Sustainable Prosperity

Policy Brief June 2010

FOR A LOW CARBON ECONOMY

Carbon pricing, investment, and the low carbon economy

Key messages

- Pricing carbon emissions, through a cap-and-trade system or a carbon tax, plays an important role in stimulating investment in low carbon energy technologies and practices.
- Such investment, particularly from private sources, is required for the transition to a low carbon economy in Canada, and globally.
- Carbon pricing is a necessary, but not sufficient, condition to promote investment in a low carbon economy. Complementary policies that provide long-term price certainty and address "public good-type" market failures (like infrastructure) are also required.
- Given the relative novelty of carbon pricing policies in Canada, more research is needed, particularly *ex-post* analysis, of the impact these policies will have on investment in the Canadian context.
- The case for promoting investment in a low carbon energy system goes beyond the direct environmental benefits of doing so. Because of the global focus on the low carbon economy, it is becoming an important matter of competitive advantage.

Sustainable Prosperity has developed this Policy Brief in the interest of informing public debate and policy development on an issue of key strategic interest to Canada. The transition to a low carbon economy looms as one of the key challenges and opportunities our society faces, and the role that carbon pricing can play in that transition will be – in our view – critical.

Sustainable Prosperity is a national, non-partisan policy and research network drawing from business, policy and academic leaders. Our focus is on developing and promoting pragmatic, economically sound policy and market models that will move Canada to a green economy.

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The issue

Carbon pricing, achieved through a carbon tax or through the primary and secondary markets of a cap-and-trade system can create new flows of investment for low carbon technologies and activities.* Such investment is necessary to help Canada, and the world, transition to the kind of low-carbon energy system that will help address climate change.

How a carbon price works

The carbon price that is established as a result of a *tax* creates an incentive to reduce carbon emissions through substitution to another low-/no-emission energy source or through increasing the efficiency in the use of the existing energy source. Either effect translates into the need to invest in new technology or new business practice.

Similarly, through the scarcity that is imposed by a *cap-and-trade* system, a value is created for carbon allowances. That value translates into potential revenues (from the sale of carbon credits) for those in the capped sectors that operate below their carbon allowance and gives them an ongoing incentive to lower emissions to increase those revenues. If the cap-and-trade system is accompanied by an offset system for those outside the capped sectors, the same incentive applies to those firms.

The expectation, or theory, is that carbon pricing from a tax or a cap-and-trade system will generate investments into technologies or activities that have lower emissions than business as usual.

This policy brief explores that theory by assessing the evidence base and policy experience on carbon pricing and investment in low carbon technologies and activities. It draws upon international experience and research. It concludes with an assessment of the implications of carbon pricing and investment for policy-makers.

The policy brief is not intended to be an exhaustive review of the "state of knowledge" on the issue. Instead, it is meant as a foundational document, to present existing and emerging evidence; and to discuss the implications of the evidence for policy makers.

* Sustainable Prosperity does not endorse one carbon pricing instrument over another, nor does it want to leave the impression that the two are always equivalent. Depending on design features of a cap-and-trade system – particularly in choices around the auctioning of allowances and the use of auction revenues – the incentives it provides may be quite different from those provided by a carbon tax. For the purposes of this document, though, we are assuming that the cap-and-trade system involves full auctioning, that any "safety valve" system it may feature does not impede trading within the system, and that offsets are kept to the minimum required. This makes it roughly equivalent to a carbon tax. For more information, please refer to Sustainable Prosperity's "Principles for Carbon Pricing", available at http://www.sustainableprosperity.ca/papers/set-carbon-pricing-principles.

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Carbon pricing and investment: the global context

To provide context to the discussion of carbon pricing and low carbon investments, it is useful to consider some of the key rationales for pursuing this type of policy intervention.

In addition to its environmental rationale, carbon pricing is increasingly justified on the basis of the economic and employment gains that may be realized from the significant investments in low carbon technologies and activities that it may incent or fund.

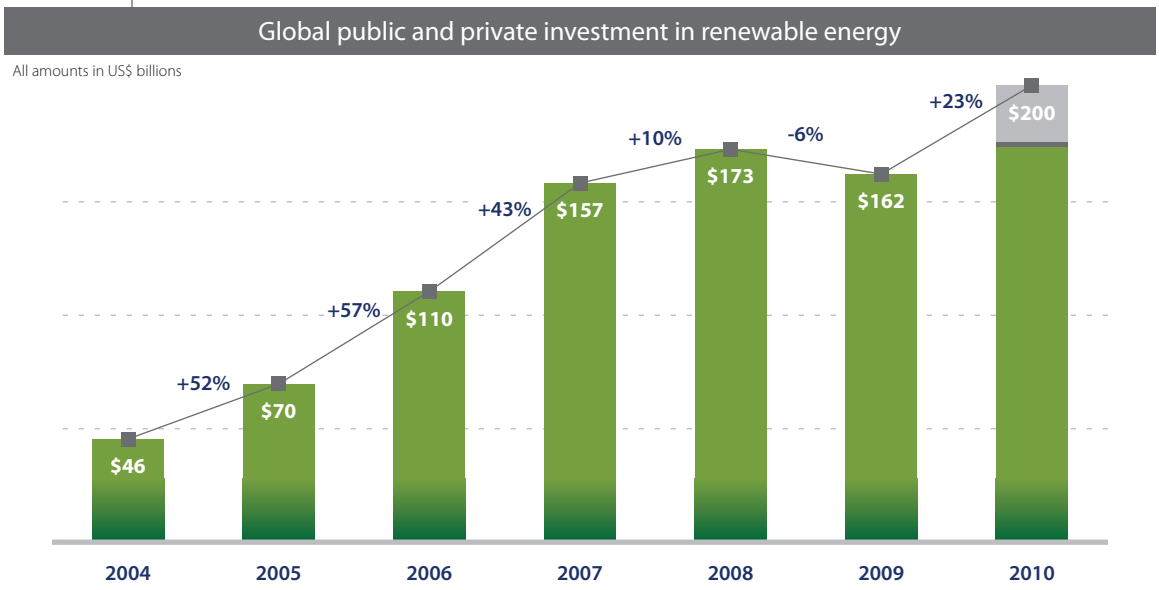
From an environmental perspective, the rationale for carbon pricing is to provide a financial and economic incentive to businesses and individuals to reduce carbon emissions to a level sufficient to avoid the dangerous impacts of climate change. From an economic efficiency point of view, carbon pricing is justified as a means to internalize some of the environmental costs associated with the production and consumption of carbon intensive goods and services, and to provide a continuous benefit to the emitter: for each unit of carbon reduced, they save money in the form of payments foregone. For the purposes of reducing emissions, then, a carbon pricing policy has been shown to be both effective and efficient.

