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Carbon Pricing, Fusion Style
– Policy Issues to Consider When Carbon Taxes Meet Cap-and-Trade

"The whole sky seems to be on fire, and nothing can be seen but smoke and flames."
– James MacSparran, 1753 Rhode Island

"On time scales ranging from decades to centuries, the rate of change of climate ideas is quite stunning. Ideas and apprehensions may well be changing much faster than the climate itself."
– James Fleming[1]

With our vast geography and diversity of weather patterns, Canadians are famous for their obsession with the weather. But the larger issue of long-term global climate change is emerging as the dominant environmental topic on the minds of both citizens and policy makers around the world.

In advance of the annual United Nations Framework Convention on Climate Change Conference in Paris this December (also referred to as COP 21), the dialogue has been dialed up. Many announcements have been made in the last six months from all levels of government – from cities and regions to national governments – about their targets and commitments on climate. Not to be outdone, the Government of British Columbia (BC) recently initiated a "review and refresh" of its climate policies with the release of the Climate Leadership Plan Discussion Paper.

According to the World Bank,[2] by 2015 some 40 national and 20 sub-national jurisdictions had put a price on carbon dioxide (CO_2) (the primary greenhouse gas, or GHG), using carbon taxes or cap-and-trade schemes -- or a combination of both. Collectively, these jurisdictions represent about 25% of global greenhouse gas emissions, although the carbon pricing instruments themselves only cover about 12% of world-wide emissions.

Carbon Tax

An economic instrument – a tax – levied on the carbon content of fuels, released as carbon dioxide when the fuel is burnt, which tries to capture the unpriced externality of using various fuels.

Cap and Trade

A limit or cap set by a government on the amount of an emissions type (e.g. carbon dioxide) that is subsequently allocated via permits (i.e. rights to emit), which can then be traded among other parties that also have permits. Regulated entities (generally industrial firms) must hold a number of permits equal to their emissions for compliance purposes.

While there appears to be a growing consensus on the need to price carbon, there is no consensus on the most effective means of doing so – either via taxes or trading schemes – and the debate continues. British Columbia, of course, was an early adopter of a carbon tax.[3] In 2008, the province implemented the *Carbon Tax Act,* which initially set the tax at $10 per tonne of carbon dioxide equivalent (CO_2e) emissions, applied to 100% of emissions from fossil fuel combustion. The tax was increased by $5 per tonne annual increments until it reached $30/t of CO_2e on July 1, 2012. The

[1] *Historical Perspectives on Climate Change*, Fleming, James R. (1998). New York: Oxford University Press.
[2] *Carbon Pricing Watch 2015* (Report No. 96602, May 2015), World Bank Group and ECOFYS, online: http://www-wds.worldbank.org/external/default/WDSContentServer/WDSP/IB/2015/08/26/090224b08309a09a/4_0/Rendered/PDF/Carbon0pricing0e0released0late02015.pdf.
[3] Other early adopters: Finland and Netherlands in 1990, Sweden and Norway in 1991, Costa Rica 1997, Denmark in 2002.

government then froze the tax for five years. Apart from the carbon tax, BC has implemented some 30 different initiatives related to the management of GHG emissions, including setting legislated emission reduction targets and establishing a technology fund.[4]

A Discernable Shift Toward Cap-and-Trade

The European Union's Emissions Trading System (EU ETS) has been in operation since 2005. It was the first and is still the most extensive system for trading GHG emission permits. The ETS covers 12,000 industrial facilities in 31 countries.[5] Japan's Parliament (the Diet) passed a law in 2011 that created a CO2 import tariff on carbon, which is supposed to be replaced with a cap-and-trade market rule by the end of 2016. South Korea launched a cap-and-trade scheme in early 2015.

In 2014, the United States and China announced their intention to cooperate on climate policy and achieve emission reductions over the medium term. In August 2015, the Obama administration's US Clean Power Plan (CPP) established national standards for carbon emissions from power plants. A similar plan covering greenhouse gas emissions from refineries and other large stationary sources is anticipated in the next few years.[6] Under the CPP, states have the option to work on multi-state approaches to address carbon emissions, including emissions trading. While the CPP does not authorize international trading or compliance, environmental policy in the United States is often precedent-setting, so the manner in which the CPP unfolds and the policy instruments that the states adopt to meet their mandated emissions reduction obligations may well have an influence beyond America's borders.

