance standard of a product category with a comparable lifetime and usage pattern. For example, the standard would be defined for a basic residential refrigerator. Over-compliance and under-compliance would be measured in fractions of the standard. A manufacturer that sold 10,000 refrigerators in Canada that outperformed the standard by 1% would receive 100 refrigerator credits. The refrigerator credits could only be used for appliances in the residential refrigerator category. The drawback of this approach is that it would create a number of separate trading programs, each with only a small number (fewer than 15) participants. The experience of the U.S. averaging, banking and trading (ABT) program for heavy-duty vehicle engine emissions standards and the Canadian ozone-depleting substances program is that there is very little interfirm trading in such cases.

[12] Small industrial sources are those whose annual emissions (or sales or energy use) is less than the threshold defined for large energy-users subject to mandatory performance standards.

the internationally agreed global warming potential values (GWPs). Sources of these emissions and how they could be incorporated in to the trading system are provided in Issue paper 1, *Potential of Including Non-Combustion Sources of GHG Emissions in a Domestic Emissions Trading Program.*

Table 2 — Non-Combustion Sources included in the Emissions Trading Program

Non-Combustion GHG Source	Gas	No. of Sources	Total (kt CO_2 eq)	Emission Rights Trading	Substance Trading
Landfills	CH_4, CO_2	10,000	18,250	√	
Adipic Acid Production	N_2O	1	10,850	√	
Aluminum Smelting	CO_2, PFCs	11	9,600	√	
Lime & Cement	CO_2	45	7,630	√	
Fertilizer Use	N_2O	12	4,030		√
Ammonia (less Urea)	CO_2	10	3,800	√	
Magnesium Smelting	SF_6	<10	1,890		√
Coal Mining *	CH_4	28	1,700	√	
Nitric Acid Production	N_2O	9	930	√	
Other Flurocarbons	SF_6, PFCs, HFCs	millions	500		√

* Fugitive and process emissions from energy production and distribution operations

Credits could be earned for capture of emissions from small landfills, open pit mines, and for carbon sequestration actions allowed by the international emissions limitation agreement. How best to address emissions from livestock due to enteric fermentation and manure needs further study.

Credits created by exceeding the performance standards and credits created through emission reduction and sequestration actions would all be fully interchangeable.

Participants in the trading program also would have full access to all international flexibility mechanisms. If the Kyoto Protocol comes into force, this would be joint implementation (Article 6), the clean development mechanism (Article 12) and international emissions trading (Article 17). Participants could purchase allowances or credits created by any of these mechanisms and could sell surplus credits to other countries.[13]

[13] Given the structure of the domestic trading system, most Canadian participants are likely to hold credits. Surplus credits could be exchanged for "assigned amount" and be sold to a buyer in another country under the provisions of Article 17. It is possible that some emission reduction actions could be structured as joint implementation projects and so create emission reduction units that could be exported under the provisions of Article 6. The clean development mechanism (CDM) applies to projects implemented in developing countries, so Canadian participants can only purchase (not create) CDM credits.

The voluntary credit trading program would be established and administered by the regulatory authorities responsible for monitoring compliance with the mandatory performance standards. The trading program is a means of compliance with those standards, so the regulatory authority must establish the requirements for achieving compliance and then monitor the performance of the participants. However, the administrator could delegate or contract many of the functions required for the operation of the program, such as the operation of the registry.

The entity established to administer the trading program will need to establish rules for credit creation and use, covering such issues as reporting requirements, credit life, banking, price disclosure, provisions for sale or use of allowances or credits from other domestic or international programs, establishment of a registry, audit and verification provisions, and penalties for non-compliance.[14] These rules would be developed in the same way as other pollution control regulations, so stakeholders would have an opportunity to comment on the proposals.

A drawback of such a credit trading program as a means of meeting a national emissions limitation commitment is that it does not cap emissions by participants very precisely. The mandatory performance standards for large energy users are defined in terms of emissions per unit of output, but the level of output — and hence total emissions — is not restricted. Similarly, the performance standards for appliances, equipment, vehicles and buildings do not control the use of those products and so do not limit total emissions. The performance standards for sources of other greenhouse gas emissions also do not limit total emissions. The government then has two options. One is to make the performance standards sufficiently stringent that they will be met under virtually any economic or weather conditions, which could be costly. The second is to run a risk of non-compliance with the national commitment.

DESCRIPTIONS OF SIMILAR EXISTING PROGRAMS

A voluntary credit trading program with mandatory performance standards would be similar to the U.S. trading program for the lead content of leaded gasoline and the averaging, banking and trading (ABT) provisions of the heavy-duty engine emissions standards.

Trading for the Lead Content of Leaded Gasoline

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[14] Many of these provisions are discussed in the NRTEE paper on Issue 8, *Analysis of Emissions Trading Program Design Features.*

Effective November 1982, the American Environmental Protection Agency (EPA) introduced trading as part of its program for phasing out lead in gasoline. The program included all refiners and importers of leaded gasoline. Trading encouraged more efficient use of lead by taking advantage of the non-linear octane response to lead.[15]

Refiners and importers were allowed to create lead rights equal to the regulatory limit on the lead content of leaded gasoline multiplied by their leaded gasoline production during the calendar quarter less the actual quantity of lead used.[16] Lead rights could be sold to other refiners and importers for use during the quarter in which they were created. The quarterly average of actual lead used by buyers could not exceed the mandated limit plus the quantity of rights purchased. Trades were reported to the EPA at the end of each quarter. Trades were not subject to an approvals process, only a potential audit.

Faced with new evidence of health damage from lead, the EPA realized that the natural reduction in lead use as leaded-fuel vehicles retired would not address the problem quickly enough. In August 1984 the EPA set a maximum lead content for leaded gasoline of 0.5 grams per gallon effective July 1, 1985 and 0.1 grams per gallon after January 1, 1986.[17]

To facilitate the reduction from 1.1 grams per gallon at the beginning of 1985 to 0.1 grams per gallon at the beginning of 1986, the EPA introduced banking into the trading system effective January 1, 1985. Refiners and importers were allowed to bank lead credits during calendar 1985 and to withdraw credits until the end of 1987. In other words, banking changed the credits from a three-month life to a maximum three-year life terminating at the end of 1987.

The lead credit trading program saved refiners over $200 million. The EPA originally estimated that approximately 9.1 billion grams of lead would be banked, and that banking alone would save refiners $226 million. The actual amount of credits banked, 10 billion grams, was close to the initial estimate, resulting in a projected average savings of 2.5 cents per gram banked.

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[15] The octane boost provided by lead declines exponentially as the lead content increases. Reducing the lead content from prevailing levels only reduced the octane rating a little. But adding the lead saved to gasoline with no lead provided most of the desired octane boost. Thus trading encouraged more efficient use of lead.

[16] The lead content was limited to a maximum of 1.1 grams per gallon.

[17] Note that the total quantity of lead was not constrained. The maximum lead content per gallon, combined with declining sales of leaded gasoline due to the decreasing number of vehicles using leaded gasoline, led to a reduction in lead emissions.

The fact that a large number of firms entered (and exited) the gasoline "refining" business over the five years of the trading program probably contributed significantly to the cost savings.[18] The fact that so many firms entered the industry suggests that profits were relatively high. The added competition probably reduced producer profits and prices to gasoline consumers.

The lead credit trading program allowed the government to reduce the maximum lead content of leaded gasoline much more quickly than under a program without trading, where each refiner would need to have adequate time to adjust to the new standards. The lead credit trading program probably did not affect overall volume of lead use or the net environmental effects. The number of violations under the trading program was similar to the number under the previous regulatory phase-down.

Heavy-Duty Vehicle Engine Emissions Standards

Another example of a voluntary credit trading program with mandatory performance standards is the averaging, banking and trading (ABT) provisions of the emissions standards for heavy-duty truck and bus engines. The U.S. Environmental Protection Agency regulates emissions from heavy-duty and non-road engines. The regulations cover carbon monoxide (CO), hydrocarbons (HC), non-methane hydrocarbons (NMHC), nitrogen oxides (NOx), particulate matter (PM) and smoke, but the emissions regulated differ for different engines. Some standards must be met by every engine, while others must be met by engine categories as a group. The NOx and PM standards allow the use of ABT provisions.

The regulations apply to manufacturers of spark ignition (Otto cycle) and compression ignition (diesel) engines for heavy-duty trucks and urban buses. The ABT provisions are limited to NOx and PM because the emissions standards for these pollutants have been tightened to the point where they are driving engine technology.[19] The ABT provisions were introduced to facilitate compliance with the lower standards that came into effect for the 1990 model year.

Where ABT is allowed, the regulations specify both the standard and a maximum emissions rate for the pollutant. Every engine must have an emissions rate lower than the

[18] A "refiner" was anyone who manufactured gasoline; thus someone who added ethanol to leaded gasoline was deemed to make an amount of leaded gasoline equal to the amount of ethanol added.

[19] In other words, the emissions standards for the other pollutants might not impose a binding constraint on manufacturers. In that case there would be no cost savings due to emissions trading, and the demand for credits would be zero.

maximum rate for each ABT pollutant.[20] The standards and maximum emissions rates for NOx and PM for different types of engines are shown in Table 3.

Table 3 — Standard and Maximum Emissions Rates for Heavy-Duty Engines
(grams per brakehorsepower-hour)

	Standard				Maximum			
	NOx	NOx + NMHC	PM Trucks	PM Urban Buses	NOx	NOx + NMHC	PM Trucks	PM Urban Buses
1988-1989[a]								
Diesel	10.7		0.6	0.6				
Otto	10.7							
1990-1992								
Diesel	6.0		0.6	0.6	10.7			
Otto	6.0				10.7			
1993								
Diesel	5.0		0.25	0.1	6.0		0.6	0.25
Otto	5.0				6.0			
1994-1995								
Diesel	5.0		0.1	0.07	6.0		0.6	0.25
Otto	5.0				6.0			
1996-1997								
Diesel	5.0		0.1	0.05[c]	6.0		0.6	0.25
Otto	5.0				6.0			
1998-2003								
Diesel	4.0		0.1	0.05[c]	5.0		0.6	0.25
Otto	4.0				5.0			
2004-								
Diesel		2.4[b]	0.1	0.05[c]		4.5	0.6	0.25
Otto	4.0				5.0			

Notes: a) The ABT provisions did not come into effect until the 1990 model year.
b) The standard for 2004 and subsequent years is 2.4 g/bhp-hr for NOx + NMHC or 2.0 g/bhp-hr for NOx with a cap of 0.5 g/bhp-hr for NMHC.
c) This is combined with a 0.07 g/bhp-hr in-use standard.

Engines whose emissions are lower than the specified standard generate emissions credits. Credits can be used to help engines in the same category whose emissions exceed the standard (but are below the maximum rate) achieve compliance with the standard. Averaging, banking and trading are different possible uses of credits, which are defined in the program as follows:

[20] Every engine must also have an emissions rate below the standard for each of the other regulated pollutants for that engine.

- *Averaging:* Credits offset emissions for engines manufactured during the same year whose emissions are above the specified average to help the company achieve compliance during that year.
- *Banking:* Credits offset emissions for engines manufactured during a future year whose emissions are above the average specified to help the company achieve compliance during that year.
- *Trading:* Credits are sold to another company and are used to offset emissions for engines manufactured during the current or a future year whose emissions are above the average specified for the year the credits are used.

Credits can only be created and used within the same engine category. There are three categories of diesel truck and bus engines: light-, medium- and heavy-duty engines. Otto cycle engines are a separate category.

Credits previously had a life of three years, but beginning in 1998 they have an unlimited life. Banked or traded credits used to be discounted by 20%, but beginning in 1998 a differential discount is applied depending on the emissions rate of the engines used to generate the credit. These changes are designed to encourage early action to meet strict new standards that come into effect in 2004.

At present, credits can only be traded among engine manufacturers. Beginning in 2004 it will also be possible to use the credits in other programs, subject to meeting the conditions of the programs for which they are purchased. For example, if new urban buses for use in an ozone non-attainment area emit less NOx than the standard, the regulatory authority might allow the NOx credits created to be used for compliance purposes by stationary sources.

Eleven manufacturers are covered by the program. Reports on ABT activity for on-highway diesel engines have been submitted on paper and are confidential. Data on use of the ABT provisions are expected to be made public late in 1998, but are currently not available. Program staff indicate that manufacturers have used averaging a little more than banking.[21] Banking tends to be used just before standards change. The first intercompany trade occurred in 1997 and involved a small quantity of PM credits.

Averaging, banking and trading provisions have also been adopted or proposed for emissions from several categories of non-road engines. Specifically:

- NOx emissions by diesel engines of more than 50 hp used in non-road equipment such as farm tractors, bulldozers, cranes and forklifts;[22]

[21] Averaging is more attractive because banked credits have been discounted by 20%, while credits used for averaging are not discounted.

[22] The EPA has proposed to replace the existing HC and NOx standards with an NMHC + NOx standard, to revise the PM standard and to allow ABT for both. The EPA is also in the process of finalizing rules to

- HC + NOx emissions by spark ignition outboard engines beginning with the 1998 model year and for personal watercraft engines beginning with the 1999 model year;
- NOx and PM emissions by locomotives, beginning in 2000; and
- proposed revised HC + NOx standards for non-road spark ignition engines of less than 25 hp.

