2011

BC Jobs Plan Special Report: The BC Greenhouse Sector

CANADA STARTS HERE

THE BC JOBS PLAN

BRITISH COLUMBIA

TABLE OF CONTENTS

PREFACE

This Report is designed to fulfill the *Canada Starts Here: BC Jobs Plan* commitment to "commission a report to identify opportunities for innovation in greenhouse heating along with other ways to spur new growth in this important industry." The Report summarizes and builds on a large body of existing work (see Appendix) to provide a foundation for potential future actions by government and the greenhouse industry to improve competitiveness and grow the sector. Possible policies and initiatives described in this report are exploratory only, and are not designed to be prescriptive either to industry or government.

The Report is the result of a collaborative effort by staff in the Ministries of Agriculture, Energy and Mines, Environment, Finance, Jobs Tourism and Innovation and others. The Report was written with assistance from Astute Management Consulting Inc., and benefited from industry input through representatives of the BC Greenhouse Growers Association and the United Flower Growers Co-operative Association. Thank you to all those who contributed time and expertise to this project.

1. INTRODUCTION

The BC greenhouse sector, comprising both vegetable and floriculture industries, produces high-value vegetables (predominantly peppers, tomatoes and cucumbers) and a wide range of ornamental plants including both flowering potted plants and cut flowers. In 2010, sales for the sector totalled approximately $560 million (Statistics Canada, 2011) representing almost 40% of total farm cash receipts for agricultural crops in BC (Fast Stats, 2010).

There are approximately 480 greenhouse vegetable and floriculture operations in BC, employing an estimated 5,420 workers. The majority of the production area is located in the Lower Mainland, although production also occurs on Vancouver Island and in the Okanagan. The greenhouse sector experienced considerable expansion through the 1990s, but growth stalled in 2000 due to significant increases in the cost of natural gas and the value of the Canadian dollar. The production area has been stable at around 500 hectares for the past 7 years (Statistics Canada, 2011).

Total farm gate sales have followed a similar trend to production area and have been relatively flat since 2004 for both greenhouse vegetable crops (approximately $276 million in 2010) and ornamental crops (approximately $284 million in 2010) although margins have declined over the same period.

There are various explanations for the flattening of growth and diminishing margins in the BC greenhouse sector. While the recent global recession impacted demand for both greenhouse vegetable products (i.e., as consumers switched to cheaper field-grown products) and floriculture (i.e., as a result of diminished discretionary incomes) BC greenhouse growers continue to face challenges to competitiveness in both domestic and export markets as a result of several interacting drivers:

- Expansion of foreign competitors (particularly in Mexico) selling into the key US market;
- Strength of the Canadian dollar and its impact on both export prices and the volume of imports;
- Rising production costs, particularly for energy and heating;
- Differences in the tax and regulatory frameworks of competing jurisdictions;
- Shift in consumption away from domestic retailers and toward large, multinational chain stores that source product based on lowest price rather than product origin and other indicators of quality; and
- Misrepresentative or inadequate product labeling to differentiate high quality Canadian product from competing products.

The purpose of this report is to explore these challenges and identify opportunities for industry and government to improve the competitiveness of the sector, with a particular focus on innovation in energy production and use.

2. PROFILE OF THE BC GREENHOUSE INDUSTRY

This section provides a high level profile of the BC greenhouse vegetable and floriculture sectors as context for the subsequent discussion.

2.1 Greenhouse Operations

Of the 480 greenhouse vegetable and floriculture operations in BC, approximately 120 are defined strictly as greenhouse vegetable and fruit operations, with employment of 2,275. There are 360 operations identified as floriculture, with 3,145 employees (Statistics Canada, 2011).

The industry is heavily concentrated in the Lower Mainland and Vancouver Island-Coastal regions. For the greenhouse vegetable industry specifically, the Lower Mainland is home to 95% of large scale operations (annual gross revenue > $250,000 per operator). Small scale operations (annual gross revenue < $25,000 per operator) are concentrated in the Island-Coastal region.

After many years of growth, the total production area of the BC greenhouse sector has been stable at around 500 hectares since 2004 (Statistics Canada, 2011).

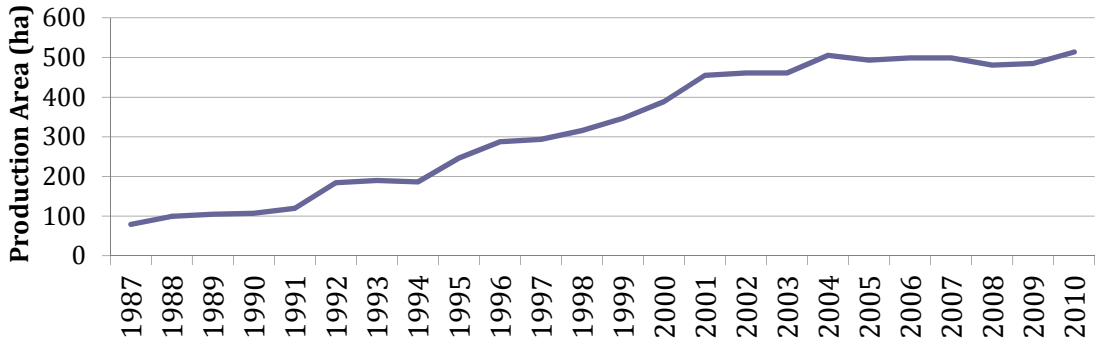

Figure 1: Greenhouse area of production from 1987 to 2010 (Source: Statistics Canada, 2011)

Greenhouse operations vary greatly in size. The average size of all greenhouse installations in BC (vegetable and floriculture) is 9300m^2 (0.93ha) although vegetable operations tend to be larger. The average size of a greenhouse vegetable operation is 22,600m^2 (2.3ha) while the average floriculture operation is considerably smaller at 4,800m^2 (0.48ha) (Statistics Canada, 2011).

The 41 members of the BC Greenhouse Growers Association (BCGGA) represent the majority of regulated greenhouse vegetable production in the province (>95%) and include the largest operations in BC. In 2009, BCGGA members had a total greenhouse area of 2,747,000m^2 (274.7ha) and thus an average size of 67,000m^2 (6.7ha) or roughly three times the overall average for vegetable operations.

2.2 Products

The greenhouse vegetable sector in North America is dominated by three products – tomatoes, cucumbers and peppers. Across Canada, tomatoes account for approximately 66% of greenhouse area, peppers 17% and cucumbers 17%.

In the past, BC's crop mix pattern has tended to reflect the national pattern, with tomatoes accounting for more than 50% of total area, followed by peppers and cucumbers. However, since 2003, the area given over to pepper production has increased and now exceeds the area under tomatoes. In 2007, peppers

accounted for 45% of greenhouse area, tomatoes 35% and cucumbers 20%. Smaller quantities of mini-cucumbers and other products are also grown.

BC greenhouse floriculture produces a wide range of ornamental plants, including both flowering potted plants and cut flowers.

2.3 Pricing and Sales

Total farm gate sales follow a similar trend to production area and have been relatively flat since 2004 for both greenhouse vegetable crops (approximately $276 million in 2010) and ornamental crops (approximately $284 million in 2010) (Figure 2). However, total farm gate sales of greenhouse vegetables per unit of production area in 2010 were below 2003 levels by 15% for cucumbers and peppers and by 3% for tomatoes (Figure 3). Similar data are not available for greenhouse ornamental crops.

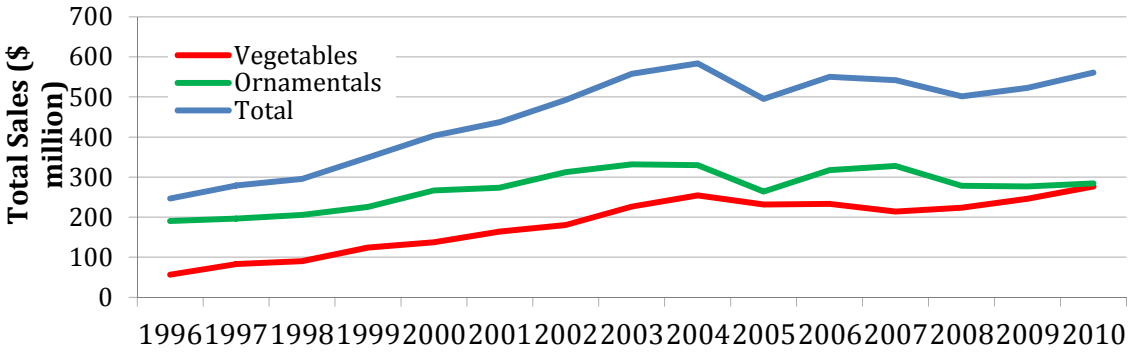

Figure 2: Total sales of greenhouse vegetables and ornamentals from 1996 to 2010 (Source: Statistics Canada)

