CHBA Background Paper on Cap and Trade

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Executive Summary

Recent years have brought growing awareness around the world of the key role greenhouse gasses (GHGs) play in climate change. Human activities – particularly the use of fossil fuels – have significantly increased the level of these gasses in the atmosphere. GHG emission impacts are not localized; they are felt around the world.

As governments in Canada and the U.S. look for ways to address climate change and reduce GHG emissions, 'cap and trade' systems are being given serious consideration. This paper examines the range of direct and indirect impacts that a cap and trade system may have on the residential construction industry and its customers. It should be noted that, at present, the exact structure of a future cap and trade system in Canada is unclear. The analysis presented here is based on the wide-system proposals – the Western Climate Initiative – already being pursued by a number of provinces.

Policy aims to cap emissions and use market forces to reduce GHGs

'Cap and trade' is a policy approach which works to set a price on emissions of GHGs (carbon dioxide and others), encouraging market forces to find the most cost-effective reductions.

It sets a 'cap' on the amount of GHG emissions permitted by large emitters. The cap will decrease in absolute terms over time. Emissions allowances and permits equal to the cap are issued on a regular basis, through a general auction or as subsidized or free allocations, or a combination. These allowances or permits also decrease in absolute terms over time.

All 'covered entities' have to report their actual GHG emissions, and turn in sufficient allowances or permits to cover them – or face large fines or penalties. Companies which reduce their emissions below their cap will be able to 'trade' (i.e., sell) their extra allowances to those whose emissions are still too high. Most systems also allow 'offset credits' for such things as reforestation projects, methane capture from landfills, and increased energy efficiency in non-regulated sectors.

Widely-based, deep-cut programs could start here in 2012

This policy approach has been used in Europe since 2005 and is being pursued in other parts of the world. Recent Canadian and American administrations did not embrace the concept, so provinces and states began taking their own action. Four Canadian provinces – British Columbia, Manitoba, Ontario, and Quebec (with Nova Scotia and Saskatchewan as observers) – are collaborating with western U.S. states to create a regional approach beginning in 2012[1]. (Alberta brought in a limited program in 2007, but it only imposed caps on the amount of GHGs per unit of production, not hard caps.)

[1] The Western Climate Initiative

At present cap and trade is being actively pursued at a federal level by the new Obama administration in the United States, but the outcome of this initiative is not yet clear. It is expected that U.S. adoption of a cap and trade system would compel Canada to take similar action. The federal government has issued draft rules for a Canadian offset credit system, and said that further details of regulatory infrastructure will be released in the fall of 2009.

Allowances are a new asset with real value and costs

Cap and trade creates a new kind of tradeable asset – carbon emission allowances – with real value. One expert has said that, depending on program details and stringency, at a carbon price of $30 a tonne, the value of Canada's carbon market could approximate $15 billion a year, the US market would be at least $150 billion, and eventually a global market could be worth $600 billion. To reach federal targets of 60 – 70% reductions by 2050, Canada's National Round Table on the Environment and the Economy (NRTEE) has said carbon prices would need to be $15 in 2012, $100 in 2020 and $300 in 2050 (2006 dollars).[2]

Cost- and trade-exposed industries: the Cement example

Not all countries or regions are looking at cap and trade proposals, and where they are the proposed starting dates, rate of reductions and program details differ. For cost-exposed and trade-exposed industries which cannot pass cost increases on to their customers, this can have serious implications. Competitors from less- or non-regulated markets will be producing the same products or services with lower costs of carbon, or none at all. In some cases, this could mean regulated industries forgo expansion, or even close existing plants in the face of lower-cost imports. Most current cap and trade program proposals recommend some support for vulnerable industries, including adjustments to emissions caps, free allocations of emissions allowances, countervailing duties on imports from jurisdictions that do not impose cap and trade policies, or similar regulations.

Cement is cost-exposed: Cement manufacturing is particularly vulnerable to a regime which puts a price on carbon for two reasons. **Controllable energy use (40% of emissions):** First, the production of a key ingredient in cement ('clinker') uses a lot of energy, currently mostly fossil-fuel-based. Although the industry is improving the energy efficiency of its production systems, cement production will remain an energy-intensive process. **Fixed process emissions (60% of emissions):** Second, the majority of GHG emissions from clinker production are an unavoidable byproduct of the chemical process involved in calcinating limestone so that it can become clinker. These emissions, per unit of clinker produced, cannot be reduced. So, to achieve a 15% decrease in GHG emissions from clinker production, a cement producer would have to improve process energy efficiency by 37.5%. Carbon capture and storage may provide a

[2] The NRTEE figures are generally considered higher than actual levels that would be reached in a carbon trading market. However, much depends on the details and stringency of the programs, and whether Canadian emissions allowances and offsets could be traded worldwide, only within certain regions or countries, or only within Canada.

long term solution – but this process remains a speculative and potentially expensive solution.

Cement is trade exposed: China already has replaced Canada as the major source of imported cement to the U.S. Cement imports into Canada are still relatively low, but growing.

Other programs include transition support for the cement industry: The European Emissions Trading Scheme and proposals in Australia, California and the U.S. (federal) include measures to help protect Energy Intensive Trade Exposed industries, and offset fixed process emissions. Cap and trade proposals by the Western Climate Initiative currently do not include such support measures.

Costs and opportunities in the residential sector

While some major material and product suppliers would be 'covered entities', a cap and trade program does not impose direct requirements onto new home builders and renovators. However, the new and potentially substantial costs of GHG emissions are expected to be passed through the economy to businesses at every level and finally on to consumers through higher product and energy costs.

Building materials: One 'orders of magnitude' rough estimate suggests that, using the NRTEE carbon price figures given above, new costs relating to accumulated GHGs in the building materials in an average new house could total $1,135 in 2012, $7,569 in 2020 and $22,707 in 2050 (2006 dollars). As noted previously, the NRTEE price projections are considered high. Also, the rough estimates in this section do not take into account any consumer offsetting decisions, new technologies and support programs. All three are expected to take place. But these estimates suggest the direction of potential additional costs, and the new impetus for GHG reduction and energy efficiency the policy could create.

Industry operating costs: Similar rough calculations suggest that residential builders' costs for fuel and electricity for vehicle, site and office operations could rise by approximately $3.90 per thousand dollars of value added in 2012, $26 in 2020 and $78 in 2050.

Home owners' operating costs: The calculations also suggest a home owner's operating costs (primarily space heating/cooling, lighting and other electric power) for a single family home could rise by approximately $174 in 2012, $1,161 in 2020 and $3,483 in 2050 as a result of a cap and trade regime.

As in the previous discussion, these figures only relate to what might happen if no offsetting decisions were taken – an unlikely outcome. However, they suggest the direction of cost impacts if new technologies can't produce the GHG reductions required, or if consumers' increased spending on new cap and trade costs drains funds from the rest of the economy.

Impacts affect regions and sectors differently

Even where a country or region has the same rules for cap and trade, there can be varying impacts. For example, regions where electricity is generated from coal or oil will face higher costs than those utilizing non-carbon systems such as hydro or nuclear generation. This will directly impact both industry and consumers. In Canada, the "carbon-intensity" of electricity varies considerably from province to province.

Reducing GHGs while avoiding disruption will be challenging

Many experts say that success of a cap and trade program will depend on how effective governments and industry are in providing consumers – or at least lower income consumers – with financial support to assist them in making energy efficiency investments. Cost increases are a key element of cap and trade regimes, as this stimulates GHG-reducing changes in behaviour. But care must be taken to avoid unintended consequences for regions and sectors – and for consumers. It is also very important to harmonize approaches among neighbouring jurisdictions and trading partners. Timing of requirements must take into account availability of new technologies. Special provisions and support programs probably will be required to make sure the main burden does not fall on small business and final consumers.

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A. Introduction

This paper was developed to assist CHBA leaders in understanding the range of potential impacts on the residential construction industry from a 'cap and trade' regime. A cap and trade system will effectively put a price on greenhouse gas (GHG) emissions, and this raises a number of issues for the industry.