> ***GHGs in Other North American Jurisdictions***
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> *In January 2009, the Regional Greenhouse Gas Initiative (comprising a number of states in the US Northeast) began operating the first market-based regulatory program in the United States to cap and reduce carbon dioxide (CO_2) emissions from the power sector. Also in 2009, the second set of cap-and-trade regulations in North America was signed into law with Nova Scotia's Greenhouse Gas Regulations. Both Québec and California have cap-and-trade systems that came into effect in 2013 and linked their programs one year later, creating North America's largest carbon market. Ontario intends to join the California-Quebec cap and trade scheme.*

More recently, in September 2015 China announced that it will institute a wider cap-and-trade program in 2017. The program will consolidate China's seven existing regional carbon markets.

Combined, the European, US, South Korean and anticipated Japanese and Chinese cap and trade markets would cover about 70% of global GHG emissions. While this represents a significant step in establishing a foundation for global action to reduce GHGs, many details still need to be worked out. Importantly, all of Canada's

[4] Other pieces of legislation included: (1) *Greenhouse Gas Reduction (Cap and Trade) Act*, which set GHG reduction targets at 33% below 2007 levels by 2020 and 80% below by 2050; this was replaced by the *Greenhouse Gas Industrial Reporting and Control Act* in 2014, which establishes intensity-based emission standards and broadens compliance mechanisms to include credits from offsets, payments to technology funds, etc. and applies to power generation and (proposed) LNG facilities; (2) *Greenhouse Gas Reduction (Vehicle Emissions Standards) Act*; (3) *Greenhouse Gas Reduction (Emissions Standards) Statutes Amendment Act*, intended to regulate landfill gas; (4) *2008 Utilities Commission Amendment Act,* to encourage low-carbon energy generation; (5) *Greenhouse Gas Reduction (Renewable and Low Carbon Fuel Requirements) Act*, to encourage the development of renewable energy and decrease the carbon content of fuels; (6) *Local Government (Green Communities) Statutes Amendment Act, 2008*, to foster the development of more sustainable, healthy communities. Other related legislation included: *Clean Energy Act*, *Energy Efficiency Act*, *Net Zero Deforestation Act*, *Carbon Neutral Government Regulation*.

[5] 28 EU countries along with Iceland, Norway and Liechtenstein.

[6] 2010 Settlement Agreement http://www.rff.org/files/sharepoint/WorkImages/Download/RFF-IB-11-02.pdf.

(and thus BC's) main trading partners – the US, Japan, the EU, Korea and China – have legislated, published enabling regulations for, or announced a firm intention to adopt cap-and-trade market rules that will apply to various portions of their GHG emissions. Globally, there is a clear move toward cap-and-trade; there does not seem to be as much enthusiasm to adopt carbon taxes like the one in BC.

Economic Theory Primer

Both carbon tax and cap-and-trade policies are aimed at achieving the same thing – to correct a market failure by putting a price on CO_2 (and greenhouse gases more generally[7]). The price is supposed to incentivize different behaviour that leads, over time, to a reduction in GHG emissions and fossil fuel use. Both policies can generate revenue for the state, which can be used to pay for new tax incentives, direct spending, "green" initiatives, or to finance the lowering of other taxes.[8] Both carbon taxes and cap-and-trade programs have monitoring, reporting, verification and compliance obligations, and both need special provisions to minimize the potential adverse effects, particularly on energy-intensive, trade exposed firms/industries. Both may drive up the prices of goods and services consumed domestically, as well as those that are exported, thereby influencing how and what is traded, access to capital, and the competitiveness of local businesses in the global market.

*An **allowance** authorizes a utility or industrial source to emit 1 ton of emissions during a given compliance period. Allowances are fully marketable commodities. Once allocated, allowances may be bought, sold, traded, or banked for use in future years.*

Key differences between the two policy tools are that with a carbon tax, the price is known but the quantity of emissions reductions is uncertain. The reverse is true for cap-and-trade, where the quantity of emission reductions is known, but the price is (somewhat) uncertain. In terms of compliance, a tax forces annual decisions on reductions and/or how much to pay, while within a trading system firms that are subject to cap-and-trade can acquire emission offsets or borrow, bank and extend compliance periods over multiple years depending on how many allowances they own. In other words, cap-and-trade offers a broader range of what are likely to be lower-cost compliance options, thus increasing flexibility for participants. Changes in economic activity will impact a firm's behavior under either system. Taxes are only changed via government action, and they generally remain at the same level regardless of economic circumstances (at least in the short- and medium-term). Under a cap-and-trade system, the price is expected to fluctuate depending on how the economy is performing, the stringency of caps imposed on industrial firms, and individual firm production functions. Cap-and-trade schemes lend themselves to linking between jurisdictions, while taxes tend to be jurisdiction-specific. Finally, carbon taxes are easier and less costly to administer than cap-and-trade programs, which usually involve multiple layers of trading rules, complex verification rules, and ongoing negotiations by the parties.

