General Analysis of Emissions Trading and Its Effects in Ontario by the City of Toronto
Phase I Report

Report to Works and Emergency Services
City of Toronto
As part of the

Study of Emissions Trading
For Smog Precursors and Greenhouse Gases

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List of Abbreviations

CDM	clean development mechanism
CO2	carbon dioxide
ERC	emission reduction credit
GERT	Greenhouse Gas Emission Reduction Trading Pilot
GHG	greenhouse gases
MOE	Ministry of the Environment (Ontario)
MOERT	Ministry of the Environment Emission Reduction Trading Program
NO	nitric oxide
NOx	oxides of nitrogen generally
PERT	Pilot Emission Reduction Trading Project
SO2	sulphur dioxide

Executive Summary

This report represents Phase I of a study to facilitate the development of a corporate emissions trading policy for the City of Toronto that is responsive to both environmental and financial considerations. The study will also inform ongoing efforts to influence and respond to the provincial emissions trading program that was recently introduced by the Ontario Ministry of the Environment.

This study is divided into two phases. Phase I examines the environmental and financial effects of emissions trading, reviews existing emissions trading systems that are relevant to the City, and explores a set of simplified examples of emission reduction projects that give rise to emissions trading opportunities. Finally, Phase I identifies issues and cases to be considered in Phase II.

Phase II looks at specific opportunities for emissions trading for the City of Toronto. A set of projects will be identified for analysis. The environmental and financial implications of pursuing the selected projects will be explored using principles developed in Phase I. Based on this analysis, Phase II will identify strategic policy issues that the City of Toronto will confront as trading opportunities arise. Phase II will also propose possible policies that the City of Toronto might adopt to guide its participation in emissions trading in the future.

Emissions trading is intended to allow pollution sources to reduce the cost of complying with regulations by allowing those sources to trade emission allowances or credits. The principal benefit from emissions trading is to reduce the cost of pollution control. Studies in the United States have found savings in the hundreds of millions of dollars per year from existing emissions trading programs.

There are two basic types of emission trading systems. One imposes a cap on a specified set of pollution sources, distributes emission allowances to each source indicating its permitted discharge amount, and authorises the polluters to trade allowances with each other. This is referred to as a “cap and trade” or “allowance” system. The other begins with existing emission limits imposed on individual sources, or with their historical emissions, or with projected future emissions and authorises sources to create “emission reduction credits” or ERCs if they reduce their emissions below one or another of these amounts. The ERCs once created can be sold to other sources which may use them to increase their emissions. Because sources in the City of Toronto are not subject to an emissions cap and trade system, its emissions trading opportunities will principally involve buying or selling ERCs.

The implications of emissions trading are explored using a simple example and trading system. We assume a region with a number of pollution sources, one of which, Alpha, considers undertaking a pollution control project; if the project is undertaken Alpha considers selling ERCs that are created. We work through the implications of these choices for regional pollution emissions, for regional pollution control costs, and for the emissions and net expenditures of Alpha itself.

Table 2 summarises the results of the example. The project reduces regional emissions by 100 kilograms in case 2 compared to the base case at a cost to Alpha of $60. Selling ERCs in cases 3 and 4 eliminates the environmental benefit of the project completely, since the buyer of the ERCs increases its emissions by 100 kilograms, but it reduces regional control costs and improves Alpha's finances. With discounting of ERCs by 10% and/or limits on the number of years that a project can create credits in cases 5, 6 and 7, some environmental benefit survives the sale of ERCs. Selling ERCs always reduces regional costs and Alpha's costs compared to case 2.

Table 2
Summary of Environmental and Economic Effects: Example

	Net Change In		
	Regional Emissions (kilograms)[1]	**Regional Costs ($)**[2]	**Alpha Net expense ($)**[3]
1. Base Case (no project)	0	0	0
2. Low Cost Project, No Trading	-100	$60	$60
3. Low Cost Project, Create and Sell ERCs	0	-$40	-$30
4. High Cost Project, Create and Sell ERCs	0	$40	$50
5. Case #2, With Discount, No Time Limit	-10	-$30	-$21
6. Case #2, With Time Limit no Discount	-50	$10	$15
7. Case #2, With Discount and Time Limit	-55	$15	$19.5

1. (-) means a reduction in regional emissions compared to the base case.
2. (-) means a cost saving compared to the base case.
3. (-) means net revenue for Alpha, i.e. Alpha ERC revenue > control cost.

The environmental and economic outcomes of emissions trading depend on the design of the system and its trading rules. It is important for a potential trader such as the City of Toronto to understand the trading systems in which it might participate in order to develop an appropriate trading strategy, and even to decide whether to trade at all.

We describe and compare two emissions trading systems that are currently operating in Ontario, the newly created Ministry of the Environment Emission reduction Trading System for trading nitrogen oxide (NO) and sulphur dioxide (SO2), which we abbreviate as MOERT, and the Clean Air Canada Inc. (CleanAir) system that is the successor to the Pilot Emissions Reduction Trading Project (PERT) and to the Greenhouse Gas Emission Reduction Trading Pilot (GERT). We contrast them with the largest emissions trading system in the United States, Title IV of the *1990 Clean Air Act Amendments*.

These systems apply to different pollutants. SOx and NO may both be traded under MOERT in Ontario. While in principle CleanAir could register reductions in these emissions, the only market for them in Canada today is in Ontario, so sellers would likely prefer to use the MOERT system. Greenhouse gases (GHG) can be traded under CleanAir, but are not within the scope of MOERT. The 10% discounting of credits and the 7-year time limitation on creation from a project of MOERT are not replicated by CleanAir, allowing wider trading in the latter but more environmental improvement in the former.

The examples summarised in Table 2 and the subsequent analysis above lead to several conclusions about emissions trading, which we link here to the numbered cases in the table:

- In the absence of emissions trading, an emission reduction project benefits the environment. (Table 2, case #2)
- Emissions trading can reduce the cost of achieving a given total degree of emission reduction among a set of sources. (#3, 5)
- Emissions trading by itself does not benefit the environment (#3), except when traded credits or allowances are discounted or time-limited enough to offset the credit for emission reductions that would have happened anyway (#5, 6, 7).
- Emission Reduction Credit systems invite the sale of "anyway" credits that can increase total emissions over what would have happened with business as usual and no ERCs.
- If a source wants to improve environmental quality, it should engage in pollution reduction projects and **not** sell ERCs created by the projects. (#2)
- If a source wants to maximize profits, it should engage in pollution reduction projects costing less than the value of ERCs created and sell the ERCs. Environmental improvement will result only to the extent of discounting and time limits and the reduction of non-traded pollutants. (#3, 5)
- If a source wants to improve environmental quality **and** generate revenue, it should engage in pollution reduction projects with a net cost less than the value of ERCs created and sell some, but not all, of the ERCs, retiring the unused remainder. (#5)

If a project involves the City and one or more partners, the ownership of any resulting ERCs must be certain before any registry is likely to register the ERCs, because of the requirement that the credits be verifiable and surplus. Therefore whenever the City contemplates a project involving partners that may create ERCs, the agreement or contract with the partners should include a clear agreement on ownership of any resulting ERCs.

In 1998, City Council reaffirmed as a city-wide target for the new City of Toronto a carbon dioxide emissions reduction goal of 20 percent relative to 1990 levels by the year 2005. While it is clear that this commitment applies to CO2 only, it is not clear whether it applies only to emissions from sources owned by the City or to all sources, whether owned by the City or others, within the geographical limits of the City. The latter interpretation seems more likely based on the language and legislative history although ultimately Council will have to determine the nature of the commitment. This commitment may affect whether credits arising from certain projects are "surplus" and therefore available for trading.

We combine the general environmental and financial effects of emissions reduction projects and emissions trading discussed above with the description of the CleanAir and MOERT emissions trading programs to explore the implications of various emission reduction projects and emissions trading for the City of Toronto. We consider a set of cases involving projects similar to some that have been or may soon be faced by the City of Toronto. These cases are presented in simplified form so that we can continue to focus on general principles.

This analysis is not as detailed as that which will take place in Phase II of this project when more institutional and factual details will be gathered and discussed. The results are summarised in Table 4.

Table 4 Summary of Trading Cases					
	Landfill	**Building conservation**	**Boiler fuel switch**	**Self tree planting**	**Other tree planting**
Pollutants reduced	Methane (& NOx, SO2)	CO2, NOx, SO2	CO2, NOx, SO2	CO2	CO2
Done anyway?	N	N	Y	N	Maybe
Regulation or voluntary commit	N	N	N	Y	Y
Trading eligible? CleanAir MOERT	 Y CH4, CO2 Y NO, SO2	 CO2 NO, SO2	 CO2 NO, SO2	 CO2 N	 CO2 N
Project effect	ENV benefit	ENV benefit	Anyway	ENV benefit	Depends
Trading lose ENV benefit?	Y	Y CO2 Part NOx, SO2	Y CO2 Part NOx, SO2	Y	Y
Trading generate revenue?	Y	Y	Y	Y	Cost

These cases suggest several issues and problems that arise in evaluating emission reduction projects and proposals for ERC creation and trading.

- Should the environmental effects of trading be compared to historic emissions or to forecast emissions without the project?
- Some projects will be done without emissions trading. Should a future-based assessment of environmental effects disallow ERCs created from such "anyway" projects?
- Where the proponent of a project has made a voluntary commitment to some emission level, analysing the effect of the project requires assessing what the proponent would do without this project. Is it this project or nothing? This project or some equivalent project? Will the proponent meet the commitment in any event, or does failure of this project leave it further from its goal?

This Phase I report presents some simple examples and develops some basic principles for emissions trading. There is, however, a need for further analysis based on specific trading opportunities and details of those opportunities that will be addressed in Phase II of the project . Issues to be considered include:

∃ implications of Toronto=s voluntary CO2 commitment;
∃ balancing environmental protection and revenue as goals for emissions trading;
∃ the merits of earmarking revenue from ERC sales for pollution reduction projects;
∃ management of ERCs within many Toronto departments and ABCs;
∃ ownership of ERCs from partnered projects – other jurisdictions;
∃ positions that Toronto may take with respect to developing Federal GHG policy;
∃ effect of redefinition of "air quality" by the Toronto Public Health Division on Toronto ET policy;
∃ local air quality effects of emissions trading;
∃ what Council should consider in evaluating trading proposals.

Phase Two will also involve the investigation of a set of cases that are more specific and detailed than those considered in this report, drawn from the following:

- low sulphur fuel purchase;
- fleet fuel reduction – change service delivery, operations.
- Landfill methane recovery and electricity generation – specific landfill
- Convert boiler from oil to gas
- Fossil, electricity conservation in City building
- Fossil, electricity conservation in private building
- City 25% green electricity purchase commitment
- Waterfront integrated energy project or other district energy project
- Street lighting program
- Tree planting, on City streets or outside the City
- Purchase CO_2 credits to meet 20% commitment

1. Background to the Project

In June, 2001, the City of Toronto issued a request for proposals for an emissions trading study. The stated purpose of the proposed study was:

> "To enable/facilitate the development of a corporate emissions trading policy that incorporates economic, environmental and financial considerations. This project will also inform ongoing efforts to influence and respond to the provincial trading program that is currently under development by the Ministry of the Environment."

Prior to this project there was considerable discussion among City staff and others regarding how the City should deal with emerging opportunities for emissions trading. There was also a major report by the International Council for Local Environmental Initiatives prepared for the City and for the Toronto Atmospheric Fund, entitled "Design of a Carbon Emissions Pilot Trade for Toronto." (ICLEI, 1998.) On October 2, 2001, the Commissioner of works and Emergency Services sent to the Works Committee a status report on emissions trading that included discussion of actions taken and potential emission reduction projects.

