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Qualitative Assessment of Carbon Tax and Cap-and-Trade Systems

prepared by

Daniel S. Hall and Carolyn Fischer
Resources for the Future

for the

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Carbon Emission Pricing Policy Project

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1 INTRODUCTION

This report examines the one of the fundamental questions confronting Canadian policymakers: What form should an emissions pricing policy take? Because placing a price on greenhouse gas emissions will be the central element of any climate policy, the choice between emissions taxes or a cap-and-trade system will have wide-ranging implications. At the same time, the choice between them is not as stark as it first seems; there are many options for adapting cap-and-trade to be more like a tax, and vice versa. The goal of this report is to provide Canadian policymakers with a broad – yet still rigorous – overview of pricing policy options that elucidates principles for crafting well-designed policy. The report does not focus narrowly on the debate over taxes and cap-and-trade, nor does it advocate one pricing instrument over the other. Rather it looks broadly at the spectrum of options that exist for pricing emissions, and highlights the trade-offs among these policy options. The report also evaluates pricing policy options in light of standard assessment criteria, and, on the basis of this analysis, synthesizes a set of broadly applicable design principles that can inform future climate policy in Canada.

The report begins with a background comparison of carbon taxes and cap-and-trade systems. This opening presentation serves to familiarize readers with the basic similarities and differences between these two emissions pricing approaches. Economists generally favor taxes (price-setting approaches) because, in theory, they will be more economically efficient. Other considerations – environmental objectives or political considerations – may argue for cap-and-trade. The two approaches are not entirely distinct, however; there are various ways in which price-setting approaches (i.e., a tax) can be blended or merged with emissions-setting approaches (i.e., cap-and-trade). These mechanisms can enhance the efficiency of cap-and-trade programs, although at the cost of certainty about emissions levels. One conclusion from this discussion is that there are many ways in which, rather than purely distinct approaches, taxes and cap-and-trade exist on a spectrum of pricing options. At one end (with taxes) there is certainty about the marginal price of emissions reductions; at the other there is certainty about the level of emissions. In between are approaches which trade-off certainty about one for increased control over the other.

The report then proceeds with its substantive analysis of pricing instrument choice in Canada in three sections. The first explores the options for emissions pricing policy. It does this through posing a series of questions that Canadian policymakers should ask when designing pricing policies. The series of questions draws out the similarities and differences between taxes and cap-and-trade in a practical manner. It also highlights the trade-offs in choosing one or the other and the ways that differences between them can be blurred. This approach is somewhat different than much of the existing literature; many reports have prepared "side-by-side" comparisons of taxes and cap-and-trade. This paper, by emphasizing the design questions, aims instead to help policymakers think through their priorities in designing climate policy, and how these priorities inform the choice of instrument.

The next section assesses various policy options on the basis of standard criteria. The National Round Table on the Environment and the Economy (NRTEE) has defined 5 assessment criteria that will be used for this analysis: policy effectiveness, economic efficiency, distributional impact, political acceptability, and governance and administration. Given the long-term nature of Canada's climate goals, a sixth criteria has been added: "institutional robustness", referring to the ability of a policy to be both durable and flexible over long time periods. The criteria are used to evaluate a set of policy options for the key design features of emissions pricing policy: the pricing instrument itself, revenue use, program coverage, the federal-provincial relationship, international linkage, and competitiveness. The evaluation is qualitative in nature. Where possible we highlight policy options that economic theory or real-world experience indicate have a clear advantage for a given criteria. In other cases we emphasize the trade-offs among various policy options. The discussion is summarized in a policy assessment matrix that evaluates each of the policy options on the basis of all criteria. The goal is not to recommend or advocate specific policy choices, but rather to provide clear analysis about the trade-offs involved in the design choices that policymakers face.

The final section distills the key lessons from the preceding analysis into a set of guidelines for policy design. This set of design principles serves as a summary of best practices for policymakers, providing grounded and practical insight into "what works." We divide the principles into two categories: general principles that will apply to any emissions pricing policy, and principles for choosing the pricing policy. In general, we recommend that when designing climate policy for Canada policymakers should:

- create an economy-wide program with marginal prices equalized;
- foster a consistent price signal over time;
- use revenues wisely;
- avoid policies that create entrenched political interests;
- auctions allowances
- set clear rules; and
- remain neutral toward specific technologies.

Five further principles should guide the choice of pricing instrument. In choosing between taxes and cap-and-trade, policymakers must:

- decide whether the priority is near- or long-term objectives;
- determine the trade-off between price and emissions certainty;
- consider the institutional environment;
- consider the domestic political constraints; and
- consider the international environment.

These design principles can assist Canadian policymakers in establishing policies now that will be efficient and effective, while remaining robust and flexible into the future as Canada strives to meet the long-term challenges of climate change.

2 BACKGROUND ON CARBON TAXES AND CAP-AND-TRADE

Carbon taxes and cap-and-trade both are incentive-based approaches to reducing greenhouse gas (GHG) emissions.[1] Economists favor incentive-based regulation because it can achieve desired outcomes at lower costs to society than traditional command-and-control regulation. Carbon taxes or cap-and-trade programs work by placing a price on greenhouse gas emissions, creating an incentive to reduce emissions. Both are efficient regulatory tools because they equalize the marginal cost of abatement across all emissions sources. This allows those sources that can reduce emissions most cheaply to engage in relatively more abatement, lowering net societal costs. In this sense, they are fundamentally similar.

2.1 Basic description

There are also differences. Chiefly, in their "pure" forms, carbon taxes provide certainty about marginal abatement costs but leave emissions uncertain, while cap-and-trade programs provide certainty about the ultimate level of emissions but allow uncertainty over the price of emission allowances. In this sense a carbon tax could be called a "price-setting" policy while cap-and-trade could be referred to as a "quantity-setting" policy. Note however that both are price-based approaches in the sense that they work by placing a price on emissions. The basic implementation features of the two approaches are discussed below.

2.1.1 Carbon tax

A carbon tax sets a per-unit charge on emissions. Typically the system involves a tax on fuels that emit carbon dioxide when burned and on other greenhouse gas emissions. A schedule for future tax rates would be established, eliminating price uncertainty and sending a long-term price signal to the economy. The tax thus provides price certainty, but leaves the annual level of emissions reductions uncertain (depending on how the market responds to the price). Critical design issues for a carbon tax include how the revenue from the tax is recycled by government, and the point of application of the tax.

2.1.2 Cap-and-trade system

A tradable allowance (commonly called "cap-and-trade") system involves setting the allowable level of emissions by issuing emission permits (allowances). If individual emitters produce more emissions that they have permits, they can purchase additional permits. Government can fix the level of emissions by choosing the number of permits to issue, but the price of permits will be set by the market and is thus uncertain. Critical design issues for an emissions trading system parallel those of the tax: the mechanism for the allocation of permits – auctioned or given freely? – and the point of application of the cap.

2.2 Instrument choice

There has been much work among academic economists to lay out the theory of instrument choice, going back to Weitzman's seminal discussion of setting prices versus quantities (1974). Weitzman showed that if 1) the marginal benefits curve for abatement is relatively flat and 2) the costs of abatement are uncertain, then a price policy target (i.e., tax) is more efficient. This has generally been understood to be the case for greenhouse gas emissions – carbon dioxide

[1] This report uses the common term "carbon tax" throughout to refer to what would actually be a carbon-equivalent tax on all greenhouse gas emissions.

accumulates in the atmosphere and remains for long periods, meaning that the benefit of reducing a ton of emissions now is roughly the same as reducing a ton next year, or the year after. Because the ultimate environmental impacts from GHG emissions depend on the cumulative level of emissions over many years, limiting emissions to a specific level in any individual year is relatively unimportant. What matters is achieving substantive cumulative reductions over longer periods. Further, economists since Pigou have recognized that externalities such as pollution should be priced at their marginal external cost. If the external costs of GHG emissions (a warmer world, more variable weather, etc.) remain relatively constant on a per-unit basis, as we suspect, then it is inefficient to allow prices to fluctuate significantly year to year. The general consensus from economists is that price-setting instruments – that is, taxes – are more efficient than quantity instruments (emissions trading) when attempting to regulate long-lived stock pollutants such as GHGs (Newell and Pizer 2003).

Another vein in the economics literature discusses which instrument might induce more innovation and technological change (see, e.g., Fischer, Parry and Pizer 2003). A carbon tax ensures a consistent price for the uptake of new abatement technologies. Under a cap-and-trade program, innovations that lower the cost of emissions abatement allow the permit price to fall, which has two effects. On the one hand, to the extent the innovating firm has to buy allowances to cover its liability, it has an additional incentive to innovate. But on the other hand, for an innovator seeking to license and sell the technology to other regulated firms, the lower permit price reduces their willingness to pay to reduce their abatement costs, since purchasing allowances becomes a cheaper compliance option. Of course, most innovations might not be sufficiently broad-based or pathbreaking as to have a significant impact on a carbon price that is determined in a large, multi-sector market. Furthermore, many innovations are created by parties other than the regulated entities; these third parties are unlikely to benefit from a fall in the permit price. For these reasons, the carbon tax may offer stronger innovation incentives. However, to the extent that either policy will be adjusted over the long run, the incentives become very similar.

The choice of taxes or cap-and-trade also has implications for investment. Achieving significant cuts in emissions will eventually require large capital investments in long-lived infrastructure, particularly in the energy sector. Taxes provide greater certainty about future prices, and hence the value of emission-reducing investments, while future prices are uncertain in cap-and-trade systems. This uncertainty can cause firms to delay investment decisions, as there is an option value in delaying investment in order to get more information in the future about the likely range of prices (Abel *et al.* 1996). On the other hand, without the possibility of higher-than-expected prices, there is little incentive to invest in higher-cost backstop technologies. Cap-and-trade (without a safety valve) allows these possibilities, but so would a carbon tax over the longer term if markets expect the tax rate to be adjusted to meet cumulative emissions targets. The main difference then appears to be the effects of price volatility within periods.

There is thus a general trend in the economics literature to favor emission taxes over cap-and-trade systems on the grounds of economic efficiency. Recent commentary, however, has pointed out some of the drawbacks of carbon taxes: initial political resistance, the potential political difficulty of ratcheting up tax rates to achieve emissions reduction targets, or the inability to engage in international emissions trading markets may reduce – or even overturn – the case for taxes as the policy of choice (Parry and Pizer 2007a). Weitzman (2008) discusses the possibility of catastrophic damages from climate change and demonstrates that low-probability, high-impact events could dominate the cost-benefit calculation for reducing emissions. If climate change damages are non-linear – if the marginal benefits curve is not in flat – then policies that cap emissions may be preferred. However, given the uncertainty about the shape of the marginal benefits curve – when do damages become non-linear? – there is still the problem of where to set the cap.