[7] The primary greenhouse gases in Earth's atmosphere are water vapor (H_20 36–72% contribution "greenhouse effect), carbon dioxide (CO_2 9 – 26% contribution), methane CH_4 4 – 9% contribution), nitrous oxide (NOx), and ozone (O_3 3 – 7%). Water vapor is not considered in the discussion of climate change policies. CO_2, CH_4, NOx and O_3 are normalized and referred to as CO_2 equivalents. CO_2 equivalency is a quantity that describes the amount of CO_2 that would have the same global warming potential (GWP) for a given mixture and amount of GHG, when measured over a specified timescale (generally, 100 years).

[8] *2004 October Report of the Commissioner of the Environment and Sustainable Development*, Chapter 3 (Insert 3.1), online: http://www.oag-bvg.gc.ca/internet/English/att_c20041003se01_e_13350.html.

From Economic Theory to Reality

Neither a carbon tax nor a cap-and-trade regime is meant to act as a substitute for regulation, even though some economics textbooks treat carbon pricing as a less costly alternative to "command and control regulation." Effective management, as always, requires a complementary suite of tools, especially since climate change is a classic "wicked problem" - large-scale and long-term, with multiple and compounding risks and uncertainties, and sharply divergent public values.[9]

In reality, in the absence of either an international carbon tax or a binding international agreement with specified GHG emission caps, only altruism prevents any given jurisdiction from free-riding. Self-interest is a powerful motivator. It is fair to say that any single nation, region, province or state that adopts a small or very modest carbon tax is therefore taking a largely symbolic step, particularly since economists estimate that such a tax would need to be in the order of $150/t$CO_2$e or more to have any substantive behavioural effect.[10] No rational government with a sense of self-preservation would impose dramatically higher tax-inclusive energy costs on its domestic industry or households, especially in the short-term, as people have a hard-wired sensitivity to loss aversion.[11] As for carbon trading schemes, emissions caps set by the government will likely reflect an as-high-as-possible estimate of future economic growth to create room for local businesses to expand in the medium-term. Issuing free allowances to existing industries and setting targets sufficiently far into the future can facilitate a transition with minimal cost impacts in the near-term, while still establishing the conditions for a gradually negative sloping emissions line. In fact, every existing and proposed carbon trading regime has created an allowance supply (free and otherwise) that exceeds the maximum physical GHG discharge capacity of the covered emitting sources by 10%-30%.[12]

Despite that fact that most jurisdictions now appear to have baseline GHG emissions (i.e., the current emissions profile overall and by source), not all baselines are the same. First, setting baselines has a subjective component. Second, the utility of baselines depends on what they are used to measure – absolute GHG reductions or intensity-based reductions. While third party verification is helpful, it may not yield fully unbiased results and there may be incentives for parties to overstate their baselines.

In terms of coverage, a tax is easier to apply economy-wide, as is the case in BC. Cap-and-trade schemes tend to capture a smaller set of emitters that are usually above certain thresholds (e.g. California and Quebec have a 25,000 tonne trigger). Therefore, many emitters are not covered with cap-and-trade, in part because the transaction costs for small entities (including households) would be prohibitive. To date, no cap-and-trade system has been designed to cover 100% of fossil fuel combustion emissions. For example, the EU ETS covers only 45% of total GHG gas emissions.[13] California estimates that 4/5 of its combustion-based emissions are covered. So, despite the excitement over the fact that the world's two largest GHG emitters – the US and China – have agreed to collaborate, it is unclear how much of their total emissions will

[9] *Wicked Environmental Problems, Managing Uncertainty and Conflict*, Peter J. Balint, Ronald E. Stewart, Anand Desai, and Lawrence C. Walters, July 2011.

[10] According to the World Bank's *State and Trends of Carbon Pricing 2015* (September 2015), Sweden currently has the highest carbon price in the world at US $130/t$CO_2$e.

[11] In prospect theory, loss aversion refers to the tendency for people to strongly prefer avoiding losses than acquiring gains. Some studies suggest that losses are as much as twice as psychologically powerful as gains. *Loss Aversion in Riskless Choice: A Reference-Dependent Model*, Amos Tversky and Daniel Kahneman, 2004.

[12] The Economist Blog http://www.economist.com/blogs/analects/2013/06/carbon-emissions.

[13] http://ec.europa.eu/clima/policies/ets/index_en.htm.

actually be subject to a price. Something less than 100% is certain. This poses a competitiveness issue for British Columbia given that virtually all combustion emissions in the province are now taxed.

