

Greenhouse Gas Reducing Technologies In The Building Sector

Research Report

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1.0 Introduction

Canada has long had a reputation of being a country in love with its outdoors. It is then no surprise that since the country's ratification of the Kyoto protocol there has been a great effort by government to do what they can to reduce greenhouse gas emissions. This support is mirrored by the attitude of the general public where 74% of Canadians support the Kyoto Protocol¹.

However while support may remain strong there still remains the question of how this has translated down into industry. Clearly the general public feels that there is not enough information on the costs of implementation and its impact (an earlier Ipsos-Reid survey found close to two-thirds, 63%, of those polled indicated they don't have enough information about the Kyoto Accord to say whether they support or oppose it). In the same Ipsos-Reid survey, eight in ten people indicated that the Government of Canada needs to spend more time investigating costs and impact of the protocol before implementing it.

With the above in mind, Industry Canada in British Columbia, in an effort to understand where the province's building sector is on the subject commissioned this report. Specifically, the question is: in the building construction sector and the products produced in BC, what technology has been generated that helps builders reduce GHG during construction?

¹ Ipsos-Reid/CTV/Globe and Mail Poll, November 8, 2002

2.0 Report Objectives

Industry Canada would like to obtain a profile of the technologies developed in BC used in the construction and building industry to help reduce greenhouse gas emissions. This does not include energy or energy management products. The objectives for this study are:

- A list of products and technologies made in British Columbia that help the construction sector reduce greenhouse gas emissions. Not to be included are technologies relating to energy efficiency and energy management
- A brief on the market opportunity and market barriers in the greenhouse gas emissions sector
- A brief on where British Columbia stands in the world market for construction technologies to reduce greenhouse gas emissions

3.0 Methodology

This report was compiled from secondary data sources available on the internet. As well, informal telephone interviews took place with individuals from the GVRD, IRAP and the building industry. A complete list of web sites visited can be found in Appendix C.

4.0 Definitions

4.1 General

“Greenhouse Gases (GHGs) are those gases in Earth's atmosphere, which retain a part of Sun's energy reflected back from the Earth's surface. This affect along with energy absorbed by the Earth's surface affects the long-term energy balance of the Earth and its atmosphere, which fundamentally controls the Earth's climate. Incoming radiation from the sun, mainly in the form of visible light, is absorbed at the Earth's surface and in the atmosphere above. On average, absorbed radiation is balanced by the amount of energy returned to space in the form of infrared "heat" radiation. Greenhouse gases such as water vapor and carbon dioxide, as well as clouds and small particles (called aerosols), trap some heat in the lower part of the Earth's atmosphere. This is called the greenhouse effect. If there were no natural greenhouse effect, the average surface temperature would be about 34°C (61°F) colder than it is today.

Natural events cause changes in climate. Over longer time spans, tens or hundreds of thousands of years, natural changes in the geographical distribution of energy received from the sun and the amounts of greenhouse gases and dust in the atmosphere have caused the climate to shift from ice ages to relatively warmer periods.

Human activities can also change the climate. The accumulation of greenhouse gases in the atmosphere due to human activities will change the climate by enhancing the natural greenhouse effect, leading to an increase in the Earth's average surface temperature. Some greenhouse gases occur naturally in the atmosphere such as: water vapor, carbon dioxide, methane, nitrous oxide, and ozone. Once, all climate changes occurred naturally. However, during the Industrial Revolution, we began altering our climate and environment through changing agricultural and industrial practices. Before the Industrial Revolution, human activity released very few gases into the atmosphere, but now through population growth, fossil fuel burning, and deforestation, we are affecting the mixture of

gases in the atmosphere. The most important GHGs and human activities that contribute to their emissions are:

- Carbon dioxide is released to the atmosphere when solid waste, fossil fuels (oil, natural gas, and coal), and wood and wood products are burned.
- Methane is emitted during the production and transport of coal, natural gas, and oil. Methane emissions also result from the decomposition of organic wastes in municipal solid waste landfills, and the raising of livestock.
- Nitrous oxide is emitted during agricultural and industrial activities, as well as during combustion of solid waste and fossil fuels.
- Very powerful greenhouse gases that are not naturally occurring include hydro fluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF6), which are generated in a variety of industrial processes.

Each greenhouse gas differs in its ability to absorb heat in the atmosphere. HFCs and PFCs are the most heat-absorbent. Methane traps over 21 times more heat per molecule than carbon dioxide, and nitrous oxide absorbs 270 times more heat per molecule than carbon dioxide. Often, estimates of greenhouse gas emissions are presented in units of millions of metric tons of carbon equivalents (MMTCE), which weights each gas by its global warming potential (GWP).