The extension of ABT provisions to other engine categories suggests satisfaction on the part of the EPA and engine manufacturers with such a trading program.

EMISSIONS COVERED BY THE TRADING PROGRAM

The mandatory performance standards and voluntary credit trading program ultimately would cover virtually all greenhouse gas emissions directly or indirectly. It would cover large energy users — energy producers, oil refineries, natural gas processing plants, electricity generators, industries, oil and natural gas pipelines, railways and airlines — directly by making them subject to mandatory performance standards per unit of output. Residential, commercial, institutional, small industrial and transportation emissions would be covered indirectly through mandatory performance standards for virtually all buildings, appliances, energy-using equipment and vehicles sold in Canada. Emissions from these sources would be addressed gradually as existing buildings, vehicles and equipment are replaced. Most sources of other greenhouse gas emissions would be covered by mandatory performance standards or be allowed to created credits for documented emissions reduction or sequestration actions.

Mandatory performance standards would be established for all large energy users. Ideally, these standards would be defined in terms of CO_2 equivalent greenhouse gas emissions per physical unit of production; for example CO_2 equivalent emissions per tonne of steel, per automobile manufactured, or per kWh of electricity produced. However, it may be difficult to find a comprehensive measure of physical output given the diversity of the output produced by many plants; chemical plants, for example, often produce a large number of products. In some cases it may be possible to identify a few key products that are relatively homogeneous across firms and account for a substantial fraction of total output, which could be used as proxies for total output.

A more general approach is to express the performance standard in terms of CO_2 equivalent greenhouse gas emissions per dollar of sales adjusted for inflation.[23] This value

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implement emissions standards for non-road diesel engines of less than 50 hp beginning in 1999. Current proposals for those rules include ABT provisions for NMHC + NOx and PM.

[23] The need to adjust for inflation raises difficult issues in terms of the appropriate inflation index for each firm. It is impractical to calculate a suitable inflation index for each firm, so a widely available index such as the gross domestic product deflator or Consumer Price Index would probably be adopted for this purpose.

would differ for each firm for a variety of reasons, so the standard would need to be specific to each firm. Firm-specific standards could be established by taking the GHG emissions per dollar of sales for the firm in a base year (say 1995) and reducing it by some percentage.[24] Thus each firm would have its own output-based performance standard for each year. New firms in an industry could be assigned a base-year value that reflects superior performance in the industry, say the 75th or 90th percentile value for existing firms in the industry.

Manufacturers and importers of appliances, energy-using equipment and vehicles would have to meet mandatory product-related emissions standards for the products sold in Canada. These would be corporate average greenhouse gas emissions standards for new products sold in Canada, similar to the corporate average fuel efficiency (CAFE) standards for new vehicles. The product-related emissions standard would be defined in terms of a specified test procedure that reflected the use of the product so that the GHG emissions over the life of the product could be calculated.[25] Sales of products whose emissions are less than the standard generate credits, while sales of products whose emissions exceed the standard require the manufacturer or importer to purchase credits to achieve compliance.

The performance standard for buildings would be reflected in the building code.[26] Builders would be responsible for meeting the building code. A builder that wished to claim a credit for a more efficient building would need to provide calculations by the architect and/or mechanical engineer to support the claim. A builder that wanted a variance from the building code that would increase emissions would need to provide calculations by the architect and/or mechanical engineer of the impact on emissions.[27]

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[24] The performance standard for the firm could be constant for some period or could become more stringent over time. An example of a constant standard would be a 25% reduction from the 1995 emissions per dollar of output (adjusted for inflation) for the period 2008-2012. An example of a standard that becomes more stringent would be a 1% per year reduction from the 1995 emissions per dollar of output (adjusted for inflation). Assuming the actual emissions reductions involved are the same, a firm might prefer the declining standard if banking is allowed.

[25] Emissions of new vehicles are tested for a highway and an urban driving cycle. Using data on average vehicle lifetime (say 150,000 km) and the mix of urban (60%) and highway (40%) driving, it is possible to estimate the lifetime emissions. Many appliances and a lot of energy-using equipment use electricity as their main or only energy source. The test procedure for such products would be defined in terms of electricity use. This would be converted into greenhouse gas emissions using an average emissions coefficient for electricity.

[26] Procedures for calculating the energy use of a building are available. Such a procedure would form the basis of the emissions performance calculation. Since weather conditions have a substantial impact on building energy use, the emissions standards would need to vary by region.

[27] A builder could also seek a variance that did not affect the emissions performance. Again, the architect and/or mechanical engineer would need to demonstrate that the emissions performance was not affected.

The builder would then need to purchase credits equal to the extra emissions to achieve compliance.

The gases/sources of non-energy emissions listed in Table 2 would be covered by mandatory performance standards with voluntary credit trading. This would include emissions from large landfills, adipic acid, nitric acid, ammonia, lime, cement and aluminum production. Emissions associated with consumption of HFCs, SF_6 and PFCs would be covered. And the N_2O emissions due to fertilizer use are also addressed.

The main sources not covered are small landfills, methane emissions from open pit coal mines and emissions from livestock due to enteric fermentation and manure. These sources could create credits for documented emissions reduction or sequestration actions.

These standards will need to be revised periodically to reflect changes in technology, changes to the national commitment, or other developments. But the standards need to be set for some time into the future so that entities affected can implement a compliance plan. Those considerations suggest that the performance standards be defined at least five years into the future, with revisions roughly every five years.

SOURCES REQUIRED TO PARTICIPATE IN THE PROGRAM

As previously described, mandatory performance standards would apply to all large energy users and all manufacturers of appliances, energy-using equipment and motor vehicles. All builders would also be required to meet the performance standard incorporated into the building code. Large landfills, aluminum smelters, lime and cement producers, fertilizer manufacturers and importers, ammonia producers, magnesium smelters, nitric acid and adipic acid producers, and manufacturers and importers of HFCs, PFCs and SF_6 would also be subject to mandatory performance standards.

The number of sources subject to the mandatory performance standards could be very large. The two categories with the largest number of sources are industry and builders. There are roughly 33,000 industrial establishments in Canada, but 75% to 80% of industrial energy use is accounted for by about 400 large establishments in energy-intensive industries, such as pulp and paper, iron and steel, chemicals, mining, smelting and refining, cement, and petroleum refining.[28]

A definition of large energy-users is needed to determine which sources are subject to the performance standards for their operations. The definition should be related to annual

[28] Statistics Canada reports 32,718 manufacturing establishments in Canada in 1995. The number has fluctuated between 30,000 and 40,000 over the past 25 years, usually between 32,000 and 35,000. In 1995 the number of establishments with annual sales in excess of $5 million was 8,400, and the number with sales in excess of $50 million was 1,283. The NRTEE paper for Options 11, 13 and 14 estimates the number of industrial firms in energy-intensive industries at approximately 400.

emissions, for example annual greenhouse gas emissions in excess of 100,000 CO_2 equivalent tonnes, but could also be based on annual sales or energy use. It is assumed that a definition would be adopted that keeps the number of participants to a manageable number, say 400 to 2,500.

While there are many thousands of contractors, the number of general contractors responsible for construction of new buildings is not known. Building contractors are currently required to comply with the building code. Changing the building code so that it incorporates an emissions performance standard will not increase the number of builders affected. But it may increase the complexity of determining compliance with the code. Ease of administration and enforcement should, of course, be a consideration in choosing how the performance standard is reflected in the building code.

Sources that are not well suited to emissions trading and sinks would be allowed to create credits. Credits could be earned for capture of emissions from small landfills, open pit mines, and for carbon sequestration actions allowed by the international emissions limitation agreement. It might also be possible to earn credits through actions to reduce livestock-related emissions from enteric fermentation or manure.

NUMBER OF SOURCES INVOLVED

As noted in the previous section, the number of industrial sources covered by the mandatory performance standards could be reduced significantly by focusing on large energy-intensive plants. That could reduce the number of industrial sources to 400 to 2,500.[29] Manufacturers and importers of energy-using appliances, equipment and vehicle would be subject to product-related emissions standards for their products. The number of firms affected depends upon the range of products affected and whether participation is limited to larger firms. As a guess the number of firms could range from 100 to 2,500.

The number of sources of non-energy emissions, considering only large landfills, is approximately 200. The total number of sources affected, excluding builders, then would be approximately 700 to over 5,000. The number of builders is not known, but changing the building code would not increase the number of builders or the number of buildings that need to be inspected.

Since the credit trading program is voluntary, it is not possible to develop a very precise estimate of the number of participants. The cost savings due to engaging in credit trading will need to be less than the administrative costs. It is likely that most builders would simply comply with the performance standard as reflected in the building code rather than

[29] The lower end of the range includes the large energy-intensive industries identified in the description for Options 11, 13 and 14. The upper end of the range is the number of establishments with sales in excess of $25 million.

seek to create or use credits. Many small manufacturers and importers of appliances and energy-using equipment subject to mandatory product-related emissions standards are also likely to focus on meeting the standard rather than engaging in emissions trading.

Thus, participants in the trading program are likely to include large energy producers, oil refineries, natural gas processing plants, electricity generators, industries, oil and natural gas pipelines, railways, airlines, builders, and manufacturers and importers of appliances, energy-using equipment and vehicles. Sources not subject to the mandatory performance standards but able to reduce greenhouse gas emissions without double counting could "opt in" to the trading program by selling credits created by such actions.[30]

The number of participants is estimated to be in the order of 700 to over 5,000. The upper end of this range is more than the number of participants for any existing emissions trading program.

It is difficult to estimate the number of standards involved. It is likely to be less than the number of firms affected. Thus, if the program is limited to larger sources it could involve a few hundred standards, while a more comprehensive program might require one or two thousand standards. Some of the processes and products, such as buildings and light-duty vehicles, are already be subject to standards, so the number of additional standards required is smaller still.

SHARE OF TOTAL EMISSIONS COVERED BY PARTICIPANTS

Virtually all greenhouse gas emissions would ultimately be covered directly or indirectly by the mandatory performance standards. Energy-related emissions by large energy producers, oil refineries, natural gas processing plants, electricity generators, industries, oil and natural gas pipelines, railways and airlines would be subject to performance standards for emissions per unit of output. The large stationary sources plus rail and air accounted for almost 50% of total energy-related GHG emissions in 1995.[31]

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[30] Since most energy-related CO_2 emissions would be covered by the performauce standards, the number of sources able to reduce emissions without double counting is relatively small. Perhaps the largest category is improvements to the building shell, but not to the heating and cooling equipment, lighting or appliances of existing buildings. Sources that implemented such measures could document the reductions and sell the stream of credits to participants subject to the mandatory performance standards. In addition, credits could be earned for capture of emissions from small landfills, open pit mines, and for carbon sequestration actions allowed by the international emissions limitation agreement.

[31] A. Jaques, F. Neitzert and P. Boileau, *Trends in Canada's Greenhouse Gas Emissions (1990-1995)*, Environment Canada, Ottawa, April 1997, Table S5, p. xv. When combined with air and rail, total greenhouse gas emissions for the large stationary sources amounted to 235,980 CO_2 equivalent kilotonnes (kt). This is just under 50% of the total emissions from fuel combustion by stationary and mobile sources, excluding wood, of 473,636 CO_2 equivalent kt.

Energy-related emissions by residential, commercial, institutional and agricultural sources and motor vehicles would by regulated indirectly through mandatory product-related emissions standards for buildings, appliances, energy-using equipment and vehicles. Together those sources accounted for just over 50% of total energy-related greenhouse gas emissions in 1995.[32] Most of these emissions are from mobile sources.

Energy-related emissions by residential, commercial, institutional and agricultural sources and motor vehicles would only be covered gradually as the existing stocks of appliances, buildings, equipment and vehicles are replaced. Thus, the fraction of these emissions covered during the commitment period could be quite small unless the product-related emissions standards were instituted well in advance of the commitment period. Since the emissions also depend use, it suggests a role for complementary policies to influence the use of vehicles, appliances, equipment and buildings.

Approximately 70% of non-energy greenhouse gas emissions are covered by this design. The emissions covered include: cement and lime production, chemical production, other non-energy uses, waste incineration, fertilizer use, most landfill emissions and anaesthetic use. The non-energy sources not covered include livestock and manure, soils, prescribed burning, wastewater/compost, and wood fuels.

Assuming that mandatory performance standards for large energy users apply only to larger firms, that some share of upstream oil and gas emissions are not addressed by the standards, and that the product-related emissions standards come into effect shortly before the commitment period, the proposed system would address about 50% of Canada's total greenhouse gas emissions initially.[33] This would gradually rise to 80% to 90% of total emissions as existing stocks of appliances, buildings, equipmant and vehicles are replaced.

HOW THE TRADING PROGRAM WOULD BE ADMINISTERED

The mandatory performance standards would be developed and administered by the federal, provincial and municipal agencies responsible for regulating:

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[32] Ibid. Commercial, residential, agriculture, public administration, steam generation, other and mobile source emissions other than air and rail amounted to 237,656 CO_2 equivalent kt, of which 65% is due to mobile sources. The total is just over 50% of the total emissions from fuel combustion by stationary and mobile sources, excluding wood, of 473,636 CO_2 equivalent kt.