This project is divided into two phases. Phase I examines the effects of emissions trading in general from the point of view of a potential participant in trading such as the City of Toronto. It examines the environmental and financial effects of emissions trading, reviews existing emissions trading systems that are relevant to the City, and explores a set of cases involving emission reduction projects that give rise to emissions trading opportunities. Finally, Phase I identifies issues to be considered in Phase II. A draft report was presented for discussion to the City at a workshop prior to producing this report, which includes Q and Q from that workshop.

Phase II of the project looks at specific opportunities for emissions trading for the City of Toronto. A set of cases will be identified for analysis, by the consultants with the advice of the Advisory Group. The environmental and financial implications of pursuing the selected projects will be explored using principles developed in Phase I. Based on this analysis, Phase II will identify strategic policy issues that the City of Toronto will confront as trading opportunities arise. Phase II will also propose possible policies that the City of Toronto might adopt to guide its participation in emissions trading in the future. A draft report will be presented for discussion to the City at a workshop prior to final revision. The revised report will be discussed by invited international experts at a subsequent workshop.

This report is written for City staff interested in emissions trading as well as City Councillors, staff of the City's agencies, boards and commissions and others in the City who share this interest. We have tried to use plain language and to avoid economic complexity to the extent that the subject matter allows.

2. Introduction to Emission Trading

Air pollution regulation in Canada, as in the United States, generally involves maximum emission rates for individual sources within an industry, based on the activity level of the source. For example, the Canadian federal guidelines for new thermal power generation emissions limit the discharge of nitrogen oxides, particulate matter, and sulphur dioxide in grams (actually nanograms) of the pollutant per Joule (ng/J) of heat input.[1] Ontario's *Boilers Regulation* prohibits the burning in boilers of oil or coal with a sulphur content greater than one percent. Ontario's guidelines for stationary combustion turbines limit nitrogen oxides and sulphur dioxide in proportion to the power output of the turbine.[2] New sources are generally regulated more strictly than existing sources. Regulations may also limit the concentration of air pollution allowed at a point of impingement. For example, Regulation 346 under the *Ontario Environmental Protection Act* limits SO2 concentrations to 830 micrograms per cubic metre.

The cost of controlling pollution emissions may vary considerably among sources, however, even within an industry. New plants can often reduce emissions at a lower cost than old plants. Some production technologies are more adaptable to pollution controls than others. Some plants may have ample room for installing controls while others face high costs to squeeze equipment into limited space. As a result, uniform emission standards applied across an industry or multiple industries may achieve a given pollution reduction at a higher cost than necessary.

For example, suppose that two factories with different production technology but identical activity levels are subject to the same activity-based emission regulation and discharge NOx at a rate of 1000 kilograms/day. An amendment to the guidelines requires both to reduce their emission rates by 20% or 200 kilograms/day. Assume that factory #1 faces a cost of $1 per kg to reduce its emissions while factory #2 faces a cost of $2 per kg to reduce its emissions. If both comply with the regulation #1 will spend (200x1) $200 on control while #2 will spend (200x2) $400. The total cost of pollution reduction will be $600 per day for a total reduction of 400 kg/day. However if factory #1 reduced its emissions by 40%, while #2 made no reduction, we would still achieve a reduction in emissions of 400 kg/day and the cost would be only (400x1) $400. We could get the same total reduction in emissions at less than 2/3 of the cost.

Emissions trading is intended to capture savings arising from regulations imposing different costs on sources by allowing those sources to trade among themselves with respect to their pollution control. In this example, after assigning an emissions limit to each factory we could allow them to trade these emissions limits among themselves, subject to notification of the Ministry of the Environment of the amount of the trade. Starting from a regulation requiring each factory to reduce its emissions by 200 kg/day, #2 would be willing to purchase emission allowances from #1 at any price less than the control cost at factory #2: $2 per kg. If #2

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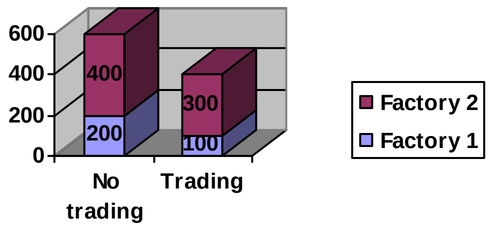
[1] Thermal Power Generation Emissions National Guidelines for New Stationary Sources P.C. 1990-333. The SO2 limit for coal-fired power plants is 258 ng/J (0.6 lbs./mmBTU) or 90 percent removal, whichever is greater.

[2] Ontario Ministry of the Environment, "Guidelines for Emission Limits for Stationary Combustion Turbines" (Toronto, MOE, March, 1994.)

purchased 200 kg/day from #1 at, for example, $1.50 per kg, #2 would save its total pollution control cost of $400 in exchange for the purchase cost of (200x1.5) $300, for a net saving of $100. Firm 1 would also be $100 better off, having received $300 for the 200 kg and having to spend only $200 to further reduce its emissions so that it can meet its enhanced pollution reduction target of 400 kg/day. See Figure 1.

Figure 1
Costs Savings from Trading



The principal benefit from emissions trading, then, is to reduce the cost of pollution control. Studies in the United States have found savings in the hundreds of millions of dollars per year from existing emissions trading programs. (Ellerman et al. 1997; Hahn and Hester, 1989a, 1989b.)

If emissions trading reduces the cost of achieving a given level of pollution control, it may be possible to make pollution reduction goals more ambitious. Indeed, extending the environmental goal in response to a reduction in control cost makes good economic and environmental sense. Because trading reduces the cost of emission control in this example, we could extend the environmental goal to, for example, a 25% reduction (250 kg/firm) in NO_x emissions. If this reduction is undertaken entirely by firm #1 it would cost $500, which is still less than the $600 cost of both firms meeting the 20% reduction in the absence of trading. Moreover, even though all of the emissions reduction would be undertaken by firm #1, with emissions trading firm # 1 would be able to sell the additional reductions in emissions to #2 so that it would share in the overall cost savings. A secondary benefit of emissions trading, then, is to expand our ambitions for emissions reduction, that is, to improve environmental quality. Some analysts believe that the US Congress would not have agreed upon the 50% SO_2 reduction in the 1990 *Clean Air Act Amendments* without the cost savings and flexibility afforded by emissions trading.

If two sources of the same air pollutant are located close together, then there is little environmental consequence of trading emissions at one source for emissions at the other. If they are further apart, however, location may matter. If the pollutant has a purely local effect, residents near factory #2 will not be happy to have its emissions increase as a result of purchasing permits from factory #1, while residents near factory #1 will be delighted at the improvement in local air quality. Critics of emissions trading have identified this problem, sometimes referred to as the problems of "hot spots" as a major concern.

There are several solutions to this problem of the location of pollution sources in a emission trading scheme.

- Allow trading only in a restricted area, a single airshed, so that transfers of emissions from one source to another will not significantly affect air quality at a particular point. The size of the appropriate trading region depends on how far the pollution travels and mixes.
- Combine emissions trading with a reduction in allowed emission limits, so that air quality in general will improve and it is unlikely that any location will experience an increase in its air pollution.
- Impose distance and directionality limits on trading. If the prevailing wind blows inland from the shore, so that air pollution problems are usually worse inland, one might limit the right of a source located inland to sell permits to a source located at the shore, since this would worsen air quality in the region between the two sources Similarly, as the sources get farther apart, one might discount the permits that are traded between them, since the two sources only partly affect the same air quality.
- Require that local air quality standards and guidelines continue to be met after trading. This does not prevent air quality from deteriorating somewhat in areas that are much cleaner than required by current standards and guidelines.

While these solutions will help in some situations, it is still possible that trading will result in some locality having more pollution than would occur in the absence of trading. This is the price paid for saving costs of pollution control or having greater air quality improvements in other areas. Like most public policies, this one may make most people better off without guaranteeing that everyone is better off.

3. Allowances Compared to Emission Reduction Credits

There are two basic types of emission trading systems. One imposes a cap on a specified set of pollution sources, distributes emission allowances to each source indicating its permitted discharge amount, and authorises the polluters to trade allowances with each other. This is referred to as a "cap and trade" or "allowance" system. The other begins with existing emission limits imposed on individual sources, or with their historical emissions, or with projected future emissions and authorises sources to create "emission reduction credits" or ERCs if they reduce their emissions below one or another of these amounts. The ERCs once created can be sold to other sources who may use them to increase their emissions.

The difference between a cap and trade system and an emissions reduction credit system can be subtle, especially when in practice, some elements of both may be included. The trading system promulgated in 2001 by the Ontario Ministry of Environment, and described below, is an example of such a hybrid system. However, the key distinction between the two systems is as follows. A cap and trade system starts from a designated total emission level that applies to specified sources and an initial allocation of 'allowances' to these sources the sum total of which does not exceed the cap. These sources can then trade the allowances and must keep their emissions in line with the allowances that they own. Any new source of emissions, such as a newly formed company, must buy allowances from current owners before they could operate in much the same way as they would have to buy or rent land from existing owners. This is sometimes referred to as a closed trading system.

An ERC system does not require an initial cap on total emissions. Instead, it starts from a level of emissions for each source (usually determined historically) against which reductions can be made and credit given. These emission reduction credits can then be sold to other sources that use them to meet a mandatory or voluntary limit. Under an ERC system, new emission sources have to meet all applicable emission regulations and standards. However, unlike a cap and trade system, they do not have to buy ERCs from existing sources so there is no automatic limit on total emissions.

Allowances Compared to ERCs

- Cap and trade (allowances)
    - Cap limits total emissions
    - Distribute allowances to existing sources
    - Trading reduces costs
- Emission reduction credits (ERCs)
    - Regulations limit individual sources
    - Reduce emission rate below regulation/history and create ERCs
    - Sell ERCs to other sources – reduce costs

Because the City of Toronto does not include sources that are currently subject to an emission cap, its emission trading opportunities are most likely to involve ERC creation and sale or even ERC purchase. At some time in the future, however, Ontario regulations or a Federal greenhouse gas control program might result in emission caps that apply to City sources.

3.1 An Example of Cap and Trade - The US Title IV SO2 Trading System

Examples of cap and trade regimes include SO2 trading under the Title IV of the 1990 *Clean Air Act Amendments* in the US;[3] NOx and SO2 trading under the RECLAIM system in southern California;[4] and the US EPA's NOx Budget Trading Program.[5] The Title IV program was used to achieve a 50 percent reduction in SO2 emissions from coal-fired electric utility boilers between the late 1980s and the year 2000. Title IV set a limit of about 8.9 million tons per year of SO2 emissions across the continental USA. This total was allocated to more than 400 utility boilers roughly in proportion to their coal consumption in 1985-87, with the annual allocation listed in the legislation itself. Each utility receives "allowances" every year for the number of tons of SO2 emissions specified in the legislation. A utility may sell its allowances, bank them for future use, or buy additional allowances from others. Utilities keep track of their SO2 emissions and must retire one allowance for every ton of SO2 discharged. The 8.9 million ton cap, which came into effect in two stages in 1995 and then in 2000 forced a 50% reduction in total national emissions from these boilers, while the trading allowed those who had high pollution control costs to save money by purchasing allowances from those with low costs. There is a market price for allowances which reflects the marginal cost of SO2 control at these boilers. Trading has been substantial and savings are estimated at hundreds of millions of dollars per year as compared to the same emission reduction without trading. (Ellerman *et al*., 1997; Schmalensee *et al*. 1998, p. 64.)