In addition to its environmental rationale, carbon pricing can generate economic and employment gains flowing from the significant investments in low carbon technologies and activities that it stimulates.

Carbon pricing and the global economic crisis

This rationale is particularly relevant in the context of the crisis that has gripped the global economy. Many governments have deliberately linked the need to create new jobs and investments to the emergence of a low carbon economy. As a result, there has been a global trend towards massively scaling up investments in clean energy technologies. The World Economic Forum predicted in 2009 that private investment in both renewable energy and energy efficient technologies would reach $450 billion by 2012 and $600 billion in 2020.[1] A great deal of that investment will be spurred by public investment in clean energy that many countries have made through the various stimulus packages announced in 2008/09, with public expenditures totalling $185 billion targeted at the renewable energy and clean technology sectors.[2]

Figure 1: Global public and private investment in renewable energy



Note: Total values include estimates for undisclosed deals. Data based on estimates from industry sources.
Source: Bloomberg New Energy Finance and CIBC World Markets

Looking specifically at renewable energy, cumulative investments since 2005 amount to $525 billion. Europe and the United States accounted for almost 60% of these investments. Canada has invested 3% of the global total.[3] According to a recent report, Canada ranks 4th out of G8 countries when it comes to investment in a low carbon economy.[4]

This same report, by the National Roundtable on the Environment and the Economy, makes the point that every country needs to consider its competitiveness in relation to the

1 World Economic Forum, *"Green Investing: Toward a Clean Energy Instrastructure,"* World Economic Forum, January 2009. http://www.weforum.org/pdf/climate/Green.pdf.

2 Roberts, Don, *The Effectiveness of Incentive Programs for Clean Energy: An International Comparison,* Presentation at the Canadian CLEANTECH Summit, Ottawa, Canada, April 28, 2010.

3 Roberts, Don, *The Effectiveness of Incentive Programs for Clean Energy: An International Comparison,* Presentation at the Canadian CLEANTECH Summit, Ottawa, Canada, April 28, 2010.

4 National Roundtable on the Environment and the Economy, *Measuring Up: Benchmarking Canada the issues Competitiveness in a Low-Carbon World*, 2010.

emerging global low carbon economy. Moreover, as pointed out in Sustainable Prosperity's *Low Carbon Investment Gap* discussion paper, the nature of the investment matters as much as the total number.[5] Canada's public investment is limited to 5 years, while the norm internationally is for at least 10. Moreover, our investment is largely focused on carbon capture and storage (CCS) and nuclear. Other countries have taken a broader approach, from incenting the creation of manufacturing capacity of mature renewable technologies (like wind), to supporting research and development in next-generation technologies like electricity storage and batteries that will be used in the transportation sector. This matters because how countries position themselves to compete across a range of technologies – not just a few – will have lasting effects on their economic viability.[6]

Carbon pricing and fiscal policy

There is an additional consideration not typically provided in considering the links between carbon pricing and investment. Carbon pricing, and the public revenues that it can in theory provide to governments through the auctioning of allowances or through a carbon tax, has a direct link to the fiscal situation in which a country finds itself. Put simply, carbon pricing can create fiscal "space" for governments. A recent Organisation for Economic Cooperation and Development report estimated the potential revenue from a carbon pricing policy that would help Canada meet its carbon reduction commitments at US$24 billion annually.[7]

That fiscal space translates into three key opportunities for investment in low carbon energy. The first is the increased capacity of governments to invest directly into those sectors and activities for which private investment may not exist (discussed later in the brief).

… the public investment delivered through the various stimulus packages has prompted large flows of private investment.

Second, that increased public investment will serve to multiply private investment into a low carbon energy system. Indeed, the story of the last eighteen months is one in which the public investment delivered through the various stimulus packages cited above has prompted large flows of private investment.