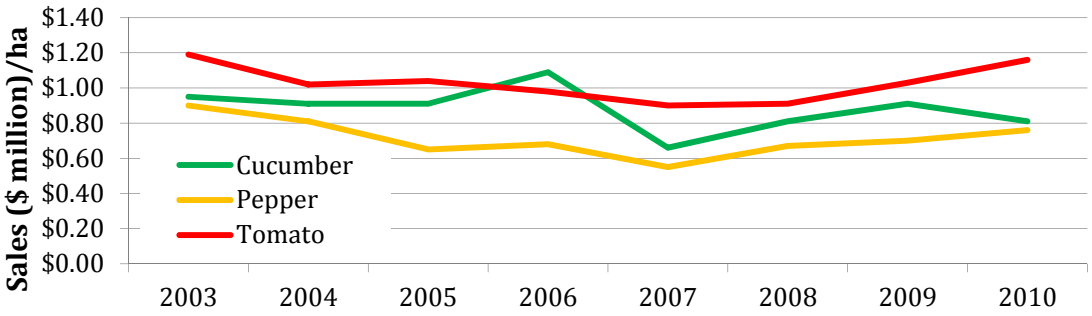

Figure 3: Greenhouse vegetable sales per area of production (ha) from 2003 to 2010 (Source: BC Vegetable Marketing Commission)

The average price received for all greenhouse vegetable crops was higher in the 4-year period from 2003 to 2006 than it was from 2007 to 2010. Figure 4 illustrates how the price per kilogram of different vegetable products have declined since the early 2000s.

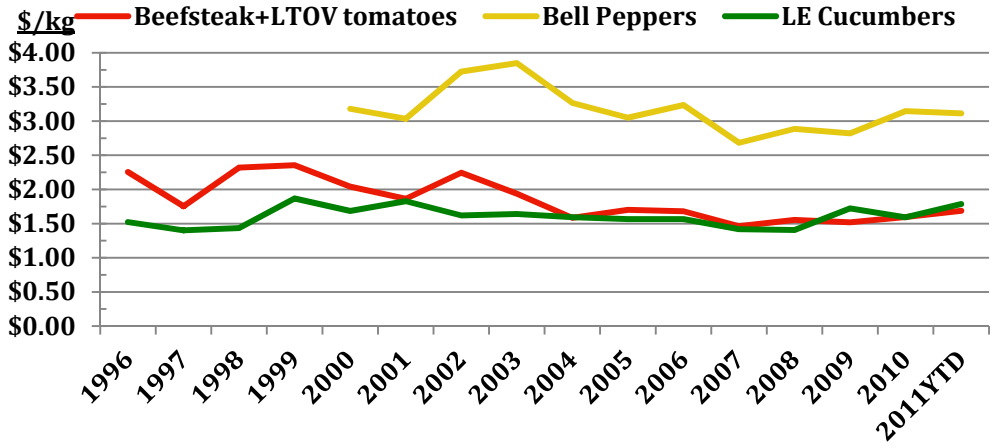

Figure 4: BC greenhouse vegetables: sales price net of freight to customer ($/kg) (YTD:Q1-3) (Source: BC Vegetable Marketing Commission)

Data on annual changes in price are not available for greenhouse ornamental crops. However, available data indicate that the average price of ornamental crops is declining (Table 1). The average change in selling price of eleven selected floriculture crops at the local flower auction declined 6.5% in 2008 and 5.7% in 2009 compared to the previous four years.

Table 1: The % change in price and units sold for 2008 and 2009 versus the average for the previous 4 years for 11 representative floriculture crops (Source: UFG Product Statistics)

Crop		% Change in Price	
		2008	2009
Cut Flower	Gerbera	-7.8%	+9.3%
	Alstroemeria	-12.0%	-7.9%
	Rose, Std (55 cm)	-9.4%	-5.8%
	Tulips	+0.8%	-13.2%
	Gladiolus (field)	-1.2%	+6.0%
	Cymbidium (on stem)	-14.2%	-27.0%
Potted	Poinsettia (15 cm)	-9.5%	-16.8%
	African violets (10 cm)	0.0%	+8.4%
	Tropical (10 cm)	-8.7%	-3.8%
	Geranium (10 cm)	+1.8%	+15.9%
	Primula (10 cm)	-0.4%	+5.5%
Average Change		**-6.5%**	**-5.7%**

2.4 Operating Expenses

Statistics Canada began to disaggregate operating expense data for the floriculture and greenhouse sectors in 2008. These data suggest that while greenhouse production area in BC remained relatively constant between 2008 and 2010, total operating expenses (i.e., labour, energy, fuel, electricity and other operating

expenses[1]) over the same period increased an estimated 7% from $353M to $379M (Statistics Canada, 2011). Energy costs (fuel and electricity) represented an estimated 15% of the sector's total operating expenses in 2010 (Figure 1). Labour costs represented almost one-third of total operating expenses, and are expected to rise due to the recent increase in minimum wage in BC.

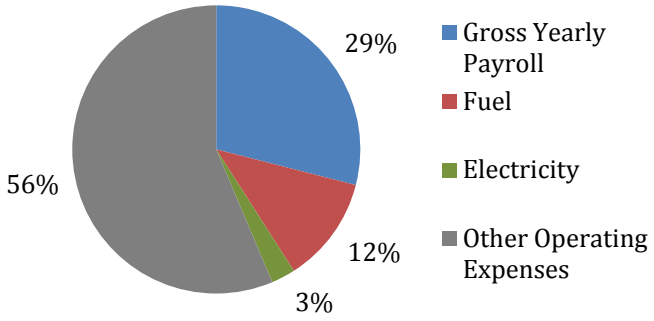

Figure 5: Breakdown of 2010 Total Operating Expenses for Greenhouse Vegetable and Floriculture Operations in BC (Source: Statistics Canada, 2011)

Although total farm gate sales and production area have remained relatively flat since 2004, net operating income and net worth have both declined (BC Ministry of Agriculture and Lands, 2009). Rising production costs and price declines are likely two major factors contributing to this trend.

2.5 Exports / Imports

BC's greenhouse vegetable exports (including tomatoes, peppers and cucumbers) declined 28% over the past six years, dropping from 72,122 tonnes in 2005 to 52,027 tonnes in 2010. The value of these exports declined nearly 25%, dropping from $174.7 to $132.1 million. In 2010, greenhouse vegetables accounted for 8.6% of the value of BC's total agriculture and agri-food exports. About 65% of BC's greenhouse vegetable sales are exports, of which 99% are destined for the United States each year, while the remainder are sent to Japan, Taiwan and Hong Kong (Global Trade Atlas, October 2011).

The US market also continues to be the main export market for BC floriculture, accounting for 95.5% of exports in 2009 (Global Trade Atlas, July 2010). Total floriculture exports have held relatively steady at 12% of total sales for the past 6 years. However, the export of fresh cut flowers and foliage is in decline (Table 2). At the same time, there has been a steady increase in the importation of cut flowers and foliage (Table 3). The importation of cheap cut flowers from South America (Colombia and Ecuador) has had a negative effect on prices, and has displaced local production. In 2009, Colombia and Ecuador accounted for nearly 50% of the total value of cut flower imports (Table 3).

[1] Other operating expenses include crop expenses (plant purchases, fertilizer, pesticides, growing mediums, irrigation, and pollination expenses) and other (interest, land taxes, insurance, packaging, repairs, machinery, and agricultural equipment).

Table 2: The value of floriculture exports from BC (Sources: Statistics Canada, Catalogue no. 22-202-X and Global Trade Atlas, July 2010)

Year	All Floriculture Products[1] ($ million)	Cut Flowers & Foliage[2] (fresh) ($ million)
2009	$33.0	$7.0
2008	$35.1	$7.3
2007	$29.0	$10.8
2006	$38.0	$17.0
2005	$31.7	$12.2
2004	$39.4	-

Table 3: The value ($ millions) of fresh cut flowers & foliage imports into BC (Source: Global Trade Atlas, July 2010)

COUNTRY	2004	2005	2006	2007	2008	2009	% of Total BC Imports[1]
WORLD	**$17.8**	**$20.1**	**$21.2**	**$22.8**	**$28.0**	**$27.2**	**100.0%**
US	$8.1	$8.95	$9.2	$10.3	$13.0	$9.7	43.0%
Colombia	$5.7	$7.0	$7.9	$7.9	$9.1	$12.0	35.0%
Ecuador	$2.0	$2.3	$2.4	$3.0	$4.3	$3.9	12.1%
Costa Rica	$0.4	$0.3	$0.3	$0.2	$0.3	$0.5	1.5%
Mexico	$0.2	$0.2	$0.1	$0.07	$0.05	$0.03	1.4%
New Zealand	$0.2	$0.3	$0.3	$0.3	$0.3	$0.3	1.3%
Netherlands	$0.5	$0.2	$0.08	$0.06	$.08	$.04	0.9%
Israel	$0.15	$0.2	$0.2	$0.3	$0.3	$0.2	0.8%
Guatemala	$0.05	$0.05	$0.07	$0.07	$0.04	$0.007	0.2%

[1] The **% of Total BC Imports** was calculated for the 2000-2009 period.