Anthropogenic emissions of greenhouse gases occur in every country of the world. These emissions result from many of the industrial, transportation, agricultural, and other activities that take place in each country. Countries that are signatories to the United Nations Framework Convention on Climate Change (UNFCCC) are committed to reporting their anthropogenic emissions of greenhouse gases to the Secretariat of the convention.”²

² Definition obtained from <http://www.renewingindia.org>

4.2 Definitions in the Construction Industry

In the construction industry there are many products and practices that contribute to GHG through the use of volatile gases in the manufacturing process, various types of adhesives used in flooring materials, the decomposition of demolition waste in the dump, choice of finishing materials etc. On the following page is a list that more clearly explains how to understand if a product is considered a good choice in a construction environment.

This list excludes other design parameters such as the distance that materials are shipped, landscaping and other

In a construction environment the ability to reduce GHG is tied to the following³:

1. Products Made with Salvaged, Recycled, or Agricultural Waste Content

- Salvaged products
- Products with post-consumer recycled content
- Products with post-industrial recycled content
- Products made from agricultural waste material

2. Products That Conserve Natural Resources

- Products that reduce material use
- Products with exceptional durability or low maintenance requirements
- Certified wood products
- Rapidly renewable products

³ www.buildinggreen.com/menus/envCriteria.cfm

3. Products That Avoid Toxic or Other Emissions

- Natural or minimally processed products
- Alternatives to conventional preservative-treated wood
- Alternatives to ozone-depleting substances
- Alternatives to products made from PVC
- Alternatives to other components considered hazardous
- Products that reduce or eliminate pesticide treatments
- Products that reduce pollution or waste from operations

4. Products That Reduce Environmental Impacts during Construction, Demolition, or Renovation

- Products that reduce the impacts of new construction
- Products that reduce the impacts of demolition
- Products that reduce the impacts of renovation

5. Products That Save Energy or Water

- Building components that reduce heating and cooling loads
- Equipment that conserves energy
- Renewable energy and fuel cell equipment
- Fixtures and equipment that conserve water

6. Products That Contribute to a Safe, Healthy Indoor Environment

- Products that don't release significant pollutants into the building
- Products that improve light quality

5.0 Market

5.1 Market Size

The size of the market for GHG reducing technologies in the building industry, as defined by the scope of this contract, will be approximately \$15 billion US in 2006. To calculate a single number for the size of the market for greenhouse gas reduction technologies in the building sector (excluding heating and ventilation, and other energy controls) the following process was followed⁴:

1. The market size for insulation, doors and windows, plastic lumber and recycled lumber was adjusted to the lowest common denominator⁵.
2. A fall 2002 study in the northeastern United States indicated that 43 percent of all windows sold in that region were Energy Star certified⁶. This number was expected to increase to 70 percent by 2004.
3. Assumption 1: If someone has gone to the trouble of ordering Energy Star certified windows they probably have also gone to the trouble of adding extra insulation, and using some level of reclaimed the woods and plastic.
4. Assumption 2: For the sake of this report we will take the 43% percent market share number for Energy Star certified windows in the northeastern United States and use it as an average for all new construction. Specifically, we will assume that 43 percent of all new construction will be Energy Star certified in some form or another.

⁴ Note to reader: The final number calculated is highly subjective and should only be used as directional in trying to understand the market opportunity.

⁵ In this case the market size for insulation was only available in 2006 terms therefore all other markets were adjusted to 2006 terms

⁶ Word on Windows, Publication Of The Efficient Window Collaborative and The Alliance To Save Energy; Fall 2002 Volume 5 number 2

Estimated Market for GHG Reduction Technologies

Technology	Unadjusted	Adjusted for 2006	Adjusted for percentage that will be Energy Star compliant ⁷
Insulation	\$5.8 billion in 2006	\$5.8 billion	\$2.494 billion
Doors and windows	\$31 billion by 2008 ⁸	\$28 billion	\$12.707 billion
Supplementary cementing materials	No numbers available		
Plastic lumber	\$1.1 billion in 2003 ⁹	\$1.587 billion	\$0.62 billion
Recycled and reclaimed wood market	\$24 million to \$81 million in 2006 ¹⁰	\$24 million to \$81 million in 2006	\$0.010 billion to \$0.035 billion
		Total in 2006	\$15.3 to \$16 billion

⁷ 43 percent of Adjusted number for 2006

⁸ growth is expected to be 4.9 percent annually until 2008

⁹ growth is expected to be 13 percent annually between December 2003 and 2006

¹⁰ growth is predicted to be 8 percent annual of all due 2005

5.2 Market Barriers¹¹

The marketing of building products in Canada that help reduce greenhouse gases comes against a number of real and perceived barriers. Some of the real barriers to these products include: a lack of access to distribution channels, building codes, and a lack of product knowledge by trades workers. The perceived barriers include the cost of the products and installation being too high.