And third, the fiscal space created by carbon pricing also means that governments need to borrow less in private markets, and so the "crowding out" effect – whereby government borrowing soaks up most of the private funding available and drives up the cost of borrowing for the private sector – can be mitigated or avoided.[8] That effect might be particularly acute right now, given the tightness of credit markets internationally. Again, that translates into a more positive climate for private investors.

5 Sustainable Prosperity, *The Low Carbon Investment Gap; Discussion Document.* 2009. Available at http://www.sustainableprosperity.ca/papers/low-carbon-investment-gap.

6 National Roundtable on the Environment and the Economy, 2010, *Measuring Up: Benchmarking Canada the issues Competitiveness in a Low-Carbon World.*

7 Organisation for Economic Cooperation and Development, *Interim Report of the Green Growth Strategy: Implementing our Commitment for a Sustainable Future.* March 2010.

8 There is some controversy in the academic literature on the significance of the crowding out effect. Most of the disagreement relates to whether the effect holds under conditions of less-than-full employment or output. But as concluded in *The 'crowding out' effect of federal government outlay decisions: An empirical note,* Richard J. Cebula, Christopher Carlos and James V. Koch, Public Choice, Volume 36, Number 2/January, 1981: "federal government decisions which act to raise federal outlays tend to diminish private-sector investment in new physical capital". The authors caution, however, that it is not all government spending that results in this effect, and that careful analysis and planning can actually lead to increased private investment through the prudent application of public investment.

The basic point to underline here is that carbon pricing now serves policy interests that go beyond climate change. It is now becoming part of a broader agenda that is focused on economic development driven by the transition to a low carbon energy system.

The knowledge base

This section of the brief includes a short discussion of the European Union's experience with its cap-and-trade scheme as well as other European experience with carbon pricing. It also reviews the impact such policies have had on investments in low-carbon technologies and activities.

The international knowledge base

Trading systems

According to the World Bank, the global carbon market continues to grow rapidly. The most significant contribution to that market is the European Union Emissions Trading Scheme (EU ETS), which came into force on January 1, 2005. It is now the world's largest greenhouse gas (GHG) emissions trading system, with over US$118 billion worth of trades in 2009.[9] The value of the secondary market was an additional US$17 billion.[10] The table below demonstrates the value of the EU ETS in comparison to other key carbon market initiatives.

Figure 2: The global carbon market

	2008		2009	
CARBON MARKET	VOLUME ($MtCO_2e$)	VALUE (MUS$)	VOLUME ($MtCO_2e$)	VALUE (MUS$)
EU ETS	3,093	100,526	6,326	118,474
New South Wales	31	183	34	117
Chicago Climate Exchange	69	309	41	50
Regional Greenhouse Gas Initiative	62	198	805	2,179
Assigned Amount Units	23	276	155	2,003
Total	**3,278**	**101,492**	**7,362**	**122,822**

Source: Kossoy and Ambrosi, *State and Trends of the Carbon Market 2010* (Washington, D.C.: The World Bank, 2010).

The ETS is a central component of the EU's strategy for meeting its obligations under the Kyoto Protocol, which require total GHG emissions from the first 15 EU member states to be reduced to 8% below the 1990 level during 2008-12 (Kyoto targets for some of the more

9 Alexandre Kossoy and Philippe Ambrosi, *State and Trends of the Carbon Market 2010* (Washington, D.C.: The World Bank, 2010), http://siteresources.worldbank.org/INTCARBONFINANCE/Resources/State_and_Trends_of_the_Carbon_Market_2010_low_res.pdf.

10 While trades in the secondary market do not result in emission reductions, they are useful to hedge against price volatility and volume risk. To the degree that such hedges provide a measure of risk management for projects, it can be argued that the secondary market provides some measure of benefit to the investment climate for projects that result in emission reductions.

recent member states are slightly different). The ETS is being rolled out in phases. Phase I of the ETS operated from 2005 to 2007; phase II is running from 2008 to 2012, and phase III will start in 2013.

… an important observation of the EU ETS that is emerging is the unexpected nature of some of the emissions abatement that is taking place.

Given the short time that has passed since the EU ETS started to function, there is currently limited empirical evidence of the effects of the EU ETS on low-carbon investment decisions. However, the lessons that do come from the European experience with carbon trading corresponds to the existing literature on pricing effectiveness, which clearly shows that many factors, above and beyond pricing, contribute to investment decisions. However, an important observation of the EU ETS that is emerging is the unexpected nature of some of the emissions abatement that is taking place. It was anticipated that significant emission reductions would be realized by switching from coal to natural gas. This did not happen on the scale expected, mainly because of the high price of natural gas. Less expected was the intra-fuel substitution (switch from brown to hard coal) that took place in Germany and the improved CO_2 efficiency realized in the United Kingdom;[11] both of which represent low carbon investments triggered by the carbon price of the ETS. This result is consistent with those observed in the United States cap-and-trade systems for SO_2 and NOx emissions, where unexpected methods of emission reduction accounted for a significant share of the emission reductions that were ultimately realized.[12]

As a general rule, these experiences show that the overall cost of the policy will be less than what models might have anticipated. For the aforementioned U.S. acid rain program, a leading researcher has concluded that *"over the first 13 years of the program, the ability to trade allowances nationwide across affected units and through time is estimated to reduce compliance costs by a total of $20 billion, a cost reduction of about 57 percent from the assumed (i.e. regulatory) alternative."*[13] The reason for that is straightforward: innovation, and the cost reductions that come from it, are hard to anticipate in both nature and scale, and forecasting their impact will be conservative in its assumptions and therefore likely to overestimate the cost.