2.6 Domestic Markets

Based on the above export figures, approximately 35% of greenhouse vegetables and 88% of floriculture products are sold into domestic markets through various distribution channels such as domestic wholesalers, mass market chain stores and direct sales to the public. Unfortunately no information is available on interprovincial trade of greenhouse vegetable or floriculture products.

3. CHALLENGES TO COMPETITIVENESS AND GROWTH

The greenhouse sector faces a number of challenges on both the demand-side (factors influencing the demand in both export and domestic markets for BC greenhouse vegetables and floriculture) and the supply-side (factors influencing the ability of greenhouse growers to supply product at competitive prices). The relative influence of these challenges has changed over time, and will continue to shift as a result of changing global economic drivers and advances in production efficiency. Causal factors for declines in net operating income and net worth in recent years are thus difficult to determine with certainty.

Note this is not intended to be an exhaustive list of challenges for industry; rather it is a summary of those challenges that are viewed as currently having the greatest impact on competitiveness and growth of the greenhouse sector in BC.

3.1 Demand-Side Challenges

This section focuses on factors that have affected prices and demand for greenhouse vegetable and floriculture products, and those that will continue to challenge the industry.

3.1.1 Downward Pressure on Pricing Resulting from Expansion of Competitors

Vegetables

The area allocated to greenhouses in North America has increased significantly in recent years. Since 2002, greenhouse area has increased 105% in Mexico (to 2,334 hectares), 39% in Canada (to 1092 hectares) and 25% in the US (to 445 hectares). Mexico now produces 60% of North American greenhouse vegetables and, as it is not a major consumer of greenhouse products, the increase in output is targeted at export markets, especially the US. This increase in production of greenhouse products is having the effect of displacing field–grown products, as well as some European imports (peppers especially). The overall increase in output is also shifting greenhouse vegetables from being a specialty product to a commodity product, with corresponding downward pressure on prices. As a result, Canadian producers in particular are focusing increasingly on new products such as mini-cukes, mini-peppers, patented varieties, proprietary production protocols and packaging, and new technologies.

North American trading patterns in this sector are seasonal, such that BC greenhouse vegetables (65% of which are exported to the US) are exported to the US market in the April-November period, while Mexican product is exported to the US from December to March. This pattern is changing with the increase in Mexican greenhouse area and quality, such that Mexican product is appearing in the US during the April-June shoulder season. This has had the effect of flattening the ‘shoulder-season’ price peaks Canadian producers previously enjoyed.

Mexico does, however, face some significant constraints in displacing Canadian product from the US market. US buyers prefer to import from Canada rather than Mexico, as the poor infrastructure in Mexico and the longer border delays on the southern border increase delivery times and thus reduce the quality and freshness of the products. Canada has significant advantages over Mexico in accessing the all important US market, though recent investments in Mexico have focused on high-end production, closing this gap somewhat. Mexican tomato producers are narrowing the technology gap with Canada to enhance both yields and quality.

Floriculture

There is also increasing competition in the floriculture sector from US product and cut flowers grown in South America.

As discussed in Section 2, the value of floriculture exports from BC has declined from a peak of $39.4 million in 2004, to $33 million in 2009. Over the same period, the total value of floriculture imports into BC increased from $17.8 million to $27.2 million.

The importation of cheap cut flowers from South America (particularly Colombia and Ecuador) has had a negative effect on prices and has displaced local production. In 2009, Colombia and Ecuador accounted for nearly 50% of the total value of cut flower imports.

As a result of the continued recession in the US and the slow recovery in Canada, growers are very conservative in the volume of product grown (Ministry of Agriculture and Lands, 2010). Since the production cycle of most potted crops is less than one year, floriculture growers are better able to quickly respond to such market changes. However, there continues to be downward pressure on prices due to competition from US and offshore (cut flowers) production, and expansion of product sales to chain stores (see 3.1.4 below).

3.1.2 Strong Canadian Exchange Rate

The Canadian dollar has increased in value relative to both the US dollar and the Mexican peso over the last decade. Fluctuations in the exchange rate present a challenge for growers as they change the price of exports, the affordability of imports.

While the US dollar was stronger than the Canadian dollar in most years between 1992 and 2002, the strengthening of the Canadian dollar since 2003, and in particular the 32% appreciation since March 2009, is seen as a significant reason for the slowing of the growth of exports to the US, and the rise in imports over the same period, especially in the floriculture sector.

Furthermore, because the value of the Canadian dollar tends to be correlated to the price of oil, there is a risk that a sharp increase in the price of oil could further disadvantage BC greenhouse vegetable suppliers.

3.1.3 Availability of Substitutes

Demand for greenhouse product is affected not just by prices and economic well-being, but also by the availability of substitute goods. Greenhouse product sales suffered reductions during the current US recession as customers switched to lower cost non-greenhouse products, such as field grown cucumbers.

Floriculture products must compete with many other discretionary items for consumers' limited disposable income. The continued recession in the US and the slow recovery in Canada are challenging the sector to maintain sales. Compounding this is an overall decreased demand for cut flower products for key floral holidays and events. For instance, more and more funerals today are requesting charitable donations instead of flowers.

3.1.4 Chain Store Expansion

The greenhouse industry has recently experienced significant transformation in domestic distribution, with the increasing influence of "big box" mass merchandisers.

On the floriculture side, by 2008, there was a significant increase in BC producer sales to chain stores (28.8% of sales) relative to the domestic wholesalers (18.9% of sales). Over the 2008 to 2009 period BC producer sales to retailers increased to 33.9% of total sales, whereas domestic wholesales dropped over 5% as a proportion of total sales over the same period.

The "big box" stores favour large scale operations, including local producers, due to larger scale demand and more complex sales agreements. As a result of these changes, the BC floriculture sector has evolved to a dual market structure, consisting of large scale producers, who can supply the "big boxes" and compete with foreign imports, and another segment of small scale producers who serve local markets based on higher quality customer service and/or being responsive to specialized consumer demands.

The greenhouse vegetable industry reports a similar shift in the channels of distribution as consumers increasingly shift their buying away from domestic retailers with long standing grower relationships, and toward large, multinational chain stores that source product based on lowest price rather than product origin or other indicators of quality.

Downward pressure on prices is expected to continue (or increase) as the chain stores expand their influence (and buying power) on the industry in terms of new store openings, and their ability to supply consumers while also meeting the needs of some landscapers at a more efficient cost than traditional wholesalers.

3.1.5 Product Co-mingling / Inadequate Labelling

There has been a marked growth in recent years in the re-export to the US of product delivered to Canadian wholesalers by air freight from Europe during the winter months, with no "country of origin" labelling.

Furthermore, wholesalers will simultaneously market product from BC greenhouses and product which they have sourced from other parts of the world. This is a practice that is referred to as "co-mingling." Co-mingling inhibits the ability to differentiate BC product and achieve higher prices since the product is not exclusively BC in origin. Co-mingling may also increase phytosanitary and food safety risks if some product originates in countries with lower standards (Canadian Horticulture Council, 2011). Consumer research indicates a growing preference among BC residents for food produced in BC for a number of reasons (e.g., safety, quality, desire to support BC economy), while the same research notes that the typically higher prices for BC product can be a barrier to purchase (Food Industry Market Development Program, 1994 & 2001).

Product arriving in the packing plants from other parts of the world for repacking may introduce foreign pests into BC greenhouses that were not previously detected in BC. If those same potential pests are found on product for re-export to the US, their presence may unfairly be attributed to BC grown product. This risk could have serious negative implications that could cause difficulties for continuing open border access to the US market. Therefore, there is a strong need by growers to see foreign product repacked for export strictly segregated from BC product and correctly labelled so that there is neither deliberate, nor inadvertent, passing off of foreign product as Canadian (Canadian Horticultural Council, 2011).

A further challenge in the marketplace is that Mexican products are labelled as "greenhouse grown" and positioned against BC greenhouse products, when in fact they could be grown in shade houses that offer significantly lower costs of production.

The combination of co-mingling and inadequate labelling challenges the BC greenhouse sector in differentiating its products and leveraging its reputation for quality and food safety to achieve higher prices for the products.

3.2 Supply-Side Challenges

This section focuses on factors that have affected cost and supply of greenhouse vegetable and floriculture products, and those that will continue to challenge the industry.

3.2.1 Labour Costs and Supply

Labour costs are higher in BC than in California and Mexico. The current minimum wage in BC is $9.50 per hour, scheduled to increase to $10.25 per hour in May 2012. This is higher than the minimum wage in California ($8 per hour) and substantially more than wages in Mexico (Delphi Group, 2011).