While emissions reporting, allowances and caps would apply only to 'large emitters', and would not directly apply to the new home building and renovation sector or to individual homeowners, a cap and trade regime will have a range of indirect impacts including increases in:

- the cost of building materials, equipment, etc. (resulting from GHG emissions during extraction, processing, manufacturing and transport)
- direct costs for new home builders' and renovators' operations (resulting from higher energy costs for offices, vehicles and site services)
- energy costs for clients related to space heating/cooling, appliances, lighting, etc.
- energy costs for clients related to personal transportation.

There will also be:

- broader impacts on local economies (regional differences in power costs, impacts on industrial base, jobs and consumer demand)
- impacts from complementary carrot or stick polices (government support and/or mandatory requirements for decreasing GHG emissions, increasing research and development, encouraging energy efficiency, fostering use of renewable energy, etc.)

Program details must be written carefully if unintended and perverse consequences are to be avoided. Some sectors face higher risks of such impacts. (See section E for a discussion of how a cap and trade system could lead to the displacement of domestically produced cement by imported product from non regulated jurisdictions, and cause *increased* GHG emissions per unit of cement used in Canada.)

B. Cap and Trade: Background

Cap and trade systems are promoted as a way of achieving environmental and economic goals through new government-created obligations and rights (with significant associated costs and value). It can be useful to compare the impact of this current creation of tradeable emissions allowances with the first Europeans' introduction of the idea of property rights and title deeds into North America. That created potential values which had not previously existed. So do cap and trade systems.

Key Elements

- Government decides which sectors and size of facilities will be included as 'covered entities' and regulated under the program.

- Government establishes a target cap or limit for total regional or country-wide GHG emissions by all covered entities, usually based on current or recent emission levels.
  - A 'hard' cap aims at reducing total emissions whether production volumes rise or fall.
  - An 'intensity-based' cap aims at reducing the emissions per unit of output. Intensity-based targets are generally viewed as being ineffective, as they provide no assurance that overall emissions will actually decrease over time.

- The initial volume of regional or country-wide GHG emissions is divided up into emission allowance caps for 'covered entities' such as utility companies, large emitters in private industry, companies distributing fossil fuels, etc. This is done based on historical emissions or industry-specific performance benchmarks.

- Emission allowances or permits for the total volume of carbon dioxide equivalent units[3] under the cap are made available, either by general auction, or by free or subsidized allocation to each covered entity, or a combination of the two.

- At the end of each compliance period, covered entities must turn in allowances equal to their actual emissions, or face fines or other penalties. Those allowances are then 'retired'.

- Allowances are tradeable, through a specialized emissions trading market. If emitter companies cannot comply with the reduced cap by changing their operations' efficiency (and/or if they expand operations), they can purchase unused allowances from others. This has the effect of establishing a 'carbon price' or 'GHG price" in the marketplace.

- 'Offsets' may also be permitted. An offset is an emission credit created through an accepted GHG-reducing project[4]. These can include projects to create new renewable energy supply, reduce emissions of a non-regulated entity, create a GHG 'sink', etc. Investment in reforestation is a common type of GHG sink offset project. Other offset projects can improve energy efficiency in non-regulated industries, capture industrial pollutants, build hydro-electric dams, create or switch to low- or non-GHG-emitting fuels, etc. in non-regulated sectors or countries. Companies that face high costs to reduce

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[3] 'Carbon dioxide equivalent units' is usually written CO_2e. There are a number of greenhouse gasses, each of which has a specific level of 'greenhouse' impact. CO_2e is the standard unit indicating an impact functionally equivalent to carbon dioxide.

[4] Again, details and oversight are important to help ensure that the GHG reductions are real, lasting and not double counted.

their own GHG emissions may buy offset credits created in projects where the costs are lower.

- Over time, the total emissions cap is reduced, which in turn reduces each emitter's allowance. This will most likely increase the value of emission allowances and make efficiency investments more attractive.

- The theory underpinning cap and trade is that, by creating a market price for emissions and allowing the free trade of allowances, the market will deliver the most economically efficient result. Emitters can determine whether making energy efficiency/GHG reduction investments at their own facilities are more or less cost effective than purchasing additional allowances, permits or offset credits being sold by others.

- Since the impact of GHGs is global rather than local, any reduction in GHGs has the same effect on the world climate.

> In Canada, 80% of total national GHGs are predominantly associated with the production or consumption of fossil fuels for energy purposes. About 44% comes from stationary sources such as electricity generation, space heating, fossil fuel industries, manufacturing, construction, and mining. Domestic transportation of goods and people accounts for 27%. The remaining 9% is from fugitive sources such as venting and flaring of waste fuel gases or releases from mine openings. Non-energy sectors such as industrial processes and solvent use are responsible for almost 8% while the agriculture and waste sectors represent 9% and 3% respectively.
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> Environment Canada website
> http://www.ec.gc.ca/cc/default.asp?lang=En&n=94A61E38-1

C. International and North American Action on Cap and Trade

Spurred by climate change science and international negotiations, carbon pricing (through carbon taxes, or cap and trade, or both) has been promoted as a key tool in reducing greenhouse gas emissions (GHGs). Cap and trade programs have been used successfully before, for example to reduce air pollutants such as nitrous oxide and sulphur dioxide, but the new programs targeting GHGs are on a very much larger scale.

The National Round Table on the Environment and the Economy reported in 2009[5] that many of Canada's top trading partners have or are considering implementing carbon pricing policies before 2020. While the report showed that China, Mexico and India had no plans, the UK, Germany, Norway, and France all had programs in effect, Australia's would be implemented shortly, Japan had a limited program and both the U.S. and South Korea had either proposed or planned initiatives. Details, especially pertaining to the stringency of some of these program proposals, remained uncertain.

Member countries in the European Union have had a cap and trade program in effect since 2005. After the first three-year pilot program phase, the European Union Emissions Trading Scheme (EU-ETS) is into its second (2008-12) phase now, and details for the 2012+ period are being finalized. Initial experience has provided some lessons.

Australia has a cap and trade program which was originally scheduled to come into effect in 2010, but has recently been delayed a year because of the economic downturn.

In recent years, Canada's federal government has been far from enthusiastic about pursuing national GHG emission reductions. Its *Turning the Corner* plan, introduced in 2007 and not yet implemented, called for cuts in GHG emissions per unit of production (intensity) of 20% below 2006 levels by 2020, and 60–70% below by 2050. However, the plan did not propose any hard caps until 2018, and allowed a high ratio of offsets or payments as a compliance option. As one group noted, the plan "has been widely criticized in Canada, mainly for its across-the-board use of intensity targets, its complex set of compliance options and exemptions, and the low emissions price that it would be likely to produce."[6]

In the absence of effective federal action in Canada and the U.S. (see below), provinces and states began taking actions on their own.

- Alberta began a cap and trade scheme in 2007, but it was limited in application to the 100 largest industrial emitters, and the province based its caps on GHG intensity, rather than hard caps on total emissions.[7]

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5 *Technical Report – Achieving 2050: a Carbon Pricing Policy for Canada*; NRTEE (Canada) 2009

6 Pembina Institute Backgrounder: The Government of Canada's Climate Policy, February 2009

7 Companies which can't reach their emissions targets can buy surplus credits from other regulated companies, contribute $15 per tonne above target to a new Alberta fund to invest in GHG reduction technologies or invest in Alberta-based and accepted projects that reduce other GHGs.

- Ten states in the northeastern U.S. created the Regional Greenhouse Gas Initiative (RGGI) with a restricted mandate to set a cap on emissions of carbon dioxide from power plants, and allow sources to trade emissions allowances. Each state brings in its own program for meeting the goals and requirements of RGGI. The program held its first allowance auction in 2008 and caps came into effect this year. BC and all Canadian provinces from Manitoba east are observers to RGGI.

- British Columbia, Manitoba, Quebec and Ontario have signed up as Partners with seven western US states in the Western Climate Initiative (WCI). Nova Scotia and Saskatchewan are also present as Canadian observers. That group is in the middle of developing agreed principles and requirements for a broad cap and trade system. Member states' and provinces' programs would cover mid- to large-scale emitters by 2012, and add in fuels for transportation and for residential, commercial and not-already-captured industrial uses by 2015. BC, Ontario and Quebec have passed or proposed legislation enabling them to introduce a cap and trade program, and detailed proposals are under development.