These barriers are falling though as the more progressive countries of the European Union have now put in place building envelope standards that force the use of the technologies. Additionally, the growing demand for LEEDs certified buildings in the United States is creating a demand for high-performance building products. A more precise breakdown of the Canadian barriers follows:

5.2.1 Technical/Infrastructure

Many of the new products that can help reduce greenhouses in construction also require new installation methods. A barrier to their use is often the contractors (Trades people) who do not know how to install the product or have the time to learn. This is also accompanied by the risk a contractor faces in using a product they're not comfortable with thereby causing some level of personal liability down the road.

In areas such as heating ventilation and air-conditioning, energy technology, and renewable energy technologies a lack of qualified installers is further exasperated by educational programs which are not yet teaching the appropriate technologies. As well, existing infrastructure is not designed to except these new technologies.

For Eco Smart concrete some of the technical barriers include¹²: the slower setting times and strength development of concrete

¹¹ Adopted and modified from www.ec.gc.ca/climate/resource/cnapcc/c3part03.html part of the National Action Plan of Canada

incorporating fly ash and slag are limiting the use of these materials in applications that need fast form-work removal. The reduced resistance of these concrete mixtures to the freezing and thawing cycles in the presence of de-icing chemicals is also considered a hurdle. The quality of the fly ash, which is related to the type of coal used for the production of electricity in the thermal power plants, is a concern in the Eastern part of the country.

5.2.2 Regulatory

In most areas of the country the actual building codes do not require any performance standards from the buildings being constructed. Nor are contractors penalized for sending material to the dump's as the cost is passed on to the owner of the building. Similarly the many standards that are based on existing technology limit or slow the introduction of new technologies that can have an impact on greenhouse gas emissions.

A key challenge for policymakers will be to distinguish barriers that are substantive market failures limiting emission reduction activities from "perceived" barriers that simply reflect market choices. A number of current initiatives and areas of opportunity aim to dispel perceived barriers and overcome informational barriers by providing more information, and to identify and reduce real fiscal and regulatory barriers to effective market operation.

5.2.3 Informational Barriers

Information is a crucial element underpinning the decisions by consumers and investors that have an effect on greenhouse gas emissions. In many cases, decisions offering net economic and environmental benefits are not taken due to incomplete or poor information. For example, consumers may not be fully aware of the cost savings to be gained through improvements in solar

¹² Materials Technology Laboratory Report Mtl 2003-4(Tr), Current Situation of SCMS in Canada; N. Bouzoubaâ and B. Fournier

walls, leading to missed opportunities to take action which has both environmental and economic benefits.

5.2.4 Market-Access Barriers

it is important that new businesses and products offering opportunities to reduce greenhouse gas emissions have access to markets. In recent years, Canada has revisited traditional concepts of monopoly markets, opening market access and encouraging development of competitive markets. Governments will build on this experience, identifying and addressing barriers to competition that prevent lower-emitting products, technologies, and processes from being able to compete fairly.

5.2.5 Investment Barriers

Investment decisions throughout the Canadian economy have an important bearing on the level of greenhouse gas emissions. There are a number of barriers which may affect financial decisions which, if taken, can help to address climate change. These include corporate access to capital, including appropriate levels of venture capital for small business, internal competition for capital resources, threshold rates of return to justify expenditures, and effective accounting of energy expenditures to identify opportunities. In many cases the investment decision is divorced from ongoing operational expenditures. For example, because of the nature of building leases, it is building owners who make decisions on capital equipment expenditures, whereas the energy costs are borne by tenants.

