Advancing the Cement Industry's Climate Change Plan in British Columbia: Addressing Economic and Policy Barriers

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Abstract

The cement manufacturing industry is both energy intensive and carbon intensive. The industry contributes to approximately 5% of global, man-made CO_2 emissions. As a result, the cement industry is highly engaged in responding to the climate change challenge. Globally the cement industry has developed a comprehensive strategy for reducing emissions through energy efficiency, fuel substitution, material substitution, and long-term research into both manufacturing processes and cement and concrete applications. While governments across North America grapple with taking action to addressing climate change, British Columbia (BC) is moving in advance of other Canadian jurisdictions in establishing a stringent price signal for greenhouse gas emissions. The newly instated carbon tax has the potential to significantly impact the competitiveness of BC's cement industry. This is of concern as provincial efforts to green the BC economy will require more, not less, cement given the many sustainability properties of cement and concrete products. If the competitiveness of the BC cement manufacturing industry is disadvantaged in relation to the global industry, the province's future cement needs will be met through imports from other jurisdictions, namely Asia. Under this scenario, when emissions resulting from the transportation of imported cement are taken into account, this will lead to net increases, rather than decreases, in global greenhouse gas emissions. This paper provides an overview of the BC carbon tax and the competitiveness considerations of the cement industry, including the economic impacts of BC's carbon tax on the cement industry. This paper assesses the policy and economic barriers that must be addressed in order for the cement industry to the advance its own globally developed and proven climate change strategy. Finally, the cement industry's recommendations on moving forward are provided.

1.0 Introduction

Governments and industries around the world are taking action to address climate change. The Province of British Columbia (BC) recently implemented an economy-wide, progressive and revenue-neutral carbon tax. Although the introduction of the carbon tax was anticipated by cement manufacturers, the application of the carbon tax to the utilization of energy inputs in cement manufacturing was not. As a carbon-intensive, energy-intensive, and trade-intensive manufacturing sector, the cement industry is disproportionately impacted by the BC Carbon Tax. The competitiveness impact of the carbon tax on the cement industry has the potential to result in the 'leakage' of cement manufacturing and its associated greenhouse gas emissions to jurisdictions that do not manage these emissions. British Columbia is the first jurisdiction in the world to impose steep carbon pricing on cement manufacturing activities. In assessing the need to address the risk of leakage, other leading jurisdictions, including the European Union, Australia and California, have each identified the cement sector as particularly vulnerable to leakage given its energy-intensity, carbon-intensity, and trade-exposure.

Recognizing the significance of climate change, the global cement industry has developed a strategy for addressing the greenhouse gas emissions associated with cement manufacturing. Under the auspices of the World Business Council for Sustainable Development *Cement Sustainability Initiative* (CSI), this strategy was developed by the leading global cement companies, including the parent companies of British Columbia's cement manufacturers. In British Columbia, greenhouse gas emission reduction opportunities exist within the cement industry and the sector has been actively advancing the CSI strategy. However, the industry continues to face considerable economic and policy challenges to implementing its Cement Climate Action Strategy within British Columbia.

This paper will review the impacts of British Columbia's carbon tax on the cement industry's competitiveness, the associated risks of leakage and measures undertaken in other jurisdictions to address these risks, as well as the opportunities and challenges facing the sector in advancing its own Climate Action Strategy. Finally, this paper will provide the cement sector's recommendations on addressing the risks of leakage and facilitating the implementation of its own Cement Climate Action Strategy.

2.0 Cement Manufacturing and Climate Change

2.1 Overview of Cement Manufacturing Process

To produce cement, limestone together with other raw materials, is ground, mixed and fired in the cement kiln to temperatures of about 1450° C.[1] This high temperature is necessary to achieve and sustain the chemical reaction that converts limestone into cement clinker, the intermediary product in the manufacture of cement. After this process, the molten hot cement clinker is cooled and ground to produce finished cement. Figure 1 presents a graphical representation of the cement manufacturing process.

[1] Battelle Memoriale Institute. (2002, March 1). *Toward a Sustainable Cement Industry.* Retrieved April 30, 2009, from World Business Council on Sustainable Development: www.wbcsd.org/, 5.

2.2 Carbon Intensity of Cement Manufacturing

The manufacture of cement is an energy-intensive and carbon-intensive process. Globally, approximately 5% of man-made carbon dioxide emissions can be attributed to the production of cement.[2] In Canada, the cement industry accounts for 1.4% of total national greenhouse gas emissions.[3] Carbon-intensive fossils fuels, primarily coal and petroleum coke, are the conventional primary fuels utilized to meet the energy requirements of the cement manufacturing process.[4] The Canadian cement industry reported that 4.46 gigajoules of energy was required to produce one tonne of cement clinker on average in 2006.[5] This included 3.91 GJ of thermal energy and 0.55 GJ of electrical energy consumption. In addition to the use of carbon-intensive energy sources, the calcination of raw materials, whereby limestone is converted to cement clinker, releases carbon dioxide ($CaCO_3$ + heat = $CaO + CO_2$). These emissions are referred to as process emissions and account for approximately 60% of the Canadian cement industry's total greenhouse gas emissions.[6] Process emissions are irreducible and occur wherever cement is produced.

2.3 Cement Industry Trends in British Columbia

British Columbia's cement manufacturing industry is comprised of two cement companies, Lafarge North America and Lehigh Hanson Canada, that operate three cement production facilities with a total annual production capacity of approximately 3.5 million tonnes.[7] Together, these three plants account for over 18% of the total production in Canada.

In 2007, approximately 2.2 million tonnes of carbon dioxide equivalent (CO_2e) resulted from the manufacture of cement in British Columbia.[8] This equated to approximately 3.1% of British Columbia's total inventory of greenhouse gas emissions. Of these emissions, 59% are irreducible process emissions, and 41% are attributable to the combustion of fossil fuels to heat the cement kilns.[9] This breakdown is presented in Figure 2.