No existing regulations were repealed when Title IV was enacted. The utilities had to meet all of their pre-existing environmental commitments. Thus trading should not make air quality worse than it had been at any location, and many locations would have better air quality. But when the cap forced the utilities to reduce their emissions to half of previous levels, trading reduced the cost of doing so.

3.2 An Example of Emission Reduction Credits – the US Offset Provisions

Examples of Emission Reduction Credit trading include the "netting", "offsets", "bubble" and "banking" systems that arose because of rigidities in the US Environmental Protection Agency's regulations in the 1970's. General ERC trading rules were formalised in the EPA's 1986 "Emissions Trading Policy Statement" and the attached "Emissions Trading: Technical Issues Document."[6] The Canadian Pilot Emissions Reduction Project (PERT), the Greenhouse Gas Emission Reduction Trading Pilot (GERT), and the Clean Air Canada Incorporated (CleanAir) programs are ERC programs, discussed in detail below, but they differ in important ways from the EPA programs.

The offset program in the US applies where a new source wishes to locate in an area that does not comply with the national air quality objectives. US legislation generally prohibits the location of new sources in such areas. However under the offsets program, the new source may

[3] 1990 *Clean Air Act Amendments* Pub. L. 101-549, Title IV, 42 U.S. Code 7401-7671.
[4] See Klier, Mattoon and Prager (1997) for a description of the RECLAIM trading system. See also http://www.aqmd.gov/reclaim/reclaim.html .
[5] http://www.epa.gov/airmarkets/fednox/index.html .
[6] Federal Register, 51: 233, December 4, 1986, pp. 43829-43859.

locate in the area if it induces an existing source to reduce its emissions by more than the allowed emissions of the new source. The new source in effect purchases ERCs from the existing source. Thus the air quality will be improved and new businesses can be created. To qualify, ERCs must reflect emission reductions not required to meet any existing regulations, and not being counted on to meet future air quality goals. That is, they must be surplus to any regulatory requirements. The reductions must be permanent, shown by amendment of the source's emissions permit to the lower emission rate. The ERCs cannot be use to meet any regulatory requirement other than the offset requirement (or netting or bubble requirements not discussed here). So, a new source cannot use purchased ERCs to emit more than the amount allowed by new source performance standards. It can use them to avoid the prohibition on new sources in a non-attainment area. Plant shutdowns are explicitly allowed as a means of creating ERCs, subject to some rules to avoid double-counting.[7]

3.3 Emissions Trading – Some General Design Issues

General design issues associated with both allowances and ERCs include:

- Does the buyer get the same quantity as the seller sold, or is there a discount or reduction to cause some environmental improvement?
- Are there distance or directionality limits on transfers?
- Are holders allowed to bank them for future use, and if so, for how long?
- Where banking is allowed, is there any limit on the quantity that may be used in any year?
- Can a source sell allowances or ERCs that arise from actions that would have occurred even in the absence of the trading program?

The last issue deserves special attention. Suppose that a factory intends for purely economic reasons to convert its boiler from burning coal to natural gas. If an emissions trading program is in place, can the factory owner sell allowances or ERCs representing the emission reduction arising from that conversion? If so, then the buyer can increase its emissions to offset the seller's reduction, and the environmental benefit of that conversion is lost. This is an emission reduction that would take place "anyway" regardless of the emission trading program, so allowing the source to sell allowances or ERCs representing the reduction makes the environment worse than it would have been in the business as usual case without trading. However it would be difficult and costly to independently verify in each case whether the reduction would have happened in the absence of the emissions trading program, so this is rarely attempted. Usually if a source makes a reduction, it can sell it.

'Anyway' credits is really an issue of the baseline against which emissions trading is to be measured. Do we compare emissions under an emissions trading program with historic emissions, do we try to forecast what emissions would have been in the future under a business-as-usual assumption, or do we just compare emissions with this project and without this project? Any of these is legitimate, but they may yield different assessments. Discussions of trading of greenhouse gas emissions in connection with the Kyoto Protocol have encountered the great

[7] Federal Register, 51: 233, December 4, 1986, p. 43841.

reduction in CO_2 emissions from Eastern Europe and the former Soviet Union, arising from economic contraction and the replacement of obsolete technology. If the baseline for trading is 1990 emissions, these countries will have lots of ERCs to sell which result from reductions that have already taken place and have nothing to do with trying to control GHG. The sale of these credits has been referred to as the sale of “hot air”.

3.4 Emissions Trading and Economic Growth

One other issue is the behaviour of emissions in a growing economy under the two systems. Since a cap-and-trade system sets a limit on total annual emissions from sources, future emissions should not increase with economic growth. For example, even if the economy doubles in activity, sources under the cap will have to reduce emissions per unit of activity to keep annual emissions within the cap. An ERC system, on the other hand, usually starts with activity-based regulations as the baseline. Even without trading, if economic activity doubles, we would expect a doubling of emissions to be allowed under traditional emission regulations based on rates of emission and/or concentrations. Since ERCs build on this system, emissions can increase under an ERC system as the economy grows. Industry may see this as a desirable feature of ERCs as it does not require them to improve their emission controls as output grows. Environmentalists may favour the cap-and-trade system because it prevents pollution from increasing with economic growth.

4. Environmental and Financial Effects of Emissions Trading: Examples

The implications of emissions trading may be explored using a simple example and a simple trading system. Assume a region with a number of pollution sources, one of which, call it Alpha, emits 100 kilograms per year of NOx, while the other sources together emit 1000 kilograms per year of NOx. All sources currently meet their regulatory requirements at a cost of $100 per year. There are no voluntary commitments. Alpha has available to it an emissions control project that would cut its emissions in half, to 50 kilograms per year at a cost of $30 per year, or $0.6 per kilogram. The project is permanent – once it is undertaken emissions are forever 50 instead of 100, but the cost goes on every year. ERCs are trading in a market at a price of 90 cents per kilogram and other sources can reduce their emissions at a cost of $1 per kilogram.

We consider three years and several cases. Year 1 is the same in all cases. In year 2, Alpha either undertakes the project or not. If it undertakes the project it may sell the resulting allowances or ERCs to other firms in the region or bank them, or retire them without using them. If it sells them in year 2, the other firms will use them in that year to increase their emissions, and the other firms will also buy and use them in year 3. The net expense to Alpha for undertaking the project and selling ERCs is indicated in Table 1, along with the effect of its actions on total emissions and total pollution control costs in the region.

In the base case, Alpha emits 100 kilograms in year 1, and the other firms emit 1000 kilograms, for a regional emissions total of 1100 kilograms. Years 2 and 3 are identical, so regional emissions total 3300 kilograms over the three years. Alpha's net expense related to the project is zero and total regional emission control costs remain at $100 per year for a total of $300 over three years.

In case 2, Alpha undertakes the project in year 2 but does no trading. Alpha's emissions fall in years 2 and 3; it has costs of $30 in each year. Total regional emissions fall to 3200 kg. Alpha spends a total of $60 on pollution control, raising the regional total control cost to $360. The environment improves, at a cost. Alpha loses money on the project, so it would choose not to do the project on economic grounds. Thus Case 2 is not a business as usual case.

In case 3, Alpha undertakes the project in year 2 and in years 2 and 3 sells ERCs or allowances to another firm which increases its emissions by the same amount. Other source emissions rise by 50 kilograms in years 2 and 3, just offsetting Alpha's reduction, so total regional emissions equal 3300 kilograms, the same as the base case and more than in case 2. Alpha's sale of ERCs or allowances generates revenue of $45 per year, its costs remain at $30 per year, so its net expense over 2 years is $30. The other firms spend $45 per year to buy allowances or ERCs from Alpha, but this is more than offset by their saving of $50 per year on their own pollution control costs. Regional pollution control costs are reduced by $40 ((-50+30)x2) to $260. Since Alpha made a profit on the project, it would choose to do it for business reasons alone. In short, emissions trading causes Alpha to undertake a project that it would not do without trading in Case 2. But the trading has also eliminated the environmental benefit from the project since other firms increase their emissions to offset Alpha's decrease.

A variation on case 3 would involve a project that was profitable even without the sale of ERCs, a project that created cost savings as well as emission reductions. Energy conservation projects might fall into this category. In such a situation, Alpha would engage in the project for business reasons even without emissions trading. The project should then be included in any business-as-usual base case. Since the project will be done anyway, emissions will be reduced anyway. Selling ERCs created by the project will allow another source to increase its emissions, increasing total regional emissions. In this case, creating and selling ERCs increases regional emissions compared to the base case.

Table 1
Environmental and Financial Effects of Emissions Reduction Credits Trading: Simple Example

Case Description	Year 1	Year 2	Year 3	Total
1. Base Case (no project)				
1 Other sources emissions (kg)	1000	1000	1000	3000
2 Alpha emissions (kg)	100	100	100	300
3 Total regional emissions (kg) (1+2)	1100	1100	1100	3300
4 Other sources control costs ($)	$100	$100	$100	$300
5 Other sources ERC payments ($)	$0	$0	$0	$0
6 Other sources net expense ($) (4+5)	$100	$100	$100	$300
7 Alpha control costs ($)	$0	$0	$0	$0
8 Alpha ERC revenues ($)	$0	$0	$0	$0
9 Alpha net expense ($) (7+8)	$0	$0	$0	$0
10 Regional control costs ($) (4+7)	$100	$100	$100	$300
2. Low Cost Project, No Trading				
1 Other sources emissions (kg)	1000	1000	1000	3000
2 Alpha emissions (kg)	100	50	50	200
3 Total regional emissions (kg) (1+2)	1100	1050	1050	3200
4 Other sources control costs ($)	$100	$100	$100	$300
5 Other sources ERC payments ($)	$0	$0	$0	$0
6 Other sources net expense ($) (4+5)	$100	$100	$100	$300
7 Alpha control costs ($)	$0	$30	$30	$60
8 Alpha ERC revenues ($)	$0	$0	$0	$0
9 Alpha net expense ($) (7+8)	$0	$30	$30	$60
10 Regional control costs ($) (4+7)	$100	$130	$130	$360
3. Low Cost Project, Create and Sell ERCs				
1 Other sources emissions (kg)	1000	1050	1050	3100
2 Alpha emissions (kg)	100	50	50	200
3 Total regional emissions (kg) (1+2)	1100	1100	1100	3300
4 Other sources control costs ($)	$100	$50	$50	$200
5 Other sources ERC payments ($)	$0	$45	$45	$90
6 Other sources net expense ($) (4+5)	$100	$95	$95	$290
7 Alpha control costs ($)	$0	$30	$30	$60
8 Alpha ERC revenues ($)	$0	-$45	-$45	-$90
9 Alpha net expense ($) (7+8)	$0	-$15	-$15	-$30
10 Regional control costs ($) (4+7)	$100	$80	$80	$260

