Early action to reduce greenhouse gas emissions before the commitment period of the Kyoto Protocol – advantages and disadvantages

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Short title: Early action

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Abstract

Current 'business as usual' projections suggest greenhouse gas emissions from industrialised nations will grow substantially over the next decade. However, if it comes into force, the Kyoto Protocol will require industrialised nations to reduce emissions to an average of five percent below 1990 levels in the 2008 to 2012 period. Taking early action to close this gap has a number of advantages. It reduces the risks of passing thresholds that trigger climate change "surprises". Early action also increases future generations' ability to choose greater levels of climate protection and it leads to faster reductions of other pollutants. From an economic sense, early action is important because it allows shifts to less carbon intensive technologies during the course of normal capital stock turnover. Moreover, many options for emission reduction have negative costs and thus are economically worthwhile because of paybacks in energy costs, healthcare costs and other benefits. Finally, early emission reductions enhance the probability of successful ratification and lower the risk of non-compliance with the Protocol. We discuss policy approaches for the period prior to 2008. Disadvantages of the current proposals for Credit for Early Action are the possibility of

adverse selection due to problematic baseline calculation methods as well as the distributionary impacts of allocating a part of the emissions budget already before 2008.

One simple policy without drawbacks is the so-called baseline protection which removes the disincentive to early action due to the expectation that businesses may, in the future, receive emission rights in proportion to past emissions. It is particularly important to adopt policies that shift investment in long lived capital stock towards less carbon intensive technologies and to encourage innovation and technology development that will reduce future compliance costs.

Key words: Climate policy, early action, market instruments, credit for early action

In June 1992, the nations of the world negotiated the United Nations Framework Convention on Climate Change (the UNFCCC). The ultimate objective of the UNFCCC is to stabilize the atmospheric greenhouse gas concentrations at a level that avoids dangerous anthropogenic interference with the climate system. The first step in achieving that goal was a commitment by the most industrialised nations to develop policies and measures with the aim of returning their greenhouse gas emissions to 1990 levels by 2000.

The UNFCCC came into force in 1994, and the first Conference of the Parties in 1995 recognised that the non-binding stabilisation commitments of the UNFCCC were insufficient to avoid dangerous interference with the climate system. The conference directed the negotiation of a legally binding emission reduction commitment. In December 1997, the Kyoto Conference of the Parties to the UNFCCC agreed to the Kyoto Protocol that, for the first time, set quantitative limits on the emissions of greenhouse gases (GHG) from a number of industrialised countries (the “Annex B Nations”). Each Annex B Nation is assigned an amount of emissions (the nation’s “Kyoto Budget”) based on varying proportions of 1990 emissions. During the “First Commitment

Period" from 2008 to 2012, Annex B Nations are required to reduce average annual emissions to a specified percentage of 1990 levels. Overall, Annex B Nations are required to reduce emissions to approximately 95% of 1990 levels. Actual national limits range from 92% for the EU to an allowable increase of ten percent for Iceland.

The emission reductions called for in the Kyoto Protocol are clearly insufficient to avert the continuing atmospheric build up of greenhouse gases, and much lower than earlier EU proposals for 15% cuts. Nonetheless, given rapidly increasing emissions in many countries, the Kyoto reductions potentially necessitate major changes. United States emissions are projected to exceed 1990 levels by 23% or more in 2010, but under the Kyoto Protocol the US is required to achieve a 7% emission reduction. The U.N. Climate change secretariat projects aggregate greenhouse gas emissions 23% higher than 1990 levels by 2010 (see Table C.6 of UNFCCC, 1998a). More recent projections of US emissions are higher. The US Energy Information Administration currently projects carbon dioxide emissions to grow to 33% above 1990 levels by 2010 (see United States, Department of Energy, Energy Information Administration, 1999a). In Canada, emissions are projected to increase by 18%, but the Protocol calls for a 6% reduction. European Union emissions are projected to increase by 6% but the EU is subject to an emission reduction target of 8%.

The Kyoto Protocol allows Annex B Parties to meet these limits through domestic emission reductions and various international flexibility mechanisms. The international flexibility mechanisms include:

- *International Emissions Trading (IET).* International emissions trading allows Annex B Parties to buy and sell assigned amount units for First Commitment Period.

- *Joint Implementation (JI).* Joint implementation allows Annex B Parties to transfer assigned amount units, but transfers are associated with emission reductions from specific projects. Rules regarding liability for non-compliance may be different under JI and IET.
- *The Clean Development Mechanism (CDM).* Starting in 2000, certified emission reductions can be generated by emission reduction activities in developing countries. These can be transferred to Annex B Parties and used to increase Annex B Nations' Kyoto Budgets.
- *Bubbles.* Parties can choose to be jointly responsible for meeting an aggregate emission limit.

The Kyoto Protocol has been signed by almost all the Parties to the UNFCCC, but is unlikely to be widely ratified prior to 2001, when negotiations over the details of these flexibility mechanisms are expected to conclude. It has not yet been ratified by any Annex B Nation.

As the targets of the Protocol only come into force in about a decade, an important policy question is whether instruments to achieve emission reduction should be introduced now and how they can be linked to the Kyoto Protocol rules. We first discuss the need for such "early action" and then look at policy proposals made in North America and Europe. We evaluate their impacts and make suggestions for improvement.

The Rationale for Early Greenhouse Gas Emission Reductions.

The Environmental Rationale

The human enhanced greenhouse effect is caused by the build up in the atmosphere of gases which remain in the atmosphere for periods that range from decades to millennia (in the case of PFCs). Avoiding dangerous anthropogenic interference with the climate system entails limiting cumulative emissions over many decades. Earlier reductions also reduce environmental impacts prior to stabilisation of greenhouse gas concentrations, and they increase future generations' ability to choose greater levels of environmental protection. Earlier action reduces the need for

deeper, more rapid reductions in the future, and reduces the risks of passing thresholds where impacts of climate change increase non-linearly. For example, the Gulf stream could stop flowing meaning that temperatures in Europe would drop by several degrees Celsius even if global temperatures rose strongly (see Rahmstorf, 1999).

