

September

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MARKET REPORT British Columbia's GREEN BUILDING & ENERGY EFFICIENCY SECTOR

Industry Insights on Job Creation
and Investment Promotion in
BC's Clean Economy



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This report is one of a series of three market reports prepared by GLOBE Advisors that examine the “core” sectors of British Columbia's clean economy. To download reports on the **Clean Energy Supply and Storage** and the **Clean Transportation** sectors, please go to www.globeadvisors.ca.



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PREFACE

In March of this year, GLOBE Advisors, in collaboration with the Washington, DC-based Centre for Climate Strategies, published a report on the West Coast clean economy that was commissioned by the Pacific Coast Collaborative (PCC) — a formal working group that involves the province of British Columbia and the US states of California, Oregon, Washington, and Alaska.

That report confirmed that opportunities abound for the members of the PCC to act jointly and co-operatively to maximize the benefits of their shared clean economies and to minimize the overlap of efforts in order to address shared priorities and challenges. GLOBE Advisors estimated that through a collective approach to investment attraction and job creation in five clean economy market opportunity areas or “sectors”, the region could generate up to an additional \$143 billion in gross domestic product (GDP) and an estimated 1.03 million net new full-time jobs by 2020.

In keeping with that analysis and other earlier work, GLOBE Advisors undertook new research over the last six months to examine three of these interrelated and potentially high-growth sectors in British Columbia’s clean economy — specifically clean energy supply and storage, green buildings and energy efficiency, and clean transportation. From this research, GLOBE Advisors has published three market reports — one on each of these three key sectors.

Secondary research and employment estimates for this study were backed up by extensive consultation and outreach activities, including more than 90 in-depth interviews

with industry leaders from successful BC companies, as well as academic institutions, government agencies, and non-governmental organizations. The interviews were designed to identify current trends, economic development opportunities and challenges, and employment demand and supply issues.

In addition, GLOBE Advisors was involved in organizing a one-day “Green Workforce Development Symposium” alongside the City of Vancouver, the Vancouver Economic Commission, and six public post-secondary institutions in March 2012 that was designed to explore current and potential future employment opportunities and challenges in BC’s clean economy.

This market report looks specifically at British Columbia’s Green Building and Energy Efficiency sector and presents a range of opportunities for creating new jobs, attracting investment, and expanding positive synergies. The job opportunities presented in this report were quantified using updated and proven methodologies that allow for the identification of industries and occupations that are part of this sector in BC.

This report is not an advocacy document. The pages that follow provide a current snapshot of the Green Building and Energy Efficiency sector in British Columbia, a sector that is a driving force behind what will ultimately be this province’s single most powerful competitive advantage — a cleaner and more sustainable economy.

ACKNOWLEDGMENTS

GLOBE Advisors would like to thank the following companies, government agencies, and industry organizations. These organizations provided important resources, insights, and/or data in support of this study.

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BC Hydro	Legend Power
Brantwood Consulting	Light House Sustainable Building Centre
British Columbia Institute of Technology (BCIT)	NovaTec Consultants
Building Owners and Managers Association of British Columbia (BOMA-BC)	Okanagan College
Cadillac Fairview	Pacific Community Resources Society
Canada Green Building Council (CaGBC)	Perkins+Will
Canadian Home Builders' Association of British Columbia (CHBA-BC)	Pulse Energy
Cascadia Windows	Prism Engineering
City Green Solutions	Province of British Columbia
City of Surrey	RDC Fine Homes
City of Vancouver	Rancho Management Services Ltd.
EchoFlex Solutions	Recycling Council of British Columbia
EMBERS Green Renovations	Schneider Electric
FortisBC	Scott Construction
FRESCo	Streamline Properties
Golder Associates / HB Lanarc	Structure Craft
Homescape Building and Design	Szolyd Development
Kasian Architecture Interior Design and Planning	The Aquarius Strata
	University of British Columbia (UBC)
	West-End Building Control

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HIGHLIGHTS

1. For the purposes of this report, the Green Building and Energy Efficiency sector is divided into five key market opportunity segments – namely green building products and technologies; architecture, design, planning, and engineering; skilled trades and construction; property and energy management; and waste management and recycling.
2. In 2011, the Green Building and Energy Efficiency sector in British Columbia was estimated to have generated some \$8.4 billion in gross domestic product (\$5.5 billion direct and \$2.9 billion indirect) and 76,450 full-time equivalent jobs (46,290 direct and 30,160 indirect).
3. British Columbia is a North American leader in green building and sustainable design. Increasing demand for sustainable design practices and energy efficiency retrofits and renovations is driving growth in this sector, in part due to progressive building codes and standards and a variety of available incentives and financing programs.
4. Significant employment opportunities exist for design, planning, and engineering services; skilled trades in construction, renovation, and deconstruction; building operations, maintenance, and energy management services; and the design and manufacturing of sustainable building products and materials.
5. Qualified and experienced engineers and technicians involved in the design, manufacturing, installation, and maintenance of energy-efficient technology and green building products and systems continue to be the most difficult positions to staff. Sourcing trades and construction workers skilled in the sequencing and application of advanced green building practices also presents challenges.
6. Green building-related education and training institutions in British Columbia are doing a good job of preparing new entrants into the workforce for the current needs of industry. However, a greater emphasis on integrated building sciences, energy management, sustainability practices, and systems-based thinking in all real estate and construction industry programs would be beneficial.
7. Important barriers to sector growth include the potential for additional upfront capital costs, risks, and liabilities for green building; the fragmented nature of the industry; the continued application of inefficient technologies; the lack of workers and professionals with green building expertise; and the lack of consumer understanding for the benefits of green building and energy efficiency.
8. Knowledge and information gaps tend to relate to the industry's overall poor understanding for sustainability-related practices, as well as for the application of new energy-efficient and renewable energy technologies in homes and high-performance buildings. There is also a need to develop additional programs and tools that encourage retraining and continuous professional development, particularly within the construction trades.
9. Accelerating growth in this sector will require greater public and stakeholder education for the benefits, costs, and risks for building green; continuing public policy support through progressive, performance-based building codes and regulations; a defragmentation of the construction process; and an evolution of green building incentive programs toward innovative and effective market-based financing models.
10. Collaboration with key players in this sector will be required in order to develop a comprehensive "innovation strategy" for BC's building industry and a human resources strategy that ensures the current and future supply of skilled workers in this sector aligns with demand.



EXECUTIVE SUMMARY

The Green Building and Energy Efficiency sector consists of a number of multi-faceted segments, including building material and energy-efficient product / technology design and manufacturing; architecture and engineering; sustainable community design and planning; construction and renovation; deconstruction, waste management, and recycling; energy management, real estate, and property management. This extensive value chain presents some of the highest potential for new investment and local job creation in British Columbia's clean economy.

In 2011, the Green Building and Energy Efficiency sector in British Columbia contributed roughly \$8.4 billion to the provincial GDP (\$5.5 billion direct and \$2.9 billion indirect) and was responsible for 76,450 full-time equivalent (FTE) jobs (46,290 direct and 30,160 indirect).

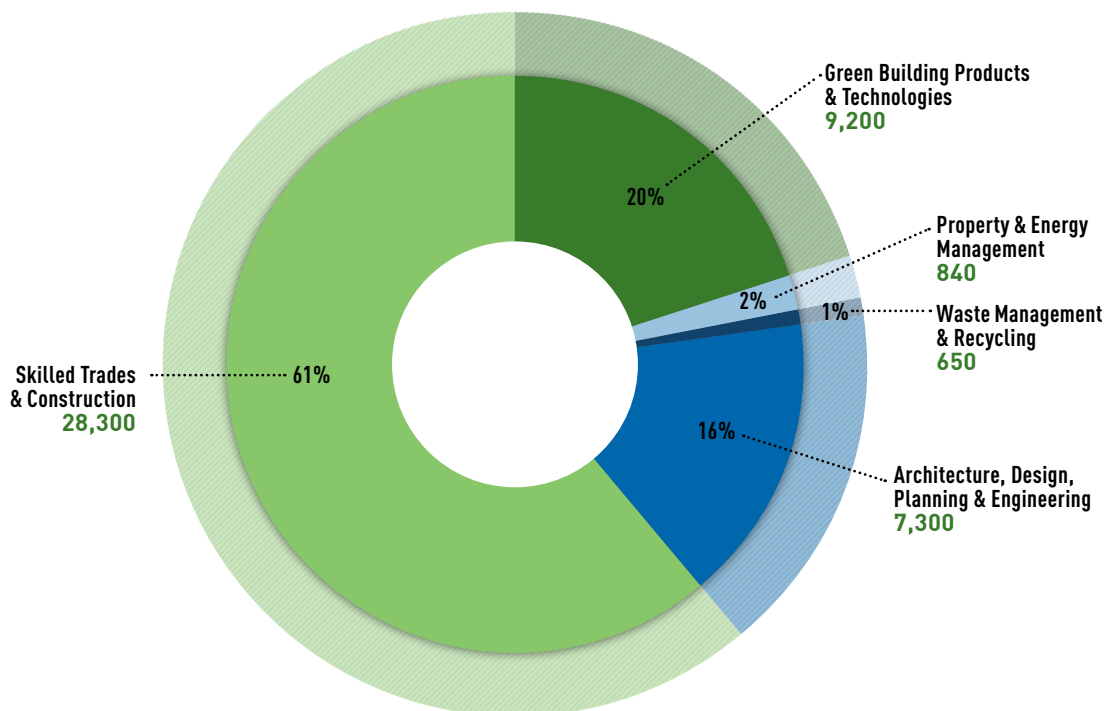
Companies active in the Skilled Trades and Construction segment accounted for approximately 28,300 direct FTE jobs, equal to 61% of total direct employment in the sector in 2011 (see Figure 1).

The Green Building Products and Technologies segment, which includes firms that produce wood-based products, energy-efficient technologies, and other green construction materials, accounted for 9,200 direct FTE jobs, equal to one-fifth (20%) of total employment. Architecture, design, planning, and engineering firms active in this sector employed approximately 7,300 direct FTE jobs in 2011, related to green building and sustainable design projects in the province.

Figure 1: ↘

Employment (direct full-time equivalent jobs) in British Columbia's Green Building and Energy Efficiency sector by segment, 2011.

Source: GLOBE Advisors



CURRENT TRENDS

The public policy landscape, technology pricing and performance, social acceptance, and other broader market and economic conditions are critical factors influencing developments in the Green Building and Energy Efficiency sector in British Columbia.

From a supply perspective, British Columbia has seen near exponential growth in sustainable design and green building knowledge, skills, and expertise over the last five years with ongoing benchmarking by the industry helping to raise the bar. A younger generation of skilled workers and professionals is now entering the industry with a marked enthusiasm for sustainability and a deeper understanding for new practices in design, architecture, engineering, construction, and management.

The real opportunity in green building can be found at the interface between public policy and practice. From a regulatory perspective, building codes provide the baseline of minimum requirements and have been important for advancing the green building sector over the last decade in British Columbia.

The provincial government has mandated under the “Carbon Neutral Government” regulation that all provincial government bodies and Crown agencies be carbon neutral. Under the 2008 Energy Efficient Buildings Strategy, all new construction, major renovations, and tenant improvements to government buildings and facilities must be carried out to a LEED Gold standard.

In addition, the *Energy Efficiency Act* sets standards for manufactured building components and equipment and the *Wood First Act* require that wood be considered as the primary building material in all new publicly-funded buildings.

Utilities in British Columbia have also been huge enablers of energy efficiency activities in the province for their customers. In 2011, BC’s energy utilities invested some \$213 million with BC Hydro’s Power Smart program alone spending more than \$190 million in this area.

Historically speaking, the engineering approach has been to break projects down into their individual pieces. More recently however, the industry has been working toward a more systems-based approach that incorporates an integrated design process and integrated project delivery models for construction. It is no longer just about buildings, but more about the relationships between buildings and their surrounding environments.





Classic examples of this are evident in university campuses across BC (the University of British Columbia for example is cited as having the best campus plan in North America), and in large-scale urban renewal projects such as the City of Surrey's revitalization of its downtown core.

The building industry also has seen a trend toward regenerative design and architecture and net-zero energy performance in construction, as well as toward a more creative use of materials and products, due in part to resource constraints. The price for commodities, materials, and products has been rising from competition for limited resources. Design-for-environment and cradle-to-cradle practices using materials that can be repurposed and recycled after use will be increasingly important in the future. This concept has also spawned the nascent "deconstruction" industry.

JOB CREATION OPPORTUNITIES

The Green Building and Energy Efficiency sector includes a number of employment opportunities in British Columbia, particularly related to:

- Sustainable design, architecture, community planning, and engineering;
- Skilled contractors and specialists in new green building and construction;
- Retrofits and renovations related to energy efficiency upgrades;
- Energy management and the operation and maintenance of buildings;
- Renewable energy, heating, and energy-efficient equipment installation and maintenance;
- Engineers, technicians, and technologists in green building product design and manufacturing (including windows, doors, insulation, and structural elements); and
- On-site construction waste management, recycling, and deconstruction.

LABOUR DEMAND AND SUPPLY

For the most part, the skills required for the construction of green building projects are similar to those applied in traditional projects, although education with respect to sustainable building best practices, systems-based thinking, and the application of new technologies is critical.

While companies continue to seek contractors with general certifications in trades and well-rounded construction skills, attention to detail is critical for green building projects — especially for workers in trades such as insulation and building envelope, plumbing, and carpentry — in order to meet requirements of building rating systems and, more recently, post-construction performance-based targets.

» The sequencing and coordination of qualified trades people and different trades with each other is increasingly important for the green building industry.

The sequencing and coordination of qualified trades people and different trades with each other is increasingly important for the green building industry for ensuring that complex projects and systems are completed to code and standard as efficiently as possible.

Professionals in this sector are increasingly in need of green building credentials as their work must meet building codes and local bylaws / regulations. The widely used Integrated Design Process (IDP) increasingly requires architects, designers, and other professionals throughout the design phase to work in teams, which in turn requires professionals to have solid communication and people skills. The demand for professionals with experience using Building Information Modeling (BIM) is also growing quickly.

Demand for heating specialists in the province is growing as the technology options for consumers have expanded considerably in recent years from furnaces to include air source heat pumps, heat recovery units, etc. This also includes work for qualified installers and service providers for heating systems, ducts, furnaces, and energy-efficient windows and doors.

Employers are looking for staff that have balanced skill-sets with both a technical and practical understanding of the challenges faced by industry and of current technical shortcomings in order to innovate new products and solutions. As such, an awareness of current industry trends (including the public policy and regulatory landscape) combined with the technical aspect of design and/or engineering is very helpful.

The major staffing challenges faced in this sector relate primarily to the development and application of new resource- and energy-efficient technologies and practices. Senior and experienced professional engineers and technicians continue to be the most difficult people to staff for companies developing and manufacturing green building materials and energy-efficient products — particularly mechanical engineers with an energy background.

With respect to construction trades, finding trades people with experience working with and installing the range of energy-efficient technologies can be a challenge, presenting a gap between apprenticeship and Red Seal program curriculums and the required skills for green building.

Architecture and design firms can find it difficult to source graduates with the deep architectural and design knowledge required for working on visionary, world-class projects.

While BC's post-secondary education and training institutions are providing a range of programs relevant to industry needs, on-the-job training is essential for most employers in this industry. Smaller companies however can find internal training to be a challenge as it takes staff away from their normal responsibilities and can affect productivity levels. Companies do make extensive use of co-operative education and other research, training, and experience programs, but again, dedicating time to train students can be a challenge, especially for shorter 4–6 month work terms.

In the trades, downward cost pressures on contractors results in a trend toward "de-skilling", which presents a challenge for ensuring quality in construction and can result in increased liabilities.

BARRIERS TO GROWTH

Many issues affecting job growth were identified by business leaders active in the Green Building and Energy Efficiency sector. On the policy side, the limitations imposed by building codes and standards, as well as the current procurement process for publicly-funded building projects were identified as the most significant barriers.

On the economic side, additional capital costs; the lack of effective financing models and incentives; split incentives and leasing structure challenges; and the longer timelines and added costs associated with deconstruction were highlighted.

Societal challenges identified include the lack of knowledge in the general public about the opportunities, benefits, costs, and risks of green building; the complexity of codes, regulations, standards, and funding application processes; the fragmented nature of the industry; and the lack of skilled professionals with green building and related technology expertise.

From a technology perspective, the continued use of energy inefficient technologies; issues surrounding technology risk and liability; and the current lack of focus on actual versus theoretical building performance were identified as key issues.

ENABLERS TO GROWTH

Government leadership at all levels to commit to green building standards and to promoting the use of high-performance building practices and equipment was cited as the most important policy enabler. Additional research on building materials, technologies, and methodologies, and moving forward with the provincial carbon neutral compliance regime and performance-based metrics in building codes were also cited.

Incentives to improve the business case for new construction, retrofits, and the use of energy-efficient materials and technologies were seen as ways to significantly accelerate market adoption and investment. New financing models and cost-effective solutions are also helping to accelerate energy efficiency initiatives, building retrofits and upgrades, and related deconstruction activities.

On the broader societal front, encouraging consumer awareness through energy benchmarking, performance standards, auditing, and labeling programs for buildings are important. Better public and stakeholder education on the benefits, costs, and added risks and liabilities of green building is essential. An integrated construction process or project delivery model, combined with procurement and contract language that clearly outlines responsibilities and specifies the need for qualified trades and specialists with green building training and/or certification, could accelerate demand, improve overall quality and efficiency, lower potential risks and liabilities, and add value to the industry as a whole. In addition, greater inclusion of sustainability principles into education and apprenticeship curriculums is needed, as well as more professional development and retraining programs for the construction trades.

On the technology front, more government support for demonstration projects were repeatedly highlighted as an essential enabler for showcasing new technologies and for acting as an educational tool. Appliance and equipment efficiency standards can also help overcome issues related to electricity load growth and put money back into the pockets of consumers.

**Photo:**

VanDusen Botanical
Garden Visitor Centre
in Vancouver

Credit: CNW Group,
Canadian Wood Council
for Wood WORKS! BC

IN SUMMARY

This latest research by GLOBE Advisors confirms that a solid basis exists that will allow British Columbia to maintain its position as a leader in green building and energy efficiency and to realize the full economic and employment benefits. However, work must continue to maintain this position through a consistent, clear, and strategic policy framework that encourages investment and market-driven growth.

Further research and more intense collaboration with key players in this sector will be required in order to design a comprehensive labour market strategy that will ensure the current and future supply of skilled workers in this sector aligns with demand.

The following is a list of elements that can help to accelerate growth in British Columbia's Green Building and Energy Efficiency sector.

1. Clear, stable, and supportive policy frameworks;
2. Support for market-based financing models;
3. Increased partnerships and collaboration;
4. Improved public education and outreach;
5. A focus on increasing productivity; and
6. Increased opportunities for knowledge transfer.



1. INTRODUCTION:

A Background on the Clean Economy

WHAT IS THE CLEAN ECONOMY?

A “clean economy” is neither an abstract concept nor a separate component of the larger economy. It is in fact an end-state that is achieved following a transition or dynamic process of change within the entire economy toward more energy- and resource-efficient solutions and longer-term sustainability planning and programming.

A cleaner economy is one that promotes enhanced economic performance, strengthens global competitiveness through energy and environmental security, and promotes sustainable investment.

It is not dissimilar from how companies in the private sector are continually improving their operating efficiencies to reduce wastes and to conserve energy, thereby enhancing their bottom lines. And while the payoff for a corporation is improved profitability and shareholder benefit, the payoff of a cleaner economy is measured in terms of creating better jobs and promoting more public and private sector investment.

As noted by the Brookings Institution, “the clean economy matters because its emergence responds to critical global and national environmental, security, and economic trends and associated challenges, most notably the growing demand for global environmental sustainability, the sharpening need for resource security, and the aspiration everywhere toward economic transformation.”¹

By definition, at the centre of the clean economy are specific industry sectors that are directly responsible for supplying technologies, products, and services with measurable benefits for reducing greenhouse gas (GHG) emissions and for improving both energy and resource efficiency throughout the economy as a whole.

In broad terms, the transition toward a cleaner economy is about creating and retaining wealth and jobs, reducing the carbon footprint of societies, restoring the natural environmental balance of critical ecosystems, and implementing improvements in energy and industrial efficiency, all of which contribute to enhanced economic competitiveness.

The concept of a clean economy supports enhanced local manufacturing and employment opportunities, and utilizing recycled or locally-sourced raw materials. It also promotes the export of value-added, processed materials and advanced products with lower embodied energy. By reducing the need for imported energy, materials, goods, and services, the goal is to keep capital circulating longer through local sourcing and supply chains.

Many economies around the world are developing progressive strategies to position themselves in order to exploit the potential benefits from the transition to a cleaner economy, which has been described by some as the greatest opportunity for economic growth over the next decade. In 2010, HSBC Global Research estimated that worldwide

revenues for clean energy-related sectors alone could grow to \$2.3 trillion by 2020.

Investment and developments in clean technology sectors such as solar and biofuels in countries such as China and Brazil underscore the importance of what truly has become a global race to seize the market opportunities.

While clean and renewable energy sources and technologies figure largely in the substance of a cleaner economy, the opportunities for job creation and investment promotion range far wider and find expression in all areas of public policy and private enterprise.

British Columbia is in reality well-positioned for realizing the opportunities. In its 2012 Green Provincial Report Card, Corporate Knights ranked British Columbia first in Canada in the areas of Energy and Buildings, Transportation, and Innovation – good news by all accounts.²

As a gateway to Asia-Pacific nations, British Columbia is well-situated to exploit the expanding global clean economy opportunities. The province also continues to enjoy strong ties with the United States, the province's largest trading partner and one of the world's largest markets for clean economy-related products and services.

WHERE ARE THE MARKET OPPORTUNITIES IN BC'S CLEAN ECONOMY?

Five market "sectors" present the highest potential in terms of new investment and job growth, as were identified in the March 2012 West Coast Clean Economy report by GLOBE Advisors (see box below).³ These sectors exist at the "core" of the clean economy and interface with the larger economy as a whole by supplying the products, technologies, and services that are helping to accelerate the transition to a lower-carbon future in British Columbia (as illustrated in Figure 1.1).

The five market opportunities at the core of British Columbia's clean economy are:

- **Clean Energy Supply and Storage** – In particular, supporting distributed energy systems, smart grid infrastructure and transmission, and enhanced integration of energy from clean and other renewable sources.
- **Clean Transportation** – In particular, enhancing public transit infrastructure, promoting cleaner-powered vehicles, and fuel switching to lower-carbon alternatives (e.g., biofuels, electricity, natural gas, etc).
- **Green Building and Energy Efficiency** – In particular, related to whole building retrofitting, renovation, and new, high-performance building and home construction.
- **Environmental Protection and Resource Management** – In particular, shifting towards greater recycling and reuse of materials and products, the advancement of sustainable, energy-efficient infrastructure, and enhanced measures to promote conservation of natural resources and restore critical ecosystems.
- **Knowledge and Support** – In particular, engaging educational institutions for workforce skills development and strengthening centers of excellence that build on the knowledge base of the clean economy.