11 Convery, Frank, Denny Ellerman and Christian De Perthis, 2008, *The European Carbon Market in Action: Lessons from the First Trading in Period, Interim Report,* MIT Joint Program on the Science and Policy of Global Change.

12 Convery, Frank, Denny Ellerman and Christian De Perthis, 2008, *The European Carbon Market in Action: Lessons from the First Trading in Period, Interim Report,* MIT Joint Program on the Science and Policy of Global Change.

13 Ellerman, Denny, Joskow, Paul and Harrison, David, *Emissions trading in the U.S., Lessons, and Considerations for Greenhouse Gases,* Pew Center on Climate Change, May 2003.

Taxes

In contrast to the limited empirical evidence to date from the EU ETS, there is more evidence of the effect that carbon pricing from carbon taxes has had on low-carbon investments. This is especially true in a number of European countries. Indeed, countries with the highest rates of environmental taxation have also realized the greatest CO_2 reductions worldwide. For example, since 1990, CO_2 emissions in the UK have fallen by 15 percent, in Germany by 19 percent, and in Sweden, in spite of considerable GDP growth, by 4 percent.[14]

Some plant owners who switched from fuel oil to biofuels said that the carbon tax was a decisive factor in their switch.

Sweden introduced a tax on CO_2 emissions in 1991, at the same time as a reduction in existing energy taxes took place. According to a 1995 study by the Swedish Ministry of the Environment and Natural Resources, the carbon tax influenced energy investment decisions. Some plant owners who switched from fuel oil to biofuels said that the carbon tax was a decisive factor in their switch. The amount of biomass fuel used at Swedish heating plants doubled between 1990 and 1995, from 10.2 TWh to 20.4 TWh, or from 25 per cent to 42 per cent of total district heating supplied.[15] The preferential rate for industry also led some facilities to sell their bio-based by-products to heating plants, which were taxed at the full rate and thus eager to use biofuels.[16]

A note of explanation is needed here: the studies cited do not seek to establish a causal relationship between carbon prices and investments, but rather between carbon pricing and reductions in carbon emissions. In situations where there continues to be demonstrable economic growth (as in the cases above), however, we can assume that the realized reductions in emissions are either the result of fuel switching or changes in industrial/manufacturing processes (or even personal consumption). Both of these would involve some investment. SP recommends that the direct links between reductions in emissions and investment be further researched.

In 1999, the federal government in Germany introduced a broad-based fiscal reform policy. A key feature of that policy was a significant carbon tax, with a corresponding reduction in labour taxes. The objectives of the reform were to reduce GHG emissions and increase employment. Labour in Germany is relatively expensive due to non-wage labour costs (social insurance contributions). The high cost of labour has negative impacts on competitiveness and contributes to relatively high unemployment in the country.

14 Green Budget Germany, *Ecotaxes and emissions trading in Germany and Europe Market-Based Instruments for the Environment,* October 2006.

15 European Environment Agency, *Environmental taxes: recent developments in tools for integration,* 2000.

16 Robert Anderson and Andrew Lohof, *The United States Experience with Economic Incentives in Environmental Pollution Control Policy* (Washington, DC: Environmental Law Institute, 1997), 11-27. Also available online at yosemite.epa.gov/ee/epa/eermfile.nsf/vwAN/EE-0216a-4.pdf/$File/EE-0216a-4.pdf.

This tax shift has generated new investment in energy efficiency and has helped increase employment, especially in the renewable energy sector.[17] More specifically, it is estimated that 250,000 jobs were created by 2003 as a result of the reform and that carbon dioxide emissions were reduced by 20 million tons in 2003. The jobs were mostly realized in labour intensive businesses and among providers of energy savings technologies.[18] It is estimated that in the renewable energy sector alone, 150,000 jobs have been created and the average annual growth in the manufacture of energy-efficient products has reached 4.6 percent and the export of such products has achieved an annual growth rate of 9 percent. In contrast, other manufacturing achieved annual growth rates of 2.6 percent, and manufacturing exports of 3.9 percent per year.[19]

A major study commissioned by the European Union in 2007, the Competitiveness Effects of Environmental Tax Reforms (COMETR), came to the same conclusions at the European level. It showed that jurisdictions that had undertaken tax shifting policies – establishing carbon taxes and reducing other, more distortionary, taxes – have succeeded in promoting carbon-reducing investments. These policies lead to significant reductions in GHG emissions, with no negative impacts, or modest positive impacts, on GDP.[20]

The overall European experience underlines the importance not only that carbon pricing plays in promoting investment, but also the fact that the use of revenues generated through carbon pricing – whether they are reinvested in low carbon energy or used to reduce other taxes in the economy – is a very important consideration in the development of carbon pricing policy.