In practice it is not entirely correct to make a sharp distinction between tax and cap-and-trade systems. Economists have proposed combining price and quantity regulation by first creating a cap-and-trade system but then selling additional permits if price rose above a fixed trigger point (Roberts and Spence 1974). This approach – commonly called a price ceiling or "safety valve" – blurs the distinction between cap-and-trade and taxes. (For example, a tight cap on emissions combined with a low price ceiling would essentially be a carbon tax.) Adding this price mechanism to a cap-and-trade program can increase the efficiency of quantity controls (Pizer 2002). There are a variety of other flexibility mechanisms that may make cap-and-trade behave more like taxes, such as banking and borrowing of permits. Further, taxes can also be modified – though perhaps to a smaller degree than cap-and-trade – so as to try to meet quantitative emissions targets. Finally, carbon taxes and cap-and-trade can be used together (Fischer et al. 2008).

2.3 Blending elements of both systems

In the real world it is unlikely that regulators will choose purely price or quantity controls for greenhouse gas emissions. The Canadian government has proposed specific targets for future reductions: 20% below current levels by 2020, and 60-70% below current levels by 2050 (Government of Canada 2008a). This implies that some degree of emissions certainty is desired, and a carbon tax set without regard to emissions levels is unlikely. The current proposal in fact would implement a cap-and-trade system, but one with significant flexibility mechanisms: caps in the early years are based on intensity (rather than absolute) targets, and the program includes a payment to a technology fund that functions like a price ceiling for the first several years (Government of Canada 2008b). Whether the current government's specific proposals are implemented in the end or not, the ultimate emissions pricing policy will likely try to strike a balance between price and emissions certainty. The discussion below highlights some of the ways that elements of taxes or cap-and-trade can be blended to achieve this balance.

2.3.1 Time flexibility mechanisms: banking and borrowing of permits

Allowing firms to bank and borrow permits across compliance periods provides intertemporal flexibility and prevents permit prices from being driven by year-to-year fluctuations in unrelated factors (e.g., weather, economic growth). In theory, given perfect foresight and an unlimited ability to bank or borrow, firms could equalize marginal abatement costs across all time periods and achieve a maximally efficient outcome (for a chosen cumulative abatement level). Banking of permits is generally uncontroversial, as it encourages early reductions to save allowances for future times when the cap is more stringent. Borrowing could be more problematic, since it implies postponing reductions. It is conceivable that firms could borrow large volumes in the near-term and then prove unable to make reductions in the future – essentially defaulting on their emissions debt. Alternately, a large borrowing deficit among many firms could increase political pressure to revise caps. The rationale for borrowing is the expectation that technological progress will drive down future abatement costs, making it sensible to shift some abatement from today to that future time. In practice, the timeline of emissions targets play a strong role in the need for time flexibility mechanisms: rather than allowing unlimited borrowing, policymakers can set targets that begin modestly and become more stringent over time – and more quickly than abatement costs are expected to fall – leaving banking the more relevant mechanism to smooth prices over time.

2.3.2 Price ceilings

As noted previously, a price ceiling (safety valve[2]) sets an upper limit on allowance prices. One of the key debates with a price ceiling is where it is set: should it be at a price well above expected permit prices, to protect against truly unforeseen costs? Or should it be set at a level where it is triggered frequently, and so behaves much more like a tax? A related question is whether emissions targets should be more ambitious in the presence of a price ceiling. Given that the price ceiling may allow emissions above the targeted cap in some compliance periods – those where marginal abatement costs are high and would otherwise rise about the ceiling – regulators may want to tighten the overall cap.

Price ceilings also have implications for capital investment. Under a cap-and-trade system there will be a probability distribution of future allowance prices with an expected value. A price ceiling removes a portion of the top end of this distribution, thus lowering the expected future price of allowances and the incentive to invest.

2.3.3 Price floors

A price floor sets a minimum price for allowances in a cap-and-trade system. One rationale for using a floor is to ensure that additional emissions reductions occur when it is relatively cheap to do so. Another rationale follows from the preceding discussion of investment incentives. A price floor can be combined with a price ceiling to maintain the same expected price for emissions allowances as would exist under a "pure" cap-and-trade without either mechanism. This maintains the same price incentive to invest, while at the same time limiting uncertainty about future prices and therefore avoiding some of the disincentive to new investment it causes. Finally, when implemented through reserve prices in allowance auctions, price floors allow governments to ensure they collect at least a certain level of revenue when selling off permits.

To implement a price floor in practice, one possibility is for the government to offer to buy back any allowances at a minimum price. Or a price floor can be implemented easily through incorporating a reserve price into allowance auctions. (This will be familiar to

[2] Although the term "safety valve" is widely used in the climate policy debate, we choose to use the more general term price ceiling. We do this partly because in America the term safety valve has acquired a pejorative connotation among many environmental advocates, who view the safety valve as an inherently low-price option for technically achieving compliance without reducing emissions to mandated levels. At the same time, we also avoid the term to reduce confusion, as in the European context the phrase safety valve has come to imply a very high price ceiling that would only be triggered under unusual (or dire) circumstances.

anyone who has bid on eBay before.) Indeed a reserve price is generally considered to be a standard element of well-designed auctions (see, e.g., Holt *et al.* 2007). Combining price ceilings and floors comes closest to directly mimicking an emissions tax. (Imagine narrowing the gap between a price floor and ceiling until the price converged.)

2.3.4 Quantity-limited reserves

Quantity-limited reserves are essentially institutionalized long-term borrowing by the government. In some regards they fall between firm-level borrowing and a price ceiling. The government brings some allowances forward from the relatively distant future and distributes them today. Given that this does not change the long-term picture – the extra allowances available now will be made up by tighter caps in the future – there is some question about whether this would have much effect on prices, as forward-looking firms may merely bank additional allowances.

There is also the question of whether the government's borrowing of distant future obligations will be viewed as credible. In practice it is very difficult for current legislators to "tie the hands" of future ones. Borrowing from the distant future, even in this institutional manner, may increase the likelihood that future caps are modified (or abandoned) by subsequent governments. And in much the same way as with firm-level borrowing, this credibility problem could prove self-fulfilling: if firms suspect that future governments will raise the caps (perhaps by disregarding earlier borrowing), they will be inclined to purchase "too many" of the extra allowances. This would lower allowance prices now, resulting in less emissions abatement now and, in the future, more political pressure for looser caps. Limiting the quantity of allowances borrowed helps limit the scope of this problem, but cannot entirely eliminate it.

2.3.5 Triggered mechanisms

There are a variety of triggered mechanisms that could be designed to kick in if allowance prices moved outside of a defined range. For example, if prices were low the emissions cap could decline more quickly over subsequent trading periods, while if prices were high the cap could stop declining or increase. Alternately, mechanisms might allow new categories of activity in response to permit prices: a period of high prices might allow firms to use more (or new categories of) offsets for meeting compliance obligations, or to increase the number of permits they borrow (assuming there were limits on these activities in the first place).

There is some concern, however, that many of these triggered mechanisms may be coarse or clumsy. How frequently will the system switch between the "normal" and "relief" regimes? Annual adjustments to the cap level might not come quickly enough to relieve significant price pressure. (Imagine a situation where triggered mechanisms were used rather than borrowing, and firms were stuck in a period of high prices until the relief mechanism was applied.) Many of these triggered mechanisms are inherently non-continuous in their design (they are either on or off). It is not difficult to imagine the system switching back and forth in each period between high prices and relief. Further, such mechanisms may increase the likelihood of gaming or odd focal effects; for example, setting a trigger might create market expectations that this is approximately where regulators expect the price to be. Or if the system is close to a trigger price, some actors might attempt to bid up prices in order trigger the system into relief mode in the subsequent period.

2.3.6 Intensity (rather than absolute) caps

Quantity-setting regulation such as cap-and-trade does not have to set absolute caps. Caps can also be indexed to the level of economic activity (or output) in a regulated sector. Such policies limit the emissions-intensity of economic activity; the aggregate level of emissions is determined by where the intensity target is set and the extent of output. An indexed cap-and-trade program will have features of both price- and quantity-setting policies. On the one had prices can still vary much more than under a tax policy, but there is greater flexibility in the total quantity of emissions than under a traditional cap-and-trade approach. Newell and Pizer (2006) demonstrate that while taxes are more economically efficient for regulating GHG emissions than either quantity-setting approach, whether indexed caps or fixed-quantity caps are more economically efficient is an empirical question. For many countries (including Canada), they show that indexed quantities are likely preferable to pure quantity caps.

In practice, an indexed cap can be set by establishing a target for how the emissions intensity of economic activity will decline over time, and then multiplying this target by the level of activity in each period (e.g., GDP). Alternately, tradable performance standards – requirements that sources meet or exceed an established emissions rate, with those sources that exceed the standard allowed to trade emissions with those that do not achieve it – can be established for certain sectors (or across the economy) and these function as an indexed target. However, if the policy goal is to achieve a specific emissions target, indexed (or rate-based) approaches will be inefficient (Fischer 2001). Further, if an indexed system is linked to a system with an absolute target – whether across sectors or national borders – aggregate emissions will rise (Fischer 2003).

2.3.7 Adjusting taxes

Carbon taxes can also be modified to give them a degree of control over emissions level, by adjusting tax rates periodically to achieve more (or fewer) emissions reductions. This could be done through periodic review of tax rates by legislators or bureaucracies. A carbon tax could also be designed to be self-adjusting, with the rate of increase (or decrease) linked to changes in emissions over time.

2.3.8 Independent oversight body

There have been proposals in the United States to create an independent oversight body – in the mold of modern central banks – which would oversee and intervene in pricing policy (Pizer 2008). In a cap-and-trade system this oversight body might be authorized to release more allowances into the market (either by enlarging the cap or by borrowing from the future). Or within a carbon tax system such a body might be charged with updating tax rates annually. In either case the goal might be to insulate decisions about climate policy from politicians. This proposal is not so much a mechanism as an institutional structure through which various policy mechanisms could be applied. One question here is whether intervention would be based more on rules or discretion.

Another question is whether the body would intervene to adjust prices or quantities. Proposals to date have typically separated the criteria for intervention from the intervention mechanism. For example, in the U.S. context, the oversight body was proposed to monitor a cap-and-trade system (quantities), but its criteria for intervention was based on allowance prices moving outside of an expected range. The permissible interventions, meanwhile, addressed the quantity of allowances, allowing more permits in from offsets or other activities. It is easy to imagine a converse mandate existing for an independent body overseeing a tax program. It would perhaps be charged with adjusting tax rates (prices) if emissions (quantities) were outside of expected ranges.

2.3.9 Combining taxes and cap-and-trade

Carbon taxes and cap-and-trade could also be adopted in tandem. For example, a downstream cap-and-trade system for major energy intensive producers and process emissions could be combined with an upstream tax to capture other fossil fuel use in the economy. A key question is the extent to which the application of the tax and cap would overlap. Would capped entities be exempt or not?