From 1990 to 2006, cement production in British Columbia increased by 63% from approximately 1.5 million tonnes to over 2.5 million tonnes.[10] Meanwhile, absolute carbon dioxide (CO_2) emissions were seen to outpace the growth in cement clinker production by approximately 11.8% resulting from the industry's transition from natural gas to more carbon intensive fossil fuels as the primary thermal energy source.[11] From 2002 to 2006, cement

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[2] Klee, H. (2007, September 3). *Making Cement Sustainable: Carbon and Other Emissions*. Retrieved April 30, 2009, from World Business Council on Sustainable Development: www.wbcsd.org/plugins/DocSearch/details.asp?type=DocDet&ObjectId=MjYxNDQ
[3] Environment Canada. (2009, 05 05). *Information on Greenhouse Gases Sources and Sinks - Online Data Search*. Retrieved 05 05, 2009, from Environment Canada: http://www.ec.gc.ca/pdb/ghg/onlineData/dataSearch_e.cfm
[4] Cement Association of Canada. (2008). 2008 *Canadian Cement Industry Sustainability Report.* Ottawa: Cement Association of Canada.
[5] *Ibid.*, 14.
[6] *Ibid.,* 11.
[7] Portland Cement Association. (2006). *U.S. and Canadian Portland Cement Industry: Plant Information Summary.* Skokie, Illinois: Portland Cement Association, 168.
[8] *Supra* at note 3.
[9] Cement Association of Canada. (2008) *CAC Internal Member Company Survey on Environment*. (B. Masterson, Interviewer)
[10] Supra at note 3.
[11] Portland Cement Association (2008). *Labour and Energy Input Survey*. Skokie, Illinois: Portland Cement Association.

production in British Columbia increased by 12.2% and CO_2 releases grew by 12.5%, inline with the growth in production.[12]

Thermal energy requirements were met by fossil fuels, making up 94% of primary energy needs, with coal accounting for the majority of kiln fuel inputs in 2006.[13] As mentioned above, the industry has transitioned from 78% of primary energy requirements being met by natural gas in 1990 to 86% of primary energy requirement being met by coal in 2006.[14] Beyond a negligible contribution from renewable energy sources, there has been no clear trend in the use of alternative and renewable energy sources. These sources have represented less than 4% of primary energy inputs from 1990 to 2004. Alternative energy sources accounted for approximately 9% of primary energy needs in 2005 and 6% in 2006.[15] Table 1 presents a list of commonly used alternative and renewable energy sources in cement manufacturing, and Figure 3 presents a comparison of 1990 and 2006 energy inputs.

3.0 Introduction of the BC Carbon Tax

3.1 Overview of carbon tax

In its 2008 Budget, British Columbia introduced a progressive (i.e. escalating) and revenue neutral tax on the purchase of fossil fuels at rates based on the greenhouse gas emissions associated with the individual fuels. BC's carbon tax was implemented beginning July 2008 at a rate of $10 per tonne of carbon dioxide equivalent associated with the combustion of fossil fuels.[16] The carbon tax is scheduled to increase by $5 per tonne annually reaching $30 per tonne of CO_2e emissions by 2012.[17] The primary fuels used in cement manufacturing – coal, petroleum coke, and tires - are among the fuels captured by the carbon tax. For coal, which accounts for approximately 80% of primary energy inputs used by cement industry, the tax begins at $20.77 per tonne of coal in 2008 and increases to $63.31 per tonne of coal by 2012.[18]

3.2 Cement Industry Response to BC Carbon Tax

While the Budget 2008 introduction of a carbon tax on motor and home heating fuels was not unexpected, the inclusion of the tax on cement manufacturing inputs did come as a surprise to the industry, which had been in consultation with the Province on the design of a cap and trade system for industrial greenhouse gas emissions.

Recovering from its shock, the BC cement industry moved quickly to engage the province in a productive working relationship on issues associated with the carbon tax and greenhouse gas emissions more generally. Working through the BC Climate Action Secretariat, then located in the Premier's Office, a joint industry-province Cement Climate Action Working Group was established with a mandate to gather the cement sector's input on the Province's climate action

[12] Supra at note 9.
[13] *Ibid*.
[14] *Ibid*.
[15] *Ibid*.
[16] British Columbia. Ministry of Small Business and Revenue. (2008, July). *Carbon Tax.* Retrieved 04 30, 2009, from British Columbia Ministry of Finance: http://www.sbr.gov.bc.ca/documents_library/notices/BC_Carbon_Tax_Update.pdf, 1.
[17] Ibid., 4.
[18] Ibid., 5.

initiatives and make appropriate recommendations to the Cabinet Committee on Climate Action, chaired by the Premier. A supporting Cement Energy Subcommittee was also established, with a mandate to provide advice to the Cement Climate Action Working Group on the policy supports necessary to support Alternative and Renewable Energies being readily available to the British Columbia (BC) cement manufacturing industry.

Through the BC Cement Climate Action Working Group and Cement Energy Subcommittee, BC cement manufacturers hoped to:

- Increase understanding of the market forces and competitiveness considerations affecting the BC cement industry and its response to the carbon tax; and,
- Increase awareness and policy support for the sector's own greenhouse gas reduction strategy.[19]

4.0 Competitive Underpinnings of the BC Cement Manufacturing Industry

4.1 A Trade Exposed Industry

Cement manufacturing in British Columbia is an export-oriented industry, with almost half of total annual provincial cement manufactured exported into the US Pacific Northwest market. While cement has historically been a regionally-traded product, today cement is a globally-traded commodity. Both the domestic and export markets for cement and cement products have changed considerably in the last decade and a half. Currently, fourteen purpose-built cement importing terminals, receiving deliveries from cement producers in Asia, are strategically located on the US Pacific Coast, as illustrated in Figure 4.[20] As a result, cement manufactured in British Columbia, whether intended for domestic consumption or export, must compete solely on the basis of price established by imported cement from Asia, as illustrated in Figure 5, in both domestic and export markets.[21]

In this open, globally competitive marketplace for cement and cement products, care must be taken to ensure that efforts to demonstrate leadership on global climate change do not disadvantage BC Cement Producers and advantage US-based and Asian-based cement manufacturers – manufacturers who import cement into BC and therefore do not currently include a price on greenhouse gas emissions (see Figure 6).

For example, in 2006, cement imports to British Columbia were at a relatively low level, less than 5% of cement consumption and have risen where cement imports into BC now account for more than 12% of domestic provincial consumption. While just 14% of BC cement imports originated from Asia in 2006, by late 2008 imports from Asia accounted for more than 33% of all BC imports.[22]

[19] Cement Association of Canada. (2008). Terms of Reference: Cement Climate Action Working Group. Ottawa.
[20] Cement Americas. (2009). *2009 U.S. and Canadian Portland Cement Map.* U.S. and Canadian Portland Cement Map. Chicago: Penton Business Media.
[21] Panagapko, D. (2007). *Canadian Cement Industry Technology Summary and Analysis.* Ottawa: Natural Resources Canada - Minerals and Metals Sector,16.
[22] Portland Cement Association. (2009). *Canadian Tracking Report - B.C. Cement Performance (April 2009).* Skokie, Illinois: Portland Cement Association.