Labour costs currently represent approximately 29% of the total operating costs for greenhouses (Statistics Canada, 2011) and, as such, continued access to competitively priced labour is essential. Growers in most parts of Canada rely on workers sourced from Mexico, Central America, and the Caribbean, mostly under Canada's Seasonal Agricultural Workers Program for an estimated 20-30% of labour needs[2]. While industry has not raised significant current concerns with labour supply and costs, the continued ability to source workers from these countries at competitive wage rates is considered essential to the future of the sector in Canada (Canadian Horticulture Council, 2011).

The labour market also appears to be more flexible in the US, with a more ready supply of Mexican workers and lower hiring costs than under Canada's Seasonal Agricultural Workers Program (Ministry of Agriculture and Lands, 2009).

3.2.2 Energy Costs

Energy is a particularly pressing issue for the greenhouse sector, as energy (fuel and electricity) accounts for an estimated 15% of the sector's total costs (Statistics Canada, 2011). Consumption by individual greenhouses varies greatly, depending mainly on the type of crop grown, carbon dioxide (CO_2) needs, and energy efficiency measures undertaken. Energy usage in the greenhouse floriculture industry, for example, is comparatively much lower at 5% of total production costs in 2010 (Statistics Canada, 2011).

Currently, most of the heating needs of greenhouses are provided by natural gas. Operations without access to natural gas often rely on diesel or propane, and a growing portion of greenhouses (currently over half) also use biomass boilers to meet heating requirements. Natural gas is an ideal fuel as its combustion provides not only heat, but food grade CO_2 which is used in greenhouses to increase the yield of plants[3]. From May to October, 90% of the natural gas used

[2] Estimate provided by greenhouse industry representatives.

[3] Research has shown that increasing the CO_2 level by 400 ppm can increase pepper fruit set by 55% and production by 30% (BC Ministry of Agriculture, Fisheries and Food, 1996).

by the sector is used to produce CO_2, not heat – equating to approximately 50%[5] of all the gas used by the sector in a year. Use of natural gas varies seasonally and diurnally, reflecting both changing heating needs and CO_2 requirements. Notably, many floriculture operations do not require CO_2 for their operations.

Flue gasses from wood pellets and wood waste also contain CO_2, but this CO_2 contains contaminants that mean it is not considered 'food grade' CO_2. As such the flue gasses need to be 'scrubbed' clean if the CO_2 is to be used in greenhouses.[4] Hence, many greenhouses utilize both wood and natural gas, and switch between the two as prices and their own heat/CO_2 requirements dictate.

Electricity is used primarily for lighting and ventilation equipment and is generally not used for heating purposes.

The greenhouse industry estimates that total energy use in vegetable greenhouse operations currently ranges between 13,000-20,000 GJ/ha/yr, and has likely decreased from the previously reported range of 22,500-28,000 GJ/ha/yr[5] in 2005 due to energy efficiency measures taken in recent years. Cucumber and pepper crop demand tends to fall in the lower end of the range while tomato crops fall into the upper end of the range.

Floriculture greenhouse energy use averages substantially lower than vegetable greenhouse consumption, due in large part to generally lower CO_2 requirements. A previous 2005 estimate reports an average energy use of 20,000 GJ/ha/yr[8] by floriculture operations; however, industry has indicated that these figures have also likely dropped in recent years.

It is expected that natural gas prices will begin to rise in the near future and combined with a scheduled increase in the BC Carbon Tax (see section 3.2.4) industry expects to see an impact on competiveness. Electricity prices are also expected to rise, with implications for increased greenhouse lighting and ventilation costs. The greenhouse sector has been quick to adopt economically viable energy saving technologies such as thermal screens, heat storage, and more efficient boilers. However, growers continue to see their margins decline and are looking for new options to reduce their costs of production and improve their competitiveness.

3.2.3 Biomass Supply

Wood pellets (derived from sawdust and other milling byproducts) are considered the next best heating fuel to natural gas, followed by wood waste (bark etc). Over half of the total BC greenhouse production area now uses wood for heat, and demand for wood biomass fuels will likely increase if natural gas prices increase.

Wood pellet production in BC is growing rapidly. In 2010, BC's pellet mills produced 1.2M tonnes of pellets; however, almost all of this production was shipped to Europe, the world's largest and highest value market for pellet products (Ministry of Forests, Lands and Mines, 2011). Some greenhouse operators have reported difficulty obtaining wood pellets during periods of high demand, a trend likely to increase with large-scale bio-energy facilities becoming established in BC.

[4] Biomass gasification systems could provide food grade CO_2 but these are not yet commercially available to the BC greenhouse sector.

[5] Zbeetnoff Agro-Environmental Consulting & Timmenga & Associates Inc., 2005. *Final Report: Feasibility of Using Biofuels.*

High transportation costs are an important factor in determining the economic feasibility of using wood pellets or wood residues for greenhouse heating in the lower mainland. Most timber and pellet processing facilities are located at a considerable distance from greenhouse operations in Mountain Pine Beetle affected areas in the BC Interior. Mill closures have reportedly further constrained the availability of free or low cost waste wood products, resulting in increased product and transportation costs (Ministry of Forests, Lands and Natural Resource Operations, 2011).

3.2.4 BC's Revenue Neutral Carbon Tax

The BC Carbon Tax is a major concern for the BC greenhouse sector. The sector maintains that the carbon tax costs associated with its consumption of natural gas for heating and CO_2 production puts them at a competitive disadvantage.

Total natural gas consumption by greenhouse accounts in 2010 was 4,375,000 GJ[6]. Assuming constant operating revenue[7] and natural gas consumption along with the scheduled tax rate increase from $25 per tonne of CO_2 equivalent to $30 per tonne in 2012, calculations equate to a projected $5.4M in carbon tax paid by the sector in 2011 and $6.3M in 2012. These estimates represent 1.4% of total operating costs (or 1% of total operating revenue) rising to 1.7% of total operating costs (or 1.2% of total operating revenue) in 2012.[8] Previous analysis completed by the Climate Action Secretariat in consultation with the greenhouse industry provided a comparable estimate of 1.16% of total operating revenues at 2012 rates, based on 2010 operating revenues.

Industry indicates that the carbon tax directly impacts competitiveness and is contributing significantly to the decline in already low profit margins, particularly as producers in competing jurisdictions, such as the US, Mexico and other Canadian provinces, are not subject to a carbon tax. California has announced that it will implement a cap and trade program with compliance obligations beginning in 2013, at which time the largest greenhouses will face a carbon cost for their emissions. Smaller greenhouses will come under the system in the second compliance period three years later.

The carbon tax is designed to not apply to biomass or clean electricity, so fuel-switching to these sources would reduce carbon tax costs.

As many greenhouse growers, particularly larger operators, have been early adopters of energy efficient technology, they are not able to benefit from making efficiency upgrades and selling resulting carbon offsets to the Pacific Carbon Trust, while reducing their carbon tax costs at the same time. Four greenhouse operators currently have carbon offset purchase agreements with the Pacific Carbon Trust, and several others have reduced their carbon tax liability by installing insulating curtains, improving efficiency, and/or switching some of their natural gas use to biomass or biogas.

[6] Fortis BC, email correspondence, December 2011
[7] The most recent data available for total revenues and total operating costs are 2010 data.
[8] This analysis is based on information from Fortis BC on the 150 natural gas accounts they have with BC greenhouses. It is important to note that greenhouse operators that use diesel will also be subject to carbon tax, but the number of these is unknown. In addition, some greenhouses do not use any heat at all, thus do not pay carbon tax.

3.2.5 Capital Costs

Finally, the greenhouse industry is highly capital intensive and this, combined with comparatively high land prices and declining margins suggests that as current facilities age and fall out of production, they may not be replaced. A recent increase to the provincial property tax exemption limit on farm outbuilding improvements (to the greater of 87.5% or $50,000) could alleviate cost pressures to some degree.

4. MEASURES TO ADDRESS THE CHALLENGES

This section discusses measures for industry and government to address the challenges the sector faces and explores barriers to adoption.

4.1 Improved Energy Efficiency

As discussed earlier, energy cost accounts for approximately 15% of the sector's total costs (Statistics Canada, 2011). As such, measures to cost-effectively improve energy efficiency are important for the industry. The use of energy in greenhouses is already considered highly efficient by industry as greenhouses are highly automated, and each input into the greenhouse, including lighting, water, heating and CO_2 is closely controlled. The industry looks for cost savings and efficiencies wherever possible and those efficiencies that have short payback periods are quickly adopted (Delphi Group, 2011).

For the relatively small number of growers that have not adopted energy efficiency measures, the following opportunities may be available.

4.1.1 Heating

A recent energy assessment of various farm types in BC[9] found a number of opportunities for greenhouse operations to improve energy efficiency:

- Isolate standby boilers;
- Install a flue-gas economizer (condenser) to recover heat from the primary boiler exhaust;
- If CO_2 is fed into the greenhouse(s) during the daytime, install a hot water storage tank to capture the heat generated by the boiler so it can be released when heating is required (this can save 15-20% of total heating energy consumption – Delphi Group, 2011);
- Disable heating water zone pumps unless there is a need for heating in the zone;
- Install a retractable thermal curtain to retain the heat at night;
- Install a retractable shade curtain to provide shade to the crop at times of peak solar radiation (crop dependent); and
- Repair glazing leaks to reduce heat leakage.