There are also other environmental benefits to individual nation's choosing early action. Aside from climate impacts, measures to reduce greenhouse gas emissions will reduce the emissions of related local pollutants such as SO_2 or NO_x, that are largely resonsible for air pollution in urban areas. A reduction of those pollutants will lead to better health of the population and reduced impacts on forestry (acid rain) and agriculture (crop losses due to elevated tropospheric ozone). Tentative calculations show that the benefits of emission reduction through reduction of local pollutants, especially SO_2, are comparable to the value of carbon credits under a carbon tax of 20-2000 $ per ton carbon (Ekins, 1996). Of course the valuation of health benefits is not strightforward but the figures give an indication of the order of magnitude.

The Economic Rationale

Economically, it makes sense neither to reduce emissions to Kyoto Protocol levels overnight nor to delay reductions until 2008. Ideally, the emissions path that makes the most sense is a compromise between these two extremes. It will depend on an assessment of the likelihood of the Kyoto Protocol coming into force and an assessment of how the costs of reductions will change over time.

It is clear that in many cases the long term costs of reductions will increase if action is not taken in the short term. As individuals, businesses and governments invest in infrastructure, equipment, buildings and production facilities, their decisions will have a long term impact on emissions. In the case of equipment such as cars this impact might last ten years and in the case of buildings and

power plants several decades. In other cases, e.g. roads and transportation infrastructure, the impact can even last centuries (Jaccard, 1997). If investments are made in carbon intensive capital stock, there will be a future cost of prematurely replacing such stock in order to meet future emission limitations. Ensuring appropriate investment in the course of capital stock turnover is particularly important in the context of greenhouse gases because there are few "end of pipe solutions" to greenhouse gas emissions. Solutions generally lie in increased efficiency throughout the economy, especially in the energy production and consumption system.

Moreover, when governments or the private sector choose between alternative technologies — e.g. between investing in the rail system or the road system, or between expanding fossil fuel production and introduction of renewables — they reinforce a pattern of development which is increasingly difficult to turn away from. Once certain choices are made, the market tends to reinforce them. Investing in low carbon intensity technologies today may sometimes impose an immediate cost, but it will help ensure that businesses and individuals do not face higher costs in the longer term. These "bifurcation points" — points where choices are made between technologies that "lock in" models of development, e.g. the availability of cars leading to suburban sprawl — are most obvious in the context of developing countries and economies in transition, but also exist in developing countries.

Government could choose to delay introduction of emission reduction policies until the First Compliance Period allowing firms to assess the likelihood of future emission limits, the likely shape of future regulations and the lowest cost emissions path given these uncertainties. However, this laissez faire approach is unlikely to yield emission reduction patterns which are ideal from a broad societal perspective:

- Even in the absence of future emission limits that are likely to increase the cost of emissions or energy usage, there is some evidence that consumers and firms already under-invest in energy efficiency due to various market failures. There is also agreement among many economists that energy efficiency gains of 10 to 30% above current trends are possible at negative or zero net cost (IPCC 1996). Measures which can cost-effectively overcome these barriers are justified regardless of future emission limits.
- Firms and individuals may be largely unaware of the Kyoto Protocol and its implications, and may be less able than governments to assess the likelihood of future emission restrictions and the likely cost of future emission reductions. This is especially true where climate change economics and science have become highly politicised.
- Firms and individuals are likely to apply a higher discount rate to future emission reduction costs, focussing too much on short term costs at the expense of long term economic well being;
- Given uncertainty as to the shape of future regulations, businesses may fear that they will be penalised for early emission reductions. Even where firms are not directly penalised for reductions, they may choose not to invest in lowest cost measures if doing so negatively impacts their ability to negotiate for beneficial climate policies.
- Firm's individual investment decisions will not take into account a number of economic and environmental benefits associated with taking early action. As noted above, measures to reduce greenhouse gas emissions will also reduce air pollution in urban areas and thus lead to benefits for public health and agriculture/forestry. Studies for European countries and the US indicate that secondary benefits of air quality improvements related to lower greenhouse gas

emissions could offset between 30 and 100% of the greenhouse gas emission reduction costs (see Pearce et al., 1996, p. 218).

- Early reduction policies are likely to lead to increased research and development on energy efficiency, renewable energy and other greenhouse gas mitigation techniques. If policies lead to innovations and development of new low cost, low carbon technologies they will reduce the costs of achieving future emission reductions for other firms. Policies that encourage innovation are particularly important in achieving long term low cost reductions.

All these factors suggest some early reduction measures are appropriate. It should be noted that early actions have another benefit: they help reduce the uncertainty that makes climate change policy difficult. Market-based policies will lead to a revelation of the marginal costs of abatement throughout the economy as has been demonstrated by the market for SO_2 permits which demonstrated that marginal abatement costs were much lower than originally thought. This aollows to fine-tune future policies.

Encouraging early domestic greenhouse gas emission reductions also make sense in the context of any single nation's domestic economic strategy. Lack of early domestic action is likely to result in greater reliance on international flexibility mechanisms. Having failed to realise low cost reductions during capital stock turnover, costs of compliance through domestic measures will be higher and the international flexibility mechanisms will appear more cost effective. This will result in lower overall investment in improving domestic efficiency and a redirection of capital away from the domestic economy.

A July 1999 study by the US Energy Information Administration examined the impacts of meeting the Kyoto Protocol under an emissions trading system starting in 2000 versus one that started in 2005 (see United States Department of Energy, Energy Information Administration, 1999b). The

methodology of the report included an implicit assumption that, contrary to the previous paragraph, reliance on international flexibility mechanisms would not be affected by the start date. Moreover, the macroeconomic study did not include economic, environmental or social benefits from reduced emissions. Despite these limitations which tend to understate the benefits of an early start, modelling indicated that earlier implementation lead to a smoother transition to a low carbon economy with lower cumulative costs. Delaying action only became relatively economic when future costs were significantly discounted.