[33] This includes approximately 75% to 80% of the emissions by air, rail and large stationary sources; 10% of the commercial, residential, agriculture, public administration, steam generation, other and mobile source emissions; 80% to 100% of cement and lime production, chemical production, other non-energy uses, waste incineration, fertilizer use, landfill and anaesthetic use emissions; and a share of upstream oil and gas, coal mining and natural gas distribution emissions.

- emissions by energy producers, oil refineries, natural gas processing plants, electricity generators, industries, oil and natural gas pipelines, railways and airlines;
- performance of appliances, energy-using equipment and vehicles;
- the building code; and
- the participating non-energy sources.[34]

Administration of the mandatory standards will involve all levels of government and require considerable coordination. The federal government has jurisdiction over interprovincial transport and products involved in interprovincial and international trade. It also plays an important role in the development of the building code. Regulation of emissions is primarily a provincial government responsibility, and building inspection is a municipal responsibility.

Administration of the voluntary credit trading program could be delegated to a new entity created for that purpose. It could have a board of directors selected by the federal and provincial agencies responsible for the mandatory performance standards. The board of directors could also include representation of all stakeholder interests. This entity would develop the rules for the trading program and change them as necessary, be responsible for operation of the registry, and coordinate enforcement with the federal, provincial and municipal agencies responsible for compliance with the performance standards.

The process for developing the rules for the trading system would be similar to that used for other environmental regulations. Stakeholders would have an opportunity to comment on the proposed rules before they are adopted. The rules for the voluntary credit trading program would cover items such as:

- credit creation — calculation of the credits created, units of measurement, credit life, documentation required to support credit creation claims, creator liability, approval requirements, and sources not subject to mandatory performance standards eligible to create credits;

- credit use and transfer — eligible trading program participants, eligible users, eligible credit uses, geographic or temporal restrictions on trading or use, trading ratios, consideration of ancillary environmental impacts, banking, user liability, environmental donation, and approval requirements;

- registry, reporting and monitoring — required notices, monitoring requirements, documentation requirements, reporting requirements, price information, and confidentiality of proprietary information; and

[34] To enable sources to create and use credits in conjunction with the mandatory performance standards, the regulations promulgated by the federal, provincial and municipal governments to implement the standards should reference the credit trading organization and its rules.

- audit and verification — authority of the regulatory authority to require information, defer uses pending and audit, order a third party audit, determine credit eligibility, require annual reports, perform a program audit, and administer prohibitions, restrictions and penalties.

The Multistakeholder Expert Group made a number of recommendations for the initial program design. Those recommendations are summarized in Table 4.

Table 4 — Key Design Issues and Proposed Choices to Address Them

Issue	Choice	Comments
Geographic scope	- National program	- Doesn't matter if other countries have different approach to emission reductions
Basket of gases and sources	- 100% coverage of all emissions from fossil fuels - 100% coverage of other GHG emissions from listed sources	- Performance standards for production processes of large energy consumers - Performance standards for energy-using appliances, equipment, buildings and vehicles - Performance standards or emission caps for sources in Table 2 - Credit trading for landfills and ruminant CH_4 emissions
Creation of competitive market	- With 700-5,000 sources, shouldn't be a problem	
Incorporation of all programs into single market	- All participants should be in a single market	- all credits and allowances denominated in CO2 equivalent tonnes based on internationally agreed GWP values
Metering & testing	- Use company records as first basis	- Use standard tests, mass balance and other appropriate methods for determining compliance with the performance standards - allow for external auditing
Liability – seller or buyer?	- Buyer	- Buyer should ensure that credits are valid - Seller should ensure compliance before sale
Price disclosure	- No	- Not required for individual transactions. There will be enough transactions that brokers will be aware of prices
Transaction costs	- Keep low	- Keep administration of the program simple to hold costs down
Banking	- Yes	- Consistent with international commitment
Credit life	- Indefinite	
Borrowing	- No	- Avoid problem of how to deal with companies which go out of business
Compliance period	- Annual	- Have 30-60 day grace period at end of accounting year to allow companies over their limit to buy credits to comply
Penalties for non-compliance	- Yes	- Should reflect severity of the violation - Retire credits for excess emissions plus fines
GWP values	- Yes – follow Kyoto	- No retroactive changes

The entity responsible for the voluntary credit trading program would establish a registry to track ownership of credits created, traded and used. The registry could be developed and operated by the entity or it could be developed and operated under contract by a qualified organization. Any person or organization, not just entities subject to performance standards, should be allowed to engage in credit trading.

The performance standards are mandatory, while the credit trading program is voluntary. The main enforcement responsibility, then, lies with the various federal, provincial and municipal agencies responsible for compliance with the various standards. Credits can be created through over-compliance.[35] A claim for credits created might require certification by the responsible regulatory agency that the entity is in good standing and that the claim is correct. Credits can also be used to achieve compliance. The responsible regulatory agency could ask the trading program administrator to verify that the credits proposed for compliance use are valid. But any penalties for non-compliance remain the responsibility of the agency responsible for the performance standard.

The entity responsible for the trading system would only be responsible for enforcing compliance with the rules of the voluntary trading program, such as proper reporting. Penalties for non-compliance would likely take the form of fines and suspension from the trading program.

HOW EMISSIONS WOULD BE MEASURED

The mandatory performance standards for large energy producers, oil refineries, natural gas processing plants, electricity generators, industries, oil and natural gas pipelines, railways and airlines take the form of allowable energy-related greenhouse gas emissions per unit of output; for example CO_2 equivalent emissions per tonne of steel, per automobile manufactured, per kWh of electricity produced, or per dollar of sales. Each source subject to such a performance standard would be required to measure and report actual or calculated greenhouse gas emissions and actual output, measured in the appropriate units, for each year.

Actual emissions could be measured using continuous emissions monitors (CEMs) or be calculated using emissions coefficients and consumption of different fuels. Fuel consumption could be measured using fuel meters or be determined from fuel purchase records.[36] The choice of monitoring method will depend on the size of the source, the

[35] It is not necessary to establish criteria for credit creation for sources subject to mandatory performance standards. If actual performance results in lower emissions than the standard, credits equal to the difference can be claimed. The mandatory performance standards become the baseline for credit creation and use. Thus, concerns about additionality must be addressed when establishing the performance standards.

[36] It may also be necessary to require sources to meter some types of non-purchased energy. However, because use of wood waste should be encouraged as a substitute for fossil fuel use, it would not be necessary to meter the quantity of wood waste used. This would encourage such substitution.

types of fuels used, the number of points that need to be monitored and the costs of different monitoring systems. Rules for monitoring and reporting actual emissions would be part of the performance standard.

Actual output must also be reported to the regulatory authority. The regulator would have the authority to audit production records, sales reports and other documents as necessary to verify the accuracy of the data. Sources could also be required to provide copies of financial statements, income tax returns and GST returns to support the level of output reported.

The actual emissions would be divided by the actual output to determine whether the emissions performance standard had been achieved. If the actual emissions rate was lower than the performance standard, the source could claim a credit for the difference. This claim would be certified by the regulatory authority and then posted on the registry by the source. If actual emissions were higher than allowed by the performance standard, the source would need to purchase, and provide the regulatory authority with, enough credits to come into compliance. The credits provided to achieve compliance would be cancelled.

The mandatory product-related emissions standards for appliances, energy-using equipment and vehicles would take the form of greenhouse gases emitted in the course of a specified operational cycle. The standard would define the test procedure to be used. Tests would need to be performed at specified intervals by qualified independent laboratories. Manufacturers and importers of such products would be required to supply the test results to the regulatory agency. The agency would have the power to order additional tests by a laboratory of its choice if it was dissatisfied with the test results supplied by the manufacturer or importer.

Manufacturers and importers of appliances, energy-using equipment and vehicles would also be required to report actual sales of each product in Canada during the year. The regulator would have the authority to audit production records, sales reports, records of imports and exports and other documents as necessary to verify the accuracy of the data. Sources could also be required to provide copies of financial statements, income tax returns and GST returns to support the level of sales reported.

Compliance would be determined by comparing the test results for each product with the relevant product-related emissions standard. If the test results indicated actual emissions were lower than the standard, the source could claim a stream of credits equivalent to the reduction. The stream of credits would be calculated using specified assumptions about the use profile and life of the product. This claim would be certified by the regulatory authority and be posted on the registry by the source. If the test results indicated higher emissions than allowed by the performance standard, the source would need to provide the regulatory authority with enough credits to come into compliance. The stream of credits needed to achieve compliance would be calculated using the same assumptions

about the use profile and life of the product. Credits used to achieve compliance would be cancelled.

Municipal inspectors would ensure that each new building met the requirements of the building code. The building code would reflect the emissions performance standard for different categories of buildings. A builder that wished to claim a credit for a more efficient building would need to provide calculations by the architect and/or mechanical engineer to support the claim. A builder that wanted a variance from the building code that would increase emissions would need to provide calculations by the architect and/or mechanical engineer of the impact on emissions. The builder would then need to purchase the necessary stream of credits to achieve compliance.

Non-energy sources would be covered by mandatory performance standards similar to those for large energy sources - an emission rate per unit of production - or product-related emissions standards. Adipic acid, nitric acid, lime, cement, and ammonia production as well as aluminum and magnesium smelting appear to lend themselves to such standards. Emissions from consumption of HFCs, PFCs, SF_6 and fertilizers can probably best addressed through product-related emissions standards.

All of these sources would need to monitor or calculate actual "emissions" using methods specified by the regulatory authority. Sources subject to performance standards would also need to report their actual output to the regulatory authority. The regulator would have the authority to audit production records, sales reports and other documents as necessary to verify the accuracy of the data.

POSSIBLE COMPLEMENTARY POLICIES

Energy-related greenhouse gas emissions by large energy users would be regulated by mandatory performance standards defined in terms of energy-related GHG emissions per unit of output. Such a standard gives sources an incentive to implement the full range of energy-efficiency and conservation measures and to switch to less carbon-intensive energy sources.

Complementary policies should help these large sources implement measures to reduce their greenhouse gas emissions.[37] Possible policies include:

- information programs on emissions reduction options, including operational practices, fuel switching and more efficient technologies;
- audits to identify opportunities to reduce GHG emissions;
- changes to the tax code to ensure that different energy sources receive comparable treatment; and

[37] See NRTEE Issue Paper 11, *Evaluation of Possible Complementary Policies.*

- taxes or royalties on carbon-intensive fuels to provide a stronger financial incentive to implement measures that reduce energy-related GHG emissions.

Energy-related emissions by residential, commercial, institutional and agricultural sources and motor vehicles would by regulated indirectly through mandatory product-related emissions standards for buildings, appliances, energy-using equipment and vehicles. These sources account for approximately half of total energy-related greenhouse gas emissions. Mobile sources represent 65% of the emissions from these sources.

The energy-related greenhouse gas emissions from these sources depend on how the buildings, appliances, equipment and vehicles are used. The performance standards do not affect the use. Thus, there is a role for complementary policies aimed at changing the use of these buildings, appliances, equipment and vehicles, especially vehicles, in ways that reduce GHG emissions. Since the standards affect only new buildings, equipment and vehicles, complementary policies are needed to reduce emissions from existing buildings, equipment and vehicles. Possible policies include:

- information programs on energy efficiency, energy conservation, fuel switching and other emissions reduction options;
- building energy audits to identify opportunities to reduce GHG emissions;
- mandatory inspection and maintenance programs for vehicles;
- transportation demand management measures such as car/van pooling programs, high-occupancy vehicle lanes, public transit lanes, subsidies for public transit, restrictions on parking, higher fuel taxes, and road pricing;
- government procurement programs to stimulate demand for more efficient buildings, equipment and vehicles;
- changes to the tax code to ensure that different energy sources receive comparable treatment; and
- taxes or royalties on carbon-intensive fuels to provide a stronger financial incentive to change behaviour in ways that reduce energy-related GHG emissions.

Many of the non-energy emissions come from a small number of industrial sources. Governments could work with industry associations and/or the affected firms to disseminate information on emissions reduction technologies or practices. However, the scope for such activities may be limited by competitiveness concerns. Programs to reduce the volume of solid waste, to encourage more efficient use of fertilizers, and to reduce the use of HFCs, PFCs or SF_6 in consumer applications could usefully complement the standards and emission caps for those sources.

SPECIAL ISSUES RAISED BY THE DESIGN

Appliances, energy-using equipment and vehicles would be required to meet mandatory emissions performance standards. Those standards would need to be the same for both

domestically produced and imported appliances and equipment to be consistent with World Trade Organization (WTO) rules.[38] In addition, the standards would need to be defined in ways that do not treat imports unfairly.

In some cases it may be difficult for Canada to establish a greenhouse gas emissions performance standard alone. If Canada is a relatively small part of the total market for a product and larger markets adopt different approaches to managing the emissions from such sources, manufacturers (foreign and domestic) may not comply with the standard. However, the ability to comply by purchasing credits may still allow Canada to implement an emissions performance standard even if other countries adopt different policies.

Large industrial sources would be subject to mandatory emissions performance standards defined in terms of greenhouse gas emissions per unit of output. Those standards apply to production operations in Canada. Imported products (other than appliance, energy-using equipment, and vehicles) would not be subject to performance standards. The emissions associated with the production of the imported products are governed by the policies in the country of origin.