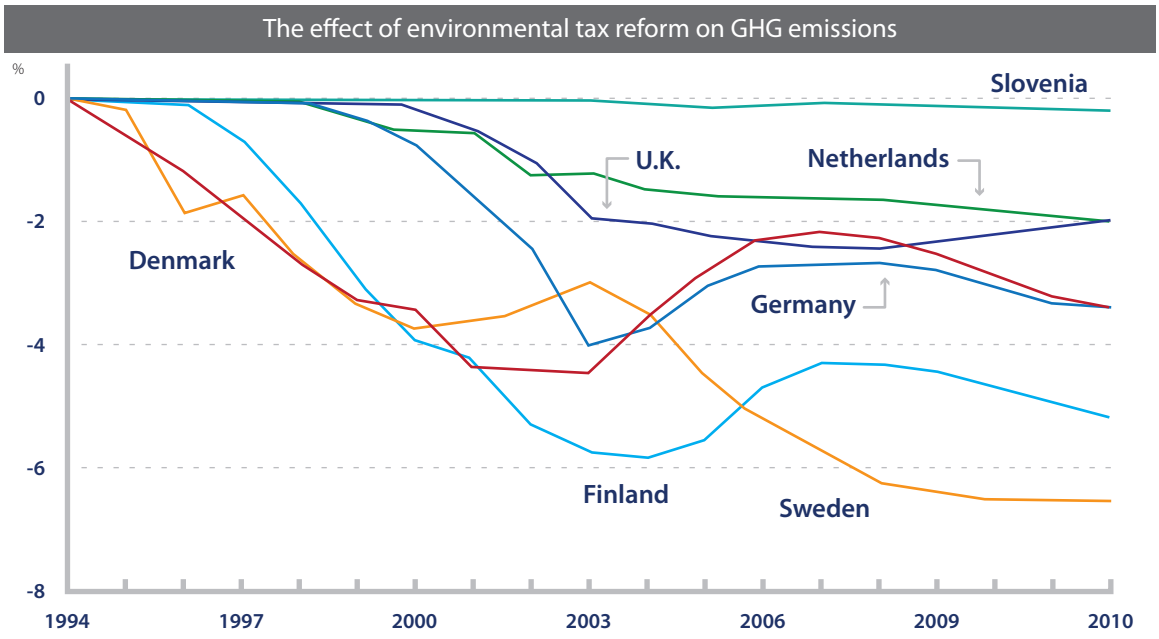
17 http://www.eco-tax.info/4fakten/index.html.

18 German Institute for Economic Research, *Effects of Germany's Ecological Tax Reform,* 2005, Study commissioned by the German Federal Environmental Agency. http://ecologic.eu/1156.

19 *Ecotaxes and emissions trading in Germany and Europe Market-Based Instruments for the Environment,* Green Budget Germany, October 2006.

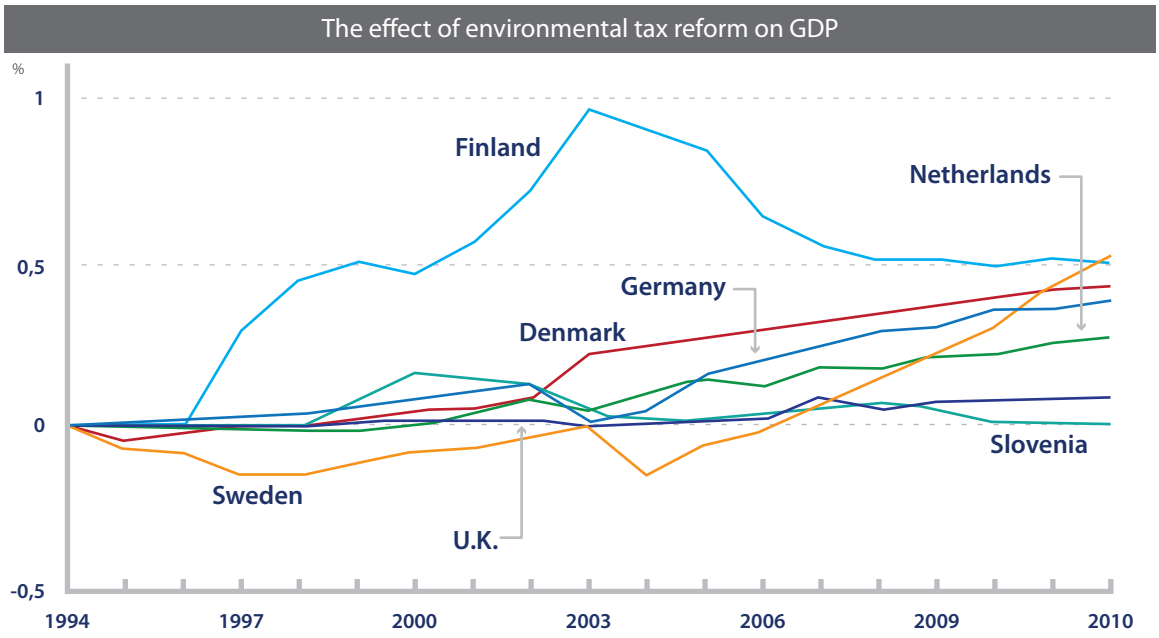
20 European Commission, *Competitiveness Effects of Environmental Tax Reforms,* 2007.

Figure 3: The effect of ETR on GHG emissions



Note(s): % difference is the difference between the base case and the counter factual reference case.
Source(s): CE.

Figure 4: The effect of ETR on GDP



Note(s): % difference is the difference between the base case and the counter factual reference case.
Source(s): CE.