5.2.6 Standards Barriers

A major barrier to increased wood recovery is the lack of grade standards for recovered wood. These standards include grading rules, engineering properties, and a grade stamp. There is also a need for technical performance testing to investigate the structural integrity of recovered wood

5.3 Canadian Leaders

5.3.1 Canadian Leaders in Window Production (by annual revenue \$US)¹³

\$200-300 million	Groupe Bocenor Incorporated www.bonnevillewd.com	Ste-Marie-de-Beauce, Quebec
\$116-155 million	All Weather Windows www.allweatherwindows.com	Edmonton, Alberta
\$116-155 million	Focus Group www.laflamme.com	Montreal, Quebec
\$116-155 million	Gienow Building Products www.gienow.com	Calgary, Alberta
\$116-155 million	Loewen Windows www.loewen.com	Steinbach, Manitoba
\$62-77 million, cont.	Starline Windows Limited www.starlinewindows.com	Langley, British Columbia
\$23-46 million	Robert Windows www.robertwindows.com	St. Francois-Xavier, Quebec
\$23-46 million	Kohler Group International www.kohler-windows.com	Debert, Nova Scotia

¹³ DFAIT; The Window, Door and Siding Market in the New England States, Nov. 2002
This was the single market that identified cdn companies by revenue. The other leaders are identified in the catalog of technologies.

6.0 Summary

- By 2006 the market for basic technologies that help to reduce the effect of GHG in the construction of buildings will be approximately \$15 billion US¹⁴.
- The major market is the United States where energy efficient windows, doors and insulation represent some of the biggest opportunities for BC firms.
- BC has a potential for leadership in paints, stains, and coatings. There are a number of firms in BC with technology that is low in VOC and uniquely positioned. While the current market size for these greener coatings is small it is predicted to grow.
- BC is home to a number of diverse companies who make products that aid to GHG reduction in buildings. Due to their size it is recommended that they collaborate on marketing and awareness creation
- Barriers to the new technologies largely still consist of building codes and contractor education.
- Canadians are supportive of the efforts to reduce GHG but their lack of awareness around costs and made in Canada solutions will create barriers to the technologies.
- Canada as a whole is making many products that contribute to lowering GHG in building construction. Given the size of the country it is recommended that a single directory be created to help them market internationally.
- Deconstruction versus demolition still represents one of the best opportunities to reduce the creation of GHG. Full cost accounting will need to implement at a municipal level before contractors start to move seriously in this direction.

¹⁴ This is primarily made up of products such as Insulation, Windows, and concrete. This excludes energy management technologies, green paint, lighting controls,

7.0 Appendixes

Appendix A. Background Numbers Used to Determine Market Size

Included were the sales of high-performance windows, insulation, recycled lumber and plastic lumber.

The value of recycled paving stones, eco friendly concrete and other less standard products was excluded. This does not affect the calculation as the size of the insulation and window market are larger by a significant amount.

Insulation¹⁵

The US market for thermal and acoustical insulation will reach \$5.8 billion in 2006, supported by greater use per structure and by upgrades for existing buildings. Fiberglass will remain the leading material but will be outpaced by foamed plastics, which will benefit from rising demand in industrial and HVAC equipment.

Doors and Windows¹⁶

In 2003 the U.S. window and door industry was projected to grow 4.9 percent annually over the next five years, to \$31¹⁷ billion. The study, entitled Windows & Doors, states that “increases in average home sizes and the growing use of value-added products” will offset the effects of a soft housing market. Global demand is expect to grow by 5.7%

Supplementary Cementing Materials (SCM)¹⁸

The use of SCMs in concrete production contributes to the reduction of the “CO₂ signature” associated with the production of every cubic metre of concrete. The data gathered on the

¹⁵ Freedonia; Insulation to 2006; publication date march 2002

¹⁶ Freedonia; World Windows & Doors to 2007; Publication Date Dec 2003

¹⁷ Appendix D

¹⁸ Materials Technology Laboratory Report Mtl 2003-4(Tr), Current Situation of SCMS in Canada; N. Bouzoubaâ and B. Fournier

current situation of SCMs in Canada have shown that around 524,000, 347,000, and 37,000 tonnes of fly ash, Ground Granulated Blast Furnace Slag (GGBFS) and silica fume were used in cement and concrete applications in 2001, which represent 11, 90, and 185% of the quantity produced, respectively. For GGBFS, the remaining 10% of the quantity produced was used in the USA, and for silica fume, 17,000 tonnes were imported from the USA and Norway to meet market demand.

Plastic Lumber Market

Demand for plastic and wood-plastic composite materials in US construction will grow nearly 13 percent annually through 2006. Advances will result from both supplantation of wood in existing applications and introduction into previously untapped uses. Decking, windows/doors and fencing will be the fastest growing markets. As of December 2003 the US composite and plastic lumber industry was worth \$1.1 billion¹⁹.

Recycled and Reclaimed Wood Market

Approximately 12.7 million tons of wood waste was generated in 2000 according to EPA. In fact, wood comprises the largest percentage of the residential C&D waste stream—approximately 42 percent of residential new construction debris—according to the National Association of Home Builders Research Center. Prior to 1990, there was limited recycling of wood waste (e.g., urban wood waste, woody debris from suburban land clearing, and rural forestry residuals) in the United States.