Petrochemical plants are among the large industrial sources that would be subject to mandatory performance standards for greenhouse gas emissions. They purchase fossil fuels for use as both an energy source and a feedstock. Since the focus is on GHG emissions and some petrochemical products sequester carbon for relatively long periods, the appropriate definition of the performance standards for the petrochemical industry needs to be carefully considered. The question of the appropriate treatment of feedstocks is discussed in a separate NRTEE issue paper.[39]

Other countries with national commitments could adopt performance standards, emissions taxes or emissions trading to manage their greenhouse gas emissions. The costs of Canada's policy to various industries could be higher or lower than the costs of the domestic policies adopted by other countries. The competitiveness impacts and leakage will be determined by the costs in Canada relative to its major trading partners. This is true regardless of whether Canada adopts a voluntary credit trading program with mandatory performance standards or some other policy to meet its national commitment.

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[38] WTO rules specify that imports cannot be required to meet more stringent standards than comparable domestic products. Since the objective is to reduce emissions, there is no reason to allow less stringent emissions performance standards for imports. Hence, both imports and domestic products should be subject to the same emissions performance standard.

[39] See NRTEE Issue Paper 5, *Design Options in a Domestic Emissions Trading System for the Treatment of Fossil Fuels Used as Feedstocks.*

TRANSITIONAL ISSUES RELATED TO A CHANGE IN THE POLICY SETTING

This option assumes that a national commitment to limit greenhouse gas emissions is in force. The commitment could become more stringent over time, or the commitment could become less stringent, perhaps to the point that no restrictions on GHG emissions are needed.

If the commitment becomes more stringent, the mandatory performance standards would need to be made correspondingly more stringent to meet the commitment. But no change would be necessary to the voluntary credit trading program.

If the commitment becomes less stringent, the mandatory performance standards could be maintained or relaxed. Again no changes would be needed to the voluntary credit trading program. But as compliance with the existing or relaxed standards became easier, the volume of trading activity and prices of credits could be expected to fall.

One advantage of this design is that implementation could begin early on a voluntary basis. Large energy users could negotiate performance standards with the federal or provincial governments. Product-related emissions standards could also be negotiated or mandated for selected appliances, equipment or vehicles. Indeed, early initiatives in this area may be crucial given the long lags before such standards have a significant impact on total emissions. Sources of non-energy related emissions also could negotiate performance or product-related emissions standards with the relevant governments before the national commitment came into force.

EVALUATION OF THE OPTION USING PROPOSED CRITERIA

The criteria proposed for evaluating proposed greenhouse gas emission trading options are:[40]

Economic efficiency
- Cost-effectiveness
- Transactions costs
- Comprehensiveness

Equity
- International equity
- Domestic equity
- Industrial equity

Technical feasibility

[40] These criteria are drawn from *Analysis of the Potential for a Greenhouse Gas Trading System for North America*, Commission for Environmental Cooperation, Montreal, May 1997, Chapter 3, pp. 32-42. They are described fully there.

- Technical flexibility
- Timing
- Leakage

Political feasibility

- Domestic political compatibility
- International compatibility
- Sovereignty

Administrative feasibility

- Measurability
- Verifiability
- Enforceability

Cost-effectiveness: Emissions trading should minimize the cost of reducing greenhouse gas emissions to individuals, firms and society. Cost-effectiveness requires that each source find the lowest cost options to reduce its GHG emissions, that the marginal cost of reducing GHG emissions be equalized across all sources, and that the costs of GHG emissions be reflected in product prices so that the mix of goods and services consumed adjusts to "economize" GHG emissions to an appropriate degree.

The cost of meeting the mandatory performance standards is likely to vary from source to source. The voluntary credit trading program improves cost-effectiveness. Sources faced with high compliance costs can reduce those costs by buying credits. Sources with low compliance costs are encouraged to reduce emissions further and to sell surplus credits. Sources are not required to engage in trading.

A system of mandatory performance standards for greenhouse gas emissions per unit of output creates an incentive to reduce emissions. And the voluntary credit trading system enables the marginal costs to be equalized across sources. But this system does not create the correct price signal for a fixed limit on national GHG emissions. This is because total emissions are not constrained; rather, output can be increased and each unit of output is allowed additional GHG emissions equal to the mandatory performance standard.

In addition, the price increases may not strictly reflect the greenhouse gas emissions associated with the different products due to taxes, the elasticity of demand for different products, and competition from other products. Consumers do not respond perfectly to changes in energy prices because of market failures.

Since product prices will not accurately reflect the greenhouse gas emissions and since some consumers do not respond optimally to energy price changes, the result will not be fully cost-effective. This system is likely to be less cost-effective than other trading system designs, such as Option 4, but more cost-effective than other forms of regulation with no trading.

Transactions costs: Transactions costs for emissions trading programs should be minimized. Combining the voluntary credit trading program with mandatory performance

standards helps reduce transactions costs. The mandatory performance standards define the baselines for credit creation and use. Monitoring and reporting for credit creation and use is combined with the monitoring and reporting for compliance with the performance standards. Reducing the transactions costs in this way encourages credit trading.

Comprehensiveness: An emissions trading program should cover as broad a range of greenhouse gas sources and sinks as possible. This design covers approximately 50% of Canada's total greenhouse gas emissions initially, but coverage gradually rises to an estimated 80% to 90% as the existing stocks of appliances, buildings, equipment and vehicles are replaced.

Approximately half of the energy-related GHG emissions would be covered directly by performance standards for large energy users. The other half would be addressed indirectly through product-related emissions standards for buildings, appliances, energy-using equipment and vehicles. Coverage of these emissions would increase gradually over time. About 70% of non-energy emissions would be covered by mandatory performance standards.

Participation in the credit trading program is voluntary and is likely to be dominated by large energy producers, oil refineries, natural gas processing plants, electricity generators, industries, oil and natural gas pipelines, railways, airlines builders, and manufacturers and importers of appliances, energy-using equipment and vehicles. The number of participants is estimated to be in the order of 700 to 5,000.

International equity: An emissions trading program should be fair to developing countries. International equity would be addressed through the agreements that establish the national commitments. The domestic credit trading program does not affect international equity because the trading simply facilitates compliance with the mandatory performance standards, which are designed to achieve the national commitment. The national commitment is part of a set of internationally negotiated national commitments, which reflect international equity and other considerations.

Domestic equity: An emissions trading program should be equitable in terms of its impacts on different income groups and regions. Equity is determined by the mandatory performance standards for different energy users. The costs of complying with the standards will vary from source to source. The costs of compliance will be passed on to customers, suppliers, employees and shareholders in the form of higher product prices, lower prices for supplies, and lower employee wages and shareholder returns.

The burden on an individual depends on how the compliance costs are distributed, the mix of goods and services purchased, and the individual's role as an employee and shareholder. Studies of the impacts of a carbon tax suggest that the impacts represent a slightly higher share of income for low-income groups. The credit trading option tends to lower the cost of compliance relative to mandatory standards without trading and so improve equity across income groups.

The product-related emissions standards affect only new appliances, buildings, energy-using equipment and vehicles. Thus, their impact on total emissions from residential, commercial, small industrial, agricultural sources and motor vehicles will be small initially. If the complementary policies are not able to achieve a "fair" share of the total emissions reduction from these sources, it would impose larger emission reduction burdens on other sources.

Industrial equity: An emissions trading program should treat different industries and sectors fairly (not necessarily equally). Equity is determined by the mandatory performance standards for different industries and sectors. Credit trading tends to improve equity by equalizing the marginal cost of compliance across sources. In any case, a source has the option of not engaging in trading.

The number of sources subject to the standards is estimated to range between 700 and 5,000, excluding builders. Compliance with the performance standards on the part of these sources will need to be enforced by a number of different federal, provincial and municipal agencies. These agencies will also need to cooperate in the development and revision of the performance standards to ensure that firms in the same industry in different parts of the country are treated fairly.

Technical flexibility: An emissions trading program should allow maximum flexibility in terms of the choice of reduction or sequestration technology to implement. How the mandatory performance standards are defined determines the range of technical options available for compliance. It is important that the standards be defined in a way that encompasses as many emission reduction options as possible. That requires performance standards for large energy users defined in terms of emissions per unit of output, which may be difficult given the diversity of products across firms and industries. Firm-specific performance standards defined in terms of greenhouse gas emissions per dollar of sales in a base year and reduced by some percentage and adjusted for inflation might be a solution.

This option involves a large number of mandatory performance standards, which will need to be revised periodically. The processes and institutions needed to establish such standards already exist in many sectors. Indeed, standards already exist for at least some of these products and processes. Thus, the technical capacity to develop the standards and to test products for compliance with standards already exists.

Timing: An emissions trading program should allow maximum flexibility in the timing of reduction or sequestration actions. If banking is allowed, as recommended by the Multistakeholder Expert Group, a voluntary credit trading program would provide sources with flexibility in the timing of actions to meet the mandatory performance standards.[41]

[41] See the NRTEE paper on Issue 8, *Analysis of Emissions Trading Program Design Features.*

Leakage: An emissions trading program should minimize increases in emissions elsewhere. The mandatory performance standards determine the burden imposed on each source and hence the economic advantage to shifting production elsewhere. The voluntary credit trading program reduces the total cost of compliance and tends to equalize the marginal costs of compliance across sources. Thus the trading program tends to reduce leakage to other countries and to reduce shifts in production among domestic sources due to differences in compliance costs. In addition, if the performance standards are expressed in terms of emissions per unit of output, the level of output is not constrained, again reducing the incentive to shift production to other countries.

Domestic political compatibility: An emissions trading program should minimize potential conflicts with existing and future domestic policies. The constitutional authority and regulatory tradition required to implement a set of mandatory performance standards is well established. The voluntary credit trading program supplements that regime, but does so in ways that are likely to be attractive to at least some industrial sectors. Effective enforcement and administration will require coordination of numerous federal, provincial and municipal agencies.

International compatibility: An emissions trading program should minimize potential conflicts with existing and future international regimes. Many countries would have national commitments, such as those under the Kyoto Protocol, to limit their greenhouse gas emissions. It is presumed that each country would have considerable latitude to adopt its preferred policies domestically, and that mandatory performance standards with a voluntary credit trading program would be an acceptable domestic policy.

The question of the compatibility of the mandatory performance standards with the domestic policies adopted by other countries then arises. If the performance standards are defined in terms of GHG emissions per unit of output, imported products would be unaffected except to the extent that they undergo further processing in Canada. The competitiveness impacts and leakage will depend on the costs of Canada's policies on various industries relative to the domestic policies adopted by other countries.

Imported and domestic appliances, energy-using equipment and vehicles would be subject to the same performance standards. This should not create any problems under WTO rules unless the standards treat imports unfairly. Since Canada is a small market for some of these products, it may be difficult to implement the performance standards if other countries adopt different policies. Motor vehicles are the conspicuous example of a product where such difficulties could arise.

Sovereignty: An emissions trading program should minimize the need for international oversight and interference. A policy of mandatory performance standards with a

voluntary credit trading program should entail no international oversight other than that required to ensure compliance with the national emissions limitation commitment.

Measurability: An emissions trading program should minimize the uncertainty and complexity of measuring emissions reduced or sequestered. The mandatory performance standards determine the quantities that need to be measured. As noted, the performance standards for large energy users should be expressed in terms of emissions per unit of output. Developing such performance standards may be difficult due to the diversity of the output of many plants. Large energy sources subject to such standards would need to monitor or calculate their actual greenhouse gas emissions using prescribed methods. The additional monitoring and reporting requirements, except where continuous emissions monitoring equipment is required, need not be very costly.

The mandatory performance standards for appliances, energy-using equipment and vehicles will require those products to be tested periodically in accordance with prescribed test procedures by qualified independent laboratories. That could be relatively costly for some products. The manufacturers and importers would need to provide the regulatory agency with the independent test results and data on sales in Canada of the regulated products.

It should be possible to measure most of the data needed to establish compliance with the performance standards quite accurately. The costs of measuring the data need not be large except where continuous emissions monitoring is required, or where independent laboratory tests are required for products with low sales volumes. The voluntary credit trading program relies on the same data and so does not increase the complexity or reduce the accuracy of the measurements required.

Verifiability: An emissions trading program should increase confidence on the part of participants and other stakeholders that the emissions reductions claimed have been achieved. Aggregate performance will be tracked through national reporting of greenhouse gas emissions. Those reports are prepared using agreed inventory methodologies and are subject to external review. The inventories rely on national statistics for energy production, imports and exports. If the performance standards are not being enforced or are not sufficiently stringent, it will soon be apparent from the national inventory.

Enforceability: An emissions trading program should maximize compliance with emissions limitation commitments. This option requires enforcement of the mandatory performance standards and compliance with the rules of the trading system.

Enforcement of the mandatory performance standards is, by far, the more difficult task. This option requires a relatively large number of performance standards to be developed and enforced. The sources subject to standards will probably number in the thousands. Compliance with the standards will need to be enforced each year. And enforcement will

be in the hands of numerous federal, provincial and municipal agencies. In short, this option poses a considerable enforcement challenge.

In addition to enforcement of the mandatory performance standards, adherence to the rules of the voluntary trading system needs to be enforced. Violations of trading rules would probably lead to fines and/or suspension of the right to participate in the trading system.