In addition, it is necessary to recognize that 100% of BC cement manufacturing is owned by global multinationals. As such, BC cement manufacturing facilities must not only compete for market share, but must also compete for investment against operations in other, less-regulated jurisdictions within their parent companies to sustain and grow their operations domestically.

When first introducing the BC Carbon Tax, the Province indicated that this would be in interim measure, in place until 2010 – at which time BC expected to have a cap and trade system up and running. While BC continues to participate in the Western Climate Initiative, the likelihood of that initiative being implemented as early as 2012 is also highly questionable. Without changes to the BC carbon tax, BC cement manufacturers will be severely disadvantaged to cement producers in neighboring US States, which will not face a federal greenhouse gas emissions rule before 2014 at the earliest, as well as to cement importers from Asia, which will not face a price on greenhouse gas emissions at any foreseeable date (see Figure 7).

4.2 Risks of Leakage

As a result of the delays in implementing a price signal on greenhouse gas emissions from cement manufacturing operations in competing jurisdictions, it is highly likely that the BC carbon tax will contribute to the leakage of cement manufacturing and related emissions to those jurisdictions. Here, leakage is defined as the relocation of an industry or firm and its associated greenhouse gas emissions to jurisdictions that do not include a price on greenhouse gas emissions. Instead of achieving greenhouse gas emissions reductions, which are global, policies that contribute to leakage merely shift the point of emissions to other jurisdictions. The result is a net increase in global greenhouse gas emissions as the original jurisdiction must import the loss of production, which contributes to increased greenhouse gas emissions through transportation.

In addition to its trade-exposure, along with its energy and carbon intensity, British Columbia's cement industry is particularly vulnerable to leakage resulting from carbon pricing based on its inability to pass through costs. According to an analysis conducted by the Canadian Industrial Energy End-use Data and Analysis Centre (CIEEDAC), when industrial process emissions are accounted for, the greenhouse gas emissions per dollar of gross output of the cement industry far exceeds that of any other sector, including the electricity sector.[23] The results of the comparison demonstrate similar findings when industrial process emissions are included. This analysis reveals that the compliance costs of a uniform application of carbon pricing across sectors will be disproportionately higher for the cement manufacturing industry. With a high price elasticity, and the globally competitive nature of the marketplace, the BC cement sector is unable to pass-through the costs of compliance, increasing the risks to its competitiveness.

The particular vulnerability of the cement sector to the risks of leakage resulting from carbon pricing has been identified by, among others, the National Round Table on the Environment and the Economy (NRTEE) and the C.D. Howe Institute. In its 2008 advisory report to the federal government, *Getting to 2050*, NRTEE noted that with "[t]he reduction in output from industrial sectors, either in response to higher energy prices or as an abatement option, could be small on aggregate. The one exception… is industrial minerals, which primarily includes cement. This

[23] Canadian Industrial Energy End-Use Data and Analysis Centre. (2007). *Cement Intensity GHG CO2e / GO (kt / 97 $Million) or (kg / 97 $).* Burnaby: Canadian Industrial Energy End-Use Data and Analysis Centre.

sector could experience large output reductions."[24] The recent C.D. Howe commentary *Pricing Greenhouse Gas Emissions*, reiterated that "if Canada were to implement an aggressive carbon price unilaterally… [b]y far the most affected sector…would be industrial minerals (cement and lime production)."[25] While the issue of disproportionate costs resulting from the uniform application of carbon pricing across all sectors should be of concern from an equity perspective, the primary concern is based on the potential impacts on the competitiveness of the cement sector and the potential for leakage. As such, leading jurisdictions have taken measures, or are in the process of developing measures, that specifically target the cement industry to avoid the risk of leakage. An overview of these measures is provided in Section 4.4 of this paper.

4.3 Economic impacts of the Carbon Tax on the BC Cement industry

In support of its messages on the likely impacts of the BC carbon Tax, the Cement Association of Canada commissioned analysis by EnviroEconomics to assess the potential impacts of increasing carbon pricing on the BC cement industry. The study found that even at relatively low carbon price level, the BC cement industry was vulnerable to competitiveness impacts. The study noted that a carbon price of $10 per tonne of CO_2e would represent 21% of a firm's profits, at a price of $20 per tonne of CO_2e this would increase to 42% of a firm's profits, and lastly at price of $30 per tonne of CO_2e this would increase to 67% of a firm's profits. The report concluded that "the compliance costs with carbon pricing above $10 per tonne of CO_2e will make firms in the sector vulnerable to closure and mostly likely adverse competitiveness impacts."[26] Significantly, the application of a Standard Financial Impact Test indicates that at rates above 3% of total throughput, compliance costs place facilities and sectors at operational risk of closure. Left unmitigated, the BC Carbon Tax will place BC cement manufacturing at such risks on 2009. This finding was highlighted by the industry in its presentation before the BC Finance Committee. In addition, in its presentation to the Committee, the industry noted that although the government intended that the carbon tax be "revenue neutral," the compliance costs of the tax will amount to $65 million over the next five years and be offset marginally with up to 2% reduction in corporate taxes, which amounts to a rebate of $1 million annually.[27]

4.4 Anti-leakage Measures in Other Jurisdictions

British Columbia is the first jurisdiction in the world to apply steep carbon pricing to the cement industry. Other jurisdictions that have implemented, or are developing carbon pricing schemes, have recognized the need to implement anti-leakage measures vis-à-vis the cement sector in order to avoid the risk of leakage. These jurisdictions include the European Union, California and Australia.

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[24] National Round Table on the Environment and the Economy. (2007). *Getting to 2050: Canada's Transition to a Low Emissions Future: Advice for Long-term Reductions of Greenhouse Gases and Air Pollutants.* Ottawa: National Round Table on the Environment and the Economy, 42.

[25] Bataille, C., Dachis, B., & Rivers, N. (2009, February). Pricing Greenhouse Gas Emissions: The Impact on Canada's Competitiveness. *C.D. Howe Institute Commentary No. 280: Economic Growth and Innovation* , 7.

[26] Sawyer, D., & Stiebert, S. (2008). *The Costs of BC's Climate Plan: Implications for the BC Cement Sector.* Ottawa: EnviroEconomics.

[27] British Columbia. Legislative Assembly. (2008, October). *Minutes Select Standing Committee on Finance and Government Services October 16, 2008*. Retrieved April 30, 2009, from 2008 Legislative Session: Fourth Session, 38th Parliament - Select Standing Committee on Finance and Government Services - Minutes and Hansard: www.leg.bc.ca/CMT/38thparl/session-4/fgs/hansard/N81016p.htm#88:1555.

