PROMOTING OPTIMAL EARLY ACTION ON GREENHOUSE GAS EMISSION REDUCTIONS: AN ASSESSMENT OF ALTERNATIVE MEASURES

Peter Kennedy

Department of Economics

University of Victoria

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ABSTRACT

This report provides an assessment of alternative measures to promote optimal early action ahead of the Kyoto commitment period, including the award of credit for early action (CEA) to reduce emissions, and the *Canadian Early Emission Reduction Program* proposal in particular. The report also examines the closely connected issue of "baseline protection" in conjunction with a future cap-and-trade program, and examines the role for the early phase-in of such a program in promoting early action.

I argue that a CEA program focuses too narrowly on rewarding emission reductions *per se*, and therefore targets only indirectly the structural adjustment needed to ensure Canada's compliance with its Kyoto commitments. In this respect it is an imprecise policy instrument. Moreover, CEA can potentially impede cost-effectiveness in the commitment period by constraining the functioning of a regulatory program in the commitment period (such as a cap-and-trade program).

A better approach is the early phase-in of the commitment period regulatory program combined, with targeted supplementary measures. The early phase-in of a cap-and-trade program could be implemented either through the progressive introduction of mandatory permits, or through trading in emission futures. The latter approach has the significant advantage of creating GHG price signals in the economy without imposing particular early emission reduction requirements. The design of supplementary targeted measures should be based on the underlying sources of the private under-valuation of early actions rather than on a goal of achieving early emission reductions *per se*.

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1. INTRODUCTION

As a signatory to the Kyoto Protocol, Canada has agreed to limit its greenhouse gas (GHG) emissions to 2825 million tonnes (Mt), measured in terms of carbon-dioxide (CO_2) equivalent, over the period 2008 – 2012. That agreement will become binding if Canada ratifies the Protocol. This cap on emissions implies an average annual allowance of 565 Mt, which is 6% less than Canada's emissions in 1990. Forecasts based on "business-as-usual" (BAU) projections estimate annual emission volumes of between 705 Mt and 925 Mt by 2010; that is, between 25% and 33% over target.[1]

Concern over this forecast shortfall lead the Joint Meeting of Federal, Provincial and Territorial Ministers of Energy and Environment (JMM) to agree in April 1998 to establish a system for crediting early action to reduce GHG emissions. The Credit for Early Action Table was established to provide advice to government on the creation of such a system. The report produced by the Table in April 1999 provides a thorough discussion of the many complex issues involved in the creation of a credit for early action (CEA) system but the Table did not present a specific proposal. Following on the work of the CEA Table, a collaboration of industry stakeholders and environmental groups proposed a specific CEA system, called the Canadian Early Emission Reduction Program (CEERP).[2]

This paper provides an assessment of alternative measures to promote optimal early action, including the CEA approach and the CEERP proposal in particular. The paper also examines the closely connected issue of "baseline protection" in conjunction with a future cap-and-trade program, and examines the role for the early phase-in of such a program in promoting early action.

The paper is organized as follows. Section 2 examines the economic rationale for promoting early action, and develops the framework for the analysis that follows. Section 3 examines the issue of baseline protection and its relationship to incentives for early action. Section 4 provides an overview of the main elements of CEERP. Section 5 then provides a critical assessment of CEA as a general policy approach while section 6 focuses on some specific elements of the CEERP proposal. Section 7 discusses the early

[1] Credit for Early Action Table (1999), p.3.
[2] CEERP Collaborative (1999).

phase-in of a cap-and-trade program as an alternative foundation to early action policy. Section 8 examines design considerations for supplementary targeted measures. Section 9 concludes with a summary of key points.

2. PROMOTING EARLY ACTION: ECONOMIC RATIONALE

The first step in assessing alternative mechanisms for promoting early action should be to pose and answer two fundamental questions:

- why is early action valuable?
- why are policy measures needed to promote early action beyond what the market itself will undertake in expectation of a carbon-constrained future?

Neither the CEA Table nor the CEERP Collaborative attempted to examine these questions beyond the general idea that awarding credit for early action will help to "bend the line" towards the Kyoto target.[3] It can be argued that many of the shortcomings of the CEERP proposal, and of CEA proposals in general, are traceable to the fact that these two questions have not hitherto been properly addressed. Only by thinking carefully about why a policy is needed can we derive the optimal form the policy should take.

2.1 Why is Early Action Valuable?

The key point to bear in mind when thinking about early action is that its primary value *does not* stem from the early emission reductions *per se*. Reducing the amount GHGs emitted domestically in the pre-2008 period does not contribute to meeting the Kyoto target; no credit is given under the Kyoto protocol for pre-2008 domestic reductions.[4] The primary value of early action lies in its constituent technological and behavioral adjustments; these structural adjustments will help to reduce the cost to Canada of complying with its Kyoto commitment. That is, the value of early action should be viewed in terms of the compliance cost savings it will yield in the commitment period, and not in terms of the actual emissions cut in the pre-2008 period.

[3] It should be noted that it was not part of the CEA Table's mandate to address these questions; it was charged only with developing ideas for a system to credit early action as directed by the JMM.
[4] In contrast, emission reductions achieved outside Canada between 2000 and 2008 through the Clean Development Mechanism (CDM) do earn credit against our Kyoto commitment.

Consider an analogy to illustrate the point. The kilometers run by an athlete in training for a race do not reduce the number of kilometers that must be completed during the race. The value of the kilometers run in training lies in their contribution to building the athlete's fitness; the fitter she is, the better will be her race performance. The same is true of early action on GHGs. The technological and behavioral adjustments that constitute early action will build Canada's economic fitness for meeting the Kyoto target (and any targets set for future commitment periods); the actual emissions cut prior to 2008 have little direct value.[5]

2.2 Why are Policy Measures Needed to Promote Early Action?

The next question we need to address in thinking about policies to promote early action is why policy is needed at all. Consider again the athletic training analogy. The prospect of the race provides the motivation for the athlete to train. She assesses the benefits of the training, in terms of its impact on her race performance, relative to the time costs of that training, and sets an optimal training regime accordingly. Similarly, we should expect Canadian firms and consumers to recognize the coming economic challenges and opportunities posed by the Kyoto commitment and take early action accordingly, based on the relative costs and benefits of doing so. However, there are two key differences between the running analogy and the realities of preparing for the Kyoto commitment:

- uncertainty about the implications of the Kyoto commitment; and
- divergence between the private and social benefits of early action.

Consider each of these in turn.

[5] There are some climate benefits that stem directly from early emission cuts but these are likely to be very modest. Canada currently accounts for less than 3% of global GHG emissions; even if emissions were cut by 100 Mt over the period 2000 – 2007, the associated climate benefits would be undone by fewer than three days worth of global emissions in the first Kyoto commitment period, and far fewer than that if emissions from developing countries continue to grow at current rates. Thus, climate benefits are not a significant consideration in a pragmatic approach to early action. Early GHG reductions also have some non-climate environmental benefits, the value of which are difficult to estimate. However, these benefits can be tapped much more effectively by targeting the specific pollutants – such as VOCs and NO_x – that underlie the non-climate air quality problems.

2.2-1 Uncertainty about the Implications of the Kyoto Commitment

Firms and consumers currently have very little idea about how the Kyoto commitment will affect them, and so the benefits of early action are very uncertain. To some extent this uncertainty is inevitable and no policy can hope to resolve that uncertainty entirely. However, the sooner economic agents are given a clear indication of what Kyoto will mean to them, the sooner they can begin to make adjustments accordingly.

The key to reducing that uncertainty is the announcement and early phase-in of the regulatory program to be used for the commitment period. This is the single most important element of an effective early action policy. That commitment period regulatory program could take various forms, including a cap-and-trade program, a carbon tax, a system of individual emission standards, or a combination of these. An assessment of the relative merits of these programs is beyond the scope of this paper, although it should be noted that a cap-and-trade program has much to recommend it. The announcement and early phase-in of a well-designed cap-and-trade program would help to create the price signals needed to stimulate structural adjustment in the economy. This is discussed at greater length in section 7 of the paper.

2.2-2 Divergence Between Private and Social Benefits of Early Action

If the private benefits (that is, market-based benefits) from early action correctly reflected the true social benefits therefrom, then no policy measures would be needed to promote early action beyond the establishment and early phase-in of a good commitment period regulatory program. However, the private benefits of early action are likely to under-represent the true social value of those actions, for four main reasons:

- strategic distortions;
- technological spillovers;
- information spillovers; and
- limited price-responsiveness.

Consider each of these in turn.[6]

2.3 Strategic Distortions

An announced regulatory program for the commitment period will not create the right price signals to drive early action unless the program carefully stipulates how early action will be treated in the context of that program. In particular, there arises the possibility that emission sources will have a strategic incentive to delay early action that they would otherwise have taken, in order to favorably effect their emission entitlements for the commitment period.[7]

The problem is best described in the context of an example. Suppose a cap-and-trade program is announced today for implementation in 2008, with permits awarded free-of-charge on the basis of emission levels in 2007. That is, each emitter is awarded a share of the Kyoto budget proportional to its share of total emissions in 2007. Thus, entity *i* would receive

$$q_{i,2008} = \left[\frac{e_{i,2007}}{\sum_{j=1}^{N} e_{j,2007}} \right] 2825$$

where $e_{i,2007}$ is entity *i*'s emissions in 2007 and *N* is the total number of emitters.[8] It is straightforward to show mathematically, and intuitively clear, that a lower value of $e_{i,2007}$ leads to a lower value of q_i. Thus, the private return from early action to entity *i* is reduced by the value of the permits it foregoes in the commitment period as a consequence. This tends to distort investment decisions against early action.

The same type of problem arises if the commitment period regulatory program is a set of individual emission performance standards, where standards are set for each firm on the basis of actual emission levels. The strategic incentive to raise the allowed limit reduces the private return from early action.

Conceptually, there are three reasonable solutions to the strategic distortion problem:

- use a carbon tax as the commitment period regulatory program;

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[6] Additional to these three are the aforementioned climate and non-climate environmental benefits.
[7] Sources may even find it profitable to artificially increase their emissions prior to the commitment period.
[8] It is worth noting that the total number of permits issued will be less than 2825 Mt if the cap-and-trade program does not have 100% coverage, but the allocation rule would still apply as stated. The same point applies to the allocation rules discussed in section 3 below.

- use a cap-and-trade program and auction the permits; or
- use a cap-and-trade program in conjunction with baseline protection.

Attention in this section is confined to the third alternative.

Baseline protection means allocating permits using a baseline that is invariant to early action. In the context of the above example, one form of baseline protection would be to base permit shares on relative emission levels in 1990:

$$q_{i,2008} = \left[\frac{e_{i,1990}}{\sum_{j=1}^{N} e_{j,1990}} \right] 2825$$

Actions taken after 1990 do not affect the allocation of permits and so there is no strategic distortion of early action investment decisions. Other approaches to baseline protection can achieve the same neutrality result. The issue is discussed in more detail in section 3 of the paper.