National Round Table on the Environment and the Economy
Table ronde nationale sur l'environnement et l'économie

Extended Description of Option 8: Voluntary Credit Trading with Mandatory Performance Standards

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August, 1998

Extended Description of Option 8: Voluntary Credit Trading with Mandatory Performance Standards

INTRODUCTION

A July 1998 National Round Table on the Environment and the Economy (NRTEE) paper on *Possible Designs for a Domestic Emissions Trading Program for Greenhouse Gases* identified fourteen possible designs for a domestic emissions trading program for greenhouse gases. Six of those designs were selected for further analysis. The fourteen designs and the six selected for further analysis are shown in Table 1.

This paper provides an extended description of one of the options selected; Option 8: A Voluntary Credit Trading Program with Mandatory Performance Standards. This paper covers:

- A description of the trading program
- Descriptions of similar existing programs
- The emissions covered by the trading program
- The sources required to participate in the program
- The number of sources involved
- Share of total emissions covered by participants
- How the trading program would be administered
- How emissions would be measured
- Possible complementary policies
- Special issues raised by the design
- Transitional issues related to a change in the policy setting
- Evaluation of the option using the proposed criteria

DESCRIPTION OF THE TRADING PROGRAM

Option 8 is a voluntary credit trading program with mandatory performance standards to meet a national commitment to limit greenhouse gas emissions.

Under this policy setting Canada is faced with meeting a national commitment to limit its greenhouse gas emissions. In Option 8 governments adopt a series of mandatory performance standards to limit greenhouse gas emissions. Voluntary credit trading is allowed to reduce the cost of complying with the standards.

Two types of mandatory performance standards would be established. Large energy users, including energy producers, oil refineries, natural gas processing plants, electricity generators, industries, oil and natural gas pipelines, railways and airlines, would be subject to performance standards for energy-related emissions per unit of output.

Manufacturers and importers of appliances, energy-using equipment, and vehicles would be subject to performance standards for the products they sell in Canada. Builders likewise would be subject to a performance standard for buildings.

Table 1: Summary of Possible Designs and Recommended Short List

Design	Short List	Description
Prospect of future commitment to limit GHG emissions		
1	✓	Voluntary credit trading
2		Voluntary cap and trade system
No specific prospect of a commitment to limit GHG emissions		
3		Voluntary credit trading
Commitment to limit GHG emissions exists		
4	✓	Cap on carbon content of fossil fuels produced and imported with trading by producers, importers and exporters
5		Cap on carbon content of fossil fuels crossing provincial and international borders, with trading by owners of the fuels
6		Cap on the carbon content of fossil fuels implemented at the narrowest point in the distribution chain, with trading by owners of the fuels
7		Voluntary credit trading
8	✓	Voluntary credit trading with mandatory performance standards
9		Mandatory credit trading
10		Voluntary cap and trade system
11	✓	Cap on emissions by fossil fuel users, trading by large fuel users and oil companies for transportation fuels
12		Same as previous option, but excluding transportation sector
13	✓	Same as option 11 but with no opportunity to purchase credits or allowances from sequestration or sources outside the program
14	✓	Cap on emissions by fossil fuel users, trading by large fuel users and municipalities for transportation and commercial/residential buildings

Large energy users would be subject to mandatory performance standards expressed in terms of emissions per unit of output; for example CO_2 equivalent emissions per tonne of steel, per automobile, or per kWh of electricity produced.[1] The regulations that establish

[1] Participants should have an incentive to implement all cost-effective measures to reduce greenhouse gas emissions. For energy users, this means all energy-efficiency and conservation measures and all fuel switching options that reduce greenhouse gas emissions. Expressing the performance standard in terms of energy-related greenhouse gas emissions per unit of output covers all of those options. In contrast,

the standards also specify the sources to which they apply. These sources have the option of participating in a voluntary credit trading program to comply with the performance standards.

Large energy users able to reduce their emissions below the level specified by the performance standard can create credits. Consider, for example, a steel company subject to a standard of R kg of CO_2 per tonne of steel that produced 1,548,000 tonnes of steel during a given year. To comply with the standard its actual emissions would need to be less than 1,548 * R CO_2 equivalent tonnes.[2] If its actual emissions for the year were 1,500 * R tonnes of CO_2 equivalent, it could claim credits of 48 * R CO_2 equivalent tonnes. The credits could be sold to another participant in the trading program, or banked for future use if this is allowed.

A source that found direct compliance with the performance standard difficult or costly could comply by purchasing credits instead. Consider, for example, an electric utility that planned to achieve compliance with its performance standard of S grams per kWh for a projected load of 867 MWh assuming average weather conditions. If a colder winter or warmer summer increased the load to 889 MWh and increased emissions due to greater reliance on coal-fired generation, it could purchase credits to achieve compliance. It would need to purchase enough credits to reduce the remaining actual emissions to 889 *S CO_2 equivalent tonnes.[3] Thus, the performance standard establishes the baseline for credit creation and use.[4]

The mandatory performance standards are not emissions caps because they are expressed in terms of emissions per unit of output. Total allowable emissions would change as actual output changed. Governments would need to set the performance standards to ensure that actual emissions are less than the national commitment. The performance standards would also need to be adjusted periodically to reflect changes in technology or the national commitment. The performance standards must be defined in a manner that facilitates credit creation and use; for example, CO_2 equivalent emissions per tonne of steel rather than a requirement to install best available control technology.

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expressing the performance standard in terms of energy-related greenhouse gas emissions per unit of energy input provides an incentive to switch to less carbon-intensive fuels, but not to implement energy efficiency or conservation measures. Thus, an output standard is better than an input standard for energy consumers.

[2] The number of credits is calculated as follows: 1,548,000 tonnes of steel multiplied by the standard of R kg of CO_2 equivalent per tonne of steel divided by 1,000 kg per tonne of CO_2 for a total of 1,548 * R CO_2 equivalent tonnes.

[3] Note that the standard applies to the actual sales of 889 MWh, not the projected sales of 867 MWh.

[4] A source would not need to document specific actions implemented to reduce its emissions. Rather credits are created by documenting that actual emissions are lower than allowed by the mandatory performance standard. The sources and output covered are also specified by the performance standards.

Residential, commercial, institutional and motor vehicle emissions of greenhouse gas emissions would be controlled indirectly through mandatory performance standards for buildings, appliances, energy-using equipment, and vehicles. New vehicles sold in Canada would be subject to mandatory corporate average fuel efficiency (CAFE) standards applied to all manufacturers and importers of cars and trucks. Similarly, manufacturers and importers of appliances and energy-using equipment would be subject to mandatory performance standards for the products sold in Canada. The performance standards would specify energy-related greenhouse gas emissions for each model under specified test conditions. Builders likewise would be subject to a performance standard for buildings.

The performance standards do not restrict sales of the appliances, equipment or vehicles nor construction of new buildings during a given year. Actual emissions will be determined by the use of the existing stock of buildings, appliances, equipment and vehicles, so the performance standards also do not cap emissions.

Exceeding the performance standard would create a stream of credits measured in CO_2 equivalent tonnes. Assume that a motor vehicle manufacturer sold 100,000 new vehicles in Canada during a given year and that the performance standard for the vehicles of that type was T tonnes per year based on a specified test procedure and assumed use profile.[5] If the vehicles actually sold beat the standard by 10%, the manufacturer could claim credit for 10,000 * T CO_2 equivalent tonnes. Those credits would be assigned to the current and future years based on the expected life and use profile of the vehicle.[6]

An appliance manufacturer whose sales in Canada did not meet the performance standard would need to purchase a stream of credits for the current and future years based on the expected life and use profile of the appliance for the excess emissions. Thus the performance standards for appliances, equipment, vehicles and buildings also define the baseline for credit creation and use.

The credits created by appliances, equipment, vehicles and buildings must be distributed over the lives of the items that generated them if they are to be tradable.[7] Otherwise

[5] The test procedure might measure emissions during urban and highway driving cycles. And the use profile might assume an average of 12,000 km per year of which 60% is urban driving and the 40% is highway driving.

[6] The credits would be distributed over time based on the scrappage profile and usage pattern for vehicles. Thus, of the 10,000 T CO_2 equivalent tonnes of credits over the life of the vehicle, 1,500 T tonnes might be assigned to the current year because new vehicles are heavily used and the scrappage rate is low while 200 T tonnes might be assigned to the 15th year of the expected vehicle life because most of the vehicles will have been scrapped and the remaining old vehicles will tend to be used less than the fleet average. A standard profile would be used to allocate the stream of credits for each type of appliance, equipment, vehicle and building over time.

[7] An alternative to converting the appliance, equipment, vehicle and building standards into a stream of credits over the life of the product is to establish a series of separate trading programs each limited to the performance standard of a product category with a comparable lifetime and usage pattern. For example, the standard would be defined for a basic residential refrigerator. Over compliance and under compliance

compliance with the national commitment is compromised. Assume that all of the 10,000 * T credits could be used immediately by large energy users. Emissions by the energy users that purchased the credits would rise well before the reductions anticipated from the more efficient vehicles are realized.

Some other greenhouse gas emissions could be controlled by emissions (allowance or credit) trading programs.[8] Credits or allowances from these other domestic programs or from the international cooperative mechanisms -- international emissions trading, joint implementation reductions, or clean development mechanism credits -- could also be used by program participants to comply with the mandatory performance standards. If a "credit for early action" incentive is established, credits registered under that program might also be eligible for use in the trading program.

The voluntary credit trading program would be established and administered by the regulatory authorities responsible for monitoring compliance with the mandatory performance standards. The trading program is a means of compliance with those standards, so the regulatory authority must establish the requirements for achieving compliance and then monitor the performance of the participants.

The entity established to administer the trading program will need to establish rules for credit creation and use, including reporting requirements, credit life, banking, price disclosure, provisions for sale or use of allowances or credits from other domestic or international programs, establishment of a registry, audit and verification provisions, and penalties for non-compliance.[9] These rules would be developed in the same way as other pollution control regulations, so stakeholders would have an opportunity to comment on the proposals.

A drawback of such a credit trading program as a means of meeting a national emissions limitation commitment is that it does not cap emissions by participants very precisely. The mandatory performance standards for large energy users are defined in terms of

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would be measured in fractions of the standard. Then a manufacturer that sold 10,000 refrigerators in Canada which out performed the standard by 1% would receive 100 refrigerator credits. The refrigerator credits could only be used for appliances in the residential refrigerator category. The drawback of this approach is that it would create a number of separate trading programs each with only a few (less than 15) participants. The experience of the American averaging, banking and trading (ABT) program for heavy-duty vehicle engine emissions standards and the Canadian ozone-depleting substances program is that there is very little inter-firm trading in such cases.

[8] Virtually all domestic energy-related greenhouse gas emissions would be covered by the mandatory performance standards and the voluntary credit trading program. Thus, credit creation for reduction of domestic energy-related greenhouse gas emissions is likely to lead to double counting. But there will be a few actions to reduce energy-related greenhouse gas emissions that do not lead to double counting, improvements to the building shell (but not the appliances or equipment) of an existing building for example. Actions that reduce emissions without double counting should, of course, be allowed under the program.

[9] Many of these provisions are discussed in NRTEE paper on Issue 8, *Analysis of Emissions Trading Program Design Features.*

emissions per unit of output, but the level of output and, hence, total emissions are not restricted.[10] Similarly the performance standards for appliances, equipment, vehicles and buildings do not control the use of those products and so do not limit total emissions. The government then has two options. One is to make the performance standards sufficiently stringent that they will be met under virtually any economic or weather conditions, which could be costly. The second is to run a relatively high risk of non-compliance with the national commitment.

DESCRIPTIONS OF SIMILAR EXISTING PROGRAMS

A voluntary credit trading program with mandatory performance standards would be similar to the American trading program for the lead content of leaded gasoline and the averaging, banking and trading (ABT) provisions of the heavy-duty engine emissions standards.

Trading for the Lead Content of Leaded Gasoline

Effective November 1982, the American Environmental Protection Agency (EPA) introduced trading as part of its program for phasing out lead in gasoline. The program included all refiners and importers of leaded gasoline. Trading encouraged more efficient use of lead by taking advantage of the non-linear octane response to lead.[11]

Refiners and importers were allowed to create lead rights equal to the regulatory limit on the lead content of leaded gasoline multiplied by their leaded gasoline production during the calendar quarter less the actual quantity of lead used.[12] Lead rights could be sold to other refiners and importers for use during the quarter in which they were created. The quarterly average of actual lead used by buyers could not exceed the mandated limit plus the quantity of rights purchased. Trades were reported to the EPA at the end of each quarter. Trades were not subject to an approvals process, only a potential audit.

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[10] It is possible to define the mandatory performance standards as limits on total emissions (caps). But then this option becomes simply an administrative variant on a cap and trade system for energy consumers, such as Option 11 as described in NRTEE paper *Description Of Different Potential Allowance Trading Programs For Canada*. Since the purpose is to explore alternative trading system designs, the performance standards are assumed to be defined as emissions per unit of output.

[11] The octane boost provided by lead declines exponentially as the lead content increases. Reducing the lead content from prevailing levels only reduced the octane rating a little. But adding the lead saved to gasoline with no lead provided most of the desired octane boost. Thus trading encouraged more efficient use of lead.