It is important to note that many growers have adopted some or all of the measures listed above, therefore their relevance may be limited. It is estimated that almost two-thirds of greenhouses have hot water storage tanks and the majority have at least one layer of thermal curtains. More recent installation of double and triple layer thermal curtains is reportedly improving efficiency considerably, and growers are claiming up to a 30% reduction in energy consumption with this technology (Climate Action Initiative, 2011) equating to $\$0.65/m^2$/year in avoided carbon tax costs (at $1.50/GJ in 2012) (Delphi Group, 2011). Automated environmental control systems are common, particularly among large operations.

[9] BC Farms Energy Assessment, Prism Engineering, 2010

Promising advances in renewable energy technologies such as solar (air and water), geo-exchange (ground source heat pump systems) and geothermal may present new opportunities for BC growers, and are currently being explored for their technological and economic feasibility in BC.[10] More efficient architectural designs and building materials that maximize passive solar absorption and thermal retention while minimizing heat loss are also emerging. There is some evidence to suggest that retrofits can be relatively more costly than adopting new technologies and architectural designs for new builds, therefore new entrants into the sector may benefit from an increased range of options for heating innovation relative to incumbents.

4.1.2 Electricity Usage

Compared to heating requirements, electricity requirements are relatively minor in greenhouse operations. Year-round production, a move which is being considered by some BC growers as a strategy to improve competition with peak Mexican production in the winter months, would increase lighting requirements. However, opportunities exist for efficiency savings on lighting (using supplemental lighting when partial light is sufficient, or using LED lights between crops in addition to sodium vapour overhead lights) as well as ventilation fans (installing energy efficient fans and variable speed drives on base-load fans) (Delphi Group, 2011).

4.2 Fuel Switching

There has been considerable uptake in BC greenhouses of switching from natural gas to bio-energy systems, focused primarily on the use of biomass from wood waste and manufactured pellets for heating. Other biomass sources such as food processing waste or biogas (e.g., landfill gas, bio-digestion of manure) could also be used for heating purposes in greenhouses. With low or no-cost feedstocks sourced locally, biomass has the potential for lower operating costs than natural gas. Some commercial biomass systems have been installed and approximately 50% of BCGGA's 41 members use biomass boilers combined with natural gas to produce heat (Delphi Group, 2011).

The main barriers to adoption of biomass technology are the high cost of capital required to implement the technology, high feedstock transportation costs, and the current lack of certainty around reliable, long-term feedstock supply and pricing. Once sourced, feedstocks often have to be trucked to the site, with increased traffic potentially causing problems with the surrounding communities. Feedstock storage on site requires space, which can be limited, as well as a storage structure if materials will not be immediately used. Additional challenges include the complexity of installation and the operation of new, lesser known and often higher-maintenance technologies requiring more time and expertise to operate.

Furthermore, CO_2 that is used in greenhouses to increase crop yields must be relatively pure ("food grade"). This is much simpler to accomplish using emissions from natural gas combustion rather than emissions from biomass combustion, which require additional purification technology. In the absence of pure CO_2 from natural gas combustion, greenhouse growers would have to purchase liquid CO_2, typically from sources outside of BC, or adopt additional technologies to purify CO_2. Installations that could switch entirely to biomass – most likely limited to operations with low to no CO_2 requirements - would save an estimated \$1.95/m^2/year in 2012 in avoided carbon tax (Delphi Group, 2011).

[10] Please see the following website for more information about the BC Renewable Energy Feasibility and Benchmarking Study: http://www.kmwpp.ca/climate_action/downloads/feasibility_studies_description.pdf

4.3 Renewable Energy

Solar photovoltaic systems have the potential to provide renewable electricity to greenhouses and solar thermal (solar air and solar water), geothermal and geo-exchange technologies could provide heat to greenhouses. One solar technology provider is currently working with several greenhouses in BC to install solar thermal systems and the Ministry of Agriculture is conducting feasibility and benchmarking studies in collaboration with five more. One large greenhouse operator in the lower mainland successfully applied for funding under the Innovative Clean Energy (ICE) fund for a geothermal heating project in 2005, but later decided not to proceed with the project, for unspecified reasons.

While there are several successful examples of these technologies being utilized by greenhouse operations in other jurisdictions, there has not yet been widespread adoption of these technologies by greenhouse growers in BC. Barriers include high costs, unproven performance of the technology under BC's specific biogeoclimatic conditions, the complexity of installation and operation, and the often significant space requirements.

4.4 Co-generation

Co-generation, or combined heat and power (CHP), is the use of a heat engine or power station to simultaneously generate both electricity and heat from a single fuel source. Heat from the engine cooling system and the exhaust gas is extracted by a heat exchanger and then used as a low temperature heat source in greenhouses, a process that also produces CO_2 which can be used by greenhouses to enhance crop production (Daniels et al., 2007; Nyboer et al., 2011).

Co-generation is an option being considered by BC greenhouse growers to reduce energy costs, generate additional revenue through electricity sales, and increase the availability of low cost CO_2 to enhance crop production. It is most attractive to the larger greenhouse operations in the Lower Mainland because they have the resources and scale of production to justify investment in this technology (Willis, 2005). Greenhouse vegetable operations are more apt to consider co-generation than floriculture operations due to the higher heat demand and CO_2 use for enhancing crop growth.

Other benefits of cogeneration include producing electricity in communities where it is needed, thereby avoiding or deferring investments in transmission and distribution network infrastructure (Kerr, 2008; PEW Center, 2011), and displacing higher-cost generation plants (Kerr, 2008). Cogeneration also reduces losses of electricity that inevitably occur during transmission from a large central power station, which are estimated to be around 9-10% of net generation (Kerr, 2008; Willis Energy Services, 2005). Cogeneration is sometimes considered to reduce emissions of CO_2 (Nyboer et al., 2011) and other atmospheric pollutants (Coyne, 1999) when displacing energy produced by a thermal power station.

The tipping point in profitability of a co-generation system occurs when the selling price of electricity exceeds the price paid for natural gas by a margin that covers system operating costs (referred to as the "spark spread"). As such, the economic feasibility of co-generation in BC depends directly on the value and long term stability of rates offered by BC Hydro for electricity purchases through its Standing Offer Program (SOP)[11], as well as natural gas costs. BC currently relies on the cleanest and lowest cost electricity generation technology available worldwide and the volatility of gas prices in North America

[11] As directed by the provincial government in its 2007 BC Energy Plan, BC Hydro implemented a Standing Offer Program (SOP) to encourage the development of small and clean energy projects throughout BC. Introduced in April 2008, the program provided a process to purchase energy from small projects with a capacity greater than 0.05 megawatts (MW) but not more than 10 MW. The BC Energy Plan directs BC Hydro to refresh SOP pricing based on the results of the latest BC Hydro call for power; a process completed most recently in early 2011.

also means that there is a level of risk on the payback of investment in co-generation.[12] Greenhouse growers in BC also need to consider the carbon tax implications of consuming increased volumes of natural gas to fuel CHP engines.

Other barriers to adoption of co-generation at greenhouses in BC include:

- Lack of clarity on capital and interconnection costs for individual projects;
- Costly process to acquire all necessary permits prior to applying to the SOP;
- Complexity in the installation and operation of co-generation systems (including the requirement for additional skill sets); and
- Restrictions on permitted land use/activities within the Agriculture Land Reserve[13].

4.5 International Market Penetration and New Market Development

On the demand side there may be opportunities to increase market penetration and develop new export markets.

Over the past three years Canada's greenhouse vegetable production sector has been formally represented at the national level by the Canadian Horticultural Council (CHC) Greenhouse Committee, which has focused on identifying ways the sector can collaborate to support export growth in the US and other markets around the world. In March 2011, the CHC completed a Long Term International Marketing Strategy in cooperation with provincial industry representatives such as the BC Greenhouse Growers Association. While the strategy is focused on continued penetration of the US market as its primary growth opportunity, noting that its proximity allows Canada to capitalize on its best competitive advantages, a minor component of this strategy involves probing international markets to identify emerging export opportunities.

Developing overseas export market is strategically appealing to mitigate risk associated with dependency on the US market. However the difficulty of cost-effectively transporting standard greenhouse vegetables long distances because of their high water content (e.g., beefsteak tomatoes) presents a critical challenge, as does the perishable nature of greenhouse products. It may be possible to identify and expand profitable export markets for higher-value niche greenhouse vegetables, such as high-brix cherry tomatoes (which are already being exported to the Asian market) should the BC industry be interested in diversifying products and exploring these market opportunities.