The markets for recovered wood vary across the United States according to regional and local supply and demand. The current market, however, is dominated by mulch and fuel applications which pay between \$12 and \$24 per ton for processed wood. Wood waste from construction and demolition activities is attractive as a fuel because of its low moisture content. Processed or chipped wood is also used as a composting bulk agent and as animal bedding. Salvaged or reused wood products are the highest value items but typically require the

¹⁹ Freedonia industry study No. 1551; composition plastic lumber; June 2002

highest costs for sorting and processing. In addition, recovered wood can be used to manufacture value-added products such as medium density fiberboard and particleboard; these manufacturers demand high-quality feedstocks, however, which can be difficult to achieve on a consistent basis²⁰.

The demolition industry is well established and is increasing its efforts to recover wood waste. In addition, the deconstruction industry continues to grow and salvage an increasing percentage of materials from old buildings. Deconstruction efforts recover and reuse wood for flooring, doors, windows, and other applications. A number of independent lumber mills have retooled their operations to process reclaimed timbers, as well. In the United States Federal and local air and water regulations provide an incentive for wood recovery by discouraging inappropriate burning or discarding of woody debris.

In 1998, 11.8 million tons of solid wood waste was generated in the U.S. as part of the municipal solid waste stream. Of this, about 5% were recovered for recycling or composting²¹

The estimate in the us market for recycled/reclaimed lumber in 2005 ranges from \$24 million US to \$81 million US depending on if you use EPA numbers for recovered wood or the Forest Association²²

²⁰ The US Environmental Protection Agency; www.epa.gov/jtr/comm/wood.htm

²¹ American Forest paper association

²² Based on 8% growth per year , a market price of 24\$/ton

Appendix B. List of BC Companies with GHG Reducing Product

Material	GHG Reduction Properties	BC Producer
Concrete	<p>High Fly ash Concrete</p> <p>Concrete is a major construction material worldwide. Unfortunately, the production of Portland cement (an essential ingredient of concrete) releases large amounts of CO₂ into the atmosphere. The need to decrease greenhouse gas emission concerns means that supplementary cementing materials be used to replace large proportions of cement in the manufacturing of concrete. One of the most readily available cementing materials is flyash, a waste product of thermal power generation.</p> <p>In high volume flyash concrete, large proportions (usually 40 to 50%, sometimes up to 65%) of the Portland cement is replaced by flyash. The proportion of materials (cement, flyash, water, aggregates, chemical admixtures such as the air-entraining admixture, water-reducer and superplasticizer) can be optimized to produce a high-quality concrete for a wide range of applications. HVFA concrete can meet most technical specifications, even those for high-performance concrete, has environmental benefits and is similar in cost to conventional concrete.</p>	<p>Con-Force Structures Ltd. 7900 Nelson Road Richmond BC V6W 1G4 www.con-force.com/ Ph. : 604-214-3205 Fax : 604-278-3537 Contact : Ken Pensack</p> <p>Lafarge Canada N.A. Construction Materials Div. 268 East Kent Avenue South Vancouver BC Ph. : 604-325-4655 Fax : 604-324-9455</p> <p>Ocean Construction Supplies Ltd. 8955 Shaughnessy Street PO Box 2300 Vancouver BC V6B 3W6 Ph. : 604-269-6407 Fax : 604-261-7573 Contact : Rodney Hicks</p> <p>Lehigh Northwest Cement Ltd. 7777 Ross Road Delta BC V3K 3S6 www.lehighnw.com/ Ph. : 604-952-5621 Contact : Brad Pope</p>