The knowledge base in Canada

The B.C. carbon tax

Experience with carbon pricing in Canada remains limited at this point in time. In 2008, the government of British Columbia introduced a carbon tax of $10 per tonne of emissions on fossil fuel consumption by households and businesses in the province. The tax will increase by $5 per tonne each year until reaching $30 per tonne in 2012. The revenue earned from the tax is used to finance reductions in existing taxes. The tax has not been in place long enough to discern the total impact it may have on investment decisions in the province. Experience in regions outside of Canada (presented above) indicates that once the tax reaches a sufficient level and has been in place long enough for individuals and businesses to adjust their behaviour and investment decisions, investments in low carbon technologies and activities in BC will increase.

The net present value of the avoided carbon taxes along with revenue the company would earn from selling carbon offsets is estimated at $4 million; the equivalent of 35% to 45% of the total capital cost of the project.

In the meantime, a case study of the impact of the tax on one company's decision to replace natural gas consumption with a biomass gasification system provides indicative evidence of the kind of low carbon investments that may be expected.[21] Kruger, a Canadian pulp and paper company, recently commissioned a biomass gasification system for its tissue factory in New Westminster, BC. The system is expected to reduce CO_2 emissions by 20,000 tonnes per year. This translates into $600,000 in avoided carbon tax payments on an annual basis. The net present value of the avoided carbon taxes along with revenue the company would earn from selling carbon offsets is estimated at $4 million; the equivalent of 35% to 45% of the total capital cost of the project. This case study demonstrates that BC's carbon tax can have a significant impact on the financial attractiveness of renewable energy investments in the province. Such case studies are highly instructive and more research needs to be done to identify such cases.

Other provinces

The province of Quebec also has a carbon tax. Quebec's tax, in place since 2007, has a low rate, and is not designed to change behaviour or influence investment decisions, but to raise revenue ($200 million annually). Those revenues can be used to fund emission reduction activities, including public transit. In Alberta, large GHG emitters have three options for meeting emission compliance targets established in that province: they can pay $15 per tonne into the Climate Change and Emissions Management Fund (Tech Fund), purchase offsets, or invest in technologies or activities to reduce emissions. In theory, they will do either of the latter two options only to the extent that they cost less than the $15 per tonne charge.[22] In effect, Alberta's system operates much like a $15/tonne carbon tax on large emitters.

21 Roberts, Don, April 28, 2010, *The Effectiveness of Incentive Programs for Clean Energy: An International Comparison,* Presentation at the Canadian CLEANTECH Summit, Ottawa, Canada.

22 http://www.preferredcarbongroup.com/admin/pdf/39%20Alberta%20carbon%20prices%20test%20price%20cap%20-%20Oct%2019,%202009.pdf.

Certainty, support policies and public investment

As central as carbon pricing policy is to establishing the basic economic case for investment in low carbon energy, experience has shown that a number of other factors are also important. The two that are most critical are (i) the requirement for a policy framework that is certain and stable, and (ii) for public investment in those activities in which private markets will not typically invest.

Certainty and stability

The incentive to invest in low carbon energy depends a great deal on the investor's perception of the certainty of the pricing policy. Policy certainty lets would-be investors know that the government is serious about taking action to reduce emissions and that the basic economic assumptions attached to a particular project, technology or activity will not be altered by changing political priorities. Experience has shown that a verbal commitment or a so-called 'plan' to introduce climate pricing policy is not sufficient to change investment patterns.

A strong and credible commitment to carbon pricing policy, over a long period of time, is important for driving substantial low-carbon investments. In other words, investments in low-carbon technologies will take place if investors believe that the government will take policy action and stick with that action. Similarly, investor perception of an increasing "forward price" for carbon is important, as it provides some assurance that an investment made today will translate into cost savings (in the form of avoided carbon prices) over time.[23]

If policy action is uncertain, an investor will wait and see whether the government will firmly commit to carbon policy since waiting may be more valuable than investing in mitigation technologies that may or may not ultimately be needed.[24] In other words, a real, credible and long-term commitment to carbon pricing is needed to minimize risks and drive low-carbon investments.[25, 26] Policy certainty is created by implementing long-term policies (10+ yrs) rather than short-term (<5 yrs) policies[27] and by backing such commitments with law. Public policy needs to provide what Deutsche Bank has characterized as TLC (transparency, longevity and certainty) for investors to effectively catalyze private investment.[28, 29]

A strong and credible commitment to carbon pricing policy, over a long period of time, is important for driving low-carbon investments.

23 Galiana, Isabel and Green, Christopher, *An Analysis of a Technology-led Climate Policy as a Response to Climate Change.* Copenhagen Consensus on Climate, 2009.

24 Fuss, S., J. Szolgayova, M. Obersteiner, M. Gusti (2008) Investment under market and climate policy uncertainty, *Applied Energy,* 85: 708-721.

25 Blyth, W., R. Bradley, D. Bunn, C. Clarke, T. Wilson, M. Yang (2007) Investment risks under uncertain climate change policy, *Energy Policy,* 35:5766–5773.

26 M. Yang, W. Blyth, W., R. Bradley, D. Bunn, C. Clarke, T. Wilson, (2008) Investment risks under uncertain climate change policy, *Energy Economics,* 30: 1933-1950.

27 M. Yang, W. Blyth, W., R. Bradley, D. Bunn, C. Clarke, T. Wilson, (2008) Investment risks under uncertain climate change policy, *Energy Economics,* 30: 1933-1950.

28 Roberts, Don, April 28, 2010, *The Effectiveness of Incentive Programs for Clean Energy: An International Comparison,* Presentation at the Canadian CLEANTECH Summit, Ottawa, Canada.