An important point is that with a cap, emissions are fixed and the price is self adjusting. To the extent the tax induces reductions in the sectors covered by the cap, the allowance price will fall. At the limit, the tax would serve as a price floor for reductions (as the allowance price cannot fall below zero if emissions fall below the cap). This is this only case in which the tax induces additional reductions from sectors covered by the cap. Another function of the tax can be to serve as a guaranteed source of revenue for the government; if it overlaps a cap for which allowances are freely allocated, the tax recaptures some of that value (Fischer, Hanson, and Pizer 2008).

Another dimension for combining the policies might be over time. A carbon tax plan could be initiated in the near future and a cap-and-trade program layered on top in the future.

Perhaps the most likely dimension of overlap is jurisdictional. Already some provinces are implementing a carbon tax while others are planning cap-and-trade regimes. If both layers of policies remain in place, different interactions will occur. If the Federal government chooses a cap that is more stringent than the provincial policies combined, it will determine national emissions, while provincial policies may influence the distribution of those emissions. For example, a province with a carbon tax will have higher overall carbon prices, and this additional abatement will allow other provinces to engage in less abatement to meet the national cap. On the other hand, if the Federal government chooses a carbon tax, for provinces with a cap, the provincial emissions price will lose value by the amount of the Federal emissions price and represent the additional cost of meeting the provincial cap. A provincial carbon tax will behave additively with a Federal tax and generate additional reductions, unless there is an “equivalency” agreement between the Federal and provincial governments that the region with the higher tax rate will collect only the marginal difference between the taxes (e.g., a Federal carbon tax is set higher than a provincial tax, and the Federal government collects only the additional tax increment).

Given all the options for blending features of carbon taxes and emissions permits, in choosing these features, an important question is whether annual quantity or price targets are more appropriate for climate policy. Over the long run, a cumulative quantity target is necessary to stabilize concentrations, but the timing of those emissions is less important. Efficient policy requires not only equalizing marginal abatement costs across firms and sectors (as with these price-based market mechanisms), but also equalizing them over time in present value terms.

2.4 Allocating allowances (or tax revenues)

As noted earlier, one of the most important decisions facing regulators who are designing emissions pricing policy is what to do with the funds raised by putting a price on emissions. This is obvious in a tax system: how will collected tax revenues be used? Cap-and-trade programs are fundamentally similar. Placing a limit on emissions makes the emission allowances an economically valuable input to production, and thus allowance allocation is a question of how valuable resources will be distributed.

This question is important because revenues can be used to enhance the economic efficiency and environmental effectiveness of policy. On the other hand, revenues can also be squandered, or even used counter-productively. Some of the most valuable uses of revenue include:

- **Offsetting other taxes** – A revenue-neutral carbon tax or cap-and-trade program uses the funds raised by carbon pricing to reduce other distortionary taxes on labor or capital to reap a "double dividend" (both a reduction in emissions and a reduction in the deadweight loss from taxes). Economic research generally shows that using revenues to lower other taxes reduces the economic costs of climate policy (the weak version of the double dividend hypothesis) but does not typically make the costs of policy negative (i.e., the strong version of the double dividend hypothesis). Research also typically shows that reductions in capital taxes lowers the costs of policy more than reductions in taxes on labor, consistent with the wisdom that capital taxes are more distortionary (Rivers and Sawyer 2008).
- **Funding research and development** – Research on innovation and technological change finds that there are positive spillovers from innovation. Patents allow innovators to capture a portion of the value of new technologies, but research shows that social returns to research and development are two to four times higher than private returns (Jones and Williams 1998). This means that private firms lack the incentive to invest in the socially optimal level of R&D. Given that technology will be one of the long-term of the drivers of the cost and success of climate policy, revenues used to fund technology and energy R&D should produce net social benefits. Note that research shows that the market failure in innovation is in basic and applied research; on the other hand, technology demonstration and deployment projects, while politically popular targets for technology support, generally do not suffer from this knowledge spillover, and so the social return to demonstration and deployment is not usually as high (Newell 2007a).
- **Addressing distributional impacts** – Climate policy will be regressive. Low-income households spend a larger portion of their budget on energy, and any effective carbon pricing policy will raise the cost of energy for consumers. Revenues can used to reduce

(or even eliminate) the regressivity of climate policy (Metcalf 2007). Further, climate policy will have disproportionate impacts on some economic sectors. Giving away revenues (or allowances) to these sectors can "make companies whole". This can usually be done with a small fraction of total revenues (or allowances), around 10-15% (Morgenstern *et al.* 2007). These revenues (or allocations) can also be done in a way that minimizes emissions leakage (the tendency of economic activity and emissions to move from regulated to unregulated regions), as discussed below. Using revenues to mitigate distributional impacts – whether for consumers or firms – will also likely help maintain political support for climate policy. Note however that there are frequently trade-offs between using revenues to maximize the efficiency of the program and using them to address distributional impacts, e.g., using revenues to effect progressive changes in income taxes may be less efficient but more equitable than reducing capital taxes.

In practice when allocating allowances in a cap-and-trade system there is a straightforward decision tree that elucidates the major allocation options. This is depicted in Figure 1 and discussed in greater detail below. These decisions also have analogues in a tax system, mentioned in each point.

The first decision is what portion of allowances will be auctioned to raise revenue and what portion will be distributed freely.

- **Auctions** – Auctioning allowances raises revenue for the government (as do taxes, conventionally). The major remaining decision is then how to use revenues.
- **Free allocation** – Free allowances can be given to either regulated or unregulated entities. (The second option is less common in cap-and-trade programs to date but has been included in some U.S. legislative proposals.) In a tax system the comparable policy to free allocation to regulated entities is a tax rebate or refund. Note that generally as long as these free allocations (or refunds) are lump-sum distributions, the marginal incentive to reduce emissions remains the same; the free allocation has distributional consequences, but not first-order impacts on economic efficiency.[3] If allowances (or tax revenues) are given to unregulated entities then the door is wide-open: policymakers can choose to distribute revenues in any way they see fit. (In most respects giving free allocation to unregulated entities is no different than auctioning allowances and then choosing to give the revenues to these same entities.) If given to regulated entities, however, there are several options for how to distribute them. The remainder of our discussion focuses here.

The second decision concerns how to distribute free allowances to regulated entities. Should allocation be based on historical or recent information?

  - **Grandfathering** – Allocation is based on a regulated entities' share of some historical metric such as emissions or output in a defined base year period. In a tax this is a lump-sum refund based on an established historical metric.

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[3] This is not always the case, however, most notably in some regulated energy markets. For example, if electricity rates are set by cost-of-service regulation, the cost savings to the utility from any free allowances (or tax refunds) will be passed on to consumers. This means that consumers will not be exposed to the marginal opportunity cost of their emissions-producing activity, lowering the incentive to conserve and reducing the overall efficiency of the program. (Paul, Burtraw, and Palmer 2008)

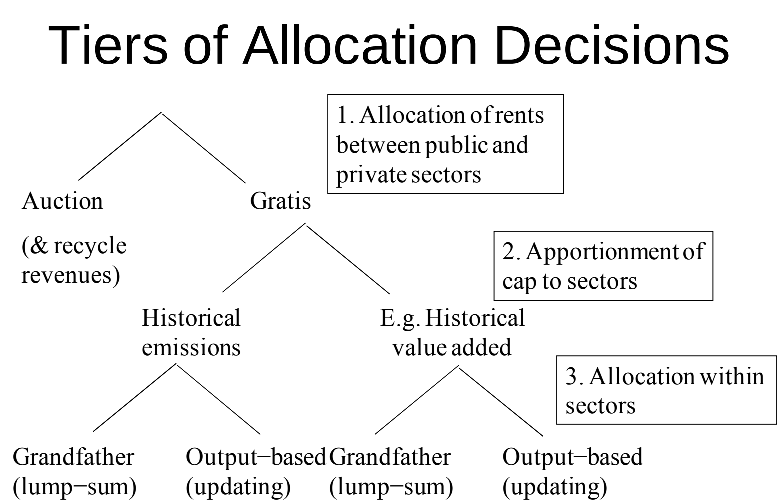
- **Updating allocation** – Rather than basing allocation on a historical period, a recent period of time is used to calculate the share of allowances each regulated entity receives (or the amount of tax refund). This is often based on output. Thus, for example, each year allocation would be based on an entity's share of the total sector-wide output in the last three years. Updating allocations act as a subsidy (to output, in the illustration here), as they provide something of value (allowances) in response to increasing activity (output). This may be desirable in trade-exposed industries that may be subject to offshoring and emissions leakage. But policymakers should remember that by subsidizing emissions-producing activity, updating allocations lower the efficiency of a climate policy.

The final decision concerns which metric should be used to determine the share of allocation. Should it be based on emissions or some other measure of output (or input)?

- **Emissions** – Allocation is based on a regulated entities' share of emissions. Grandfathered allowances have traditionally been based on historical emissions.
- **Output (or input) metrics** – Allocation is based on output (e.g., value-added) or perhaps on an input (such as employment). This approach is proposed more often when considering updating allocations.

Note that these second and third decisions – the basis and metric for distributing free allowances to regulated entities – can be made in either order, and can be resolved differently for different sectors of the economy. This is illustrated in Figure 1. Observe that once some allowances are set aside to be given away, there is typically a decision made about how to apportion allowances among economic sectors, and then a subsequent decision about distributing allowances among firms within each sector.

Figure 1: Allocating allowances (or tax revenues)



The total value of allowances (or tax revenues) in a Canadian carbon pricing system will be very large, likely tens of billions of dollars each year, and the way these revenues are used will have large implications for the efficiency and distributional impacts of a program.

2.5 Summary of pricing policy choice

As can be seen from this discussion, suggestions for blending price and quantity regulation have become so numerous that in many ways it is no longer helpful to think of taxes vs. cap-and-trade as a sharp dichotomy. Rather, they represent two ends of a spectrum, with trade-offs between price and emissions certainty as you move from one to the other.

This means that it is far too simple to think "taxes good, cap-and-trade bad" – or vice versa – when evaluating policies. (For example, a carbon tax that exempted major emitting sectors, causing economic inefficiencies and distortions, and whose revenue was squandered by the government would be very bad policy.) What matters most for legislators is crafting well-designed policy.

This is not to say that instrument choice is unimportant. As noted in this section, a consistent insight from the economics literature is that price-setting approaches – either taxes or cap-and-trade with flexibility mechanisms – are typically more economically efficient for reducing emissions. This efficiency is valuable not only because it will reduce the net social costs of achieving reductions, but also because, by reducing these costs, it can help maintain long-term political support for emissions reductions. But economic efficiency is not the only metric for successful policy. Regulators will have numerous priorities – economic efficiency being one, but environmental effectiveness and distributional consequences certainly also important among others – when crafting climate policy. In the next section we move to a series of questions designed to help regulators think about these priorities and the options for meeting them.

3 QUESTIONS TO GUIDE POLICYMAKERS

We now turn to a discussion of the questions that policymakers face when designing emissions pricing policy. The first two questions apply regardless of which policy instrument is chosen, although instrument choice may affect how those fundamental decisions are implemented. The remaining questions may help guide which instrument is preferred.