Baseline protection is a conceptually straightforward solution to strategic distortion. Implementation in practice is of course less straightforward but nonetheless feasible. Thus, the strategic distortion problem does not in itself provide a reason to adopt supplementary early action promotion program.

2.4 Technology Spillovers

The most promising route to meeting the Kyoto target without incurring huge compliance costs is through the development and adoption of less GHG-intensive technologies. As with all forms of technological change, there are substantial positive spillovers associated with the development of such technologies. That is, the social return from the development of a new technology is considerably higher than the private return. There are two main reasons for this:

- knowledge spillovers; and
- economies of scale.

2.4-1 Knowledge Spillovers

The growth of knowledge in one sector often has substantial effects on the growth of knowledge in other sectors. For example, the development of fuel cell technology for

transportation can spawn energy-saving ideas in other areas. The value of these spin-off ideas generally cannot be captured commercially by the creator of the original idea, so this spillover value does not enter into the calculus of private returns. Investments in knowledge based purely on private returns therefore tend to be under-valued from a social perspective.

2.4-2 Economies of Scale

"Economies of scale" refers to a property of many production processes whereby the average cost of production falls as more product is produced. This means that a product that is not profitable at low levels of production might be profitable at higher levels of production. Economies of scale can therefore act as a "barrier to entry": new products cannot achieve profitability until they capture market share but high initial production costs mean that prices cannot be set low enough to capture that market share. There is sometimes a role for government to intervene to promote the growth of market share for these products in the early stages of their market life; this is the so-called "infant industry" argument for intervention. In the context of alternative fuels and other products related to energy efficiency, the argument has considerable merit.

2.5 Information Spillovers

Information spillovers are of a similar nature to technology spillovers; the private returns to providing or acquiring information tend to under-represent the true social value. Important examples in the context of early action include:

- information dissemination about energy-efficient products and processes;
- learning about emission trading processes and their potential benefits; and
- learning about CDM processes and opportunities.

2.6 Limited Price-Responsiveness

A variety of goods and services are provided through regulated markets or though public and quasi-public bodies. Important examples include electricity generation and public transportation. Investment decisions in these sectors are determined more by public policy than by market price signals. Thus, the creation of GHG price signals through the

phase-in of a commitment period regulatory program will be relatively ineffective in driving early action in these sectors.

2.7 Policy Implications

The divergence between the private and social returns from early action – due to technology spillovers, information spillovers and limited price-responsiveness – justify a role for early action policies supplemental to a commitment period regulatory program.

In thinking about what policy measures are best suited to promoting early action it is worth referring again to the running analogy made at the outset of this section. A sole focus on running pre-race kilometers will achieve an inferior level of preparation for the race than a more diversified training regime that includes diet management, strength training, and stretching. Similarly, an exclusive emphasis on rewarding actual emission reductions in the pre-2008 period will likely be less effective in achieving economic fitness for meeting the Kyoto commitment than a broader policy approach that targets the structural adjustments required.

3. BASELINE PROTECTION

Recall from section 2.3 that the private return to early action can be seriously distorted if entities are penalized, in terms of emission entitlements for the commitment period, by taking that action. The purpose of baseline protection is to eliminate that distorting disincentive for early action.

It is important to note at the outset that the need for baseline protection does not arise if entities are required to purchase all of their emission rights from the government at the prevailing market price. Such would be the case under a carbon tax or a cap-and-trade program where all permits are auctioned. The idea of auctioning permits under a cap-and-trade program, combined with targeted revenue recycling, has received far less attention in the North American policy debate than it deserves. One of the most positive features of that system is its implications for early action incentives. (This is discussed further in sections 3.5 and 7). If instead permits are allocated based on emission levels then some form of baseline protection is required.

Three different approaches to baseline protection have received most attention. They are:

- flat baseline;
- projected baseline; and
- reconstructed baseline.

Each of these is reviewed in turn.

3.1 Flat Baseline Approach

A flat baseline is one that takes an entity's emissions in a specified historical year (the base year) as the reference point for setting the entity's emission entitlements for the commitment period. For example, if the base year is 1990, then under a flat baseline the emission entitlements allocated to entity *i* are

$$q_{i,2008} = \left[\frac{e_{i,1990}}{\sum_{j=1}^{N} e_{j,1990}} \right] 2825$$

This allocation to entity *i* is invariant to any action it takes after 1990 and is therefore neutral with respect to early action incentives (that is, it is non-distorting).

A base year of 1990 might be considered a "natural" choice because 1990 was chosen as the base year for the Kyoto protocol. However, there is no compelling reason to choose 1990; any base year earlier than 1999 will ensure that emission allocations are invariant to early action decisions from this point forward.[9] The key difference between different base years is their implications for the distribution of emission entitlements across entities. This important issue is discussed in section 3.4 below.

3.2 Projected Baseline Approach

A projected baseline is based on a forecast made today of BAU emissions in a future reference year, such as 2007. That is, a forecast is made today about what emissions for an entity would be in 2007 if it undertook no early action between now and then. Under a projected baseline the emission entitlements allocated to entity *i* are

[9] Base year emissions could also be calculated as average emissions over a number of years prior to 1999. Note too that the same base year need not apply to all entities.

$$q_{i,2008} = \left[\frac{E_{1999}[\hat{e}_{i,2007}]}{\sum_{j=1}^{N} E_{1999}[\hat{e}_{j,2007}]} \right] 2825$$

where $E_{1999}[\hat{e}_{i,2007}]$ is the expected level of emissions for entity *i* in 2007 along the BAU trajectory for that entity, as forecast in 1999. Note that $\hat{e}$ denotes BAU emissions, as distinct from actual emissions. Thus, for an entity that undertakes early action, $E_{1999}[\hat{e}_{i,2007}]$ is a forecast along a counter-factual emissions trajectory, the trajectory the entity would have followed had it not undertaken early action.

3.3 Reconstructed Baseline Approach

A reconstructed baseline is somewhat like a projected baseline in the sense that emission entitlements are based on a calculation of BAU emissions. The key difference between the projected and reconstructed baseline approaches relates to when that calculation is made. In the case of the projected baseline, the calculation is made today based on a forecast of future BAU emissions. In the case of the reconstructed baseline, the calculation of future BAU emissions is not made – and the allocation of entitlements not finalized – until some point in the future closer to the commitment period. The rationale behind the reconstructed baseline approach is to allow information about actual growth patterns between now and the commitment period – as opposed to forecast growth patterns over that period – to influence the determination of emission entitlements. For example, under a reconstructed baseline using a 2007 calculation year, the emissions entitlements allocated to entity *i* in 2008 are

$$q_{i,2008} = \left[\frac{E_{2007}[\hat{e}_{i,2007}]}{\sum_{j=1}^{N} E_{2007}[\hat{e}_{j,2007}]} \right] 2825$$

where $E_{2007}[\hat{e}_{i,2007}]$ is an estimate of what entity *i*'s emissions would have been in 2007 had it followed its BAU trajectory, as calculated (or "reconstructed") in 2007.

There are a variety of ways in which BAU emissions could be reconstructed. The latest proposal in the Canadian context involves reconstruction based on a record of verifiable emission reductions resulting from specific and identifiable actions by the entity. Eligible emission reductions include the avoidance of an emissions increase that

would otherwise have occurred. The starting point of the BAU emissions path for the purpose of baseline reconstruction is 1990.

3.4 An Assessment of Baseline Protection Approaches

Despite the apparent similarity of the projected and reconstructed baseline approaches, the two most similar approaches from an economic perspective are the projected baseline and the flat baseline. Thus, the discussion here will first address those two approaches and then examine the reconstructed baseline approach.

3.4-1 Flat Baseline vs. Projected Baseline

The important commonality between these two approaches is the fact that all the data used to calculate the baselines are invariant to actions taken by entities from this point forward (because no future data is used). This guarantees the neutrality of these baselines with respect to early action incentives.

The key difference between the two approaches is in their implications for the distribution of emission entitlements across entities. The distribution of emission rights is important for two reasons. First, these rights are extremely valuable: at an average projected value of $20 per tonne of CO_2-equivalent, ownership rights over Canadian GHG emission entitlements in the first commitment period are worth $56.5 billion.[10] Thus, the manner in which these national assets are handed out to various entities should be given careful consideration. Second, the distribution of emission entitlements could have important implications for cost-effectiveness and competitiveness.

The flat baseline approach grants entitlements on the basis of historical emission patterns and thereby favours entities whose emissions were relatively high in the past. In contrast, the projected baseline approach favours expanding entities whose emissions would be expected to grow relatively quickly on a BAU trajectory. The difference can be dramatic. For example, a rapidly expanding firm that began business in 1995 would receive no emission entitlements under a flat baseline using a 1990 base year but could receive a significant entitlement under a projected baseline.

[10] Derivation: 2825 Mt @ $20 per tonne.

The choice between these two baseline approaches has to consider three main issues:

- equity;
- expected social return; and
- data and forecasting requirements.

3.4-1-1 Equity

Various arguments can be made about which baseline approach is more "equitable" but equity is entirely in the eye of the beholder. For example, a projected baseline approach would impose higher costs on relatively stagnant or declining firms with high current levels of GHG emissions, and these firms will likely suffer capital losses as a consequence; is that equitable? On the other hand, a flat baseline approach using 1990 as a base year would grant valuable emission entitlements to the firms that have contributed most to the climate change problem; is that equitable? There are no definitive answers to these questions and the policy process should not become bogged down in trying to resolve them.

3.4-1-2 Expected Social Return

The distribution of emission entitlements has direct implications for the cost of doing business and in choosing between baseline approaches the government is implicitly choosing to favour some firms over others. It is useful to think about that choice problem in the following terms. The government is currently holding $56.5 billion worth of a scarce national resource: emission entitlements. In choosing between baseline approaches the government is effectively choosing, on behalf of all Canadians, where best to invest those resources. That choice should be based primarily on the expected social return. In this respect, the projected baseline approach has a clear advantage over the flat baseline approach since forecast future trends are likely to provide better information about future social returns than historical emission levels.

3.4-1-3 Data and Forecasting Requirements

The projected baseline approach requires extensive forecasting at the entity level, which for practical purposes would have to be based on standardized forecasting rules. Thus, the

informational advantage of the projected baseline approach is somewhat less important in practice than in theory. However, there are also likely to be many gaps in the data on past emissions levels at the entity level. On balance, neither approach clearly dominates the other in terms of data issues.

3.4-2 Projected Baseline vs. Reconstructed Baseline

The reconstructed baseline approach has the same expected entitlement distribution profile as the projected baseline approach. That is, a forecast made today of a future reconstructed baseline for a given entity is necessarily the same as today's projected baseline for that entity (assuming statistically efficient and unbiased forecasts). Thus, there is little to distinguish them in terms of distributional properties.