Gypsum Board	GHG reducing Gypsum will consist of recycled content gypsum core and 100% recycled paper liner. To be considered they should also have no formaldehyde added in the manufacturing process	<p>Westroc Inc. 1070 Derwent Way, Annacis Island New Westminster BC V3M 5R1 www.westroc.com/ Ph. : 1-800-661-3120 Fax : 1-877-472-4506 Email : info@westroc.com</p> <p>Georgia-Pacific Canada Inc. 12509-116 Avenue Surrey BC V3V 3S6 www.gp.com/gypsum/index.html/</p> <p>Fax : 604-580-1073 Toll Free Ph. : 1-800-387-6823</p>
Insulation (cellulose)	<p>Cellulose Insulation (Loose fill thermal and acoustic cellulose) insulation primarily for wood frame construction. Composed of approximately 85% fiberized cellulose with boric acid and sodium borate additives to act as a fire retardant and for mould, decay, insect and rodent resistance. Cellulose contains 95% post-consumer recycled newsprint. Class A flame-spread rating.</p> <p>The GHG reduction properties include the fact that it has been diverted from a landfill and that no VOC are present</p>	<p>Can-Cell Industries Inc. 14715-114 Avenue Edmonton AB T5M 2Y8 http://www.can-cell.com/</p>
Insulation (rigid)	<p>PlastiSpan insulation board is a rigid expanded polystyrene (EPS) product. The closed cellular structure of PlastiSpan insulation guarantees the long life of its thermal insulation properties. This product is inert to a wide range of chemicals. It will not attract insects, parasites or animal and plant life. EPS does not contain CFCs, HCFCs, or HFCs and therefore does not contribute to global warming. However, this product is derived from fossil fuels. EPS is totally recyclable.</p>	<p>Plasti-Fab 679 Alford Avenue, Annacis Island Delta BC V3M 5P5 www.plastifab.com</p>

<p>Concrete forms</p>	<p>Interlocking Concrete Forms Interlocking concrete forms use the rigidness of panels made of Expanded Polystyrene (EPS) and ties made of High Density Polyethylene (HDPE) to create a concrete form that will accommodate vertical and horizontal Reinforcing Steel as required. Filling the cavity with Concrete will create a solid Concrete Wall. The EPS Forming System will stay in place and turn into the best insulation available today, saving energy and the waste of plywood.</p>	<p>Quad-Lock Building Systems Ltd. 7398 - 132nd Street Surrey, B.C. V3W 4M7</p>
<p>Flooring materials</p>	<p>To be considered here the flooring either had to be recycled or low in VOC</p>	<p>D. Litchfield & Co. Ltd. (Simply Wood) 3046 Westwood Street Port Coquitlam BC V3C 3L7 www.dlitchfield.com/ Ph. : 604-522-1736 Fax : 604-944-1674 Toll Free Ph. : 1-888-303-2222 Email : sales@dlitchfield.com Vancouver Timber 2350 Beta Avenue Burnaby BC V5C 5M8 www.vancouvertimber.com/ Ph. : 604-925-4597 Fax : 604-925-4597 Divided Spaces Inc. 3770 Commercial Street Vancouver BC V5N 4G2 Ph. : 604-875-9355 Fax : 604-879-2508 Email : info@dividedspaces.com</p>

<p>Curtain Walls</p>	<p>Curtain wall system with integrated photovoltaic cells. Polycrystalline or amorphous silicon solar electric modules convert light energy from the sun directly into electricity without using fuel. The curtain wall is also thermally separated. The system can be incorporated into vertical and sloped glazing applications</p>	<p>Kawneer 1000 Walalee Drive Delta BC V4M 2L8 www.kawneer.com/ Ph. : 604-948-9767 Fax : 604-948-9787 Email : mark.degoutiere@alcoa.com Contact : Mark de Goutiere</p>
<p>Windows</p>	<p>Low Conductivity Window Frames</p> <p>A window or curtain-wall framing system constructed from materials with low thermal conductivity in order to reduce heat loss. Some use recycled glass from demolitions others used recycled wood in frames.</p>	<p>Visionwall #110, 14904-123 Avenue Edmonton AB Canada T5V 1B4 tel 1 780 451 4000 fax 1 780 451 4745 www.visionwall.com Kawneer 1000 Walalee Drive Delta BC V4M 2L8 www.kawneer.com/ Ph. : 604-948-9767 Fax : 604-948-9787 Email : mark.degoutiere@alcoa.com Contact : Mark de Goutiere The Glass Station 1161 Kingsway Avenue Port Coquitlam BC V3C 1S2 Ph. : 604-552-3738 Fax : 604-552-3778 Email : glassstation@telus.net</p>
<p>Lighting</p>	<p>The use of T8 Lamps helps to save energy; a further reduction in energy use is achieved if each office can control their lights. The Ergolight™ is an intelligent lighting and energy management system for open and private offices featuring personal dimming control, integrated occupancy and daylight sensors and system-wide scheduling and load shedding is capable of delivering up to 85% lighting energy savings.</p>	<p>Ledalite Architectural Products 19750-92A Avenue Langley BC V1M 3B2 www.ledalite.com/</p>