[12] The lead content was limited to a maximum of 1.1 grams per gallon.

Faced with new evidence of health damage from lead the EPA realized that the natural reduction in lead use as leaded fuel vehicles retired would not address the problem quickly enough. In August 1984 the EPA set a maximum lead content for leaded gasoline of 0.5 grams per gallon effective July 1, 1985 and 0.1 grams per gallon after January 1, 1986.[13]

To facilitate the reduction from 1.1 grams per gallon at the beginning of 1985 to a 0.1 grams per gallon at the beginning of 1986, the EPA introduced banking into the trading system effective January 1, 1985. Refiners and importers were allowed to bank lead credits during calendar 1985 and to withdraw credits until the end of 1987. In other words, banking changed the credits from a three-month life to a maximum three year life ending at the end of 1987.

The lead credit trading program saved refiners over $200 million. The EPA originally estimated that approximately 9.1 billion grams of lead would be banked, and that banking alone would save refiners $226 million. The actual amount of credits banked, 10 billion grams, was close to the initial estimate, resulting in a projected average savings of 2.5 cents per gram banked.

The fact that a large number of firms entered (and exited) the gasoline "refining" business over the five years of the trading program probably contributed significantly to the cost savings.[14] The fact that so many firms entered the industry suggests that profits were relatively high. The added competition probably reduced producer profits and prices to gasoline consumers.

The lead credit trading program allowed the government to reduce the maximum lead content of leaded gasoline much more quickly than under a program without trading where each refiner would need to have adequate time to adjust to the new standards. The lead credit trading program probably did not affect overall volume of lead use or the net environmental effects. The number of violations under the trading program was similar to the number under the previous regulatory phase down.

Heavy-Duty Vehicle Engine Emissions Standards

Another example of a voluntary credit trading program with mandatory performance standards is the averaging, banking and trading (ABT) provisions of the emissions standards for heavy-duty truck and bus engines. The U.S. Environmental Protection

[13] Note that the total quantity of lead was not constrained. The maximum lead content per gallon combined with declining sales of leaded gasoline due to the decreasing number of vehicles using leaded gasoline led to a reduction in lead emissions.

[14] A "refiner" was anyone who manufactured gasoline, thus someone who added ethanol to leaded gasoline was deemed to make an amount of leaded gasoline equal to the amount of ethanol added.

Agency regulates emissions from heavy-duty and non-road engines. The regulations cover carbon monoxide (CO), hydrocarbons (HC), non-methane hydrocarbons (NMHC), nitrogen oxides (NOx), particulate matter (PM) and smoke, but the emissions regulated differ for different engines. Some standards must be met by every engine, while others must be met by engine categories as a group. The NOx and PM standards allow the use of ABT provisions.

The regulations apply to manufacturers of spark ignition (Otto cycle) and compression ignition (diesel) engines for heavy-duty trucks and urban buses. The averaging, banking and trading provisions are limited to NOx and PM because the emissions standards for these pollutants have been tightened to the point where they are driving engine technology.[15] The ABT provisions were introduced to facilitate compliance with the lower standards that came into effect for the 1990 model year.

Where ABT is allowed, the regulations specify both the standard and a maximum emission rate for the pollutant. Every engine must have an emission rate lower than the maximum rate for each ABT pollutant.[16] The standards and maximum emission rates for the NOx and PM for different types of engines are shown in Table 2.

Engines whose emissions are lower than the specified standard generate emission credits. Credits can be used to help engines in the same category whose emissions exceed the standard (but are below the maximum rate) achieve compliance with the standard. Averaging, banking and trading are different possible uses of credits, which are defined in the program as follows:

- *Averaging*: Credits offset emissions for engines manufactured during the same year whose emissions are above the specified average to help the company achieve compliance during that year.

- *Banking*: Credits offset emissions for engines manufactured during a future year whose emissions are above the average specified to help the company achieve compliance during that year.

- *Trading*: Credits are sold to another company and are used to offset emissions for engines manufactured during the current or a future year whose emissions are above the average specified for the year the credits are used.

Credits can only be created and used within the same engine category. There are three categories of diesel truck and bus engines: light, medium and heavy-duty engines. Otto cycle engines is a separate category.

[15] In other words the emissions standards for the other pollutants might not impose a binding constraint on manufacturers. In that case there would be no cost savings due to emissions trading and the demand for credits would be zero.

[16] Every engine must also have an emission rate below the standard for each of the other regulated pollutants for that engine.

Credits previously had a life of three years, but beginning in 1998 they have an unlimited life. Previously banked or traded credits were discounted by 20%, but beginning in 1998 a differential discount is applied depending on the emission rate of the engines used to generate the credit. These changes are designed to encourage early action to meet strict new standards that come into effect in 2004.

Table 2: Standard and Maximum Emission Rates for Heavy-Duty Engines
(rates are in grams per brakehorsepower-hour)

	Standard				Maximum			
	NOx	NOx + NMHC	PM Trucks	PM Urban Buses	NOx	NOx + NMHC	PM Trucks	PM Urban Buses
1988 - 1989[a]								
Diesel	10.7		0.6	0.6				
Otto	10.7							
1990 - 1992								
Diesel	6.0		0.6	0.6	10.7			
Otto	6.0				10.7			
1993								
Diesel	5.0		0.25	0.1	6.0		0.6	0.25
Otto	5.0				6.0			
1994 - 1995								
Diesel	5.0		0.1	0.07	6.0		0.6	0.25
Otto	5.0				6.0			
1996 - 1997								
Diesel	5.0		0.1	0.05[c]	6.0		0.6	0.25
Otto	5.0				6.0			
1998 - 2003								
Diesel	4.0		0.1	0.05[c]	5.0		0.6	0.25
Otto	4.0				5.0			
2004 -								
Diesel		2.4[b]	0.1	0.05[c]		4.5	0.6	0.25
Otto	4.0				5.0			

Notes: a) The ABT provisions did not come into effect until the 1990 model year.
b) The standard for 2004 and subsequent years is 2.4 g/bhp-hr for NOx+NMHC or 2.0 g/bhp-hr for NOx with a cap of 0.5 g/bhp-hr for NMHC
c) This is combined with a 0.07 g/bhp-hr in-use standard

At present, credits can only be traded among engine manufacturers. Beginning in 2004 it will also be possible to use the credits in other programs subject to meeting the conditions of the programs for which they are purchased. For example, if new urban buses for use in an ozone non-attainment area exceed the NOx standard, the regulatory authority might allow the NOx credits created to be used for compliance purposes by stationary sources.

Eleven manufacturers are covered by the program. Reports on ABT activity for on-highway diesel engines have been submitted on paper and are confidential. Data on use of the ABT provisions is expected to be made public late in 1998, but is currently not

available. Program staff indicate that manufacturers have used averaging a little more than banking.[17] Banking tends to be used just before standard changes. The first inter-company trade occurred in 1997 and involved a small quantity of PM credits.

Averaging, banking and trading provisions have also been adopted or proposed for emissions from several categories of non-road engines. Specifically:

- NOx emissions by diesel engines of more than 50 hp used in non-road equipment such as farm tractors, bulldozers, cranes and forklifts;[18]
- HC+NOx emissions by spark ignition outboard engines beginning with the 1998 model year and for personal watercraft engines beginning with the 1999 model year;
- NOx and PM emissions by locomotives, beginning in 2000;
- proposed revised HC + NOx standards for non-road spark ignition engines less than 25 hp.

The extension of ABT provisions to other engine categories suggest satisfaction on the part of the EPA and engine manufacturers with such a trading program.

EMISSIONS COVERED BY THE TRADING PROGRAM

The mandatory performance standards and voluntary credit trading program would cover virtually all energy-related greenhouse gas emissions directly or indirectly. It would cover large energy users -- energy producers, oil refineries, natural gas processing plants, electricity generators, industries, oil and natural gas pipelines, railways and airlines -- directly by making them subject to mandatory performance standards per unit of output. Residential, commercial, institutional and transportation emissions would be covered indirectly through mandatory performance standards for virtually all buildings, appliances, energy-using equipment, and vehicles sold in Canada.

Mandatory performance standards would be established for all large energy users. Ideally, these standards would be defined in terms of CO_2 equivalent greenhouse gas emissions per physical unit of production; for example CO_2 equivalent emissions per tonne of steel, per automobile, or per kWh of electricity produced. However, it may be difficult to find a comprehensive measure of physical output given the diversity of the output produced by many plants, let alone firms of industries. In some cases it may be

[17] Averaging is more attractive because banked credits have been discounted by 20% while credits used for averaging are not discounted.

[18] The EPA has proposed to replace the existing HC and NOx standards with a NMHC + NOx standard, to revise the PM standard and to allow ABT for both. The EPA is also in the process of finalizing rules to implement emissions standards for non-road diesel engines of less than 50 hp beginning in 1999. Current proposals for those rules include ABT provisions for NMHC + NOx and PM.

possible to identify a few key products that are relatively homogeneous across firms and account for a substantial fraction of total output which could be used as proxies for total output.

A more general approach is to express the performance standard in terms of CO_2 equivalent greenhouse gas emissions per dollar of sales adjusted for inflation.[19] This value would differ for each firm for a variety of reasons, so the standard would need to be specific to each firm. Firm-specific standards could be established by taking the greenhouse gas emissions per dollar of sales for the firm in a base year (say 1995) and reducing it by some percentage.[20] Thus each firm would have its own output-based performance standard for each year. New firms in an industry could be assigned a base year value that reflects superior performance in the industry, say the 75th or 90th percentile value for existing firms in the industry.

Manufacturers and importers of appliances, energy-using equipment and vehicles would also be subject to mandatory performance standards. These would be corporate average greenhouse gas emissions standards for new products sold in Canada, similar to the corporate average fuel efficiency (CAFE) standards for new vehicles. The performance standard would be defined in terms of a specified test procedure that reflected the use of the product so that the greenhouse gas emissions over the life of the product could be calculated.[21] Sales of products whose emissions are less than the standard generate credits while sales of products whose emissions exceed the standard require the manufacturer or importer to purchase credits to achieve compliance. The ability to generate credits should lower or eliminate the traditional price premium for more energy-efficient products.

[19] The need to adjust for inflation raises difficult issues in terms of the appropriate inflation index for each firm. It is impractical to calculate a suitable inflation index for each firm, so a widely available index such as the Gross Domestic Product deflator or Consumer Price Index would probably be adopted for this purpose.

[20] The performance standard for the firm could be constant for some period or could become more stringent over time. An example of a constant standard would be a 25% reduction from the 1995 emissions per dollar of output (adjusted for inflation) for the period 2008-2012. An example of a standard that becomes more stringent would be a 1% per year reduction from the 1995 emissions per dollar of output (adjusted for inflation). Assuming the actual emissions reductions involved are the same, a firm might prefer the declining standard if banking is allowed.

[21] Emissions of new vehicles are tested for a highway and an urban driving cycle. Using data on average vehicle lifetime (say 150,000 km) and the mix of urban (60%) and highway (40%) driving it is possible to estimate the lifetime emissions. Many appliances and energy-using equipment use electricity as their main or only energy source. The test procedure for such products would be defined in terms of electricity use. The greenhouse gas emissions would be calculated using an average greenhouse gas emissions factor for electricity. The emissions factor should be a sales-weighted average for the region where the products are sold. This emissions coefficient would be the same for all manufacturers and importers of a particular product.

The performance standard for buildings would be reflected in the building code.[22] Builders would be responsible for meeting the building code. A builder that wished to claim a credit for a more efficient building would need to provide calculations by the architect and/or mechanical engineer to support the claim. A builder that wanted a variance from the building code that would increase emissions would need to provide calculations by the architect and/or mechanical engineer of the impact on emissions.[23] The builder would then need to purchase credits equal to the extra emissions to achieve compliance.

The program clearly involves a large number of mandatory performance standards. These standards will need to be revised periodically to reflect changes in technology or changes to the national commitment. But the standards need to be set for some time into the future so that entities affected can implement a compliance plan. Those considerations suggest that the performance standards be defined at least five years into the future, with revisions roughly every five years.

SOURCES REQUIRED TO PARTICIPATE IN THE PROGRAM

As previously described, mandatory performance standards would apply to all large energy users and all manufacturers of appliances, energy-using equipment and motor vehicles. All builders would also be required to meet the performance standard incorporated into the building code.

The number of sources subject to the mandatory performance standards could be very large. The two categories with the largest number of sources are industry and builders. There are roughly 33,000 industrial establishments in Canada, but 75% to 80% of industrial energy use is accounted for by about 400 large establishments in energy-intensive industries, such as pulp and paper, iron and steel, chemicals, mining, smelting and refining, cement, and petroleum refining.[24] It would be possible to establish mandatory performance standards only for those large, energy-intensive establishments and to manage emissions by small industrial sources indirectly through the performance standards for buildings and energy-using equipment.

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[22] Procedures for calculating the energy use of a building are available. Such a procedure would form the basis of the emissions performance calculation. Since weather conditions have a substantial impact on building energy use, the emissions standards would need to vary by region. That means they could also reflect the mix of fuels used in the region, including the greenhouse gas emissions coefficient for electricity.