In November 2008, the election of Barack Obama in the U.S. opened the way for a major policy reversal on climate change in that country. At the end of June, 2009, the House of Representatives passed a massive bill with far-reaching programs in energy and climate matters, including measures for a broad-based cap and trade program.

> "Canada has done so little for so long that our climate policy has laid us wide open to the serious protectionist provisions in the 1500 page US House of Representatives Bill HR 2454, the *American Clean Energy and Security Act*. That likely means that Canadian rules must match American ones. As climate laggards, Canadian exporters will face substantial tariff barriers to their access to US markets if our rules aren't found to be consistent with those in the US.
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> "Now that the 2008 US senate election fight is finally over, with Senator Franken confirmed, Obama has 60 Democratic seats and a better chance of getting something like ACES through the Senate. The Senate starts its hearings on the Bill on July 7, in the hope of adopting something by the fall. In the expected bitter Senate fight, protectionism seems more likely to increase than to decrease.
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> "Faced with this reality, our federal government has finally abandoned its Alberta-based insistence on intensity-based targets, and promised real carbon caps."
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> from Ontario Environmental Lawyer, Dianne Saxe's EnviroLaw blog (July 7, 2009)
> www.envirolaw.com/2009/07/03/us-climate-rules-and-ontarios-cap-and-trade-plan/

The American Clean Energy and Security Act (ACES, also referred to as Waxman-Markey) also includes provisions to pre-empt state or regional cap and trade schemes such as WCI and RGGI. A number of amendments were made before passage, and there are measures which would negatively affect Canadian exporters.

Democrats Kerry and Boxer introduced their bill to the Senate on September 30, 2009. It is raising lots of controversy, and there are no guarantees at this point of what, if anything, will get passed by that group. The administration's initial goal of announcing a firm commitment on GHG reductions and a national cap and trade system at the United Nations climate change conference in Copenhagen this December may not be achieved.

As the new proposals in the U.S. have emerged the Canadian federal government's positions have changed somewhat. In August, it joined with the US and Mexico in promising to build capacity and infrastructure with a view to facilitate future cooperation in emissions trading systems. Recent reports suggest it wants to introduce hard caps in most of the economy but keep intensity caps in the oil and gas sector.

> "A linkage between Canada and the United States could reduce competitiveness risks and increase the liquidity of a Canadian emissions trading market ...
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> "On the other hand. an un-linked Canadian system would allow initial flexibility for adopting domestic cost containment mechanisms such as price ceilings or banking (of allowances), and would allow Canada to more easily adapt its approach to carbon pricing over time ... (and) implement a carbon pricing policy immediately without having to wait for the United States to finalize its policy design and implementation.
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> "A staged approach, in which a unified Canadian system is first developed and then linked internationally, could be a viable option to meet this international goal."
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> Technical Report – Achieving 2050: A Carbon Pricing Policy for Canada
> National Round Table on the Environment and the Economy, 2009

D. Key Issues in Cap and Trade, and Details of the WCI Proposals

This section examines the elements of a cap and trade program and some of the key lessons, controversies and uncertainties involved. It uses the WCI proposals as the 'base case'.

WCI is a collaborative effort of seven U.S. states and four Canadian provinces to identify, evaluate, and implement measures to reduce greenhouse gas (GHG) emissions in participating jurisdictions.

WCI was started in February 2007 by the governors of five western states: Arizona, California, New Mexico, Oregon, and Washington. BC joined as a full partner in April 2007, followed by Utah and Manitoba. In 2008, Montana, Quebec and Ontario joined the group. (See below for a list of other jurisdictions who sit in as observers.)

Design recommendations were developed after 18 months of gathering stakeholder input, analysis, and planning. Released in September 2008, these recommendations provide the blueprint for the Partner-by-Partner legislation and regulations that would implement the WCI program in each participating jurisdiction.

The design recommendations set out a cap and trade program with a broad scope, to be implemented in two phases. The first phase, beginning on January 1, 2012, would cover emissions from electricity and large industrial and commercial sources. The second phase would begin January 1, 2015 and expand to cover emissions from transportation and residential, commercial, and industrial fuel use not otherwise covered. Mandatory reporting of GHG emissions would begin prior to the cap and trade program, with 2010 emissions reported in early 2011. To encourage emissions reductions prior to the official beginning of the program, certain reductions will be awarded Early Reductions Allowances.

In some areas of the program, WCI outlines options which Partners can choose between, or sets targets, but leaves implementation details to each jurisdiction.

Program Element: Scope

The first element of a cap and trade proposal is scope. Key issues include:

- Who is regulated
  Some programs/proposals only include electrical utilities, while others are very broadly based, including emissions from combustion of fuels in the residential, commercial and small industrial sector, plus vehicle emissions.

- What is covered (GHGs in carbon dioxide equivalent units – CO_2e)

- Where the rules apply
  Do they match the rules in nearby jurisdictions/trading partners?

Key Elements	Western Climate Initiative (WCI) proposal	Comments
Who is regulated Which sectors are defined as 'covered entities'	− For 2012: Electricity generation and imports, large industrial and commercial combustion sources, industrial process emissions (including oil and gas venting) − For 2015: Residential, commercial, and industrial fuel combustion, transportation fuel combustion also included	
Threshold: "Covered entities"	− Entities with annual emissions equal to or greater than 25,000 metric tons (25 kt) of carbon dioxide equivalent emissions (CO_2e) annually must meet caps	This has been criticized by some groups as being too low – below the threshold for existing federal emissions reporting.
Threshold: "Reporting entities"	− Entities with annual emissions equal to or greater than 10,000 metric tons (10 kt) of CO_2e must report − To begin in 2011 for 2010 reporting year	As above.
What is covered GHGs covered (in carbon dioxide equivalent units – CO_2e)	− carbon dioxide (CO_2) − methane (CH_4) − nitrous oxide (NO_2), − hydrofluorocarbons (HFCs) − perfluorocarbons (PFCs) − sulphur hexafluoride (SF_6)	− US ACES Act passed by the House would cover carbon dioxide (CO2) and 16 other GHGs (including methane, nitrous oxide, and several hydrofluorocarbons)
Sources covered	− combustion emissions − fixed process emissions	− WCI has not yet decided on recommended approach to fixed process emissions
Where the rules apply (will apply)	− WCI members represent four Canadian provinces with an estimated 80% of the country's population and seven US states with an estimated 20% of that country's population	− federal plans could pre-empt plans/programs introduced by WCI's U.S. partners

Program start date	− 2012 for caps and trading − reporting to start in 2011 for 2010 emissions data	− 2012 matches US ACES Act start date, as passed by the House of Representatives in June, 2009
Coverage	− Expected to capture the vast majority of GHGs from the region in Phase 2	A very high percentage. EU-ETS covers only about 40% of GHGs.

Program Element: Caps on Emissions

The second key element is the overall cap or limit on emissions, which declines over time. It becomes illegal for those covered under the program to exceed their allocated caps. If they cannot reduce emissions in their own operations, they must use alternate compliance methods, such as buying unused allowances or offset credits from others.

Key issues include:

- Reduction targets

  'Hard' cap or 'intensity-based' reduction? (hard caps restrict the absolute amount of GHG emissions; intensity-based caps address only the amount of GHG emissions per unit of production). In a stable or declining economy, meeting intensity-based caps would lead to absolute reductions in emissions; however, in a growing economy, companies could meet their intensity targets and still substantially increase their real level of emissions. On the other hand, hard caps can tend to stifle an economic recovery, and during recessions they can end up decreasing the rate of GHG reduction.

- Base year

  If economic activity was depressed during the base period and subsequently improves, it can become harder to meet a target reduction of 15%, for example. On the other hand, if the base year was a peak of economic activity and production subsequently drops, the lower volume will be responsible for at least part of the 15% reduction. Since different regions of the same province or country can have very different economic cycles, choice of base year may disadvantage one region over another.