(i) European Union

Within the European Union many countries have had carbon taxes in effect on the combustion of fossil fuels for a number of years. While the specific design elements of these carbon tax schemes differ greatly across Europe, there has been a common approach in the treatment of the cement industry. The cement industry in each jurisdiction with a carbon tax has been fully, or in large part, exempted from the tax, or provided extensive rebates or discounts. Examples include[28]:

- Denmark has applied energy, CO2 and SO2 taxes on industry since 2003. Heavy process industries, including cement, are provided extensive discounted rates as well as a total exemption on energy taxes. In addition, a further 50% reduction from CO2 taxes is available to cement manufacturers that enter into performance agreements with the government.[29]
- Germany has applied energy taxes on the fossil fuel combustion and electricity combustion. An 80% discount is provided to the manufacturing sector, including the cement industry, and energy-intensive industries are reimbursed for any payment of the tax above 120% savings they achieve through lower employer social contributions (as part of the shift in taxation). In addition, the cement industry has been fully exempted from the tax on solid fuels (coal, coke, lignite) introduced in 2006.[30]
- Sweden first introduced its carbon tax on energy use in 1991. Initially a 50% discount was provided to industry for competitiveness reasons. While the currently tax is approximately $150 per tonne of CO2, industry payments are capped at a level equivalent to 0.8% of annual turnover. The increases in the carbon tax since 1991 were accompanied by broader tax reform, including significant reductions in corporate and payroll taxes.[31]

In developing its post-2012 emissions trading scheme the European Commission *Impact Assessment* working paper highlights that "when comparing full auctioning to allocating allowances for free, due regard must be given to the aspects of competitiveness and carbon leakage."[32] Two measures are assessed to identify the potential impact of carbon pricing on industrial sectors. Price-elasticity is used to measure whether an industry can pass through the costs, and openness to trade is used to measure trade exposure.[33] In 2008, the European Commission adopted its Directive stating that "[t]o address the risk of carbon leakage, the Community will allocate 100% of allowances free of charge to sectors or sub-sectors meeting the relevant criteria." The EU Environment Commission is currently undertaking analysis and

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[28] In addition to the countries listed here, the United Kingdom, the Netherlands, Finland, France, and Norway have also provided exemptions/discounts/rebates on carbon taxes to the cement industry.

[29] Denmark. Statistics Denmark. (2003) *Energy Taxes in the Nordic Countries - Does the polluter pay*?. Final report to Eurostat by Statistics Denmark.

[30] Rupp, Susanne and Bailey, Ian. (2003). *German Climate Change Policy Report: New Environmental Policy Instruments and German Industry.* Plymouth, UK: University of Plymouth.

[31] Johansson, Bengt. (2006). *Climate Policy Instruments and Industry: Effects and Potential Responses in the Swedish Context.* Energy Policy Vol. 34, 2344-2360.

[32] British Columbia. Legislative Assembly. (2008, October). *Minutes Select Standing Committee on Finance and Government Services October 16, 2008*. Retrieved April 30, 2009, from 2008 Legislative Session: Fourth Session, 38th Parliament - Select Standing Committee on Finance and Government Services - Minutes and Hansard: www.leg.bc.ca/CMT/38thparl/session-4/fgs/hansard/N81016p.htm#88:1555, 107.

[33] European Union. European Parliament. (2009, March 26). *Council Directive PE-CONS 3737/08 Amending Directive 2003/87/EC*. Retrieved April 30, 2009, from http://register.consilium.europa.eu/pdf/en/08/st03/st03737.en08.pdf.

consultations to identify those sectors at significant risk of leakage. Preliminary published results identify the cement sector as being exposed to a significant risk of leakage.[34]

(ii) Australia

Australia is currently developing its Carbon Pollution Reduction Scheme which will include the introduction of a cap-and-trade program commencing in 2010. The Australian government has recognized that "if constraints on emissions are placed on activities in Australia, but not elsewhere, there is a possibility that some emissions-intensive trade-exposed activities (EITEs) may choose to leave Australia (or new investment could be discourage" resulting in carbon leakage.[35] In its 2008 Green Paper, the Australian Government has identified cement manufacturing as significantly emissions-intensive and trade-exposed and is proposing to allocate 90% of allowances free of charge to the cement industry in order to address potential competitiveness impacts and the risk of leakage.[36]

(iii) California

In 2006, California passed the *Global Warming Solutions Act* (AB 32) requiring the state to achieve state-wide greenhouse gas emissions reductions through the implementation of market-based mechanisms. In its final Scoping Plan, California states that "[m]inimizing leakage will be a key consideration when developing the cap-and-trade regulation and the other AB 32 program measures."[37] The Scoping Plan specifically recognized that "[f]or energy intensive industrial sources, such as cement manufacturing, stringent reduction requirements in California, either through inclusion in a cap-and-trade program or through direct regulation, have the potential to drive manufacturing activity out of California unless those locations have similar requirements."[38] The Scoping Plan identifies that in order to minimize leakage, both in-state and imported products need to be subject to equivalent standards.[39]

(iv) Proposed US Federal Legislation

In line with these leading jurisdictions, the draft cap and trade legislation currently before the U.S. Congress (*American Clean Energy and Security Act of 2009*) reaffirms concerns regarding the potential impacts on competitiveness and risk of leakage. The Act includes a section specific to "preserving domestic competitiveness" which encompasses measures to address competitiveness impacts in eligible domestic industries. Wherein, to address the potential risk of leakage, the Act provides that energy-intensive and trade-exposed industries would be eligible for rebates of 85% of the specified sector's emissions intensity plus an additional indirect amount

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[34] European Commission. Enterprise and Industry. (2008). *Identifying Sectors Deemed to be Exposed to Significant Risk of Carbon Leakage: Direct CO2 Cost Calculation and Preliminary Results.* Brussels: Enterprise and Industry. Retrieved April 30, 2009 from: http://ec.europa.eu/environment/climat/emission/pdf/20090428_prel_results_citl_calc_stakeholder_%20mtg_v3.pdf.
[35] Australia. Department of Climate Change. (2008). *Carbon Pollution Reduction Scheme: Green Paper.* Canberra: Department of Climate Change. Retrieved April 30, 2009 from: www.climatechange.gov.au/greenpaper/report/pubs/greenpaper.pdf, 27.
[36] *Ibid*., 320.
[37] California Air Resources Board. (2008). *Climate Change Proposed Scoping Plan: A Framework for Change (Aproved).* Sacramento: California Air Resources Board. Retrieved April 30, 2009 from: www.arb.ca.gov/cc/scopingplan/document/psp.pdf, 31
[38] California. California Air Resources Board. (2008). *Climate Change Proposed Scoping Plan Appendices: Volume I: Supporting Documents and Measure Detail.* Sacramento: California Air Resources Board. Retrieved April 30, 2009 from: /www.arb.ca.gov/cc/scopingplan/document/appendix1.pdf, C-16.
[39] *Ibid*.