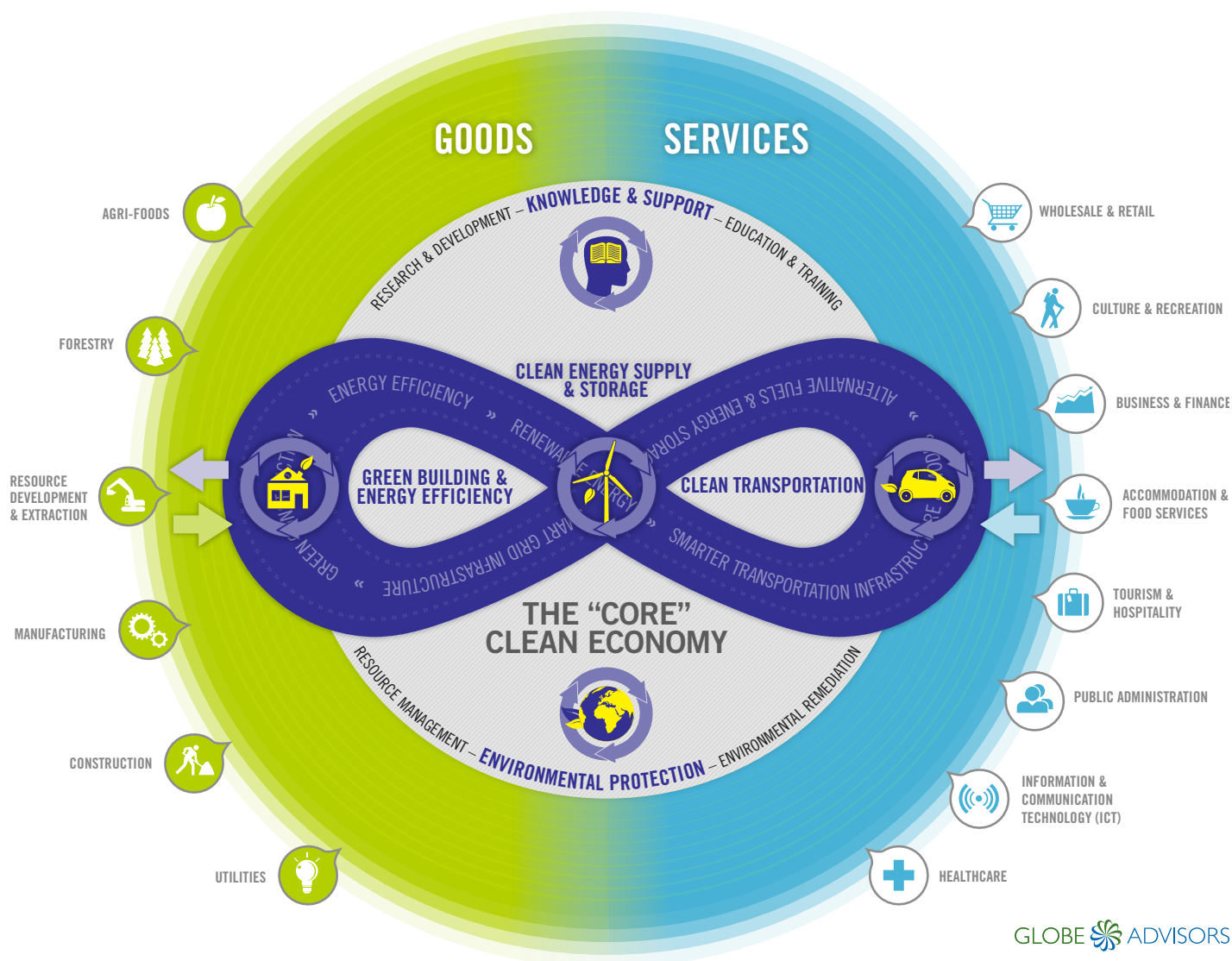


Figure 1.1: ↗

The “core” sectors of BC’s clean economy supply important products, technologies, and services to help accelerate the transition to a more energy and resource-efficient economy as a whole.

Source:
GLOBE Advisors

Three of these core clean economy sectors exist in an interrelated relationship as part of an “endless energy” loop. These are the Clean Energy Supply and Storage, the Clean Transportation, and the Green Building and Energy Efficiency sectors.

The three interrelated sectors at the core of BC’s clean economy are also responsible for a considerable level of investment, employment, and economic activity in the province at the present time.

As illustrated in Figure 1.2, the total market value of BC-based public companies listed

on the TSX and TSX-Venture exchanges and active in the three key market sectors of BC’s clean economy was approximately \$2.56 billion at the end of June 2012.

But public companies in these sectors represent only a fraction of the total employment and economic activity in these sectors in BC. Collectively, the three interrelated sectors in British Columbia were estimated to be responsible for 123,350 full-time equivalent (FTE) jobs (75,170 direct and 48,180 indirect) and \$15.1 billion in gross domestic product (\$10.7 billion direct and \$4.4 billion indirect) in 2011.⁴

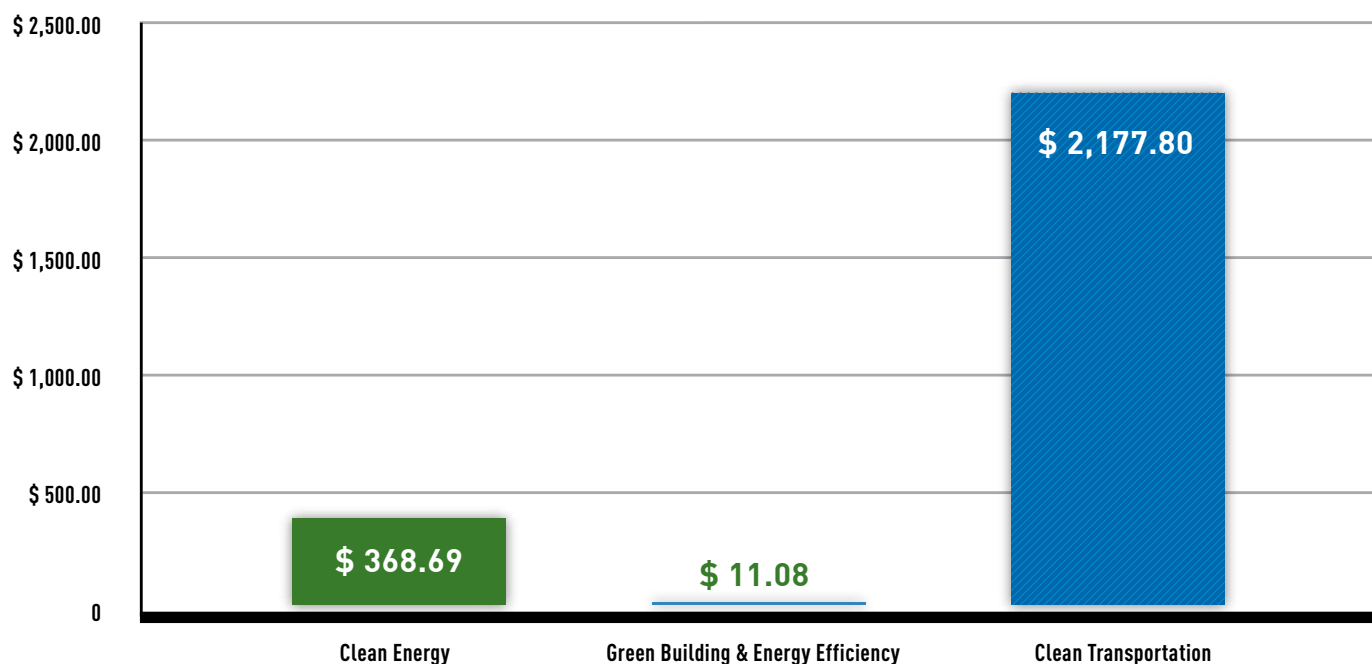


Figure 1.2: ↗

Market capitalization of BC public companies listed on the TSX and TSX-Venture Exchanges by clean economy sector (as of June 30, 2012), \$ millions.⁵

Source:

TMX Group and
GLOBE Advisors

LOOKING AHEAD IN THIS REPORT

This report looks specifically at the Green Building and Energy Efficiency sector in British Columbia. The sections that follow provide:

- The latest estimates of economic activity (in terms of GDP) and current employment for the sector;
- A detailed overview of the current status of activities in this sector;
- An examination of the current trends affecting job growth;
- An overview of labour market demand and supply issues, including key occupations and skill sets;
- A summary of the barriers and enablers to sector growth; and
- A list of policy, program, and financial drivers.



To download reports on the **Clean Energy Supply and Storage** and the **Clean Transportation** sectors, please go to www.globeadvisors.ca.

2. GREEN BUILDING AND ENERGY EFFICIENCY: Jobs and GDP

The Green Building and Energy Efficiency sector consists of a number of multi-faceted segments, including building material and energy-efficient product / technology design and manufacturing; architecture and engineering; sustainable community design and planning; construction and renovation; deconstruction, waste management, and recycling; energy management, real estate, and property management. This extensive value chain presents some of the highest immediate potential for new investment and local job creation.

The sector has experienced rapid growth over the last decade, with expertise and knowledge penetrating the sector at near exponential rates. Ongoing benchmarking by industry has helped to raise the sustainability bar as projects have evolved over time.

In 2011, the sector was estimated to have generated some \$8.4 billion in gross domestic product (\$5.5 billion direct and \$2.9 billion indirect) and employed 76,450 full-time equivalent workers (46,290 direct and 30,160 indirect).⁶ For the purposes of this report, the sector has been divided into five segments, as illustrated in Figure 2.1 below.

Companies active in the Skilled Trades and Construction segment accounted for approximately \$3.7 billion or 68% of total provincial GDP from the sector in 2011. The Green Building Products and Technologies segment, which includes firms that produce wood-based products, energy-efficient

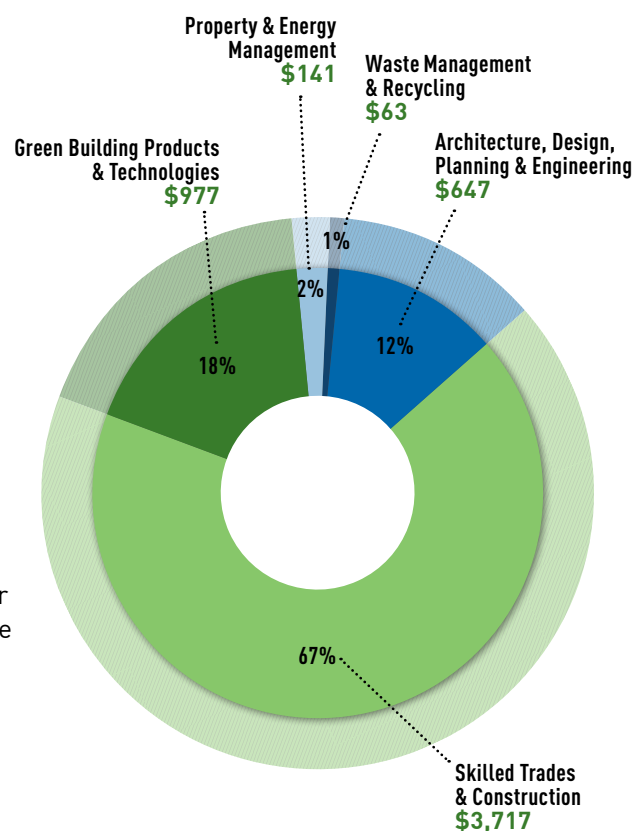


Figure 2.1: ↗

Direct GDP by segment generated by firms active in British Columbia's Green Building and Energy Efficiency sector, 2011 (\$ million).

Source: GLOBE Advisors

technologies, and other green construction materials, accounted for \$977 million or 18% of total GDP generated by the sector. Architecture, design, planning and engineering firms active in this sector are estimated to have generated approximately \$647 million in provincial GDP in 2011.

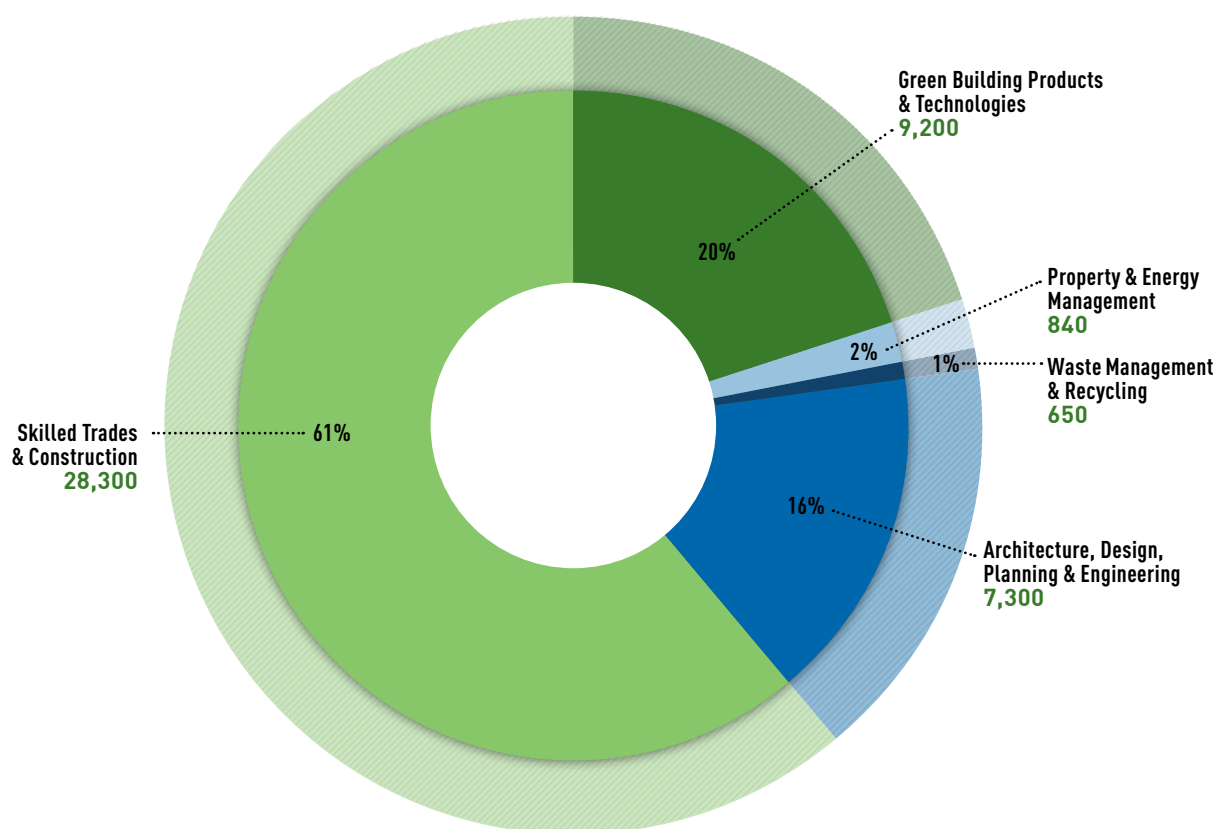
In terms of employment, companies active in the Skilled Trades and Construction segment accounted for approximately 28,300 direct full-time equivalent (FTE) jobs in BC, equal to 61% of total direct employment in the sector in 2011 (see Figure 2.2). The Green Building Products and Technologies segment accounted for 9,200 direct jobs, equal to one-fifth (20%) of total employment. Architecture, design, planning and engineering firms active in this sector employed approximately 7,300 direct FTE jobs related to green building and sustainable design projects in the province.

» In 2011, the sector was estimated to have generated some \$8.4 billion in gross domestic product and employed 76,450 full-time equivalent workers.

Figure 2.2: ↓

Employment (direct full-time equivalent jobs) in British Columbia's Green Building and Energy Efficiency sector by segment, 2011.

Source: GLOBE Advisors





3. SECTOR PROFILE

The Green Building and Energy Efficiency sector includes a number of employment opportunities in British Columbia, particularly related to:

- Sustainable design, architecture, community planning, and engineering;
- Skilled contractors and specialists in new green building and construction;
- Retrofits and renovations related to energy efficiency upgrades;
- Energy management and the operation and maintenance of buildings;
- Renewable energy, heating, and energy-efficient equipment installation and maintenance;
- Engineers, technicians, and technologists in green building product design and manufacturing (including windows, doors, insulation, and structural elements); and
- On-site construction waste management, recycling, and deconstruction.

The following sub-sections describe these market opportunity areas in more detail.

SUSTAINABLE DESIGN, ARCHITECTURE, PLANNING, AND ENGINEERING

British Columbia is a globally-recognized centre for green building expertise and sustainable community design.

The local market in BC has matured quickly over the last few years with sustainable design now found in nearly all areas of practice for architects and engineers. Government leadership, including the setting of carbon neutral building targets and greenhouse gas emission reduction goals, combined with increasingly stringent building codes and regulations, has been a large contributing factor.

» The local market in BC has matured quickly over the last few years with sustainable design now found in nearly all areas of practice for architects and engineers.

Public sector institutions in the province, particularly universities and colleges, have begun incorporating sustainable design criteria into their requests for proposals (RFPs). The private sector (residential, commercial, and industrial) has been slower to come on board but building code requirements are raising the bar and the awareness level for the benefits of sustainable design and green building has been growing with property owners.

There has also been rapid growth in Leadership in Energy and Environmental Design (LEED) projects in the province, due largely to building code requirements at the provincial and municipal levels. In 2005,

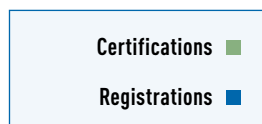
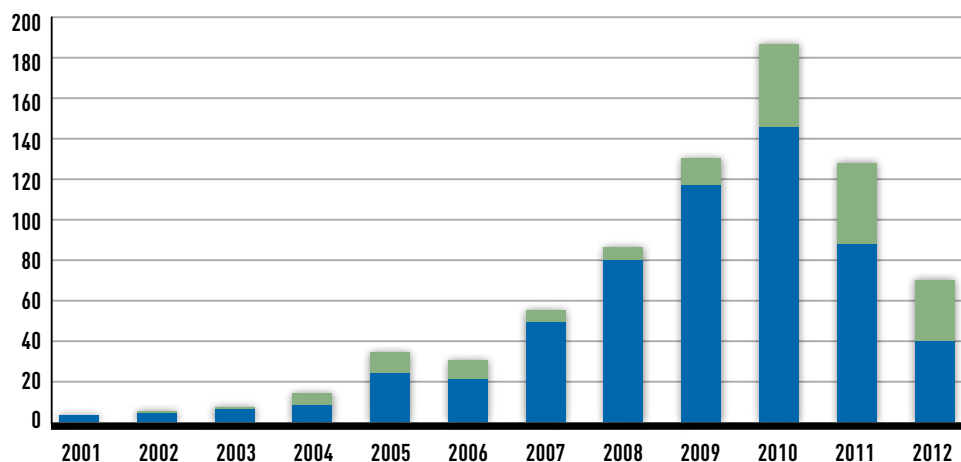


Figure 3.1: ↗
LEED certified and registered projects in British Columbia as of July 31, 2012.

Source:
Canada Green
Building Council



there were 10 LEED-certified projects in BC. At the end of July 2012, a total of 163 projects were LEED certified, along with an additional 575 projects registered in the province (see Figure 3.1). British Columbia currently lays claim to the highest number of LEED projects per capita of any province in the country (equal to nearly one-quarter or 23% of all LEED certified projects in Canada).

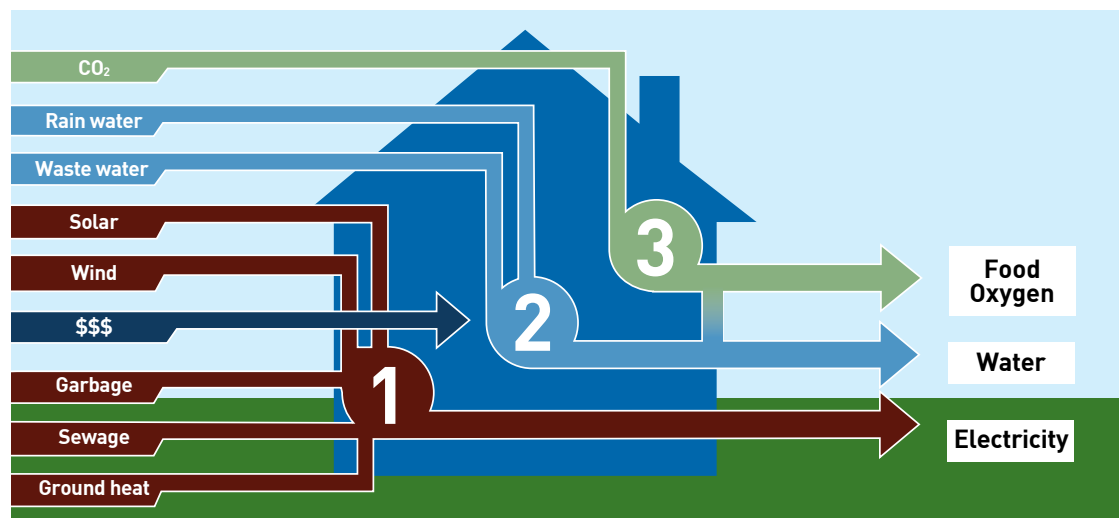
In British Columbia, the LEED program is managed by the Cascadia Green Building Council, a chapter of the Canada Green Building Council (CaGBC). Between 2005 and July 2012, approximately 3,290 professionals in the province received training from the CaGBC, either as LEED Green Associates or Accredited Professionals (APs).

Additional popular design and performance standards used by the industry include R-2000 / EnerGuide, Passive House, BOMA BEST, BuiltGreen, and Green Globes.

Firms such as Perkins+Will, B+H Bunting Coady, Bing Thom Architects, CEI Architecture Planning Interiors, and Kasian have been working on designs that promote integrated energy and water systems (see Figure 3.2). The design of healthy living environments and work spaces are also helping to raise productivity levels. Kasian, for example, has a large client base in the health care sector where natural light and sustainability-inspired design is a natural fit with the healing process and for “wellness” in general (see Profile Box 1).

Figure 3.2: ↘
The home as a bridge between the natural and built environments through three integrated systems: (1) energy; (2) water; and (3) green roofs and walls.

Source:
CoCo Laboratory



PROFILE BOX 1

KASIAN: GLOBAL LEADERSHIP IN SUSTAINABLE ARCHITECTURE AND DESIGN



Photo Credit:
Kasian Architecture
Interior Design
& Planning

Kasian is one of the leading 100 architecture, interior design, and planning firms in the world, with offices in Vancouver, Edmonton, Calgary, Toronto, Abu Dhabi, Mumbai, and Shanghai. Kasian employs an integrated, collaborative approach to design in order to create exceptional places and sustainable environments. Its award-winning projects range from advanced children's hospitals, to master plans for the most densely populated cities on the planet.