3.1 Who is covered?

This question includes three key components:

- **Point of regulation** – Carbon taxes and cap-and-trade programs can be implemented at any point in the fossil fuel supply chain. This is because the carbon content of fossil fuels is known, and so the eventual emissions can be calculated on the basis of standard emissions factors.
    - **Upstream** – The point of compliance can be where fossil fuels are extracted, processed, or distributed.
    - **Downstream** – Or the point of compliance be downstream at the point of combustion.
    - **Hybrid** – These approaches can also be blended. For example, oil could be regulated upstream (at the refinery) while coal was regulated downstream (at electric generating facilities).

  In general it is thought that emissions coverage is maximized (and administrative complexity minimized) when an upstream point of regulation is used. Frequently there are fewer actors who have to be regulated in order achieve coverage of all emissions (although this is an empirical question and is not necessarily the case). A related argument for upstream regulation is that as a policy it makes coverage of all emissions the default option, and this may make it harder for specific sectors to lobby for exemptions. Downstream regulation, on the other hand, may be more prone to political rent-seeking as some sectors try to argue that climate policy is particularly burdensome or just administratively unworkable in their sector. Downstream regulation is often required as a practical matter, however, for some greenhouse gas emissions, particularly those that arise from activities other than fossil-fuel combustion (e.g., process emissions from manufacturing).

- **Scope** – A related question is the extent of coverage. In order to maximize efficiency, legislators should aim to include as many sources of emissions as possible within the pricing policy. Broader coverage results in greater emissions reductions at lower price, since it implies more opportunities for cost-effective reductions. Broad coverage also reduces leakage (the tendency for emissions to shift over time to sources not covered by the policy), and prevents economic distortions caused by emissions being priced in some sectors but not in others. This last point is particularly important when the policy aims to achieve deep cuts in emissions over long time periods. If certain sectors face a much lower (or no) price for emissions, then an inefficient portion of economic activity – and emissions – will shift into these sectors over time, making it more expensive and difficult to achieve long-term emissions reduction goals.

- **Offsets** – Offsets are in some ways an extension of the scope discussion. They allow emissions reductions outside of a regulated system to ‘off-set’ emissions-reduction requirements inside the system. Although most commonly associated with cap-and-trade proposals, offsets can also be used under a mandatory emission tax as a way to offset the tax. Offset credits would reduce the tax liability of sources (as well as tax revenues to the government). Offsets can be a valuable addition to regulatory programs because they expand the available pool of emissions reductions, presumably to include more low-cost options in sectors of the economy that are not regulated or across a wider geographical area. In Canada, representative offset project types might include upstream fugitive emissions in the energy-production, as from oil and natural gas wells, or biological sequestration in forests and soils.

  Offsets come with a fundamental tension, however: How can the quality of offsets be assured at a low cost? Performance criteria commonly applied to offsets require that emissions reductions are real, additional, and permanent. That is, offsets should be credited only to activities that actually reduce emissions, are additional to what would have happened anyway, and do not merely shift emissions to another time or place. Ensuring that this is the case requires measurement, monitoring, and verification procedures – and determining counterfactual baseline emissions. Ideally, such procedures would verify high-quality offsets while remaining transparent, streamlined, and administratively simple. In reality, there are trade-offs between ensuring environmental integrity and minimizing transaction costs. Biological sequestration projects, for example, frequently raise concerns about what activities are genuinely additional, and the permanence of reductions, since the carbon could still be released later.

  While either a tax or cap can link to offsets, the effect of non-additional offsets has subtle differences in the two regimes. With a cap-and-trade system, offsets are used in lieu of reductions, meaning additionality problems effectively expand the cap. With a carbon tax, offsets reduce tax payments, meaning that revenues are inefficiently foregone, but incentives to engage in domestic emissions reductions remain intact, since the price does not change.

  Decisions about whether to include offsets (or what types of projects to include) need to consider broader program goals. For example, policymakers may desire to include offsets for biological sequestration because it is likely that large numbers of offset credits could be generated at relatively low cost, thus keeping allowances prices low (or reducing the costs of compliance with a tax). On the other hand, if one of the goals of climate policy is to drive fundamental long-term change in the industrial and energy sectors, then allowing permit prices to stay low by using large numbers of biological sequestration reductions will likely hamper this change. Given existing uncertainties about baseline and permanence issues for some offset project types, it may be wise to consider a policy where a limited offset program is developed initially to certify projects that raise the fewest monitoring, measurement, and verification problems, and then new project types are included as methodologies are improved over time.

Note that the questions of point of regulation, scope, and offsets are essentially distinct from the question of instrument choice (with the caveat, noted above, that offsets do interact somewhat differently with a tax versus a cap). Legislators must make these fundamental choices about coverage regardless of the pricing policy used.

One further point about coverage warrants discussion. The tendency for institutions to be "sticky" suggests that decisions about these questions will last. Thus, once the point of regulation is set, it seems unlikely that it would change later on (absent major changes to the entire climate policy): a program that is initially downstream will likely remain there. Similarly, if certain sectors of the economy are excluded from a program early on, they are less likely to be included later. A policy could be designed that would gradually introduce carbon pricing to various sectors of the economy over time, and gradually work up to an economy-wide approach. The downside is that this leaves the door open for future political rent-seeking, as some sectors may lobby subsequent governments to continue to put off emissions pricing in their sector. This question of coverage is thus key for legislators, because its impact is likely to be as long-lived as the regulation.

The current Federal government proposal would establish a GHG cap-and-trade program that covered most industrial emissions, including: electricity generation, oil and gas (including oil sands, upstream oil and gas, natural gas pipelines, and petroleum refining), and major industrial sources such as cement, iron and steel, pulp and paper, and chemicals and fertilizers (among others). There would be a regulatory cut-off for *de minimis* sources. Together the covered sectors account for around 40% of Canada's GHG emissions (Environment Canada 2008).[4] The proposed framework would include offsets, both domestic and – to a limited extent – international projects. (Government of Canada 2008b)

3.2 What stakeholders have to be compensated?

Pricing emissions represents the creation of a huge public asset that needs to be allocated. Economists generally recommend collecting the value of this asset through a carbon tax or by auctioning allowances in a cap-and-trade system and then using these revenues to offset other, more distorting taxes in the economy (see section 2.4). Implicitly, this makes taxpayers the main recipients of compensation. However, other compensation goals may demand some use of the revenues.

For example, since energy price increases tend to be regressive, some part of the tax reform may be targeted to help low income groups. Certain sectors may be disproportionately affected by the climate policy, and judicious allocations can help offset stranded capital assets and lost competitiveness for trade-exposed industries that cannot pass on the costs. However, it is important to note that these losses tend to be a small share of emissions values and not necessarily proportional to emissions across sectors. Finally, the government is also a stakeholder that will incur increased energy costs and will likely need a portion of the revenue. Some proponents of free allocation voice concerns that additional revenues would be spent by government, rather than recycled to lower taxes; if a tax shift is not possible, a "citizen dividend"

[4] The major source of emissions that is uncovered is transportation, which accounts for about one-quarter of national emissions. The transportation sector will be covered by fuel efficiency standards. Other major sources of uncovered emissions are commercial and residential fuel use (10% of emissions) and agriculture (9%).

is an option to ensure that households benefit and not just the shareholders of industries with free allocations. Some complementary policies will legitimately require government spending, such as policies to retrain displaced workers, and to support technological and infrastructure development to bring down the cost of meeting emissions targets.

3.3 How to balance (and trade off between) price and emissions certainty?

As discussed previously, a variety of policy mechanisms are available to allow trade-offs between price and emissions certainty. Legislators must make some choice about balancing the tension between the two objectives.

One of the first questions facing legislators is the timeframe of targets. Firm near-term targets may require quantity approaches. If targets are long-term, or cumulative over long periods, then it may be possible to use price-setting approaches. For example, a carbon tax could be gradually adjusted to achieve a mid-century target, or a price ceiling could be used for a number of years before being phased out so as to ensure a long-term goal.

If carbon taxes are used to achieve medium- or long-term targets they will likely require adjustment over time. A schedule of self-adjusting taxes is one option: taxes would increase at a faster (slower) rate if emissions were above (below) targeted levels. Policymakers would have to cede some control, however, over the level of taxes (and certainty about tax rates). If carbon taxes are used without automatic adjustment, then either legislators or bureaucrats will have to hold the responsibility for periodically reviewing and updating rates (assuming still that there will be targeted reduction levels). Note that if tax rates must be adjusted to achieve a long-term target they lose some of their efficiency advantage relative to cap-and-trade, since there is a loss in certainty about long-term costs and the smoothness of the price path.

If cap-and-trade is used, what flexibility mechanisms will be employed? Does the government have specific targets (or international commitments) it is trying to meet? The current government's proposal uses indexed (rather than fixed) targets out to 2020, and employs a price ceiling (the technology fund payment) out to 2018 (Government of Canada 2008b). These are combined with a stated commitment to achieve a specific emissions level: 20% below current emissions by 2020.

In general flexibility mechanisms should be transparent and have clear rules. Insight from the economics literature – chiefly, that price-setting mechanisms are generally more efficient – should be kept in mind. These principles suggest that price floors and ceilings should be preferred to triggered mechanisms or vaguely-defined oversight bodies. Policymakers should recall that private markets will provide some flexibility mechanisms. For example, private markets offered a full range of risk-management products – hedges, options, futures, etc. – immediately upon the start of the European trading system. Governments should avoid creating rules that will impinge on the ability of private markets to manage this risk.

Another lesson from the EU experience is the importance of regular, freely accessible information about energy use and emissions performance. The price crash in 2006 occurred when participants finally realized emissions were going to be under the target. Had information been available to gauge industrial emissions in an ongoing fashion, prices would not have overshot dramatically in the first place.

3.4 Is linking to other systems a priority?

At this point, Europe has implemented a cap-and-trade system, and if the United States adopts climate policy in the near future, cap-and-trade is the likely choice. While both may allow offsets, such as through the Clean Development Mechanism (CDM), it is not clear whether linkage with other emissions trading programs is planned in the near term. Certainly the momentum in international negotiations is for linking up national (or supranational) allowance programs, rather than trying to implement and harmonize carbon taxes. Thus, if legislators place a priority on linkage with climate programs in other developed countries, this argues for cap-and-trade. Of course, Canada could still adopt a carbon tax, and then attempt to harmonize tax rates with prevailing allowance prices in the U.S. or Europe.[5] But international negotiations generally remain focused on emissions trading, and thus it appears that possibilities for linkage would be facilitated by establishing a cap-and-trade program.

Linkage could have significant consequences, both positive and negative. Furthermore, one can envision two types of linkage.