Exit lighting	Replacing existing exit lights with LED lights with LED lamp assemblies uses 2.6-3.8 watts versus 40 watt for the standard exit sign.	Edwards 7989 Enterprise Street Burnaby BC V5A 1V5 Ph. : 604-420-4113 Contact : Scott McCuaig
Motion sensors	Occupancy Sensors provide automatic ON/OFF switching of lighting for convenience, security and long-term energy savings. Passive infrared (PIR) units respond to changes in the infrared background by turning lights on when people entered the monitored space and off when the space is unoccupied. Applying these sensor technologies to spaces provide automatic lighting control for conference rooms, restrooms, stockrooms, stairwells interior parking areas, exterior patios, porches and residential yards. Products are designed for use in institutional, commercial and residential spaces.	Leviton Manufacturing of Canada Ltd. 2009-7445-132nd Street Surrey BC V3W 1J8 www.leviton.com Ph. : 604-594-8415 Fax : 604-594-3365 Email : pkennedy@leviton.com Contact : Paul Kennedy
HVAC controls	Control systems are available for residential, commercial, and institutional buildings to control the heating and cooling of rooms (or zones), radiant floor heating, boilers, and/or domestic hot water. The control system features an outdoor sensor to adjust the heat required before the room temperature is too cold or too hot. For hot water, heat is quickly transferred to the tank when hot water is required rather than always heating water, as in conventional systems.	Tekmar Control Systems Ltd. Canada 5100 Silver Star Road Vernon BC V1B 3K4 www.tekmarcontrols.com Ph. : 1-250-545-7749 Fax : 1-250-545-0650 Delta Controls Inc. 17580-56 Avenue Surrey BC V3S 1C7 deltacontrols.com Ph. : 604-574-9444 Fax : 604-574-7793 Email : ldickson@deltaccontrols.com Contact : Lee Dickson
Heat Recovery System	Approximately 70-80% of the heat from the exhaust air is recovered and transferred to the incoming air. This reduces the energy needed to heat fresh air to a comfortable temperature.	Eneready Products Ltd. 4-6420 Beresford Street Burnaby BC V5E 1B6 Ph. : 640-433-5697 Fax : 604-438-8906 Contact : David A. Hill

Recycled paving material	There are different varieties to be considered. Some are manufactured from discarded tires and so are simply pavers that have been recycled. Both types avoid sending material to landfills which helps to reduce GHG pavers	(Made from discarded tires) Dinoflex Manufacturing Ltd. 5590-46th Avenue SE, PO Box 3309 Salmon Arm BC V1E 4S1 www.dinoflex.com Ph.: 1-250-832-7780 Fax: 1-250-832-7788 Toll Free Ph.: 1-877-713-1899 Email: sales@dinoflex.
Lumber replacement	Manufactured with 80% post-consumer and 20% post-industrial recycled plastic, synthetic lumber is used for landscaping and marine applications	Syntal Products (Victoria) Ltd. 6722 Bertram Place Victoria BC V8Z 1M6 www.syntalproducts.com Ph. : 1-250-544-1676 Fax : 1-250-544-1756
Stains and Paints	GHG reducing paints and stains are low in VOC and toxicity. Some are made from natural oils and resins.	Broda 1435 Rupert Street North Vancouver BC V7J 1E9 www.brodacoatings.com Ph. : 604-980-3325 Fax : 604-980-7933 Toll Free Ph. : 1-800-316-3325 Email : info@brodacoatings Valhalla Wood Preservatives Ltd. PO Box 328 Salt Spring Island BC V8K 2H9 www.valhalco.com Ph. : 1-250-538-5516 Fax : 1-250-538-5517
Water treatment	Water treatment is not usually considered in GHG reduction however the reduction of energy at the primary source to treat the water used and the reduction in sludge at the filtration plant (reduction in methane producing GHGs) are benefits. The two products listed are quite different. Solar Aquatics treats wastewater using the natural purifying processes of streams and wetlands combined with the best features of conventional technologies in a controlled environment, typically a greenhouse. While Davey Consulting has	Davey Consulting and Engineering PO Box 473 Errington BC V0R 1V0 www.daveyconsulting.com/ Ph. : 1-250-248-7203 Fax : 1-250-248-9744 Toll Free Ph. : 1-800-838-9887 Email : daveyconsulting@shaw.ca Contact : Robert A. Davey Solar Aquatics Eco-Tek