One of Kasian's flagship projects is the Jim Pattison Outpatient Care and Surgery Centre, a Public-Private-Partnership (P3) project in Surrey, BC, that embraces the latest thinking in health care delivery and medical treatment to provide faster diagnosis, reduced waiting times, and improved health outcomes. The Centre is designed to meet LEED Gold certification standards. The building is constructed of materials containing 30% recycled content and 40% regionally-produced manufactured content, which exceeds existing LEED program requirements. Scientific methodologies, including strategies based on Lean Design

and Evidence-based Design, ensure that this functional and flexible facility is built around the needs of patients, visitors, and staff to provide a safe, secure, and welcoming environment. Other sustainable design, construction, and operational features include:

- The implementation of an effective Construction Waste Management Plan which diverted approximately 79% of construction waste from landfill;
- Heat pumps used in conjunction with heat reclamation and a high-performance building envelope provide 54% energy savings over a typical reference building. This increases building efficiencies and provides cost savings. Energy costs typically represent up to 3% of a hospital's operating budget;
- Efficient plumbing fixtures reduce water intake and usage by 30% over a standard conventional building;
- Extensive use of non- or low-volatile organic compound (VOC) emitting materials in interior adhesives, sealant, paints, carpets, agrifibers, and most woods creates a healthy indoor environment;
- All but two of the ancient trees along Green Timbers Way, the main access road to the facility, were preserved. A ratio of one tree to every five parking stalls keeps the area shaded and helps to reduce Heat Island Effect. In addition, wood sourced from trees ravaged by the pine beetle is incorporated throughout the Centre; and
- Rainwater harvesting, combined with the introduction of native plants and drought tolerant ornamental species, eliminates the need for additional irrigation.

To learn more, see: www.kasian.com



Photo Credit:
City of Surrey

» The City of Surrey's new downtown core is an example of a visionary, integrated community design.

Industry-led sustainable design efforts in BC have been growing, including interest in initiatives such as the "Living Building Challenge" and "net-zero energy" and "net-zero energy ready" building construction. The Living Building Challenge, operated by CaGBC and the International Living Future Institute, is a certification program that addresses development at all scales and is comprised of seven key performance areas.⁷

There are approximately 10 projects registered under the Living Building Challenge in BC, including the UniverCity Childcare Centre at SFU, Centre for Interactive Research on Sustainability (CIRS) building at UBC, the Robert Bateman Art and Environmental Centre at Royal Roads University, the Jim Pattison Centre of Excellence in Sustainable Building Technologies and Renewable Energy Conservation at Okanagan College, and the \$20 million upgrade recently completed at VanDusen Gardens.

Net-zero energy projects are ones which, on an annual basis, produce as much energy as they use from clean, renewable, on-site energy. In BC, examples include the Harmony House in Burnaby (see Profile Box 2) and the Sun Rivers Green Dream Home in Kamloops

(both Canada Mortgage and Housing Corporation Equilibrium Projects), as well as the UniverCity Childcare Centre at SFU and a 67-unit residential building at the Olympic Athletes Village at Southeast False Creek in Vancouver.

More and more, BC firms are using Building Information Modeling (BIM) and other software-based technologies as part of their cost-effective integrated design process (IDP), enabling projects with increasingly complex systems. These models also allow industry players from all project phases to become involved in the design process. As such, construction contractors in BC are becoming educated on BIM and these models are now being used by building managers.

Design builders are also finding unique ways of using BC-based products. As one example, Delta-based StructureCraft is using its wood design and construction expertise to integrate cross-laminated timber (CLT) and glue-laminated beams from BC into its projects, which include the 2010 Winter Olympic speed skating oval in Richmond, the public library in Whistler, the Musqueam Nation Pavilion in Vancouver, the Marine Centre in Bamfield, and a unique pedestrian bridge in Princeton.

PROFILE BOX 2

HARMONY HOUSE: GREEN BUILDING COLLABORATION ACHIEVES NET-ZERO ENERGY SUCCESS



Photo Credit:
BC Hydro

The Harmony House EQUilibrium™ Project located in Burnaby is Western Canada's first net-zero energy house and the winning entry in the Canada Mortgage and Housing Corporation's (CMHC) EQUilibrium™ Initiative competition. The competition is designed as a national sustainable housing demonstration that brings the private and public sectors together to develop homes and communities that address occupant health and comfort, energy efficiency, renewable energy production, resource conservation, reduced environmental impact, and affordability.

The award-winning design by Chris Mattock of Vancouver-based Habitat Design focuses on the entire home as an integrated system. It takes into account a variety of factors: the home's influence on and interaction with the surrounding environment; the environmental impacts related to the production, distribution, and utilization of various building materials; and building life-cycle analysis.

While smart design is at the heart of the project, the 4,700 square foot house also makes extensive use of locally-produced, environmentally-appropriate building materials, such as triple-glazed windows by Langley-based Cascadia Windows, wireless lighting switches and sensors from EchoFlex in Squamish, and home heating from a very efficient air to air heat exchanger supplied by Burnaby's Eneready Products and a heat pump by Mitsubishi.

The Harmony House also integrates a home energy display system from BC Hydro, which acts as an end-use monitoring system, allowing electricity use to be tracked on a minute-by-minute basis by both the tenants and the project team.

To learn more, see: www.harmony-house.ca

Sustainable community design and master planning are additional core competencies that have been developed by BC firms. The University of British Columbia for example has been recognized globally for having one of the best campus plans in North America. The City of Surrey's new downtown core is an example of a visionary, integrated community design. The city centre will have a 5,000 person pedestrian plaza, flanked by a library, city hall, university, arts centre, medical and senior facilities, and will serve as a public transportation hub that will include a light rapid transit (LRT) system.

Leading companies such as Civitas and HB Lanarc (recently acquired by Golder Associates) strategically apply the core principles of smart growth, sustainable transportation, green buildings and infrastructure, economic development, and urban design to their projects. Services include community, neighbourhood, and regional planning, trail and park planning, and transportation planning. These companies are supported by organizations such as the Urban Development Institute and the Urban Land Institute.

Larger BC firms have also been successful at exporting their services globally, including to the US, Asia Pacific, and the Middle East. British Columbia's close proximity to Asia was identified as a real advantage in this respect. However, for the vast majority of smaller architecture, design, engineering, and planning firms, capacity to export services remains a challenge due to the scale of international projects and competition with larger global firms. In addition, inter-provincial legislation, codes, and other characteristics of the Canadian marketplace can act as barriers for BC firms looking to provide their services to other provinces.

The approach to achieving new energy-efficient buildings can be summarized in the following order:

1. Reduce building loads (e.g., through energy-efficient lighting, high-performance building envelope, and plug loads);
2. Use passive design features (e.g., natural ventilation and day lighting);
3. Apply energy recovery technologies (e.g., through heat pumps); and
4. Apply self-generation technologies (e.g., through solar photo-voltaic arrays).

NEW CONSTRUCTION

As described above, amendments to provincial and municipal building codes and carbon neutral requirements, combined with incentive programs and support from utilities, have helped to raise the sustainability bar for new building construction and renovation. Within the institutional and commercial sectors, longer-term property holders tend to appreciate the added health and cost-saving benefits of developing green buildings and are prepared to make the additional upfront capital investments.

The most cost-effective way to promote energy efficiency is by implementing energy recovery and self-generation after building loads have been minimized / reduced.

To assist building owners, developers, and the design industry in creating high-performance buildings, BC Hydro has developed a "New Construction" program. The program offers financial incentives, resources, and technical assistance around whole building, energy-saving systems, and energy-efficient lighting system design (see Appendix B on policy and program drivers).

Full-service, integrated architecture, design, engineering, and construction firms such as Omicron and Stantec have been successfully developing high-performance buildings in the province.

Leading design-build and construction management companies such as PCL, ITC, Ledcor, and Scott Construction have developed internal policies and programs in order to minimize on-site waste production and improve recycling, as well as adding environmental criteria to their purchasing decisions. For these companies, consideration is given to suppliers that provide reduced packaging, as well as locally-sourced, recycled, and environmentally-friendly products.

In the residential sector, an EnerGuide rating (energy modeling) is required for all new houses in BC by programs including BuiltGreen, LEED Canada for Homes, BC Hydro's New Construction program, and for the CMHC Mortgage Insurance Rebate, as well as for new houses in the City of Vancouver. Using Natural Resource Canada Certified Energy Advisors (CEAs), builders can review plans and test the integrity of the building envelope throughout the construction process to ensure the end result is a healthy, energy-efficient home that will save money over time.

The Canadian Home Builders' Association (CHBA) BuiltGreen Program has also been responsible for embedding sustainability into the new residential construction market in BC. At present, there are approximately 240 members and more than 80 certified builders offering the BuiltGreen Program in the province, with over 3,200 single-family homes enrolled in the program since its beginning in 2005.⁸ The program recognizes responsible home construction practices with the "house as a system" approach that focuses on five



key areas including resource efficiency, comfortable homes, a healthy environment, durability, and enhanced and retained value.

Companies such as Adera Development, RDC Fine Homes, Naikoon Contracting, Glacier Creek Pacific Contracting, Homescape Building and Design, and Verity Developments are industry leaders in constructing energy- and resource-efficient single-family homes



Photo Credit:
Stephen Wu

and/or multi-unit residential buildings (MURBs). These green building experts are focused on tight building envelopes and good air flow properties to create more comfortable, quieter, and healthier living environments.

Increasing housing density is another way to enhance sustainability. Companies such as Smallworks, Kitsilano Laneway Housing, and Lanefab specialize in building “laneway” housing in the Lower Mainland. A laneway house is a smaller, detached home located where the garage would normally go on a single-family lot. Recent revisions to zoning and development by-laws in the City of

Vancouver have resulted in an rapid increase in this style of affordable housing.

It should be noted that there is still significant non-compliant buildings to the current ASHRAE 90.1 building code. Due to current design practices, newer high-rise MURBs for example will often have higher glazing percentages for their exterior facades which results in greater energy use than older buildings. As these MURBs represent a growing typology for cities in BC, this presents a real issue with respect to achieving energy efficiency.

While the implementation of new, more stringent building codes (e.g., ASHARE 90.1 2010) is expected to help move things along, a change in industry practices in terms of how buildings are designed, built, and operated will be needed in order to move beyond code toward near net zero or net zero buildings.

To advance the efficient new construction of high-rise MURBs in the province, Light House Sustainable Building Centre recently published a carbon neutral framework that focuses on high-performance building envelope design and mechanical systems for heat recovery and ventilation; the application of energy efficiency equipment and renewable energy sources; and quality assurance.⁹ This report provides an excellent overview of the issues and opportunities.

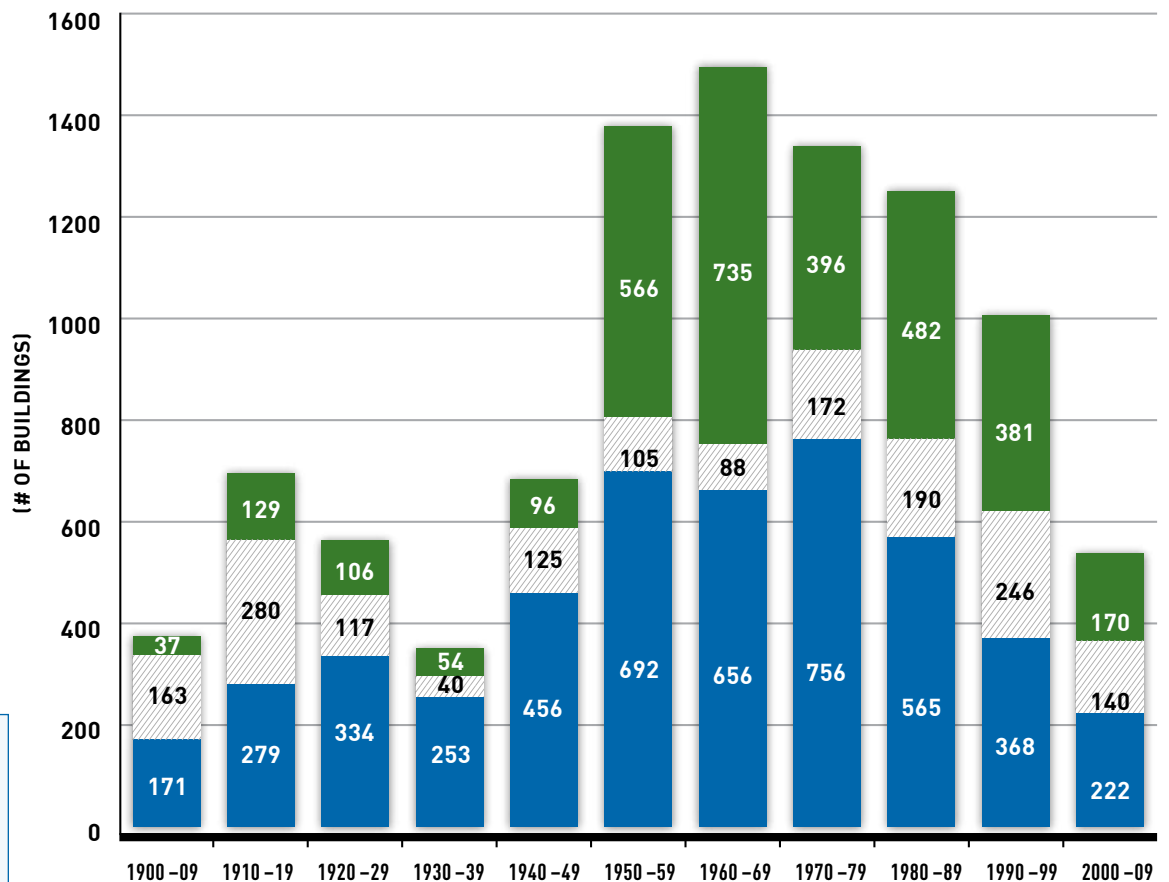
ENERGY EFFICIENCY RETROFITS AND PROPERTY MANAGEMENT

With approximately 98% of the building stock in British Columbia found in existing buildings (the other 2% under development in new construction), the market and employment opportunities from energy efficiency retrofits, renovations, and repairs are enormous. The bulk of the residential, institutional, commercial, and industrial buildings in the province are now 30 to 60 years old and many are overdue for upgrades (see Figure 3.3).

The BC Provincial Government has been encouraging energy efficiency retrofits through multiple policies and programs including the *BC Energy-efficient Buildings Strategy*, the *Energy and Water Efficiency*

Figure 3.3: Buildings constructed in British Columbia over the last century.

Source:
BOMA BC



Act, the *Public Sector Energy Conservation Agreement (PSECA)*, and the highly-successful “LiveSmart BC” program (see Appendix B on program and policy drivers).

The LiveSmart BC “Efficiency Incentive” program in particular has had outstanding success. It is estimated that the program has already stimulated between \$468 million to \$520 million in economic activity and created between 4,600 and 7,800 jobs.¹⁰ The program has stimulated a rapid increase in training and employment for CEAs, whose numbers in BC rose from 30 at the launch of the program to more than 130 today. Licensed service organizations such as AmeriSpec, Building Insight Technologies, E3 Eco Group, HomeTech Energy Solutions, and City Green Solutions employ CEAs to perform home inspections in order to identify opportunities for energy efficiency improvements.

With LiveSmart BC’s “Small Business” program, Business Energy Advisors (BEAs) are working with BC Hydro and FortisBC’s commercial customers who spend up to \$200,000 per year on their utility bills. Above this rate tier, commercial and industrial customers have the opportunity to employ an energy specialist and/or energy manager to help them improve energy efficiency and promote a culture of conservation (see Profile Box 3).

To drive forward public awareness for the benefits of energy efficiency, time of sale home energy labeling programs have been piloted in parts of the province, including the Capital Regional District on Vancouver Island, as well as on Saltspring Island. To get an energy efficiency rating, home sellers schedule a home energy efficiency assessment on their home and receive an EnerGuide label that describes the home’s total energy efficiency. Home sellers then post this rating on the Multiple Listing Service

(MLS) to show buyers how efficient their home is compared to others.

BC Hydro continues to actively pursue energy efficiency initiatives through its award-winning “Power Smart” program, which offers support for its residential and business customers looking to conserve energy and upgrade technology and equipment. FortisBC has also been actively promoting energy conservation initiatives through its “Power Sense” program and recently worked with the City of Rossland on a unique “Energy Diet” program that might be expanded to other regions throughout BC (see Profile Box 4). Combined, BC energy utilities invested \$213 million into energy efficiency in 2011, with BC Hydro’s Power Smart program alone spending more than \$190 million in this area.¹¹

A number of innovative financing solutions for energy efficiency upgrades have also been piloted over the last year in BC. The City of Vancouver, in co-operation with Vancity, FortisBC, BC Hydro, and Natural Resources Canada, has designed a 12-month pilot “Home Energy Loan” program, where unsecured loans will be offered to homeowners at low, fixed-interest rates over 10 years, allowing them to make energy efficiency upgrades for insulation, high-efficiency furnaces and hot water tanks, heat pumps, and air sealing / weatherization.¹² The money saved on energy bills is expected to significantly offset the loan payments.

A similar on-bill financing program is being piloted by the City of Nelson, funded by Nelson Hydro, FortisBC, the Columbia Basin Trust, and Natural Resources Canada (see Appendix B on policy and program drivers).¹³

More recently, amendments to BC’s *Clean Energy Act* added provisions that require provincial energy utilities (i.e., BC Hydro

PROFILE BOX 3

BC HYDRO ENERGY MANAGERS: CREATING A CULTURE OF CONSERVATION



At the present time, BC Hydro's Energy Manager Program employs close to 90 commercial and 42 industrial Energy Managers throughout the province. The industrial program has grown by 400% since 2008 while the commercial program has grown by 143% over the same period. Organizations with Energy Managers realize significantly higher energy savings compared to those without. The strategic approach taken by Energy Managers also yields long-term cost and maintenance benefits.

The Energy Manager Program also helps advance a greener economy in other ways including:

- Energy studies commissioned by Energy Managers create a demand in the market place for qualified consultants with an understanding of energy conservation.
- As Energy Managers implement energy conservation projects, the pressure on manufacturers to supply the market with energy-efficient technologies grows.

- As the Energy Manager role matures and they become more sophisticated, they are looking for new leading edge energy conservation technologies to help meet their organizations energy conservation targets. This pushes research and development and creates a marketplace for demonstrative projects.
- Key partnerships are also being developed to ensure alignment and integration with other organizations. For example, Fortis Gas developed a program for Energy Specialist roles, supporting Energy Managers. Companies using this team approach to energy management also see additional energy and cost savings above and beyond the savings realized with one resource in energy management.

The energy management career path is supported by various post-secondary education programs at institutions in the Lower Mainland, ensuring that the knowledge and skills of future professionals are developed.

It is expected that the need for energy management professionals will continue to grow as more and more organizations will start to use energy management as a strategic approach to reducing energy and maintenance costs for long-term benefits.

To learn more, see:

www.bchydro.com/Power Smart

PROFILE BOX 4

FORTIS BC LAUNCHES SUCCESSFUL “ENERGY DIET” IN ROSSLAND



Photo Credit:
Fortis BC

With a relatively high number of poorly insulated and energy inefficient heritage homes built in the early 20th century, the City of Rossland was at one time using 36% more electricity than the average home in British Columbia. To tackle the opportunity for reducing its energy consumption and put money back into the pockets of its residents, Fortis BC teamed up with the City, the Columbia Basin Trust, and the Nelson and District Credit Union in order to carry out an “eco-vention”.

The response from the community was incredible. While the original program target was to reach 100 homes, more than double that number received an energy assessment (259 in total). The program reduced the price of the energy assessments, helped connect

residents with local qualified contractors to do the retrofit work, and helped households capitalize on the Provincial LiveSmart and the former Federal ecoENERGY incentive programs.

While the final numbers have yet to be tallied, residents, program administrators, and local businesses have declared victory. Preliminary results from the program include:

- 135 homeowners (53% of program participants and 12% of the entire community) invested in significant energy efficiency home improvements and accessed rebate programs (40% gas-heated homes and 60% electricity-heated homes). An additional 9% made improvements or adjusted their behaviours but did not access rebate programs.
- Approximately 6% of the entire community participated in a light bulb exchange during a December blizzard and 35 small businesses received free lighting retrofits.
- Total reductions: 2220 GJ of natural gas, 1,478,000 kWh of electricity, and 338 tonnes of GHGs annually.

Based on BC LiveSmart averages, the residents of Rossland invested \$1.6 million dollars and created 20-30 jobs over the six-month period of the Energy Diet campaign. The program leveraged collaboration and creativity as a means to help create local green jobs, help residents save money on their utility bills, and rally a community behind an initiative which ultimately benefits Rossland and the province as a whole by reducing greenhouse gas emissions.

To learn more, see: www.fortisbc.com/electricity/Power Sense/inyourcommunity/rosslandenergydiet/Pages/default.aspx

and FortisBC) provide financing for energy efficiency upgrades. As such, the BC Government is currently working toward an energy efficiency financing regulation that will set requirements for BC utilities to offer “Pay-As-You-Save” (PAYS) financing programs to eligible customers (see Appendix B on policy and program drivers). Long-term, the PAYS program may replace the LiveSmart BC incentive-based program, whose current funding is set to expire after March 31, 2013.

While retrofit projects for multi-unit residential buildings (MURBs) can produce tremendous savings relative to their costs by conserving energy and water, many building owners are reluctant to undertake such measures, either because the up-front capital costs act as a barrier, or because the process is complicated and time consuming (see section 6 on barriers and enablers). The City of Vancouver is currently working on a “Green MURBs Pilot Project” (GMPP) along with FRESCO, the BC Sustainable Energy Association, Vancity, BC Hydro, FortisBC, and the BC Government to help facilitate retrofits of up to 15 MURBs in the City.

The project is helping building owners and managers through the retrofit process, coordinating building assessments and cost / benefit analyses, securing incentives and financing, and establishing contracts with companies that will undertake the retrofit work. An energy labeling project is also part of the GMPP.¹⁴

Companies in BC are also involved in providing weatherization services to residential customers, including draft-proofing, weather stripping, ventilation, and insulation. One unique example is EMBERS Green Renovations, a social enterprise in Vancouver that launched as a result of a 2010 pilot program that worked with 50 Vancouver homes to demonstrate and measure the benefits of home weatherization and draft-

Typology of buildings in the City of Vancouver

BUILDING TYPE	# OF BUILDINGS
Low Rise	600
High-rise	621
Skyscrapers	58

Source: Light House Sustainable Building Centre, 2012

proofing (see Profile Box 5). As a result, the not-for-profit company provides training and job opportunities to people that face barriers to employment.

Within the commercial, institutional, and high-rise residential sectors in BC, large property owners and managers such as Ivanhoe Cambridge, Bentall Kennedy, Oxford Properties, Morguard, Colliers International, and Cadillac Fairview are involved in various retrofit initiatives for their entire portfolios in order to maintain the value of their properties, reduce operating costs by improving efficiencies, and attract and retain tenants by positioning the properties as sustainable.

To realize the opportunities, many building owners and real estate management companies in BC are putting their properties through certification programs such as CaGBC’s “LEED for Existing Buildings: Operations and Maintenance” (EB:O&M) and the Building Owners and Managers Association’s (BOMA) “Buildings Environmental Standards” (BEST) program.

The LEED EB:O&M certification helps building owners and operators measure operations, improvements, and maintenance on a consistent scale, with the goal of maximizing operational efficiency while minimizing environmental impacts.