The first type of linkage is to offset markets, such as the CDM, which are project-based mechanisms, rather than cap-and-trade systems. Offsets, including international offsets, can be allowed with either a domestic tax or cap. To some extent, international offsets can link the Canadian system indirectly to other major programs, since competition for certified emissions reductions will pressure all emissions prices to come in line. However, this linkage is likely to be imperfect, given that the EU, U.S., and Canadian proposals all have limitations on the share of international offsets allowed for compliance. Transactions costs in these markets (particularly the CDM) also appear to be high. Finally, while offsets can offer low-cost emissions reduction opportunities, they suffer the problem of voluntary compliance mechanisms: it is difficult to know what emissions would have been in the absence of the project. Voluntary mechanisms will tend to over-allocate emissions reductions, since they attract investments that might have gone forward anyway (Fischer 2005).

There is general agreement that widespread opportunities exist for low-cost emission reductions in developing countries (Weyant and Hill 1999). The reason is that the energy- and carbon-efficiency of developing countries tends to be lower than in developed countries; there are fewer capital assets to be stranded by climate policy; and given rapid growth rates in countries like China, there are opportunities to place growth on a more sustainable path from the beginning. However, the current CDM market has been criticized for focusing mainly on short-term industrial gas reductions and failing to produce much lasting change in the energy sector (Wara and Victor 2008). Furthermore, it remains unclear how strongly developing countries will be

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[5] Given the apparent divergence between EU and U.S. officials on the urgency of emissions reductions, however, it is questionable whether emissions prices in the two regions will be equal in the near term. Current allowance prices in the EU ETS are above prices that are frequently mentioned in the U.S. legislative debates about proposals. If the EU and (potential) U.S. systems remain unlinked in the near term (perhaps to 2020) then Canada would probably be unable to harmonize tax rates with both partners.

engaged in international climate policy beyond 2012, and how or whether the CDM will be reformed.

The second form of linkage – allowing trade in allowances from other cap-and-trade systems in developed nations – is much easier to envision. Note that whether a country is a net seller or buyer of allowances under linkage depends on the relative stringencies of policies; in general there are gains to trade regardless of the position, but certain groups may be made worse off (Haites and Mullins 2001). In the absence of international trading, Canada looks likely to have higher prices on emissions than the U.S., assuming current proposals (or similar ones) are adopted in each country (NRTEE 2007 and EIA 2008). Since Canada has an open economy that is small relative to major potential trading partners like the U.S., the permit prices (and price volatility) of other linked programs will be imported to Canada. This suggests a trade-off between opportunities for lower cost reductions in other countries, and the ability to retain national control over setting emissions prices or levels. The prospect of full linkage with large markets such as the EU or U.S. also raises the potential for large capital flows, and these could be controversial (Victor, House and Joy 2005 and McKibbin et al. 1999). Finally, linkage (or lack of linkage) could influence perceptions about fairness (Pizer 2006). On the one hand if systems remain unlinked and prices are widely divergent (perhaps much higher in Canada than the U.S.) then there will likely be complaints about unequal commitments. (There would also be larger competitiveness concerns). On the other hand, if linked systems lead to a much greater share of reductions coming from one region than another (because of differences in marginal abatement costs), this may also drive complaints about an unfair sharing of reductions.

3.5 What institutions will manage?

In Canada, tax policy decisions are generally taken by Revenue Canada, while environmental regulation is governed by Environment Canada. Regardless of whether a carbon tax or cap-and-trade is adopted, both tax and environment agencies will likely be involved in climate policy, given that any realistic policy will raise some revenue for government, and will also be designed to achieve environmental outcomes that will have to be monitored. However, it is important to ask whether and how the choice of instrument and lead institution will affect the administrative burden, effectiveness, and flexibility of the program.

This consideration about the location of responsibility for implementing climate policy may be particularly important if different institutions will have different goals. For example, a tax agency may place priority on raising revenue, whereas the environment department may focus on environmental outcomes. (In this sense an alternate formulation may be, “Is the priority to raise revenue or reduce emissions?”) The institutional setting could have implications for the enforcement approach. Will agencies seek arbitration or litigation with violating firms? Will there be criminal penalties for non-compliance?

Importantly, the choice of institution could also affect the flexibility of the program. Policymakers will likely have to modify goals as more information about the pace and intensity of climate change becomes available. Will a government agency have authority to adjust a tax rate or cap level, or will these require new legislation? Achieving political consensus on new climate legislation can be costly and time-consuming. Will legislators be willing to delegate responsibility for decisions about setting targets – or tax rates – to bureaucrats?

Thus, the question is not whether the economically ideal carbon tax is preferred to quantity targets, but whether the best feasible carbon tax or the best implementable cap-and-trade system is better. Institutional and legal frameworks inform the feasibility aspect of this question, as does the political landscape.

3.6 What is the domestic political landscape?

Which policies are feasible given realistic constraints on domestic politics? The Federal government has proposed a cap-and-trade program as the centerpiece of its emissions mitigation policy (Government of Canada 2008a). The major opposition political party has proposed a revenue-neutral carbon tax as one of its central election platforms. British Columbia has implemented a carbon tax. Ontario is planning a cap-and-trade system. Several provinces are observers or participants in the Regional Greenhouse Gas Initiative (RGGI) or the Western Climate Initiative (WCI), both regional cap-and-trade systems initiated by states in the U.S.

Conventional political wisdom suggests that taxes are difficult to pass.[6] Though cap-and-trade does essentially the identical thing – it places a price on GHG emissions, which raises costs for consumers and industries – it does it less transparently. This may be a political advantage. And yet the experience in British Columbia suggests that carbon taxes can be passed when they are designed and marketed smartly: if they are revenue-neutral, accompanied by per capita rebates to compensate consumers, and explained clearly to the populace. Whether British Columbia can maintain political momentum for its carbon tax remains to be seen, and may serve as a useful test case for the policy space that is realistically open to Canadian legislators.

3.7 How will competitiveness concerns be addressed?

As a relatively small open economy, Canada may be concerned about the effects of carbon pricing on the competitiveness of its most trade-dependent sectors. Several potential remedies are available, some of which may vary depending on which instrument is chosen.

One way to avoid disproportionate effects on competitiveness is to keep the emissions price in line with that of other key trade partners; however, this tactic may delay significant action and require more dramatic abatement efforts in the future. Another is to exempt certain trade-sensitive industries – or apply a lower carbon price to them – but this would reduce the effectiveness of the climate policy and ultimately require greater abatement efforts elsewhere in the economy. A third way is to combine the emissions price with a policy to offset the cost differentials created by the higher fuel prices.

One of these options involves making adjustments at the border, requiring imported goods to pay for their unpriced emissions costs and/or relieving exports of their expected emissions costs. Since these policies amount to trade tariffs and subsidies, they are likely to be disciplined by WTO obligations. Legal scholars have differing opinions over whether border adjustments will pass muster in a dispute, but some methods seem likelier than others (see, e.g., Pauwelyn 2007;

[6] Certainly this is true in the United States, where currently it seems very unlikely that the national government could pass carbon tax legislation, while there is much broader support for cap-and-trade. However, other countries, such as Norway and Sweden, have found carbon taxes acceptable, although taxes generally are more accepted in Scandinavia.

Brewer 2008). For example, a border tax and export rebate probably could only be combined with an emissions tax, not a regulation. With a cap-and-trade system, one could possibly require imports to purchase allowances (something being considered in proposed legislation in the U.S.), but that requirement would be limited to the home country sector's net emissions permit liability. That is, the burden on imports should not exceed that on domestically produced like goods, and the extent to which permits are allocated freely, the import requirement would need to be reduced. Meanwhile, export rebates are less likely to be WTO compatible with a cap-and-trade system.

Another option for avoiding the diversion of production abroad is to mitigate the marginal cost increases at home through the judicious allocation of emissions allowances on an updating basis, so that additional production is incentivized with additional allowances. For example, allocations could be based on some performance standard (like average emissions or a best practice emissions rate) multiplied by a metric of output. As the allocation functions as a production subsidy, the methodology must be designed carefully so as to target sectors appropriately. Legally, however, the allocation (unless overly generous) is likely to be viewed as an integral component of the regulation, not as an actionable subsidy. Theoretically, one could also combine output-based rebating with an emissions tax, but the rebate might appear more obviously as a subsidy in the eyes of trade law.

3.8 What is the role of complementary policies?

Complementary policies will likely be adopted alongside an emissions pricing program. These could include funds for research and development, support for technology deployment, and perhaps sector-specific policies (such as building codes, vehicle and appliance efficiency standards or renewable energy mandates). The general point about such policies is that they can lower the total social cost of achieving emissions *if* they are used to remedy specific market failures.

One key insight to remember when using complementary policies alongside emissions pricing policy in covered sectors of the economy is the following: when combined with carbon taxes they allow you to achieve greater reductions at a given tax rate, whereas when paired with cap-and-trade systems the emissions reductions are the same but allowance prices are reduced (i.e., marginal abatement costs are reduced). However, to the extent either policy would be adjusted in the long run, these differences wane.

3.9 How will investment be encouraged?

Long-term climate policy will require nothing less than the fundamental transformation of the energy and industrial system. This will require massive capital investment over the next two generations. For example, a recent report from the International Energy Agency estimated that it would require $45 trillion (USD) in additional investment worldwide to cut global emissions levels by 50% by 2050 (IEA 2008).

As discussed in section 2.2, the choice of pricing policy instrument has implications for investment. At the margin, the price volatility in cap-and-trade programs creates incentives to delay investment.[7] Mechanisms that mitigate price volatility – without introducing significant regulatory uncertainty – can provide greater investment planning certainty for firms. If a price ceiling is used in a cap-and-trade program, it should be combined with a symmetric price floor, in order to maintain expected prices and hence the returns to investment. Investment can also be encouraged through the use of some of the emissions revenues. In addition to reducing aggregate economic costs, using revenues to reduce capital taxes can encourage investment throughout the economy. Targeted funds can also be used to support the deployment of specific technologies, although policymakers should remember that if these funds are not targeted at solving a market failure they may raise societal costs (Newell 2007b).

3.10 What will be the balance between Federal and provincial action?

The current political environment for climate policy in Canada has both the Federal and provincial governments moving forward with plans for climate policy, as discussed previously. Given progress by the provinces on climate policy, one of the features of the Federal program is "equivalency" – the idea that provincial plans must be at least as stringent as the Federal plan. This emphasis on equivalency, combined with the fact that Canadian provinces enjoy a greater degree of autonomy than in many federal systems (e.g., the United States), suggests that the Federal government may be unlikely to preempt provincial programs. It may therefore be instructive to look at Europe's experience with the Emissions Trading Scheme, where member states retained much of the decision-making power over mitigation policy.