The Political Rationale

Early greenhouse gas emission reductions are also consistent with existing obligations. As noted above, the UNFCCC commits most industrialised nations to develop policies and measures with the aim of returning their greenhouse gas emissions to 1990 levels by 2000.

Although stabilisation at 1990 levels is a goal and not a binding commitment, in many cases Annex 1 nations cannot be said to have delivered on their commitment in a meaningful way. For instance, a 1998 report on domestic climate change policy by the Canadian Parliament's independent Auditor General concluded that many of the key elements necessary to manage the implementation of Canada's response to climate change are missing or incomplete (Auditor General of Canada, 1998).

The failure of most Annex 1 Parties to meet the stabilisation target and the failure of several nations to implement policies that could realistically hope to stabilise emissions carries a political cost in current international climate change negotiations. Developing countries, for instance, have been highly critical of Annex 1 failures. Calls for quantitative emission caps on developing countries emissions have been criticised as premature given Annex 1 Parties' failure to implement their initial commitments.

Failure to take early action is also increases the risk of non- compliance with the Kyoto Protocol. First, the Protocol calls for demonstrable progress in achieving commitments by 2005. Second, as noted above, the failure to take early action is likely to lead to increased reliance on the international flexibility mechanisms. At the same time, the EU is calling for stringent limits on use of the mechanisms. If such limits are adopted, there is an increased likelihood of a breach if early actions are not taken.

Economic Policy Approaches to Early Action

Given the above, governments will likely need to adopt policies prior to 2008 in order to meet the Kyoto target. Figure 1 indicates the purpose of early policies to reduce emissions. Early programs shift the emission path from business as usual-growth to a downward-sloping path. Ideally, they will reduce emissions during the first compliance period to below a nation's Kyoto Budget. While a portfolio of measures will likely be needed to achieve this end, the creation of incentives to reduce emissions throughout the economy are likely an essential part of this portfolio. Such incentives can be created by market instruments or through Credit for Early Action.

Figure 1 about here

Market Instruments

Outside of North America, policy makers responsible for developing economy wide incentives to reduce greenhouse gas emissions have focussed on either emissions trading and/or carbon taxes.

The Rationale for Market Instruments

Both economic theory and experience suggest that these market instruments have a number of advantages. In particular:

- *Achieving emission reductions at lowest possible cost.* In a competitive market without any market failures, well-designed market instruments should reduce emissions at the lowest possible costs. In practice, market failures (e.g. information barriers, externalities or preponderance of other objectives) exist, but the market will still often be more effective than government regulators in locating low cost emission reductions. In the case of many consumer products, the barriers might be overcome by environmental labelling or standards.
- *One instrument yields a myriad of adjustments.* One instrument can encourage production efficiency, shifts in purchasing behaviour, shifts to renewable energy, changes in consumption patterns, and recycling, but these behaviours are only encouraged to the extent that they are the most cost effective emission reduction solutions.
- *Incentive to innovation.* Market instruments create an economy wide economic incentive to innovate in ways that reduce greenhouse gas emissions. In a traditional regulatory "command and control" environment, emitters have no incentive to reduce emissions beyond required levels and may even be fearful that innovation will lead to government imposing stricter regulation.
- *Shifting the onus for finding low cost emission reductions.* Market instruments also have an advantage in terms of the political achievability of reductions. Regulations that prescribe a particular technology or emission rate encourage businesses to exaggerate the cost of emission reductions so that they can avoid stringent regulations. Government is usually at a disadvantage in determining whether a business can cost effectively reduce its emissions. It does not have the same understanding of an emitters' needs and opportunities as does the actual emitter, and it cannot easily separate gross exaggerations from valid concerns. Market mechanisms shift the onus of finding most cost-effective emission reduction measures from government to the private sector.

- *Separation of where emission reductions occur and who bears the cost.* Market instruments generally allow government to achieve equitable sharing of costs while also ensuring cost effective solutions. Market instruments separate the issue of who pays for emission reductions and where they occur. In the case of a carbon tax or emissions trading with auctioned allowances, government can determine the distribution of benefits and costs through the recycling of revenue. Where allowances are allocated gratis, the allocation formula will determine winners and losers.

How Market Instruments Work

There are innumerable permutations in how an emissions trading system or carbon tax could work, but there are a number of basic elements that can be used by themselves or combined. Under a carbon tax or emissions charge, a charge is placed on emissions. In the context of greenhouse gases this can be most easily accomplished by placing a charge or tax on the carbon content of fossil fuels. The revenue can be used to reduce other taxes, to reduce the debt or fund increased program spending. The tax would be highest per unit of energy on carbon intensive fuels such as coal and non-existent on renewable energy sources. Changes to the prices of energy will be reflected in prices for products. Energy providers have an incentive to switch to renewables, manufacturers to switch to more efficient production processes, and consumers to switch to products which consume less energy, especially fossil fuel energy, in their manufacture and use. Although taxes on carbon content of fossil fuels cover the great majority of most Annex 1 emissions (e.g. 84 percent of US emissions) a tax could be extended to many other emissions (e.g. greenhouse gases from industrial processes).

Figure 2 shows how a carbon tax works. If government sets a carbon tax equal to T_1, and the supply for emissions reductions is as indicated by the line S_1, emissions will be reduced by Q_1. Over time the carbon tax should spur innovation and technological development. This will

enhance the supply of reduction options (the supply curve moves from S_1 to S_2), and the same carbon tax (T_1) should result in a larger reduction to Q_2. On the other hand, growth in the economy will tend to move the supply curve to the left, but at the very least a carbon tax will ensure less growth in emissions.