Case Description	Year 1	Year 2	Year 3	Total
4. High Cost Project, Create and Sell ERCs				
1 Other sources emissions (kg)	1000	1050	1050	3100
2 Alpha emissions (kg)	100	50	50	200
3 Total regional emissions (kg) (1+2)	1100	1100	1100	3300
4 Other sources control costs ($)	$100	$50	$50	$200
5 Other sources ERC payments ($)	$0	$45	$45	$90
6 Other sources net expense ($) (4+5)	$100	$95	$95	$290
7 Alpha control costs ($)	$0	$70	$70	$140
8 Alpha ERC revenues ($)	$0	-$45	-$45	-$90
9 Alpha net expense ($) (7+8)	$0	$25	$25	$50
10 Regional control costs ($) (4+7)	$100	$120	$120	$340
5. Case #2, With Discount, No Time Limit				
1 Other sources emissions (kg)	1000	1045	1045	3090
2 Alpha emissions (kg)	100	50	50	200
3 Total regional emissions (kg) (1+2)	1100	1095	1095	3290
4 Other sources control costs ($)	$100	$55	$55	$210
5 Other sources ERC payments ($)	$0.0	$40.5	$40.5	$81.0
6 Other sources net expense ($) (4+5)	$100.0	$95.5	$95.5	$291.0
7 Alpha control costs ($)	$0	$30	$30	$60
8 Alpha ERC revenues ($)	$0.0	-$40.5	-$40.5	-$81.0
9 Alpha net expense ($) (7+8)	$0.0	-$10.5	-$10.5	-$21.0
10 Regional control costs ($) (4+7)	$100	$85	$85	$270
6. Case #2, With Time Limit no Discount				
1 Other sources emissions (kg)	1,000	1,050	1,000	3050
2 Alpha emissions (kg)	100	50	50	200
3 Total regional emissions (kg) (1+2)	1,100	1,100	1,050	3250
4 Other sources control costs ($)	$100	$50	$100	$250
5 Other sources ERC payments ($)	$0	$45	$0	$45
6 Other sources net expense ($) (4+5)	$100	$95	$100	$295
7 Alpha control costs ($)	$0	$30	$30	$60
8 Alpha ERC revenues ($)	$0	-$45	$0	-$45
9 Alpha net expense ($) (7+8)	$0	-$15	$30	$15
10 Regional control costs ($) (4+7)	$100	$80	$130	$310
7. Case #2, With Discount and Time Limit				
1 Other sources emissions (kg)	1000	1045	1000	3045
2 Alpha emissions (kg)	100	50	50	200
3 Total regional emissions (kg) (1+2)	1100	1095	1050	3245
4 Other sources control costs ($)	$100	$55	$100	$255
5 Other sources ERC payments ($)	$0.0	$40.5	$0.0	$40.5
6 Other sources net expense ($) (4+5)	$100.0	$95.5	$100.0	$295.5
7 Alpha control costs ($)	$0	$30	$30	$60
8 Alpha ERC revenues ($)	$0.0	-$40.5	$0.0	-$40.5
9 Alpha net expense ($) (7+8)	$0.0	-$10.5	$30.0	$19.5
10 Regional control costs ($) (4+7)	$100	$85	$130	$315

(+) is cost; (-) is revenue

Case 4 is like Case 2 except that the cost of the project is $70, not $30. Now the cost of the project exceeds the revenue and Alpha will not choose to do the project on purely economic grounds even when it can sell the ERCs. If Alpha does the project, regional air pollution control costs will rise by $40 to $340 with no environmental benefit. Case 5 is like Case 2 except that the ERCs created by the project are discounted by 10% when they are sold. While Alpha's emissions are reduced by 50, the other firms increase theirs by only 45 (50-10%) in periods 2 and 3, and pay $40.50 for the ERCs, yielding a net improvement of 5 kilograms in each year. Alpha still makes a financial gain on the project and total regional emissions are down to 3245 kilograms, for a net environmental gain. Regional air pollution costs reflect the savings of $15 in years 2 and 3 ($45-$30).

In Case 6, ERCs are created for one year even though the project reduces emissions in years 2 and 3. As a result of this time limit on the longevity of ERCs, Alpha makes a loss on the project since it can only sell the ERCs in year 2, and the project is not economically attractive.

Case 7 combines the discount of case 5 with the time limit of case 6 and the project becomes even less economically attractive for Alpha.

Table 2 summarises these results. Doing the project reduces regional emissions by 100 kilograms in case 2. Selling ERCs in cases 3 and 4 eliminates the environmental benefit of the project completely. With discounting and/or time limits in cases 5 and 7 some environmental benefit survives the sale of ERCs. Selling ERCs always reduces costs compared to case 2. In comparison with the base case, only two cases offer regional economic benefits (cases 3 and 5) and only one of these (case 5) also offers environmental benefits as well.

Table 2
Summary of Environmental and Economic Effects: Example

	Net Change In		
	Regional Emissions (kilograms)[1]	**Regional Costs ($)**[2]	**Alpha Net expense ($)**[3]
1. Base Case (no project)	0	0	0
2. Low Cost Project, No Trading	-100	$60	$60
3. Low Cost Project, Create and Sell ERCs	0	-$40	-$30
4. High Cost Project, Create and Sell ERCs	0	$40	$50
5. Case #2, With Discount, No Time Limit	-10	-$30	-$21
6. Case #2, With Time Limit no Discount	-50	$10	$15
7. Case #2, With Discount and Time Limit	-55	$15	$19.5

1. (-) means a reduction in regional emissions from the base case.
2. (-) means a cost saving compared to the base case.
3. (-) means net revenue for Alpha, i.e. Alpha ERC revenue > control cost.

This analysis and the example illustrate several conclusions about emissions trading which we link here to the case numbers in the example:

- In the absence of emissions trading, any emission reduction project benefits the environment. (Table 2, case #2)
- Emissions trading can reduce the cost of achieving a given total degree of emission reduction among a set of sources. (#3, 5)
- Emissions trading by itself does not benefit the environment (#3), except when traded credits or allowances are discounted enough to offset the credit for emission reductions that would have happened anyway. (#5, 6, 7)
- ERC systems invite the sale of “anyway” credits which can increase total emissions over what would have happened with business as usual and no ERCs.
- A regulatory system with emissions trading can improve the environment if the cap in a cap-and-trade system is reduced over time, or if the emission regulations on which the credits are based are tightened over time.
- If a source wants to improve environmental quality, it should engage in pollution reduction projects and **not** sell ERCs created by the projects. (#2)
- If a source wants to maximize profits, it should engage in pollution reduction projects costing less than the value of ERCs created and sell the ERCs. No environmental improvement will result except to the extent of discounting and time limits and the reduction of non-traded pollutants. (#3)
- If a source wants to improve environmental quality **and** generate revenue, it should engage in pollution reduction projects costing less than the value of ERCs created and sell some, but not all, of the ERCs, retiring the remainder unused.

5. Trading Systems: CleanAirCanada/PERT, Ontario's Emissions Trading Regulation

In this section we describe and compare two emissions trading systems that are currently operating in Ontario, the newly created system for trading NO and SO2, the Ministry of the Environment Emission Reduction Trading System which we will refer to as MOERT and the Clean Air Canada Inc. (CleanAir) system that is the successor to the Pilot Emissions Reduction Project (PERT) and to the Greenhouse Gas Emission Reduction Trading Pilot (GERT). We contrast them with the largest emissions trading system in the United States, Title IV of the 1990 *Clean Air Act Amendments*. The main features of these systems are summarised in Table 3.

These systems apply to different pollutants. SOx and NO may both be traded under MOERT in Ontario. While in principle CleanAir could register reductions in these emissions, the only market for them in Canada today is in Ontario, so sellers would naturally prefer to use the MOERT system. Greenhouse gases (GHG) can be traded under CleanAir, but are not within the scope of MOERT. The 10% discounting of credits and the 7-year time limitation on creation from a project of MOERT are not replicated by the CleanAir, allowing wider trading in the latter but more environmental improvement in the former.

These systems also differ in that MOERT and US Title IV are emission reduction and trading regimes established by government regulation or legislation. PERT, GERT and CleanAir are voluntary credit certification regimes, but they do not have the force of law and do not limit emissions.

All trading schemes provide for measurement and verifications of emissions, and registering the ownership and transfer of credits or allowances. These are essential features of any emissions trading scheme. However, we do not see substantial differences between the trading systems discussed here with respect to these features, so we will not discuss them further in this report.

The ownership issue must concern the City of Toronto if it contemplates creating and selling ERCs or buying ERCs. If the ERCs are likely to be valuable, then securing contractual ownership may require the City to pay more or receive less than would otherwise be the case, but this is a natural consequence of receiving the benefit of ownership. In the case of projects already entered into, for which the ownership has not been agreed, negotiation or litigation may be the only means of determining clear ownership that would satisfy a registry.

Table 3 Principal Features of Selected Trading Systems			
System Features	**CleanAir**	**MOERT**	**US Title IV**
Pollutants covered	GHG (CO_2, CH_4, HFC, etc) and others.	NO, SO_2	SO_2
Geographical area for seller, buyer	Not limited	Creation: Ontario, D.C. & 12 states; Use: Ontario	48 states
Who may create trading units?	Anyone	sources?	none
Inter-pollutant trading?	No	No	No
Trading units	Metric tonnes	Metric tonnes	Tons
Baseline must be less than regulatory limit and:	VOL & BAU Forecast	HIS (last 3) & BAU Forecast	1985-87 fuel use base.
Credit for reduced activity, shutdown?	N (ex for shift to cleaner)	N	Y
Credit for temp. reduction?	Y	Y (fuel switch)	Y
Credit for conservation?	Y	N, get allowances	Source only
Credit for mitigation?	Y	N	N
Banking allowed, duration?	Y, no limit	Y, no limit	Y, no limit
Discounting of credits, %?	N	Y, 10%	N
Limit/discount for direction, distance?	N	Y Ontario and named states.	N
Max years of creation from a project	NA	7	NA
Offset for leakage to other sources?	Y	Y	N

VOL = voluntary commitment; BAU = business as usual; HIS = recent historic emissions

5.1 CleanAir/PERT

The Pilot Emissions Reduction Trading project (PERT) was established in 1996 by an industry-led stakeholder group as a demonstration project to evaluate emissions reduction trading in the Windsor-Quebec corridor and to develop an emissions trading framework for Ontario. (PERT, 1997, p. 1.) The PERT Draft Trading Rule, adopted in 1998, provided for trading of NOx, SO2, VOC, CO, and six greenhouse gases (GHG): CO2, CH4 (methane), N20, HFCs (hydrofluorocarbons), PFCs (perfluorocarbons) and SF6 (sulphur hexafluoride). (PERT, 1998, pp. 4, 2.) Trading activity through 2001 primarily involved first Ontario Hydro and then its successor Ontario Power Generation purchasing ERCs to cover its voluntary commitments for NOx and CO2 reduction. In 2001, PERT was succeeded by Clean Air Canada Inc. (CleanAir) and the PERT working group became a technical committee of CleanAir.

To be eligible for credit under the PERT rules, which were generally adopted by CleanAir, an emission reduction must be: real, meaning that it results from a pollution reduction project not a reduction in business activity; quantifiable; surplus to the requirement of any regulation or voluntary commitment; verifiable; and unique, so that a given project cannot give rise to PERT ERCs and ERCs under some other system. (PERT, 1998, s. 2.4.)

Under what circumstances does the existence of a voluntary commitment preclude the party making the commitment from creating ERCs? The practice under PERT was apparently flexible. Under CleanAir, a voluntary commitment would not prevent ERC creation unless the commitment would result in enforceable penalties. Thus a simple promise to achieve an emission reduction goal would not prevent the promisor from creating ERCs with projects that were needed to satisfy that promise. However if failure to meet the goal would lead to a financial penalty or ejection from membership in an industry association that would preclude creating ERCs from emission reductions that would lead toward meeting the goal.