- Phasing: what is/are the period(s)? what are the target percentage reductions?

Key Elements	**Western Climate Initiative (WCI) proposal**	**Comments**
Caps	Type proposed = hard cap − Initial regional cap in 2012 equalling the sum of Partner jurisdictions' allowance budgets − Partners' allowance budgets based on best estimates for actual emissions by covered sources in 2012	

Base year for targets	− 2005 (Individual Partners' proposals vary from 1990 to 2007)	Does not match Kyoto protocol base year (1990), which may restrict tradeability internationally. US ACES also uses 2005.
Reduction targets First period 2020 2050	Straight-line reduction: − 15% below 2005 in 2020 (based on individual members' commitments)	Other programs have set goals for longer time frames – mostly to 2050. For comparison, here are the goals in the US Clean Energy and Security Act (CESA), passed by House of Representatives in June, 2009: 17% below 2005 in 2020 42% below 2005 in 2030 80% below 2005 in 2050

Program Element: Allowances

The third key element is the system of allowances or permits which can be used to meet a covered entity's obligations (i.e., to cover their actual emissions). Unused and unwanted allowances can be traded on an exchange.

Key issues include:

- How are allowances calculated?
  - On the basis of historic emissions or benchmarking by industry/process? Or a combination? (Historic emissions tend to reward poorly performing companies, but benchmarking is more complex and difficult.)
  - How does the calculation process deal with volume downturns, recoveries, periods of mergers/acquisitions, new market entrants?
  - What adjustments or special treatments are available? Who qualifies for them? Are they fair?
  - How are energy-intensive trade-exposed sectors defined and supported, if at all?
  - Do people get credit for early action? How does it work?

- How are they distributed?
  - Free allowances, auction, set price, or combination?
  - Who makes the decision/hands them out?

- If free: Who gets them and under what conditions?
  - How does the system avoid over-allocating them?
  - How does it prevent corruption and graft?
  - Are parts or all of the free allocations specified for certain uses (customer adjustment, research, etc)?
  - How many are reserved for public bodies/purposes?
  - What controls/audits are in place?

- If auctioned: Who gets the resulting public funds?
  - How can/must it be used?
  - What controls/audits are in place? (See also Trading mechanism, below.)

- How often are they handed out/auctioned? Can they be banked?
  The European Union's Emissions Trading System created serious problems in its first phase by not charging for the allowances, basing them on historical emissions (which rewards poorly-performing facilities with lots of permits), overestimating needed amounts, handing them out in one lump sum for the three years, and not allowing banking (they expired at the end of Phase 1). As the Phase 1 deadline approached, unused allowances flooded the market causing prices to crash. But before then a number of companies had simply sold their generous allocations and closed their factories.

- How well is the allowance system harmonized with those of neighbouring jurisdictions? important trading partners? Can/do the trading markets link to one another?
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Key Elements	Western Climate Initiative (WCI) proposal	Comments
Allowance/Credit calculation	Based largely on recent emissions performance. Banking allowed. Current thinking is to distribute allowances at least once a year.	See comments on the EU-ETS above.
Credit for Early Action	− Early Reduction Allowance program for reductions after January 1, 2008 and before January 1, 2012 (eligibility to be jointly determined by partners) − Partners have discretion to recognize other early actions	
Allowance/Credit Distribution	− Auction a minimum 10% of WCI Partner (state or province) allowance budget in first compliance period beginning in 2012, increasing to 25% in 2020 − Each WCI Partner jurisdiction has discretion to auction a greater portion of its allowance budget as it sees fit	The US proposal for 100% auctioning was changed by the House of Representatives to 15% auctioning in 2012.

Program Element: Trading Mechanism

This 'trade' part of the system can create a very large amount of new value. In March 2009, one expert on policy impacts told the US House Ways and Means Subcommittee on Income Security and Family Support that "a CO_2 cap-and-trade program would constitute the greatest creation of government-enforced property rights since the 19th century. Depending on the stringency of the cap and breadth of the program, the annual market value of these property rights will range from $100 billion to $370 billion ..." One Canadian expert has said that if the carbon price is $30 a tonne, the value of Canada's carbon market could be

approximately $15 billion a year. The US market would be at least $150 billion, and eventually a global market could be worth $600 billion.[8]

Key issues include:
- Who is allowed to buy and trade in allowances? Only 'covered entities'? Open market?
- Should investment products like derivatives be allowed?
- How should risks be handled?
- Do smaller buyers and sellers have equal effective access to the market?
- How can speculation and/or market manipulation be avoided?

Program Element: Other Compliance Alternatives

Where a company cannot reduce its own emissions deeply enough or quickly enough, several alternatives may be offered beyond the trading in allowances. 'Offsets' refer to GHG reduction projects undertaken outside the operations of the covered entity, either in Canada or abroad, that result in reduced atmospheric GHGs. Such GHG reductions create offset credits, which can be purchased and applied in place of tradeable allowances. Where the cost of emission reductions within an operation are high, it may prove more economical to purchase offsets if these are less expensive than purchasing traded allowances.

Key issues include:
- Are offsets allowed?
- Are they limited to a certain percentage of a company's emissions obligation?
- Do they have to be achieved within the same province/country/region?
- If a high percentage of out-of-province or international offsets are allowed, that can help achieve reductions at lower cost. But it can also mean large flows of money to other regions or offshore – which may not be politically acceptable.
- Analysis and verification. How do the offset projects prove that they actually contribute to lowering global GHG emissions? (There have been criticisms of projects accepted under the Kyoto protocol's Clean Development Mechanism and Joint Initiative program in the past.) How does the system avoid 'gaming'?

Key Elements	Western Climate Initiative (WCI) proposal	Comments
Use of Offsets	− No more than 49% of the total emission reductions from 2012-2020. Each WCI partner jurisdiction will have the discretion to set a lower percentage limit − Proposes to accept domestic offsets and Clean Development Mechanism credits	

[8] Statement by Jack Mintz, Palmer Chair of Public Policy at the University of Calgary, quoted in *Emissions Trading*, Alberta Oil magazine, May 29, 2008. www.albertaoilmagazine.com/?p=310&year=

Transition Support

Reducing GHG emissions will require costly new investments by covered entities. Also, a number of these costs will be passed on through the economy to other industries and to final consumers. Support for the transition to a lower-carbon economy will be vital.

Key issues include:

- Are initial allowances auctioned by government or given away?
- What rules govern how the funds from auction or the value from free distribution are used?
- Are low-income consumers adequately compensated for needed energy improvements?
- Are energy-intensive trade-exposed industries adequately protected from unregulated competition?

Transition Support	− Use of auction revenues for purposes such as energy efficiency, renewable energy, and research, development, demonstrations and deployment − Also used for jurisdiction-specific objectives such as consumer support and industry competitiveness support	
Treatment of Energy Intensive Trade Exposed Sectors (EITS)	− As yet undefined. − Statement of principles drafted, and comparison of approaches in other areas (publication expected in late July 2009) − Collecting information – white paper on options expected in 2010.	For comparison, if passed by the Senate, the ACES Act which passed the US Congress in June 2009 would include: − Allocation reflects sum of direct and indirect emissions − 100% allowance rebates for eligible energy intensive industries until 2025 − Rebates up to sectoral average emissions per unit production − Beginning in 2026, percentage drops by 10% annually

E. Building Material Cost Impacts: The Case of Cement

Cap and Trade, like any new policy has the potential to produce unforeseen/undesirable results. As discussed above, there can be different impacts among different regions, between different industry sectors, and different technologies within the same sector. This section looks at some of the factors affecting the cement industry, where there is considerable potential for undesirable results.

Energy intensive

Cement manufacturing requires high, sustained kiln temperatures of more than 1,500^{o}C. In Canada, energy accounts for approximately 40% of operating costs, and more than 20% of the value of shipments. In 2006, approximately 78% of the cement industry's energy consumption was coal and petroleum coke. Another 12% was electricity, 6% came from alternative and renewable energy sources, and natural gas and petroleum products each accounted for 2%. The industry has been working to reduce its energy use, through energy efficiency, fuel switching, etc. The Cement Association of Canada (CAC)[9] reports that, for combustion emissions alone, cement is the second most GHG-intensive of all industry sectors, second to electricity (GHG emissions per dollar of output).