Figure 2 about here

Under emission trading programs, like carbon taxes, individual polluters are given flexibility in how to reduce their emissions. Where an emitter can, at a low or negative cost, reduce emissions or energy use beyond what is required by regulation they can sell an emission reduction credit or an emission allowance to a polluter who cannot reduce their emissions as easily. The purchaser of the credit or allowance is then allowed to emit more. Trading itself is not intended to reduce emissions; it is intended to reduce the cost of meeting a government imposed limit on emissions. The essential difference between trading and a carbon tax is that under a trading regime government controls the quantity of emissions through regulatory limits, but not the price of emission rights. Under a tax, the price is set by government, but not the quantity. Under the example in figure 2, if government sets the quantitative limit on emissions at Q1, the price for emission limits will initially be P1, but will reduce to P2 as innovation occurs.

There are essentially three basic forms of trading that could be used to reduce greenhouse gas emissions. Any actual program is likely to combine these forms. The three forms are:

- *Downstream cap and emission allowance trading.* The quantitative limit on emissions is set by an explicit cap on actual emissions from defined sources during a defined time period. Government then makes a political choice as to how it allocates allowances to emit greenhouse

gases. The total emissions permitted by all allocated allowances is equal to the cap. Allowances can be allocated through a number of different mechanisms; these including grandfathering based on emissions in a historic base period, auctioning, or allocation on the basis of production levels (e.g. one allowance per tonne of steel produced in a historic allocation base period). Several other allocation methods are discussed below in the descriptions of specific proposals. Those sources that expect to emit less than permitted by their allowances may sell surplus allowances to other sources whose emissions would otherwise exceed the allowances allocated to them. Over time, the number of allowances in circulation can be reduced and thus total emissions are reduced. Because of the administrative difficulty of making individuals, households and small businesses responsible for their emissions, the cap is likely only to apply to major industrial sources and other large emitters.

- *Upstream cap and carbon allowance trading.* This program is similar to cap and emission allowance trading but the quantitative cap is set by regulating the source of emissions rather than emissions per se. Rather than trading an allowance to emit a given unit of greenhouse gases, allowances represent licences to sell or import carbon bearing fuels for the purposes of combustion. Exemptions or credits would be available for fossil carbon exports or carbon sequestered in long lived products. Since carbon in fossil fuels is a very close proxy for the carbon dioxide emitted by burning those fossil fuels, and since carbon dioxide from fossil fuel combustion accounts for the overwhelming majority of greenhouse gas emissions, the limitations on carbon in fossil fuels reduces greenhouse gas emissions. The cap can also be extended to other gases and other sources that can be easily and accurately monitored. In order to match demand for fossil fuels with a limited supply, allowance holders will charge a premium on carbon based fuels. Carbon allowances are valuable and the holders of the allowances are not necessarily bearing the

costs of emissions reductions. Because of this, in order for a upstream program to be socially acceptable, it is likely government would need to either auction allowances or tax back windfall profits, and use the revenue to reduce other taxes or invest in government programs and transition strategies.

- *Mandatory performance standards and credit trading.* The quantitative cap on emission is less explicit than other programs. Government, rather than prescribing a cap, prescribes numerous performance standards (e.g. *x* kg CO_2 per kWh/ *y* kg CO_2 per tonne of steel produced). Emitters who cannot cost effectively meet the applicable standard can buy credits from emission reductions at other locations. Credits can be generated by improving performance beyond required standards or by reducing emissions at sources not covered by a standard.

The above classification of programs should not be taken as meaning there are only three ways of implementing emissions trading. As will be seen below, actual proposals often combine elements of programs. For instance, credit trading can supplement an upstream or downstream cap and allowance trading program. Credits can be generated by reducing emissions at facilities outside the cap, and used in lieu of allowances. Alternatively, downstream trading might be applied to the industrial sector while upstream trading or a carbon tax is applied to small sources.

Credit For Early Action.

Introduction to Credit for Early Action

Many North American proposals for encouraging early greenhouse gas emission reduction have focused on creating incentives for voluntary emission reductions without imposing new regulations or fiscal incentives. This appears to be due to a widely perceived lack of political appetite for mandatory greenhouse gas emission limits or carbon taxes. Indeed, within the US

Senate there has been opposition to any regulatory initiatives to implement the Kyoto Protocol prior to ratification.

There are two aspects of the proposals for encouraging early voluntary action: Credit for Early Action and baseline protection. Credit for Early Action is the core of several US proposals.

Credits are generated when an entity reduces its greenhouse gas emissions below a credit generation baseline. The baseline is set by reference to absolute emissions in a credit generation base period or emissions per unit of production in a credit generation base period. In some cases, entities can generate credits from reducing emissions at facilities that lie outside their operations. In these cases a separate baseline has to be created for the specific project.

Figure 3 provides an example of Credit for Early Action. A company gets credit for all the cumulative reductions below baseline, but not reductions below business as usual which fall above baseline. Some reductions (the area between credit generation baseline and BAU emissions) would have occurred anyway (i.e. non-additional reductions).

Figure 3 about here

The credits are usable in any future where there is either a tax on greenhouse gas emissions or there are regulatory limits on greenhouse gas emissions. For instance, if an upstream carbon allowance trading program is implemented, emitters might receive allowances to import or produce fossil fuels. They could sell these to fossil fuel producers or importers. Credits are tradable, so that a company can profit from emission reductions even if it does not expect to need credits.

While Credit for Early Action involves the generation of credits that could be used under any carbon constrained future, baseline protection only comes into play if a future regulatory system

uses "grandfathering." Grandfathering occurs where allowable emission levels or emission permits are given to emitters based on their emissions in an allocation base period. In the event of grandfathering, and in the absence of baseline protection, emitters who took voluntary action prior to the allocation base period would receive a smaller allocation. Baseline protection is intended to wholly or partly protect emitters from this possibility, thus wholly or partly removing a disincentive to early action.

Figure 4 indicates the relation between baseline protection and Credit for Early Action. In the figure it is assumed that credit is only given for absolute emission reductions. The area ACD represents the total credit generated. These cumulative reductions are rewarded with credits. Under baseline protection, in the event of grandfathering, the amount of reductions achieved in the allocation base period (BCDE) are added onto actual base period emissions (DEFG) for the purposes of calculating the allocation. Government might, for instance, give emitters allowances equal to 85% of their protected base period emissions (BCFG).