The substantive difference between the two approaches is in their efficiency properties. Reconstructed baselines have more information content than projected baselines because the former is based on actual future trends while the latter is based only on forecast future trends. This is the main advantage of the reconstructed baseline approach. However, there are two important shortcomings to this approach that more than outweigh that advantage:

- it is not generally neutral with respect to investment incentives; and
- it delays the resolution of uncertainty over the commitment period regulatory program.

3.4-2-1 Non-Neutrality with Respect to Investment Decisions

Unlike a flat baseline or a projected baseline, a reconstructed baseline uses future data to determine the allocation of emission entitlements. This raises the potential for non-neutrality with respect to investment choices; the reconstructed baseline approach could potentially encourage investments in GHG-emitting projects that would not otherwise have been made. In particular, if a firm expands capacity after 1999 but does so with a more GHG-efficient technology than it could have used, then it would be entitled to reconstruct its baseline on the basis of the higher emissions technology. Thus, the firm would receive valuable emission entitlements as a result of the investment. This additional private return from the investment could be high enough to turn an otherwise

unprofitable project into a profitable one, and thereby generate GHG emissions that would not otherwise have been created.

Consider a numerical example to illustrate the point.[11] Table 3.1 illustrates the GHG emissions for two entities and their emission entitlements under a cap-and-trade program (with grandfathering) introduced in 2005 in the case where neither entity expands capacity between 1999 and 2005. The assumed annual cap to be split between the two entities is 180 Kt.

Table 3.1: Emission Rights with No New Investment

	Entity A	Entity B
1999 actual emissions	100	90
2005 actual emissions	100	90
Reductions from early action (1999 – 2005)	0	0
2005 baseline reconstructed	100	90
Allocated emission rights (with reconstructed baseline protection)	95*	85*

* Derivation: 180(100/190) = 94.7; 180(90/190) = 85.3.

Now consider an alternative scenario in which entity B makes an investment in capacity in 2002. Suppose that under a BAU strategy this investment would have generated 30 Kt in additional annual emissions; instead the entity adopts an aggressive early action strategy and achieves the same production increase with only 10 Kt in additional annual emissions. Thus, the entity is able to register 20 Kt in "emission reductions" (relative to BAU) in the calculation of its reconstructed baseline. The allocated emission rights in 2005 are as presented in Table 3.2. Note that entity B gains 13 Kt in additional emission rights relative to a no-investment strategy even though its actual emissions rise by only 10 Kt. This windfall in emission rights adds directly to the

[11] This example is based on the scenario presented in the NAICC draft "Backgrounder on Baseline Protection".

private return on the capacity investment and has the potential to transform an otherwise unprofitable investment into an artificially profitable one.[12]

Table 3.2: Emission Rights with New Investment by Entity B

	Entity A	Entity B
1999 actual emissions	100	90
2005 actual emissions	100	100
Reductions from early action (1999 – 2005)	0	20
2005 baseline reconstructed	100	120
Allocated emission rights (with reconstructed baseline protection)	82*	98*
Difference in emission rights (relative to no investment by entity B)	- 13	+ 13

* Derivation: 180(100/220) = 81.8; 180(120/220) = 98.2.

This non-neutrality problem arises because the reconstructed baseline attempts to account for actual growth (as opposed to forecast growth). This means that the baseline is a function of actual future investment decisions, and is therefore subject to strategic manipulation, and the consequent distortion of those investment decisions.[13] That is, the counter-factual BAU trajectory that the reconstructed baseline approach attempts to reconstruct is in fact influenced by the reconstruction rules.

A closely related problem relates to the difficulty of verifying claims with respect to counter-factual behavior. Entities have a clear incentive to claim that any investment decision represents "early action" relative to some alternative decision that could have

[12] It should be noted that entity A faces the same distortion of investment incentives as entity B. Thus, in equilibrium, no entity would gain the same additional emission rights that would accrue to it if all other entities were passive. However, the investment distortion still arises in equilibrium. (In fact, a game-theoretic model of investment under the reconstructed baseline approach yields a Nash equilibrium in which investment incentives are distorted and all entities are potentially worse-off than without baseline protection).

[13] The same type of problem arises in the CEERP program (see section 6. 3).

been made because that action is rewarded with additional emission entitlements.[14] The asymmetry of information between the entity and the government with respect to the entity's planned BAU behavior makes it impossible for the government to judge whether or not a claimed avoided increase in emissions would truly have otherwise occurred. Thus, the verifiability problem is inherently insurmountable.

3.4-2-2 Delay in the Resolution of Uncertainty

An additional disadvantage of the reconstructed baseline approach is the delay it implies for the resolution of uncertainty for individual entities with respect to their obligations under the commitment period regulatory program. Section 2.2-1 emphasized the importance of the early announcement and phase-in of a cap-and-trade program for creating the price signals needed to stimulate structural adjustment in the economy. (See also section 7). The early resolution of uncertainty about the allocation of emission entitlements under that program will allow entities to respond more confidently to those price signals.

3.4-3 Conclusion

The reconstructed baseline approach has a number of important shortcomings with respect to its incentive properties. It is not a recommended approach. The projected baseline and flat baseline approaches both have desirable neutrality properties but both have problematic data requirements. On balance, the informational advantage of the projected baseline approach – in terms of directing emission entitlements to where they will have the greatest social return – probably makes it the better choice among the three alternatives.

3.5 Baseline Protection and Policy Flexibility

It was noted at the beginning of section 3 that the need for baseline protection only arises when a future cap-and-trade program or system of individual emission standards is implemented with grandfathering; that is, an initial allocation based on historical or

[14] This is a standard problem with all subsidy-type instruments: if a reward is offered for not doing something then everybody starts to not do it in order to claim the reward.

current emission levels. Baseline protection is a non-issue if permits are fully auctioned or if a carbon tax is used in place of a permit system.[15] This point raises the possibility that by announcing a baseline protection system, the government is implicitly committing itself to a grandfathering approach to emission entitlements. It would be unwise for the government to tie its hands in this way until the commitment period implementation strategy is more fully developed.

One solution to this problem would be to delay any discussion of baseline protection until the commitment period implementation strategy is closer to finalization. This approach is unsatisfactory because the strategic distortion problem discussed in section 2.3 does pose a very real obstacle to early action and needs to be addressed sooner rather than later. There are two reasonable alternative solutions:

- announce a hybrid allocation scheme with baseline protection; or
- announce full auctioning of emission entitlements.

3.5-1 A Hybrid Allocation Scheme

A hybrid allocation scheme would allocate a fraction of aggregate entitlements to be assigned free-of-charge on the basis of protected baselines and the remaining fraction to be auctioned. This would not circumvent the problem of choosing a baseline protection method but it would provide the government with more flexibility. The ongoing debate over the form of baseline protection could continue effectively in the absence of any early statement on what the precise split would be since baseline protection is about entitlement shares not absolute amounts.[16] Any suggestion that entitlements will be auctioned rather than granted free-of-charge will of course ignite immediate and vocal opposition in some sectors, but the time to raise the issue is now rather than later.

[15] The baseline protection issue does not vanish entirely under a cap-and-trade program with auctioning if the program does not have 100% coverage. In that case the size of the cap on the covered entities relative to uncovered entities must still be chosen. While no individual entity is likely to have a sufficiently large impact on the aggregate emissions of the covered entities to have any strategic influence over the setting of the cap, there does arise the possibility of strategic influence through collusive behavior among a group of entities.

[16] Indeed, the reconstructed baseline approach necessarily delays any determination of absolute entitlements until the reconstructions are actually made.

3.5-2 Full Auctioning

If government is willing to initiate a debate on auctioning in a hybrid context then it should consider raising an even more radical trial balloon: full auctioning. The arguments against assigning entitlements by auction are clear: it involves an explicit and dramatic reassignment of property rights to the atmosphere relative to the status quo; and it may have adverse consequences for national wealth through the impact on competitiveness. As noted in section 3.4-1-1, there is no definitive answer to whether or not a reassignment of property rights would be "equitable"; this is ultimately a political question.[17] The competitiveness issue is more easily subjected to economic analysis and there is a reasonable case to be made against auctioning on this basis. A complete investigation of this issue is beyond the scope of this paper; discussion here is confined to a brief review of an approach to auctioning that would mitigate some of the impact on compliance costs for emitting entities.[18]

The impact of auctioning on emitting entities could be mitigated by two key mechanisms:

- revenue recycling; and
- discounted auctioning.

The revenue raised from entitlement auctions cannot be returned directly to entities as compensation in proportion to their costs, or else the effective price of entitlements falls to zero, demand becomes unconstrained and there is no equilibrium in the permit market. However, revenue can be recycled indirectly, possibly through targeted subsidies for emission reduction projects. Moreover, auctioning entitlements could provide a source of revenue to fund potential government initiatives to promote early action whose value is not captured in private returns to early action. (See section 8 for further discussion).

Discounted auctioning could operate in a variety of ways. Possibilities include: a two-for-one purchase scheme; quantity discounts (which could be used to mimic grandfathering to a limited degree); and a number of other variations on standard auction types.

[17] Economic analysis is not entirely silent on the issue. In particular, the incidence of emission permit acquisition costs does not necessarily fall on those parties who incur those costs initially. Cost can be at least partly transferred upstream and downstream depending on demand and supply elasticities and market structure.

The auctioning of entitlements would eliminate the need for complex baseline protection schemes and the potential distortions that some of those schemes (such as baseline reconstruction) can create. Moreover, all three of the baseline protection approaches discussed above require the government to make an implicit investment of national emission entitlements based on very limited information about where the returns to that investment will be highest. In contrast, auctioning emission entitlements would allow the market itself to make that assessment based on price signals. Finally, resolution of the baseline protection issue through a commitment to auctioning would allow government to advance on the design and early phase-in of a cap-and-trade program as the primary instrument for promoting early action.

4. CEERP: A Brief Review

This section presents a brief review of some key elements of the CEERP proposal. This review is not intended to be a comprehensive description of the program; its purpose is to highlight some important properties of the program and to provide some illustrative examples of how the program would function.

4.1 Participation and Timing

Participation in CEERP is to be voluntary and open to any *corporate entity*.[19] Pooling arrangements would allow small scale emitters to participate as a group and thereby reduce transaction costs. Some general provisions are also proposed for indirect participation by other parties, such as individual households.[20] All six GHGs covered by the Kyoto Protocol are to be included.[21] CEERP would be implemented in 2001 but would apply to actions taken as early as 1991.[22]

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[18] See section 5.3 for additional discussion on competitiveness.
[19] CEERP Collaborative (1999), p.10.
[20] ibid., p.17.
[21] ibid., p.8.
[22] ibid., pp.7,12.