Carbon leakage, another key issue, is particularly important for jurisdictions that are home to energy-intensive, trade-exposed industries (EITE). Without special provisions or offsets to address increased energy-related costs stemming from more stringent domestic climate policy, businesses may shut down or shift production (and/or capital investment) to other jurisdictions which have fewer or no constraints on emissions. Carbon leakage in some cases could lead to an increase in overall global emissions. British Columbia, in introducing its carbon tax, failed to protect its EITEs, and it has only belatedly addressed the needs of two vulnerable sectors (agriculture and cement production). The EU has identified 147 industrial activities that are considered EITEs[14] and thus receive special treatment; some of these are competitors to certain industries present in BC (i.e. aluminum, pulp and paper, natural gas, minerals, etc.).

As noted earlier, an attractive element of carbon taxes and cap-and-trade schemes for policy-makers is the revenue that can be generated. Governments are always on the lookout for new sources of revenue. The counterintuitive negative for carbon taxes is that as emissions decline, so too should tax revenues, which creates a built-in bias in favour of future carbon tax increases. In BC's case, the revenue neutrality feature of the province's carbon tax policy mitigates this concern, even though in practice more carbon tax revenues are re-distributed than are collected in the first place. Revenues are less certain with a cap-and-trade program, unless a reserve price is set, which establishes a potential minimum total amount of revenue (assuming all allowances available are sold). Regardless, there is always a strong lobby from various domestic groups for a say in how revenues from a carbon tax or from the sale of cap-and-trade allowances will be used or shared.

Policy Issues to Consider When Carbon Taxes meet Cap-and-Trade

Looking ahead, BC may eventually consider a hybrid carbon pricing system that segments the market between industrial activities and commercial transportation (63.4% of GHG emissions) and the rest of the economy (31.7% of emissions[15]). In this world, the former would be included in some form of cap-and-trade scheme; the latter would continue to pay the carbon tax. Challenges are discussed below.

Revenues

Under a hybrid system in the BC context, revenue flowing to the government would likely decline by at least 32%,[16] possibly more, since 63% of existing carbon tax revenue would be sourced from some kind of allowance auction process, at a reference price that is likely to be similar to the value of allowances traded in the California-Quebec auction market.[17]This assumes that no free allowances are issued (unlikely) and that linkages are created with other markets. Use of free allowances for emitters covered by cap-and-trade would cost revenue from the government's perspective.

Clearly in this process BC industries, especially those that are EITIs, would benefit compared to

[14] http://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:32014D0746&from=EN#ntr4-L_2014308EN.01011401-E0004.

[15] The remaining portion of emissions reflects the impact of deforestation.

[16] 2014: 63% of $1.6 billion = $1 billion; 32% of $1.6 billion = $512 million; US $13/tCO2e divided by US$23t/CO2e (the BC carbon tax in US dollars) = 56%; 56% of 1 billion = $560 million; $560 million + $512 million = $1.1 billion; $1.1 billion/$1.6 billion = 68%; 100% - 68% = 32%.

[17] Reference value for a tonne of CO2e is ~ US$13 as of September 30, 2015.

the current situation with the carbon tax. This is because the cost pressure from a US$10/tCO2e differential would be addressed. The rest of the economy would be indifferent insofar as the carbon tax burden would remain unchanged. Unfortunately, government may consider new or increases to existing taxes to offset any revenue declines associated with moving large and mid-sized emitters to a cap-and-trade regulatory scheme and away from the carbon tax regime.

A key design principle[18] of the BC carbon tax was (and is) its "revenue neutral" character, where all carbon tax revenue is returned to taxpayers through other tax reduction measures. Revenue neutrality can also be applied in a cap-and-trade model, but in this scenario, government revenues are more unpredictable, depending on how allowances are distributed and the pricing (floor or float) results of auctions. The Ontario Chamber of Commerce suggests that in the design of that province's planned cap-and-trade program, revenues could (should) not only be used for initiatives that further reduce GHGs (e.g. technology, efficiency, etc.), but also to help EITE businesses in the province remain competitive.[19]

Targets

As we know, the main feature of a carbon tax is price but not emissions reduction certainty. This is demonstrated in the case of BC, which adopted a GHG reduction target of 33% below 2007 levels by 2020. Between 2007 and 2013, Ministry of Environment statistics show a 4 Mt emissions decline – or 6%. At this rate, it would take another 18 years (until 2031) to reach the stated 2020 target. This also assumes that ongoing 1% per year declines in total GHG emissions are achievable, even though most of the "low-hanging fruit" has already been harvested and the province's population continues to grow by ~1% per year.