Figure 4 about here

Credit for Early Action has several advantages similar to market instruments. In particular,

- *One Instrument encourages multiple adjustments.* Depending on its design one Credit for Early Action instrument can encourage many changes. These include production efficiency and shifts to renewable or less carbon intensive energy.
- *Incentive to Innovation.* Credit for early action can create an incentive to innovate if properly designed.

However, credit for early action does not create a clear price signal that values all emission reductions equally. This is due to the fact that the baseline fixed in the respective law does not necessarily correspond to the business-as-usual emissions path. Some emissions reductions from business-as-usual may thus not receive credits. While it is an incentive to low cost emission reductions, it may not achieve lowest cost emission reductions. Credit for early action is better described as a "quasi-market instrument."

As indicated in figure 5, there are two main forces influencing the degree of emission reduction achieved through Credit for Early Action – supply and demand for credits.

Figure 5 about here

Figure 5 assumes no international trade in emission permits.

In the case of very low demand (D_0) and ample supply of credits resulting from activities that would have occurred in the absence of Credit for Early Action (x0), the price of credits would be zero. Even a somewhat higher level of demand (represented by D_1) only non-additional credits are supplied (x1) at a price (p1) that covers the costs of verification. If the CEA system were designed to only give credit for additional emission reductions, no trading would occur. This situation might be the case if market participants expected the Kyoto Protocol to fail. On the other hand, if there is an expectation of entry into force of the Protocol and an expectation that emission levels will exceed the Kyoto budget, greater demand will result (D_3) and additional emission reductions will occur (x2). If major shortfalls between actual and allowed emissions are expected, or if high emission reduction costs are expected, the curve would move even further to the right.

For companies, participating or not participating in Credit for Early Action bears both advantages and disadvantages. For the participating company, the advantages are a prolonged emissions planning period (up to 13 instead of 5 years), partial or complete relief from future reduction obligations, a “green” public image, and in some cases the ability to sell credits that are excess to the needs of the company. Where credit is received for non-additional reductions, it will be a fortuitous windfall. On the other hand, under some proposals participants are liable if their emissions exceed the credit generation baseline or receive less credits if they do not reduce emissions to the extent they initially projected. In either case, companies may find themselves compelled to accelerate reductions that have higher costs than expected at the time they enrolled in the CEA program. Non-participating companies may be able to delay their investment and thus profit from lower opportunity costs (although there is no loss of opportunity cost if the reductions are non-additional or profitable). Similarly, they may benefit from lower implementation costs if the program as a whole leads to lower cost emission reduction technologies.

Early International Action

The Kyoto Protocol only directly credits early action in the context of the Clean Development Mechanism (CDM). Certified Emission Reductions in non-Annex B nations can be generated beginning in 2000 (although rules may be uncertain until some later date), and used as credit towards meeting Annex B obligations for the 2008 to 2012 period. In this chapter, we will provide a short description of the CDM and make proposals on how national and international action can be combined.

The Clean Development Mechanism (CDM) has a number of special properties because it was designed both to reduce the cost of achieving the Kyoto Protocol and because of the desires of developing countries to ensure development that benefited them. The explicit purpose of the CDM is to achieve sustainable development. Ideally, the CDM will shift investment patterns at key

junctures in developing countries development paths, re-enforcing a pattern of less carbon intensive development. Participation by the host countries is voluntary and projects must lead to "real, measurable, and long-term benefits related to the mitigation of climate change" and emission reduction must be "additional to any that would occur in the absence of the certified project activity". Emission reductions achieved abroad need to be independently certified as being additional before they can be transferred to the investing country (Kyoto Protocol, Art. 12 (5)). This certification process brings about problems of defining the business-as-usual case (in contrast most domestic Credit for Early Action proposals simply define a "one size fits all" baseline that is unlikely to work in the context of developing countries).

Currently, the rules for determining additionality, certifying projects, measuring emission reductions and whether projects meet the sustainable development purposes of the CDM are completely undefined. The international community has identified the CDM as a high priority for further definition of rules, but little progress has been made to date. The 6th Conference of the Parties to the UNFCCC in November 2000 has been set as a deadline for further elaboration of the CDM. Because of the importance of the CDM to the US and several other members of Annex B, it is unlikely that there will be widespread ratification of the Kyoto Protocol until after the further resolution of CDM rules.

The impact of Credit for Early Action or market instruments on domestic emission reductions will clearly be affected by their relation to the Clean Development Mechanism. Both emitters and governments will need to consider this interaction in designing programs.

In the absence of a cap on use of the Kyoto Mechanisms (the CDM, international trading, joint implementation and bubbles), the price for CERs and forward contracts for assigned amount units set an upper bound on the price for early action credits or domestic emission allowances.

Similarly, if assigned amount units or CERs can be used as a credit against carbon taxes, they will set an upper bound on the tax level.

Depending on which project categories are eligible for the CDM, costs per unit of CO_2 equivalent for reductions achieved under the CDM are supposed to be considerably lower than those in Annex B countries. On the other hand, adders for CDM administration and for adaptation measures against climate change in especially vulnerable countries will increase the costs of "Certified Emission Reductions" (CERs).

If a cap on use of the Kyoto Mechanisms is imposed, as declared by the EU ministers of the environment (Anonymous, 1999), governments will need to define upper limits for credits to be acquired through these mechanisms. Paradoxically, this could cause a run-up for these limited GHG reduction options, thereby delaying domestic investment. As shown in Figure 6, the availability of CERs will bend the domestic supply curve from S_1 to S_2 and reduce credit prices from pa to pCDM. As soon as the CER world market price level (pCDM) is reached domestic credits will no longer be attractive. If a quantitative restriction (Xa) for CERs is chosen, S_3 will result. In practice, the CDM supply price will not be stable but will rise as higher quantities are reached. Countries that chose not to support CDM in phase I may have to acquire CERs later when their costs will be higher.