4.2 Definition of Entity Emissions

For the purposes of CEERP, an entity's emissions includes both direct emissions (from all facilities and projects owned by the entity) and upstream emissions related to the production and distribution of energy and electricity inputs used by the entity.[23]

4.3 Verified Reduction Credits

A participant would receive "verified reduction credits" (VERs) if its GHG emissions in a given year are lower than a specified target for that year. It would incur a VER deficit if its emissions exceed the target. VERs are measured in tonnes of CO_2-equivalent.

The yearly targets are specific to each participant and are determined on the basis of a "credit baseline" for that participant. (This is distinct from the notion of an entitlement baseline described in section 3 above).[24] The credit baseline is derived from the participant's emissions in a specified base year, adjusted for output growth and a predetermined "improvement coefficient". (The derivation of the credit baseline is discussed in more detail below).

VERs are cumulative in the sense that VERs earned from a better-than-target performance in a given year are added to the participant's balance of VERs earned in earlier years.

Figure 4.1 illustrates the basic idea. An example credit baseline (from a base year of 1999) is depicted alongside a schedule of actual emissions; the difference in each year is credited to the participant as VERs. The participant's cumulative balance of VERs is illustrated by the columns on the graph. VERs earned in 2004 are highlighted to illustrate the relationship between the two parts of the graph. Note that Figure 4.1 depicts an example in which VERs are accumulated even though emissions actually *rise* over time; such an outcome is entirely possible under CEERP. [25]

[23] ibid., p.9.
[24] The term "credit baseline" is not used in the CEERP proposal; the term used is simply "baseline". Similarly, Credit for Early Table (1999) does not use distinguishing terminology.
[25] This type of outcome would not necessarily be the norm.

4.4 The Credit Baseline

The credit baseline is a sequence of yearly emissions targets, derived from the participant's emissions in a specified base year. That base year is chosen by the participant itself at the time of registration in CEERP, subject to some limitations. In particular, participants who register in CEERP prior to December 31, 2000 may choose any year after 1990 as their base year. Participants who join after December 31, 2000 may choose any year after 1999 as their base year.[26] The base year cannot be changed after registration. Actions taken by a participant to limit emissions in any year after its base year are eligible for credit. Thus, CEERP allows credit for past actions (though not before 1990).

The emissions target in the base year is set equal to actual emissions in that year (as in Figure 4-1). The target in any subsequent year is set by applying two adjustments to the target in the previous year.[27] First, an adjustment is made to reflect any growth in the participant's real production. Second, an "improvement coefficient" is applied that, *ceteris paribus*, continually reduces the target over time. Consider each of these adjustments in turn.

4.4-1 Adjustment for Production Growth

The method of adjustment for changes in the level of real production depends on the source of the change. Production growth due to increased capacity utilization raises the emissions target on a proportionate basis.[28] In the case of production growth due to new capacity, the adjustment to the target is made using a "most GHG-efficient commercially available technology" adjustment factor. That is, the target is increased by the amount of emissions that would have resulted from the production increase had it been made using the most GHG-efficient technology.[29] No firm proposal is made with respect to what

[26] ibid., p.12
[27] The credit baseline would also be adjusted if the entity "adopted" emission reduction targets from non-participants.
[28] "Adjustments for changes in capacity utilization would reflect the emissions performance of the facility at the time the change takes place" (ibid., p.15). This implies that the average output-emissions coefficient would be applied to the marginal output increase. Thus, an *x*% increase in production translates into an *x*% increase in target emissions.
[29] ibid., p.15.

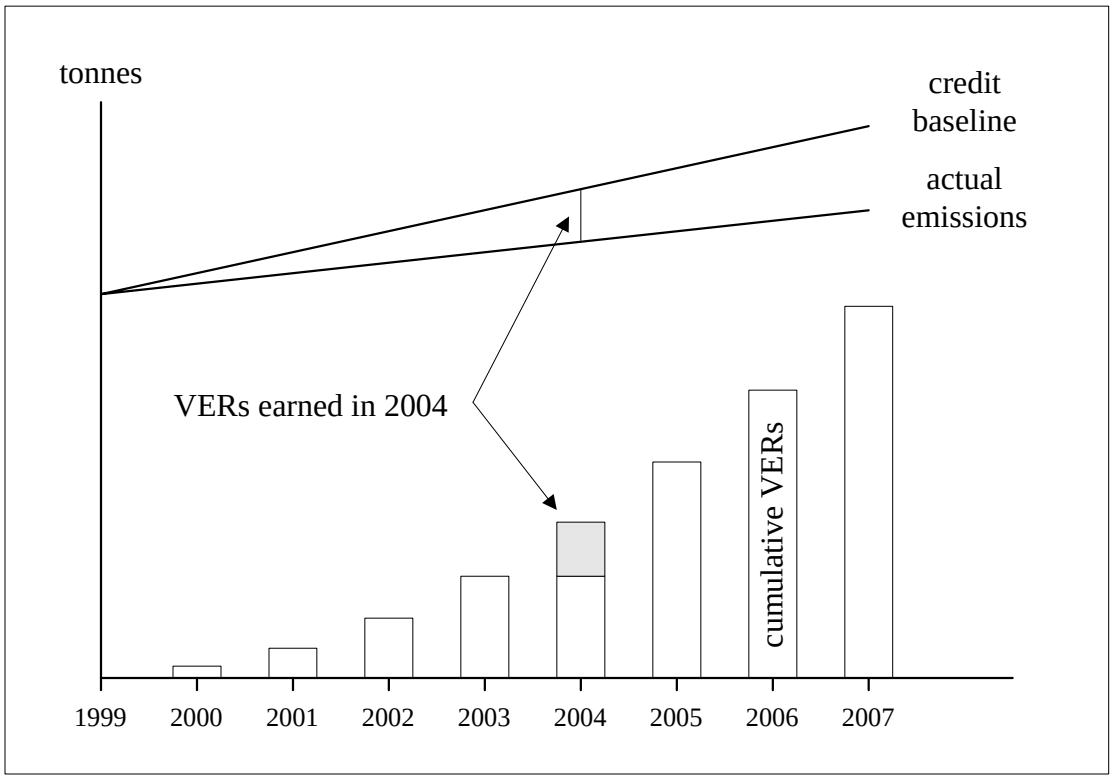

Figure 4-1: Verified Reduction Credits (for base year = 1990)

reference year should be used for defining "most GHG-efficient technology".[30] Contractions in real production appear to have no effect on the emissions target unless the production facility is actually shut-down.[31]

4.4-2 Improvement Coefficients

Fixed "improvement coefficients" are specified at the beginning of the program that, *ceteris paribus*, set progressively higher hurdles for entities to pass in order to generate VERs. These coefficients are to be based on an increasing scale according to the amount by which base year emissions exceed 1990 emissions; that is, a relatively stringent coefficient is applied to a participant whose base year emissions are high relative to its 1990 emissions. No specific proposal is made with respect to the magnitude of these

[30] Two possibilities are posed (see ibid., p.15). These are discussed further in section 6.3 below.
[31] It is proposed only that entities who substantially reduce production without actually shutting down (in order to generate VERs) be "audited" (ibid., p.16).

coefficients (although an example in the proposal report presents coefficients ranging from 0.247% to 0.5% per year[32]).

4.4-3 An Illustrative Example

The following example illustrates this target adjustment process. The participant's baseline target for 2001 is 100t, as illustrated in Figure 4-2. Real production in 2001 is 100,000 units. Assume the improvement coefficient specified by CEERP is 0.5% p.a. Without regard to production growth, application of the improvement coefficient would yield an emissions target of 99.5t for 2002 (that is, a reduction of 0.5% from 2001). However, production in 2002 is 5% higher than in 2001 due to an increase in capacity utilization. Without regard to the improvement coefficient, this production increase would translate into an emissions target of 105t for 2002 (that is, a 5% increase from 2001). When the improvement coefficient is applied to this growth-adjusted target, the overall target for 2002 is 104.48t (that is, 99.5% of 105t). Thus, the 2002 target is 4.48% higher than the 2001 target.

4.4-4 Baseline Adjustment for Upstream Producers

Upstream emissions are included in an entity's actual and baseline emissions. When an action by a downstream entity causes a reduction in emissions upstream (such as through reduced use of electricity), the downstream entity receives VERs. If the upstream energy producer is also a CEERP participant then its baseline is adjusted downwards to reflect the reduced energy production.[33] The merits of this procedure are discussed further in section 6.2 below.

4.5 Use of Credits

VERs accumulated under CEERP are to be convertible into "credit against any GHG emission regulatory obligation upon termination of CEERP" (p.20).[34] These credits are to be provided on a tonne-for-tonne basis: one tonne of VERs is equal to one tonne of

[32] ibid., p.14. The 0.247% rate is stated as "0.5% per 24 months".
[33] ibid., p.36.
[34] CEERP does not specifically address the question of credit against a carbon tax, since a carbon tax does not impose an *obligation* to reduce.

credits. This is deemed by the CEERP Collaborative to be a "fundamental requirement" of the program (p.8). An entity with a VER deficit would be required to "balance" its account "by purchasing an equivalent amount of GHG emission reduction credits in the marketplace" (p.20).

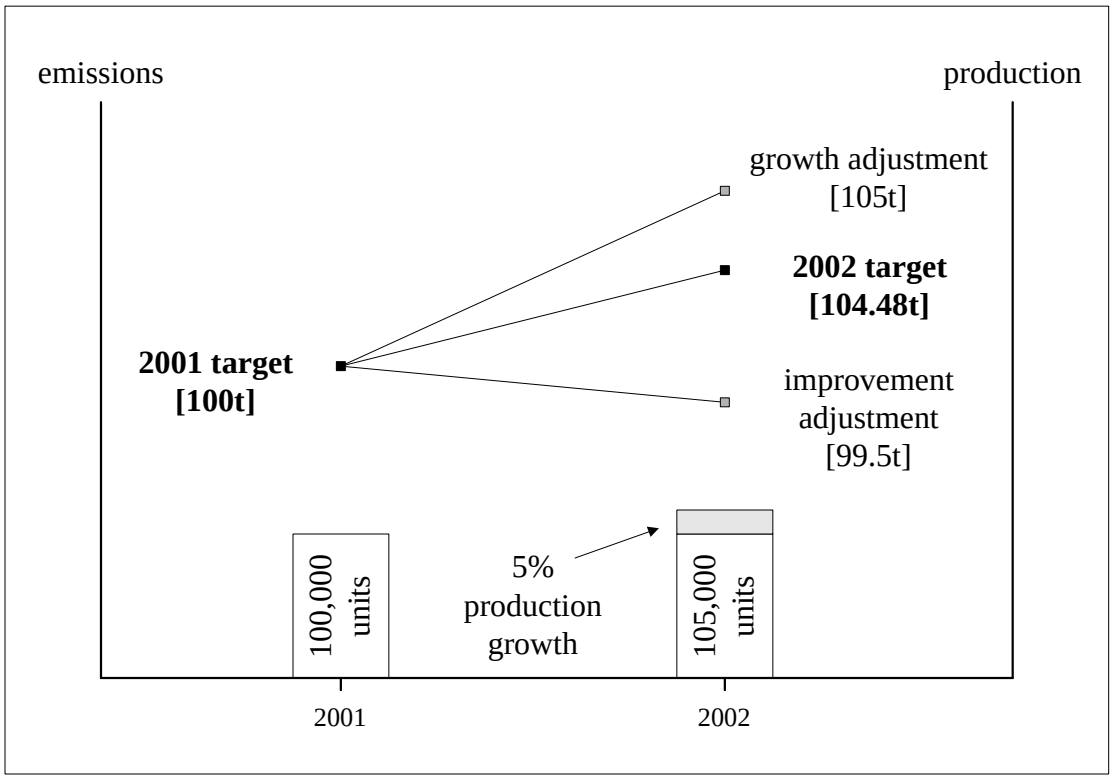

Figure 4-2: Target Adjustment

4.5-1 An Illustrative Example

Suppose an entity chooses 1990 as the base year and its emissions in that year are 100t. Suppose further that the adjusted baseline (adjusting for real production growth and the improvement coefficient) rises at an average annual rate of 1% over the period 1990 – 2007. Aggressive early action limits the growth of actual emissions to an average annual rate of 0.5% over that period. Thus, at the end of 2007 the entity has accumulated 83 VERs.[35] Its actual emissions in 2007 are 109t.[36]