PROFILE BOX 5

EMBERS GREEN RENOVATIONS: SOCIAL ENTERPRISE BOOSTS GREEN JOBS



Photo Credit:
EMBERS Green
Renovations

Statistics:

- 5 gigajoules in annual gas savings (median for pilot homes)
- 20% average reduction in air leakage
- 1,100 tonnes in CO₂e reductions to date
- 100% of profits invested into local employment initiatives

EMBERS Green Renovations is a non-profit, social enterprise providing home renovations and energy efficiency solutions. EMBERS Green Renovations started with a pilot program developed in conjunction with and supported by the City of Vancouver, Fortis BC, and BC Hydro in September 2010. During that

time, EMBERS Green Renovations worked with 50 Vancouver homes to measure the benefits of home weatherization and draft-proofing.

Weatherization is considered by the construction industry as a “win-win” in terms of its ability to deliver cost savings from energy efficiency improvements. However, public awareness for the benefits and impressive return on investment (ROI) remains low, despite intense marketing efforts by EMBERS and the City of Vancouver showcasing the results from the pilot program which demonstrated that a relatively modest investment in air sealing can cut homeowners’ heating bills by 15-30%.

In order to obtain the necessary skill sets for EMBERS staff, the organization had to send its original workers to Bellingham in Washington State, as there is no local facility which specializes in air sealing and weatherization.

In 2011, EMBERS Green Renovations diversified its services to include general contracting, such as household renovations, repair services, thermal imaging, and restoration work, in order to compliment its weatherization services and generate additional revenues throughout the year. As such, the company has had continued success and remains one of BC’s leading providers of weatherization services, as well as a preferred supplier through the BC LiveSmart program.

To learn more, see: embersvancouver.vcn.bc.ca/green-renovations-main

LEED EB:O&M addresses whole-building cleaning and maintenance issues (including chemical use), recycling programs, exterior maintenance programs, and systems upgrades. It can be applied both to existing buildings seeking LEED certification for the first time and to projects previously certified under LEED for New Construction, Schools, or Core and Shell.

The BOMA BEST program is a four-level performance certification program that combines best practices, performance standards, and building characteristics to evaluate a building’s overall performance. Buildings are evaluated on six key areas: energy, water, waste, emissions/effluent, indoor air quality, and environmental management systems. The certification is available for five specific building types including offices, shopping centres, open air retail plazas, light industrial buildings, and multi-unit residential buildings.

British Columbia currently has 250 buildings certified as BOMA BEST (approximately 18% of certifications in Canada) and another 50 currently undergoing the process. Three of these buildings have achieved Level 4 status in the province, including the Shangri La and Shaw Tower in Vancouver, as well as a commercial building in Burnaby. Buildings in BC that are BOMA BEST certified perform on average 16% better than average and are estimated to emit 22% less carbon dioxide per square meter.¹⁵

As illustrated in Figure 3.4, the majority of BOMA BEST certified buildings are located in the Lower Mainland and on Vancouver Island: Vancouver (45%), Burnaby (23%), Richmond (12%), and Victoria (10%). The number of certified properties declines quite rapidly with building size and when examining municipalities outside of Metro Vancouver.

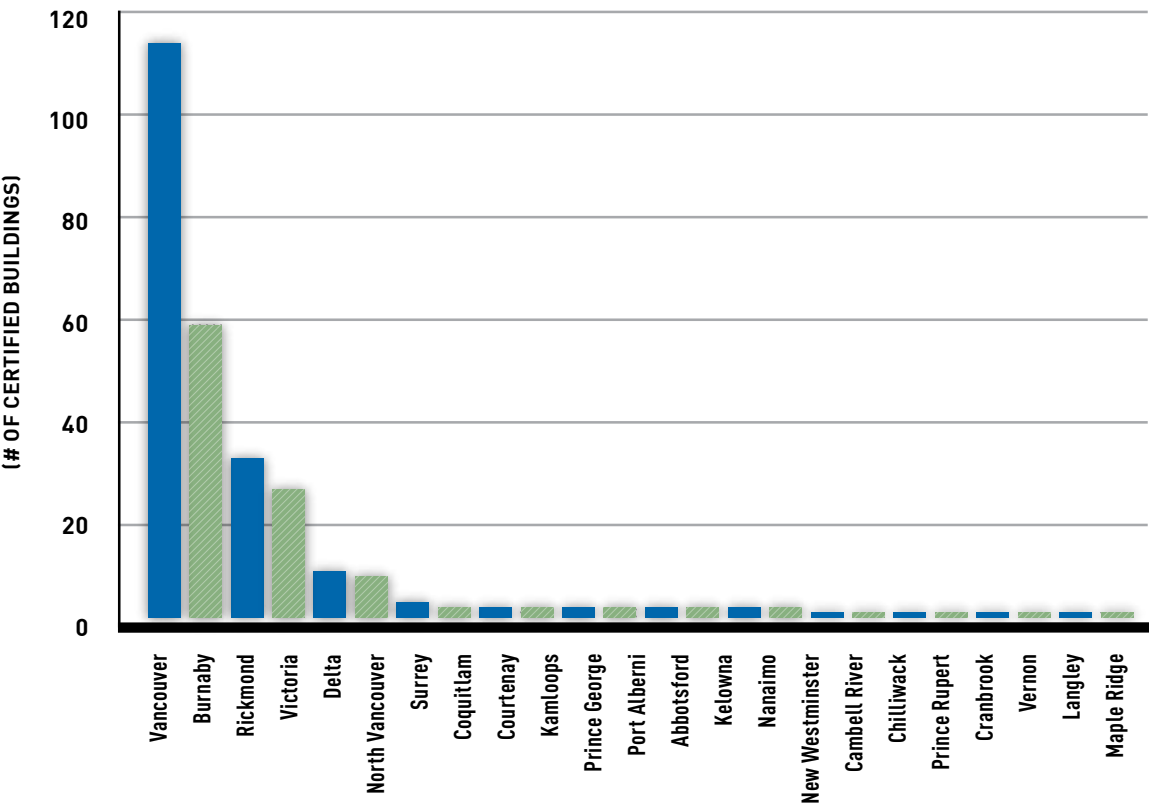


Figure 3.4: BOMA BEST certified buildings by BC municipality, April 2011.

Source: BOMA BC

» Optimizing the performance of buildings can present a better payback or return on investment (ROI) than other investment alternatives in today's uncertain marketplace.

Enormous opportunities exist to increase certification of properties as only approximately 8% of Vancouver's building stock is certified under the BOMA BEST program. Across the province, only 27% of buildings with floor areas below 50,000 square feet and 56% of buildings with floor areas greater than 100,000 square feet that are owned or managed by BOMA's members are certified under the program.

Life insurance companies and pension fund-owned management companies are increasingly requiring buildings in their investment portfolios to be certified as energy-efficient in order to enhance the capitalization rates on their assets. In many cases, optimizing the performance of buildings presents a better payback or return on investment (ROI) than other investment alternatives in today's uncertain marketplace.

The BC Hydro Power Smart Continuous Optimization program focuses on improving operations in large commercial buildings by combining consultants and software tools to help the building's facilities staff understand, reduce, and manage their building's energy use.

Companies such as Prism Engineering and the Integral Group (formerly Cobalt Engineering) offer energy efficiency services including energy and water audits, energy management and planning, operator training, and mechanical and electrical system upgrades. Companies including Johnson Controls, Schneider Electric, Reliable Controls, Honeywell Controls, and Delta Controls provide technical support and service for the maintenance of high-performance buildings and related HVAC and control technologies.

Increasingly, "deep green" or "whole building" retrofits are being explored by property owners and managers as they present some of the greatest benefits in terms of cutting costs while improving energy efficiency and reducing greenhouse gas emissions.

In addition to energy efficiency savings, additional cost savings can be realized through the whole building approach by bundling projects with low and high internal rates of return (IRR) or payback periods together to bring the improvements forward as a package.

Instead of having multiple energy conservation measures (ECMs) that require multiple contractors and budgets, bundling projects can result in efficiencies and cost savings by having a single company responsible for a project. An example of a leading company offering such services in BC is LEDCOR Renew.

In addition, by upgrading to energy-efficient technologies, property owners and managers are finding that they can boost revenues while simultaneously saving on their energy bills (see Profile Box 6).

New revenue streams can also be identified through the "whole building" approach that looks to optimize the productivity of a building's existing square footage, opening up additional leasable floor space from downsizing technologies such as chillers and HVAC units and/or adding retail space on the ground floor as examples.

In British Columbia, there are a handful of whole building retrofit projects that are in the initial scoping and feasibility planning stages. However, without incentive programs to help lower the payback period for many of these projects below the five to six year mark, further movement in this direction remains a challenge.

PROFILE BOX 6

SPORTING ASSOCIATION BOOSTS REVENUES FOLLOWING GEOTHERMAL UPGRADES



Photo Credit:
Northern Development
Initiative Trust

Located in Vanderhoof and host to numerous community clubs ranging from cross country skiers to rod and gun enthusiasts and conservationists, the Nechako Valley Sporting Association completed major energy efficiency upgrades to the society's clubhouse.

A geothermal heating system was installed that replaced the facility's reliance on a small pellet-fired stove, energy-efficient windows were installed throughout the clubhouse, and a new roof and insulation were installed to lower the cost of heating the facility. These renovations now allow the numerous community groups who rely on the building for their events to continue to use the facility year round while reducing operation costs.

Most importantly, this project is enabling the Nechako Valley Sporting Association to more readily rent the facility throughout the year and to a wider range of user groups, bringing new revenue into the association that is directly enhancing the financial sustainability of the society. The Nechako Valley Sporting Association Clubhouse serves as a social hub for the area and hosts numerous events throughout the year that draw visitors to the community of Vanderhoof and the Nechako Valley.

The upgrades that were done to the facility created short term work that was secured predominantly from local contractors, creating a direct positive economic benefit throughout the Vanderhoof community.

The hall is an important centre for Vanderhoof area and rural residents. The many renovations and energy efficiency improvements made to this facility is a "good news" story in Vanderhoof and will act as an anchor facility supporting recreational activities for residents in Vanderhoof for years to come.

Source: <http://www.northerndevlopment.bc.ca/explore-our-region/success-stories/upgrades-to-sporting-association-clubhouse-to-boost-revenues/>

GREEN BUILDING MATERIALS AND ENERGY-EFFICIENT PRODUCTS

BC wood-based products continue to be the province's largest strength in terms of locally-sourced, sustainable building products. The industry is supported by changes to the BC Building Code in 2009 allowing for six-storey wood frame construction for residential buildings, as well as the provincial government's *Wood First Initiative* and its *Wood First Act*, which require that wood be considered as the primary building material in all new publicly-funded buildings (see Appendix B on policy and program drivers).¹⁶

In addition, a number of communities have passed resolutions and by-laws to adopt the principles of the *Wood First Initiative*.

Locally-made products from wood such as cross-laminated timber (CLT) and spruce-pine-fir (SPF) glue-laminated timber beams are being used in buildings here in BC and abroad. Penticton-based Structurelam has had its products showcased in landmark structures such as the 2010 Winter Olympic speed skating oval in Richmond and the Nicola Valley Institute of Technology campus in Merrit.

Companies in BC have also developed wood-based products and expertise which are being sold internationally. As one example, New Westminster-headquartered Probyn Group worked with Surrey's Power Wood Corp. to supply 280 cubic metres of BC Western red cedar cladding which adorns the exterior of the 2012 Olympic velodrome in London, England.¹⁷

From an export perspective, BC forest product exports in 2011 totalled \$9.95 billion (\$5.67 billion for wood products and \$4.28 billion for pulp and paper products), up 8.8%

from 2010 and 31% from 2009 – accounting for 30% of BC's total export value in 2011.¹⁸ China has emerged as BC's second largest export market for forest products after the US, with exports totalling \$3.24 billion in 2011 – up from 47% in 2010. Exports of softwood lumber and logs to China have been growing steadily as a share of total exports in relation to other forest products, making up nearly 45% of total exports in 2011.

Additional opportunities for the export of BC-made green building products exist and research in this area continues. Expert advice and assistance for BC's wood-based industry exists through organizations such as the Wood Enterprise Coalition, the BC Wood Specialties Group, BC Wood, Forest Innovation Investment, FPIInnovations, the Wood Supply Network, and Wood WORKS! BC. Industry associations including the Council of Forest Industries, Forest Products Association of Canada, Coast Forest Products Association, and the BC Construction Association provide additional support for their members.

Other locally-made sustainable building products include pre-cast concrete, wood fiber insulation, recycled glass products, and structural insulated panels. As an example, Szolyd Industries, based in Victoria, makes a sustainable concrete product from up to 85% local recycled glass.

Energy-efficient windows and doors are also made in BC. Langley-based Cascadia Windows is currently the only manufacturer of fibreglass windows and doors on the West coast of North America (see Profile Box 7). The company also recently developed a fibreglass thermal spacer which has won several awards for innovation, providing twice the energy efficiency of traditional exterior insulated walls with continuous steel girts.

PROFILE BOX 7

CASCADIA WINDOWS AWARDED FOR INNOVATIVE WINDOW TECHNOLOGY



Photo Credit:
Cascadia Windows

Cascadia Windows became the first manufacturer of fiberglass windows and doors on the West coast of North America when it commenced operations four years ago at its facility in Langley. The company's fiberglass products have a distinct advantage over more traditional vinyl, wood, and aluminum products in the green building and retrofit markets as they carry significant energy saving attributes, while meeting industry leading performance standards.

Supported by some of the best building science credentials available in North America, Cascadia is driven to innovate. Its products recently received the "Sustainable Construction and Innovation Award" from the Vancouver Regional Construction Association. The company was also recognized as one of BC Business Magazine's top ten most innovative companies in the province for 2012,

and is currently nominated for the World Technology Award by the World Technology Network. At the forefront of Cascadia's current efforts is the patented Cascadia Clip, which increases the effective R-value of wall claddings by as much as 100%. This construction cost neutral innovation significantly reduces energy consumption and yields energy savings for building owners for the life of the building.

Rising energy prices, demand for green building products and services, and incentives for energy-efficient building technologies have all been instrumental to the company's growth. While the elimination of tax exemptions on ENERGY STAR qualified products and increased competition from new players in the market threatened to slow growth, the company was not deterred.

Cascadia's management team has also maintained a competitive advantage in the marketplace by innovating new products to address the energy efficiency demands of the industry. They are also attracting top young talent from across Canada and accessing qualified graduates from local post-secondary institutions. Cascadia is currently working with clients and design teams from California to Alaska, and from BC to the East coast of North America. Locally, Cascadia was also a partner in the Harmony House project in Burnaby – the first truly net-zero home on the West coast of North America.

To learn more, see:
www.cascadiawindows.com



Cascadia's products are extremely energy-efficient compared to vinyl and aluminum, allowing them to be used in net-zero construction projects and to qualify for additional points under the LEED standard.¹⁹

Another innovative company is Burnaby-based SWITCH Materials, a company developing "smart" window film technology using advanced materials from proprietary molecules that switch optical properties of the windows on command. The technology increases energy efficiency by reducing the energy consumed from building HVAC systems and by improving natural lighting.

North Vancouver-based Eltec Elevators is producing regenerative drive elevators that can return energy to a building's micro electricity grid.

EchoFlex Solutions, based in Squamish, manufactures switches, sensors, and controls for automation solutions and energy-saving systems (i.e., lighting and heating) which it sells to original equipment manufacturers (OEMs) around the world, who rebrand its products for residential, commercial, institutional, and industrial markets.

Legend Power produces a technology that reduces energy consumption in commercial buildings by allowing electrical equipment to be operated at a reduced and controlled voltage level so it can run with greater efficiency. In turn, the technology saves energy, reduces costly premature equipment failure, and extends a product's life expectancy. The company is currently expanding in Ontario and is looking to enter several US markets.

Pulse Energy is an energy information software company that is helping the world's commercial buildings to become more energy efficient. Pulse's trade-marked platform delivers solutions for the full range of commercial energy users, and is distributed through utilities to help them reach conservation targets and increase customer satisfaction. The company grew to a 90% market share among large commercial buildings in British Columbia and is using this foundation to meet industry needs internationally, including three of North America's five largest utilities.

In the realm of geo-exchange and heating, companies such as GeoTility, Exchangenergy, Fenix Energy, and GroundForce geoDrilling Solutions provide leading technology such

» **Successful companies in British Columbia tend to differentiate from the global competition based on their higher quality, performance, aesthetics, operational attributes and service.**

as ground heat exchangers and air source heat pumps, ventilation, as well as related installation and servicing.

British Columbia also has a number of leading energy-efficient lighting technology companies. Carmanah Technologies has been engineering some of the most innovative solar LED lighting technology on the market. Light-Based Technologies develops LED drivers and control technologies that simplify and add functionality to solid state lighting applications. SunCentral's innovative passive lighting technology allows lights to be turned off up to 75% of the time during daylight hours in multi-storey buildings. The technology also reduces building HVAC cooling costs by turning off artificial lighting.

Green building products and materials from successful companies in British Columbia tend to differentiate from the global competition based on their higher quality, performance, aesthetics, and operational attributes. The service element is also a distinguishing factor for many companies, who often provide ongoing customer support for clients.

WASTE MANAGEMENT AND DECONSTRUCTION

Effective construction waste management plans are key for builders developing projects that are seeking certification under a green building rating system such as LEED for New Construction, BuiltGreen, and BOMA Go Green. These rating systems award points for reducing and diverting waste, reusing building materials, and/or for reusing existing structures.

At the present time however, the construction, renovation, and demolition of buildings continues to generate an enormous amount of materials that end up in landfills.

In Metro Vancouver alone, construction, renovation, and demolition activities produce approximately 20% of all waste disposed in the region, equal to more than 300,000 tonnes per year.²⁰ Approximately 48% of waste generated (by weight) from the construction sector is derived from the demolition and renovation of residential buildings.²¹

Recycling materials is one way to avoid sending them to landfill. In 2010, Metro Vancouver recycled approximately 800,000 tonnes of demolition, land clearing, and construction waste.²²

The region has set a target to reuse and/or recycle an additional 155,000 tonnes per year of building materials (mostly wood) in order to reach its 70% diversion goal for the entire region by 2015, as set out in its *Integrated Solid Waste and Resource Management Plan* (part of Metro Vancouver's "Zero Waste Challenge").

To reach its 2015 goal, the Plan calls for a 42% increase in expenditures on recycling activities (for a total of \$270 million per year) and a 39% decrease in expenditures on disposal.²³

It was suggested that the high quantity of waste coming from this sector is due in part to the current lack of integrated project delivery by trades people and sub-contractors on construction sites. Access to material collection services and recycling infrastructure is another issue, particularly for smaller and more remote communities. These are areas where provincial, municipal, and regional governments will need to work together in order to meet diversion targets and reduce landfill costs related to disposal.

Metro Vancouver, in collaboration with Home Depot, has developed a pilot Wood Waste Recycling Depot, a free service for residential

users and small contractors. Wood is brought to Urban Wood Waste Recyclers who process the wood as hog fuel and as a mulch product for composting or for the landscaping industry. In its first 2 months of operation, the Depot served over 1,200 customers and recycled some 255,000 kilograms of wood.

Organizations across British Columbia through a process known as “deconstruction” are looking at how to take waste streams from the construction industry and turn them into profit streams.

The City of Vancouver recently introduced an advanced permit for deconstruction in order to encourage contractors to deconstruct and salvage at least 75% of materials from single-family homes.²⁴

Companies such as 3R Demolition in Burnaby are now able to recycle close to 85% of building materials during the deconstruction process.

While the deconstruction segment is a relatively new industry, it has a high growth potential and presents an area with potential for job creation in BC.

As part of a recent pilot project, the Pacific Community Resources Society (PCRS) worked with Pacific Labour Solutions to assess the feasibility of deconstructing two single family houses of different sizes. The goal was to divert significant amounts of materials from regional landfills while helping support community development and green job opportunities (see Profile Box 8).

The major challenge for the deconstruction industry in BC at the present time is the cost associated with delivering the service. While deconstruction has a high job creation potential, it also results in higher labour costs due to extended time periods relative to a standard demolition job (i.e., 3-5 days versus 1-2 days). The limited market for commercial deconstruction material is another challenge that results in a low resale value of materials.

To address some of the issues related to the limited market for materials, PCRS, the City of Vancouver, and a consortium of other non-profit organizations have been developing a plan for a centre that will be able to receive and sort materials from deconstruction and retrofit sites for resale. The “Rebuilt Hub” will be designed as a social enterprise that will employ at-risk youth and provide them with skills such as woodwork, de-nailing, marketing, and retail sales.

PROFILE BOX 8

PACIFIC COMMUNITY RESOURCES SOCIETY: DECONSTRUCTION PILOT PROJECT



Photo Credit:
Pacific Community
Resources Society

The Pacific Community Resource Society (PCRS) is an award winning, accredited, not-for-profit society which provides alternate education, employment, addiction counselling and prevention services, housing support, and cultural enrichment for children, youth, adults, and families.

In 2011, PCRS worked with Pacific Labour Solutions to create a deconstruction skills and training program (i.e., the Creating a Sustainable Tomorrow or CAST program) with support from the Government of Canada and the City of Vancouver.

The program's aim was to promote and create a local industry for deconstruction in BC to divert recyclable and re-usable material away from landfills. The program was also designed to support and train at-risk youth with life skills that would enable them to seek employment opportunities in this field. As part of the pilot, the youth were responsible for deconstructing two houses of different sizes.

The project was hugely successful in meeting their landfill diversion goals, reaching 93% re-purposing by weight. The salvaged materials were able to recover some of the project costs, but this income proved to fall short of covering the additional labour costs associated with the relatively time intensive process of dismantling and sorting the materials.

The pilot project was instrumental in helping better understand the future potential of deconstruction projects in the city, and has also highlighted the need to establish a marketplace for salvaged and local materials to help drive demand for these recovered products and help improve the financial feasibility of future deconstruction initiatives.

To learn more, see: www.pcrs.ca



4. CURRENT TRENDS

The Green Building and Energy Efficiency sector in British Columbia finds itself in a constant state of flux. The public policy landscape, technology pricing and performance, social acceptance, and other broader market and economic conditions are critical factors influencing developments in this sector. The following section touches on some of the key trends affecting this sector in BC, based on the insights of industry leaders interviewed as part of this study.

Rapid growth in the understanding of green building practices and benefits

From a supply perspective, British Columbia has seen near exponential growth in sustainable design and green building knowledge, skills, and expertise over the last five years with ongoing benchmarking by the industry. Since 2006, LEED practices have become widely accepted and the contractors and trades subcontractors are meeting that challenge. A younger generation of skilled workers and professionals (i.e., Generation Y) is now entering the industry with a marked enthusiasm for sustainability and a deeper understanding for new practices in design, architecture, engineering, construction, and management. On the other hand, evolving performance and construction requirements are presenting new challenges.

In terms of the demand for green building services, an understanding for the benefits of sustainable design and construction is becoming more established in all parts of the marketplace. This is particularly true in the public (institutional) and commercial sectors where long-term property owners appreciate the cost-savings, health and comfort benefits, and higher property values provided by building green.