The BC Ministry of Agriculture has investigated the information sources it uses to analyze export markets and has concluded that there is currently insufficient market intelligence available to be able to assist industry in identifying export opportunities of this nature. However, through the Market Information and Export Capacity Building[14] initiative of the federal-provincial Growing Forward program, the Ministry

[12] This volatility and below market value of electricity has recently slowed the installation of co-generation systems in Ontario (Nyboer et al., 2011).

[13] A recently released discussion paper outlining this issue in detail can be accessed at the following URL: http://www.agf.gov.bc.ca/resmgmt/sf/co_generation_in_ALR/index.htm

[14] For more information on this initiative please visit the following URL: http://www4.agr.gc.ca/AAFC-AAC/display-afficher.do?id=1238587686348

has secured funding to commission an export market analysis study for BC's greenhouse industry through a third-party market intelligence provider, and intends to pursue this opportunity in early 2012.

BC's greenhouse industry has identified some interest in exploring new markets in New Zealand and Australia, however while these two countries ship horticulture products into Canada, they currently block reciprocal trade due to concerns regarding exotic pests. Although the federal government is responsible for addressing market access issues with foreign countries, the BC Ministry of Agriculture can raise industry's concerns with Agriculture and Agri-food Canada's Market Access Secretariat and encourage action to overcome known trade barriers moving forward.

4.6 Domestic Market Penetration

Efforts can be made in domestic markets to increase demand for BC greenhouse vegetable and floriculture products by differentiating BC products against the competition, and by increasing overall consumer awareness and interest in the products. For example:

- A marketing support program, supported by consistent messages, identity and collateral, could enable marketing agencies to both differentiate BC product, based on superior quality and food safety standards, and increase consumer awareness and interest at retail locations.

- Increased marketing activity in targeted markets to promote interest and awareness of BC greenhouse products through out-of-home advertising such as billboards, transit and in-store activities.

- Information and education campaigns to targeted audiences (e.g., K-12 students) on benefits of consuming greenhouse fruit and vegetables.

- Exploration of alternative distribution channels (e.g., farmers' markets).

5. OVERCOMING BARRIERS TO ADOPTION AND SUPPORTING INNOVATION

This section highlights ways in which innovation and adoption of energy efficiency measures and new technologies can be encouraged by the government and industry, as well as other measures to support competitiveness and growth in the greenhouse sector. Based on consultation with industry representatives, the sections appear in order of importance to the greenhouse industry, as well as the extent of their applicability across the sector.

5.1 Carbon Tax Review

Tax policy sets the framework for economic certainty and a competitive business environment for BC industries, and the province has provided an overall attractive tax environment for business growth. However, the greenhouse industry has expressed continued concern that the carbon tax directly impacts competitiveness and is contributing significantly to the decline in profit margins because producers in competing jurisdictions are not subject to a carbon tax, and other planned carbon pricing schemes have yet to be implemented (e.g., California's cap and trade program).

The Minister of Finance reviews provincial taxes and considers changes in the context of the fiscal situation and government spending priorities.

5.2 Explore Co-generation Opportunities

In order to determine the viability of greenhouse co-generation projects in BC, further clarity is required on a number of fronts.

High-efficiency natural gas fired co-generation projects are currently eligible under BC Hydro's SOP as long as the project is designed and constructed to meet the BC Energy Plan requirement of an overall efficiency rate (heat and electricity production) in excess of 80%[15]. Measurements of overall efficiency can vary depending on whether efficiency calculations are based on the lower heating value (LHV) or the higher heating value (HHV) of natural gas. The Ministry of Energy and Mines is currently working with BC Hydro to clarify the definition of high-efficiency co-generation under the SOP, as well as to develop revised criteria for determining project eligibility and measuring system efficiency.

Industry has also indicated a need for clarity around capital and interconnection costs for cogeneration projects[16] and industry consultation regarding this issue is planned for early 2012.

The Ministry of Agriculture recently released a discussion paper on the establishment of criteria intended for use by local governments to regulate combined heat and power generation (co-generation) at greenhouses in the ALR[17]. The proposed criteria are intended to form the basis for a Minister's Bylaw Standard under the *Farm Practices Protection Act*. This effort is an important step in addressing the demand for co-generation at greenhouses without compromising the long term productivity of agricultural

[15] Co-generation systems are commonly reported to convert 75% to 80% of the fuel into useful energy (heat and electricity) (Kerr, 2008). Modern systems being used by greenhouse operations around the world can have even higher overall efficiencies of 90% or more (Kerr, 2008; Willis Energy Services, 2005). For example, a successful co-generation installation in the Netherlands saw Royal Pride Holland achieve 20% reduced production costs on a 45 ha greenhouse tomato operation (Neville, 2009). These studies do not specify whether the LHV or HHV was used in calculations.

[16] Ministry of Energy and Mines, *personal communication*, December 2011.

[17] Please see: http://www.agf.gov.bc.ca/resmgmt/sf/co_generation_in_ALR/index.htm

land, and discouraging the establishment of cogeneration facilities in the ALR that far exceed the heating needs of the greenhouse. Public consultation on the discussion paper is ongoing.

5.3 Carbon Offsets

Carbon offsets provide a potential opportunity for revenue generation and decreased carbon tax liability. Four greenhouses currently have offset purchase agreements with the Pacific Carbon Trust for fuel switching or energy efficiency projects.

The Pacific Carbon Trust will purchase offsets as a way in incentivize new projects that can reduce emissions. This can be a financial incentive for greenhouses to do energy conservation or fuel-switching projects that will provide new carbon revenue streams, reduce energy costs, and reduce carbon tax costs. Low-carbon greenhouses then have a low-carbon tax cost while benefitting from the corresponding tax cuts brought about by the revenue neutral carbon tax. However, because offsets are purchased from additional activities undertaken, they will not subsidize industries for investments already taken that do not result in a new reduction in greenhouse gas emissions.

Nevertheless, given that greenhouse growers would be engaged in carbon reduction opportunities, carbon offsets provide an excellent 'fit' for incenting efficiency actions. The development of an energy efficiency protocol specific to the greenhouse sector is underway, and may result in new offset opportunities. Programmatic offsets could provide an added incentive for individual growers who can have difficulty generating sufficient offsets to overcome costs of project documentation. Consideration of developing potential offset opportunities for greenhouses with existing, unused high efficiency wood boilers may provide an opportunity to re-incent use. Note that the cost of biomass systems must make financial sense with the requirement for liquid CO_2 should insufficient natural gas be combusted on site (Delphi Group, 2011).

5.4 Property Tax Changes

The 2008 BC Farm Assessment Review found that the existing farm building exemption of $50,000 no longer reflects the capital investment that farmers make in intensive farm operations, such as greenhouses. A recent proposed amendment to the *BC Assessment Act* increased the property tax exemption limit on farm outbuilding improvements to the greater of 87.5% or $50,000. This change will result in an estimated $766,000 tax reduction for the greenhouse sector. It is hoped the changes will be brought into effect for the 2013 tax year.

5.5 Regulatory Change / Tax Credits

Regulatory policies and incentives have helped to drive adoption of co-generation and renewable energy technologies in many parts of the world. For example, the Public Utilities Regulatory Policies Act (1978) and federal tax credits for co-generation investments were responsible for a three-fold increase in co-generation capacity in the US (PEW Center, 2011). The US Energy Improvement and Extension Act of 2008 and the American Recovery and Reinvestment Act of 2009 further encourage adoption of co-generation (PEW Center, 2011). Some states also offer investment tax credits to help offset the capital costs of co-generation investments (PEW Center, 2011). The situation is the same in many European countries. After the liberalization of their electricity market in 2001, the Dutch government began providing incentives for co-generation to revitalize the industry and meet national greenhouse gas and energy efficiency targets. Incentives were introduced in the form of long term agreements, feed-in subsidy schemes, energy tax exemptions, rebates, financing schemes and internal emissions trading systems. Government initiatives have played a major role in Europe achieving the highest proportion of co-generation in the world (Brown and Robb, 2005).

A 30% input tax credit on the capital investment and a five year electricity purchase agreement at approximately 30% over market rate are examples of California's solar incentives (Delphi Group).

Similar policies to support energy innovation in BC should bear in mind that the economics differ considerably across jurisdictions due to differing costs and sources of fuel and electricity, particularly as compared to Europe. Further research is required to determine how other jurisdictions are encouraging greenhouse growers to adopt new technology and what changes may be successful in supporting capital investments in BC.

5.6 Increased Depreciation Rates

Depreciation rules in Canada do not allow accelerated capital cost depreciation for assets, as they do in some states in the US. In the US, growers can depreciate all equipment investments made in 2012 over two years, with the ability to carry that depreciation loss forward for 15 years.

Furthermore, California allows depreciation over 1 year for installation of renewable energy and energy efficiency technologies, whereas Canada has a 2-year timeframe for depreciation of applicable technologies.

Similar policies would accelerate the pay-back period for capital investments in Canada (Delphi Group, 2011).