Industrial process emissions (calcination)

In the case of cement, the basic chemistry of the manufacturing process could create a very difficult situation for manufacturers under a cap and trade system, without delivering the desired environmental outcome. This is because production of clinker for cement powder results not only in energy use emissions, but also industrial process emissions. When one includes process GHGs, cement manufacturing is the most GHG-intensive of all sectors.

Emissions Due To Production Of Cement Clinker

Emission type	Definition	Emissions share	Reduction strategy?	Change required to achieve 15% GHG reduction
energy-use emissions	CO_2 released when fuel is burned to power the cement kilns	40%	increased efficiency, fuel switching, etc.	37.5%
fixed process emissions	CO_2 released as a byproduct of the chemical process when limestone is calcined to form 'clinker'	60%	cannot be reduced	not applicable

[9] CAC membership comprises eight companies operating clinker and cement manufacturing facilities, granulating and grinding facilities, and distribution terminals from Atlantic Canada to the Pacific coast. Members delivered 98% of Canadian cement production in 2007.

Combined impact

Cement manufacturing facilities emitting more than 25,000 tonnes GHGs a year would be covered under the WCI program. As discussed above, WCI calls for emissions to be reduced by 15% from 2005 levels by 2020. Because of the fixed nature of calcination process emissions, a 15% overall reduction in total CO_2 emissions from the production of cement clinker, would require a 37.5% reduction in fuel-related emissions.

So far, WCI has not published any longer-term goals, but other programs have internationally. They range from 60 to 90% reductions by 2050. The ACES Act passed in the U.S. House of Representatives in 2009, for example, called for GHGs to be reduced by 43% below 2005 levels by 2030, and 83% below 2005 by 2050. For cement production, that is physically impossible with current technology.

A number of companies and associations in the cement industry have been pursuing energy substitution and related efficiency improvements individually and through an international group called the Cement Sustainability Initiative. These efforts include the use of alternative fuels and renewable energy sources, combined heat and power generation, reducing the amount of clinker used to make finished cement, and pursuing changes to standards.[10] The industry is also participating in research on longer-term technologies, such as pre-combustion or decalcination and carbon capture and storage (CCS).

However, at least in the short- to mid-term, without some kind of special treatment, the cement sector would definitely be unable to meet proposed cap targets. This would require the industry to buy significant amounts of emission permits or offset credits, or else reduce production levels through plant closures and reliance on imported product. This creates real potential for dislocation within the cement industry without achieving any net environmental benefit.

Importing cement from jurisdictions that do not impose a cap and trade regime or other GHG reduction/carbon cost regulations, would simply move the source of GHG emissions, not reduce these emissions. In practice, the additional transportation requirements to source off-shore cement would most likely lead to a net increase in GHG emissions.

For the residential construction industry, the question is: what impact would this scenario have on the builders and their customers?

[10] Canadian allowed levels for ground (rather than calcined) limestone in cement are being increased from 5% to 15%. In Europe, standards apparently allow up to 30%.

Trade exposure

Where there is competition from cement manufacturers based in non- or less-regulated countries, cement users will still have an opportunity to purchase cement at prices that do not include cap and trade cost impacts. As a result, Canadian manufacturers will come under increasing price pressure and may lose market share to importers. If the price differential gets large enough, it can affect decisions on where companies locate new plants, expand their operations, or even close facilities. This has obvious implications for Canadian jobs and economic growth. As well, Canadian new home builders and renovators could become vulnerable to manufacturing and supply decisions taken outside the country.

It is important to note that if, as a result of cap and trade costs, cement consumed in Canada is sourced from offshore, there will be no reduction in GHG emissions and no net environmental benefit. In fact, as mentioned previously, it is quite likely that growth in the use of imported cement would result in increased GHG emissions. Clearly, such an outcome is not consistent with the environmental goals of a cap and trade system.

International: A fine, dry powder, cement is manufactured around the world, and is easy to ship long distances. Between 40% and 45% of Canada's annual production is shipped to the U.S. Imports into Canada are still low, but they are growing and the barriers to market entry are not high.

The NRTEE has identified the cement sector as having the highest level of cost and trade exposure of any industrial sector. Between 2001 and 2006, China has definitely replaced Canada as the largest supplier of cement to the U.S. In 2001, Canada's share of U.S. cement imports was19.7%, compared to China's 14.7%. By 2006, Canada's volume of shipments had declined slightly, leaving it with only 14.1% of the growing U.S. import market. China's share had increased by a factor of three, to an impressive 35.5%. Cement imports into Canada from China have also grown.

Cement markets can be broken down geographically. Coastal areas tend to be more vulnerable to foreign supplies than inland areas, as the cost of shipping by water is typically lower than shipping by land.

One European study[11] modelled a typical EU state economy in relation to inland and coastal regions. It found that if there were no costs for EU-ETS GHG allowances, coastal cement producers would have a 20% import rate and aggregate operating profits of approximately 84 million euros (coastal). Inland producers would have a zero import rate and aggregate operating profits of 178 million euros. An allowance price of 20 euros per tonne would result in an import rate of 33% and operating profits of zero for coastal producers, and a 6% import rate and 120 million euros operating profits for inland producers. If the allowance price went to 50 euros per tonne, that would result in an import rate of 51% in the coastal regions and operating losses of 129 million euros. Inland producers would manage to

[11] EU Emissions Trading and the cement sector: a spatial competition analysis, Jean-Pierre Ponssard and Neil Walker, May 2008

survive, but their import rate would jump to 23% with profits of just 19 million euros. With pure auctioning of emission permits (i.e., no special protection for the cement sector) and CO_2 prices of up to 50 euros/tonne, non-EU imports could conceivably result in a carbon leakage rate from the EU of more than 70%.

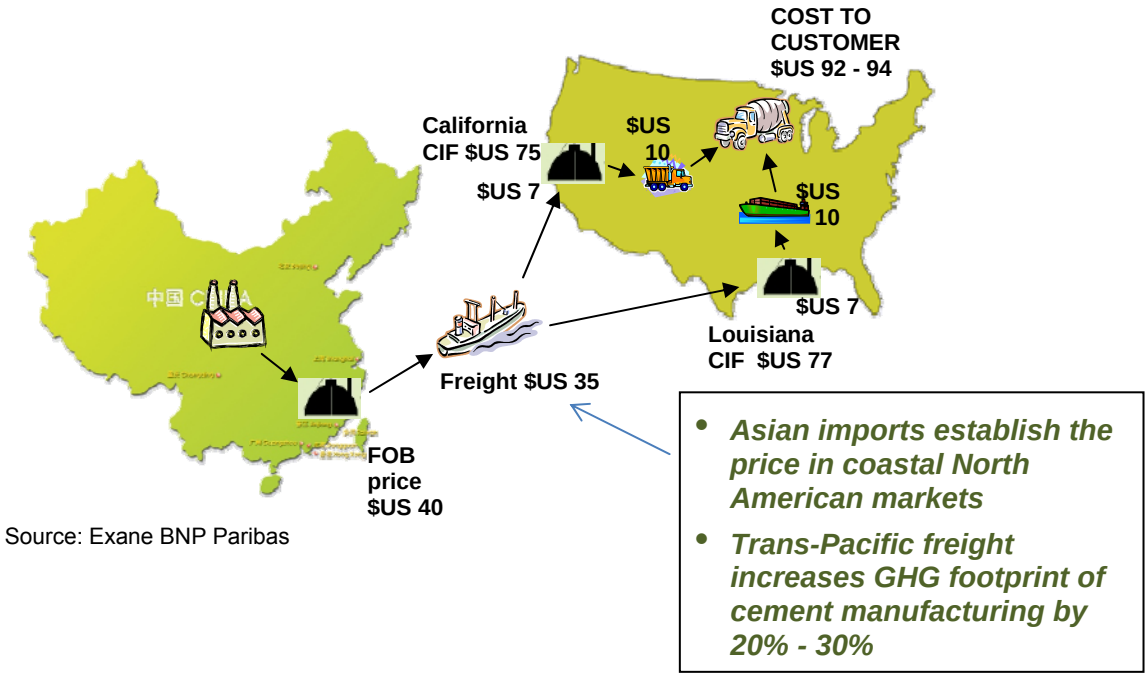
In the last example, there could be immediate leakage through plant mothballing or closure of coastal plants, the report says, "although only to the extent that export capacity was immediately available in non-EU countries":