The quantity of ERCs resulting from a project was calculated, under PERT, from the formula: ERC = (BER-CER)*CA where BER is the baseline emission rate, CER is the creation period emission rate, and CA is the creation period activity. (PERT, 1998, s. 2.5.) The ERCs are measured in tonnes. Thus PERT, like most ERC systems, is an activity-based system with emission rates measured as tonnes of emissions per unit of production activity such as fuel used or product output. The baseline emission rate is the lower of the actual rate or the allowable emission rate. The actual rate before the project may be either the historical emission rate from the most representative rate from the 10 years before the project, **or** where the historical rate is not appropriate, the projected future emission rate without the project. The allowable emission rate is the lower of the regulated rate, including regulated rate reductions at any time, or the rate associated with any voluntary commitment. (PERT, 1998, s. 2.7.)

If a source eliminated its emissions by shutting down, its activity CA in the creation period (the clean period) would be zero, so no ERCs would be created. However PERT Rule 2.10 provides that if a source shuts down and shifts its production to another cleaner facility in Ontario, it can claim ERCs for the reduction in the emission rate between the closed and the continuing facility.

Under CleanAir, the quantity of the emission reduction in any year is the difference between the actual emissions and the baseline emissions. The baseline emissions are the lower of any regulatory requirement (or voluntary commitment) and "the emissions that would be expected to occur in the absence of the emission reduction project." (CleanAir, 2001, s. 5.3.) CleanAir calls for estimating these baseline emissions using a forecasting model that includes the principal determinants of emissions from the source, including activity levels. (CleanAir, 2001, s. 5.3.)

Any source anywhere could create PERT ERCs (PERT, 1998, s. 2.2), but it appears that non-sources could also create ERCs by mitigation or conservation projects. Nothing prevents the creation of "indirect" credits when, for example, a building owner conserves electricity and claims ERCs for the reduction in emissions from the thermal power plants that make the electricity. (James, 2002.) The ERCs may be banked and they have unlimited life (PERT, 1998, s. 2.9). The rules impose no geographical restriction on trading, although they anticipate schedules of geographical limitations for individual pollutants (PERT, 1998, s. 3.7). The rules impose no discount or limit on distance or direction between creator and purchaser. PERT rules allow ERCs purchased under PERT to be used to meet any "eligible emission reduction targets, limits, caps, bubbles or averages for facilities, firms or groups of facilities." (PERT, 1998, s. 3.2.) However the Ontario MOE has the authority to allow or disallow the use of ERCs as part of a means of complying with MOE regulations or emission limits. Moreover the rules say clearly that ERCs may not allow a source to cause a violation of a point-of-impingement air quality standard in Ontario (PERT, 1998, s. 6.1), nor to violate a source's emission limits specified in a law, regulation, certificate of approval, order or guideline without specific MOE approval (PERT, 1998, s. 6.2). Thus while PERT could help buyers comply with voluntary commitments, other uses depend on MOE indulgence. CleanAir seems no more restrictive than PERT with respect to who may create credits.

CleanAir was established in 2001 to develop emissions trading for greenhouse gases across Canada, with most PERT members transferring their membership to CleanAir. With the adoption in 2001 of an emission reduction trading regulation for NO and SO2 from the electricity sector by the Ontario Ministry of the Environment, PERT was no longer needed by Ontario generators, since they would have to comply with the new Ontario rules. CleanAir applies the 1998 PERT rules and has published a Guidance Manual that provides operational details. (CleanAir, 2001a.) CleanAir lists permanence as an element of validity for emission reductions (CleanAir, 2001a, s. 4.3) but says that while many systems require that reductions be permanent, CleanAir does not impose that requirement at this time. The CleanAir documents note that while CleanAir provides a framework for validating and registering trades, traders will want to satisfy the rules of any jurisdiction in which the credits are to be used, so for any particular credit, the rules may be more restrictive than those imposed by CleanAir. CleanAir is also in negotiations with Ontario to operate the registry that will record ERC creation and trading for Ontario's new emissions trading system.

CleanAir reports that PERT and CleanAir have reviewed over 50 projects representing more than 19 million metric tonnes of GHG, 95,000 tonnes of NOx, 32,000 tonnes of SO2, and 43 tonnes of VOCs. (CleanAir, 2001b, p. 1.) We have found no report of the volume of emissions actually traded.

See Table 3 for a summary of the CleanAir features.

5.2 GERT

GERT was a pilot program to test the effectiveness of trading emission reduction credits for reducing greenhouse gases. GERT was developed by representatives of 11 Canadian federal, provincial and municipal governments and 11 industry, labour and environmental associations. The pilot rule lists six GHG that are formally considered for trading: CO2, CH4, N20, HFCs, PFCs and SF6. (GERT, 1999, s. 4.1.) To be eligible for credit, an emission reduction must be: real, meaning that it results from a specific action or undertaking, net of leakage of emissions to a third party or jurisdiction; measurable; verifiable; and surplus to reductions that are otherwise required. (GERT, 1999, s. 6.2.) Emission reductions may consist of: the reduction of emissions from existing sources; the avoidance of an emissions increase from an existing source; or the sequestration of GHG that would otherwise have been released to or remained in the atmosphere. (GERT, 1999, s. 4.2.) GERT was more explicit than PERT about the use of forecasting of emissions without the project as a means of determining the baseline. The memorandum of agreement that supported GERT expired at the end of 2001 and GERT is being wound down. Future development of GHG trading in Canada may be pursued by CleanAir.

GERT reports a number of project applications to sell and offers to buy, and a number of projects reviewed. Five are reported as trade-matched, although it is not clear whether the trades actually occurred.[8]

5.3 The Kyoto Protocol and Canada

Canada is a signatory to the Kyoto Protocol and is expected to decide whether to ratify the Protocol during 2002, perhaps as early as June. The Kyoto Protocol Article 3.1 and Annex B commits Canada to a 6% reduction of emissions of greenhouse gases, of which carbon dioxide is one, from 1990 levels in the commitment period of 2008-2012. As well, Annex I countries, including Canada, must have made "demonstrable progress" by the year 2005 in meeting their commitments under the Protocol.

The Kyoto Protocol explicitly provides for emissions trading among nations as a means of meeting national commitments the years 2008-2012. Three mechanisms are listed. "Joint Implementation" (Article 6) allows Annex I Parties to implement projects that reduce greenhouse gas emissions by sources or enhance removals by sinks in the territories of other Annex I Parties and to credit the resulting "emission reduction units" against their own emission

[8] http://www.gert.org/listings/ .

targets. The "clean development mechanism" (CDM) (Article 12) allows Annex I Parties to implement projects that reduce greenhouse gas emissions in non-Annex-I Parties. Emissions trading (Article 17) permits an Annex I Party to transfer part of its "assigned amount" (its 2008 target) to another Annex I Party. The actual mechanisms and regulations concerning emissions trading were worked out at meetings in Buenos Aires in November, 1998, in Bonn and in Marrakesh in October/November, 2001 at the Conference of Parties (COP) 7.

The Kyoto Protocol and subsequent agreements therefore create a framework for countries to establish their emissions baseline, commitment, and methods of measurement and to establish emissions trading among themselves. How a country pursues its target internally is its own affair, but emissions trading is permissible as an element in the country's strategy. Thus it is up to Canada to establish its own domestic process to pursue its Kyoto commitment and to arrange any domestic and international trading that may facilitate that process.

For descriptions of greenhouse gas trading regimes under development in the UK, in Denmark, in the EU and elsewhere, see ICLEI (2002, Appendix B) and TPWG (2000, Annex D). The UK plans to use a tax on the energy content of fuel supplied to industry, 80 percent of which can be avoided by negotiating a reduction in the emissions of greenhouse gases and participating in emissions trading. Denmark has established a pilot cap and trade system for CO2 from the electricity sector, with a penalty of about $7 (US) per tonne of CO2 emitted beyond the permits held. The EU is working to implement a cap and trade system for CO2 to take effect in 2005 involving large industrial sources, with other policies for smaller sources. To date, the EU member states have agreed on the initial distribution of allowances among the states.

The Federal government has been working with provincial and territorial governments to develop a national policy for dealing with climate change, one aspect of which has been the investigation of emissions trading as a tool to facilitate the Canadian response. In April, 2000, the Tradable Permits Working Group issued its report outlining several options for implementing emissions trading if that approach should be adopted for Canada. (TPWG, 2000.) The report examines using emissions trading limited to large final emitters of GHG as well as a much broader application of trading. It considers trading limited to those sources covered by caps that support Canada's Kyoto objectives as well as trading that would allow credit creation by non-covered sectors. Emissions goals and therefore trading by emitters of GHG are considered as well as limits and trading imposed on upstream sources. The report also considers international trading integrated with domestic trading and examines various methods for distributing permits to be traded. In May, 2002, the Federal government released a discussion paper on Canada's climate change strategy. (Canada, 2002.) This discussion paper set out four policy options in general terms and announced a process of consultation and analysis that should yield a draft plan in the Fall of 2002. The design of the final plan will determine who bears the possibly substantial cost of meeting Canada's Kyoto goals. We expect that decisions on these matters will be made deliberately.

At this time, little can be said about the likely shape of any GHG emissions trading system that may become a part of Canada's program for compliance with Kyoto. There is of course the possibility that Canada will not ratify the Kyoto Protocol, but even that would not end consideration of GHG emissions trading. Canada could still decide that some GHG reduction that fell short of the Kyoto goals was desirable, and that emissions trading was a useful means of pursuing that reduction.

Since the distribution of allowances for trading to meet the Kyoto goals might not occur before 2008, some system might be put in place to encourage early action prior to that time. Whether an early action system is needed will depend on an assessment whether the announcement of a Kyoto trading system to take effect in 2008 will be sufficient to induce appropriate early action. The shape of such an early action system is, at this time, entirely unclear, as is the probability of its creation.

The City of Toronto's pursuit of its 2005 CO2 commitment will likely have to be planned in the near term without a Kyoto emissions trading system or framework in Canada.

5.4 Ontario's Emissions Trading Program

MOERT is an emissions trading system established in 2001 by the Ontario Ministry of the Environment by promulgation of a regulation[9] and a code[10]. (OMOE, 2001.) The regulation applies specifically to the electricity generating sector (sec. 1), although it contemplates expansion to other sectors of the Ontario economy. It was developed by the OMOE in consultation with various stakeholders as part of the process of restructuring the electricity sector in Ontario.

MOERT combines a cap-and-trade limit on emissions of NO and SO2 from thermal generating stations in Ontario with emissions reduction trading that allows sources of these pollutants that are not covered by the cap to sell credits to generators that are subject to the cap. The NO cap begins at 35 kilotonnes (kt) per year for OPG in 2002, declining to 25 kt in 2004 and 17 kt in 2007, with Lakeview receiving a special allocation of allowances. The non-OPG thermal plants are capped at 10 kt/year in 2004, and their cap increases through 2006 to 13.9 kt/year. In 2008 all generators come under a single cap of 27 kt/year. Beginning in 2007, the cap is partitioned so that no more than 24.6 kt/yr are available south of the 48th parallel. (O. Reg. 397/01, ss. 6-10.) The SO2 cap begins at 153.5 kt in 2002 for the large OPG coal and oil-fired stations, dropping to 127 kt/year in 2007. (O. Reg. 397/01, ss. 12-14.) Allowances may be traded among electricity generating stations or with any other person. (O. Reg. 397/01, s. 19.)

MOERT also provides that 1 kt/year of NO and 4 kt/yr of SO2 allowances will be set aside and allocated to approved energy conservation or renewable energy projects. (O. Reg. 397/01, ss 12, 15.) Any unused allocations from this set-aside will be given to capped thermal generating stations. Since a conservation or renewable project does not use allowances, it will likely sell those allowances to a capped generator. Thus the set-aside operates as a subsidy to approved projects, the value of the subsidy depending on the allowances that they qualify for and the market price of allowances.