29 DB Climate Change Advisors, 2009, *Paying for Renewable Energy: TLC at the Right Price, Achieving Scale through Efficient Policy Design,* Deutsche Bank Group.

Examples: Support Policies

Renewable Portfolio Standard – a regulation that requires increased production of energy from renewable energy sources, such as wind, solar, biomass, and geothermal.

Feed-in Tariffs – Specify the premium price to be paid to producers of renewable energy for the energy they produce. Feed-in laws offer renewable energy producers a guaranteed power sales price (the feed-in tariff), coupled with a purchase obligation by utilities.

Production Incentive – Provides the investor with payments based on the amount of electricity generated from qualifying technologies. A production tax credit does the same, but the incentive is provided as a credit against annual tax payments.

Grant, Rebate or Refund – Offsets a portion of the costs incurred in purchasing renewable energy technologies.

Property, Income or Sales Tax Credit, Refund or Exemption – Provides a tax credit, refund or exemption (in the case of sales tax) to individuals who purchase renewable energy technologies. The credit or refund for a portion or all costs incurred would reduce the amount of income or property tax due.

Support policies and public investment

TRANSPARENCY	How easy is it to navigate through the policy structure and execute?
LONGEVITY	Does the policy match the investment horizon and create a stable environment?
CERTAINTY	Does the policy deliver predictable revenues to support a reasonable rate of return?

A stable, predictable price can help drive investment to economical technologies. Modelling efforts indicate that certainty around CO_2 prices leads to early adoption by emitters, while uncertainty leads to late adoption and postponements of low-carbon investments.[30] The potential for the carbon price from a cap-and-trade scheme to fluctuate is sometimes cited as resulting in "poor climates for investment." This concern reinforces the need for "clear rules of the game" that send credible long-term price signals to investors[31] and is a key reason for the trend towards cap-and-trade design features that limit price fluctuations. More specifically, to reduce the price uncertainty associated with cap-and-trade schemes, establishing an allowance price ceiling or price floor is increasingly proposed. One method of establishing a price ceiling is to give the regulator the ability to sell allowances (from a reserve the regulator holds) to prevent the allowance price from rising further. Similarly, a price floor is enforced by the regulator purchasing allowances when the allowance price falls to a pre-established floor price.[32] The Kerry-Lieberman Bill (see text box next page) in the United States includes a price floor of $12/tonne and a price ceiling of $25/tonne changing over time depending on the rate of inflation.[33] Potential price volatility of allowance systems can also be reduced by allowing firms to bank permits for future compliance periods when allowance prices are low, and to run down previously banked permits or borrow permits when allowance prices are high.[34]

As a general point, a carbon tax – by its nature – provides price certainty. That is especially true where accompanied by a commitment to ramp it up along a pre-determined schedule, as B.C. and Germany have done.

Most pollution problems are best addressed through the use of multiple policy instruments.[35] Research and experience demonstrates that in the case of climate change, a price on carbon alone is unlikely to be enough to achieve the level of investment needed to meet necessary emission reduction goals – particularly in the near-term when carbon prices are likely to be fairly low. Thus, while the best long-term measure to grow the clean energy sector is to price carbon,[36] it is important to recognize that a portfolio of policies will be needed to attract the investment required to drive a complete transformation to a low carbon economy.[37] In other

30 Fuss S., J. Szolgayova, M. Obersteiner, and M. Gusti (2008) Investment under market and climate policy uncertainty, *Applied Energy* 85: 708–721.

31 NRTEE (2009) *Achieving 2050: A Carbon Pricing Policy for Canada,* NRTEE. Available online at: www.nrtee-trnee.ca.

32 Goulder, Lawrence and Ian Parry, 2008, *Instrument Choice in Environmental Policy,* Oxford University Press.

33 http://wonkroom.thinkprogress.org/2010/05/12/kerry-lieberman/.

34 Goulder, Lawrence and Ian Parry, 2008, *Instrument Choice in Environmental Policy,* Oxford University Press.

35 Goulder, Lawrence and Ian Parry, 2008, *Instrument Choice in Environmental Policy,* Oxford University Press.

36 Roberts, Don, April 28, 2010, *The Effectiveness of Incentive Programs for Clean Energy: An International Comparison,* Presentation at the Canadian CLEANTECH Summit, Ottawa, Canada.

37 Roberts, Don, April 28, 2010, *The Effectiveness of Incentive Programs for Clean Energy: An International Comparison,* Presentation at the Canadian CLEANTECH Summit, Ottawa, Canada.

words, policies that complement carbon pricing policies and target key areas or sectors are also needed. As is discussed in more detail below, support policies have an important role to play in increasing investments in low-carbon technologies and activities especially when: a) the carbon price level is low; b) a market failure exists; or c) administrative challenges make carbon pricing difficult or cost prohibitive.

In the early days of policy implementation, if the price level resulting from a tax or cap-and-trade scheme is too low to drive significant investments (as is likely to be the case), support policies will be warranted. Put another way, a non-existent or low carbon price will mean business as usual – investments in low-carbon technologies and activities will not be realized on the scale needed to avoid dangerous climate change. During this initial period, to achieve emission reduction targets, government intervention in other areas is required. Indeed, in the absence of significant carbon pricing policies, governments in Canada and elsewhere have relied on alternative forms of government intervention to try to drive investments in low-carbon technologies and activities. Common policies include feed-in-tariffs, renewable portfolio standards, renewable energy production incentives, tax breaks, and grants. Some such policies can be phased-out over time as the price of carbon increases and investments in low carbon technologies and activities ramp up.