[23] A builder could also seek a variance that did not affect the emissions performance. Again the architect and/or mechanical engineer would need to demonstrate that the emissions performance was not affected.

[24] Statistics Canada reports 32,718 manufacturing establishments in Canada in 1995. The number has fluctuated between 30,000 and 40,000 over the past 25 years, usually between 32,000 and 35,000. The number of establishments with annual sales in excess of $5 million was 8,400 and the number with sales in excess of $50 million was 1,283. The paper for options 11, 13 and 14 estimates the number of industrial firms in energy intensive industries at approximately 400.

While there are many thousands of contractors, the number of general contractors responsible for construction of new buildings is not known. Building contractors are currently required to comply with the building code. Changing the building code so that it incorporates an emissions performance standard will not increase the number of builders affected. But it may increase the complexity of determining compliance with the code. Ease of administration and enforcement should, of course, be a consideration in choosing how the performance standard is reflected in the building code.

NUMBER OF SOURCES INVOLVED

The number of sources subject to the mandatory performance standards would be at least 30,000. The number of builders is not known, but changing the building code would not increase the number of builders or the number of buildings that need to be inspected. Industry accounts for most of the sources that would be subject to the performance standards, some 30,000 establishments. Appliance, equipment and vehicle manufacturers would be subject to performance standards for the energy-related greenhouse gas emissions due to their production activities and to performance standards for their products.

As noted in the previous section, the number of industrial sources covered by the mandatory performance standards could be reduced significantly by focusing on large, energy-intensive plants. That could reduce the number of industrial sources to 400 to 2,500.[25] The total number of sources affected, excluding builders, then would be approximately 2,500 to 5,000. Smaller industrial sources would then be covered indirectly by the performance standards for their buildings and equipment.

Since the credit trading program is voluntary it is not possible to develop a very precise estimate of the number of participants. The cost savings due to engaging in credit trading will need to be less than the administrative costs. It is likely that most builders would simply comply with the performance standard as reflected in the building code rather than seek to create or use credits. Many small industrial users, if they are subject to mandatory performance standards, are also likely to focus on meeting the standard rather than engaging in emissions trading.

Thus, participants in the trading program are likely to include large energy producers, oil refineries, natural gas processing plants, electricity generators, industries, oil and natural gas pipelines, railways, airlines builders, and manufacturers and importers of appliances, energy-using equipment and vehicles. The number of participants is estimated to be of the order of 2,000 to 5,000, which is more than the number of participants for any existing emissions trading program.

[25] The lower end of the range includes the large energy-intensive industries identified in the description for options 11, 13 and 14. The upper end of the range is the number of establishments with sales in excess of $25 million.

SHARE OF TOTAL EMISSIONS COVERED BY PARTICIPANTS

Virtually all energy-related greenhouse gas emissions would be covered directly or indirectly by the mandatory performance standards. Energy-related emissions by large energy producers, oil refineries, natural gas processing plants, electricity generators, industries, oil and natural gas pipelines, railways and airlines would be subject to performance standards for emissions per unit of output. The large stationary sources plus rail and air accounted for almost 50% of total energy-related greenhouse gas emissions in 1995.[26]

Energy-related emissions by residential, commercial, institutional and agricultural sources and motor vehicles would by regulated indirectly through mandatory performance standards for buildings, appliances, energy-using equipment and vehicles. Actual emissions from those sources will depend on how the buildings and equipment are used. Together those sources accounted for just over 50% of total energy-related greenhouse gas emissions in 1995.[27] The emissions by these sources, mainly mobile sources, would be less effectively regulated than those from large stationary sources, suggesting a role for complementary policies to influence the use of vehicles, appliances, equipment and buildings.

HOW THE TRADING PROGRAM WOULD BE ADMINISTERED

The mandatory performance standards would be developed and administered by the federal, provincial and municipal agencies responsible for regulating:

- emissions by energy producers, oil refineries, natural gas processing plants, electricity generators, industries, oil and natural gas pipelines, railways and airlines;
- performance of appliances, energy-using equipment and vehicles; and

[26] A. Jaques, F. Neitzert and P. Boileau, *Trends in Canada's Greenhouse Gas Emissions (1990-1995)*, Environment Canada, Ottawa, April 1997, Table S5, p. xv. Large stationary sources are taken to be power generation, industrial and producer consumption. When combined with air and rail, total greenhouse gas emissions for these categories amounted to 235,980 CO_2 equivalent kilotonnes (kt). This is just under 50% of total emissions from fuel combustion by stationary and mobile sources, excluding wood, of 473,636 CO_2 equivalent kt.

[27] A. Jaques, F. Neitzert and P. Boileau, *Trends in Canada's Greenhouse Gas Emissions (1990-1995)*, Environment Canada, Ottawa, April 1997, Table S5, p. xv. Commercial, residential, agriculture, public administration, steam generation, other and mobile source emissions other than air and rail amounted to 237,656 CO_2 equivalent kt of which 65% is due to mobile sources. The total is just over 50% of total emissions from fuel combustion by stationary and mobile sources, excluding wood, of 473,636 CO_2 equivalent kt.

- the building code.[28]

Administration of the mandatory standards will involve all levels of government and require considerable coordination. The federal government has jurisdiction over interprovincial transport and products involved in interprovincial and international trade. It also plays an important role in the development of the building code. Regulation of emissions is primarily a provincial government responsibility. And building inspection is a municipal responsibility. Firms in the same industry in different provinces should face equally stringent performance standards, which will require considerable coordination.

Administration of the voluntary credit trading program could be delegated to a new entity created for that purpose. It could have a board of directors selected by the federal and provincial agencies responsible for the mandatory performance standards. The board of directors could also include representation of all stakeholder interests. This entity would develop the rules for the trading program and change them as necessary, be responsible for operation of the registry, and coordinate enforcement with the federal, provincial and municipal agencies responsible for the performance standards.

The process for developing the rules for the trading system would be similar to that used for other environmental regulations. Stakeholders would have an opportunity to comment on the proposed rules before they are adopted. The rules for the voluntary credit trading program would cover items such as the following:

- Credit creation - calculation of the credits created, units of measurement, credit life, documentation required to support credit creation claims, creator liability, approval requirements, and sources not subject to mandatory performance standards eligible to create credits;

- Credit use and transfer - eligible trading program participants, eligible users, eligible credit uses, geographic or temporal restrictions on trading or use, trading ratios, consideration of ancillary environmental impacts, banking, user liability, environmental donation, and approval requirements;

- Registry, reporting and monitoring - required notices, monitoring requirements, documentation requirements, reporting requirements, price information, and confidentiality of proprietary information;

- Audit and verification - authority of the regulatory authority to require information, defer uses pending and audit, order a third party audit, determine credit eligibility, require annual reports, perform a program audit, and administer prohibitions, restrictions and penalties.

[28] To enable sources to create and use credits in conjunction with the mandatory performance standards, the regulations promulgated by the federal, provincial and municipal governments to implement the standards should reference the credit trading organization and its rules.

The entity responsible for the voluntary credit trading program would establish a registry to track ownership of credits created, traded, and used. The registry could be developed and operated by the entity or it could be developed and operated under contract by a qualified organization.

The performance standards are mandatory while the credit trading program is voluntary. The main enforcement responsibility then lies with the various federal, provincial and municipal agencies responsible for the various standards. Credits can be created through over compliance. A claim for credits created might require certification by the responsible regulatory agency that the entity is in good standing and that the claim is correct. Credits can also be used to achieve compliance. The responsible regulatory agency could ask the trading program administrator to verify that the credits proposed for compliance use are valid. But any penalties for non-compliance remain the responsibility of the agency responsible for the performance standard.

The entity responsible for the trading system would only be responsible for enforcing compliance with the rules of the voluntary trading program, such as proper reporting. Penalties for non-compliance would likely take the form of fines and suspension from the trading program.

HOW EMISSIONS WOULD BE MEASURED

The mandatory performance standards for large energy producers, oil refineries, natural gas processing plants, electricity generators, industries, oil and natural gas pipelines, railways and airlines take the form of allowable energy-related greenhouse gas emissions per unit of output; for example CO_2 equivalent emissions per tonne of steel, per automobile, or per kWh of electricity produced. Each source subject to such a performance standard would be required to measure and report actual or calculated greenhouse gas emissions and actual output, measured in the appropriate units, for each year.

Actual emissions could be measured using continuous emissions monitors (CEMs) or be calculated using emissions coefficients and consumption of different fuels. Fuel consumption could be measured using fuel meters or be determined from fuel purchase records.[29] The choice of monitoring method will depend on the size of the source, the types of fuels used, the number of points that need to be monitored, and the costs of different monitoring systems. Rules for monitoring and reporting actual emissions would be part of the performance standard.

Actual output must also be reported to the regulatory authority. The regulator would have the authority to audit production records, sales reports and other documents as necessary

[29] It may be necessary to require sources to meter some types of non-purchased energy. Use of wood waste as a substitute for fossil fuels should be encouraged. Metering purchases of fossil fuels but not wood waste would encourage such substitution so it would not be necessary to meter the quantity of wood waste used.

to verify the accuracy of the data. Sources could also be required to provide copies of financial statements, income tax returns and GST returns to support the level of output reported.

The actual emissions would be divided by the actual output to determine whether the emissions performance standard had been achieved. If the actual emissions rate was lower than the performance standard, the source could claim a credit for the difference. This claim would be certified by the regulatory authority and then posted on the registry by the source. If actual emissions were higher than allowed by the performance standard, the source would need to purchase, and provide the regulatory authority with, enough credits to come into compliance. The credits provided to achieve compliance would be cancelled.

The mandatory performance standards for appliances, energy-using equipment and vehicles would take the form of greenhouse gas emissions emitted in the course of a specified operational cycle. The performance standard would define the test procedure to be used. Tests would need to be performed at specified intervals by qualified independent laboratories. Manufacturers and importers of such products would be required to supply the test results to the regulatory agency. The agency would have the power to order additional tests by a laboratory of its choice if it was dissatisfied with the test results supplied by the manufacturer or importer.

Manufacturers and importers of appliances, energy-using equipment and vehicles would also be required to report actual sales of each product in Canada during the year. The regulator would have the authority to audit production records, sales reports, records of imports and exports and other documents as necessary to verify the accuracy of the data. Sources could also be required to provide copies of financial statements, income tax returns and GST returns to support the level of sales reported.

Compliance would be determined by comparing the test results for each product with the relevant performance standard. If the test results indicated actual emissions were lower than the performance standard, the source could claim a stream of credits equivalent to the reduction. The stream of credits would be calculated using specified assumptions about the use profile and life of the product. This claim would be certified by the regulatory authority and be posted on the registry by the source. If the test results indicated higher emissions than allowed by the performance standard, the source would need to provide the regulatory authority with enough credits to come into compliance. The stream of credits needed to achieve compliance would be calculated using the same assumptions about the use profile and life of the product. Credits used to achieve compliance would be cancelled.

Municipal inspectors would ensure that each new building met the requirements of the building code. The building code would reflect the emissions performance standard for different categories of buildings. A builder that wished to claim a credit for a more efficient building would need to provide calculations by the architect and/or mechanical engineer to support the claim. A builder that wanted a variance from the building code

that would increase emissions would need to provide calculations by the architect and/or mechanical engineer of the impact on emissions. The builder would then need to purchase the necessary stream of credits to achieve compliance.

POSSIBLE COMPLEMENTARY POLICIES

Energy-related greenhouse gas emissions by large energy users would be regulated by mandatory performance standards defined in terms of energy-related greenhouse gas emissions per unit of output. Such a standard gives sources an incentive to implement the full range of energy-efficiency and conservation measures and to switch to less carbon-intensive energy sources.

Complementary policies should help these large sources implement measures to reduce their greenhouse gas emissions.[30] Possible policies include:

- Information programs on emission reduction options, including operational practices, fuel switching and more efficient technologies;
- Audits to identify opportunities to reduce greenhouse gas emissions;
- Changes to the tax code to ensure that different energy sources receive comparable treatment; and
- Taxes or royalties on carbon-intensive fuels to provide a stronger financial incentive to implement measures that reduce energy-related greenhouse gas emissions.

Energy-related emissions by residential, commercial, institutional and agricultural sources and motor vehicles would by regulated indirectly through mandatory performance standards for buildings, appliances, energy-using equipment and vehicles. These sources account for approximately half of total energy-related greenhouse gas emissions. Mobile sources represent 65% of the emissions from these sources.

The energy-related greenhouse gas emissions from these sources depend on how the buildings, appliances, equipment and vehicles are used. The performance standards do not affect the use. Thus, there is a role for complementary policies aimed at changing the use of these buildings, appliances, equipment and vehicles, especially vehicles, in ways that reduce greenhouse gas emissions. Possible policies include:

- Information programs on energy-efficiency, energy conservation, fuel switching and other emission reduction options;
- Building energy audits to identify opportunities to reduce greenhouse gas emissions;

[30] See NRTEE Issue Paper 11, *Evaluation of Possible Complementary Policies.*

- Mandatory inspection and maintenance programs for vehicles;
- Transportation demand management measures such as car/van pooling programs, high-occupancy vehicle lanes, public transit lanes, subsidies for public transit, restrictions on parking, higher fuel taxes, and road pricing;
- Government procurement programs to stimulate demand for more efficient buildings, equipment and vehicles;
- Changes to the tax code to ensure that different energy sources receive comparable treatment; and
- Taxes or royalties on carbon-intensive fuels to provide a stronger financial incentive to change behaviour in ways that reduce energy-related greenhouse gas emissions.