Figure 6 about here

Early CDM credits could thus delay domestic action, thereby contradicting the objective of a domestic early action program. Although there might be some technology spin-off of CDM projects, most of the solutions required for developing countries (e.g. building up a decentralised power grid) are not applicable to emission reduction needs of the industrialised world.

Conclusions

Policies will be most efficient and most effective in causing cost effective emission reductions if all emissions have equal opportunity costs. Well-designed market instruments will create an equal opportunity cost for all emissions. Ensuring an incentive to pursue least cost reductions is more difficult in the context of Credit for Early Action systems. Reductions that are not below credit generation baselines have no incremental value. Moreover, incentives to reduce emissions through structural shifts to lower carbon intensity inputs may either be non-existent or ineffective.

Environmental implication of the different instruments

The last section compared Credit for Early Action and market instruments in terms of their ability to reduce the cost of compliance with the Kyoto Protocol, and in terms of their ability to achieve the lowest cost emission reductions in the pre-commitment period. However, it ignored the climate, local air pollution, human health and other environmental benefits of achieving more reductions in the short term. This section discusses the relative environmental effectiveness of market instruments and Credit for Early Action.

Market Instruments

Because they generally create a clear market signal, environmental effectiveness of different market instruments is relatively easy to predict (at least in theory). As shown in figure 2, above, the effectiveness and cost of market instruments are relatively simple to predict from a theoretical perspective. Cap and trade programs will reduce emissions to the defined cap. The difference between projected emission trends and the cap gives a good indication of environmental effectiveness of the program. The long and short term effectiveness of a carbon tax is harder to predict in practice, but is theoretically simple: if twenty percent emission reductions are possible over ten years at prices below $25 per tonne, a $25 per tonne charge should yield a 20% emission

reduction in ten years. Economists will inevitably argue over business as usual emission trends and the effectiveness of different levels of carbon tax, but there is a theoretical basis for predicting effectiveness, and economists are familiar with the macro economic models that allow them to predict effectiveness.

However, emissions trading that does not cover all emissions will be subject to leakage. Moreover, the issue of baseline protection comes in when initial allocation is to be decided. Baseline protection can only be achieved without perverse incentives if there is independent verification which leads to transaction costs. Thus it is likely that real world emissions trading programs will suffer relevant efficiency losses compared to theory.

Credit for Early Action

Predicting the effectiveness of a Credit for Early Action system is comparatively difficult. As shown in figure 5 above, the effectiveness of early crediting will depend on supply and demand for credits. The effectiveness of an early crediting system is thus dependent on a number of variables (in addition to the cost of emission reductions which determines effectiveness of a carbon tax):

- *The number of creditable, low cost additional emission reductions.* Some low cost reductions may not be pursued because they are not creditable.
- *The number of creditable, non-additional emission reductions.* Large amounts of credit from non-additional emission reductions will increase the supply of credit, and increase the volume of credits generated. However, it will depress prices and thus decrease the incentive for emission reductions that are additional to what would occur in the absence of Credit for Early Action.

- *Perceptions as to the likelihood of future emission limits.* Early action credits only have value if there is future regulation of emission limits. If emitters expect the Kyoto Protocol to fail, there will be less demand for credit.
- *Perceptions as to the future value of one tonne credits.* A Credit for Early Action system will be less effective if most emitters expect a low price for domestic allowances, AAUs, or CERs.
- *Discounting of future cost savings.* A Credit for Early Action system encourages immediate investments in emission reductions in return for potential future cost savings. These future cost savings will be discounted.
- *Extent of non-creditable emission reductions necessary to generate credit.* More stringent baselines will — up to a point — increase the number of additional, non-creditable emission reductions that are pursued in order to begin generating credit.
- *Perceived risk of credits being discounted.* As discussed below, several proposals include a credit budget — a limit on the total amount of the Kyoto Budget allocated to Credit for Early Action. In some cases the cap is enforced by limiting the number of participants in the Credit for Early Action program; in other cases credits are discounted so that the portion of the Kyoto Budget apportioned to Credit for Early Action is not exceeded. Either way, credit for non-additional emission reductions will reduce the effectiveness of a program. If most credit goes to a few participants with non-additional emission reductions little is left to encourage shifts in the emissions trajectory. Similarly, if credits from additional emission reductions are at risk of being severely discounted due to credit for non-additional emission reductions, there will be less incentive to reduce emissions.

Several observations should be drawn from the above.

First, overly stringent baselines as well as overly aggressive baselines can reduce the effectiveness of Credit for Early Action. A stringent baseline will decrease the amount of credit generated by non-additional emission reductions; this will increase the price for credits and encourage more reductions. It will also reduce the amount of a limited credit budget used to compensate for non-additional reductions. Finally, more stringent credit generation baselines will lead to emitters pursuing additional emission reductions which are not creditable because they are above the baseline. On the other hand, as baselines become more stringent there will become an increasing number of additional, cost effective emission reductions that are not be pursued because the total cost of reductions to generate credits outweigh the value of the credit.

Second, Credit for Early Action will work best if there is minimal variation among emitters' emission patterns and emission reduction costs relative to the chosen metric for setting baselines. If, for instance, all emitters can achieve a 1.5 percent per year reduction in emissions per unit of revenue at no cost, there will always be an incentive to make low cost emission reductions. Similarly, if very few emitters exceed the 1.5 percent performance improvement rate in a business as usual scenario, there is little risk that a limited credit budget will be used to reward non-additional emission reductions. On the other hand, if there is great variability in emission patterns and costs, more participants with low cost emission reductions will have no incentive to pursue those reductions, and a limited credit budget may be spent on pursuing non-additional emission reductions.