> "The condition attaching to the fourth of these points is ultimately an empirical question, and the answer may be contingent on the economic growth cycle in potential exporting countries. For example, a global economic slowdown could quickly free up a very large amount of kiln capacity. The situation in cement trade could then be reminiscent of what happened in the mid 1980s when the technology of bulk maritime transportation enabled large export flows from countries with excess capacity such as Greece and Turkey into European markets such as France and the UK (Dumez and Jeunemaître, 2000). A number of years later, major French and British cement firms acquired some Greek and Turkish firms (Ponssard *et al*, 2007). That consolidation move reduced the degree of competition between these EU regions. There is, however, one important difference. The Greek and Turkish producers were not intrinsically more cost efficient, whereas in the current situation, producers which do not incur the social cost of CO_2 emissions would enjoy an absolute advantage over EU-based producers. Therefore, any future consolidation move by EU producers may involve a partial relocation of production."

The CAC says coastal/inland supply chain differences are already emerging in North America. As well as harming cement companies, the growing imports from countries such as China can actually worsen GHG emissions in two ways:

- Production of imports from non- or less-regulated areas often results in higher levels of emissions during production. For example, 55% of installed capacity in China uses the less efficient wet or dry shaft kiln technologies, they note, as compared to 0% in WCI provinces and 5% in WCI states.

- There can be a substantial GHG cost because of the transportation energy used in shipping. The CAC uses the following graphic from Exane BNP Paribas to show the impact of shipping.



Based on current industry information, there is no planned expansion of cement production facilities in coastal areas of the western US and Canada. The only new cement production capacity currently planned is in inland areas, beyond the mountains. This provides some indication of the impact which cement imports are already having on investment decisions in the cement industry.

Intra-national/regional trade:
In the absence of national cap and trade programs, states and provinces may well continue to pursue different approaches to cap and trade. Trade imbalances can happen when nearby jurisdictions have differing cap and trade systems that result in lower or higher operating costs. Less-talked-about, but still an important issue, is the ongoing competition for market share between partially or wholly substitutable products, such as wood, steel and cement. GHG emissions and carbon pricing could definitely affect those markets if cement and concrete face much higher emission-related costs.

Cap and Trade approach to competitiveness issues

As mentioned above, the WCI proposal includes industrial process emissions in calculating the GHG cap that will adversely impact the cement industry. The caps and allowances committee has drafted a statement of principles on competitive issues. However, WCI is still a long way from finalizing the details. In fact, one source suggested they will probably explore options but leave final decisions to each Partner jurisdiction.

The cement industry has been arguing strenuously that it needs protection – either to have its calcination process emissions excluded when calculating caps, or to be granted enough free allowances to cover those emissions.[12]

The cement industry points out that all other major cap and trade systems have recognized the threat of trade leakage due to competitiveness in the cement sector:

- **EU-ETS Phase 1, 11 and 111 (proposals for post 2012)**
  The Phase 111 agreement reached in December 2008 calls for auctioning of allowances to start at 20% in 2013 and move to 70% by 2020. However, "sectors at significant risk of leakage" will continue to receive 100% free allocations at "the level of the best available sector technology". To be considered "at risk":
  - the sector's costs to comply with the caps must exceed 30% of gross value added (GVA), or
  - the value of the sector's exports outside the EU plus imports must total more than 30% of the total EU market, or
  - compliance costs must exceed 5% of GVA ***and*** the value of exports outside the EU plus imports must exceed 10% of the EU market.

- **California's *Global Warming Solutions Act* (AB 32)**
  This says policies must not contribute to leakage. Discussions suggest that the state will introduce options to encourage alternate technologies. Tradeable performance standards are being consideration, possibly in parallel with cap and trade regulation of combustion-only emissions.

- **Australia** plans to auction allowances, but major trade-exposed industries such as cement will be given up to 95% of permits for free.

- **The US ACES Act**
  Passed by the House of Representatives in June, this would make energy-intensive trade-exposed sectors eligible for rebates (equivalent to free allowances). If those were not effective, the Act proposes a 'border adjustment' program, where importers would have to pay for special allowances to cover the CO_2 emissions tied to their products. The revenues would be given to US producers.

No one in the Canadian industrial sector wants to be on the wrong side of a border adjustment.

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[12] Exact design of the assistance is important to prevent unintended consequences. For example, a privately owned Australian company about to bring a new low carbon cement into production has taken issue with its government's proposed carbon trading program. According to an article published in Aggregate Research (http://aggregateresearch.com/article.aspx?ID=16597), Zoebond says cement producers have convinced Australia to give them 94.5% free allowances – something his own company's much lower GHG emissions probably will not qualify for. Also, because the allowances are based on the amount of clinker produced rather than cement binder, producers could add more substitutes earlier in the process, increasing the volume of free permits they could receive for the same volume of blended cement.

F. Cost Impact Pathways for the Residential Sector

Carbon pricing will introduce new costs to the economy, and create winners and losers.

Exactly who wins and who loses depends on program details – who pays how much and how it affects competitive positions and final prices to consumers. The level and effectiveness of 'revenue recycling' is also important:

- how much of the value of permits and allowances goes to industry or government
- how they use these revenues (do they pass it on to industry and consumers to compensate for the extra costs of achieving GHG reductions). The value of free allowances given to sectors where there is a straight cost pass through to customers is likely to be distributed to shareholders rather than the buyers of their products
- There is likely to be a temptation for governments to divert auction funds to other non-GHG-reduction uses.

In its 2009 Technical Report, NRTEE said that revenue can be used to improve carbon pricing policy in four ways:

- cuts to personal income, corporate or sales taxes (economic efficiency),
- direct rebates to households and consumers (social equity),
- free allocations or rebates to vulnerable sectors (international competitiveness), and/or
- funds for technology, innovation and research and development (technology deployment).[13]

Finally, impacts depend on Canadians' ability to take advantage of opportunities in new technology, jobs, etc. The oft-cited promise of 'green jobs and industries' is put forward as a mechanism through which economic impacts could be mitigated.

Six key cost/opportunity pathways

Through implementation of a cap and trade regime, carbon pricing is intended to permeate the economy. The goal is to create new price signals that change decisions and behaviour in the market, so that overall GHG emissions go down. While the first impacts will be felt by the major emitters who have to report their emissions and meet mandatory caps, those companies will be passing on as much of the increased costs as possible to their customers, and so on down the line. By the time this process reaches new home builders and renovators, it will be showing up in six main areas:

- building materials, equipment, etc. (through GHG emission costs from extraction, processing, manufacturing and transport)

- new home builders' and renovators' operations (through capital and operating costs related to office, vehicles and site)

[13] NRTEE, Op. cit.

- house-related fuel costs for clients – increasing the cost of home operations (fossil fuels and fossil-fuel-generated electricity for space heating/cooling, appliances, lighting)

- non-house related fuel costs for clients – primarily transportation costs

- broader impacts on local economies (regional differences in power cost, impacts on industrial base, jobs and consumer demand)

- complementary carrot or stick polices (government support and/or mandatory requirements for decreasing GHG emissions, increasing research and development, encouraging energy efficiency, fostering renewables, etc.)

The following sections give more information about each of these pathways.

1. Building materials, equipment, etc. (extraction, processing, manufacturing and transport)

Under a cap and trade regime, materials and equipment will be exposed to new cost pressures. Those with low embodied emissions should find themselves in a better competitive position. Products and technologies which offer GHG reduction should see better market economics and experience higher demand. Some companies also may be able to invest in offset projects, providing additional flexibility in meeting their own GHG emissions requirements, or additional revenue through trading offset credits. Manufacturers with high 'embodied' GHG emissions/high fuel use associated with their products, such as the cement industry, will see an appreciable increase in costs unless they are given special treatment.