More and more, people now associate “green” with “wellness” and the reality that building green supports better health and

workplace productivity is beginning to have a tangible value in the marketplace. The education component is now increasingly focused on the level to which green design can be applied for a specific project based on the payback periods and desired performance levels.

It should be noted however that the general public’s awareness of the full benefits of building green beyond the energy and longer-term cost savings remains low. As education and awareness levels grow, so too should the demand for new green building products and services.

Increasing focus on regenerative design and architecture

The price for commodities, materials, and products has been rising from competition for limited resources. As one example, China has been rapidly adding production capacity in sectors such as steel, drywall, and concrete resulting in rising prices.

As such, the building industry has seen a trend toward regenerative design and architecture, as well as toward a more creative use of materials and products, due in part to these resource constraints.

Regenerative design is an idea developed by experts at UBC’s School of Architecture and Landscape Architecture in which buildings

**Photo:**

Jim Pattison Centre of Excellence in Sustainable Building Technologies and Renewable Energy Conservation at Okanagan College

Credit: PCL Construction

and communities have a positive (rather than a negative or neutral) impact on the environment. Instead of focusing on damage mitigation, this approach aims to improve the surroundings. A regenerative building produces more energy than it consumes, sequesters more carbon than it emits, and recycles more material than it sends to the landfill.

Design-for-environment and cradle-to-cradle practices using materials that can be repurposed and recycled after use will be increasingly important in the future. This concept has also spawned the nascent deconstruction industry and the concept of “reverse” distribution chains.

Continued importance of green building codes, regulations, standards, and certifications

The real opportunity in green building can be found at the interface between public policy and practice. From a regulatory perspective, building codes provide the baseline of minimum requirements and have been important for advancing the green building sector over the last decade in British Columbia.

The provincial government also mandated under a “Carbon Neutral Government” regulation that all provincial government bodies and Crown agencies starting in 2010 must be carbon neutral. Under the 2008 Energy Efficient Buildings Strategy, all new construction, major renovations, and tenant improvements to government buildings and facilities must be carried out to a LEED Gold standard. In addition, the *Energy Efficiency Act* sets standards for manufactured building components and equipment and the *Wood First Act* requires that wood be considered as the primary building material in all new publicly-funded buildings.

British Columbia uses ASHRAE 90.1 as the energy standard for buildings, a tool that is primarily used for system optimization during the design phase.

At the municipal level, the City of Vancouver has a goal to reduce the amount of energy consumed by the city’s new homes by 33% by 2020, with the goal of making all new buildings “carbon neutral” by 2020. At the same time, the goal is to reduce GHG emissions from existing buildings by 20% over 2007 levels. Achieving this goal requires a shift to performance-based codes and to a building design approach that focuses on envelope first which will have a major impact on the entire construction supply chain.

In addition, all new buildings on reasoned sites, as well as all new municipal facilities over 500 square meters, are required to meet the LEED Gold standard – the highest environmental standard required by any local government in North America.²⁵ The City of Vancouver also requires that all new single-family homes and off-street bicycle storage rooms have dedicated electric plug-in outlets and is now requiring charging infrastructure for 20% of all parking stalls in new condo buildings.

The City of North Vancouver established a *Hydronic Heat Energy Service* by-law to create a district heating service area for Lower Lonsdale, with a requirement that all new or retrofitted buildings over a certain size be connected to and use the system.²⁶ Additional municipalities in BC have requirements that new buildings be district heating “ready”, while others are considering net-zero energy readiness.

The current trend is toward performance-based metrics as a quantitative means to assess “green” buildings. Movement toward the European Passive House standard is moving across North America quickly. This standard is applicable to a wide range of buildings, not just houses, and establishes an energy use intensity target of 15kWh/m²/yr for space heating and hot water. While green building standards and rating systems have been integral in helping to move industry forward, they may become less important as building codes evolve and continue to raise the bar. Already, much of the industry is following the standards as guidelines although many are choosing not to pursue certification in the end.

It should be noted that building to the “equivalent” of certain green rating system standards comes with inherent risks for developers and homebuyers who, without proper certification, may end up with properties that do not meet expectations.²⁷ And if a property is not assessed by a third-party agency, owners will be unable to know its ability to meet specific energy efficiency ratings and the property cannot be sold under a recognized green building standard brand name. In addition, without a third-party assessment for residential properties, homeowners are unable to garner rebates from BC Hydro’s Power Smart program or capitalize on Canada Mortgage and Housing Corporation’s rebate on mortgage insurance.

Increasing demand for energy and resource efficient green building materials and products

Rating systems, standards, and certifications including LEED, BuiltGreen, Green Globes, BOMA BEST, and the Living Building Challenge award higher points for materials, products, and technologies that prove their energy and resource efficiency, are low in toxicity, and/or are sourced locally.

As a result, manufacturers must ensure that their building products and materials meet specific sustainability criteria in order to be able to sell their products. Products are often certified by various third-party agencies and/or programs such as Forest Stewardship Council (FSC), Sustainable Forestry Initiative, the International Organization for Standardization (ISO), and ENERGY STAR in order to prove they can meet the required specifications.

This is resulting in positive benefits for some companies in British Columbia that specialize in energy-efficient windows, insulation, and other green building products from locally-sourced and/or recycled materials.

Greater emphasis on integrated systems and community development

Historically speaking, the engineering approach has been to break projects down into their individual pieces. More recently however, the building industry has been working toward a more integrated, systems-based approach. This interdisciplinary method supports ecosystems-based thinking around natural and urban systems design and is important for understanding related feedback mechanisms.

In-line with a more systems-based approach, green building and sustainable design is increasingly focused on the relationship between buildings and their surrounding

environment and communities, not just a building in isolation. As such, buildings are now being designed as part of larger community energy plans so that they can share energy and resources through the capture of waste heat and the reuse water as examples. Such projects can be found across the province, particularly in public institutional settings such as hospitals and care facilities, community centres, and on university and college campuses such as UBC, SFU, UNBC, and Okanagan College.

The nexus between energy and water management in buildings is becoming increasingly important. Water is no longer seen as a “waste” product but instead as an asset for its embedded energy content (e.g., organic material, heat, etc.). By managing water systems more holistically in buildings and urban settings and reusing grey water wherever possible, property owners and municipalities can save money in operating costs and in some cases may not be required to expand services such as sewage facilities. As one example, the Vancouver Convention Center saves approximately \$12,000 per month in water charges by reusing water for its green roof and toilets.

Master planning for community development is also focused less on single occupancy vehicles such as cars and more on “walkability” and cycling by designing for mixed-use buildings, integrated green spaces, and public transportation hubs.

New integrated practices, applications, and technologies acting as enablers

The building industry, which has traditionally worked in relative silos, is increasingly looking to an integrated approach to project delivery and the design process. The Integrated Project Delivery (IPD) model involves a collaborative alliance of people, systems, business structures, and practices integrated into a process that harnesses

the talents and insights of all participants to optimize project results, increase value to the owner, reduce waste, and maximize efficiency through all phases of design, fabrication, and construction.²⁸ The Integrated Design Process (IDP) where architects, engineers, contractors, and other stakeholders work together during the planning phase to create synergies and to identify creative solutions has had very positive results in terms of advancing green building practices and delivering cost savings.

The integration of information technologies and heightened collaboration between designers and builders throughout the design and project delivery process for example has had a positive impact on productivity and project efficiency through streamlining and the reduction of waste during construction, resulting in significant cost savings. Building Information Modelling (BIM) and other related software technologies have been important enablers, allowing the entire supply chain to collaborate throughout a project’s lifetime and explore creative new solutions to old problems.

New technologies and innovations are also changing the building landscape and making “smart” buildings more efficient. In particular, the adoption of sophisticated energy management, control, and automation systems in buildings has been proven to reduce energy consumption and greenhouse gas emissions. The ability of these systems to process and analyze huge volumes of energy-related data has shifted the way buildings are designed, built, and operated, but it has also proven challenging for the people who operate buildings on a daily basis.

Additional technologies such as heat pumps and exchangers, solar thermal hot water heaters, and cross-laminated timber panels are requiring advanced skills in plumbing, heating and ventilation, building envelope design and weatherization, and carpentry.

» **The building industry, which has traditionally worked in relative silos, is increasingly looking to an integrated approach to project delivery and the design process.**

As technologies and building systems continue to evolve in complexity, project managers and contractors are requiring expertise in multiple technical areas. Skilled trades, which have become more specialized over time, are now requiring that workers understand their role in the larger integrated system. This has resulted in push back by some in industry who are interested in “de-skilling” trades in order to save costs by hiring unskilled workers.

The demand for knowledge and expertise related to building sciences is also increasing and BC has seen the launch of new programs dedicated to this field in the last couple years, such as UBC’s Sustainable Building Science Program – the first of its kind in Canada.²⁹

Green building incentive programs moving toward creative market-based financing mechanisms

There is a gradual shift as the green building sector matures away from government and utility-based incentive programs (e.g., NRCan’s EnerGuide and BC’s LiveSmart programs) toward more creative, long-term, market-based financial mechanisms such as green bonds, sustainable building funds, and on-bill financing (e.g., BC’s “Pay-As-You-Save” program).

Government and utility incentive programs tend to have time limits tied to budget cycles that are often too short for the construction cycle (e.g., two-year rebate programs and one-year federal tax credit for home renovations).

Municipalities in BC, which have made commitments to reducing their GHG emissions are largely driving the efforts to improve the energy efficiency of their building stocks and in turn are offering financing mechanisms such as Vancouver’s “Home Energy Loan” program, bonds, and density bonus schemes as the bar is raised.



Private sector players are also stepping into the arena. Sears for example is now offering interest free loans on home energy retrofits and energy efficient equipment / appliances and the Co-operators insurance company offers an insurance rider for green homes. These mechanisms are bolstered further by rising energy costs which favour the adoption of green building practices and energy-efficient products and technologies.

However, it should be noted that the structure of the majority of existing incentive programs available to the industry in BC do not adequately reward innovation and leading-edge developers for undertaking first-mover risks. Additional support in this area would be beneficial.



5. LABOUR DEMAND AND SUPPLY

The boom and bust cycle of the real estate market in many ways dictates the demand for labour in British Columbia's green building industry. Despite minimal growth in the current residential and commercial construction marketplace across the province, the demand for green building expertise and related skilled trades continues to increase.

In addition, the job creation potential from programs such as LiveSmart and BOMA BEST is large due to the accelerated strategic retrofit activities designed to improve energy efficiency and building performance. This includes work for product and technology suppliers, consultants providing energy studies and audits, design consultants, and construction contractors.

Below is a description of industry needs in terms of key occupations, essential knowledge, and important skill sets as they relate to sustainable architecture, design, planning, and engineering; construction and renovation; property management; green building product design and manufacturing; and the corresponding supply chain.

INDUSTRY WORKFORCE NEEDS

Architecture, Design, Planning, and Engineering Services

Architecture and Design Services

Knowledge and expertise in sustainable architecture and design rests very much at the core of the Green Building and Energy Efficiency sector. Professionals in BC are increasingly working on projects required by the provincial or municipal building codes and local regulations to be built to specific standards following green rating systems or certification programs. As such, architects and designers in BC are requiring professional designations such as LEED Accredited Professional (AP).

The widely used Integrated Design Process (IDP) increasingly requires architects, designers, and other professionals throughout the design phase to work in teams, which in turn requires professionals to have solid communication and people skills. The demand for professionals with

experience using Building Information Modeling (BIM) is also growing quickly, as is the demand for those with experience using related integrated modeling software applications for 3-D coordination, project review and simulation, and building systems design and analysis such as Autodesk's Ecotect, Navisworks, and Revit.

The emerging focus on regenerative, cradle-to-cradle design and design-for-environment practices requires that professionals have an understanding and appreciation of the full life cycle analysis of their buildings and relevant building products and technologies. New resource- and energy-efficient green building materials require a solid understanding of the structural properties of these new products – which is particularly important in BC where wood is increasingly being incorporated into the design of buildings and structures.



» **Professional engineers need growing capabilities in modeling with respect to energy, daylight, compensational fluid dynamics, and ventilation.**

Sustainable Urban Planning Services

A systems-based, interdisciplinary approach is imperative for urban planners. Ecosystems-based thinking for both natural and urban systems is important, as is an understanding of feedback mechanisms. Creativity, critical thinking, and a willingness to look at issues from different angles are also important attributes. Being a generalist is important in order to understand ideas and concepts from different perspectives. There is also a need to understand how behaviour changes the environment, so attitudinal skills are critical. In addition, the ability to communicate to different groups on a variety of sustainability issues through stakeholder engagement is critical for raising awareness.

Engineering Services

Engineers are a third group of professionals offering critical services to advance a more sustainable built environment. Chemical, physical, environmental, mechanical, structural, civil, electrical, energy, and façade engineers all play essential roles.

Environmental engineers with building physics backgrounds and mechanical engineers with an understanding of complex

systems (including HVAC systems, district energy / biomass systems, and waste heat recovery systems) are growing in importance. Mechanical engineers tend to be the largest group transferring into energy-related engineering fields, although engineers with a chemical background are also valuable for this area of expertise because both chemical and energy engineering are process-based disciplines.

Structural engineers are critical for companies working with wood design and other materials. Engineers coming from Europe for example, have more experience than those in North America working with engineered wood products such as cross-laminated timber. As such, there are many Europeans working with BC companies in this space.

Professional engineers need growing capabilities in modeling with respect to energy, daylight, compensational fluid dynamics, and ventilation. Experience with 3-D modeling is also important. Building envelope engineering is an additional area of considerable importance as building exteriors are a critical component to ensuring efficient buildings, as well as for the collection and distribution of energy.

Skilled Trades in Construction, Renovation, and Deconstruction

Skilled Trades and Contractors

As trades have become more specialized and technical over the last 20 years, companies are increasingly sub-contracting out the work. As such, many companies in the province have downsized their workforce to remain competitive and are increasingly focused on a core set of staff.

At present, most contractors in BC require an understanding of green building practices.



Many contractors have received LEED training in last five years, although LEED accreditation is not a major hiring consideration for most construction companies as contractors are typically not involved in the design process.

For the most part, the skills required for the construction of green building projects are similar to those applied in traditional projects, although education with respect to sustainable building best practices, systems-based thinking, and the application of new technologies is critical. Companies involved in green building projects consider it essential that their staff and trades people understand the benefits behind green building practices and techniques and are engaged in the process.

While companies continue to seek contractors with general certifications in trades and well-rounded construction skills, attention to detail is critical for green building projects – especially for workers in trades such as insulation and building envelope, plumbing, and carpentry – in order to meet strict requirements of building rating systems.

There is also a growing need for advanced skills in carpentry (including journeymen framers or timber framers and/or apprentices), high-performance building envelope technologists, hydronics specialists (e.g., radiators, in-slab radiant systems, heat pump technologies), weatherization and air sealing / draft proofing contractors, and

» **The skills needed for the construction of green building projects include education in sustainable building best practices, systems-based thinking, and the application of new technologies.**

technical services tied to building sciences and energy efficiency retrofits, such as Certified Energy Advisors.

Presently, green building technologies and systems (such as tilt beams, radiant slabs, solar hot water, solar photovoltaic (PV) arrays, and geothermal systems) are applied in only a small number of projects across the province and therefore, the demand for skilled workers with related experience is relatively low.

However, the demand for expertise in BC related to these technologies and systems is growing quickly as technology prices fall, consumer awareness for the benefits continues to rise, and architects increasingly specify them into projects.

Demand for heating specialists in the province is also growing as the technology options for consumers have expanded considerably in recent years from furnaces to include such equipment as air source heat pumps and heat recovery units. This also includes work for qualified installers and service providers for heating systems, ducts, furnaces, and energy-efficient windows and doors.

One result of trades becoming more specialized and technical is that workers are often performing their duties independently from one another, which can be a problem for green building projects that require a more integrated and holistic approach. More recently however, integrated, project-based learning is resulting in greater coordination between trades. As such, contractors require greater communication skills and expertise with BIM and related software modeling applications.

Construction Management

The sequencing and coordination of qualified trades people and different trades with each other is increasingly important in the green building industry for ensuring that complex projects and systems are completed to code and standard as efficiently as possible.

Construction management companies in BC tend to sub-contract out all trades work and hire only managers, superintendents, estimators, and on-site safety professionals. As such, these companies value staff with skills in project management, coordination, and communications. Management companies often seek experienced project managers who have some general knowledge in a variety of areas such as engineering, biology, architecture, and energy in order to supervise and coordinate the project team and ensure that trades people are performing well together. An ability to learn quickly on the job is of critical importance.

Deconstruction

While still a nascent industry in BC, jobs in deconstruction can be found with respect to work managing and repurposing materials from resource pools as they come back into the “reverse” distribution chain. Skills in woodworking, de-nailing, marketing, retail sales, and art all have value for this sub-sector.

Building Operations and Maintenance Services

The skill sets required by current building operators are very different from operators in the past. Work is more process-oriented with operators acting more as administrators and monitors of sophisticated building automation systems using advanced technology. Building operators are often incentivized to improve the energy performance of their buildings and thus integrate performance into their personal objectives.

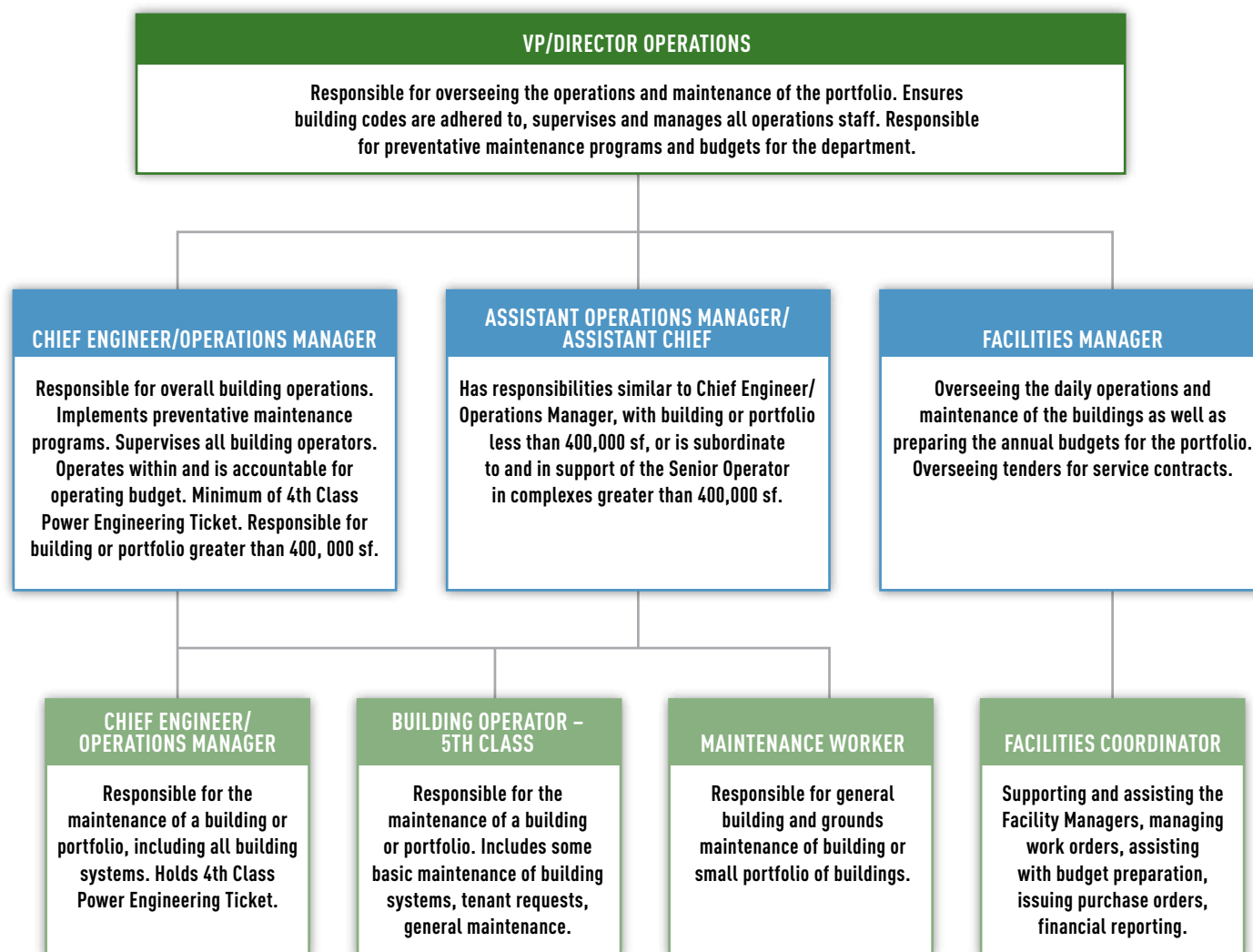


Figure 5.1: ↗
Job titles and descriptions in building operations.

Source:
ECO Canada (2011),
Building Operator
Scoping Study.

High-performance buildings now require sophisticated expertise for managing and maintaining complex computerized systems, controls, and related data for advanced HVAC systems, valves, and pumps for fluid and air movement.

As a result, the competitive landscape for “smart” building managed services is evolving at a rapid pace, offered by companies such as Johnson Controls, Schneider Electric, and Corix, which specialize in managing energy and water systems and related technologies in high-performance buildings.

At the moment, there is no formal accreditation for operators of high-performance buildings in Canada and while there is no standardized inventory of job titles and descriptions, Figure 5.1 illustrates the range of common positions depending on the size and type of the building and budget assigned to building operations / maintenance.

Mechanical and engineering skill sets are very much in demand. Real estate management companies tend to hire individuals who are qualified as Building

Operators with a Class 4 or 5 Power Engineering certification or who have certification from the BOMI Systems Maintenance Technician (SMT), Facilities Management Administrator (FMA), or Systems Maintenance Administrator (SMA) programs.

Advanced water systems are also requiring additional skill sets in civil and environmental engineering. Sub-metering and energy management information systems require operators who can analyze regular power usage and take real-time corrective action to address problems. Experience with Building Management System (BMS) software is also important for ensuring that high-performance buildings are running at optimal levels.

Previous experience in property management and in an office environment is often beneficial, as is general maintenance and construction experience.

Green Building Products and Materials: Design and Manufacturing

Due to the range of green building products and materials developed in BC, combined with the diversity of design and manufacturing processes, it is difficult to comprehensively cover the needs of companies in this area when it comes to a skilled and qualified workforce. That being said, companies do share some common needs, particularly when it comes to product design and engineering, business development, and process management.

Product Design and Engineering

The ability to develop innovative yet simple and cost-effective solutions is essential. Employers are looking for staff that have balanced skill-sets with both a technical and practical understanding of the challenges faced by industry and of current technical short-comings in order to innovate new products and solutions.

As such, an awareness of current industry trends (including the public policy and regulatory landscape) combined with the technical aspect of design and/or engineering is very helpful. Engineers and designers need to be forward-thinking and able to develop a product that is not just slightly better than the current model but will still be considered cutting-edge years into the future.