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9 Emissions Trading, O.Reg. 397/01, available at http://www.ene.gov.on.ca/envision/env_reg/er/documents/2001/RA01E0020-A.pdf

10 Ontario Emissions Trading Code, December, 2001, available at: http://www.ene.gov.on.ca/envision/env_reg/er/documents/2001/RA01E0020-B.pdf

The emission reduction credit aspect of MOERT is described principally in the Emissions Trading Code. ERCs may be created only by sources to which allowances have not been distributed, and then only by reducing emissions of NO or SO2 in accordance with an approved Standard Method. (Code, ss. 4, 4.1.) Two Standard Methods are set out in Appendix 1 of the Code: the installation of low-NOx burners on electricity generators, and SO2 reduction from fuel switching by electricity generators. Two Standard Methods are also set out in Appendix 2 of the Code: renewable energy projects (based on photo-voltaics, wind turbines, run of river hydro, and new hydro-electric power from existing dams); and electricity conservation projects. Other Standard Methods may be approved by the MOE. Credits may be created by a project for up to seven years after the project is completed; no credit may be given after the 7^{th} year even though the emission reduction may continue. (Code, s. 4.2, 4.7.) To qualify, an ERC must be: real, meaning that it results from a pollution reduction project not a reduction in business activity, and the reduction must be net of leakages or consequent increases elsewhere; surplus to any regulation, agreement, permit or control order; quantifiable; unique, meaning it must not have been used in any other emissions trading scheme; and verifiable. (Code, s. 5.4.) The amount of the emission reduction is the actual emissions less the baseline emissions, defined as “the emissions that would be expected to occur in the absence of the emission reduction project.” (Code, s. 5.5.3.) Standard Method #1 in Appendix 1 to the Code provides an ERC calculation similar to that of the PERT program:

ERs = (Baseline Emissions Rate – Actual Emissions Rate)*Actual Activity.

As with PERT, this method appears not to create ERCs for reductions in business activity or for shutdowns. There is no apparent requirement that the reduction be permanent; Standard Method #2 deals with an electricity generator switching to lower sulphur fuel.

Any source within Ontario and 12 states plus the District of Columbia may create ERCs which may be banked indefinitely. (O. Reg. 397/01, s. 18; Code, s. 4.8.) However all ERCs are discounted by 10 percent when they are retired, providing for a reduction in total regional emissions equal to 10% of the ERCs retired. (ss. 20, 21.) Furthermore in any year the retirement of ERCs by a source will be limited to 33 percent of allowances used for SO2 and 10% of allowances used for NO. (O. Reg. 397/01, s. 26.) Limits on distance and directionality that appeared in earlier drafts of the Regulation are replaced by the 12-state list in the final version.

In summary, MOERT imposes a cap on the emissions of NO and SO2 by the electricity generation sector, with the cap declining over time to achieve an improvement in air quality in Ontario. Emissions trading allows generators to shift this allocation among themselves to minimise costs of compliance. In addition, non-generators are allowed to create Emission Reduction Credits which can be sold, after a 10% discount, to the generators thus allowing the generators to increase their emissions by the amount of the post-discount ERCs. See Table 3 for a summary of the MOERT features. For comparison, see Section 3.2 above for a description of the US EPA’s ERC trading system based on a set of policies adopted in 1986.

5.5 US SO2 Trading: *CAAA* Title IV

The 1990 *Clean Air Act Amendments*, Title IV created a cap-and-trade system for trading of SO2 and to a lesser extent NOx by electric utilities across the United States. This system is described briefly in Section 3.1 above. There is no ERC system associated with Title IV – only allowances are traded. As a result there has not been the concern that trading will lead to actual increases in emissions. There have been concerns about regional air quality degradation, with some states attempting to block certain trades that they believe would degrade air quality in their state. However with the 50% reduction in overall emissions achieved by the legislation, most regions of the US will see improved air quality, not degradation. This 50% emission reduction is twice the 25% reduction in SO2 incorporated in MOERT. See Table 3 for a summary of Title IV features.

6. Case Analysis of Trading Under CleanAir and MOERT

We can combine the general environmental and financial effects of emissions reduction projects and emissions trading discussed above with the description above of the CleanAir and MOERT emissions trading programs to explore the implications of various emission reduction projects and emissions trading for the City of Toronto. We consider here a set of cases involving projects similar to some that have been or may soon be faced by the City of Toronto. These cases are presented in simplified form so that we can continue to focus on general principles. However the cases include details that make them more complicated than the simple cases discussed in section 4 above. We consider which emissions trading system each project might qualify for. This analysis is not, however, as detailed as that which will take place in Phase II of this project when more institutional and factual details will be gathered and discussed.

6.1 Landfill Methane Control

Assume that the owner of a landfill installs a system to capture escaping methane and burn it as fuel in an electricity generator converting the methane to carbon dioxide and water vapour. There is a direct net global warming benefit since the warming effect of methane is 21 times that of CO_2. Furthermore the electricity displaces some fossil electricity from the grid, causing an indirect reduction of GHG, NO_x and SO_2. We assume that the owner is subject to no methane regulation or voluntary commitment to reduce the methane emissions from this landfill. Finally, we assume that the project generates negative net revenues even considering ERC revenue.

This project reduces methane emissions compared to past emissions and compared to emissions that would have occurred without the project. Global warming is reduced by the amount of the methane emission reduction, offset by increased CO_2 emissions, over the life of the project. The warming effect of the emissions is global, so the location of the source is irrelevant for creating the benefits. There is a secondary benefit of the project; since methane is a precursor of ozone, the project will also reduce ozone formation near the landfill during the smog season. Finally, the electricity generated will displace some fossil-fuelled electricity generation, reducing CO_2, NO_x and SO_2 emissions.

Both the direct and indirect GHG reductions arising from this project should qualify for ERC creation under CleanAir. CleanAir calls for a forecast of the likely emissions without the project. ERCs may be created based on the extent to which actual emissions after the project fall short of the forecast emissions. CleanAir will require a calculation of the net GHG emissions reduction considering the methane reduction, the direct CO_2 increase from the generation and the indirect CO_2 decrease from reducing fossil fuel combustion elsewhere.

Any ERCs created by this project can be sold to any Ontario thermal generator or any other source that requires ERCs to meeting some commitment to greenhouse gas emission reduction, or that anticipates future regulation of its GHG emissions for which these credits would qualify. The ERCs may qualify for trading under the rules of CleanAir or under the emerging rules for Kyoto trading. The trading may, under CleanAir, involve a foreign buyer. If the owner sells ERCs created by this project, the buyer will presumably use them to increase its emissions of greenhouse gases, or to avoid some other more costly reduction of GHG. In either case, the sale of the ERCs cancels the global warming benefits of the project. Under CleanAir there is no discounting of ERCs, so the global warming benefits are completely eliminated. Some benefit remains, however, because the local reduction in hydrocarbon emissions should reduce local ozone levels somewhat, and there is an indirect reduction of NOx and SO2 from reduced fossil generation.

The sale of ERCs by the owner of the landfill will generate revenue that can be used to offset the cost of the project.

The methane reduction is not eligible for MOERT because methane is not covered by MOERT. The electricity generation from methane does not qualify as renewable energy under the MOERT definition of renewable energy in the Standard Method for renewable energy in Appendix 2 of the Code. However there is a process for proposing new Standard Methods, so the owner of the landfill could propose a new Standard Method that would allow projects such as this to qualify as a renewable energy project under the Code and thus earn allowances. If MOERT accepted a new Standard Method and this project, then 90% of the NO and SO2 indirect benefits would be lost for 7 years if credits are created and sold.

6.2 Office Building Energy Conservation

Assume that the owner of an old office building undertakes a renovation that reduces electricity consumption in the building by 25%. The owner is subject to no regulation or voluntary commitment regarding energy efficiency. The project does not meet the owner's investment criteria, so it would not be done on a business basis alone.

Assume that using Schedules 1 and 2 in Appendix 2 to the Code this project reduces CO2 emissions by 100 tonnes/year, NOx emissions by 10 tonnes/year, SO2 emissions by 10 tonnes/year, all from coal-fired electricity generating stations owned by OPG, in comparison to the emissions that would have occurred without the project. Global warming is reduced by the amount of the CO2 and N2O emission reduction over the life of the project.[11] The warming effect is global, so the location of the source is irrelevant for creating the benefits. However the project will also reduce concentrations of NOx and SO2 in the vicinity of the OPG generating stations, and the NOx reduction will reduce ozone formation in the region near the generating stations during the smog season.

The CO2 and N2O reductions should be eligible for ERC creation under CleanAir. Presumably the building owner would own the right to these ERCs, but it might have to confirm this with the generator which actually emits the pollutants in order to prove that they are "claimable" by the building owner under CleanAir rule 2.4.5. The trading may, under CleanAir, involve a foreign buyer.

[11] N2O contributes to global warming while other NOx contribute to ozone formation but not to global warming.

If the owner sells ERCs matching the CO_2 and N_2O reduction under CleanAir, the global warming benefit of the project will be completely eliminated. The owner will gain revenue. The only surviving benefits of the project are the reductions in pollutants other than CO_2 and N_2O.

The building owner cannot create ERCs under MOERT because it does not emit pollution when it uses electricity. Capped Ontario thermal generators cannot create ERCs from the project. However MOERT does allow proponents of conservation projects to earn allowances from the "set-aside"[12]. The Standard Method for Conservation Projects specifies how to calculate the displacement of NO and SO_2 resulting from reduced electricity consumption. The owner will earn allowances equal to this calculated reduction in NO and SO_2, which it can then sell to any electricity generator. If more conservation (and renewable) allowances are claimed than are available under the set-aside, each claimant gets a proportional share of the set-aside. Any unclaimed allowances from the set-aside are given to capped Ontario thermal generators.

If the owner sells NO or SO_2 allowances under MOERT, the local and regional environmental benefits of these reductions will be lost except to the extent of 10% plus all emissions after 7 years. The owner will gain revenue. The benefits of the CO_2 reduction will remain. The only way to retain the benefits of the NO_x and SO_2 reduction is to claim the allowances and not sell them.

Variation: Suppose that several partners were involved in the conservation project including the owner, a municipality, the local electric utility. This would not alter the project's eligibility to earn ERCs or allowances, but the partners would have to come to an agreement as to ownership of the allowances in order to satisfy the verifiability or uniqueness provisions of CleanAir and MOERT.

6.3 Boiler Fuel Switch

The owner of a factory replaces a worn-out boiler and switches from heavy oil to natural gas for boiler fuel. Natural gas will be less costly and more convenient, so the switch is the result of a business decision. The factory emissions were below regulated levels both before and after the replacement.

The project reduces emissions of SO_2, NO_x and CO_2 below historic levels for this factory and below forecast levels assuming that the old boiler continued to be used, which was uneconomic. Global warming is reduced by the CO_2 and NO_x reduction. Local SO_2 and NO_x levels are reduced along with regional acid rain and ozone. However because the project would be undertaken even ignoring emissions issues, the project does not reduce emissions below the levels that would have occurred in the absence of emissions trading programs. This project would have taken place "anyway" without emission trading.

The owner is an emitter, so it is eligible to create ERCs under CleanAir (N_2O and CO_2) and MOERT (SO_2, NO). The CleanAir rules say that the emission reduction compares the

[12] Emissions Trading, O.Reg. 397/01, ss. 12, 15.

forecast emissions **without the project** with the actual emissions with the project. The MOERT rules are similar. This suggests that ERCs may be created even if the project would have been done in the absence of the chance to sell ERCs. If the owner does not sell ERCs, the project improves the environment compared to historic emission rates, but not compared to the business-as-usual forecast. The trading under CleanAir may involve a foreign buyer.