Unfortunately, at time of writing, the authors were unable to locate any attempt to quantify variability among corporate emission reduction patterns (either measured as absolute emissions or measured as emissions per unit of production. Several relevant studies are underway, but not complete. Both the Canadian Industry Energy End-Use Database and Analysis Centre in Burnaby, Canada, and Lawrence Berkeley National Laboratories in the US are working on studies which

look at variability in emissions per unit of production in fairly disaggregated sectors. Neither study looks at different corporate entities. However, anecdotal evidence suggests that differences in technological opportunities and different opportunities to reduce emissions as capital stock is replaced make for significant differences in emission patterns among companies and sectors. For instance, business as usual projections for the US aluminium sector suggest that, despite modest growth, reductions of PFC emissions of twenty five percent between 1993 and 2010 will be achieved due to improved technology. In Norway, the aluminium industry has made considerable progress in achieving an agreed 50% cut in PFC emissions between 1990 and 2000 (Storey, 1996 and personal communication with Peir Stiansen, Norwegian Ministry of Environment). Canadian Industry Program for Energy Conservation (CIPEC) reports 1990 to 1994 improvements in energy efficiency/intensity between sectors that vary between a decrease in efficiency of 4.9% (glass) to an improvements of 19.2% (pulp and paper) (Canadian Industry Program for Energy Conservation, 1995). In the case of utilities, declining performance baselines will give little incentive for a hydro based utilities to meet new demand through investment in natural gas, while they may provide credit for non-additional emission reductions to a coal fired utility that is doing the same thing.

Third, investment in additional domestic emission reductions for the purpose of generating credit is very speculative. If there is much chance that credits will be discounted, investments in domestic emission reductions will be more risky than investments in international flexibility mechanisms. This may minimise the extent of investment in additional domestic actions.

Finally, the variables involved in determining the effectiveness of Credit for Early Action are considerably more complex than the variables involved in determining the effectiveness of a carbon tax or emissions trading. For this reason, there has been little attempt to quantify the reductions achievable by Credit for Early Action in anything but the most cursory way.

Leakage

Programs can create situations where there is an economic benefit to shifting emissions to another location. A program that rewards this shifting – also know as leakage -- will be less effective in reducing greenhouse gas emissions.

Generally with market instruments, the potential for leakage will be minimised if the system is comprehensive. On the other hand, Credit for Early Action programs inherently create incentives to shift production or consumption to goods with lower embodied emissions; to outsource production that involves higher emissions, and to simply reduce production but do not create an inherent cost to shifts in the opposite direction (Michaelowa and Stronzik, 1999). Credits may be generated for reductions at one location, but these may be completely offset by leakage from shifting production to other locations. Of course these problems also occur if an emissions trading system is introduced with only partial coverage as well as in the case of other instruments if their coverage is partial.

The challenge of operationalizing provisions against leakage is significant. For instance, quantifying the leakage associated with reductions in production or shifts in production mix is daunting, requiring knowledge of the emissions intensity of different products. Unfortunately, such information is often unavailable, difficult to produce or not sufficiently disaggregated (US, Department of Energy, Energy Information Administration, 1999c, p. 8). Government administrators will have extreme difficulty assessing whether or not reductions are real. Rules to avoid leakage may also create loopholes.

Conclusion

The emission targets of the Kyoto Protocol only apply to the period 2008-2012. Thus, in North America and Europe policymakers have proposed Credit for Early Action schemes that allocate a

part of the emissions budget to companies that reduce emissions before 2008. However, the environmental effectiveness of Credit for Early Action is difficult to predict in comparison to market instruments. The speculative nature of credits may make them less effective in motivating additional emission reductions. Both too lax and too stringent a baseline reduces effectiveness. Credit for early action will be more effective if there is less variability among company emission patterns relative to the chosen baseline metric. Credit budgets will reduce effectiveness, but may be necessary for other reasons.

Both market instruments and Credit for Early Action can potentially create perverse incentives under which emitters can gain through activities that simply shift emissions elsewhere. However, the lack of a clear price signal in early crediting programs increases the potential for leakage significantly. Credit for leakage is not only inefficient and inequitable, it reduces effectiveness of a program by depressing the price for real emission reductions.

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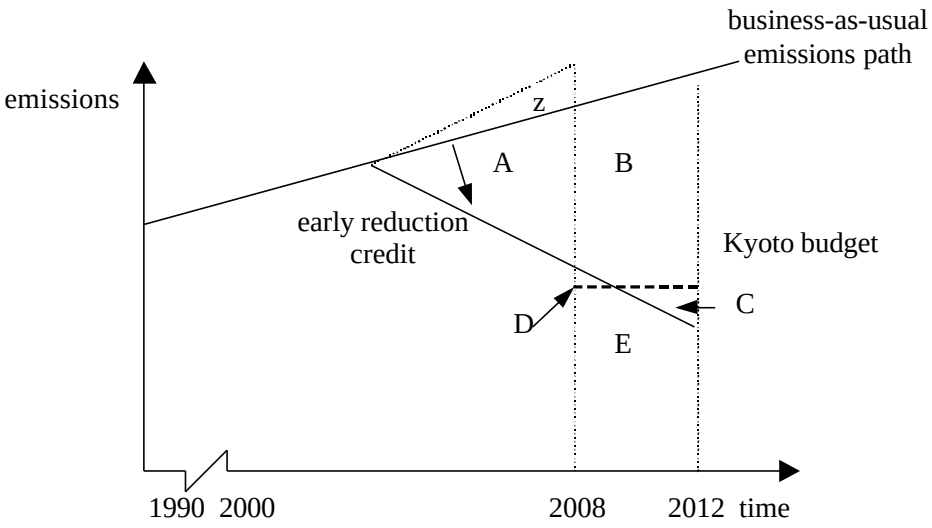
1