Companies in BC developing wood products are often looking for staff with advanced skills in wood technology, including cross-laminated timber and glue-laminated product design and fabrication. Firms developing energy-efficient green building products and technologies seek mechanical, electrical, and software engineers and technicians, as well as individuals with electrical hardware and firmware experience (building automation experience is helpful for those involved in the controls industry). Companies will often bring in contractors for specialized design features, installation, and legal support related to patents and intellectual property.

Because many of the companies working in this space in BC are at the leading edge of innovation and therefore have difficulties finding an exact match for their required skill sets, companies often train internally and as such, look for entrepreneurial staff with positive, energetic attitudes. Knowledge of industry needs and of the construction site are often helpful, as is an ability to think “outside-of-the-box”.

Marketing, Sales, and Business Development

Companies developing green building products and materials need staff who can sell the innovative products in the marketplace, including to wholesalers, retailers, architects, and specification writers. This not only requires a complete technical understanding of the products and services being offered (including product specifications

» **Procurement experts and specification writers with a deep understanding of green building concepts and technologies are needed.**

and certifications), but an ability to effectively communicate and articulate the cost, energy, environmental, and health benefits to potential clients. Companies often employ an “educational” rather than an “aggressive” approach to sales.

Process Management

Companies in product and material design and manufacturing are in need of knowledgeable and experienced product and installation managers, as well as plant managers and supervisors. Patience and effective communication skills are important, as is a complete technical understanding of the products under production. Problem-solving capabilities are paramount as products are often so cutting-edge that they are regularly improved upon during their development and manufacturing processes.

Other Relevant Occupations

Client Services and Business Development Professionals

Client services and business development is an important factor for the success of many green building companies and organizations. Companies need managers with solid organizational, communication, sales, and customer service skills that also have an understanding of the technical side of their industry. Organizations involved in running programs specific to the sector need staff with solid coordination, communication, budgeting, and financial management skills.

Public Education and Outreach Professionals

Public education and outreach is a large component to the Green Building and Energy Efficiency sector. Raising awareness for the benefits of green building practices, as well as energy efficiency initiatives such as weatherization and the demand-side management of power, is critical to the widespread adoption of these efforts.

In addition, the wide variety of incentive programs available in the marketplace can be overwhelming to many and experts who can help educate the public on the options and guide them through the process are in demand.

Financial, Legal, Regulatory, and Procurement Professionals

The fiscal aspect to advancing the Green Building and Energy Efficiency sector requires qualified and experienced professionals in financial management and control. Innovative financing mechanisms could be the key to unlocking the accelerated deployment of green building solutions and energy-efficient technologies. Being able to establish a business case for a given product or service in this sector is an important strength.

Writing skills for both technical reports and other areas such as grant writing are very important and in high demand by industry. Procurement experts and specification writers with a deep understanding of green building concepts and technologies are needed.

Individuals who have expertise in legal contracts, valuation, and estimation, as well as with regulatory frameworks and building codes are vital for this sector. In some instances, companies in BC have hired strategic management professionals who have a good understanding of public policies such as the *Wood First Act* to work with municipal officials in order to advance their business development efforts.

WORKFORCE RECRUITMENT AND RETENTION

From the interviews conducted as part of this research, most companies active in this sector in BC are not overly challenged in terms of finding the skilled and qualified staff they need. This is due in part to a cyclical downturn in the construction sector in the province that has resulted in a relative abundance of trained workers as companies have downsized.

However, the building industry is projecting that as the economy begins to pick-up once again, a skilled labour shortage is imminent, particularly at the project site level. The Vancouver Regional Construction Association (VRCA) and the BC Construction Association (BCCA) have already been on multiple recruitment drives to Europe this year alone.

In the field of architecture and design, firms tend to look for professionals that understand sustainability as a core competency, combined with previous experience using the various industry software applications and tools.

The marketplace in Canada for qualified architects and interior design professionals is highly competitive, often making it difficult for companies to attract the best talent. As a result, many firms recruit globally. In general, Vancouver and the surrounding area is seen as a clean, international, urban centre and this perception attracts qualified professionals from around the world – and particularly from Europe in the green building space. Companies in BC often use federal and provincial programs to help bring foreign workers with architectural expertise into the province.

In terms of recruitment tools, referrals coming from personal networks are the dominant source for companies looking for qualified workers. Company management in some cases also teach courses at post-secondary institutions in the province, which in turn helps them recruit staff directly from the classroom.

For more technical or specialized positions, or when word-of-mouth referrals are not sufficient, companies will post employment opportunities on-line, including on their corporate websites, on the websites of industry organizations and associations, on specialized job boards, and on websites such as Craigslist. Social media tools such as Linked In, Facebook, and Twitter may also be used for recruiting purposes.

Traditional local print media channels (i.e., magazines and newspapers) are used by some firms to help find people for lower-level positions and companies will advertise internationally for more senior, harder to fill positions. In some cases, companies will turn to third-party recruitment agencies to find key technical staff and senior management positions.

Co-operative education (co-ops) and internship programs (for architecture, design, engineering, and technical firms) and apprenticeship programs (for companies in construction and trades) are very common pathways used by companies to recruit successful graduates. In the engineering space, programs such as “Engineers Without Borders”, as well as MITACS and other graduate research programs, have proven to be good sources for future staff.

Finally, companies in the construction and renovation sub-sectors have availed of the “Targeted Wage Subsidy” program that provides a temporary wage subsidy to help bring on workers who face barriers to employment.³⁰

EDUCATION, TRAINING, AND PROFESSIONAL DEVELOPMENT

External Education, Training, and Experience Factors

Professional Education and Training

British Columbia's public post-secondary institutions are leaders in North America with respect to programs in sustainable architecture and design, building sciences, and energy management.

UBC's wide variety of programs, including building sciences, architecture, design, planning, and engineering (with specializations in areas such as clean energy and wood) have resulted in well-educated graduates entering the workforce.

SFU's Centre of Sustainable Community Development offers programs that integrate economic, social, and environmental objectives into community planning and development.

The level of consciousness coming out of these institutions is raising the bar for industry as a whole.

Trades and Industry-based Training

Many industry experts have identified that skilled trades are almost certain to see the biggest gains in terms of new employment opportunities as green building projects continue to penetrate the marketplace in British Columbia. This has created a strong demand for modern training programs with sufficient capacity to help meet current and future industry demand.



» **Skilled trades are almost certain to see the biggest gains in terms of new employment opportunities as green building projects continue to penetrate the marketplace.**

Skilled trades training — including carpentry, plumbing, pipefitting, welding, and electrical — is mostly handled by BC's colleges and technical institutes, in partnership with industry. Many of the traditional trades are being adjusted to include new green technologies and practices such as the design, installation, and maintenance of district energy and geo-exchange systems. Certificate programs for building envelope and geothermal technicians, as well as an evolution within apprenticeship training programs, are helping to ensure that supply meets demand.

The British Columbia Institute of Technology (BCIT) has been actively working on a program to "Green the Trades", exploring ways to incorporate and add-on green building knowledge at practices into existing apprenticeship and Red Seal trades through initiatives such as a pre-program orientation and lunch-and-learns.

BCIT's architectural science, building sciences and engineering, and sustainable energy manager advanced certificate (SEMAC) programs are also recognized by industry as leading edge. The SEMAC program provides graduates with the skills and knowledge of sustainable energy management principles, approaches, techniques, and tools.

Okanagan College and the adjacent Jim Pattison Centre of Excellence in Sustainable Building Technologies and Renewable Energy Conservation provide a range of leading programs in green building, from sustainable construction management, to geo-thermal, life cycle site management, and metering and monitoring of high-performance buildings.³¹

Douglas College offers a Building Environmental Systems program, as well as a unique Building Energy and Resource Management (BERM) certificate program that is helping to build capacity in the field



of energy management. The BERM program also exposes students to principles of internal waste management programs, setting up transportation programs, water conservation measures, and GHG “hidden” in building materials.

Additional industry-based education and training courses and programs are offered by private institutions, industry associations, and other organizations. Industry organizations such as the Canadian Solar Industries Association (CanSIA), the BC Ground Water Association, GeoExchangeBC, the Thermal Environmental Comfort Association (TECA), the Canadian Green Building Council (CaGBC), the Canadian Home Builders’ Association of BC (CHBA-BC), the Building and Managers Association (BOMA), and the BC Construction Association (BCCA) are involved in curriculum development for green building related specialty certifications and several offer their own industry training programs.

The CaGBC for example has trained close to 3,300 people since 2005 in British Columbia, including 560 Green Associates and 116 LEED Accredited Professionals since 2010. CHBA-BC provides the BuiltGreen certification for its members.

BOMI Canada offers three designations for building operators, including the Facilities Management Administrator (FMA), the Systems Maintenance Administrator (SMA), and the Systems Maintenance Technician (SMT) certification. These programs are designed to improve the operating effectiveness of building assets. BOMA also offers an on-line training platform (i.e., Energy Training for Building Operations Program³²) designed to educate building operators, property managers, realtors, and

consultants around energy efficiency, as well as an energy management program to help its more than 300 members with energy efficiency initiatives – particularly its smaller members that lack in-house resources or capabilities. The Light House Sustainable Building Centre provides custom educational programming for the construction, building, and real estate sector, including custom training and education programs for professionals and businesses, public outreach and education programs, project team mentoring, and multi-tier training for construction teams – in the classroom, in the office, and on site.

A key benefit to many of these successful programs is that they offer students the opportunity for field experience (through co-op programs, internships, apprenticeships, field research, and/or research projects).

The programs referenced above are but a few of the specialized educational and training programs that are offered by institutions in British Columbia and are important to this sector; there are of course many others that could be cited.

For more information on education and training related to the Green Building and Energy Efficiency sector in British Columbia, download GLOBE’s Reference Guide to Green Education and Training:

**Skilled, Qualified and Sustainable:
A Reference Guide to Green Education
and Training in BC**

Internal On-the-Job Training, Mentorship, and Professional Development

Similar to many industries, companies in the Green Building and Energy Efficiency sector offer significant on-the-job training. Regardless of the skill set, there is always a need to bring new employees up-to-speed with a company's business practices and/or on the details of a specific project. In some areas of green building such as timber design, the field is so unique in BC that companies must train internally.

Architecture, Design, Planning, and Engineering

Architectural and design firms will often have a budget for their professional staff for sustainability-related education, and often provide workshops on software tools such as BIM and other industry topics. Many companies pay for their staff to become LEED-certified and for other professional designations and development programs,

offered by organizations such as the Association of Energy Engineering and the Association of Professional Engineers and Geoscientists of BC (APEGBC). Co-op programs and internships were again identified as a critical element to gaining on-the-job experience.

Architects and designers at larger firms in BC are often part of a team of professionals working on projects all over the world. As such, some firms offer programs that allow employees to work globally in order to gain additional experience. This helps staff develop technical knowledge, increases their experience and productivity levels, and helps to develop leadership qualities.



Construction, Renovation, and Deconstruction

Many companies will train their workers on sustainable building practices in areas such as building science, energy auditing, building envelopes, and on-site waste management and recycling. Most contractors involved in green construction will bring on apprentices and journeymen and will train workers in their attention to detail. Companies involved in weatherization and air sealing work will often hire people with carpentry and construction skills and will provide the specialized training internally.

In terms of professional development, some construction companies will pay for their managers and senior staff to become certified by programs such as The Natural Step, LEED, and BuiltGreen as the additional knowledge related to energy efficiency and sustainable building practices is considered beneficial by these companies.

A number of industry leaders have developed construction and demolition recycling programs and pilot projects to determine recycling rates and develop ways to improve the process through on-going training. These companies have had to educate their on-site contractors and train management to think of waste streams as potential profit centres rather than as an added cost.

Building Operations

Property management companies often provide support to staff and will send them to local post-secondary institutions to acquire the necessary skills and training when appropriate (e.g., 5th Class Power Engineering certificate). Much of the re-training for building operators is done in-house and companies will often bring in consultants to provide specialized training with respect to ongoing commissioning and re-commissioning work. Internal programs

will also be offered for management in terms of leadership skills and related training.

Some major property management companies in BC are showing leadership in this area. Cadillac Fairview for example has developed a proprietary program called GREEN AT WORK™, an internal certification process which requires staff to set operational benchmarks for reducing energy consumption and waste, improving environmental protection, encouraging sustainable procurement, and promoting ongoing communication with key stakeholders.³³

Green Building Product Design and Manufacturing

For many companies involved in green building product design and manufacturing, cross-training opportunities are regularly offered to staff – often done through a combination of training from management and other skilled technicians during slower periods. Senior engineers, technologists, and technicians with more extensive knowledge play a huge role in mentorship of newer employees and encourage knowledge transfer. The more that staff members are capable of doing, the more valuable they are to a company. In some cases, employees are given time in the shop to learn about the design and manufacturing process before moving into office roles in business development, sales, or management.

Co-op programs from post-secondary institutions (particularly UBC, SFU, UVic, and BCIT) have been important vehicles for providing experience to newly-graduating mechanical and electrical engineers hired on by companies in the Lower Mainland. Programs such as NRC-IRAP and SR&ED have also been helpful for supporting employee training (Appendix B on policy and program drivers).

STAFFING CHALLENGES AND KNOWLEDGE, EDUCATION, AND TRAINING GAPS

Key Staffing Challenges

The major staffing challenges faced in this sector relates primarily to the development and application of new, resource- and energy-efficient technologies and practices.

Senior and experienced professional engineers and technicians continue to be the most difficult people to staff for companies in the development and manufacturing of green building materials and energy-efficient products – particularly mechanical engineers with an energy background.

Because newer energy-efficient technologies are often so cutting-edge, companies can have a difficult time finding qualified staff (technicians and technologist) with the right combination of technical expertise and hands-on experience working in the shop. Companies will look to find skill sets that can be good starting points but must provide considerable on-the-job training for specialized new technologies.

Finding the time to train on-the-job is difficult as it takes people away from their normal responsibilities and can affect productivity levels. Companies do make extensive use of co-op and other research, training, and experience programs, but for smaller companies, it can be a challenge to dedicate time to train students, especially for shorter 4-6 month work terms. There are further opportunities for government to help facilitate this process.

Architecture and design firms can find it difficult to source graduates with the deep knowledge required for working on visionary, world-class projects. In interior design for example, many graduates are

coming out of school with only a surface level understanding of specific areas such as kitchen design rather than having more well-rounded expertise. There is also a shortage of experienced and qualified energy modellers and engineers.

With respect to construction trades, finding contractors with experience working with and installing the range of energy-efficient technologies can be a challenge. For some areas such as solar thermal heating for example, contractors need to have installed at least 50 units or systems before they are proficient with the technology. Companies involved in wood building design and construction are challenged to find builders with more comprehensive skill sets than framers. Sustainable builders need a more holistic approach to construction that is focused on quality, durability, and accuracy.

Knowledge and Information Gaps

Sustainability Related

There is still a great need to embed a deeper understanding of sustainability into the industry and to train everyone throughout the value chain. From architects, to painters, building operators, and inspectors, the need exists to build a better understanding of their roles in the larger picture of the green building process. At the moment for example, there is a gap in certain trades with some builders unaware of what practices, materials, technologies, and equipment should be used for building greener projects or how to apply them efficiently. A more integrated construction process that clearly articulates accountability, assigns responsibility, and encourages communication at all levels, supported in specification and contract documents, is essential to eliminating fragmentation in the industry.

» **There is still a great need to embed a deeper understanding of sustainability into the industry and to train everyone throughout the value chain.**

In addition, many professionals and trades people in the industry, particularly in the residential sector, still see the green building sector as a sideshow. This is compounded by the fact that most professional codes (i.e., architects and designers) do not receive a formal sustainability designation as part of their training and education – although many will acquire sustainability-related accreditation on their own and most will embed sustainability concepts into their projects.

Sustainable construction management is an additional critical area requiring more skill development. The contractor's role needs to be expanded back into the design phase and across more aspects of construction. A sustainable construction industry will not be achieved unless process, roles, and responsibilities evolve.

Energy Related

In terms of knowledge and information gaps related to energy, one of the key pressure points in this sector is at the actual construction site. Architects and engineers can design energy-efficient buildings but the actual construction of such buildings requires considerable expertise that often is not present in the building community.

There is a need to develop better knowledge and skill sets related to the installation of heating and cooling systems, as well as for the efficient construction of building skins (i.e., the building envelope). High-performance buildings are highly dependent on envelope performance yet in BC, there is no specialist engineer who signs off on overall building envelope performance factors such as structure, moisture, thermal, daylight, etc. (in Europe, this specialist is known as a façade engineer).

In addition, there is a shortage of workers with skills specific to energy efficiency retrofits (most focus on new buildings). As such, qualified and skilled contractors in the area of weatherization, air sealing, and draft proofing are in demand.

The new BC LiveSmart “Qualified Installer” grant for heating systems was developed as an attempt to improve the accreditation of heating system contractors. The provincial government is also hoping to do the same for weatherization contractors but at the moment, there is no widely accepted accreditation for this area of expertise in BC. The provincial government has been working with the Building Performance Institute in Bellingham, Washington, that is looking to offer its training programs in BC in order to create local weatherization capacity.

In terms of building operations and management, there is a gap in knowledge with respect to the ability of the average building manager or operator to work with and maintain high-performance, computerized building systems. This is particularly a problem as buildings end up running inefficiently, often on backup systems that are not designed for regular use, consuming higher amounts of energy and resources and adding costs to owners and/or tenants.

Additional expertise is also required for commissioning agents with respect to the proper calibration of new and energy-efficient equipment and lighting technologies in buildings.

Research Related

A gap currently exists in terms of research in-line with the Green Building and Energy Efficiency sector in the province. There is a need to develop skills for conducting basic research as they relate to architecture and engineering – skills which can be transferred from other sectors.

A second critical area of needed research is in the assessment of building performance. There is often a wide divergence between how a building actually performs with respect to energy efficiency compared to the theoretical measures identified. Part of the challenge is tied to systems for the collection and management of data for measuring building performance relative to predicted results. Developing additional skill sets in this area would be highly beneficial to industry.

Gaps in Education and Training**Architecture, Design, and Engineering**

To help graduates meet the deep knowledge needs of industry, it was suggested that more graduates with full Bachelors and/or Masters level degrees, rather than diplomas, in architecture and interior design are needed. There is also a need to re-orient the focus of much of the architectural and engineering training in order to develop an appreciation of the full life cycle analysis of projects by focusing concepts such as “design-for-environment” and regenerative design.

Across Canada, the CaGBC works with a number of colleges and universities to incorporate LEED training into the student curriculum. Despite the growth in LEED projects in the British Columbia, this has not yet happened in this province.

Construction and Trades

There is still much room for integrating sustainability into all construction trades, including more comprehensive training on best practices such as Integrated Project Delivery models, on-site waste management and recycling, quality control, and the application of advanced technologies and software tools such as BIM. Apprenticeship and Red Seal training teaches basic skills but need to focus on more holistic green building systems, which requires further training – particularly in the areas of building envelope, mechanical, and electrical engineering.

Building technologies have changed significantly over the last decade and the large number of recent building code updates and additional changes coming down the pipeline over the next 12 to 18 months will require ongoing updates to course content for specific trades, as well as for project management programs.

As builders in BC become more experienced working with wood, programs will need to diversify beyond wood framing as graduates will need to understand how to work with other wood-based materials and will need expertise with respect to product integration. Different tools and layout concepts will be essential when working with wood beams and larger sectional materials and accuracy and attention to detail will be critical as mistakes will result in higher costs to industry due to materials being more expensive.

More on-the-job training was highlighted by industry respondents as being essential, including opportunities for students to train on building sites and demonstration projects. In addition, technical colleges and trades-training institutions will need to play a larger role in training graduates with deconstruction skills. There is an opportunity for post-secondary institutions to work with industry

and construction trade associations to provide the necessary certification and training with respect to deconstruction.

While some property management companies require a minimum of a Class 5 Power Engineering certification, this program falls short in terms of training for control systems, which is the key to energy management in newer high-performance buildings. BOMA's Building Operator program, BOMI's SMA and SMT designations, Douglas College's BES and BERM programs, and BCIT's SEMAC and Industrial Instrumentation and Controls Technician programs do offer relevant expertise but none give the comprehensive training that is needed for the modern day building operator. Developing a program that provides courses in building control systems, HVAC, and building envelope, combined training for other building maintenance duties such as rooftop landscaping, security systems, and strata law, could form the basis for an important new "building operator" specialty program.

The green building industry is evolving quickly with respect to codes, techniques, and products, yet there is no formal system for ongoing professional development. There is a need for more programs with respect to continued education and ongoing learning, designed to target industry at all the various career stages. This includes technical training programs for existing property managers, caretakers, and building operators that would allow them to upgrade their skills with respect to high-performance buildings and operating systems.

Product and Technology Design and Development

Some respondents stated too many training curriculums were geared around memorization and short-term skill development. Instead, they suggested, such programs should focus more on creative problem solving skills in order to promote "outside-of-the-box" type thinking. Working on real-world projects as part of a program that combines both theoretical building sciences with shop time was suggested by industry as very beneficial.

Additional Areas for Education and Training

The evolution of the green building sector is also demanding new training for people in allied service sector areas such as GHG emissions accountants, information and communication technology (ICT), energy auditors and specialists, legal and financial experts, contract writers, and procurement specialists. Currently, there is a gap with respect to the capabilities of individuals who can develop and present the business case for sustainability in the Green Building and Energy Efficiency sector. Graduates with a greater understanding of cash flow calculations and innovative financing models and mechanisms could help advance the opportunities further and faster.

» There is a need for more programs with respect to continued education and ongoing learning, designed to target industry at all the various career stages.



6. BARRIERS AND ENABLERS FOR SECTOR GROWTH

Many issues affecting job growth were identified by business leaders active in the Green Building and Energy Efficiency sector. This section also highlights the enablers that could possibly guide efforts to mitigate the challenges facing the sector or to put in place measures that would promote job growth.

Barriers and enablers are grouped into four broad areas: Policy, Economic, Societal, and Technological. Understandably there are overlapping issues involved in many of the barriers and enablers cited. Efforts have been made to minimize these overlaps as much as possible.

BARRIERS

Limitations to Building Codes, Targets, and Standards

- Existing building codes are a barrier to innovation in the construction sector. There is a current disconnect between policy-maker goals and actual practice in terms of facilitating green building and the adoption of energy-efficient technology.
- Indirectly, carbon neutral targets and performance-based energy efficiency regulations can result in increased electricity loads. Often, projects tend to comply with energy efficiency regulations through the installation of technologies that can actually increase energy demand, rather than targeting the reduction of building loads in the first instance. As an example, moving from gas-fired boilers to heat pumps can increase efficiency in some cases but in others it can actually increase energy demand because of the additional cooling function of heat pumps.
- The lack of harmonized codes, standards, and protocols creates challenges for industry which can result in increased legal risks.

Public Procurement Process for Building Projects

- The current approach to the construction of publicly-funded projects, such as the standard RFP process for design / bid / build or design / build projects, can be a barrier to innovation and efficient project delivery. Issues with the current delivery models include wasted effort producing design details that do not get built; redundancy in the effort needed to select a product or system for a building (at both the design and construction stages); inflated design changes during construction; lack of coordination of construction efforts leading to added costs, material destruction, and waste; and a focus on cost / schedule rather than life-cycle value.