[35] Derivation: $\sum_{t=1}^{17}\left[100(1.01)^t - 100(1.005)^t\right] = 82.90$

Suppose emission entitlements for the 2008 – 2012 period are assigned using a 1990 flat entitlement baseline. Then the entity's emissions allowance for the period is 470t (that is, 94% of 100t for 5 years). If accumulated VERs are credited towards an obligation-to-reduce on a tonne-for-tonne basis then the entity's adjusted allowance for the period is 553t (that is, 470t plus 83t). This can then be applied against the entity's actual emissions during the period.

It is worth noting that in this example, the entity's adjusted allowance for the 2008 – 2012 period would exactly match its total actual emissions for the period if its emissions continue to grow at an annual rate 0.5%.[37] This means the accumulation of VERs during the pre-2008 period would allow the entity to emit 17.7% more than its Kyoto budget for the commitment period (using the 1990 entitlement baseline) if it chose to draw down its entire balance of VERs over that period.[38]

4.6 Eligible Actions

CEERP allows VERs to be earned from various domestic actions, including energy efficiency and conservation activities, fuel substitution, methane recovery, and physical and biological sequestration.[39] Emission reductions associated with CDM and JI activities for the period 2000 – 2008 are also included, as are AIJ activities prior to 2000.[40] The CEERP Collaborative recognizes that a number of these actions are not currently eligible for credit under the Kyoto Protocol; this point is discussed further in section 6.1 below.

4.7 The CEERP Budget

The CEERP budget is to be denominated in dollars, equal to the market value of GHG credits represented by the accumulation of VERs when valued on a tonne-for-tonne

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[36] Derivation: $100(1.005)^{17} = 108.85$

[37] Derivation: $\sum_{t=1}^{5}\left[109(1.005)^{t}\right] = 552.46$

[38] Derivation: (553-470)/470 = 0.177. The continuation of carbon restrictions beyond 2012 means that drawing down an entire VER balance over the 2008 – 2012 period would probably not be an optimal strategy for the entity.

[39] ibid., p.8.

[40] ibid., p.9.

basis.[41] If the demand for VERs exceeds the supply, as reflected in the dollar budget, then the budget is to be increased or the program will be closed, without prejudice to existing approved VERs (that is, there is to be no discounting of approved VERs).

5. AN ASSESSMENT OF CEA AS A GENERAL APPROACH

This section examines credit for early emission reductions as a general approach to supplementary policy for promoting early action (that is, supplementary to a commitment period regulatory program with appropriate baseline protection where necessary).

The assessment of CEA provided in this section is based on three main economic considerations:

- cost-effectiveness;
- fiscal responsibility and the distribution of compliance costs; and
- implications for competitiveness.

Each of these is considered in turn.

5.1 Cost-Effectiveness

In assessing the merits of CEA it is necessary to think about cost-effectiveness on two levels:

- the allocation of emissions across sources during the commitment period, given the structural characteristics of the economy at that time; and
- optimal structural adjustment prior to 2008 in preparation for the commitment period.

CEA has potential implications at both of these levels. The most obvious effect of CEA is at the second level; its primary purpose is to foster structural adjustment. However, CEA can also have an impact – potentially adverse – on the capacity of the commitment period regulatory program to achieve a cost-effective allocation of emissions during that period. That is, CEA could potentially constrain the efficiency of commitment period policy. In order to frame the discussion of these two potential effects of CEA it will be useful to begin with a brief review of the meaning of cost-effectiveness at the two levels.

[41] The estimated market value of one tonne of CO_2-equivalent during the 2008 – 2012 period is between $10 and $30 (ibid., p.5).

Cost-effectiveness during the commitment period refers to the minimization of aggregate compliance costs for the economy as a whole, given its structural characteristics during the period, subject to meeting the Kyoto target.[42] This requires allocating emissions across sources in a way that equalizes marginal abatement costs across sources.[43] (The main appeal of a cap-and-trade program for the commitment period is its capacity to achieve that outcome, under certain conditions, as a market equilibrium).

The level to which compliance costs can be driven down through a cost-effective strategy during the commitment period is a direct function of the structural characteristics of the economy at that time. Technological and behavioral adjustment prior to 2008 can alter those structural characteristics so as to make the minimized commitment period compliance cost lower than it would otherwise be.[44] The associated cost saving is the primary social benefit of early action.[45]

It is worth stressing that the optimal level of pre-2008 structural adjustment is one that balances the benefits of that adjustment – in terms of compliance cost savings during the commitment period – with the costs of that adjustment. Thus, the economic objective behind early action should not be to maximize the level of early action, but rather to strike an optimal balance between the benefits and costs of structural adjustment. The discussion in section 2 of this paper argued that the market equilibrium level of structural adjustment is likely to be lower than is optimal, even when a well-designed commitment period regulatory program is phased-in, due to a divergence between market-based returns and true social benefits.

In summary, CEA as a policy measure for promoting early action should be assessed with respect to cost-effectiveness against two criteria:

- its ability to supplement the commitment period regulatory program in a way that corrects for the divergence between market-based returns and social returns from structural adjustment; and

[42] In terms of the running analogy used in section 2: running the fastest race time possible, given the level of pre-race training and preparation, subject to completing the race distance.
[43] Marginal abatement cost refers to the cost of cutting emissions by one additional tonne.
[44] In terms of the running analogy: pre-race training will yield a faster race time for an optimally run race.
[45] In technical terms, the structural characteristics of the economy place constraints on the commitment period cost-minimization problem. Pre-2008 structural adjustment relaxes those constraints and so allows the minimized compliance cost to be lowered. The value of the LaGrange multipliers on the structural constraints, evaluated at the optimum, represent the value of early action.

- its potential interference with the minimization of compliance costs during the commitment period.

Each of these is now considered in turn.

5.1-2 Promoting Optimal Structural Adjustment

CEA does not address directly the technology and information spillovers that cause structural adjustment to be under-valued in the market. However, it does so indirectly by rewarding the emission reductions that structural adjustment is likely to yield. Thus, it is not necessarily a bad policy in terms of promoting structural adjustment. The more relevant question is whether it is the best policy for that purpose; there are two main reasons from a cost-effectiveness perspective why it may not be:

- policy imprecision; and
- high administrative costs.

5.1-2-1 Policy Imprecision

Not all early emission reductions are necessarily of equal value in terms of their associated structural adjustment. A CEA program like CEERP does not allow for discrimination in rewarding emission reductions according to the value of their structural adjustment spillovers. Thus, the program cannot target those structural adjustments that have the highest social return. In this respect CEA is a very imprecise policy instrument.

In addition, some valuable forms of structural adjustment will be missed under a CEA program like CEERP. For example, promoting the use of public transit and bicycles would be difficult to translate into a VER for any corporate entity under CEERP but would arguably be a valuable early action measure. Moreover, valuable investments in the development of new technology may not reap significant emission reductions for a number of years; such investments may have substantial structural adjustment value but are not rewarded under a CEA scheme.

The over-arching point here is that CEA places a sole focus on rewarding early emission reductions, while the benefits of early action relate to the underlying structural adjustments, and not to early emission reductions *per se*.

5.1-2-2 A Note on Crediting Past Emission Reductions

Rewarding past behavior has no direct incentive effects; past actions are sunk and are necessarily independent of any reward given for their consequences. Thus, crediting emission reductions made prior to 1999 has virtually no value in terms of promoting further structural adjustment. The main consequence of crediting past emission reductions is to change the distribution of compliance costs in the commitment period (see section 5.2 below).

It is important to note one qualification to this argument. Past emission reductions undertaken as part of a specific government program (such as GERT[46]) should receive some form of recognition (though not necessarily in the form of emission credits) in order to maintain the credibility of government programs in general. That is, there is an important reputational value associated with recognizing government-fostered past actions in a manner consistent with the terms of the original program.

5.1-2-3 Administration Costs

The cost of setting up and running a CEA program like CEERP is considerable. Ongoing monitoring and verification procedures are required; upstream emissions must be tracked and attributed; various adjustment factor coefficients must be determined and continually updated. The cost of this program administration must be weighed carefully against the expected benefits of the program, relative to alternative policies for promoting early action.

Many of these same administrative requirements apply to a commitment period cap-and-trade program; hence, the argument can be made that setting up a CEA program will provide valuable experience for designing a cap-and-trade program. On the other hand, devoting resources to the construction of a complex CEA program necessarily takes away from the resources available for setting up a cap-and-trade program. Thus, the CEA program could inadvertently exacerbate uncertainty over commitment period obligations by delaying the early phase-in of the commitment period regulatory program. Moreover, the design problem for the commitment period program is made more

[46] Greenhouse Gas Emission Reduction Trading pilot (see http://www.gert.org/).

complex by the possible existence of a CEA program because of the need to ensure that the two programs are integrated properly.

5.1-2 Implications for Cost-Effectiveness in the Commitment Period

CEA has the potential to impede the minimization of compliance costs in the commitment period through its effect on the functioning of the commitment period regulatory program. The nature of that effect depends on the type of regulatory program.

A Cap-and-Trade Program

In a cap-and-trade program for the commitment period, VERs would be credited with emission permits (on a tonne-for-tonne basis under CEERP). This necessarily means that fewer permits could be auctioned or granted since the Kyoto budget is fixed. This has important implications for the distribution of compliance costs (see section 5.2 below) but no significant direct effect on the efficiency properties of the program.[47] The only potential problem in terms of impedance to cost-effectiveness is a distortion of the permit equilibrium due to permit ownership concentration. This problem would arise only if a relatively small number of entities acquired a large number of VERs through the CEA program and thereby gained significant market power in the permit market.