associated with electricity use.[40] In addition, the Act would an International Reserve Allowance Program. This program would require importers of "a covered good" (includes cement) to submit "international reserve allowances" to account for the greenhouse gas emissions associated with the good.[41]

5.0 BC Cement Industry Greenhouse Gas Emissions Reduction Strategy

5.1 Cement Sustainability Initiative

Both cement manufacturing companies in British Columbia, Lafarge North America and Lehigh Hanson Canada, are signatories to the World Business Council on Sustainable Development Cement Sustainability Cement Sustainability Initiative ("CSI") through their parent companies, Lafarge and Heidleberg. The Cement Sustainability Initiative is an industry-led, multi-stakeholder global initiative to address the challenges of sustainability.

From its inception in 1999, the CSI has recognized the need to take action on climate change as an important issue to the sustainability of the cement industry. The membership of the CSI now encompasses over half of global cement production outside of China and includes 19 of the world's cement companies.[42]

In 2002, following a multi-stakeholder engagement process, the CSI released its *Agenda for Action* which focuses on six areas of joint and individual company action to improve the industry's sustainability: (1) climate protection and CO2 management; (2) the responsible use of fuel and materials; (3) employee health and safety; (4) emission monitoring and reporting; (5) local impacts on land and communities; and, (6) reporting and communication.[43]

As part of its *Agenda for Action*, the CSI has articulated a four-part strategy to address the challenges of climate change within the global cement sector:

1. Improving the energy efficiency of manufacturing operations;
2. Substituting alternative (waste derived) and renewable (biomass) energy sources for fossil fuels utilized in the manufacturing process;
3. Substituting supplementary cementitious materials for clinker in the production of blended cements and other cement products; and,
4. Undertaking long-term research and development on less CO_2-intensive cementing materials and manufacturing operations.[44]

Each of these strategic priorities is fully compatible with the emissions reduction efforts in British Columbia's cement manufacturing sector and therefore form the basis of the BC Cement Sector Climate Action Strategy.

[40] United States. House of Representatives (2009). *American Clean Energy and Security Act (Discussion Draft).* Washington, 537-548.
[41] *Ibid*., 555-559.
[42] Cement Sustainability Initiative. (2008). *Climate Actions.* Geneva: World Business Council on Sustainable Development.
[43] Cement Sustainability Initiative. (2002). *Agenda for Action.* Geneva: World Business Council for Sustainable Development.
[44] *Ibid*.

5.2 Implementation of the CSI in British Columbia

To date, British Columbia's cement manufacturing sector has been active in implementing the Cement Sector Climate Action Strategy.

(i) Energy Efficiency

As shown in Figure 7, the provincial sector is comprised of relatively modern, efficient and low-emitting facilities.

Against an ideal 'best practice plant' with an energy efficiency index of 100, two of the three BC plants already perform in the top quartile among all Canadian cement facilities, and out-perform the 'good practice' threshold index of 75.[45]

Given the limitations of existing plants to achieve significant increases in fuel efficiency, the BC Cement manufacturing sector has focussed energy efficiency efforts in the area of improving electricity efficiency. Working independently, and with BC Hydro Power Smart Initiative, the sector has undertaken numerous energy efficiency activities within the last five years. These efforts include:

- Audits and improvements related to plant compressed air, motors, fans and lighting;
- On-line XRD (X-Ray Defraction) for assurance of consistent kiln feed quality;
- Installation of variable speed drives for motors, fans, belts etc; and,
- Benchmarking energy performance from the perspective of management systems, installed equipment and technical practices, and overall energy efficiency.[46]

(ii) Energy Substitution

As outlined above, the British Columbia cement sector is currently 94% reliant on primary fossil fuels, with just 6% of energy inputs provided through alternative energy sources. Among the substitute energy sources currently utilized by the sector are post consumer tires, waste oil products and wood wastes from the construction and demolition sector, as listed in Table 1.[47] The sector has also been actively engaged with Metro Vancouver, promoting the role that the cement sector can play in the management of residual municipal biosolids and in diverting municipal solid wastes from existing landfills or new facilities.[48] Through the Cement Climate Action Working Group a Cement Energy Sub-Committee has been established to understand the barriers to increasing the use of alternative and renewable energy sources and make recommendations to facilitate the substitution of alternative and renewable energy sources in the BC cement manufacturing sector.

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[45] Cement Association of Canada. (2008) *CAC Internal Member Company Survey on Environment*. (B. Masterson, Interviewer).
[46] *Ibid.*
[47] *Supra* at note 4.
[48] British Columbia. Legislative Assembly. (2008, October). *Minutes Select Standing Committee on Finance and Government Services October 16, 2008*. Retrieved April 30, 2009, from Select Standing Committee on Finance and Government Services - Minutes and Hansard: www.leg.bc.ca/CMT/38thparl/session-4/fgs/hansard/N81016p.htm#88:1555.

(iii) Material Substitution

BC cement manufacturers avoid nearly 250,000 tonnes CO_2e emissions annually by substituting limestone, flyash, and other supplementary cementitious materials for the energy and carbon-intensive clinker.[49] BC cement manufacturers continue efforts to identify, analyze and utilize additional quantities of such clinker substitutes on an on-going basis.