As noted in section E above, sectors which face both significant cost increases and high exposure to competition from other non- or less-regulated areas are particularly vulnerable, and may experience losses in market share unless they receive support.

The National Round Table on the Environment and the Economy (NRTEE) has modelled the cost and trade exposure of several large economic sectors. Their threshold for determining whether a sector was 'trade exposed' was whether exports or imports represent more than 40% of sector output (a very high figure[14]). On that basis, its modelling suggests that sectors that are both cost-exposed and trade-exposed (exports) include iron and steel, chemical products, gas, oil, and coal. Those considered both cost-exposed and trade-exposed (imports) are oil, chemical products and coal. (It is worth noting that although iron and steel and industrial minerals are below the 40% cut off related to imports, they are very close to it, and would be considered trade-exposed in other jurisdictions.)

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14 One threshold for determining whether a cost-exposed industry is trade exposed in the EU is where the combined value of exports from and imports into the EU are 10% or more of the total EU market for that sector) – a figure which would take in much of the Canadian economy.

"(Given that chemical companies are some of the biggest energy users amongst manufacturers) ... Success for a chemical company in a cap-and-trade system could boil down to the energy-saving value of the products it sells—not just how much energy it consumes.

Chemical companies sell a variety of energy-saving materials, including industrial gases used as an insulator between glass panes in energy-efficient windows, foams used in the blades of electricity-generating windmills, and lightweight plastics used in car parts that help vehicles consume less energy.

Some chemical companies report demand for their energy-saving products is strong already, even in the midst of the economic recession.

DuPont Co. expects by 2015 its sales from renewable materials that displace fossil fuels will nearly double to $8 billion.

German chemical maker BASF SE sees big business opportunities in the weatherproofing of residential homes, which typically contain an average $17,000 worth of chemical products, according to the chemistry council. There is room to raise that to up to $30,000 per house, said BASF.

Other chemical companies are installing projects that will lower their own energy bill and potentially generate pollution credits to help offset their emissions.

"Whether your inspiration is cap-and-trade or the prospect of $140-a-barrel oil, you need to be strategically involved in this space," said Rich Wells, vice president of energy for Dow."

from InTech Automation Update July 20, 2009
http://www.isa.org/InTechTemplate.cfm?Section=Technology_Update1&template=/ContentManagement/ContentDisplay.cfm&ContentID=77992

Those sectors with cost increases, but a low exposure to competition from other non- or less-regulated jurisdictions, will be in a better position to pass increased costs on to their buyers. The NRTEE modelling puts the electricity sector (very high costs), petroleum refining, freight, and industrial minerals into this category based on export percentages. Based on import percentages, it would include electricity generation, natural gas extraction, freight, petroleum refining, iron and steel and industrial minerals (although as mentioned above the last two are very close to the 40% cut off). [15]

Even when a sector may not be considered cost- and trade-exposed, one or more of its segments can face quite different conditions. See section E for a discussion of how cap and trade proposals affect the cement industry (a segment of the relatively unexposed

[15] In both cases, agriculture is also included, although this has less relevance to the home building sector.

industrial minerals sector) which, modelled separately, would show some of the highest cost and trade exposure figures on the NRTEE's chart.

2. GHGs in the average home by time of sale

Total GHGs emitted by the building components (from raw materials extraction to completion of construction) are relatively small in comparison to the total GHGs from operating the home, but they can still be significant.

A 2002 study by the Athena Sustainable Materials Institute compared life cycle impacts of a 207.4m^2 (2,204 sf) home built to typical standards of the 1970s, 1990s and R2000 (in 2001). The institute calculated the life cycle (cradle to grave) GHG impact of the structure and envelope of the R2000 home at 80.52 tonnes CO_2e, before adjustment for required maintenance and replacement of structural or envelope components.[16] After discussion with Athena SMI staff, this report reduced the study's 'subtotal' and 'total' figures by 6% to remove the effect of GHG emissions related to demolition and disposal at the end of the building's useful life. Figures do not include GHG emissions associated with the manufacture of heating/cooling equipment, appliances, or other 'extras' often included with a new home sale or rental.

This paper uses the adjusted GHG emissions figures from that study to approximate potential additional costs of carbon assuming a straight pass through of the prices NRTEE estimated would be required to meet the federal government's future goals for GHG reductions, and no adjustments. (In 2006 Canadian dollars, those 'required' prices are $15 in 2012, $100 in 2020 and $300 in 2050.)

Potential additional costs related to straight pass through of Carbon Pricing (life cycle)

2,204 sq. ft. R-2000 house (2001), with basement

	embodied GHG (tonnes CO_2e)*	2012 ($15/t CO_2e)	2020 ($100/t CO_2e)	2050 ($300/t CO_2e)
Structure				
– below grade total	41.10	*Cast in place concrete slab, footings and basement walls*		
– exterior walls	2.23	*2" x 6" wood, KD*		
– interior walls	0.49	*2" x 4" wood, KD*		
– 1st and 2nd floors	2.10	*Solid wood joists and plywood decking*		
– roof	2.20			
Structure Total (report) Adjusted (-6%)	48.12 45.23	$ 678.45	$ 4,523.00	$ 13,569.00

16 This compares with 78.62 tonnes for the 1990 house and 67.3 for the 1970 house.

Envelope				
– roof	5.27	*Asphalt shingle*		
– ceilings	1.20	*R-50 fiberglass batt*		
– basement walls	1.29	*R-20 fiberglass batt*		
– interior walls	1.70	*Gypsum*		
– exterior walls	11.48	*Clay brick, R-20 fiberglass batt*		
– windows	11.46	*PVC double pane, Low E, Argon filled*		
Envelope Total (report) Adjusted (-6%)	32.40 30.46	$ 456.90	$ 3,046.00	$ 9,138.00
Initial Building Total Adjusted (-6%)	80.52 75.69	**$ 1,135.35**	**$ 7,569.00**	**$ 22,707.00**

** life cycle embodied and process GHG estimates from Athena Sustainable Materials Institute, including extraction, processing, manufacturing, transportation, and construction, not including additional materials for maintenance and repair. To approximate overall total without end costs (demolition and final disposal after useful life of building), we have subtracted 6% from the study's pre-maintenance and repair figures.*

The total GHG figure in this example is consistent with worksheets prepared by King County in Washington State[17] to calculate lifetime embodied GHG emissions (extraction, processing, transportation, construction and disposal of materials and landscape disturbance) for single family homes. They assume that an average 2,272-square-foot single family home contains 88 $MTCO_2e$ of embodied GHG emissions, or 39 metric tonnes CO_2e/1000 square feet) – very comparable to the above, although the contributions of elements appears to differ somewhat.

King County's worksheets also assume the same 39 metric tonnes CO_2e/1000 square feet factor for embodied GHG emissions in multiple units, resulting in:

- 33 $MTCO_2e$ embodied GHG emissions for a small (850 square foot) apartment in a large building ($3,300 at the NRTEE 2020 carbon price)
- 54 $MTCO_2e$ embodied GHG emissions for a larger (1,390 square foot) apartment in a small building ($5,400 at the NRTEE 2020 carbon price)

Embodied GHG emissions are only a fraction of energy-related GHG emissions for building operations over the building's lifespan. See point 3, below.

[17] Used for meeting the Washington's State Environmental Protection Act review of GHG impacts of development proposals – see http://www.kingcounty.gov/property/permits/info/SiteSpecific/-ClimateChange.aspx#SEPA

3. New home builders' and renovators' office and site operations

Under a cap and trade regime, business operating costs would rise from use of fuel in construction, office space heating/cooling; power for equipment; fuel for company vehicles; and electrical power.