A Carbon Tax

Under a carbon tax, VERs would be treated as tax credits. Whether these credits are refundable or non-refundable (that is, whether or not they can be exchanged for cash from the government) is central to the distribution of compliance costs (see section 5.2) but it is of little direct importance for cost-effectiveness *if* the VER-based tax credits are freely tradeable. If VER-based tax credits are *not* tradeable and are not refundable then the carbon tax will not necessarily yield a cost-effective outcome. However, a problem would only arise if an entity had accumulated enough VERs to more than offset its entire emissions in the commitment period. The inability of that firm to either sell or obtain a

[47] There may be indirect effects relating to competitiveness (see section 5.3 below).

refund for the tax credits in that case would mean that marginal abatement costs could not be equated across sources and overall compliance costs would not be minimized.[48]

5.2 Fiscal Responsibility: the Distribution of Compliance Costs

One of the most important aspects of CEA is its implications for the distribution of compliance costs. A CEA program like CEERP rewards early emission reductions with emission entitlements for the commitment period, additional to any entitlements that might otherwise be granted. Since VERs granted under the CEA program do not add to the Kyoto budget, awarding and crediting these VERs necessarily means that fewer emission entitlements can be granted.[49] This redistributes the costs of complying with the Kyoto target away from the entities who have accumulated VERs and onto other parties. There are two important margins along which this redistribution can occur:

- the distribution of costs across emitters;
- the distribution of costs between emitters and government.

Consider each of these in turn.

5.2-1 The Distribution of Costs Across Emitters

The degree to which costs are shifted onto entities who have not acquired VERs depends on the response of government. If government repurchases and retires all VER-based entitlements then other entities do not bear any additional costs. However, suppose government does not repurchase VER-based entitlements; what is the effect on other entities?

The answer depends on the nature of the commitment period regulatory program. If a cap-and-trade program is used, with permits granted free-of-charge, then fewer permits are granted and other entities will have to buy relatively more permits on the market.[50] If instead the commitment period program is a carbon tax then other entities are

[48] It should be noted that under ideal conditions the carbon tax does induce an equalization of marginal abatement costs and can therefore achieve a given level of emissions cost-effectively. However, setting the right tax rate to achieve a particular level of emissions – such as the Kyoto target – is problematic.
[49] If VERs are accumulated from Kyoto-credited CDM activity then the budget does expand and the redistribution of costs is less pronounced.
[50] Note that the aggregate supply of permits is unchanged since VERs are credited for permits.

unaffected; the cost is borne implicitly by government in the form of lower tax revenue. The same outcome is true for a cap-and-trade program with auctioning.

If the commitment period regulatory program is a system of individual emission standards then VERs exchanged against those standards are implicitly paid for by other GHG emitters, whose standards must be that much stricter, since the aggregate emissions limit is fixed.

It is worth noting that the redistribution of emission entitlements under CEA can be amplified if early emission reductions are also credited under a reconstructed baseline approach to baseline protection. In particular, there arises the possibility of double-counting of early emission reductions.

5.2-2 Fiscal Implications for the Government

The fiscal implications of CEA for government depend on the nature of the commitment period regulatory program, and how VERs are exchanged in the context of that program. The government automatically absorbs the cost of VERs if they are credited against a carbon tax or against auctioned permits. That cost takes the form of foregone revenues.

If the commitment period regulatory program is a cap-and-trade program with permits granted free-of-charge, or a system of individual emission standards, then the government can in principle avoid any cost to itself by specifying in the CEA program that VERs are tradeable but non-refundable. However, if the program generates a large number of VERs then government will likely come under heavy pressure to alleviate the consequent shifting of costs onto other emitters by repurchasing some VERs and retiring them.

The size of the associated potential exposure for government is difficult to estimate since very little information is available on the likely uptake of VERs under a program like CEERP. However, to put some perspective on the issue, consider an example scenario. Suppose entities accounting for 20% of GHG emissions in 1990 participate in CEERP, and suppose that credit baselines for those entities rise at 1% per year while actual emissions rise at 0.5% per year. Then the aggregate number of VERs

accumulated over the period 1990 – 2007 will be almost 100Mt.[51] At an average forecast price of CO_2-equivalent of $20, that represents a potential exposure to government of $2 billion.

5.3 Implications for Competitiveness

International competitiveness refers to the capacity of domestic firms to capture economic rents on the global market (which are then distributed to residents in the form of higher wages, salaries and dividends). That capacity is determined primarily by relative production costs and the relative rate of product innovation and development. The impact of CEA on the level and distribution of Kyoto compliance costs has potentially important implications for both of these factors.

5.3-1 Cost-Effectiveness and Competitiveness

If the overall cost of compliance is not minimized – that is, if the Kyoto commitment is not met cost-effectively – then the relative production costs of domestic firms will be higher than necessary, and their international competitiveness will suffer. Similarly, wasting resources on unnecessarily high compliance costs leaves fewer resources available for product innovation and development, with adverse consequences for competitiveness. That erosion of competitiveness will be even more pronounced if Canada's trading partners, especially the United States, are able to meet their Kyoto targets more cost-effectively than Canada. Thus, it is essential that policies to promote early action be targeted where they will have maximum effect in achieving the technological and behavioral adjustments needed to reduce compliance costs in the commitment period.

5.3-2 The Distribution of Compliance Costs and Competitiveness

The impact of the Kyoto commitment on competitiveness is also a function of how compliance costs are distributed: a given level of overall compliance costs can have greater or lesser impact on competitiveness depending on who bears those costs. The key policy choice in this regard is the nature of the commitment period regulatory program.

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[51] Derivation: 20% of 1990 emissions is 120.2 Mt; $\sum_{t=1}^{17}\left[120(1.01)^t - 120(1.005)^t\right] = 99.6$.

On one hand, with a "polluter pays" approach – such as through a carbon tax or a cap-and-trade program with auctioning – emitters are required to buy emission entitlements if they wish to emit GHGs. This necessarily adds to the compliance costs for those emitters. On the other hand, freely assigning emission entitlements to emitters – such as through a cap-and-trade program with free-of-charge permit grants – means that compliance costs for emitters are lower. Thus, there is a trade-off between requiring polluters to pay for their emissions and protecting competitiveness. Where the optimal balance lies is to some extent a function of how other nations – especially the United States – proceed, since competitiveness is a relative notion; a lesser emphasis on the polluter pays principle in the United States would call for a similarly lesser emphasis in Canada.

The same type of considerations apply to the choice of early action promotion policies. However, at that level the relationship between incidence and competitiveness is more subtle. Recall from section 5.2 that crediting VERs can cause a redistribution of compliance costs among emitters (unless government repurchases those VERs). In particular, under a cap-and-trade program, crediting VERs causes compliance costs to be borne more heavily by non-VER holders, since the Kyoto budget is fixed. Thus, the additional protection to competitiveness that CEERP provides to VER holders comes at the expense of the competitiveness of non-VER holders. This should give some cause for concern because the type of entities most likely to accumulate VERs – firms with a history of high GHG emissions – are not necessarily the type of entities to which Canada would wish to provide relatively greater protection in a carbon-constrained future. Any such policy measure should at least be taken consciously and not as an unrecognized by-product of a CEA program.

6. SPECIFIC PROBLEMS WITH CEERP

This section deals with specific elements of the CEERP proposal that should create cause for concern, but are not necessarily shortcomings of a CEA policy approach in general.

6.1 Eligible Actions

The CEERP proposal recognizes a number of emission reduction activities that do not currently yield credits for Canada against its Kyoto target. These include engineered and biological sequestration, pre-2008 JI activities and pre-2000 activities implemented jointly. Awarding VERs for these activities further exaggerates the redistributional implications of CEA discussed in sections 5.2 and 5.3 above.

6.2 Credit for Upstream Reductions and Leakage

There are two problems related to the manner in which CEERP awards credit for upstream reductions, both of which can lead to a significant leakage of emissions from the system. These problems can be illustrated in the context of an example.[52]

Suppose a participating entity ("firm A") reduces electricity consumption by 10 MW.h per year. Suppose further that the energy-emissions coefficient for electricity is 0.2 kg of CO_2-equivalent per kW.h. of electricity. Then under CEERP rules, firm A is awarded 2t of VERs per year, *ceteris paribus*.

The reduced consumption by firm A represents a shift in the demand for electricity, as illustrated in Figure 6-1. That demand reduction is met partly by a reduction in supply and partly by an increase in demand from other energy users; the relative magnitude of the two is a function of the relative elasticities of supply and demand. For simplicity suppose the split is 50-50, as illustrated in Figure 6-1. Thus, total emissions actually fall by 1t less than the 2t credited to firm A. To ensure a proper accounting of VERs, a debit of 1t should be recorded somewhere in the overall CEERP balance sheet. However, it will not be.

The electricity producer records a reduction in emissions of 1t but under CEERP rules it must also lower its baseline by 1t (to ensure against double-counting). Thus, no VERs are awarded to the electricity producer. This is entirely sensible. The problem

[52] This example is based on a scenario in CEERP Collaborative (1999), Appendix Four, p.36 (example 2).

arises with the treatment of the firms whose electricity use has risen by 5 MW.h. These firms are entitled to adjust their baselines up by 1t (in aggregate) if the increased consumption is due to increased production, as it likely is. That is, the credit baselines rise (in aggregate) by the same amount as aggregate emissions for these firms, so no debits are recorded in their VER accounts. Thus, a VER worth 2t is recorded on the CEERP balance sheet (to firm A) but overall emissions in the economy fall by only 1t.[53]