(iv) Research and Development

Through their parent companies and through joint undertakings with the Cement Association of Canada ("CAC") and the Portland Cement Association ("PCA"), BC cement manufacturers are engaged in research development and deployment activities with an emphasis on:

- Expanding access to, and uptake of, currently available carbon dioxide control technologies;
- Increasing understanding of, and addressing technology and cost barriers to, deployment of mid-term technologies, including zero-carbon and carbon-neutral energy sources; and,
- Participating in cross-sectoral research efforts on potential technologies for cement GHG mitigation in the longer-term in areas of pre-combustion technologies for de-carbonization of cement fuels and post-combustion technologies for the separation and capture (and storage) of CO_2.[50]

In addition, through the CAC and PCA, BC cement manufacturers are active participants in the Asia Pacific Partnership on Clean Development and Climate's Cement Task Force and its global research activities relating to cement CO_2 mitigation.[51]

5.3 Implementation Challenges

The overarching challenge that cement manufacturers in British Columbia currently face is maintaining domestic and export market share in the face of competing US and Asia-based cement manufacturers unaffected by carbon pricing. Although this is a preeminent challenge, the BC cement sector also faces challenges specific to its efforts to implement the Cement Sector Climate Change Strategy. These challenges are outlined below, grouped by key element of the sector's climate change strategy:

- *Energy Efficiency* – Any future improvements in overall thermal efficiency at BC cement facilities will require investment in new / modernized plant. Given current capacity, location in the capital cost cycle, trade exposure considerations, and other investment climate considerations, no such investment is currently planned in British Columbia over the period 2008 – 2015. Moreover, and for similar reasons, of the twenty-five new build and modernization initiatives planned over 2008-2013 in the North American cement

[49] *Supra* at note 45.
[50] Portland Cement Association.
[51] Asia Pacific Partnership for Clean Development and Climate. *Cement Task Force*. Retrieved April 30, 2009, from Asia Pacific Partnership for Clean Development and Climate: www.asiapacificpartnership.org/english/tf_cement.aspx.

sector, just one modernization is planned within the entire Pacific Coast Region – at the Oro Grande plant in the California interior;[52]

- *Waste Energy Substitution* – The key barriers to increased substitution of waste-derived energy sources for primary fossil fuels are the existing waste management policies in the Province and regions which fail to divert calorific or energy-rich waste streams from landfill. Simply put, such energy resources are not available to cement manufacturers in BC as there is ample ability and relatively low cost to dispose of such materials in landfill. In Europe, where waste energy substitution rates are considerably higher, the EU Waste Directive and member states' waste policies place an emphasis on diversion (through outright bans and price signals) high calorific materials from landfill and facilitating their utilization in cement and other industry operations;[53]

- *Renewable Energy Substitution* – Cost is the primary barrier to substitution for fossil fuels in cement manufacturing with the Province's abundance of renewable resources from the agricultural and forestry sectors. In short, a tonne of woody biomass currently sells for approximately twice the price of coal, and contains only half as much energy per tonne.[54] This means that cement manufacturers energy costs, already 40% of marginal operating costs, would quadruple if the industry attempted to utilize such materials. Given the realities of an open and competitive marketplace for cement and cement products, as described above, such actions are not economically feasible;

- *Material Substitution* – There are two barriers to increased substitution of supplementary cementing materials for the carbon and energy intensive clinker. The first barrier is the unavailability of certain substitute materials. Common substitute materials such as steel slag and silica fume are not available in the Pacific Northwest. As well, the availability of flyash from coal-fired electric power generating stations is limited and currently well utilized by the industry. As climate policies place pressures on the coal fired electricity sector, the long-term contribution of flyash is less certain. Limestone is the substitute material that presents the greatest opportunity for cement manufacturers in British Columbia. In Canada, the current Canadian Standards Association standards allow for a maximum 5% limestone utilization.[55] In Europe, cement standards allow for a general purpose Portland Limestone Cement consisting of up to 35% ground (uncalcined) limestone – this cement type comprises approximately 31% of the market share for cement.[56] Efforts are currently well advanced to increase the limestone standard in Canada to 15%. Despite the potential, unless, and until, the ASTM / ASHTO standards in the US are similarly revised, the potential contribution from limestone utilization will be significantly limited.

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[52] Portland Cement Association. (2008). *Flash Report: Capacity Expansion Update.* Skokie, Illinois: Portland Cement Association.
[53] European Union. European Parliament.(2006). *Council Directive 2006/12/EC of the European Parliament and of the Council of 5 April 2006 on waste* . Geneva: European Commission.
[54] *Supra* at note 28.
[55] Portland Cement Association. (2009). *Concrete Technology: Cement Basics: Canadian and U.S. Cements*. Retrieved April 30, 2009, from Portland Cement Association: www.cement.org/tech/ca_us_cements.asp.
[56] British Cement Association. (2006). *Fact Sheet 8: Factory-made Portland Limestone Cement.* Retrieved April 30, 2009, from British Cement Association: www.cementindustry.co.uk/pdf/FACT%20SHEET%208%20Portland%20limestone%20cements%20CAC.pdf.

8.0 Cement Sector Recommendations

8.1 Cement Sector Vision

Thus far, this paper has reviewed the impacts of British Columbia's carbon tax on the cement industry's competitiveness, the associated risks of leakage and measures undertaken in other jurisdictions to address these risks, as well as the opportunities and challenges facing the sector in advancing its own Climate Action Strategy. This following section puts forward the cement sector's recommendations on how British Columbia can address these significant issues.

The recommendations outlined below ensure that looking to the future, cement manufacturing in British Columbia remains a viable business consideration. As such, these recommendations ensure that British Columbia will continue to benefit from a strategic, secure, reliable, and locally-produced supply of cement and cement products. In addition, this future vision of cement manufacturing in British Columbia envisions a market wherein:

- Export markets for BC cement and cement products remain open and are not subject to trade measures;
- BC cement manufacturers have maximized their transition to lower carbon and carbon neutral fuels, with reliance on primary fossil fuels reduced by approximately 50% overall;
- BC cement manufacturers have sustained and grown the important contribution realized through the utilization of substitute cementitious materials; and,
- BC cement manufacturers have adopted new, proven CO_2 control technologies and practices emanating from global research, development and deployment efforts.

8.2 Policy Options

(i) Addressing Competitiveness Risks

Over the immediate short-term, measures must be taken to address the significant risk to the competitiveness of British Columbia's cement manufacturing industry resulting from the introduction of the provincial Carbon Tax. As highlighted in this paper, if left unmitigated, the BC Carbon Tax will place BC cement manufacturing facilities at operational risks in 2009.

Building on its engagement with the industry-government Cement Climate Action Working Group, the BC cement manufacturing industry has explored options for addressing the competitiveness risks of the BC carbon tax on the cement industry. The recommended policy options presented below are informed in part by measures developed and being developed in leading jurisdictions, namely the Europe Union, Australia and California, as reviewed previously.

Similar to the approach currently utilized by European nations for sectors that are identified as carbon and energy intensive, the first option is to establish an upper limit or ceiling on the total compliance costs of the carbon tax.This upper limit can be established as a percentage of sales, profits, or energy costs, as implemented in Sweden. This measure could be applied uniformly,

and would provide equitable treatment across all sectors by ensuring that no one sector is disproportionately affected by the carbon tax.