When the owner replaces the boiler, they will have to secure a new Certificate of Approval from the Ministry of the Environment. It is likely that energy efficiency guidelines and emissions limits specified in the new CofA will be more strict than under the CofA for the old boiler. Is the baseline for determining "surplus" ERCs the old CofA or the new one? The MOE indicates that it would use the old CofA in such a situation because to do otherwise would reduce the ERCs created and thus discourage such projects.[13]

If the owner sells ERCs, this eliminates any environmental improvement for the pollutants that are sold, except under MOERT to the extent of 10% plus all emissions after 7 years from the project in-service date. Compared to the business-as-usual forecast, selling ERCs makes the environment **worse** than it would have been, although not as much worse under MOERT as under CleanAir because of the 10% and 7 year limit under the former.

6.4 CO2 Mitigation by Source with Voluntary Commitment

The owner of some pollution sources plants trees to sequester CO2. The planting is expected to sequester 25 tonnes per year of CO2 for the next 30 years. The owner has made a commitment to reduce CO2 emissions to a specified level by 2005. That level has not yet been reached and will be difficult to reach. There is no business case for the project other than reducing atmospheric CO2.

This project will reduce atmospheric CO2 levels compared to what would have occurred in the absence of the project.

The CleanAir baseline is the emissions that would have occurred in the absence of the project. The test is not whether the project would have occurred without emissions trading, but the emissions reduction caused by the project. This project appears to pass that test. CleanAir also says that the reduction must be surplus to a voluntary commitment that is supported by enforceable penalties. In this case, the commitment was entirely voluntary, with no penalties for failure, so it would appear to qualify for CleanAir. The trading may, under CleanAir, involve a foreign buyer.

This project is not eligible for MOERT because CO2 is not covered by MOERT.

If the owner does not sell ERCs under CleanAir, global warming is slowed, but no revenue is generated for the owner.

If the owner sells ERCs under CleanAir, the buyer may emit CO2 in the amount of the ERCs so the global warming benefit is completely lost. The owner generates revenue which

[13] Tony Rockingham, personal conversation, January 29, 2002.

could help pay for the project, but since the project combined with the sale achieves no environmental benefit this seems pointless except that it gives the owner the appearance of meeting its voluntary commitment.

Issue: What if the project would have made economic sense for a lumber company in the absence of emissions trading because they can cut the trees after 25 years and use the lumber for building houses? Does this mean there is no environmental benefit from the project even if no ERCs were sold? Would this affect eligibility for CleanAir?

6.5 Purchase ERCs from Tree-Planting to Meet Voluntary Commitment

The owner of some pollution sources proposes to contract with a farmer who will plant trees to sequester CO2 and sell the resulting ERCs to the owner. The planting is expected to sequester 25 tonnes per year of CO2 for the next 30 years. The owner has made a commitment to reduce CO2 emissions to a specified level by 2005. That level has not yet been reached and will be difficult to reach. There is no business case for the owner contracting with the farmer other than sequestering CO2.

Assessing the effect of this project requires forecasting what would happen in the absence of this project. Suppose that the owner has no substitute for this project, so that not doing this project will leave the owner 25 tonnes/year short of reaching its CO2 commitment. Then this project will reduce atmospheric CO2 levels compared to what would have occurred in the absence of the project. On the other hand, if the owner has a list of other projects for CO2 reduction or sequestration, and the owner is determined to meet its commitment, then doing this project simply substitutes for doing another equally effective project. There is no effect of this particular project on global warming since by 2005 the owner will have met its goal anyway.

This project is not eligible for MOERT because it only involves greenhouse gases.

This project appears to be eligible for CleanAir as a means of mitigation. Selling ERCs under CleanAir will provide the owner with revenue to offset the costs of the project. The trading may, under CleanAir, involve a foreign buyer.

If the owner will not meet the CO2 commitment without the tree-planting project, and if the farmer would not plant the trees absent the ERC transaction, then not being able to trade means not reaching the goal. In this case, trading is essential to doing the project and improving global warming.

On the other hand, if the farmer would plant the trees in the absence of the ERC transaction, then the ERC transaction does not improve the environment. And if the owner would undertake other actions to meet its commitment, this ERC transaction displaces some other action to meet the goal and this “anyway” transaction worsens the environment compared to the alternative action.

In summary, the environmental effect of trading in this case depends on what the various parties would have done in the absence of trading. This case differs from the others in this respect only in having two parties involved in doing the project, each of whom might operate independently.

Table 4 summarises the results of these cases.

Table 4
Summary of Trading Cases

	Landfill	**Building Conservation**	**Boiler fuel switch**	**Self tree planting**	**Other tree planting**
Pollutants reduced	Methane (& NOx, SO2)	CO2, NOx, SO2	CO2, NOx, SO2	CO2	CO2
Done anyway?	N	N	Y	N	maybe
Regulation or voluntary commit	N	N	N	Y	Y
Trading eligible? CleanAir MOERT	 Y CH4, CO2 Y NO, SO2	 CO2 NO, SO2	 CO2 NO, SO2	 CO2 N	 CO2 N
Project effect	ENV benefit	ENV benefit	Anyway	ENV benefit	Depends
Trading lose ENV benefit?	Y	Y CO2 Part NOx, SO2	Y CO2 Part NOx, SO2	Y	Y
Trading generate revenue?	Y	Y	Y	Y	Cost

6.6 Summary

These cases suggest several issues and problems that arise in evaluating emission reduction projects and proposals for ERC creation and trading.

- Should environmental effects be compared to historic emissions or to forecast emissions without the project? The latter is more difficult but usually more relevant.
- Some projects will be done even without emissions trading. Should a future-based assessment of environmental effects recognise that the project would be done anyway?
- Where the proponent of a project has made a voluntary commitment to some emission level, analysing the effect of the project requires assessing what the proponent would do without this project. Is it this project or nothing? This project or some equivalent project? In short, is the proponent committed to meeting the commitment in any event, or does failure of this project leave it further from its goal?

Several conclusions may also be drawn from this analysis.

- Projects reduce emissions except where they displace an equivalent project.
- Creating and selling ERCs may encourage the completion of emission reduction projects that would not be done otherwise.
- Once the decision has been made to do a project, creating and selling ERCs generates revenue but increases emissions compared to no trading.

7. Toronto's Carbon Dioxide Commitment for 2005

On January 29, 30 1990, the Council of the old City of Toronto considered a report by the Special Advisory Committee on the Environment: "The Changing Atmosphere: A Call To Action" which came with a set of recommendations from the Executive Committee. Council adopted the report and the Executive Committee recommendations, the first of which read: "That City Council declare an official commitment to the 20% reduction of the 1988 levels of carbon emissions into the atmosphere within the City of Toronto by the year 2005." After amalgamation, on December 16 and 17, 1998, the new City Council reaffirmed the previous commitment by adopting the following Clause: "The Strategic Policies and Priorities Committee recommends that Council adopt, as a city-wide target for the new City of Toronto, a carbon dioxide emissions reduction goal of 20 percent relative to 1990 levels by the year 2005." The two obvious changes in the commitment were moving the base year from 1988 to 1990, the base year for the Kyoto Protocol, and expanding the commitment from the old City to the new City.

This commitment may affect the City's pollution control projects and its emissions trading strategy because of the principle, discussed above, that ERCs should only be created and sold if they are surplus to existing requirements, whether regulations or binding commitments. Two issues are raised by the Toronto commitment. Does it refer to greenhouse gases in general or only to CO2? Does it refer to emissions by the City and its agencies, boards and commissions, or does it refer to all emissions by sources both public and private within the City limits?

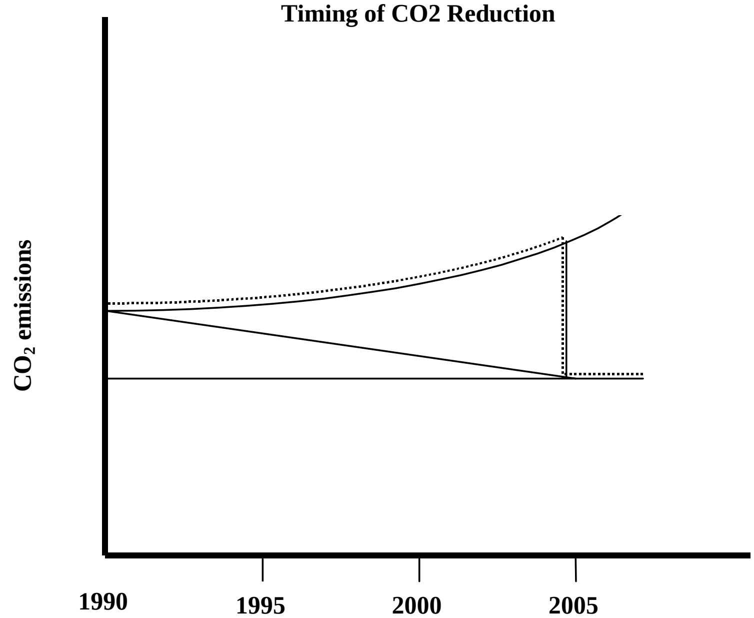
The answer to the first question seems clear. The 1990 wording refers to carbon while the 1998 wording refers to CO2. The current commitment appears to involve a reduction of CO2 emissions not greenhouse gases in general.

The answer to the second question is ambiguous. The City might be expected to make a commitment confined to sources controlled by the City, including its agencies, boards and commissions. This would include the TTC, Toronto Hydro, the Housing Authority, City Hall, but not apartment buildings, factories, federal and provincial facilities, and commercial establishments within the City. This interpretation appears not inconsistent with the 1998 wording of a "city-wide target". On the other hand, the 1990 wording "carbon emissions into the atmosphere within the City" seems to point to all sources, not just sources controlled by the City. Moreover the list of policy initiatives contained in the report of the Special Advisory Committee includes: encourage the Province to control the worst motor vehicle polluters; enhance public transit and manage traffic demand and vehicle occupancy during rush hours; promote bicycling and walking; explore the potential of electric and natural gas vehicles; encourage energy conservation in all buildings. This policy agenda suggests that the Special Advisory Committee had set its sights on reducing total emissions from within the City boundary, not just emissions from City-owned sources.

It appears to us that the best interpretation of Council's intentions in 1990 and perhaps in 1998 was to commit the City to reducing all emissions of carbon dioxide from all sources owned by the City and by anyone else within the City boundaries. However the meaning of these resolutions is not without ambiguity, and ultimately the City will have to decide the precise nature of its commitment.

Finally, there is a timing issue. The Council resolutions both refer to a 20 percent reduction "by the year 2005." This means that in 2005 the emissions must be 20 percent below 1990, presumably including any credits that may be applied in that year. What about years after 2005? Did Council intend emissions to stay at or below the commitment level forever, or are they allowed to grow at normal rates after 2005? The language provides no guidance. And what about years before 2005? Does the commitment to a target for 2005 imply that emissions, net of any ERCs purchased or sold, should decline steadily from 1990 levels to the 2005 target, as shown in the downward sloping straight line in Figure 2? Alternatively, may the City allow emissions, net of any ERCs purchased or sold, to rise through 2004 then reduce them in 2005 to meet the 90% commitment as shown by the dotted line in Figure 2? The answers to these questions will influence how the City deals with emission reductions it makes before 2005. Suppose that in 2002, the City can claim creation of some CO2 ERCs from the street lighting project and that actual CO2 emissions in 2002 are above the trend line from 1990 to the 2005 target. Are these 2002 ERCs surplus to the City's commitment or not? If the commitment is to a steady reduction, the answer is no, and the City has nothing to sell or bank. If the answer is yes, then the City can sell any ERCs that buyers will accept, or bank them for its own future use, regardless of how high the CO2 emissions are, until 2005 when the target must be met.