Starting in 2012, the WCI design recommendations would cover GHGs from the *production* of energy products that would affect consumers and small companies – electricity generation and imports, oil and gas extraction, processing and refining. The program would be expanded to include GHGs related to *end-user combustion of fuels* – for transport and for commercial, industrial and residential operations not otherwise covered – as of 2015. (The intent is to add a new class of 'covered entities' – initial distributors of gasoline, heating oil, natural gas, and similar products – and set their allowances based on the estimated GHGs produced when their products get used by their customers.)

Both phases are expected to produce increases in fossil-fuel related energy costs. The amount of the increase will depend on the ratio of free allocations/auctioning of allowances, any over-allocations, availability of offsets, and prices established in the carbon exchange market.

A study for the US Environmental Protection Agency[18] showed that the construction industry as a whole produced 6% of industrial GHG emissions in the United States – the third highest industrial sector after oil/gas, and chemicals. Emissions by new home builders and renovators accounted for 18.4% of that total (18.4 of 6% = 1.1% of industrial GHG emissions).

The study measured how much the sector spent on fossil fuels for on-and off-highway construction vehicle combustion of gasoline and diesel fuel, natural gas combustion for office power, heating and tools, and diesel used for generators, plus electricity purchases. Operational GHG emissions were calculated in total figures and in GHG intensity. GHG intensity of operations by residential builders and renovators was approximately 0.26 metric tonnes of CO_2e per thousand U.S. dollars (2002) value added.

The chart below is a very simple calculation of how that intensity could translate into additional costs due to carbon pricing, assuming straight cost pass through, no gross-up, and no adjustments. *(At this point, it just assumes one 2002 US dollar equals one 2006 Canadian dollar.)*

[18] *Potential for reducing Greenhouse Gas Emissions in the Construction Sector*, US EPA, February 2009

Potential additional costs related to straight pass through of Carbon Pricing

Industry operations, per thousand dollars of value added

Operations GHG intensity	2012 ($15/t CO_2e)	2020 ($100/t CO_2e)	2050 ($300/t CO_2e)
0.26 metric tonnes of CO_2e per thousand US $ (2002)	$ 3.90	$ 26.00	$ 78.00

4. Fuel costs for clients

Indirect impacts for new home builders and renovators arise from GHGs related to the use of fuel by clients for home heating/cooling/power/operation. These can have an impact on consumer demand for efficient homes (construction quality/type), and can further change the relative demand for new construction technologies – whether in new homes or renovations and additions – as compared to existing housing.

A 2007 CMHC study quoted Canadians' average GHG emissions related to housing and private transportation as 5 tons per occupant per year (consistent with the above figures), with 10% going to in-home electricity (appliances, computers, home entertainment, lighting, etc.), 40% to home heating and 50% to automobile use.

For the same typical buildings as above, King County estimates GHGs from building operation - energy as follows (in metric tonnes/CO2e):

GHG emissions (e) from building operation – energy

building type	avg life span	e/year/unit	life-e/unit	life-e/1000 sf
○ single family home	57.9 yr	11.61	672	266
○ small apartment in large building	80.5 yr	4.44	357	422
○ larger apartment in small building	80.5 yr	8.45	681	489

Finally, the King County worksheets also add estimates of GHG emissions related to transportation (vehicles) by occupants over the building's lifespan as follows (in MTCO2e):

GHG emissions (e) from vehicle use/transportation

building type	people/unit	e/year/unit	life-e/unit	life-e/1000 sf
○ single family home	2.8	13.7	792	313
○ small apartment in large building	1.9	9.5	766	904
○ larger apartment in small building	1.9	9.5	766	550

The following chart calculates approximate potential additional costs of carbon per unit per year, assuming a straight pass through of the prices NRTEE estimated would be required to meet the federal government's future goals for GHG reductions, and no adjustments. It is important to note that virtually all cap and trade policy discussions stress that program revenues must be returned to consumers – or at least lower income consumers – to offset these kinds of cost increases.

Potential additional costs related to straight pass through of Carbon Pricing

Costs to clients per unit per year: building operations and vehicle use

Building type	Activity and GHG emissions	2012 ($15/t CO_2e)	2020 ($100/t CO_2e)	2050 ($300/t CO_2e)
Single family home	operations: 11.61	$ 174.16	$ 1,161	$ 3,483
	vehicle use:13.70	$ 205.50	$ 1,370	$ 4,110
small apartment in large building	operations: 4.44	$ 66.60	$ 444	$ 1,332
	vehicle use: 9.50	$ 142.50	$ 950	$ 2,850
large apartment in small building	operations: 8.45	$ 126.75	$ 845	$ 2,535
	vehicle use: 9.5	$ 142.50	$ 950	$ 2,850

5. Broader impacts on local economies, supplies and demand

Additional indirect impacts flow from the effects of a cap and trade regime on the broader economy, through forced reallocation of expenditures and the follow-on impacts on capital utilization, employment creation and final demand. This paper has already noted how the mix of fuel source(s) locally available and used to produce electricity results in very different GHG reduction challenges in different regions. Similar impacts can be expected for other industries. Vulnerable industries may postpone expansions or even shut down plants in higher GHG cost areas, with impacts local economies, job creation and resulting housing demand.

Industries which create a lot of GHGs can be very valuable to their regional economies, and (as in the case of cement production) provide essential components for other needed products – creating political dilemmas. Alberta's oil sands sector is a prime example.

6. Complementary carrot or stick polices

Associated impacts arise from 'complementary policies' designed to reduce GHGs. Recommendations for government policies to assist in this goal are mentioned in connection with virtually all cap and trade plans and proposals. These include new energy efficiency standards and building code requirements, transportation efficiency measures, funding for research and development, new technologies, education, etc.

These policies are expected to make a large contribution to meeting the cap and trade caps. Policy details and implementation will be very important.

> "1.2.6. The WCI Partner jurisdictions recommend covering combustion from transportation, residential, commercial and industrial (including electricity) fuel sources with the expectation that the individual WCI Partner jurisdictions will:
>
> - Mitigate the economic impact on consumers;
> - Implement other policies that will reduce demand for transportation fuels (such as vehicle output standards, smart growth, low carbon fuel standards, transit options, etc.; and
> - Address any issues associated with the point of regulation and implementation"
>
> from *Design Recommendations for the WCI Regional Cap and Trade Program*, Western Climate Initiative, September 2008

NRTEE's recommended program included complementary command and control regulations to avoid oil and gas venting, flaring and pipeline leaks, capture of landfill gas emissions, reducing agricultural emissions, switching to new fuels/power sources for vehicles, and "standards to overcome principal-agent failures in the building sector". On that last point (to address energy reduction disincentives in the landlord/tenant relationship), NRTEE suggested using a LEED standard or equivalent as the base for all new commercial buildings, and "at least a 50% increase in shell efficiency for all residential buildings compared to current or planned codes". [19]

The WCI's complementary policies committee is expecting to publish an initial white paper in the fall of 2009. Potential policies will be evaluated by criteria such as effectiveness (cost/metric tonne), ease of implementation/compliance, effects on low-income communities and small businesses, barriers to harmonization, collateral benefits and costs (e.g., conserving water, increasing use of carbon-neutral electricity) or collateral detriments (e.g., more smog), effects on other GHG production/leakage, and potential to create green jobs and transition to a low-carbon economy.

[19] NRTEE, Op. cit.

G. Summary

Many experts say that the success of a cap and trade program will depend on how effective governments and industry are in providing consumers – particularly low income consumers – with financial support to assist them in investing in energy efficiency and GHG reduction. The same applies to industry – especially those small businesses which cannot pass added costs on to consumers. How such support might be implemented will depend, to a large extent, on the revenue flows to governments arising from a cap and trade regime. It is generally assumed that such revenue could be redistributed through progressive reductions in income tax rates in concert with direct subsidies for low income earners. At the moment, all such initiatives remain theoretical.

Price increases are important to create GHG-reducing changes in behaviour. But care must be taken to avoid unintended consequences for regions and sectors – and for consumers. It is also very important to harmonize approaches between neighbouring jurisdictions and trading partners. Timing of requirements must take into account availability of new technologies.

Special provisions and support programs likely will be required to make sure the main burden does not fall on small business and low income consumers.