A related approach could be to provide rebates or exemptions for carbon pricing compliance costs for sectors that are energy intensive and trade intensive, as implemented in the Netherlands, Finland, Norway, the United Kingdom and Germany. This proposed approach is included in the *Climate and Energy Security Act of 2009* currently before Congress. The approach would require the development of evaluation criteria for identifying those sectors that are energy-intensive and / or trade-intensive. As proposed in the U.S. bill, the exemption or rebate could expire following the application of similar carbon pricing on those sectors in other jurisdictions.

A third approach would be to implement measures that could have the effect of "levelling the playing field." This type of measure proposes to apply the carbon price signal on greenhouse gas emissions related to cement consumption, as considered by California in its Draft Scoping Plan. Another means of "levelling the playing field" could be achieve by exempting the greenhouse gas emissions associated with the domestic production of carbon and energy-intensive exports from carbon pricing.

(ii) ***Facilitating the BC Cement Climate Action Strategy***

With the exception of the Carbon Tax and the development of the cap and trade initiative, British Columbia's cement manufacturing industry is not directly addressed through other aspects of the provincial Climate Action Plan. Similarly, the Climate Action Team Report includes no recommended measures that would directly support further implementation of the BC Cement Sector Climate Action Strategy. However, as outlined in Section 5, through implementation of the BC Cement Climate Action Strategy, British Columbia's cement industry can contribute to the provincial climate change goals.

In addition to contributing to British Columbia's climate change objectives, facilitating the BC Cement Climate Action Strategy also provides a pathway to assist in addressing the competiveness of the provincial cement industry. The cement sector has identified a number of opportunities where existing provincial undertakings could be expanded to align the province's Climate Action Plan, Energy Plan, Bioenergy Plan, and waste management efforts with the Cement Climate Action, including:

- **Facilitating energy substitution with waste derived fuels.** The province could take steps to keep or ban any calorific-containing waste products from Provincial landfills. Future updates to the Province's Climate Action Plan, the recommendations of the Climate Action Team Report, and the Province's waste management strategy could include a direct and specific emphasis on energy from waste recovery for the province's industrial sector.

- **Facilitating energy substitution with renewable fuels.** As noted previously, the primary barrier to increased utilization of renewable energy sources is economical. While considerable direct and indirect incentives are available for the utilization of renewable resources to generate liquid fuels and electricity by the provincial and federal government in British Columbia, no such incentives are available to their utilization in cement

manufacturing. In order to address the economic barrier to the utilization renewable energy sources, the province could provide comparable direct and indirect incentives to cement manufacturing facilities.

As well, additional and important signals can be provided by including reference to the potential role of renewable energy substitution in the cement manufacturing sector within future updates of the Climate Action Plan, Climate Action Team Report, and BC Bioenergy Strategy.

- **Facilitating material substitution.** There are two important steps that the Province of British Columbia can take to facilitate material substitution in the cement sector:

    - Support BC cement sector calls for implementation of cement sector cap and trade requirements on the basis of a "cement greenhouse gas emissions performance standard" that recognizes and incents the important contribution from material substitution in the sector within WCI.
    - Once the Portland Limestone Cement Standard is adopted by the Canadian Standards Association, British Columbia could take steps to fast-track the revision of the BC Building Code to reference this new CSA standard.

9.0 Conclusion

In order to ensure the future viability of cement manufacturing in British Columbia, measures must be taken to address the competitiveness risks the industry faces in light of the newly instated carbon tax. An assessment of the economic impacts of the carbon tax on BC's cement manufacturing industry reveals that as of 2009 the cement manufacturing facilities are at operational risk of closure resulting from the increased costs associated with the carbon tax. This paper has noted that BC stands alone in the world as the single jurisdiction to apply steep carbon pricing to the cement manufacturing sector. In assessing the potential risk of leakage, other leading jurisdictions have identified the cement sector as particularly vulnerable to the risk of leakage based on its energy-intensity, carbon-intensity and trade-exposure. Instead, each of these jurisdictions have undertaken, or propose to undertake, measures to address the potential competitiveness impacts of carbon pricing on the cement manufacturing industry. Although carbon and energy intensive, the cement sector has a globally developed and proven climate change strategy. However, there are significant policy and economic barriers to the implementation of the BC Cement Climate Action Strategy. The cement sector recommends specific actions be undertaken to facilitate the advancement of this strategy and realizing the sector's potential contribution to BC's climate change goals.

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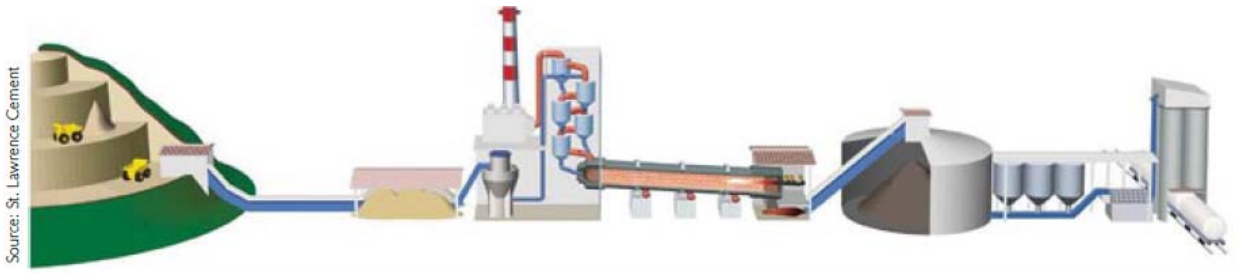
11.0 Tables

Table 1 – Examples of Alternative and Renewable Energy Sources Utilized in Cement Manufacturing

Alternative Sources	Renewable Sources
• Scrap tires • Used oils • Recovered solvents • Recovered asphalt shingles • Oily waters • Oil shales • Plastics • Certain hazardous wastes	• Fibre residue from forest products manufacturing • Meat and bone meal • Municipal solid waste • Agricultural waste • Post-consumer paper and packaging • Recovered wooden utility poles • Residue wood biomass from forestry operations

12.0 Figures

Figure 1 – The Cement Manufacturing Process



Quarrying	Raw Materials Preparation	Clinker Production	Cement Grinding and Distribution
Limestone and small amounts of sand and clay are extracted, usually from a quarry located near the cement manufacturing plant.	The extracted materials are analyzed, blended with additional mineral components depending on the type of limestone available, and finely ground for further processing.	The materials are heated in a kiln reaching a temperature of 1,470°C. The heat transforms the materials into a molten product called clinker, which is then rapidly cooled.	The clinker is stored and then finely ground. Gypsum is added to control setting time, along with supplementary cementing materials, such as fly ash or slag, to obtain a fine powder called cement, with the desired properties of strength and chemical resistance.