A: emissions reduced through the early action policy

B: emission reduction need from business as usual to meet the Kyoto commitment

C: gross surplus

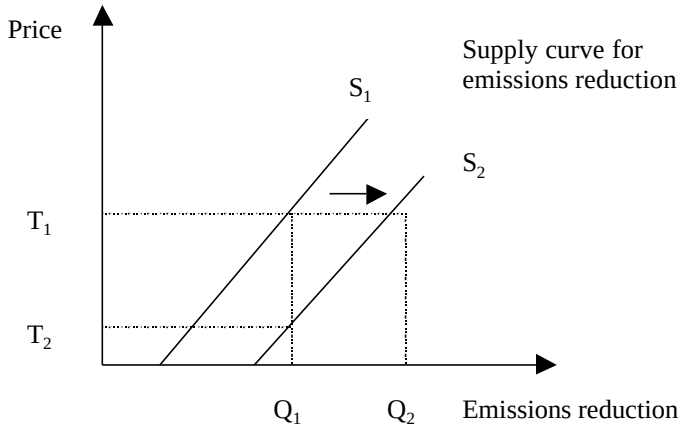
D: gross shortfall

z: non-additional reductions

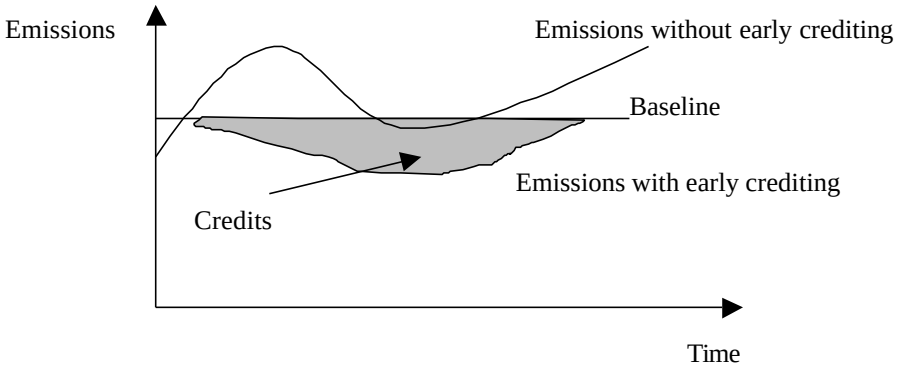
E: emissions during budget period

A+z-C+D: reduction of domestic emissions budget due to early policies. The higher the reduction, the higher the internal price for emission rights if all else is kept equal

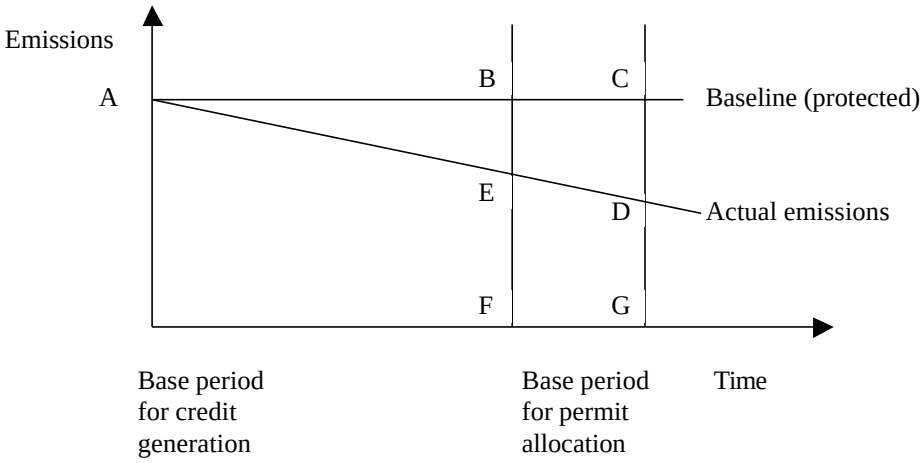
2


Price
Supply curve for emissions reduction
S1
S2
T1
T2
Q1
Q2
Emissions reduction

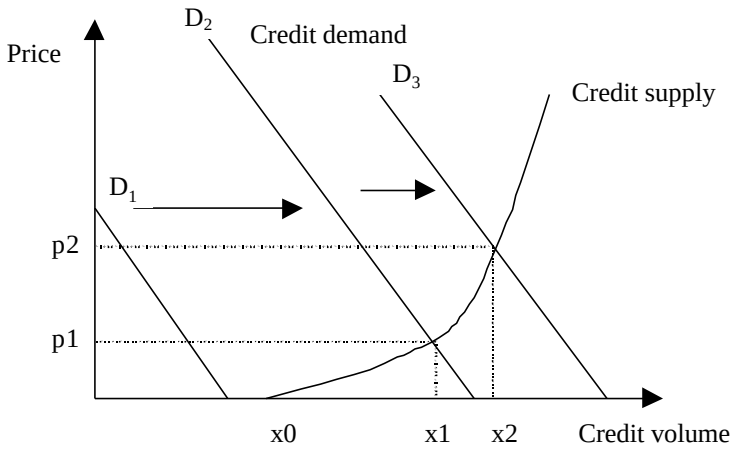
3


Emissions
Emissions without early crediting
Baseline
Emissions with early crediting
Credits
Time

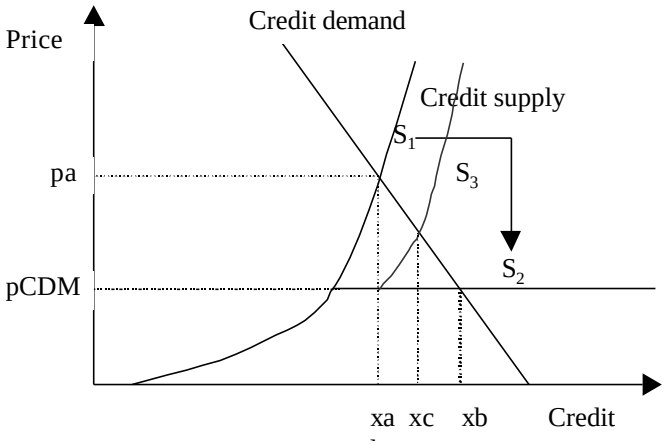
4


Emissions
A
B
C
Baseline (protected)
E
D
Actual emissions
F
G
Base period for credit generation
Base period for permit allocation
Time

5


Price
D2
Credit demand
D3
Credit supply
D1
p2
p1
x0
x1
x2
Credit volume

6


Price
Credit demand
Credit supply
S1
S3
S2
pa
pCDM
xa
xc
xb
Credit