	<p>created a single-pass aerobic biofilter designed for the biological treatment of waste water.</p>	<p>10-20543-96th Avenue Langley BC V1M 3W3</p> <p>Ph. : 604-728-9599 Fax : 604-882-9331 Email : ecotek@windsong.bc.ca Contact : Kim Rink</p> <p>BioGreen System (Pacific) Ltd. 4-11443 Kingston Street Maple Ridge BC V2X 0Y6</p> <p>Ph. : 604-460-0203 Fax : 604-460-0263 Cellular : 604-880-4987 Email : biogreen@lynx.bc.ca Contact : Masa Takahashi</p>
<p>Moisture protection for foundations</p>	<p>Typical products are high in VOC, Xpex is the one product in this space that is not. The less volatile gases released the less harmful the affect on GHG</p>	<p>Xypex Chemical Corporation 13731 Mayfield Place Richmond BC V6V 2G9 www.xypex.com Ph. : 604-273-5265 Fax : 604-270-0451 Toll Free Ph. : 1-800-961-4477 Email : info@xypex.com</p>
<p>Roofing Materials</p>	<p>These products have to offer low VOC, be recycled or recyclable</p> <p>RoofRoc are slate replica roofing tiles made from recycled high density polyethylene products such as milk jugs and other sources. The addition of pigmentation and fire retardant are the only non recycled elements in RoofRoc.</p>	<p>RoofRoc Canada Corp. 110-155 Glacier Street Coquitlam BC V3K 5Z1</p> <p>Ph. : 604-468-9539 Fax : 604-464-6541 Email : smcfaul@roofroc.com Contact : Suzette McFaul</p>

Appendix C. GHG Related Web Sites

Site	Address	Comment	Sponsor
Advanced Building Technologies	www.advancedbuildings.org	Excellent source more than 90 environmentally-appropriate technologies and practices --	Sponsors; CMHC Canada Nrcan, Enermodel Engineering
Australian Greenhouse Office	greenhouse.gov.au	Excellent source of studies on the implication of reducing technologies	Government of Australia
Canadian Construction Association	www.cca-aac.com/overview/overview.htm	Information on the size of the building sector in Canada	Canadian Construction Ass.
Us Government Consensus	www.census.gov/const/www/charindex.html#singlecomplete	Characteristics of New Housing Index in the United States	US Government
Energy Foundation	www.ef.org/home.cfm	The Energy Foundation is a partnership of foundations in sustainable energy.	Various US based foundations
US EPA Leaders	www.epa.gov/climateleaders/	Climate Leaders is an excellent example of a voluntary industry- government partnership that encourages companies to develop long-term comprehensive climate change strategies and set greenhouse gas (GHG) emissions reduction goals.	US Environmental Protection Agency
Evolution Markets Brokerage Services	evomarkets.com	Good site on carbon credit trading	Evolution Markets
Gvrd Buildsmart	www.buildsmart.ca	Excellent site with a full list of technologies that help reduce GHG in building solutions	Greater Vancouver Regional District
Us Green Building Council	www.usgbc.org	Great site with stats of green certified US buildings	Member driven
Sustainable Products Corporation	www.sustainableproducts.com	SPC provides environmental product communication or labeling language to increase sales and market share, and necessary legal opinions and warranties.	Revenue driven
U.S Embassy	www.usemb.nl/pd11121.htm	Great summary on the US progress towards Climate Change Summary and Greenhouse Gas Emission Reduction	US Government
United Nations	unfccc.int	The Kyoto source	UN and members
Greentie	www.greentie.org	An excellent international Directory of suppliers whose technologies and services help to reduce greenhouse gas emissions	European Union
Building Green	www.buildinggreen.com	An industry driven database of green products. Great place for alternative products	Building Green

Appendix D. U.S. Window and Door Demand

U.S. Window & Door Demand (in million dollars)					
Item	1997	2002	2007	%Annual Growth	
				1997/02	2002/07
Total Demand	18,370	24,500	31,050	5.9	4.9
Wood	7,810	10,370	11,900	5.8	2.8
	8,290	9,780	12,950	3.4	5.8
Plastic	2,270	4,350	6,200	13.9	7.3
Net Imports	140	900	1,650	45.1	12.9
Shipments	18,230	23,600	29,400	5.3	4.5

Source: The Freedonia Group Inc. (Cleveland, OH)

Appendix E. Calculation of Recycled/Reclaimed Wood Industry Figure

Year	1998	2000	2001	2002	2003	2004	2005	2006
Wood waste tons (low)	590000	635000	684530	737923	795481	857529	924417	996521
Wood waste Tons (high)	2000000	2156000	2324168	2505453	2700878	2911547	3138648	3383462
Price per ton	24	24	24	24	24	24	24	24
Value high (\$ millions)	\$14,160	\$15,240	\$16,429	\$17,710	\$19,092	\$20,580	\$22,186	\$23,916
Value low (\$ millions)	\$48,000	\$51,744	\$55,780	\$60,131	\$64,821	\$69,877	\$75,328	\$81,203