Complementary policies are discussed in more detail in a separate issue paper.

SPECIAL ISSUES RAISED BY THE DESIGN

A voluntary credit trading program with mandatory performance standards may raise issues related to the treatment of imported appliances, energy-using equipment and vehicles relative to the treatment of comparable domestic products.

Appliances, energy-using equipment and vehicles would be required to meet mandatory emissions performance standards. Those standards would need to be the same for both domestically produced and imported appliances and equipment to be consistent with World Trade Organization (WTO) rules.[31] In addition the standards would need to be defined in ways that do not treat imports unfairly.

In some cases it may be difficult for Canada to establish a greenhouse gas emissions performance standard alone. If Canada is a relatively small part of the total market for a product and larger markets adopt different approaches to managing the emissions from such sources, manufacturers (foreign and domestic) may not comply with the standard. The most significant case is motor vehicle manufacturing. Since Canada is a relatively small part of the North American market, it may be difficult to implement an emissions performance standard in Canada if the United States adopts a different strategy. However, the ability to comply by purchasing credits may still allow Canada to implement an emissions performance standard even if the United States adopts a different policy.

[31] WTO rules specify that imports can not be required to meet more stringent standards than comparable domestic products. Since the objective is to reduce emissions, there is no reason to allow less stringent emissions performance standards for imports. Hence, both imports and domestic products should be subject to the same emissions performance standard.

Large industrial sources would be subject to mandatory emissions performance standards defined in terms of greenhouse gas emissions per unit of output. Those standards apply to production operations in Canada. Imported products would not be subject to those performance standards, except to the extent that they undergo further processing in Canada. The emissions associated with the production of the imported products are governed by the policies in the country of origin.

Petrochemical plants are among the large industrial sources that would be subject to mandatory performance standards for greenhouse gas emissions. They purchase fossil fuels for use both as an energy source and a feedstock. Since the focus is on greenhouse gas emissions and some petrochemical products sequester carbon for relatively long periods, the appropriate definition of the performance standards for the petrochemical industry needs to be carefully considered. The question of the appropriate treatment of feedstocks is discussed in a separate NRTEE issue paper.[32]

Other countries with national commitments could adopt performance standards, emissions taxes, emissions trading to manage their greenhouse gas emissions. The costs of Canada's policy on various industries could be higher or lower than the costs of the domestic policies adopted by other countries. The competitiveness impacts and leakage will be determined by the relative costs in Canada and its major trading partners.[33] This is true regardless of whether Canada adopts a voluntary credit trading program with mandatory performance standards or some other policy to meet its national commitment.

TRANSITIONAL ISSUES RELATED TO A CHANGE IN THE POLICY SETTING

This option assumes that a national commitment to limit greenhouse gas emissions is in force. The commitment could become more stringent over time, or the commitment could become less stringent, perhaps to the point that no restrictions on greenhouse gas emissions are needed.

If the commitment becomes more stringent, the mandatory performance standards would need to be made correspondingly more stringent to meet the commitment. But no change would be necessary to the voluntary credit trading program.

If the commitment becomes less stringent, the mandatory performance standards could be maintained or relaxed. Again no changes would be needed to the voluntary credit trading program. But as compliance with the existing or relaxed standards became easier, the volume of trading activity and prices of credits could be expected to fall.

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[32] See NRTEE Issue Paper 5, *Options for Treatment of Fossil Fuels used as Feedstocks.*

[33] The impacts of alternative domestic greenhouse gas emissions trading designs will be addressed in a separate NRTEE issue paper.

EVALUATION OF THE OPTION USING PROPOSED CRITERIA

The criteria proposed for use in the evaluation of the emissions trading options are summarized in Table 3. These criteria are drawn from *Analysis of the Potential for a Greenhouse Gas Trading System for North America*, Commission for Environmental Cooperation, Montreal, May 1997, chapter 3, pp. 32-42, and are described fully there.

Cost-effectiveness. Emissions trading should minimize the cost of reducing greenhouse gas emissions to individuals, firms and society. The cost of meeting the mandatory performance standards is likely to vary from source to source. The voluntary credit trading program improves cost-effectiveness. Sources faced with high compliance costs can reduce those costs by buying credits. Sources with low compliance costs are encouraged to reduce emissions further and to sell surplus credits. Sources are not required to engage in trading.

Table 3: Criteria for Evaluating Proposed Greenhouse Gas Emissions Trading Systems

Economic efficiency
- Cost-effectiveness
- Transactions costs
- Comprehensiveness

Equity
- International equity
- Domestic equity
- Industrial equity

Technical feasibility
- Technical flexibility
- Timing
- Leakage

Political feasibility
- Domestic political compatibility
- International compatibility
- Sovereignty

Administrative feasibility
- Measurability
- Verifiability
- Enforceability

Transactions costs. Transactions costs for emissions trading programs should be minimized. Combining the voluntary credit trading program with mandatory performance standards helps reduce transactions costs. The mandatory performance standards define the baselines for credit creation and use. Monitoring and reporting for credit creation and use is combined with the monitoring and reporting for compliance with the performance standards. The cost savings due to engaging in credit trading will need to be less than the transactions costs. It is likely that most builders and small industrial users, if they are subject to mandatory performance standards, would focus on meeting the standard rather than engaging in emissions trading due to the transactions costs.

Comprehensiveness. An emissions trading program should cover as broad a range of greenhouse gas sources and sinks as possible. The mandatory performance standards should provide comprehensive direct or indirect coverage of energy-related greenhouse gas emissions. Approximately half of the energy-related greenhouse gas emissions would be covered directly by performance standards. The other half would be addressed indirectly through performance standards for buildings, appliances, energy-using equipment and vehicles.

Participation in the credit trading program is voluntary and is likely to be dominated by large energy producers, oil refineries, natural gas processing plants, electricity generators, industries, oil and natural gas pipelines, railways, airlines builders, and manufacturers and importers of appliances, energy-using equipment and vehicles. The number of participants is estimated to be of the order of 2,000 to 5,000. Sources participating in the trading program are likely to represent 40% to 75% of total energy-related CO_2 emissions.

International equity. An emissions trading program should be fair to developing countries. International equity would be addressed through the agreements that establish the national commitments. The domestic credit trading program does not affect international equity because the trading simply facilitates compliance with the mandatory performance standards, which are designed to achieve the national commitment. The national commitment is part of a set of internationally-negotiated national commitments which reflect international equity and other considerations.

Domestic equity. An emissions trading program should be equitable in terms of its impacts on different income groups and regions. Equity is determined by the mandatory performance standards for different energy users. The costs of complying with the standards will vary from source to source. The costs of compliance will be passed on to customers, suppliers, employees and shareholders in the form of higher product prices, lower prices for supplies, and lower wages and returns to shareholders. The burden on an individual depends on how the compliance costs are distributed, the mix of goods and services purchased, and the individual's role as an employee and shareholder. Studies of the impacts of a carbon tax suggest that the impacts represent a slightly higher share of income for low income groups. The credit trading program tends to lower the cost of compliance and so improve equity across income groups.

Industrial equity. An emissions trading program should treat different industries and sectors fairly (not necessarily equally). Equity is determined by the mandatory performance standards for different industries and sectors. Credit trading tends to improve equity by equalizing the marginal cost of compliance across sources. In any case, a source has the option of not engaging in trading.

Technical flexibility. An emissions trading program should allow maximum flexibility in terms of the choice of reduction or sequestration technology to implement. How the mandatory performance standards are defined determines the range of technical options available for compliance. It is important that the standards be defined in a way that encompasses as many emission reduction options as possible. That requires performance standards for large energy users defined in terms of emissions per unit of output which may be difficult given the diversity of products across firms and industries. Firm-specific performance standards defined in terms of greenhouse gas emissions per dollar of sales in a base year and reduced by some percentage and adjusted for inflation might be a solution.

However, this option involves a large number of mandatory performance standards which will need to be revised periodically. The number of sources subject to the standards could exceed 30,000. Compliance with the performance standards on the part of these sources will need to be enforced each year by a number of different federal, provincial and municipal agencies. These agencies will also need to cooperate in the development and revision of the performance standards to ensure that firms in the same industry in different parts of the country are treated fairly.

Timing. An emissions trading program should allow maximum flexibility in the timing of reduction or sequestration actions. If banking is allowed, as is proposed in the NRTEE paper on Issue 8, a voluntary credit trading program would provide sources with flexibility in the timing of actions to meet the mandatory performance standards.[34]

Leakage. An emissions trading program should minimize increases in emissions elsewhere. The mandatory performance standards determine the burden imposed on each source and hence the economic advantage to shifting production elsewhere. The voluntary credit trading program reduces the total cost of compliance and tends to equalize the marginal costs of compliance across sources. Thus the trading program tends to reduce leakage to other countries and to reduce shifts in production among domestic sources due to differences in compliance costs. In addition, if the performance standards are expressed in terms of emissions per unit of output, the level of output is not constrained, again reducing the incentive to shift production to other countries.

Domestic political compatibility. An emissions trading program should minimize potential conflicts with existing and future domestic policies. The constitutional authority and regulatory tradition required to implement a set of mandatory performance standards is well established. The voluntary credit trading program merely supplements that

[34] See the NRTEE paper on Issue 8, *Analysis of Emissions Trading Program Design Features.*

regime, but does so in ways that are likely to be attractive to at least some industrial sectors. The number of sources affected will increase significantly. And compliance with the performance standards will need to be enforced annually. Thus the regulatory burden would be substantially higher. Effective enforcement and administration will require coordination of numerous federal, provincial and municipal agencies, which could be difficult to sustain over a long period of time.

International compatibility. An emissions trading program should minimize potential conflicts with existing and future international regimes. Many countries would have national commitments, such as those of the Kyoto Protocol, to limit their greenhouse gas emissions. It is presumed that each country would have considerable latitude to adopt its preferred policies domestically, and that mandatory performance standards with a voluntary credit trading program would be an acceptable domestic policy.

The question of the compatibility of the mandatory performance standards with the domestic policies adopted by other countries then arises. If the performance standards are defined in terms of greenhouse gas emissions per unit of output, imported products would be unaffected except to the extent that they undergo further processing in Canada. The competitiveness impacts and leakage will depend on the costs of Canada's policies on various industries relative to the domestic policies adopted by other countries.

Imported and domestic appliances, energy-using equipment and vehicles would be subject to the same performance standards. This should not create any problems under WTO rules unless the standards treat imports unfairly. Since Canada is a small market for some of these products, it may be difficult to implement the performance standards if other countries adopt different policies. Motor vehicles are the preeminent example of a product where such difficulties could arise.

Sovereignty. An emissions trading program should minimize the need for international oversight and interference. A policy of mandatory performance standards with a voluntary credit trading program should entail no international oversight other than that required to ensure compliance with the national emissions limitation commitment.

Measurability. An emissions trading program should minimize the unceratinty and complexity of measuring emissions reduced or sequestered. The mandatory performance standards determine the quantities the need to be measured. As noted the performance standards for large energy users should be expressed in terms of emissions per unit of output. Developing such performance standards may be difficult due to the diversity of the output of many plants. Large energy sources subject to such standards would need to monitor or calculate their actual greenhouse gas emissions using prescribed methods. The additional monitoring and reporting requirements, except where continuous emissions monitoring equipment is required, need not be very costly.

The mandatory performance standards for appliances, energy-using equipment and vehicles will require those products to be tested periodically in accordance with prescribed test procedures by qualified independent laboratories. That could be relatively

costly for some products. The manufacturers and importers would need to provide the regulatory agency with the independent test results and data on sales in Canada of the regulated products.

It should be possible to measure most of the data needed to establish compliance with the performance standards quite accurately. The costs of measuring the data need not be large except where continuous emissions monitoring is required, or where independent laboratory tests are required for products with low sales volumes. The voluntary credit trading program relies on the same data and so does not increase the complexity or reduce the accuracy of the measurements required.

Verifiability. An emissions trading program should increase confidence on the part of participants and other stakeholders that the emissions reductions claimed have been achieved. Aggregate performance will be tracked through national reporting of greenhouse gas emissions. Those reports are prepared using agreed inventory methodologies and are subject to external review. The inventories rely on national statistics for energy production, imports and exports. If the performance standards are not being enforced or are not sufficiently stringent, it will soon be apparent from the national inventory.

Enforceability. An emissions trading program should maximize compliance with emission limitation commitments. This option requires enforcement of the mandatory performance standards and compliance with the rules of the trading system.

Enforcement of the mandatory performance standards is, by far, the more difficult task. This option requires a relatively large number of performance standards to be developed and enforced. The number of sources subject to standards will number in the thousands. Compliance with the standards will need to be enforced each year. And enforcement will be in the hands of numerous federal, provincial and municipal agencies. In short, this option poses a considerable enforcement challenge.

In addition to enforcement of the mandatory performance standards, adherence to the rules of the voluntary trading needs to be enforced. Violations of trading rules would probably lead to fines and/or suspension of the right to participate in the trading system.