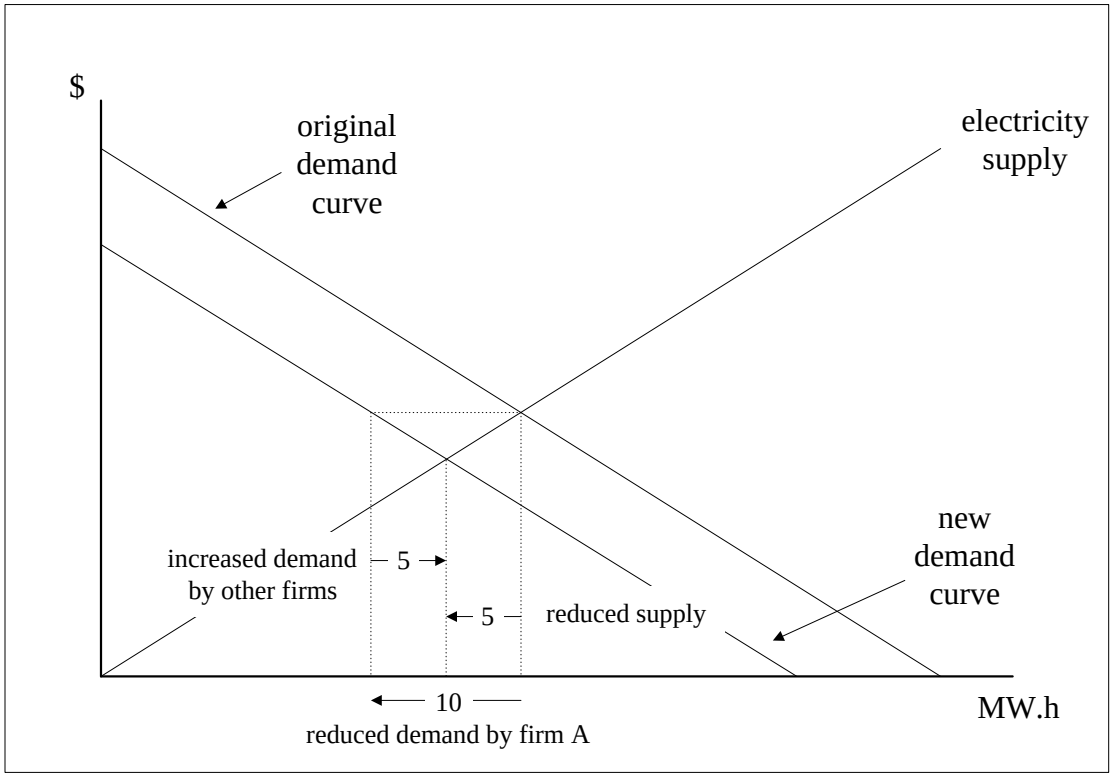

Figure 6-1: Supply and Demand Responses to Action by a Participant Firm

The immediate source of the problem here is the allowance for growth. The reduction in electricity consumption by one entity, for which VER credits are awarded, is partly offset in the new market equilibrium by an increase in consumption by other firms. That

[53] Only in extreme (and unrealistic) cases where the elasticity of electricity supply is perfectly elastic or the demand for electricity is perfectly inelastic will the VER accounting be correct; in both cases there would be no consumption increase by other firms.

increased consumption does not translate into VER debits because credit baselines are adjusted upwards to accommodate this growth.

It is important to note that a problem would still arise even if credit baselines were not adjusted. This secondary problem relates to the voluntary nature of CEERP. If some or all of the "other firms" in the above example are not participants in CEERP, then there is no mechanism through which VER debits can be created to reflect their increased consumption of electricity. The only possible approach would be to discount the VER awarded to the entity taking the action to account for the market equilibrium response by other firms. However, this would require a complex set of calculations based on detailed information about demand and supply elasticities.

The leakage of emissions in this example reflects a basic problem with a voluntary program: it is generally not possible to "close" the system when entities can choose whether or not to participate. Market equilibrium responses to actions by participating entities cannot be offset within the program unless all entities in the market are also participants in the program.

6.3 The Potential for Perverse Investment Incentives

Every standard textbook in environmental economics warns of the potential for perverse effects associated with subsidizing pollution reduction. A subsidy paid for each unit of pollution eliminated reduces the average cost of production and hence encourages entry into the polluting industry; an increase in aggregate pollution may be the outcome. Similar perverse effects could arise from a credit system like CEERP, depending on exactly how credit baselines are adjusted in response to new investment. In particular, CEERP could potentially encourage investments in GHG-emitting projects that would not otherwise have been made.[54]

Consider an example. Suppose an entity can choose between three investment alternatives:

[54] This is the same basic problem that arises with respect to entitlement baseline reconstruction (see section 3 above).

- Option 1. Expanded capacity using a technology with a relatively high GHG-intensity (technology 1). The estimated net present value (NPV) of the investment is V_1. Incremental GHG emissions are e_1 per year.
- Option 2. Expanded capacity using a technology with a relatively low GHG-intensity (technology 2). The estimated NPV is V_2. Incremental GHG emissions are e_2 per year.
- Option 3. No investment. The NPV is zero 3 and incremental emissions are zero.

If the entity chooses either option 1 or 2 then under CEERP rules its baseline would be adjusted upwards by an amount reflecting the "GHG emissions increase that would have resulted had the investment been made in the 'most GHG-efficient commercially available technology'" (p.15). This suggests that the baseline would be increased by e_2 in this example, regardless of which investment option is made. Such an adjustment would have no perverse implications for investment incentives. However, the Collaborative proposes one candidate interpretation of this adjustment rule that would make the adjustment based on the 'most GHG-efficient commercially available technology' defined for the base year.[55] This appears to mean that an entity whose base year is 1995 would receive a credit baseline adjustment based on the most efficient technology available in 1995, for any investment in new capacity made in subsequent years. Since technologies become more efficient over time, a technology available in 2002 could be significantly more efficient than the most efficient technology available in the base year. In such circumstances the potential exists for perverse investment incentives.

Consider the problem in the context of the example. Suppose the base year technology is technology 1. In that case the entity would receive a credit baseline adjustment equal to e_1 if it chooses either option 1 or 2. Choosing option 1 would create emissions that exactly offset that baseline adjustment, while choosing option 2 would yield a VER of $(e_1 - e_2)$ per year (before the improvement coefficient adjustment). Suppose the market present value of this VER stream (adjusted for the improvement coefficient) is *s*. Then the effective NPV of option 2 is $V_2 + s$. This creates an incentive

for the entity to choose option 2 over option 1, all other things equal. That is, the more GHG-efficient technology is made relatively more attractive. This is clearly the intent of CEERP. However, the VER stream associated with option 2 also makes it relatively more attractive vis-à-vis option 3. That is, awarding credits for the low emissions investment makes it relatively more attractive than no investment (and no emissions) at all. This investment incentive can potentially lead to a perverse outcome from a social perspective. In particular, it is possible that $V_1 < 0$ and $V_2 < 0$ but $V_2 + s > 0$. That is, in the absence of the credit program, no investment would be made and there would be no increase in emissions, but due to the program, an otherwise unprofitable investment is made (option 2) and emissions are created than would not otherwise have occurred. This type of outcome is most likely in the case of marginal investments, where the value of the VERs generated is enough to turn a bad business investment into an artificially good one.

It is worth noting that the source of the problem here is the adjustment to the credit baseline in response to growth. Any adjustment in response to an investment that exceeds the actual incremental emissions from that investment can potentially distort the investment decision and produce a perverse outcome with respect to GHG emissions.

7. EARLY PHASE-IN OF A CAP-AND-TRADE PROGRAM

The central message of the foregoing discussion is that credit for early action is not a good program for promoting optimal early action. The best foundation for an early action program is the early phase-in of a well-designed commitment period regulatory policy. This would create the type of price signals in the economy needed to generate positive private returns to early action. This early phase-in strategy should be supplemented with additional targeted measures to address the externalities associated with early action. This section focuses on some options for the early phase-in of a commitment period cap-and-trade program. Section 8 then discusses design considerations for supplementary targeted measures.

Two different approaches to the early phase-in of a cap-and-trade program are considered here:

- progressive introduction of mandatory permits; and

[55] CEERP Collaborative (1999), p.15

- trading in emission futures.

Each is discussed in turn.

7.1 Progressive Introduction of Mandatory Permits

Under this approach entities would be required to submit permits against emissions in years prior to the commitment period. The rationale behind this approach is to allow a permit market to develop ahead of the commitment period and at the same time create some early price signals in the economy.[56] This phase-in approach could take various forms; discussion here is confined to two:

- progressive contraction of the permit supply; and
- progressive expansion of coverage.

7.1-1 Progressive Contraction of the Permit Supply

Phase-in of the cap-and-trade program under this approach would operate as follows. All entities to be covered by the cap-and-trade program would have to submit permits for their emissions in each year of the phase-in period in precisely the same manner as during the commitment period. The supply of permits in each year of the phase-in period would be set at some percentage above the annual Kyoto budget; that percentage would decline towards zero in the approach to 2008 according to a pre-announced schedule.[57] Permits could be banked within the phase-in period but could not be carried over into the commitment period (or else the Kyoto budget constraint could be violated).

It is important to note that this approach to the phase-in of a cap-and-trade program does not circumvent the initial allocation issue. If permits during the phase-in period are allocated on the basis of historical or current emission levels then some form of baseline protection is required to prevent the distortion of early action investment decisions.

[56] Pilot trading programs like GERT and PERT are intended to play a similar role although the non-mandatory nature of these programs means that no meaningful price signals are created.

[57] This schedule could be adjusted on the basis of developments with respect to the likelihood of ratification of the Kyoto Protocol.

7.1-2 Progressive Expansion of Coverage

This approach to the phase-in would involve placing initial permit submission requirements on only a subset of the entities that would eventually be covered by the permit program. Coverage would then be gradually expanded to include the entire set of entities to be covered during the commitment period. [58] This approach could in principle be combined with the progressive contraction of the permit supply.

The initial permit allocation issue is somewhat more complicated under this approach since the shares of permits assigned to subsets of entities must be decided (whether permits are granted free-of-charge or auctioned). Moreover, the order in which different entities are brought under coverage is likely to create considerable controversy and wasteful lobbying.

7.1-3 Shortcomings of an Early Mandatory Permit System

An early mandatory permit system will be effective in fostering market development and creating price signals if it is binding (that is, if demand exceeds supply at zero price). However, a central message of this paper is that early emission reductions are valuable only in so far as they reflect underlying structural adjustments for dealing with the constraints imposed on the economy by the Kyoto commitment. The early emission reductions *per se* are of minimal value. While an optimal trajectory towards the commitment period will undoubtedly involve some early emission reductions – reflective of underlying structural adjustment – there is no reason to believe that the scale and timing of early reductions imposed by an arbitrary cap-and-trade phase-in schedule will implement that optimal trajectory.[59]

Ideally, an early phase-in program should create appropriate price signals to drive early action but at the same time not impose any particular schedule of early emission reductions on the entities involved. The following section describes an approach to early phase-in that comes closer to meeting that ideal.

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[58] The sulfur dioxide trading program in the United States has been introduced in this way, with the phase 2 coverage being much broader than that in phase 1.

[59] Allowing banking during the phase-in period provides more flexibility than binding annual targets but the overall scale of early emission reductions is still dictated by the phase-in program.

7.2 Trading in Emission Futures

The early phase-in of a commitment period cap-and-trade system could in principle be based on trading in emission futures. Emission permits for the commitment period would be issued at some point well before 2008 (say 2001) and would be freely traded among entities prior to and during the commitment period. The only major restriction on trade that might be advisable in the initial years of the phase-in is a requirement that permits be traded domestically; low initial prices might otherwise result in an outflow of wealth from Canada. This approach to the phase-in would allow a market to develop and price signals to be created without imposing particular early emission reduction requirements.

The initial allocation issue is arguably more sensitive under this approach since the government is tying its hands earlier than by waiting until 2008 to issue permits. However, this loss of flexibility could be partially offset by holding back some permits for issue closer to 2008. Moreover, the potential for early action investment distortion is minimized with an early determination of permit allocations.