With a hybrid system, and assuming no change to targets or achievement dates, the burden of GHG reductions would probably largely fall to industry since, as discussed above, the main feature of cap-and-trade is the ability to adjust the cap. For EITE industries in BC, this worry is exacerbated by the province's baseline emissions, which unlike other jurisdictions, do not include a large quantum of emissions from electricity generation, since the system in BC has long relied almost wholly on non-carbon sources. Compared to some other provinces and almost all American states, BC is at an economic disadvantage in terms of the availability of low-cost GHG abatement options because its existing electricity system produces so few GHGs,

Regardless of whether BC stays the course with its carbon tax or moves towards a hybrid system of some sort, the province's current GHG reduction targets look to be unachievable. Some adjustment will be necessary before 2020.

Market Coverage

For purposes of this paper, it has been assumed that 63% of British Columbia's GHG emissions inventory would be covered by a future cap-and-trade scheme. It may be some other number, of course. Transition mechanisms for industries that move over time from a carbon tax to a cap-and-trade regime would be important. If "performance" is measured in terms of the rate of reduction from base-year emissions, it will be necessary to account and fairly treat covered sources that were already highly efficient/less greenhouse gas-intensive in the base year. Unfortunately, BC once again would be disadvantaged by its existing low-carbon electricity system.

Carbon Pricing

[18] *BC Climate Action Summary*, online: http://www2.gov.bc.ca/assets/gov/environment/climate-change/policy-legislation-and-responses/climate-leadership-plan/bcclimateactionsummary.pdf.

[19] http://www.occ.ca/wp-content/uploads/2013/05/Cap-and-Trade-Report.pdf.

To the extent that policy makers opt to link carbon taxes to a cap-and-trade system, significant questions will have to be answered about whether the carbon tax should act as a price floor or ceiling under cap-and-trade. Either would help reduce price volatility; and since in reality no emitter invests to reduce GHGs in reaction to 1 to 10 month price fluctuations (only long-term price trends), stability would help with capital investment decisions around emission reductions. Regardless, it should be noted that as an empirical matter, every cap-and-trade regime has played out the same way: (1) If there is an auction floor price, current vintage allowances trade within 10% of the floor;[20] (2) if there is no floor price (i.e. the EU ETS), the highest prices for allowances are realized in the first 1.5 to 3 years of the regime, after which they decline and stay low.[21]

Harmonization with Other Jurisdictions

Given the mix of industries and the diversity of economic circumstances in each jurisdiction, establishing equivalent carbon pricing and emission reduction targets is a complex task. What is essential is that similar products with similar global greenhouse gas footprints attract similar direct or indirect tax treatment in the jurisdictions in which they are sold. To date, no cap-and-trade regime has met this test, and it is unclear whether this will change over time.

Here, the challenge lies in how to define carbon policies in a manner that competing products with similar carbon footprints are treated similarly, across regions and national borders, in order to minimize carbon leakage and eliminate unfair carbon price discrimination against products based on country or facility of origin. An opportunity exists for BC to become a leader in smart regulation design in this area. Apart from seeking alignment on carbon pricing policies and emission reduction targets, policy makers can also look to establish: (i) industry-specific initiatives; (ii) a general method for establishing caps that treats competing products with similar carbon footprints the same, regardless of country of origin; (iii) standardized guidelines for generating high quality offset credits; and (iv) the creation of a single registry to manage offsets and allowances.

The Need for a Diverse Set of Policy Tools

Neither a carbon tax nor a cap-and-trade system will be the perfect or sole solution to climate change in any jurisdiction that pursues long-term emissions reductions. Whether hybrid or individually, they need to be supplemented with other tools like energy efficiency initiatives, performance standards and investments in infrastructure and clean technology. All of the measures must be integrated in an intelligent manner, with an eye to economic competitiveness and a recognition that the health of BC's economy ultimately depends on our ability to trade.

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[20] California's 2013 floor/auction reserve price was set at US$10/tCO2e with a median price for 2013 vintage allowances of US$11.81; the 2015 floor/auction reserve price is US$10/tCO2e, with a median price for 2015 allowances of US$10.75; the California- Quebec joint auction 2014 floor/auction reserve price was set at US$12.10/tCO2e with a median price for 2014 vintage allowances of US$12.50. Source: http://www.arb.ca.gov/cc/capandtrade/auction/auction_archive.htm.

[21] EU ETS 2006 allowance price US$33.70/tCO2e, 2013 allowance price ~US$5.62/tCO2e.