One of the major defects of the EU Emission Trading Scheme in Phase 1 (2005-2007) was the decentralized approach to target-setting and allocation. Each country was allowed to establish its own cap for regulated entities and decide how allowances would be distributed. This led to over-allocation in many countries and the collapse of prices mid-way through Phase 1 when this was realized (Kruger, Oates, and Pizer 2007). Meanwhile, only a tiny fraction of allowances were auctioned; most were given freely to regulated entities – partially due to successful lobbying and/or regulatory capture at the country level – and this led to windfall profits, particularly in the electricity sector (Ellerman and Joskow 2008). It is relatively easy to imagine something similar occurring in a Canadian program that devolved responsibility to the provinces. At the very least it is important to think about the incentives that provinces may have if decisions about targets or revenue use are decentralized.

Problems with loose targets appear to have been resolved for Phase 2 of the ETS (2008-2012). Further, allocation will be centralized to a large degree in Phase 3 (2013-2020), with a large move towards auctioning allowances. Both of these are positive developments and suggest Europe is learning from early mistakes. If a Federal program in Canada devolves allowance allocation (or revenue use) to the provinces, can it structure provincial incentives so as to encourage the widespread use of auctions? Auctioning allowances may be particularly important to outcomes in some sectors, such as electricity generation, where in order to realize efficiency gains it is necessary that the impact of marginal emission prices are seen by end users.

[7] Although a tax policy that was subject to frequent revision might have enough regulatory uncertainty that it would create similar disincentives for investment. The impermanent status of the wind production credit in the U.S., even if it is always extended, is often cited as a barrier.

As discussed in section 2.3.9, separate pricing instruments can be used at the Federal and provincial levels. If the Federal government sets a nation-wide cap while certain provinces retain additional carbon taxes, the overall level of emissions will remain the same, but the distribution of reductions will be different than under a single program. Sources required to comply both with the cap and an additional carbon tax would reduce emissions further, while untaxed regions would have to engage in less abatement to meet the national goal. A similar problem could arise with overlapping carbon taxes, although in that case it is easy to imagine that the Federal government could allow harmonization by letting provinces keep their tax revenues, e.g., if the national government set a $50 per ton carbon tax, and British Columbia had its own $30 per ton tax, the Federal government could collect only the additional $20 marginal tax rate for emissions in British Columbia.

4 ASSESSING DESIGN ELEMENTS

We now turn to an assessment of the options for climate policy. The questions in the previous section were generally focused around an individual element of climate policy (e.g., the pricing instrument (tax or permits), scope, revenue use, or linkage). In some respects policymakers can disassemble climate policy into these constituent elements and consider the design options for each element individually.[8] The background discussion at the beginning of the paper and the preceding discussion of design questions illustrated the range of options available to policymakers for each element.

This section assesses the various design options for the main elements of climate policy: the pricing instrument, revenue use, coverage, the federal-provincial relationship, linkage, and competitiveness. We consider a representative range of policy options for each design element. The goal is not to be exhaustive, as this is not possible – earlier discussion has emphasized the essentially continuous trade-off that policymakers face between price and emissions certainty, and similarly continuous choices exist for issues such as revenue use (or allocation). The intent is to cover a range of options open to policymakers, focusing on likely design choices for the key elements of climate policy.

4.1 Assessment criteria

We assess each design element using six criteria: policy effectiveness, economic efficiency, distributional impact, political acceptability, governance and administration, and institutional robustness. Each of the criteria is defined here:

- **Policy effectiveness** – Does the policy option accomplish its objective? Most importantly, does it accomplish the environmental objective of reducing carbon emissions and lowering atmospheric concentrations of greenhouse gas emissions?
- **Economic efficiency** – Does the policy minimize total costs? Which policies are most cost-effective? This question is most directly tied to whether compliance costs are minimized under a given policy. It also considers the transaction costs involved in a policy and whether a policy can address other existing economic distortions or market failures (e.g., offsetting taxes, innovation spillovers).
- **Distributional impact** – Does a policy choice equitably distribute costs among producers and consumers? Does it create disproportionate impacts in certain sectors (e.g., trade-exposed industries)? Are there disproportionate regional cost impacts? Which design options minimize income effects on impacted groups?
- **Political acceptability** – Is the policy acceptable to stakeholders? Does it address the concerns of federal, provincial, and territorial governments? Does it address concerns from existing emitters about high short-run costs (e.g., stranded capital) and/or have a low share of the regulatory burden falling on regulated industries? Does it have public support, including from environmental NGOs?
- **Governance and administration** – Will government need to develop new expertise to implement new policies? What will be the interaction between federal and provincial

[8] Some elements remain linked, however, particularly given realistic constraints. For example, while in theory it may be possible to accomplish linkage with international systems under a tax policy, in reality the constraints of international negotiations may make it much easier under a cap-and-trade policy.

governments? Will the policy be easy or difficult to coordinate among government entities and across various levels of government?

- **Institutional robustness** – Is the policy flexible? Can it be adjusted over time and in response to new information? Does the policy reduce rent-seeking and avoid creating entrenched political interests?

4.2 Design elements

Our assessment focuses on six of the key design elements for carbon pricing policy and evaluates a few of the major options for each element:

- **Pricing policy instrument** – Will greenhouse gas emissions be priced through a tax or a permit system? What flexibility or "cost containment" mechanisms will be used to adjust the trade-off between price and emissions certainty? We primarily focus our discussion on a carbon tax, a cap-and-trade with a price ceiling, and a cap-and-trade with intertemporal flexibility (banking and borrowing of permits). Because our focus is on policies that achieve the current Canadian government's emissions goals – an inherent limitation on how uncertain emissions can be – we assume that price-setting policies like the tax or cap-and-trade with a ceiling are adjusted over time to at least come close to a long-term goal, and that a cap-and-trade system with banking and borrowing maintains a cumulative cap. However, we remind readers that the range of options for pricing policy is broad: regulators could choose a tax policy that is focused on raising revenue rather than achieving any specific emission reduction goals,[9] they could start with carbon taxes and transition to cap-and-trade, or they could incorporate other cost containment and flexibility mechanisms into a cap-and-trade program, such as a reserve of allowances (e.g., a quantity-limited price ceiling), or setting an intensity-based cap.
- **Revenue use/allocation** – Will allowances be given freely to regulated entities or will they be auctioned? Equivalently under a tax program, will tax revenues be rebated (or inframarginal emissions exempted), or revenues collected by the government?
- **Coverage** – Will the program be economy-wide and establish an equimarginal emissions price across all sources and gases? Or will there be a range of policies, perhaps sectoral in scope, that cover some (or even all) emission sources but result in differing emissions prices in various economic sectors? Further, will changes in biological sources of carbon emissions – forests and soils – be incorporated into the policy through an offsets program?
- **Federal-provincial relationship** – Will the emissions pricing policy consist of a comprehensive federal program (whether implemented through federal or provincial agencies) or will there be a number of provincial-level initiatives? Significantly, if there are a range of provincial programs will this mean a range of emissions prices? This question is germane given current policy dynamics in Canada, as the provinces are currently ahead of the national government in designing and implementing emissions pricing policies.
- **Linkage** – Will Canada link its emissions pricing policy to other programs internationally? We consider three options here: full linkage with an international system (as yet undeveloped), linkage with other major developed countries (e.g., the EU and presumably the United States), and a Canadian policy without linkage.

[9] The British Columbia carbon tax is a current example.

- **Competitiveness** – We consider three policy options for addressing emissions leakage and competitiveness concerns: a border tax adjustment (or equivalent border allowance requirement); a targeted free allocation (or use of tax revenues) to affected industries based on output; and a "no adjustment policy" option.

4.3 Assessment of policy options

The policy options for the six design elements we have highlighted are now evaluated on the basis of the assessment criteria. Our assessment consists of a qualitative discussion of the relative advantages and trade-offs among various policy options. The assessment is informed by the academic literature, by other examples of emissions pricing programs, and (to a limited degree) by our own judgment. We emphasize those areas where economic theory or research, or real-world experience, suggest that one policy option is strongly preferable to another for a given criteria. In cases where the preferred policy is more ambiguous, we attempt to highlight the trade-offs between various choices.

4.3.1 Pricing policy instrument

As discussed in section 2.2, a carbon tax is generally viewed as the most cost-effective approach to emissions reduction, as it provides maximal flexibility about where and when emissions occur, as appropriate for a global stock pollutant like carbon dioxide (and other GHGs). A cap-and-trade system, meanwhile, is viewed as being more focused on the environmental outcome (achieving specific reductions) and so would rank higher in policy effectiveness. Elements that trade-off price and emissions certainty – price ceilings and floors, or frequent adjustment of the tax rate to target specific reductions – will be more (less) economically efficient than the "pure" version of the policy, but provide less (more) certainty about environmental outcomes. Policymakers should remember, however, that either of these incentive-based approaches is far more economically efficient, and likely effective, than traditional prescriptive environmental regulation.

The choice of pricing instrument does not significantly alter the distributional impacts. Placing a price on emissions, and hence raising the price of energy, will generally be regressive, and it will have disproportionate impacts in some economic sectors. This is true regardless of the pricing instrument. The extent of distributional impact depends much more on other policy design elements, e.g., the target stringency, coverage, and competitiveness policy. Most significantly, revenue use (or allowance allocation) has large distributional consequences, discussed below.

The relative political acceptability of various pricing instruments is difficult to judge *ex ante*. Conventional wisdom says that carbon taxes are impossible, but this is only true until it is not. British Columbia has shown it can be done, particularly when done in a revenue-neutral fashion with rebates designed to reduce policy regressivity. At the national level the Liberal Party has proposed a similar carbon tax. On the other hand, much more current political momentum exists for cap-and-trade approaches: Ontario is moving forward with plans to introduce a provincial emissions trading scheme; several provinces are observers or participants in RGGI or WCI; and the current ruling government has proposed using the cap-and-trade approach in its climate policy.

Carbon taxes enjoy a couple of small advantages with respect to their ease of implementation by government. First, as British Columbia has demonstrated, carbon taxes can be set up and started relatively quickly. Experience in Europe with the Emission Trading Scheme suggests cap-and-trade systems take more time to set up and can experience some early kinks (Ellerman and Buchner 2007). Second, carbon taxes may require fewer other institutions to be formed. For example, governments may have to set up an auction format for allowances under cap-and-trade, or private sector institutions will need to arise (as in Europe) to trade allowances. This second difference may be quite small, as again the EU experience suggests these institutions can be formed relatively quickly and efficiently. In the medium and long term there are few differences between carbon taxes and cap-and-trade with respect to governance and administration. Both approaches must monitor and verify emissions, assess (tax or permit) liabilities, distribute revenues (or allowances), and enforce compliance.

Finally, these pricing policy instruments are all robust regulatory tools. Indeed, the efficiency and effectiveness of these policies (compared to traditional prescriptive regulation) can increase public support and make these policies durable. Both policies can be adjusted in response to new information over the relevant time-scales (years or decades). There are a couple of small differences between taxes and cap-and-trade that confer slight advantages to one or the other. First, some commentary notes that taxes may be less vulnerable to rent-seeking than cap-and-trade, particularly through the allocation of allowances.[10] Second, cap-and-trade systems can adjust almost instantaneously to new information. If firms expect caps to be tightened in the near future – perhaps because of new scientific information – they will begin banking allowances now in anticipation of tighter future caps, thus raising allowances prices and increasing abatement in the present.[11] In a similar situation under a carbon tax, on the other hand, firms would not change abatement actions until the carbon tax was adjusted by the government.