5.7 Increase Biomass Fuel Accessibility

Certainty of long-term fuel supply and cost (particularly transportation cost) is critical to a fuel switching decision, particularly a full-time use of biomass or a switch to bio-gas. Fuel partnerships (whether wood pellet, biomass or biogas feedstock) with other greenhouse producers or industry partners, could provide this certainty for both growers and feedstock providers.

Research and development may result in new opportunities for lower cost wood feedstock sources. For example, the BC BioEnergy Network and the Wood Pellet Association of Canada are assessing the feasibility of commercially producing torrefied pellets which could result in an estimated 40-50% decrease in transportation and storage costs compared to traditional pellets due to their higher density and water-repellance (Ministry of Forests, Lands and Mines 2011).

Encouraging new builds close to alternative fuel sources (e.g., anaerobic digestion facilities producing biogas), or locating new biogas production facilities near greenhouse operations could also considerably decrease or eliminate natural gas requirements for greenhouse operations.

5.8 Access to Industrial Sources of CO_2

Industry has indicated that securing a low-cost domestic source of CO_2 would create considerably more options for operators interested in adopting biomass or other renewable energy technologies that do not produce food grade CO_2 as a by-product.

Industrial sources of CO_2 exist in relatively close proximity to a high concentration of large greenhouse operations in the lower mainland. Further research and development is needed to determine the viability of CO_2 scrubbing technologies (required to achieve food grade CO_2 quality) as well as CO_2 transportation infrastructure (e.g., CO_2 pipelines) that could link industrial (e.g., cement operations, breweries) or municipal sources (e.g., landfills) of CO_2 with one or more greenhouse operations.

5.9 Support for Improved Business and Marketing Practices

The BC greenhouse industry is regarded as highly innovative and efficient as a whole. However, as would be expected in any highly competitive industry, variability in performance of farm operations is a direct function of business management practices (Ministry of Agriculture and Lands, 2009).

The BC Farm Business Advisory Services Program[18] provides tools, access to consulting expertise and funding to support financial analyses and specialized business planning to enable agricultural producers to make more informed decisions and strengthen their farm business. The program is aligned with the goals of improved competitiveness and growth for the industry and may be particularly relevant to smaller or more remote operations, or operations not represented by industry associations.

Under this program, the Ministry of Agriculture provided training in lean management (to reduce waste and improve labour efficiency) in 2011, and a similar lean training program for the greenhouse vegetable sector is planned for 2012. Floriculture industry representatives have indicated that expansion of such training would benefit some floriculture growers.

5.10 Grants

The Environmental Farm Plan, which has a grant incentive administered through the BC Agricultural Research and Development Corporation (ARDCorp), currently allows for a farm cap of $70,000 to be invested in action items (Beneficial Management Practices) identified through the Environmental Farm Plan. Greenhouse facilities can cost upwards of $60 million, and retrofits can be similarly costly; industry has suggested that increasing both the total cap and amount allocated for individual BMPs could incent more expensive retrofits.

Fortis BC is conducting an independent evaluation of thermal screening (curtains) technologies and potential energy savings with the goal of developing an incentive program for greenhouse growers in 2012 (Delphi Group, 2011).

5.11 Research and Development

Both the government and industry have a role to play in providing meaningful production-related R&D opportunities for growers. Government and industry can work together to identify and encourage partnerships between technology providers, research agencies, marketers and greenhouse growers.

For example, Government could consider supporting energy innovation by:

- Providing financial assistance to demonstration or research projects in order to validate rates of return for new technologies and technology upgrades (in conjunction with an organization like Sustainable Development Technology Canada, or as a further step towards commercial adoption).

- Targeting monies within the Innovative Clean Energy (ICE) Fund to expand new greenhouse technology applications (e.g., Sun Select's project to develop wood waste energy and capture the $C0_2$. The ICE Fund made a $2.24 million investment on a $6.69m total value project).

- Continuing the ICE Fund, providing added guidance on what constitutes a 'new' technology, allowing room for innovative projects based on established technologies with a high potential for adoption.

[18] For more information, please see: http://www.agf.gov.bc.ca/busmgmt/FB_Advisory_Services.html

Canadian producer organizations are funding research into lighting systems to achieve results in which the payback from the incremental yield is greater than the cost of the electrical energy to provide the lighting. Artificial lights are used by growers in some parts of Canada to maintain year-round production and advances in LED lighting may bring the cost of lighting down and enable an expansion in the use of lights in the shoulder months.

Other examples of promising R&D opportunities identified at a national level by the sector[19] include:

- Incentivizing varietal adaptive innovation by supporting trial experiments (to determine optimal growing conditions for new varieties) and promoting collaboration with marketing agencies (to assess and align trials with market interest). Trials could focus products with high yields under winter low light conditions or late spring/early summer maximum light conditions.

- Supporting sustainable product packaging innovation, or the use of post-consumer waste materials or materials derived from agriculture (i.e., plant-based) to develop packaging that meets consumer functionality and convenience while also meeting consumers' growing interest in product sustainability.

5.12 Increased Awareness of Other Government Support Programs and Incentives

A 2008 report by Deloitte[20] identified awareness of government incentive and support programs as an issue for greenhouse growers. For example, the authors found:

- Greenhouse operators are worried about the capital investment required to adopt alternative energy sources, such as methane or biomass boilers, anaerobic digesters and co-generation systems; however, operators can offset costs by accessing both federal and provincial programs (e.g., ecoAgriculture Biofuels Capital Initiative[21]).

- The AgriStability[22] program protects farm income from declines. Changing the size of the operations or the mix of commodities, however, requires the completion of a "structural change adjustment". It can be difficult for greenhouse operators to determine which expenses are eligible. One mistake in assessing an AgriStability claim can easily result in a missed benefit of $100,000 or more.

- Many greenhouses are unclear about what activities qualify for Scientific Research & Experimental Development (SR&ED)[23] tax incentives provided by Revenue Canada with support from the Province. Eligible activities of relevance to the sector include efforts to improve a plant's production or fruit quality, create solutions for a new disease, trial a new growth regime for existing plants or develop a new irrigation system.

Other existing programs with potential to benefit the sector include the BC Labour Market Partnerships Program and Labour Market Solutions Program[24] which provide financial assistance to analyze, support

[19] Canadian Horticulture Council (2011). "Long Term International Strategy for Canadian Greenhouse Vegetables"
[20] Deloitte (2008). "It's a Growing Concern."
[21] Fore more information see the following URL: http://www4.agr.gc.ca/AAFC-AAC/display-afficher.do?id=1295549500949&lang=eng
[22] For more information, see the following URL: http://www4.agr.gc.ca/AAFC-AAC/display-afficher.do?id=1291990433266&lang=eng
[23] For more information see the following URL: http://www.cra-arc.gc.ca/txcrdt/sred-rsde/menu-eng.html
[24] For more information see the following URL: http://www.aved.gov.bc.ca/sector-partnerships/welcome.htm

and facilitate labour force issues, encourage human resource planning activities and implement training recommendations resulting from this work.

There is an opportunity for government to support increased awareness of such programs by increasing access to government resources and information as well as engaging in exploratory dialogue with industry to identify opportunities.

6. CONCLUSION

This report was designed to fulfill the *Canada Starts Here: BC's Jobs Plan* commitment to "commission a report to identify opportunities for innovation in greenhouse heating along with other ways to spur new growth in this important industry." The report provides the foundation for potential future actions by government and industry to improve competitiveness and grow the greenhouse sector. Policies and initiatives described herein are exploratory only, and are not prescriptive either to industry or government.

After a long period of steady expansion, both the greenhouse vegetable and floriculture industries in BC have experienced a flattening of sales and declining margins in recent years due to both demand side factors such as increased international competition and the relative strength of the Canadian dollar, and supply side factors such as rising energy costs.

The North American greenhouse vegetable industry is changing, with significant increases in production in Mexico, the US and Canada. Cost of production differentials between the three countries are important, but product quality and the time-to-market (crucial to freshness) are equally, or more important. Greenhouse technology and production management are the key determinants of product quality, while in-country infrastructure and border crossing times are the key determinants in determining time-to-market. On both counts, Canada has significant advantages over Mexico in accessing the important US market. However, recent investments in Mexico have focused on high-end production, and are reportedly closing this gap.

Energy is an important component of the sector's total cost of production, and energy costs are expected to rise in the long-term. Coupled with the need to produce food grade CO_2, this has led the greenhouse vegetable industry to place considerable emphasis on energy as an area where both production efficiencies and regulatory reform might be advantageous. Analysis indicates that the BC carbon tax currently represents approximately 1% of greenhouse operating revenues, and that this will rise as the tax rate increases in 2012, from $25 to $30 per tonne of CO_2 equivalent.

The global economic crisis has significantly affected the floriculture industry worldwide, with demand for floricultural products declining in all the major consuming countries, such as Europe, US, Canada and Japan, affecting export levels, profit margins, and employment in the flower sector. The decline in floriculture sales is expected to level off should the global economic recovery take hold.