Support policies are also required when a market failure exists. For example, even with a relatively high carbon price, investments in low-impact renewable energy may be limited because market failures prevent adequate private investment in the transmission infrastructure needed to capture the full potential of these technologies. Likewise, transit investments are not expected to respond efficiently to a carbon price, yet more convenient transit services can significantly reduce emissions from transportation. In such cases, where public goods (i.e. either the transmission lines or the transit system) are unlikely to benefit from private sector investment because of the diffuse nature of the benefit of the investment, government intervention will continue to be needed.

The Effect of Carbon Pricing on Investment in the US: The American Power Act

On May 12, 2010, Senators John Kerry and Joseph Lieberman released details of the American Power Act. The American Power Act would establish an economy-wide carbon price starting at $16.47 per ton in 2013 and growing to $55.44 dollars per ton in 2030. It is estimated that the Act would result in a reduction in greenhouse gas emissions from covered sources (85 percent of all emissions) of 22 percent below 2005 levels by 2020 and 42 percent by 2030 including international offsets. Economy-wide emissions (including offsets) would be 17 percent below 2005 levels by 2020 and 31 percent by 2030. The American Power Act would prompt $41.1 billion in annual electricity sector investment between 2011 and 2030, $22.5 billion more than under business as usual. Renewable and nuclear energy would grow from 8 percent of US energy supply today to 16 and 14 percent respectively in 2030. Over the next two decades, 106 gigawatts of renewable power, 78 gigawatts of nuclear power, and 72 gigawatts of carbon capture and sequestration would be built, replacing or retrofitting an aging fleet of coal-fired power plants. The legislation would also improve energy efficiency in homes, businesses, and vehicles, reducing overall energy demand by 5 percent relative to business as usual in 2030.

Source: Trevor Houser, Shashank Mohan, Ian Hoffman, 2010, Assessing the American Power Act: The Economic, Employment, Energy Security and Environmental Impact of Senator Kerry and Senator Lieberman's Discussion Draft, Peterson Institute for International Economics.

Another scenario that warrants use of support policies is when administrative challenges make pricing emissions difficult or very costly.[38] An example of this is in the agricultural sector. Greenhouse gas emissions from the agriculture sector are administratively difficult to cover in a cap-and-trade scheme. Support policies that reduce emissions in this sector are thus justified. One such policy option is to make emission reductions from this sector available for purchase through an offsets system, or provide direct incentives for carbon-conserving activites.

In summary, to achieve emission reduction goals and facilitate increased investment in low-carbon technologies and activities, an effective climate plan will need to include substantial public investment in areas where infrastructure is publicly owned (e.g., transit, electricity grids), where it is difficult to regulate (e.g., agricultural emissions), or when the carbon price may not initially be high enough to produce needed results (e.g., renewable electricity). As pointed out earlier, revenues from carbon pricing (through a tax or allowance auctioning) can provide an important source of funds for such public investments, particularly in a time of fiscal restraint.

… while the best long-term measure to encourage the clean energy sector is to price carbon, it is important to recognize that a portfolio of policies will be needed to attract the investment required to drive a complete transformation to a low carbon economy

38 Goulder, Lawrence and Ian Parry, 2008, *Instrument Choice in Environmental Policy,* Oxford University Press.

Implications for policy-makers:

This brief is meant as an overview of the theory and experience on carbon pricing and investment. Sustainable Prosperity believes that the following conclusions are of direct relevance to policy makers engaged in the development of carbon policy in Canada:

1. The theory underpinning a positive relationship between carbon pricing and investment is strong. Put simply, pricing carbon changes the business case for technologies and practices that reduce or replace carbon-intensive energy, and so increases investment in those technologies and practices.

2. Going beyond the theory, there is a growing base of evidence of a positive link between carbon pricing policy and investment in low carbon energy technologies and practices. That evidence base is strongest in those jurisdictions with the longest history of carbon pricing policy regimes, which allows for *ex-post* analyses of these linkages. In other places where less historical experience exists, including that of Canada, there is some anecdotal (but not yet definitive) evidence that this kind of positive relationship exists.

3. At the same time, the academic literature and policy experience on carbon pricing and investment tells us that, while carbon pricing is the single greatest driver of investment, a host of other important factors influence investment decisions. For example, key characteristics of the pricing policy itself – most notably its certainty and stability, and the level of the price, are critical to investor perceptions of the risks associated with low-carbon investments. Similarly, there are sectors or activities, with diffuse benefits that go beyond any single investor interests ("public goods"), for which some measure of public investment is required above and beyond the incentive, provided by carbon pricing.

4. Furthermore, carbon pricing policy can create indirect positive impacts for private investment by generating significant public revenues that translates into (i) the capacity to provide public investment where needed (that will attract and multiply private investment) and (ii) reduced cost of capital for private investors resulting from an avoided crowding out effect of public borrowing and debt financing.

5. The case for promoting investment in a low carbon energy system goes beyond the direct environmental benefits of doing so. Increasingly, given the substantial private and public investments being made in low carbon technologies and activities around the world, it is becoming a matter of competitive advantage in the global economy.