4.3.2 Revenue use/allowance allocation

Policies that raise revenues – taxes or auctioning allowances – and then use these revenues wisely have several economic advantages over policies that give allowances away freely (or rebate taxes). These policies can be more economically efficient, as the revenues they raise can be used to offset other distortionary taxes and thus mitigate the general equilibrium economic impacts of climate policy (see, e.g., Rivers and Sawyer 2008). For energy sectors in which retail rates are regulated, such as electricity, policies that raise revenue also ensure that the price signal on emissions is transmitted throughout

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[10] On the other hand, Parry and Pizer (2007b) note that if under a carbon tax the government excludes some firms or sectors in response to rent-seeking, the outcome will likely be less efficient than a cap-and-trade system with free allowances. Excluding some firms or sectors – thus shielding them from the carbon price – will produce economic distortions that will lower the efficiency of a program.

[11] This indeed occurred in the U.S. Acid Rain trading program around 2004. The current administration proposed new rules that would have tightened the cap, and allowance prices began rising immediately, about two years before the final rules were ultimately promulgated. (For a review of the legislative history see: http://www.epa.gov/cair/rule.html Allowance prices for SO_2 can be found at: http://www.pewclimate.org/node/5934)

the entire energy supply chain. For example, when electricity rates are set using average-cost pricing, firms that receive free allowances will be required to pass this savings on to consumers. This eliminates the emissions price signal to consumers, who then lack the appropriate marginal incentive to reduce energy use. Finally, as noted in section 2.2, policies that raise revenue can provide greater incentive for technological innovation (Fischer, Parry, and Pizer 2003).

Another major advantage of auctioning allowances (or collecting tax revenues) is that this minimizes opportunities for political rent-seeking. Systems that give permits away freely or rebate taxes must have rules to determine how these "assets" will be distributed. Given the enormous financial value at stake here – over $10 billion even with a relatively low marginal price of $20 per ton of CO_2 – there will undoubtedly be significant political lobbying from industry to secure favorable treatment.

Auctioning allowances will likely be administratively simpler. Although auctions do require the establishment of an institution and format to conduct auctions, free allocation requires the measurement, reporting, and verification of whichever metrics are ultimately used as the standard for distributing allowances. Auctions eliminate this need for detailed *ex ante* information about who "deserves" permits.

Decisions about revenue use have major distributional implications. Climate mitigation policy will be regressive, as energy expenditures consume a greater share of the budget in poor households. Tax or auction revenues can be used to ameliorate (or even eliminate) this regressivity, by making other portions of the tax code more progressive and/or providing other assistance such as per capita dividend checks or targeted funds for low-income energy consumers (Metcalf 2007; Rivers and Sawyer 2008). Climate policy will also have disproportionate impact on certain geographic regions or economic sectors. Revenues can be used directly, or free allocation can be used, to make industries "whole" or to compensate losers. Note that policymakers frequently face a trade-off between equity and efficiency when making these decisions: policies to address distributional consequences often come at the price of some cost-effectiveness. For example, free allocation to regulated electricity utilities will lower cost impacts on low-income energy consumers, but also lower the overall efficiency of a policy.

Revenue use has relatively smaller implications for the environmental outcomes, but revenues can be used to enhance policy effectiveness. Targeted free allocation can be used to minimize emissions leakage under climate policy (see section 4.3.6 below). Under a carbon tax program, wise revenue use can increase emissions mitigation. For example, investment in research and development can lower long-run marginal abatement costs and thus lead to greater emissions reductions at a given tax rate.

Revenue use poses trade-offs for political acceptability. Free allocation reduces the burden on regulated entities and so may reduce political resistance to regulation among emitters; on the other hand consumer and stakeholder groups will likely favor policies that reduce income taxes and/or provide rebates for energy purchases. These decisions can impact not just the acceptability of legislation as it is passed, but also the continuing support for climate policy. The extensive use of free allocation in the EU ETS led to large windfall profits for industry, particularly in the electricity sector as deregulated firms passed along the opportunity costs of allowances to consumers through higher energy prices (Ellerman and Joskow 2008). This led to much grumbling among consumers, and the political controversy led to proposed changes for the next phase of the ETS (European Commission 2008). The experience with implementing a carbon tax in British Columbia seems to be a more positive example. In this case the provincial government made clear that carbon tax revenues would be used to offset both income and capital taxes, and per capita dividend checks were sent to consumers up front to cushion the rise in energy prices.

4.3.3 Coverage

Policies that cover all economy-wide emissions will be more environmentally effective, economically efficient, and dynamically robust than programs that establish a set of separate sectoral caps, taxes, or other policies. Primarily this is because economy-wide programs can equalize marginal emissions prices across space and time and so generate the most reductions for a given price and minimize dynamic inefficiencies. On the other hand, it is likely that sectoral policies can more easily be "tuned" to address disproportionate sectoral impacts. Sectoral policies are often more politically acceptable to regulated entities, presumably because the alternative regulation is viewed by the industry as less burdensome than an economy-wide pricing policy. These sectoral approaches may raise greater concern over rent-seeking and regulatory capture, however.

The other major decision about coverage in an emissions pricing policy concerns the use of offsets (discussed in section 3.1). In theory offsets can enhance the effectiveness and efficiency of emissions pricing policy – if offsetting reductions in uncapped sectors are real, verifiable, and permanent. By covering sources that may not be amenable to including in a cap (perhaps because of problems with *ex ante* measurement), offset programs can extend opportunities for more and/or lower-cost emissions reductions. But in practice, the case for offsets may be overturned by uncertainties about their additionality, permanence, or the transaction costs for monitoring and verification (Wara and Victor 2008). For example, in the energy sector when considering upstream fugitive emissions from resource production, what is the baseline emissions rate? What reductions are additional? Much offset discussion in Canada centers on biological sequestration in forests and soils. How permanent are these reductions? What are the transaction costs for quantifying and monitoring sequestration? A variety of policy mechanisms can be used to control the number or type of offset projects allowed into a pricing program, including quantitative limits, set asides, trading ratios, and rental credits (Hall 2007). Such mechanisms can help ensure reduction commitments are met or exposure to offset risk (e.g., impermanence) is limited; the mechanisms will also place greater burdens on government agencies to establish and enforce offset rules. In the near-term regulators cannot escape the fact that offsets carry a trade-off between low-cost reductions and policy certainty.

4.3.4 Federal-provincial relationship

A comprehensive Federal program for pricing GHG emissions will likely be more environmentally effective and economically efficient, simpler to administer, and more robust over time. An economy-wide Federal program will equalize marginal emission prices. A unified system prevents coordination problems and a potential "race to the bottom" among provinces. (As noted in section 3.10, problems with over-allocation and windfall profits in the early years of the EU ETS were largely a function of the decentralized nature of the program.) A Federal program can avoid unnecessary duplication in bureaucracy. And Federal governments should be able to commit more credibly to long-term action, particularly internationally.

At the same time, provincial programs may be more responsive to addressing distributional impacts. They may be better posed to address the regressivity of policy on households. They may also be more likely to offer redress for disproportionately affected industries. (Although this could have downsides – if some provinces weaken requirements for certain sectors there could be problems with cross-provincial leakage.) Provinces currently appear to have a slight lead on the Federal government in taking action on climate policy, indicating that political support may be easier to secure at the provincial level. On the other hand, this lead may primarily be a function of the rather modest provincial goals; it could be much harder to win political support for ambitious – and costly – action, regardless the level of government.

4.3.5 Linkage

Canadian climate policy can be environmentally effective – in terms of achieving national goals for emissions reductions – with or without international linkage. Linkage with other national programs will improve global economic efficiency. There are always gains from trade (whether through allowances in a cap-and-trade system or perhaps with offsetting reductions under a tax system). There will, however, be distributional impacts from price changes. As noted previously, the emissions price (and volatility) of Canada's trading partners will likely dominate, as Canada is relatively small. This may be perceived as an advantage in terms of allowance prices, if prices in the U.S. or EU are below those that would prevail in a closed Canadian system. But if Canadian firms are buying large numbers of emissions reductions internationally then the volume of capital flows could become controversial. Recall that one of the major sources of enhanced efficiency from a global trading regime is the access to low-cost reductions in the developing world. If these are unavailable in the near-term – because of a lack of mandatory policy, or the difficulty of generating reductions from offsets – then linkage may be a lower priority.

Linkage can help address competitiveness issues. Particularly with major trading partners such as the U.S., it ensures that competitors face the same prices. Because linkage has impacts on permit prices and distributional and competitiveness effects, it also has implications for political acceptability. If linkage lowers prices and reduces competitiveness impacts it will almost certainly attract political support. If effects are more ambiguous – for example, competitiveness concerns are reduced but permit prices are higher or more volatile – then it is hard to know whether linkage will enhance political acceptability.

It is difficult to forecast the impact of linkage on policy robustness. Integration into an international trading system may solidify policy and help make it durable; on the other hand it reduces the ability of the national government to unilaterally adjust policy (e.g., to manage permit prices) and so it may reduce domestic political viability.

4.3.6 Competitiveness

One way to avoid disproportionate effects on competitiveness is implicitly addressed in the sectoral coverage section. Particularly trade-sensitive sectors could be given less stringent caps or lower carbon tax rates, or exempt altogether. These methods send different carbon price signals to different sectors, which reduces the efficiency of emissions pricing while it reduces leakage. More effective options would retain the consistent emissions price signal, but combine it with a separate policy to offset the cost differentials created by the higher fuel prices.

Border adjustment is one option, and we have discussed some of the legal challenges. Ideally, one would like to require imported goods to pay for their unpriced emissions costs. However, this option raises not only legal hurdles, as previously noted, but also administrative challenges. Calculating the emissions embodied in imports is difficult, from defining the product category and gathering emissions data to accounting for trade in intermediate goods and component parts. Somewhat simpler (and less discriminatory) is using domestic industry averages, but relatively clean trading partners may object, while relatively emissions intensive ones will still retain some cost advantage.

While import adjustments level the playing field between domestic production and imports, export rebates level the playing field between Canadian exports and production abroad. A recent study indicates that export rebates may be an even more important component of border adjustment for Canada (Fischer and Fox 2008). However, it is important to define the rebates in such a way as to retain the emissions price signal. Thus, rather than exempting exports, one could rebate the average value of emissions, based on a performance standard.