ENABLERS

Supportive Public Policy, Building Codes, and Regulation

- BC needs to move forward with its carbon compliance regime and emission regulations and to establish BC-specific energy factors and GHG coefficients that can be used to calculate building energy and carbon performance. Municipal policies which encourage green building practices (e.g., Bill 27) and the provincial government requiring communities to do energy planning and set targets have been major drivers for advancing the sector as a whole in BC.
- The continued advancement of the provincial building code, coupled with the enforcement of mandatory energy efficiency performance for new buildings (including promotion of “net-zero energy ready” buildings and communities) would serve as powerful incentives for change in the sector. Regulations which encourage sub-metering in MURBs, building labeling systems, and building energy audits could further support energy efficiency efforts.
- The development of standards, protocols, best practices, and supporting facilities that encourage recycling and waste diversion for construction and building materials would help move the province closer to a “zero waste” goal. This could include exploring minimum recycled product content regulations for construction / building materials.

Government Leadership

- Government leadership at all levels to commit to building to performance-based standards that ensure energy-efficiency for all public buildings would greatly reduce latent levels of uncertainty in the sector.
- Government can play a role in ensuring that the design and construction industries are aware of best practices for ensuring energy efficiency when building code changes are brought in and targets are set. Education key stakeholders on the importance of reducing electricity loads before adopting new technologies and ensuring the efficient design of building facades are two examples.
- Additional research on building materials, technologies, and methodologies and related products for green building applications would also help to raise levels of awareness in the sector and could facilitate the use of local materials and certified green building products – e.g., windows, doors, and energy-saving technologies.
- With respect to publicly-funded projects, government could support innovation and increase the efficiency of project delivery in this sector by working with design, construction, and contract / legal professionals, as well as other industry stakeholders to advance alternative project delivery models. As an example, the American Institute of Architects (AIA) has made great strides in the United States advancing the Integrated Project Delivery model which has benefited the industry as a whole in that country.

BARRIERS

Additional Capital Costs

- The valuation process as it exist presently for new and retrofitted buildings does not support the wider use of energy-efficient design and technologies. Green buildings may cost up to 7% more than conventionally built units and consumers with “cheap versus quality” mentality lead developers to find loopholes to get around sustainability improvements that cost them money since they are not able to recoup the upfront costs of a more energy-efficient property in the future.
- The potentially higher upfront capital costs for building green often act as a barrier. The Public-Private Partnership (P3) project model for example, a process that favours low-cost solutions, often does not recognize operational savings and payback and therefore does not encourage the integration of advanced sustainable design features which tend to have higher upfront costs. In addition, the challenges that face large commercial building owners who are interested in conducting “whole building” energy analysis and/or retrofit feasibility studies can make them non-starters.

Lack of Effective Financing Models and Incentives

- Incentives and rebate programs for energy-saving retrofits of homes and commercial establishments (e.g., provincial sales tax rebate for ENERGY STAR products, LiveSmart rebates, and ecoENERGY rebates) have been sporadic and inconsistent, resulting in disincentives for trained professionals involved in renovating or upgrading the existing built environment.
- Relatively low energy costs are a disincentive to retrofitting buildings or constructing new more energy-efficient or net-zero energy buildings. Businesses want a faster return on their investments and are thus less interested in retrofits versus alternative investments such as purchasing new buildings.
- From a technology perspective, the cost for research and development is often taken on by companies and passed on to consumers which raises the final price for energy-efficient products. As well, current technologies are not yet sufficiently widespread to make economic sense to builders. In addition, while there are many lenders (i.e., banks) and government grants available to property owners to finance technology adoption, there is a shortage of risk financing available for new and/or unproven technologies.

Split Incentives and Leasing Structure Challenges

- Split incentives between developers and tenants are a barrier to energy efficiency. Developers often do not benefit from energy savings from the application of green building design and energy-efficient technologies. At the same time, future buyers may not be aware of the benefits of an energy-efficient building though its life cycle cost.
- Leasing structures may not allow building owners to pass their capital investments on to tenants, which acts as a disincentive given the potentially higher upfront costs involved. As such, measures that have payback periods that are longer than 10 years can be difficult to justify for commercial customers that do not want the added investment risk. Sub-metering is also cost-prohibitive at the present time which adds further to the challenges.
- Leasing regulations do not allow building owners / operators to pass on the costs of their capital investments or major equipment improvements to tenants, which acts as a disincentive given the potentially higher upfront costs involved.
- Specifically for MURBs, developers at the moment tend to focus on the components they identify as valued by potential tenants / buyers, such as high glazing percentages, granite counter tops, etc. Since currently there is no effective method for validating the energy performance of a building for the end user, energy conservation measures or designs tend to have a lower priority for MURBs or other types of projects with potential split incentives.
- It can be cost-prohibitive for property owners / managers and/or strata councils of small and medium-sized buildings (e.g., less than 200 tenants) to hire qualified and experienced operators for their high-performance buildings. This in turn can result in inefficient building operations and expensive servicing for equipment when it malfunctions. In addition, proprietary building automation systems can create a financial challenge for many building owners, managers, and strata councils with respect to the maintenance and servicing of their high-performance buildings.

Longer Timelines and Added Costs in Deconstruction

- The longer time required to deconstruct a property versus outright demolishing it is a barrier due to the added costs. At the moment, the business model is not financially viable, particularly because of the lack of market demand for recycled materials.

ENABLERS

Develop Effective Incentives

- Incentives with the highest rate-of-return for improving the business case for green building, as well as to advance the adoption and integration of energy-efficient products, could significantly accelerate high-performance building construction, renovations, and related investments. These incentives could include tax credits (e.g., property taxes, renovation tax credits, tax breaks for companies manufacturing energy-efficient products, etc.) and incentives structured as investments with measured pay backs. It is also important that incentives align with activities that property developers and owners perceive as being most attractive.
- Assistance with orchestrating and providing incentives to help with the consulting fees for property / building owners with respect to “whole building” energy analysis and/or feasibility studies for energy efficiency retrofits and upgrades could help spur on owners in this sector (as it has done with homeowners).
- Incentives could also be developed to help overcome barriers to hiring building operators for property owners / managers and/or strata councils. The provincial government for example could fund energy providers or a program managed by an organization such as the Condominium and Home Owners Association (CHOA) to meet with strata councils in order to explain the cost savings of having trained on-site maintenance staff.
- With respect to promoting construction waste recycling and deconstruction activities, diversion rates could be much higher with properly structured incentives and the facilities and infrastructure in place. As an example, Alberta requires a deposit for issuing demolition permits and a higher percentage of the deposit is returned depending on the amount of the building that is recycled.

Develop Innovative Financing Models and Cost-Effective Solutions

- New financing strategies and models are the key to accelerating building retrofits, energy efficiency upgrades, and related deconstruction activities. These could include capital leases, on-bill utility financing, and green bonds. A range of tools would be most beneficial through a streamlined application process wherever possible.
- Innovative approaches such as Vancity’s current evaluation of measuring carbon offsets associated with innovative green projects and incrementally discounting the value of these to the present for evaluating loans is one example of what can be done on a practical level to develop new financing models. In the United Kingdom, the innovative “Green Deal” financing mechanism could provide insights on effective on-bill financing models.³⁴
- During the design and implementation stages for high-performance buildings, the installation of open source building automation systems could be required, or at least more than one control company should be allowed access to all of the proprietary software and hardware in order to bring down maintenance and servicing costs for owners and strata. Open systems also create the opportunity for more jobs in this space.

BARRIERS

Lack of Knowledge for the Opportunities, Benefits, and Risks

- Consumers are not being properly informed on the value-added benefits of a green building or home, and developers who are unable to recoup the added costs of building green tend not to incorporate sustainability into their properties. Green building is driven by the client who needs to understand and appreciate the impacts of green building solutions on budget and schedule. In addition, because trade employers often do not appreciate the value of green building and they face downward pressure to cut costs, they are not prepared to hire skilled workers with advanced qualifications.
- The lack of an industry-wide definition of “green built” projects is a disincentive for building owners / operators in terms of best practices for building systems and the use of new technologies. There is often a disconnect between design and occupancy with tenants who do not understand the complexity of advanced energy-efficient systems and technologies.
- The growth of the green building sector in BC comes with new risks and potential liabilities, and the onus of risk and responsibility is shifting. A key barrier to green building is the structure of contracts, the allocation of risk, and the role of professional indemnity insurers. At this time, there is no-one on the design / construction team taking responsibility for environmental performance. In addition, the use of third-party rating systems for green building projects adds layers of complexity that builders are reluctant to take on due to the scope of liability exposure.³⁵
- There is a current lack of governance and regulation over the scope, standard of service, and overall control of new specialist services entering the market, such as commissioning agents, green roof installers, rammed earth experts, geo-exchange installers. This can lead to added risks and liabilities for the industry as a whole.

Complexity of Issues and Funding Application Process

- Existing green building and energy efficiency rating programs and standards can be difficult for consumers to understand. In addition, it can be a challenge for a typical bundling and MURB owner to understand references to building codes or building labeling systems to compare a building from an energy performance stand point.
- The wide array of rebate programs and incentives can be complicated for those looking to access financing. Knowledge of how to get started with the retrofit assessment process can be particularly challenging – especially for smaller property owners and management companies.

Fragmented Industry

- Despite a more integrated design process and an increasing use of more energy-efficient technologies, the building industry from design to operation remains highly fragmented. The developer's lack of ongoing involvement in a building once it is complete is another disincentive for innovation, particularly in the residential sector.
- The financing and procurement process for green building needs new measures and metrics in order to better manage accountability. At the moment, sustainability factors are not valued in quantifiable terms in the construction industry and green building qualifications and skill sets are not specified in specification documents or procurement contracts (in contrast to European standards).
- From an education perspective, the fragmented system is a problem for the modern day needs of engineers and other professionals who must have well-rounded capabilities in technology, building codes and regulations, and the various engineering disciplines, as well as skills in project management, communications, and contract law.

Lack of Skilled Professionals with Green Building Expertise

- There is a need to recognize the opportunity for re-organizing trade training in light of the aging workforce and looming labour crunch. The lack of skilled labour for detailed retrofit work and for accurate and quality installation and maintenance of heating systems, building envelopes, and other energy-efficient technologies has negative consequences for the industry as a whole. In addition, the absence of a formal process for continuous professional development within the construction trades is a major impediment for the sector.
- With respect to building operations, a lack of experienced and qualified building managers who are able to maintain and service high-performance buildings and related technologies, such as mechanical HVAC and fluid systems, controls, pumps, and valves, results in the inefficient operation of buildings from an energy perspective.

ENABLERS

Increase Education and Outreach

- Encouraging consumer awareness through energy benchmarking, performance standards, auditing, and labeling programs for buildings are as important as economic incentives, creative financing mechanisms, and innovative partnership models in advancing the sector. An effective building labeling system can provide a way for building owners to assess and validate a building's energy performance. An example of a benchmarking tool is the Canada Green Building Council's "Green Up" pilot program, which allows owners to measure the performance of their buildings against one another with an online tool.³⁶ In addition, the US EPA "Portfolio Manager" program has been successful in the United States in terms of providing an interactive energy management and benchmarking tool which could be applied in British Columbia.³⁷

- Better public education on green building benefits and the use of awards, public recognition, and bursaries that support innovation and the commercialization of new energy-efficient products could greatly assist in changing public perceptions about green building. Procurement and tendering processes must also be modified to reflect the need for green trade skills. Leveraging support from industry organizations can also play a large role in this regard.
- With respect to risk and liability, there is a need for government and industry stakeholders to work together to raise awareness for the issues, as well as with legal professionals and insurance providers. Increasing education for construction managers, professional consultants, specification writers, and all those involved in the preparation of construction contract documents is essential. A review of standard forms of contract to enable a better description of the environmental performance criteria of a building project is important and the preparation of model language to be included into construction documents and contracts in collaboration with industry, government, legal, and insurance experts could assist in this respect.

Improve Opportunities for Education and Training

- The need for a complete training sequence and new pathways from basic skills to advanced skill sets in the sector are crucial. Programs need to be more comprehensive in nature, beyond basic skill sets to include more holistic building and design concepts. It is important that students from different disciplines work together to undertake collective, problem-solving tasks that involve project-based learning. There is also greater room to incorporate sustainability principles and education into apprenticeship curriculums and retraining programs offered in the province.
- Programs and tools (e.g., online web-portals) that provide continuing education for skilled trades within the realities of the construction process, including industry trends and best practices, are needed to help workers who cannot go back to school or for those newly immigrating to BC. Trades and construction industry associations also have a large role to play and can be providing the necessary training to upgrade the skill levels of their members.
- Government and industry can engage with the engineering education establishments (e.g., UBC, SFU, BCIT, etc.) and relevant professional associations (e.g., APEG-BC, etc.) in order to advance specializations in key occupations such as building envelope, environmental systems, and facade engineering in order to address gaps and risks.
- Developing a compact but comprehensive training program for building managers / building operations supervisors with respect to high-performance buildings could help overcome issues with respect to new, advanced technologies and building systems. Developing an accredited “green building operator” program that introduces building sciences and covers basic physical, mechanical, and electrical issues for the maintenance of high-performance buildings could provide a needed supply of qualified and affordable property managers.

BARRIERS

Continued Use of Energy Inefficient Technologies

- The continued production and sale of low-cost, energy inefficient products and technologies presents a significant challenge to consumers looking to save costs from energy use.

Issues Surrounding Technology Risk and Liability

- New green building technology needs to be proven before it can be applied and the risks surrounding this often act as a barrier to its adoption.

Lack of Focus on Actual Building Performance

- The current emphasis on theoretical building performance in design instead of on actual building performance in practice is an impediment to energy efficiency efforts in this sector. While green rating systems for new construction do require submission of building performance data one year out, the information is nominal.

ENABLERS

Establishing Appliance and Equipment Efficiency Standards

- Appliance and equipment efficiency standards are one of the most effective ways of reducing energy use. Appliance efficiency standards reduce the market cost of energy efficiency improvements by incorporating technological advances into base appliance models, creating economies of scale and facilitating lower consumer energy costs and spurring efficient technology innovation.
- Establishing minimum appliance and efficiency standards for technologies such as televisions and set-top boxes, lighting, and other common household electronics can generate local economic growth by putting money back into consumers' pockets. Appliance and equipment efficiency standards can be implemented at the provincial level for appliances not covered by federal standards, or where higher-than federal standard efficiency requirements are appropriate due to regional achievement of market transformation from voluntary measures and utilities' demand-side management programs.

Government Support for Technology and Demonstration Projects

- Government could provide leadership and support to assist project teams understand and consolidate data related to Integrated Project Delivery and technologies such as BIM so that it is useful over the complete life cycle of a building.
- Demonstration projects were repeatedly highlighted as an essential enabler for showcasing new technologies and for acting as an educational and training tool. As an example, the 2010 Winter Olympic Games held in Vancouver and Whistler were used successfully as a showcase for local wood design construction. Similar projects that demonstrate other technologies for green building design and performance would help to advance the opportunities.

7. CONCLUSIONS

Becoming a world leader in green building and energy efficiency requires strong leadership, a clear vision, and a well-articulated plan. British Columbia has already demonstrated this type of leadership, having implemented progressive environmental and technological innovation policies, programs, building codes, and standards that serve as an example for other jurisdictions across North America and around the world.

The Green Building and Energy Efficiency sector profiled in the foregoing sections is already a significant generator of well-paying jobs in British Columbia, employing an estimated 76,450 full-time equivalent workers (46,290 direct and 30,160 indirect) in 2011 in a variety of occupations. This sector is also estimated to have generated some \$8.4 billion in GDP (\$5.5 billion direct and \$2.9 billion indirect) last year.

This latest research by GLOBE Advisors confirms that a solid basis exists that will allow British Columbia to maintain its position as a leader in Green Building and Energy Efficiency and realize the full economic and employment benefits. However, work must continue to maintain this position through consistent, clear, and strategic action that encourages investment and market-driven growth.

Based on the foregoing commentary, the following conclusions are put forward to help accelerate investment and employment growth in British Columbia's Green Building and Energy Efficiency sector.

- 1. Clear, stable, and supportive policy frameworks** – Having clear, stable, and supportive policy frameworks (including incentives, regulations, standards, and building codes) that encourage private sector investment, address barriers, and foster competitive market-based platforms for green building-related goods and services are crucial to the creation of more jobs and the deployment of innovative energy-efficient technologies across the province.
- 2. Support for market-based financing models** – While government financial support and related incentives are important for reducing technology risk and accelerating market adoption of green building products and technologies, innovative market-based mechanisms and financing models must be allowed to work their way into the functioning of the clean economy. Market-based mechanisms are able to work faster than public policy to accelerate economic growth.
- 3. Increase partnerships and collaboration** – Collaboration between governments and industry stakeholders can help identify and exploit synergies to grow the green building and energy efficiency sector. The research conducted for this project has revealed numerous instances where collaboration and strategic partnerships have resulted in industry success. The design of an “innovation” strategy for the building sector would help BC business seeking export opportunities as well as foreign investors interested in establishing themselves in the province.
- 4. Improve public education and outreach** – More targeted public education programs are needed to build awareness and trust for the benefits of adopting green building practices and energy-efficient technologies. These could be tied to building awareness for the cost-saving and environmental benefits, as well as to reducing real and perceived risks to technology adoption.
- 5. Focus on increasing productivity** – Increasing productivity is critical for realizing the opportunities in the Green Building and Energy Efficiency sector. This will require investment in technology innovation and workforce development. Investing more in education, training, and skills-based learning by developing and implementing a human resource strategy and action plan focused on green building workforce gaps and challenges will also be critical for boosting productivity levels.
- 6. Facilitate knowledge transfer** – Promoting knowledge transfer across the sector is critical to accelerating its market penetration. More cross-training and systems-based approaches to problem solving are required. Demonstration projects are also important, not only as a means for proving new technologies and solutions to potential buyers, but also as tools for education and skill development.

APPENDIX A: TECHNICAL NOTE

Estimates of employment and economic activity (measured as contributions to gross domestic product) in British Columbia's Green Building and Energy Efficiency sector were developed through a series of steps that included:

- Identifying relevant industries important for the sector and related NAICS codes;
- Developing intensity ratios that consider the amount of clean economy activity within each industry; and
- Estimating current employment and GDP based on Industry Canada and Statistics Canada data and economic models.

The process that was applied is described in more detail below.

IDENTIFYING INDUSTRY NAICS CODES

A list of North American Industry Classification System (NAICS) codes at the six-digit level that best describe the activities within the Green Building and Energy Efficiency sector was developed and the codes were examined in detail. This list represents considerable research and dialogue over the past three years by GLOBE Advisors. The list of NAICS codes was also aligned with the US Bureau of Labor Statistics (US BLS) list of six-digit industry NAICS codes that are used to classify clean economy goods and services in the United States.³⁸

The identified NAICS codes were verified by cross-checking the primary NAICS codes of identified companies in the Green Building and Energy Efficiency sector using both the Hoover's Company database for British Columbia and Industry Canada's Canadian Company Capabilities database to ensure they aligned with the sectors which they were assigned to as part of this study.

DEVELOPING INTENSITY RATIOS

Previous work conducted by GLOBE Advisors in BC and elsewhere in North America, combined with information obtained through industry research, key informant interviews, and through recent work by the US BLS to identify intensity ratios within green industries in the United States as part of their Green Goods and Services survey³⁹, resulted in a hybrid methodological approach to calculating industry intensity ratios for BC's Green Building and Energy Efficiency sector.

In order to estimate the volume of "clean economy activity" within the sector in BC, the proportion of clean economy-related activity within each industry was estimated. These intensity ratios were calculated by comparing the revenue associated to clean economy-related activity to total industry revenues wherever possible.

In the case of certain industries where clean economy-related revenues were not available, estimates were generated based on research such as the market penetration of residential, commercial, and institutional real estate properties that were certified under a green building standard or rating system in 2011.

ESTIMATING CURRENT EMPLOYMENT AND GDP

Total direct employment for each six-digit industry NAICS code were estimated based on Industry Canada's Canadian Business Patterns publication (Catalogue 61F0040XCB). The data published in Canadian Business Patterns represents the current number of locations or establishments for a specific reference period, which is taken from the Statistics Canada Business Register Database.

In terms of indirect employment and direct and indirect gross domestic product (GDP) impacts for the Green Building and Energy Efficiency sector, estimates were based on industry multipliers published by Statistics Canada, derived from the British Columbia Input-Output (I-O) model (Catalogue number 15F0046XDB).

An I-O model is a way of understanding and estimating how economic changes in one industry can affect other industries. For example, changes in ethanol sales will have immediate (direct) effects on the blended retail gasoline industry, but also less immediate (indirect) effects on the agriculture industry, the transportation industry, and on any other industries which provide inputs to the production of ethanol.

Input-Output tables cover all economic activities conducted in the market economies of each province and territory, encompassing

persons, businesses, government, and non-government organizations (NGOs), and entities outside its jurisdiction that give rise to imports or exports (inter-provincially or internationally).

The I-O tables represent the most detailed accounting of the Canadian economy available and thus serve as benchmarks to the Canadian System of National Accounts. These tables are the most comprehensive and detailed statistics on transactions involving production activity, as well as intermediate and final consumption of goods and services in the economy.

The simplest application of the I-O model is to estimate the economic impacts of a change in the final demand for some commodity produced by the economy. For example, suppose that there is an increase in exports of solar panels. Each of the industries that make these panels will increase production accordingly. To do this, they will each purchase more of the inputs they require. Industries which make those inputs will increase production accordingly. To do so they will need to buy more of their inputs, and so on. The model does all of these calculations simultaneously and provides estimates of the increased outputs for each industry affected by the change. In addition, it is able to provide estimates of the changes in GDP, employment, and taxes paid for each affected industry.

For the more detailed methodology – including a list of the NAICS codes and intensity ratios, as well as the direct and indirect full-time equivalent jobs and GDP for the Green Building and Energy Efficiency sector – contact GLOBE Advisors by email at info@globeadvisors.ca.



APPENDIX B: PUBLIC POLICY, PROGRAMS, AND FINANCIAL DRIVERS

Governments at all levels (federal, provincial, and municipal) in BC have pursued a number of key policies and programs that have helped to drive growth in the Green Building and Energy Efficiency sector over the last decade. Below is a select number of important policy, program, and financial drivers identified by industry as important for growth of this sector.

NOTE THAT POLICY AND PROGRAM TITLES ARE HYPERLINKED TO MORE INFORMATION.

OVERARCHING PUBLIC POLICIES

[Bill 44 – BC Greenhouse Gas Reduction Targets Act \(2007\)](#)

The *BC GHG Reduction Targets Act* committed that BC reduce greenhouse gas (GHG) pollution in line with internationally agreed-to targets (33 per cent by 2020 and 80 per cent by 2050).

[Carbon Neutral Public Sector](#)

The *BC GHG Reduction Targets Act* committed the province's public sector to carbon neutrality by 2010. BC became the first jurisdiction to make such commitments with aims to act as a leader to reduce GHG emissions and carbon pollution, and achieving energy savings while providing accurate measurements. Public sector organizations that fail to reduce to these levels are required to purchase carbon offsets from the Pacific Carbon Trust.