Figure 2
Timing of CO2 Reduction



Whatever the commitment, it will influence how the City monitors its performance in pursuing the goal, the choice of strategies for achieving that goal, and the likelihood that the goal has been or will be achieved. This in turn will influence whether CO2 reductions arising from projects with which the City is involved can generate emission credits that are "surplus" to its commitments.

8. International Implications

Emissions trading can have environmental effects even when it does not change the total quantity of pollution emitted just by changing the location of the emissions. Sometimes those effects are limited by the rules of the systems. Generally greenhouse gas trading systems such as CleanAir ignore the location of the trading parties because the effects of the emissions are global not local, while MOERT limits ERC creation to Ontario, 12 states and the District of Columbia. When trading parties are in different countries, trading may also be affected by national policies or by treaty obligations. With Ontario bordering on eight states and with substantial air movements both ways across the international border, the international implications of emissions trading deserve explicit consideration. We consider the effects of the rules, followed by environmental and financial effects of international trading in turn.

8.1 Limitations of the Rules

Toronto's CO2 commitment is voluntary, so any trading in CO2 will only be subject to the rules of the system that certifies the ERCs and to Toronto's own standards for creating or purchasing CO2 ERCs. With a voluntary commitment, Toronto need not meet any legislative standard. On the other hand, if Toronto wants its trading to be recognised under any system that may be adopted by the Federal Government for greenhouse gas trading under Kyoto or under any other international commitment, then Toronto will have to meet the requirements of the Federal system.

CleanAir imposes no limitations on international trading of ERCs. This is consistent with the focus of CleanAir on greenhouse gases, which are well mixed around the world. If Toronto found that it was having trouble meeting its voluntary CO2 commitment, it could investigate whether CleanAir had certified any CO2 ERCs that met Toronto's standards. If Toronto found that it had reduced its emissions more than necessary to meet its voluntary CO2 commitment, it could try to certify those reductions with CleanAir or with any other system for certifying and registering credits.

The Climate Trust has been set up to purchase CO2 credits created anywhere to offset the CO2 emissions from new fossil electricity generation plants in the state of Oregon.[14] If Toronto finds that it has excess CO2 reductions beyond what is needed to meet its voluntary commitment, it could offer them to the Climate Trust, which would apply its own standards to determine whether they would qualify for purchase. The Climate Trust indicates that it is considering some ERCs at $1.50 (US) per tonne of CO2, and would not pay more than $10 per tonne. A utility in Washington State, Seattle City Light, has in the past solicited the purchase of CO2 or GHG ERCs, and might be a buyer in the future.

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[14] See www.climatetrust.org .

A number of US firms are establishing a pilot GHG trading system called the Chicago Climate Exchange in which they will impose a voluntary cap on themselves, based on 1999 emissions, and trade allowances among themselves and buy credits from other sources.[15] It appears that Canadian participation will be welcome in 2003. It is not clear whether participants have to submit to a voluntary cap or whether anyone can buy or sell.

It seems likely that other firms and jurisdictions may have entered into voluntary commitments regarding GHG reductions and therefore might be potential buyers of surplus ERCs from the City.

MOERT limits the creation of ERCs to Ontario, the District of Columbia and 12 nearby states. Flexibility is provided by a provision that permission may be granted for creation in other places if it can be demonstrated that the creation will affect Ontario's air quality. This replaces a provision in the draft regulation that discounted credits based on distance and direction from the purchaser in Ontario. This is consistent with a rough approximation of the flows of pollution from the US into Ontario.

We are not aware of legislative or regulatory emissions trading systems in the United States in which the City of Toronto could buy or sell ERCs or allowances. However trading systems such as the US EPA's NOx Budget Trading Program might permit such trades in the future. This program has established a limit on total NOx emissions in the northeastern United States, with portions of the limit assigned to individual states. The states may then reassign their budget to individual sources. The states may also establish emissions trading programs within the state to allow sources to minimise their compliance costs. Since a number of these states are within the same airshed as southern Ontario, it is possible that in the future trading rules might allow trading between the states and Ontario sources.[16] Trading opportunities are likely to be limited, however, since the purpose of the program is to prevent sources in one state from degrading air quality in adjoining states.

The Government of Canada has been considering how it will participate in international GHG trading under the Kyoto Protocol. At the present time it is still unclear what the Canadian strategy for GHG reduction will be if we do ratify Kyoto. See Section 5.3 above.

8.2 Environmental Effects

Greenhouse gases cause their climatic effect over many years and decades, during which time the gases become fully mixed in the atmosphere. The location of a GHG source is irrelevant in assessing its global warming effect, given this mixing, in which case international trading of GHG does not differ in its environmental effects from trading within a country or province. However some GHG, such as methane have local effects as well as global warming effects, in which case international movements may be important.

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[15] See http://www.chicagoclimatex.com/html/initial.html .
[16] See http://www.epa.gov/acidrain/otc/ovrvw.html .

Ozone is a regional problem, as is acid rain. An increase or decrease in emissions from a particular source of NOx or SO2 will have an effect that depends on the location of the source. Political boundaries, however, are irrelevant; what matters is wind patterns. When considering trading of NOx or SO2, then, it is important to consider distance and directionality, but not borders. Ontario tends to receive air pollution from states in the US midwest and to send pollution to Quebec and the US northeast, but there is an exchange of pollution with the states immediately bordering the great lakes. Detailed air modelling has examined the flows between points in Ontario and points in the US.

The City of Toronto could take the position that political boundaries are relevant to its objectives; that it cares more about pollution levels in the City of Toronto than about pollution elsewhere in Ontario; that it cares more about pollution levels in Ontario than elsewhere in Canada; that it cares more about pollution levels in Ontario than in the US. In this case, any trades of NOx and SO2 should be preceded by air modelling analysis to determine the air quality impacts of the trade in these different jurisdictions.

8.3 Financial Effects

The only financial implication of international trading is associated with exchange rate risk and payment risk. Any trade with, e.g., a US partner, in which the payment takes place after the contract is signed raises the risk that the exchange rate may change in the interim. This risk may be reduced by denominating the price of the trade in Canadian dollars. If that is not acceptable to the partner, the price can be denominated in US dollars and the City can adopt a risk management strategy to deal with the exchange rate risk. These risks are the same as the risks associated with the purchase of supplies from a US firm over a similar period of time.

9. Issues and Cases for Toronto

This analysis has shown the general implications of trading for Toronto or any other jurisdiction or air emissions source. There is, however, a need for further analysis based on specific trading opportunities and details of those opportunities that go beyond the simple cases presented here. These issues will be addressed in Phase Two of the project and in the Phase Two report. These issues include:

∃ implications of Toronto=s voluntary CO_2 commitment for control and trading of greenhouse gases;
∃ how will Toronto balance environmental protection and revenue as goals for emissions trading;
∃ what are the merits of earmarking revenue from ERC sales for pollution reduction projects;
∃ management of ERCs within many Toronto departments and ABCs;
∃ ownership of ERCs from partnered projects – what have other jurisdictions done;
∃ positions that Toronto may take with respect to developing Federal GHG policy;
∃ effect of redefinition of "air quality" by Toronto Public Health Division on Toronto ET policy;
∃ local air quality effects of ET;
∃ what should Council consider in evaluating trading proposals?

Phase Two will also involve the investigation of a set of cases that are more specific and detailed than those considered in this report. We have received a number of suggestions for cases to examine in Phase Two, including the following:

- low sulphur fuel purchase;
- fleet fuel reduction – change service delivery, operations.
- Landfill methane recovery and electricity generation – specific landfill
- Convert boiler from oil to gas
- Fossil, electricity conservation in City building
- Fossil, electricity conservation in private building
- City 25% green electricity purchase commitment
- Waterfront integrated energy project or other district energy project
- Street lighting program
- Tree planting, on City streets or outside the City
- Purchase CO_2 credits to meet 20% commitment

The final selection of cases will be made after consultation with the City.

10. Questions and Answers from the April 17, 2002 Workshop

Some of the discussion at the April 17, 2002 workshop resulted in changes to the body of the report. We reproduce some of the questions and answers that are of general interest.

Q: If it is easy for sources to create ERCs, is the regulation not strict enough?
A: Regulations often apply uniformly to a number of sources in the same industry, since it would be too costly, and perhaps infeasible, for the Ministry of the Environment to know the cost and feasibility of control for each source. So, a regulation that reasonably balances costs and benefits may impose high control costs on some sources and low costs on others. If this is the best we can do with regulation, it provides an opportunity for emissions trading which can reduce total control costs by letting high and low-cost sources trade.

Q: What if a source buys ERCs but does not use them that year?
A: They may use them in a future year if the emissions trading system allows such "banking". In that case, emissions are reduced in the year of purchase and increased in the year of use. If the firm never uses them, it has improved the quality of the environment in the amount of the unused ERCs.

Q: If the City creates credits with projects that help to meet its voluntary CO2 cap, can it sell them in the Ontario trading system?
A: The Ontario trading system only deals with SO2 and NO at the present time, so no CO2 trading is possible there.

Q: Under the Ontario trading system, if a project cannot create credits after the 7^{th} year, won't the project owner just increase its emissions in year 8 to save money?
A: Many emission reduction projects involve substantial capital investment that is not easily reversible. In these cases, the emission reduction may continue for years after the ability to create ERCs has expired. In other cases, for example where the emission reduction arises from operational changes, the owner might abandon the emission reduction when he cannot create and sell credits. I expect that the majority of projects will be of the former type.

Q: Can you bank credits and use them in the future?
A: That depends on the system. All three systems summarised in Table 3 allow banking. Most of the GHG trading systems under discussion allow banking, since GHG represent a long-term problem, not an acute problem. But it is coherent to have trading without banking, or with limited banking.

Q: When someone reduces emissions, who owns the credits?

A: That depends on the situation and on any agreements. If you are going to take actions that might create credits, you should consider ownership before you start and enter into contracts with any partners that clearly determine the ownership of any resulting credits.

Q: Can you mix cap and trade and ERC systems?

A: Yes. The Ontario emissions trading system is a cap and trade and credit system. The fossil electric generating stations are capped, but anyone can create ERCs and sell them to the generators.

Q: Suppose that Toronto expects to meet its CO2 target by 2005. Can we sell emission reductions created before 2005?

A: That depends on the rules of the buyer, the rules of the system that certifies the credits, and the City's own policies. Nothing in the CleanAir rules precludes the City from selling all emission reductions prior to 2005, nor does it appear that any future Federal rules would preclude it. The City might adopt a policy, however, of not making such sales on the grounds that its commitment was to ramp down emission to the target in 2005.

Q: If a project is uneconomic, would the rules preclude selling credits that it creates?

A: No. On the contrary, being uneconomic guarantees that it is not an "anyway" project.

Q: If we do a project to meet the City's 20% CO2 target and sell the credits, can we use the revenue to fund other environmental projects?

A: Yes. But selling ERCs from projects needed to achieve the CO2 target means that we have not actually reduced worldwide GHG. The City might adopt a policy that it would not engage in such sales. However any time the City does sell ERCs, if it reinvests the money in environmental projects, there is, of course, an environmental benefit.

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