Over the next few years the BC floriculture industry is expected to maintain a newer norm of limited or no sector expansion, and lower profitability largely due to rising production costs and international competition. Should the economy continue to recover, no major changes in industry structure are anticipated nor are significant price changes expected to occur in this market in the short term. Producers will continue to experience significant competition from imported products and moderate downward pressure on prices will continue as the chain stores maintain or increase their influence on the industry.

The greenhouse sector will need to address challenges on both the demand side and the supply side in order to remain competitive in the coming years. For the greenhouse vegetable industry, where 65% of sales are exports, marketing strategies should focus on increasing penetration of the US market as well as developing new international markets where economically viable.

Broadening BC's floriculture marketing efforts and exposure with the buying community, such as growers external to the province, wholesalers, supermarket and discount chains, home centres, and retail nursery buyers will be essential to maintaining future market share. Collectively, BC growers will need

to heighten buyer awareness and expand marketing initiatives especially to recapture markets within the US.

There are a number of measures that can be taken to improve energy efficiency in greenhouse installations, as well as innovations in heating technology such as co-generation systems, which will also provide an opportunity for diversified revenue streams, and systems that use renewable energy. However, significant progress has already been made by industry in pursuing energy efficiencies in existing greenhouse systems, and there are currently significant barriers to the adoption of new heating technologies. For renewable energy systems these barriers are primarily the high costs and complexity of both installation and operation, and the unproven performance of the technology under BC's biogeoclimatic conditions. For co-generation systems the barriers are not only high costs of installation and operation, but also include regulations related to use of co-generation in the ALR, the carbon tax implications of increased natural gas usage, and the risk associated with volatility of natural gas prices.

To ensure the continued competitiveness of the BC greenhouse sector, and to stimulate growth in the long term, action by the BC government may be required on the regulatory, energy policy and tax policy frameworks that impact BC greenhouse operations, to mitigate or remove the barriers to adoption of new technology. This action should be based on further, comprehensive research into how other jurisdictions, and especially our trading partners, are encouraging their greenhouse growers to adopt new technology, in order to identify what changes and initiatives are most likely to be successful in BC.

APPENDIX: SOURCES

BC Ministry of Agriculture and Lands (2010). "BC Floriculture Sector Analysis."

BC Ministry of Agriculture and Lands (2009). "BC Greenhouse Vegetable Sector Analysis."

BC Ministry of Agriculture, Fisheries and Food (1996). "Greenhouse Vegetable Production Guide for Commercial Growers."

Brown, B. and Robb, G. (April 1, 2005). "Co-generation – Makes Sense." Canadian Consulting Engineer. URL: http://www.canadianconsultingengineer.com/news/co-generation--makes-sense/1000184270/

Canadian Horticultural Council (2011). "Long Term International Marketing Strategy"

Chau, Jo (July 2008). "Evaluation of Wood Biomass Utilization for the Greenhouse Industry in BC" Master of Science Thesis, University of British Columbia. URL: https://circle.ubc.ca/handle/2429/1227

Coyne, Larry (March 22, 1999). "Economics of Co-generation." Public Works and Government Services Canada. URL: ftp://ftp.tech-env.com/pub/ENERGY/Cogen/cogen_economics_coyne.pdf

Climate Action Initiative (March, 2011). "BC Farm Energy Assessment "Fact Sheet 1 Vegetable & Floriculture Greenhouses". URL: http://www.bcagclimateaction.ca/wp/wp-content/media/BCFEA-FactSheet-1.pdf

Daniels, B.W., Boerakker, Y.H.A., van der Welle, A.J. and Wetzels, W. (2007). "High-efficiency Co-generation in the Netherlands." Prepared for the Dutch Ministry of Economic Affairs. URL: http://www.code-project.eu/wp-content/uploads/2009/05/NL_Report_Art_6_National_Potential_en.pdf

DDACE Power Systems (2009). "Greenhouse Co-generation with CO_2 Fertilization." URL: http://www.ddace-energy.com/CaseStudy_11.pdf

Deloitte (2008). "It's a Growing Concern." URL: http://www.deloitte.com/assets/Dcom-Canada/Local%20Assets/Documents/ca_FA_ItsAGrowingConcern_aug08.pdf

Delphi Group (2011). "Greenhouse Growers Summary Report." Prepared for Climate Action Secretariat, November 25, 2011

Fast Stats (2010). "Agriculture, Aquaculture and Food." BC Ministry of Agriculture. URL: http://www.agf.gov.bc.ca/publicat/stats/FastStats2010_R2.pdf

Food Industry Market Development Program (1994). "Baseline Research". Roger Barnes Marketing Planning.

Food Industry Market Development Program (2001). "Food Industry Market Development Program 2001 Tracking Study". Roger Barnes Marketing Planning.

GAIN Report (April 22, 2010). "Greenhouse and Shade House Production to Continue Increasing." USDA Foreign Agricultural Service. URL: http://gain.fas.usda.gov/Recent%20GAIN%20Publications/Greenhouse%20and%20Shade%20House%20Production%20to%20Continue%20Increasing_Mexico_Mexico_4-22-2010.pdf

Henvey, Tania (2006). "The Potential for Co-generation in Ontario's Open Market." The Electricity Forum. URL: http://www.electricity-today.com/et/Issue0802/i08_co-generation.htm

Hovius, Paul (2010a). "Co-generation in the Netherlands." Greenhouse Canada, April 2010

Hovius, Paul (2010b). "Assessing CHP Feasibility." Greenhouse Canada, June 2010

Kerr, Tom (March 2008). "Combined Heat and Power: Evaluating the Benefits of Greater Global Investment." International Energy Agency (IEA) Secretariat. URL: http://www.iea.org/papers/2008/chp_report.pdf

Kramp, D. and Hesener, J (April 19, 2011). "Advancing British Columbia's Greenhouse Sector with GE Greenhouse CHP and BC Hydro's Standard Offer." Presentation to BC Greenhouse Vegetable Industry

Los Angeles Times (October 21, 2011). "California becomes first state to adopt cap-and-trade program." URL: http://articles.latimes.com/2011/oct/21/local/la-me-cap-trade-20111021

Modak, Shonodeep (May 5, 2011) "Advancing U.S. Agriculture with Ultra-Clean CHP and CO_2 Fertilization for Greenhouse." Presentation at the 2011 US Clean Heat & Power Association Spring Forum. URL: http://www.uschpa.org/files/Conferences-Presentations/Spring%20CHP%20Forum%202011/Modak_050511%20-%20Advancing%20US%20Agriculture%20with%20Ultra%20Clean%20CHP%20for%20Greenhouses.pdf

Ministry of Agriculture (December 15, 2011) "Regulating Combined Heat and Power Generation at Greenhouses in the ALR: Draft Discussion Paper and Standards." URL: http://www.agf.gov.bc.ca/resmgmt/sf/co_generation_in_ALR/CHP_Discussion_Paper_December_2011.pdf

Ministry of Forests, Lands and Mines (January 2011). "The Forest Industry Snapshot: a Selection of Monthly Statistics." URL: http://www.for.gov.bc.ca/ftp/het/external/!publish/web/snapshot/201101.pdf

Ministry of Forests, Lands and Natural Resource Operations (2011). "Major Primary Timber Processing Facilities in British Columbia 2009". Competitiveness and Innovation Branch, Victoria B.C.

Neville, Angela (Sept 2009). "Top Plants: Royal Pride Holland Commercial Greenhouse Co-generation Plant, Middenmeer, North Holland Province, Netherlands." Power (Business and Technology for the Global Generation Industry). URL: http://www.powermag.com/gas/Top-Plants-Royal-Pride-Holland-Commercial-Greenhouse-Co-generation-Plant-Middenmeer-North-Holland-Province-Netherlands_2125.html

Nyboer, J., Groves, S., Rudd, S., and Lutes, K. (2011). "A Review of Existing Co-generation Facilities in Canada." Simon Fraser University. URL: http://cieedac.sfu.ca/media/publications/Co-generation_Report_2010_Final-1.pdf

PEW Center (March 2011). "Co-generation/Combined Heat and Power (CHP)." URL: http://www.pewclimate.org/docUploads/Co-generationCHP.pdf

Shiell, Jim (2011). "Market & Statistical Review." Report presented at the BC Vegetable Marketing Commission AGM, March 2011

Statistics Canada (2011). "Greenhouse, Sod and Nursery Industries" Catalogue: 22-202-X. URL: http://www.statcan.gc.ca/bsolc/olc-cel/olc-cel?catno=22-202-X&chropg=1&lang=eng

Willis Energy Services Ltd. (2005). "Co-generation Potential – Lower Mainland Greenhouse Industry." Report prepared for BCGGA and UFG.

Zbeetnoff Agro-Environmental Consulting & Timmenga & Associates Inc., 2005. "Final Report: Feasibility of Using Biofuels In Greenhouse Applications in the BC Fraser Valley."