Figure 2 – BC Cement CO2 Emissions (2007), tonnes

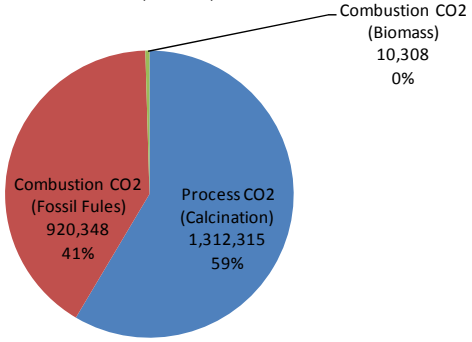


Figure 3 – Comparison of Primary Energy Inputs, 1990 v. 2006

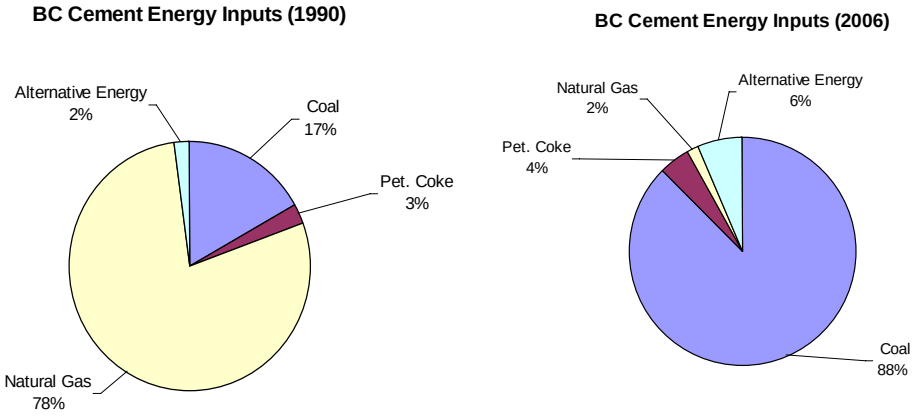


Figure 4 – Existing Pacific Coast Cement Importation Facilities

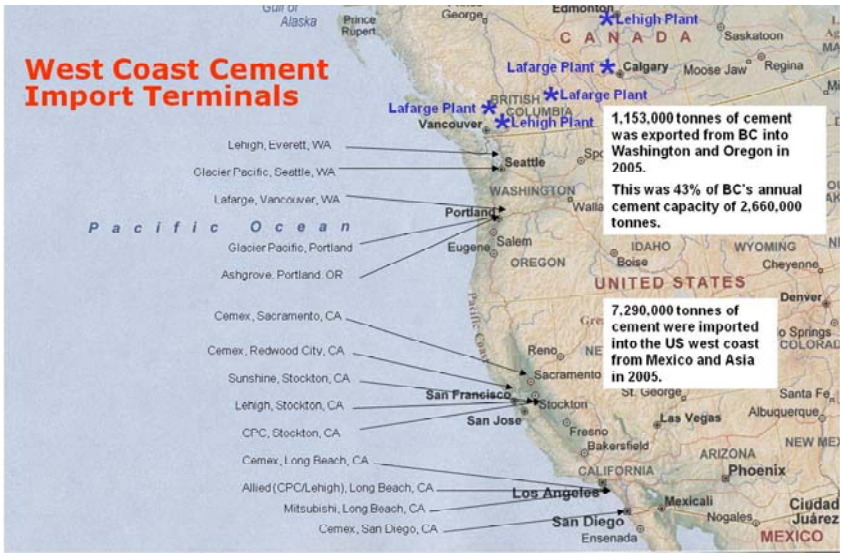
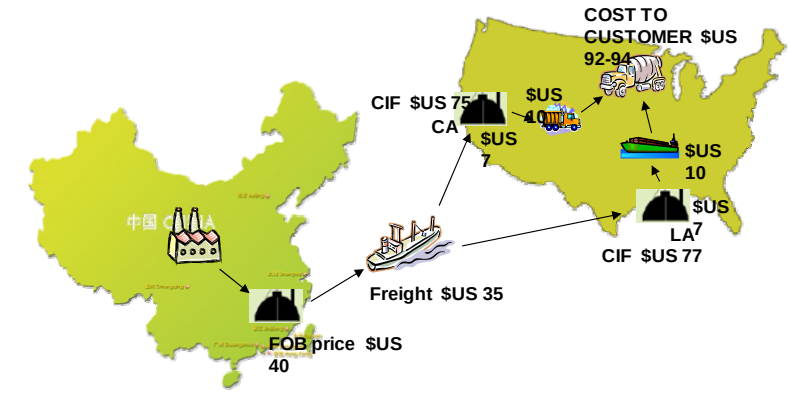


Figure 5 – The Economics of Cement Imports



Source: Exane BNP Paribas

Figure 6 – Carbon Price as a Share of Total Cement Sales (estimated)

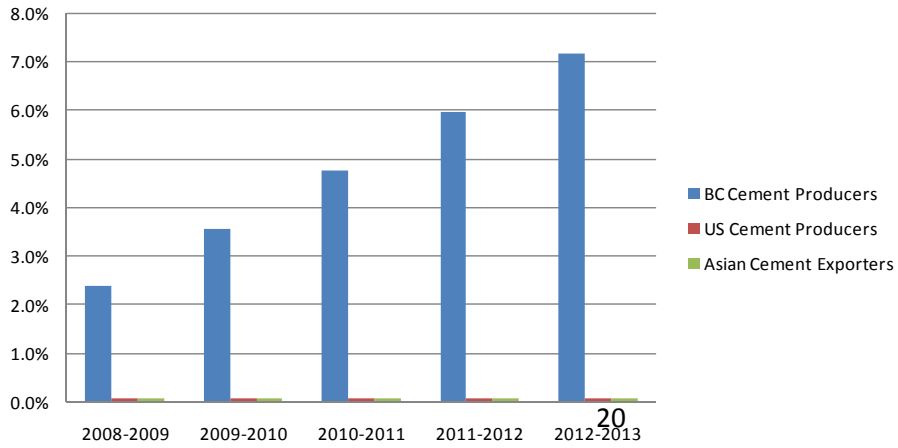


Figure 7 – BC Kiln Technology

Kiln Technology	Average Energy Consumption (GJ / tonne clinker)	% Installed Capacity (Canada, 2008)	% Installed Capacity (China, 2005)
Calciner	3.3	**50%**	30%
Preheater	4.0	30%	
Dry	5.0	20%	15%
Wet	5.0 – 6.7	0%	5%
Vertical Shaft	5.0 – 8.3		**50%**