[BC Carbon Tax \(2008\)](#)

In 2008, BC was the first province to implement a carbon tax on fuels such as gasoline, diesel, natural gas, heating fuel, and propane. This tax is designed to be revenue-neutral where the tax revenue is legally required to be transferred back to the taxpayer as a reduction. This tax aims to reduce the amount of greenhouse gas emissions while helping to reduce the switching costs for cleaner alternative fuels.

Since the carbon tax took effect in 2008, British Columbians' use of petroleum fuels (subject to the tax) has dropped by 15.1% - and by 16.4% compared to the rest of Canada. BC's GHG emissions have shown a similarly substantial decline. BC's GDP growth has outpaced the rest of Canada's (by a small amount) since the carbon tax came into effect – suggesting that it has not adversely affected the province's economy, as some had predicted.

To date, the carbon tax has returned far more in tax cuts (by over \$400 million) than it has received in carbon tax revenue – resulting in a net benefit for taxpayers. BC's personal and corporate income tax rates are now the lowest in Canada, due to the carbon tax shift. The carbon tax is currently under review by the provincial government.

BC Climate Action Charter

Out of 188 municipalities, 180 have signed the Climate Action Charter. The charter commits these progressive municipalities to measuring and reporting their community's GHG emissions. At the same time, they will commit to achieving carbon neutrality by 2012. As a result of this initiative, many communities are investigating clean energy solutions to help them reduce their GHG emissions and meet their own community energy needs.

Bill 17 – BC Clean Energy Act (2010)

The *Clean Energy Act* builds upon the strong commitment in the Energy Plan for clean energy development and deployment across the province. The Act advances 16 specific energy objectives with three identified priority areas including:

- Ensuring electricity self-sufficiency at low rates;
- Harnessing BC's clean power potential to create jobs in every region; and
- Strengthening environmental stewardship and reducing greenhouse gas emissions.

The *Clean Energy Act* also sets a legislated target of displacing 66% of incremental electricity demand in the province through conservation by 2020, which is a leading driver of BC Hydro's Power Smart Program.

SECTOR-SPECIFIC PUBLIC POLICIES

BC Green Building Code

At the provincial level, greening the building code is an ongoing initiative. The current focus is on reducing energy and water use by:

- Making homes solar hot water ready (where practical);
- Requiring high-efficiency toilets (including dual-flush) and urinals in new construction;
- Requiring increased use of non-potable water for toilet flushing and sub-surface irrigation in 2011; and
- Improving the energy performance of both small-scale housing and larger, more complex residential, industrial, commercial and institutional buildings.

Bill 32 – The Energy and Water Efficiency Act (2012)

The *Energy and Water Efficiency Act* was introduced in March 2012 to help reduce consumers' energy bills and lower operating costs for BC businesses. The legislation replaces the *Energy Efficiency Act* and provides improved standards, streamlined enforcement of regulations, and better energy performance for industrial energy users through benchmarking standards.

Bill 9 – Wood First Act (2009)

As part of the BC government's wood-first initiative, the *Wood First Act* requires all publicly-funded buildings to consider wood as the primary building material. With average annual budgeted capital spending of \$3 billion, this Act not only helps stimulate higher demand for BC wood products, but also promoting climate-friendly construction. As a result of this Act, many BC municipalities have created new resolutions or policies that have endorsed the wood-first initiative. The Wood Enterprise Coalition provides support to various government ministries and communities to promote wood buildings.

Bill 27 – Local Government (Green Communities) Statutes Amendment Act (2008)

Bill 27 provides local governments with some additional powers to make changes in their communities, yet gives them the flexibility they require to adapt operations in ways that meet their unique needs and circumstances. One of the key amendments focuses on local governments setting targets to reduce GHG emissions within their communities, as well as developing policies and actions to achieve those targets in their Official Community Plans and in Regional Growth Strategies for those regional districts where this is applicable.

Energy-efficient Buildings Strategy

The Energy-efficient Building Strategy is a tool aimed to help the province reach its goal of electricity self-sufficiency by 2016 and reducing GHG emissions by 33% in 2020. This program provides practical solutions through five action areas including:

- The Livesmart BC program with a \$60- million program that provides a single reference point for federal, provincial and utility incentives.
- Greening of the BC Building code and installation of smart meters for better monitoring and measurement of energy consumption.
- Increasing the efficiency of institutional and commercial properties and promoting new labeling and certification standards.
- Pursuing the *Public Sector Energy Conservation Agreement* with BC Hydro to become the largest Power Smart partner, which will see a \$25 million fund that will retrofit existing buildings over three years.

Public Sector Energy Conservation Agreement (PSECA)

The *Public Sector Energy Conservation Agreement (PSECA)* committed \$75 million over three years to help public sector organizations reduce provincial GHG emissions, energy consumption, and operating costs, as well as support government in achieving its goal of carbon neutrality. PSECA has funded Provincial Ministries and Agencies, Boards of Education, Universities and Colleges, Health Authorities, and Crown Corporations. Over three years to the end of 2010, PSECA supported 247 projects, created an estimated 500 jobs, saved taxpayers \$12.6 million annually and reduced GHG emissions by 35,600 tonnes. Capital funding was not provided for the PSECA program in fiscal year 2011/12.

Municipal Building Codes, By-Laws and Zoning

The City of Vancouver's building code and by-laws for municipalities across the province have taken the lead in pushing for stringent reforms in the way properties and buildings can be developed and how zoning and rezoning permits are issued. For example, the City of Vancouver now requires dedicated circuitry for electric vehicle charging stations in single- and multi-family homes. The City of North Vancouver has a district heating by-law and a new requirement for solar-thermal ready plumbing to be in place for all new developments.

INCENTIVE-BASED FUNDING PROGRAMS

NRCan ecoENERGY Programs

This federal program run by Natural Resources Canada (NRCan) is aimed to reduce energy use and consumption in the country. The program provides incentives for Canadians wishing to retrofit their home and commercial properties and become more energy-efficient. Over five years, the federal government is investing over \$195 million to help improve energy use in Canada. The program also is pushing forward new labelling standards to help consumers better understand their options when making new purchases. However, due to new budget commitments of the Canada Economic Action Plan, some ecoENERGY programs have ended as of March 31, 2011.

CMHC Mortgage Insurance Rebate

A 10% CMHC mortgage loan insurance premium refund, and a premium refund for a longer amortization period (if applicable), may be available for homeowners when using CMHC insured financing to purchase an energy-efficient home or when making energy-saving renovations.

BC LiveSmart Programs

The BC government's hugely successful LiveSmart program conducts a wide range of public education and outreach activities and provides incentives for consumers wishing pursue energy-efficient upgrades. These rebates and incentives encourage property owners to pursue retrofits and other energy-efficient upgrades. The program also provides a wide selection of case studies and tools for British Columbians to use as references for their own projects.

Efficiency Incentive Program

The successful "Efficiency Incentive" program continues to stimulate job growth by providing \$30 million for upgrades to homes over 2 years, with a further \$11.7 million available from the provincial utilities. The province launched a \$15 million 3-year program in January 2011 to support small businesses through energy efficiency advisors, enhanced product incentives, equipment installation, and funding for innovative energy solutions.

The BC LiveSmart Efficiency Incentive program, in partnership with BC Hydro and FortisBC, will invest \$85 million over 5 years (2008-2013) to help families in BC lower their energy bills by subsidizing customized energy efficiency assessments of homes and providing up to \$7,000 in rebates for energy saving improvements and equipment. By the end of November 2011, more than 82,000 participants had benefited from the program and over 43,000 receiving a rebate. An additional 27,500 families are expected to benefit until the period end date of March 31, 2013.

It is estimated that the program has already stimulated between an estimated \$468 million to \$520 million in economic activity and the creation of 4,600 to 7,800 jobs. The LiveSmart BC program has stimulated a rapid increase in training and employment for Residential Certified Energy Advisors, whose numbers in BC rose from 30 at the launch of the program to more than 130 today. Manufacturers, distributors, contractors, and trades people who sell and install energy-efficient products have also benefited from the program's incentives and subsidies.

Recent changes to the program and new incentives put more emphasis on building envelope upgrades including insulation, windows and doors, air sealing, and heating equipment and encourage homeowners to use certified installers, improving the quality and value of the work done.

Small Business Program

In July 2010, LiveSmart BC launched a "Small Business" program to help small businesses across BC reduce their energy consumption and access energy-efficient products at reduced costs to lower their energy bills. The Small Business program works in partnership with six Chambers of Commerce across BC, four Industry Associations from different small business sectors, two non-profit organizations, BC energy utilities including Fortis BC (electric), Fortis BC (gas) and BC Hydro, and the City of Vancouver.

In the first year of the three-year program, the LiveSmart BC: Small Business Program has helped businesses across the Province save an estimated \$6 million in electricity costs per year. The Program has achieved its three-year target of reaching 4,800 small businesses through direct installations, incentive payments and free energy walk-through assessments by Business Energy Advisors in its first year.

The program has also exceeded targets for participation in its utility partner programs. BC Hydro's Product Incentive Program (PIP) has served 285% of the target number of customers for the first year. FortisBC's Lighting Installation Program (FLIP) has served more than 1,300 businesses and saved some 8.8 million kWh by May 2012. The program has resulted in the direct creation of 95 jobs in British Columbia: 16 full-time Business Energy Advisors, three full-time LiveSmart Staff, and 46 full-time plus 30 part time staff employed by the FLIP program.

BC Pay-As-You-Save Program

In British Columbia, groundbreaking 2010 legislation under the *Clean Energy Act* has allowed for "improvement financing", often referred to as pay-as-you-save or utility on-bill financing. This legislation enables utilities to introduce financing that is transferable between building owners and renters. The PAYS financing model enables homeowners to invest in energy efficiency or renewable energy retrofits with no upfront payment, and to pay the costs over time on their utility bills.

Some concerns have been raised as to whether the new PAYS program alongside current utility incentives will be enough for homeowners to finance retrofit activities. BC Hydro and FortisBC are in the process of piloting PAYS programs in Colwood (BC Hydro) and the South Okanagan (FortisBC) respectively which are helping to shape the final structure of the program in order to ensure that it is effective.

BC Hydro Power Smart Program

Power Smart is BC Hydro's program for implementing its world recognized demand-side management (DSM) objectives. Through public education, rebates and incentives, the program has played a significant part in helping the province properly manage its scarce energy resources. In the 2012 Integrated Resource Plan draft, DSM efforts will incorporate both energy and capacity saving measures and implemented through this program.

Energy Manager Programs

In addition to incentive funding for capital projects, BC Hydro offers co-funding for a dedicated on-site energy manager to its large commercial and industrial customers. This full-time resource will implement a long-term energy management strategy within the organization, focusing on business practices applied to energy management as well as technical energy efficient projects. BC hydro supports the Energy Manager with effective tools and templates as well as educational and promotional support.

New Construction Program

Through its Power Smart program, the provincial utility has a "New Construction" program offering considerable financial incentives for whole building, lighting, and system design. This BC Hydro program provides significant levels of support including 100% funding for an energy modelling study. Buildings with energy savings over 50,000 KWh have the highest potential for obtaining capital incentives. Enrolment in the program has doubled over the last year and in the last two years, 50 buildings have been built to high energy efficiency standards, saving approximately 32 gigawatt hours of electricity per annum.

Continuous Optimization Program

The BC Hydro Continuous Optimization program focuses on operational conservation measures, "low or no-cost" measures that do not require the purchase and installation of new equipment. The program consists of two main components:

1. Fund 100% of the cost for a re-commissioning consultant to study your building and recommend energy efficiency improvements, provide training of the building operators and conduct follow-up coaching sessions.
2. Helping maintain and continually improve the level of efficiency of building operations by funding the installation of an Energy Management Information System (EMIS).

FortisBC Power Sense Program

FortisBC offers its own rebates and incentives to its customers, which encourages them to pursue energy efficiency savings. The program targets homes, businesses and communities providing a wide array of tools and ideas including crop irrigation tips, providing free laundry lines, etc.

Energy Conservation Assistance Program

The “Energy Conservation Assistance” program provides eligible low income BC Hydro residential and FortisBC natural gas customers with a free home energy evaluation and installation of energy savings products. To date, over 5,000 customers have participated in this program enabling households to realize up to \$250 in energy savings. Energy savings products that have been installed include:

- Low-flow showerheads and faucet aerators;
- Water heater blanket and pipe wrap;
- Draft-proofing, such as caulking and door sweeps;
- Insulation for attics, walls and crawlspaces;
- ENERGY STAR refrigerator; and
- Energy saving light bulbs (CFLs).

City of Vancouver’s Green MURBs Pilot Project program

The Green MURBs Pilot Project (GMPP) program is designed to help organize and fund building retrofits, with financial incentives of up to \$60,000. This pilot project is designed to help strata identify the top energy-saving opportunities and calculate the payback; coordinate utility incentives and secure financing that matches repayments with energy savings; and coordinate the retrofit work. Incentives may include:

- \$15,000 in lighting upgrades from BC Hydro;
- \$20,000 for a solar hot water system;
- \$15,000 for five electric vehicle charging stations; and
- \$10,000 towards engineering design and installation costs.

RetrofitBC has launched the GMPP program to help facilitate retrofits to up to 15 MURBs in the City of Vancouver. GMPP is being professionally managed by FRESCo, with support from a number of organizations including: the City of Vancouver; Vancity; Vancity Community Foundation; the BC Ministry of Energy and Mines; FortisBC; and BC Hydro.

City of Vancouver's Home Energy Loan Program

As part of Vancouver's Greenest City Action Plan 2020, this loan program provides financing to select home energy efficiency upgrades for city residents. It provides between \$4,000-\$16,000 in financing administered by Vancity at a fixed interest rate of 4.5% with an amortization period of 10-years. The program also provides end-to-end support, connecting residents with experts and contractors to perform the necessary upgrades.

City of Nelson's ECO Save Energy Retrofits program

The "ECO Save Energy Retrofits" program is an on-bill financing initiative for residents that supports the city's long term 2040 low carbon plan. In partnership with Nelson and District Credit Union, financial planning and financing options for non-residents and businesses to pursue retrofit projects on their properties.

Solar Colwood

Solar Colwood is a community-wide initiative encouraging energy conservation and clean energy adoption for all its residents. This demonstration of community-level public leadership promotes the adoption of emerging technologies including smart homes/ grids, energy-efficient appliances, solar photovoltaic, geothermal and district energy solutions among others.

Saanich Green Home Building Rebate Program

The District of Saanich through its own municipal by-laws is offering building permit fee rebates for new and renovated single family homes to reach energy-efficient standards. The level of rebates available range from 10%-30% depending on the actual EnerGuide level achieved.

Vancity's Bright Ideas Financing

Vancity provides Bright Ideas Financing for home improvements that incorporate energy efficiency through the BC LiveSmart program. If a home's EnerGuide rating improves by a minimum of five points, homeowners may be eligible for a low-interest renovation loan (at prime rate), in the range of \$3,500-\$20,000, for up to ten years.

Royal Bank's Energy Saver Loan

RBC offers an Energy Saver loan for consumers that have either recently purchased—or are planning to purchase—an energy efficient product or service for their homes. By making a qualifying environmentally-friendly purchase, consumers can receive a 1% discount or a \$100 home energy audit rebate on a fixed rate installment loan over \$5,000.

RESEARCH, DEVELOPMENT, AND INNOVATION FUNDING PROGRAMS

Natural Sciences and Engineering Research Council (NSERC) of Canada

NSERC provides support to universities and researchers as well as encouraging Canadian companies to also embark on scientific quests to continue Canada's research and innovation excellence. Companies such as the Automotive Fuel Cell Coop which is performing fuel cell industrial research and development has collaborated with NSERC in the past to accelerate development of this technology.

Canadian Innovation Commercialization Program (CICP)

CICP is a federal program designed to help kick start businesses and allow innovative products including those related to clean energy and energy efficiency to move from a lab to the marketplace. This program awards contracts to companies with promising pre-commercial innovations and provides valuable feedback on the technology and how to access the larger Canadian marketplace.

Scientific Research and Experimental Development (SR&ED) Program

The SR&ED program is a federal tax incentive program that encourages Canadian businesses to conduct research and development activities in the country. This program constitutes as the largest single source of funding for industrial RandD activities by the federal government. Activities including experiment development, applied research, basic research, and support work are all eligible for this tax incentive.

SDTC Sustainable Development Tech Fund

This federally administered \$590 million fund supports clean technology projects pass through critical stages of technology development and demonstration. The fund supports innovators without taking an equity stake and without requiring ownership of intellectual property. The fund also does not obligate supported projects to repay any financial contributions.

NRC Industrial Research Assistance Program (IRAP)

The IRAP program administered by the National Research Council (NRC) provides a wide variety of services to businesses conducting industrial research. Through this program the following services are provided to its program participants:

- Technical and advisory services;
- Financial assistance programs;
- Networking and linkage services; and
- Youth employment programs.

ecoENERGY Innovation Initiative

The ecoENERGY Innovation Initiative (ecoEII) is a new program that received \$97 million in funding in Budget 2011, the Next Phase of Canada's Economic Action Plan, for a comprehensive suite of research and development (R&D) and demonstration projects. The program's objective is to support energy technology innovation to produce and use energy in a more clean and efficient way. This Initiative is a key component of the Government of Canada's actions to achieve real emissions reductions, while maintaining Canada's economic advantage and its ability to create jobs for Canadians. Activities funded under ecoEII will include energy efficiency as one of five strategic clean energy priority areas. The Initiative consists of two separate funding streams: one for R&D projects, and one for demonstration projects.

MITACS Programs

In partnership with governments, academia, and businesses, MITACS provides research and training programs to next generation researchers and innovators. The organization provides five key programs including:

- **MITACS Accelerate** – A research internship program connecting companies with graduate students from over 50 research-based Canadian universities.
- **Elevate** – A postdoctoral fellowship that allows recent PhD graduates to work on joint industry-academic projects for two years.
- **Globalink** – Provides access for undergraduate students from India, China, Brazil and Mexico to take on research projects in Canada supervised by a Canadian university faculty member.
- **Step** – A comprehensive program providing business-ready skills to up and coming researchers.
- **Outreach** – Provides outreach programs to engage children in science and mathematics.

BC Commercialization Voucher Program

The new \$7-million "Commercialization Voucher" program will connect small- and medium-sized companies from a variety of key sectors and regions throughout the province with cutting-edge researchers in B.C.'s post-secondary system. Those collaborations will help get the most innovative products to market faster.

OTHER PROGRAMS

City of Vancouver's Great Beginnings Program

With a \$10 million allocation in 2008 by the City of Vancouver, the program aims to create more community pride, liveability, and public appeal in the city's Gastown, Chinatown, Japantown, and Strathcona communities. This includes public space improvements, and the development of arts and culture, community living, capacity building, and community pride.

Targeted Wage Subsidy Program

Targeted Wage Subsidy is an employment program that provides employers with financial assistance towards wages of eligible individuals whom they hire. The program encourages employers to hire eligible individuals whom they would not normally hire in the absence of a subsidy.

ENDNOTES

1. See: http://www.brookings.edu/~media/Series/resources/0713_clean_economy.pdf
2. See: <http://www.corporateknights.com/report/green-provincial-report-card-2012>
3. For more details on this study, see: <http://www.globeadvisors.ca/market-research/west-coast-clean-economy-study.aspx>
4. Employment and GDP estimates are based on the latest work by GLOBE Advisors. For more information, see the “Technical Note” section in Appendix A.
5. Most BC clean economy companies are privately owned. Of the companies that are publicly listed, 15 Clean Energy, 5 Green Building and Energy Efficiency, and 3 Clean Transportation companies are listed on the TSX and TSX Venture stock exchanges.
6. See Technical Note in Appendix A for more details on how GDP and employment for this sector was estimated.
7. See: <https://ilbi.org/>
8. See: <http://www.builtgreencanada.ca/british-columbia>
9. See: <http://www.sustainablebuildingcentre.com/wp-content/uploads/2012/06/TowardsCarbonNeutralBuildingsInBC-Final.pdf>
10. Source: BC Provincial Government, November 2011.
11. Source: BC Provincial Government, Ministry of Energy and Mines, 2012.
12. See: <http://vancouver.ca/greenestcity/energyloan/index.htm>
13. See: <http://www.nelson.ca/EN/main/services/electrical-services/energy-grants.html>
14. See: <http://www.bcsea.org/node/3090>
15. See: http://www.boma.bc.ca/media/10624/boma_best_bc_buildings_annual_report_-_external_updated_apr5-2011_.pdf
16. See: <http://www.jti.gov.bc.ca/woodfirst/wood-first-act.html>
17. See: <http://www.bcbusinessonline.ca/energy-and-resources/bc-lumber-goes-olympic-gold>
18. See: <http://www.for.gov.bc.ca/ftp/het/external!/publish/web/snapshot/201202.pdf>
19. In 2011-12, Cascadia Windows products were used in the Harmony House Equilibrium Project in Burnaby, the first truly net-zero house built on the West coast of North America. See: www.harmony-house.ca

20. See: <http://www.metrovancouver.org/services/solidwaste/planning/Pages/default.aspx>
21. See: <http://www.naturallywood.com/sites/default/files/Construction-Waste-Management.pdf>
22. See: http://public.metrovancouver.org/about/publications/Publications/2010_Solid_Waste_Management_Annual_Summary.pdf
23. See: <http://www.metrovancouver.org/about/publications/Publications/ISWRMP.pdf>
24. See: <http://vancouver.ca/home-property-development/demolition-deconstruction-permit.aspx>
25. See: http://vancouver.ca/sustainability/building_green.htm
26. See: <http://www.citynorthvan.ca/c//DATA/2/98/BY-LAW%207575.PDF>
27. Jetelina, Margaret, "Sustainable Knockoffs". BC Homes Magazine, June/July 2012.
28. See: http://en.wikipedia.org/wiki/Integrated_project_delivery
29. See: <http://sbsp.ubc.ca/>
30. See: http://www.labourmarketservices.gov.bc.ca/job_seekers/targeted_wage_subsidies.html
31. See: http://www.okanagan.bc.ca/Community/Okanagan_College_Foundation/Centre_of_Excellence.html
32. The Energy Training for Building Operators program is owned and operated by BOMA BC. See: http://www.bomalearning.com/beet_welcome
33. See: http://www.cadillacfairview.com/notesdata/hr/cf_lp4w_lnd_webstation.nsf/page/Green+Initiatives
34. See: http://www.decc.gov.uk/en/content/cms/tackling/green_deal/green_deal.aspx
35. British Columbia Construction Association (September, 2011), A Study on the Risks and Liability of Green Building. See: <http://ogca.ca/wp-content/uploads/The-Risks-and-Liabilities-of-Green-Building.pdf>
36. See: http://www.cagbc.org/AM/Template.cfm?Section=GREEN_UP
37. See: http://www.energystar.gov/index.cfm?c=evaluate_performance.bus_portfoliomanager
38. See: http://www.bls.gov/green/final_green_def_8242010_pub.pdf
39. See: <http://www.bls.gov/ggs/#news>



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