An important additional advantage of a phase-in based on emission futures trading is the insurance role it can play. Different entities facing different risks can manage those risks more effectively than in the absence of early trading opportunities.

It is worth noting that the development of a futures market in emissions does not strictly require that permits be issued ahead of the commitment period. Entities could freely enter into futures contracts based on expectations of permit supply and demand conditions during the commitment period. However, the uncertainty associated with such contracts is likely to create substantial barriers to trade. A much more vibrant market is likely to develop if entities can trade in actual permits.

8. TARGETED SUPPLEMENTARY MEASURES

The discussion in section 2 highlighted the fact that the private returns to early actions are likely to under-represent their true social value due to technology and information spillovers, and limited price-responsiveness in some sectors of the economy. This divergence between the private and social returns from early action justifies a role for policy to actively promote it, supplemental to the early phase-in of the commitment period regulatory policy. This section examines some design considerations for those

supplementary policies. The discussion is organized around the main sources of divergence between the private and social returns from early action.

8.1 Targeting Technological Spillovers

There are two broad policy measures available for addressing the technological spillovers associated with early action measures:

- subsidies; and
- direct regulation.

8.1-1 Subsidies

The standard textbook solution to positive externalities is to subsidize the source activity. In principle, the subsidy is chosen so that the subsidized private return properly reflects the true social return. Subsidies can take the form of direct payments or tax breaks (such as accelerated deprecation programs, etc.).

The optimal point of intervention for a technology subsidy depends on the nature of the spillover addressed. For example, if the primary spillover is due to economies of scale, then subsidized production or adoption of the particular technology at issue is the most appropriate route. If, in contrast, the spillover is further upstream – knowledge spillovers – then subsidized research and development may be most appropriate. Note that spillovers are likely to be highest – and the case for subsidization strongest – for new, infant technologies.

It is important to stress that the goal of subsidizing technological adjustment is not to reduce GHGs in the pre-2008 period *per se*. The subsidy is directed at the underlying technological change and is designed to reflect the fact that technological spillovers are not taken into account in private investment decisions. Thus, the subsidy is awarded for technological change rather than for emission reductions.

8.1-2 Direct Regulation

Subsidies will not always be effective in internalizing spillovers. In particular, instances of multiple market equilibria can arise in which subsidies are of limited use. Such instances are most likely to arise where there are network externalities associated with a

technology; that is, where the returns to using a particular technology are increasing in the number of other users of that technology. This can give rise to inefficient equilibria. For example, technology A may have a higher private return than technology B because technology A is more widely employed than technology B, even though technology B would yield the highest return if it was used more widely. Subsidizing the adoption of technology B in this example may not induce a switch to a new equilibrium in which technology B is widely used unless an extremely high subsidy is set. In such instances, direct regulation may be preferred. In particular, regulation could mandate a certain level of the new technology use and thereby induce a switch to a new market equilibrium.

Subsidies also require the expenditure (directly or indirectly) of government revenue. The cost of this approach is therefore inflated by the marginal cost of public funds. For this reason too, direct regulation may sometimes be the preferred approach.

8.2 Targeting Information Spillovers

The private returns to information production and acquisition tend to under-value their true social returns for two main reasons:

- information is a public good; and
- feedback externalities.

8.2-1 Information as a Public Good

Information is a special type of public good; that is, the acquisition of information by one economic agent does not deplete the amount of information available to others, and in addition, it is difficult for a provider of information to prevent its dissemination to economic agents who have not paid the provider to acquire it.[60] Thus, an information provider cannot capture the full social value of the information provided. This can mean that information remains unavailable in the marketplace despite having a positive net social value.

[60] Note that the term "public good" refers to a good with these two characteristics; it does *not* mean a good provided by the public sector.

8.2-2 Feedback Externalities

Feedback externalities are a more subtle source of information under-valuation. The value of acquiring information stems primarily from its role in improving the quality of a consumption or investment decision. If those consumption and investment decisions have associated unpriced externalities – that is, effects that are not taken into account in the calculation of the private returns from those decisions – then the information acquired to improve the quality of those decisions will tend to be under-valued from a social perspective. This is called a feedback information externality.

Consider an example to illustrate the point. Suppose a firm has an opportunity to adopt a set of energy efficiency measures. In deciding whether or not to conduct an energy audit to assess the potential cost-savings from those measures, the firm takes into account only the potential private cost savings; it has no incentive to take into account any external cost savings, such as those associated with reduced upstream GHG emissions. This means that the energy audit itself will tend to be under-valued relative to its true social value. Thus, socially valuable opportunities for energy savings may go undiscovered.

8.2-3 Policy Implications

The distinction between these sources of information under-valuation may appear too subtle to be of policy relevance but in fact the distinction is an important one, for the following reason. Feedback externalities in information valuation are eliminated if the primary externalities associated with consumption and investment decisions are properly priced. Consider this point in the context of the energy audit example. The incentive for the firm to conduct the audit would properly reflect the true social value of the audit if the price it pays for energy properly reflected the full cost of that energy, inclusive of the associated GHG emissions. This means that much of the existing information failure associated with early action opportunities could be adequately dealt with by the creation of appropriate price signals through an early phase-in of a well-designed commitment period regulatory program.

In contrast, the public good problem in information provision would not be eliminated through the creation of GHG price signals; there would remain a role for supplementary policy to promote information provision, either through direct public information campaigns or the subsidization of private information provision services.[61] The nature and scope of this type of information policy will generally differ from policy aimed at correcting feedback information externalities; thus, information policy should ideally be closely coordinated with any phase-in of a commitment period implementation strategy.

8.3 Targeting Limited Price-Responsiveness

The creation of market price signals through the early phase-in of a commitment period implementation strategy will not motivate adequate early action in sectors where investment decisions are only loosely related to price pressures. Thus, heavily regulated industries, together with public and quasi-public bodies, will require direct measures to promote early action, over and above the supplementary measures needed to address the technology and information spillovers that arise in market-driven sectors.

8.4 Identifying and Quantifying Targeted Measures

The key to identifying the most appropriate targeted measures is to focus on the source of the problems to be addressed. For example, the market and engineering characteristics of different technologies make them more or less prone to particular technology spillover problems. While not a trivial task, it should be possible to roughly identify those areas in which supplementary policy intervention would be most appropriate, and to identify the type of policy measures that would be most effective.

A more difficult problem is to determine the right scale of intervention. Implicitly, this involves ascertaining the magnitude of any divergence between the private and social returns from the targeted early action. This is feasible in some instances, for example where the divergence is due to measurable scale economies, but is a more vexing problem in relation to knowledge and information spillovers. The best that could be done

[61] There is an important distinction between influencing behavior through information provision and attempts to change underlying preferences. The term “education” is often used to describe both activities without much attention to the distinction. The economic argument for government-sponsored efforts to

in this regard is to use existing empirical measures of technology diffusion rates as a proxy for the magnitude of these spillovers, and then choose the scale of intervention accordingly, based on simulations of the structural adjustments in a general equilibrium model of Kyoto compliance costs.[62]

Identifying and quantifying appropriate early action measures for public and quasi-public bodies, such as public transit providers and electricity utilities, should in principle be more straightforward since the basis for the action is the entire social return therefrom; it is not necessary to estimate the divergence between the social and private return. On the other hand, modeling these quasi-market elements of the economy in the context of a general equilibrium model is difficult precisely because they do not operate according to straightforward profit-maximization rules.

9. CONCLUSION

The cost to Canada of meeting its Kyoto target will be eased considerably if early technological and behavioral adjustments are made prior to the commitment period. The most important element of any policy to promote those early adjustments is the early phase-in of a well-designed commitment period regulatory policy, such as a cap-and-trade program. This would create price signals in the economy that would in turn generate positive private returns to early action. However, these private returns to structural adjustments are likely to under-represent their true social value due to technology and information spillovers, and limited price-responsiveness in some sectors of the economy. This divergence between the private and social returns from early action justifies a role for policy to actively promote early action, supplemental to the early phase-in of a commitment period regulatory policy.

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change preferences rests on much shakier ground then the arguments presented here for objective information provision.

[62] Technically, the exercise involves calculating the LaGrange multipliers on the appropriate structural constraints in a cost-minimized representation of the commitment period economy. For example, in the case of energy efficiency constraints, this could be done by simulating different energy-emission coefficients and deriving the associated changes in estimated aggregate compliance costs. The estimated LaGrange multiplier represents the social return from energy-efficiency improvements. The private return could then be calculated by discounting the estimated social return by a fraction proportional to the independently estimated rate of technology diffusion for energy-efficiency improvements. The external return, on which the scale of any intervention would be based, could then be calculated as the residual.

An important element of a commitment period regulatory policy is baseline protection; this is crucial for creating correct incentives for early action (unless emission entitlements are auctioned). A flat baseline approach and a projected baseline approach both ensure that incentives are not distorted. The main difference between these two approaches is in their distributional implications and in their information content. The projected baseline approach has an advantage in the latter respect. A reconstructed baseline approach is not recommended because of its potential to distort investment decisions. It is worth stressing that the auctioning of entitlements would eliminate the need for complex baseline protection schemes and the potential distortions that some of those schemes (such as baseline reconstruction) can create.

In thinking about supplementary policies to promote early action, the key point to recognize is that the main benefits of early action do not arise from pre-2008 emission reductions *per se*, but from the structural adjustments that underlie those reductions. The best approach to early action policy is likely to be one that targets structural adjustments directly.

A CEA program like CEERP focuses exclusively on rewarding emission reductions and therefore targets structural adjustment only indirectly. In this respect it is an imprecise policy instrument. Moreover, CEA can potentially impede cost-effectiveness in the commitment period by constraining the functioning of the regulatory program in that period (such as a cap-and-trade program), although this is likely to create serious problems only if a very large number of reduction credits are accumulated by a relatively small number of entities. CEA also has important implications for the distribution of compliance costs, which can in turn have adverse consequences for competitiveness, and important implications for costs to government.

CEERP also has a number of specific elements that create additional problems. In particular, the treatment of upstream emissions has the potential to allow a leakage of emissions from the system, and the adjustment rules for growth through new investment can create perverse effects with respect to GHG emissions. Both of these problems relate to the way in which CEERP attempts to accommodate growth.

The shortcomings associated with CEA-type programs argue against it as a measure to promote optimal early action. A better approach is the early phase-in of the

commitment period regulatory program combined with targeted supplementary measures. The early phase-in of a cap-and-trade program could be implemented either through the progressive introduction of mandatory permits, or through trading in emission futures. The latter approach has the significant advantage of creating GHG price signals in the economy without imposing particular early emission reduction requirements. The design of supplementary targeted measures should be based on the underlying sources of the private under-valuation of early actions rather than on a goal of achieving early emission reductions *per se*.

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