Another option for avoiding the diversion of production abroad is using an updating allowance allocation to incentivize production. For example, allocations could be based on some performance standard (like average emissions or a best practice emissions rate) multiplied by a metric of output. In this case, additional production is rewarded with additional allowances, which offsets some of the costs of the additional emissions liability. (The updating component is important, because with grandfathered permits, additional production does not change the allocation, so the allocation does not improve marginal costs.) Output-based allocation thus keeps product prices down, making exports more competitive and imports relatively less attractive, but the trade-off is that it also weakens the price signal for conservation as a means to reduce emissions. Therefore, while it might be helpful in certain trade-sensitive sectors, it can be highly counterproductive in others (like electricity generation or refining) that are major emitters with abundant opportunities for conservation by consumers and less exposure to trade competition. Another disadvantage is that it does not differentiate across countries based on their climate regimes; thus it would need to be phased out as most trading partners implement comparable emissions pricing strategies.

4.4 Policy assessment matrix

The table on the following pages summarizes the discussion of policy options.

Table 1: Policy Assessment Matrix

An asterisk indicates that a given design option has an advantage along the dimension in question.
It does not mean that other design options have no impact along a given dimension.

	Policy effectiveness (accomplish environmental objective)	Economic efficiency (cost-effectiveness)	Distributional impact (incl. by income, sectoral, regional)	Political acceptability (to regulated entities, households, stakeholders)	Governance and administration (ease of implementation)	Institutional robustness (flexibility over time)
Pricing policy instrument						
Carbon tax	Can be adjusted to achieve long-term target	*	Generally not applicable – depends much more on revenue use/allocation, target stringency, coverage, and competitiveness policy	If proposed as tax shift; implemented in BC, Norway, Sweden	*	Depends on overseeing institution
Cap-and-trade with price ceiling and floor	May need adjustment of future caps to achieve long-term goal	See below		Ceiling may appeal to industry; current Canadian government proposal; likely approach in U.S.	Same as below, but with management of trading band added	Depends on regulatory authority
Cap-and-trade (cumulative cap, intertemporal flexibility)	*	If markets robust and transaction costs low; markets shoulder burden of cost uncertainty		May be less transparent to taxpayers; used in EU ETS, RGGI, proposed for WCI, California	Experience in EU suggests cap-and-trade requires more lead time but once in place requirements are comparable	Depends on regulatory authority
Revenue use/allocation						
Free allocation/tax rebates	Some free allocation can reduce leakage	Maintains marginal incentive to reduce emissions but no opportunity for offsetting taxes	Targeted allocation can reduce impacts on specific industries or firms	Low share of burden falling on regulated entities	Depends on mechanism for allocation	May be difficult to remove/alter allocations
Auctioned/tax collected (revenue-neutral)	Use revenue to fund R&D (which could reduce emissions in a tax program)	* Improves efficiency of overall economy if distorting taxes reduced	Can be used to shift taxes and reduce regressivity of pricing program	Likely preference of households, ENGOs	* Must establish auction mechanism	*

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An asterisk indicates that a given design option has an advantage along the dimension in question.
It does not mean that other design options have no impact along a given dimension.

	Policy effectiveness (accomplish environmental objective)	Economic efficiency (cost-effectiveness)	Distributional impact (incl. by income, sectoral, regional)	Political acceptability (to regulated entities, households, stakeholders)	Governance and administration (ease of implementation)	Institutional robustness (flexibility over time)
Coverage						
Economy-wide (upstream)	*	* Requires inclusion of process emissions and storage options	*		* Fewest entities to regulate	*
Energy-intensive sectors (downstream)	*	Greater reductions and costs required from regulated sectors		More transparent to lay people	*	
Use of offsets	Concerns with offsets about monitoring, leakage, permanence	Can offer lower-cost reductions		*	Difficult to determine baselines and verify	
Separate sectoral caps/taxes	Requires more stringency from fewer sources	Different prices less efficient	*	*	Requires methodology to tailor policies; subject to lobbying pressure	May be difficult to adjust preferential treatments
Federal-provincial relationship						
Comprehensive federal program	*	*			*	*
Provincial-level initiatives (possibly aggregated up)			* Although concerns about cross-provincial leakage	*		

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An asterisk indicates that a given design option has an advantage along the dimension in question.
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<table>
<tr><th></th><th>Policy effectiveness (accomplish environmental objective)</th><th>Economic efficiency (cost-effectiveness)</th><th>Distributional impact (incl. by income, sectoral, regional)</th><th>Political acceptability (to regulated entities, households, stakeholders)</th><th>Governance and administration (ease of implementation)</th><th>Institutional robustness (flexibility over time)</th></tr>
<tr><td colspan="7">Linkage</td></tr>
<tr><td>Full linkage with international system</td><td>*</td><td>*</td><td rowspan="3">Depends on target stringency, relative prices and whether Canada buys or sells permits</td><td>If increases perceptions of fairness</td><td>Need to verify international allowances</td><td rowspan="3">More integration with int'l system may increase policy robustness but against this there will be loss in ability to set or adjust Canada's own emissions and/or price</td></tr>
<tr><td>Partial linkage (e.g., US and EU)</td><td>*</td><td>Gains from trade, but foreign price likely to dominate</td><td>Can reduce competitiveness concerns and hence enhance political viability</td><td></td></tr>
<tr><td>Canada-only policy</td><td>*</td><td></td><td>Most control over distributional outcomes, which may enhance political support</td><td>*</td></tr>
<tr><td colspan="7">Competitiveness</td></tr>
<tr><td>Border tax adjustment</td><td rowspan="2">Can reduce leakage and global emissions if competitors relatively dirty; depends on trade sensitivity and degree of adjustment / allocation</td><td></td><td>*</td><td>*</td><td>Difficult if based on other countries' data; similar to OBA if based on Canadian data; may be challenged in WTO</td><td rowspan="2">If genuinely reduces large competitiveness issues then may make policy more robust; on the other hand could lead to entrenched interests or stifle trade</td></tr>
<tr><td>Output-based allocation</td><td>Depends critically on design (see discussion in text)</td><td>*</td><td>*</td><td>*
If based on a metric that is already being measured</td></tr>
<tr><td>No adjustment policy</td><td></td><td></td><td></td><td></td><td>*</td><td>*</td></tr>
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5 DESIGN PRINCIPLES FOR CARBON PRICING POLICY

This final section draws on the lessons learned from the preceding analysis to provide a summary of the "best practices" for designing emissions pricing policy.

5.1 General principles

Create an economy-wide program with marginal prices equalized. Either pricing policy is superior to command-and-control in terms of cost-effectiveness, and also in terms of its ability to be flexible and robust over time (Goulder and Parry 2008). Broad-based pricing systems that cover as many sources of emissions as possible – and at the same carbon-equivalent price – will be most efficient and effective. In the near-term, they ensure that the incentive to reduce emissions is applied throughout the economy and this helps find all low-cost abatement options. In the long-term they prevent economic activity from being inefficiently shoved into unregulated sectors, as would happen if certain sectors were either uncapped or had lower (or were exempt from) carbon taxes. Ultimately, the broader the coverage, the less deep the policy needs to be; narrower policies will have to ask more of the covered sectors – and impose greater costs – to achieve the same reductions as a broad-based policy.

Foster a consistent price signal over time. Allowing efficient trade-offs in abatement over time is an important component of a cost-effective climate policy. For a carbon tax, this means a graduated schedule of increases over time. For cap-and-trade, a schedule of increasingly stringent targets should be combined with flexibility mechanisms like banking.

Use revenues wisely. Regardless of the pricing policy used, it will have the capability of raising large funds for government (whether in the form of tax revenues or allowance value). Better practices use some of the revenues to cover additional government costs and complementary programs, use the bulk of the revenues to offset payroll and capital taxes in the economy, with some attention paid to addressing the regressivity of energy price increases, and reserve a small share for targeted compensation in initial periods to sectors that cannot adjust quickly and pass along cost increases during that time.

Avoid policies that create entrenched political interests, such as tax exemptions, or free allocations that do not expire. Any policies intended to deal with emissions leakage should also be designed to phase out as trade partners regulate or price their emissions.

Auction allowances. This flows naturally from the two previous design principles, as it will raise revenues and help avoid creating a strong political coalition around free allowances. Auctioning allowances simplifies decisions about incorporating new entrants, as they face the same rules and incentives as incumbents. More broadly, well-designed auctions help allowance markets function, by aiding in price discovery and increasing liquidity (each permit sold at auction is a transacted permit).

Set clear rules. Climate policy will have wide-ranging impacts on the Canadian economy. The temptation for legislators is to create special rules or complicated provisions that attempt to mitigate many of these impacts. But labyrinthine legislation will be more prone to political rent-seeking, regulatory loopholes, and gaming. Clear, simple, transparent rules usually work best.

Remain neutral toward specific technologies. The benefit of market-based policies is to send a broad signal to find the more cost-effective means to achieving the emissions goal, including through innovation. Complementary policies should also be broad efforts to create a supportive environment for technological innovation and adoption, focusing on general R&D support and removing barriers, while avoiding picking winners.

5.2 Principles to guide instrument choice

Economics can inform the choice of policy instrument but ultimately – like the choice of a target – this decision is a political one. The answers to the following questions and considerations will fundamentally determine the type of pricing policy used.

Decide whether the priority is near- or long-term objectives. Short-term emissions goals may be more difficult to reconcile with a tax.

Determine the trade-off between price and emissions certainty. This trade-off is informed by views over the range of abatement costs and uncertainty about these costs; the investment environment in key sectors; the robustness of markets to develop hedging mechanisms; the sensitivity of the economy to energy price volatility; and voter or stakeholder preferences for the integrity of emissions targets in the relative timeframe.

Consider the institutional environment. If the governing institutions would differ depending on whether the instrument is a tax or a cap, which would be better suited and able to manage the program and goals? What regime would better be able to respond to new information and achieve long-run objectives, particularly if that involves increasing the stringency of the program? What regime would better be able to resist special interest pressures?

Consider the domestic political constraints. Can carbon taxes be sold at the Federal level now, and would future increases that might become necessary to meet reduction goals be acceptable? Cap-and-trade may be less transparent to most voters. A Federal cap may also facilitate regional transfers and/or distributional impacts through allowance allocation. On the other hand, British Columbia has successfully passed a carbon tax.

Consider the international environment. Linkage is not necessary to achieve Canadian emissions goals, but it can provide opportunities for gains from trade, as reductions are allocated cost-effectively across countries. However, as a relatively small economy, the Canadian carbon price is likely to be dominated by that of major trading partners. Most of those partners are implementing (or headed toward implementing) cap-and-trade programs. An important question is whether the Canadian policy choice or the opportunity for linkage can also influence the climate policy strategies and stringencies of partner countries in a way to promote better coordination and stronger results.

In conclusion, these insights from the economics and broader public policy literatures do not lend themselves to absolute statements about the superiority of taxes or cap-and-trade. Policymakers must decide what their priorities are, and then choose the instrument – and the flexibility mechanisms – most appropriate for their goals. These design principles can guide the design of policy even as the relative priorities of policymakers shift over time. The challenge for

Canadian policymakers now is to establish policies that will be efficient and effective, and can remain robust and flexible into the future as Canada strives to meet the long-term challenges of climate change.

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