September
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MARKET REPORT

British Columbia's CLEAN ENERGY SUPPLY & STORAGE SECTOR

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

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Paul Shorthouse
Director, Research & Planning
info@globeadvisors.ca

GLOBE Advisors
World Trade Centre
Suite 578 – 999 Canada Place
Vancouver, British Columbia
Canada V6C 3E1

Phone: **+1 (604) 695.5001**
Toll Free: **+1 (800) 274.6097**
(North America)

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 **Green Building and Energy Efficiency** 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, 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.

This market report looks specifically at British Columbia's Clean Energy Supply and Storage 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 Clean Energy Supply and Storage 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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City of Surrey

Clean Energy BC

Coastal First Nations – Great Bear Initiative

Corix Utilities

Covanta Burnaby Renewable Energy Inc.

Endurance Wind Power Inc.

Finavera Wind Energy

Fink Machines Inc.

First Power Canada

FortisBC

Gitga'at First Nations (Hartley Bay Band Council)

GreenTech Exchange

Lignol Energy Corp.

Nanaimo Bioenergy Centre

Nexterra Systems Corp.

Pacific Bioenergy Corp.

Province of British Columbia

Regional District of Nanaimo – Wastewater Services

Revelstoke Community Energy Corp.

Run of River Power Inc.

Schneider Electric

Sea Breeze Power Corp.

Siemens AG (International)

Thermal Environmental Comfort Association (TECA)

Veresen Inc. and subsidiaries

XEITL LP

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HIGHLIGHTS

1. For the purposes of this report, the Clean Energy Supply and Storage sector is divided into three key market opportunity segments – namely clean energy generation; technology development and manufacturing; and smart grid and transmission.

2. In 2011, the Clean Energy Supply and Storage sector in British Columbia was estimated to have generated some $4.9 billion in gross domestic product ($3.9 billion direct and $1.0 billion indirect) and 25,100 full-time equivalent jobs (13,000 direct and 12,100 indirect).

3. British Columbia is a North American leader in clean energy. The province's long-term commitment to having renewable energy account for at least 90% of the province's energy mix, combined with the continuous renewal and upgrading of existing transmission infrastructure and the increasing global demand for BC clean energy solutions and technologies are the primary drivers for industry growth.

4. Significant employment opportunities exist for engineering, technical, and scientific research services; project management; information and communications technology (ICT); plant/ facility operations and maintenance; community and First Nations engagement; and management and professional business support services.

5. Experienced engineers, technicians, and skilled construction trades people continue to be among the most difficult occupations to source for this sector, especially for projects located in northern and more remote locations. While there is no shortage of new graduates with the theoretical skills, the lack of hands-on experience with specific advanced clean energy technologies is preventing many academically-qualified individuals from finding employment in this sector.

6. While many rural and remote communities are interested in developing their own clean energy projects and/or support the development of projects in their regions, many do not have the knowledge or skills capacity required to seize the opportunities.

7. Barriers to sector growth include factors such as: industry's continued dependence on clean energy-related public policy; funding cuts to government programs; the low cost for energy in the province acting as a barrier to diversified clean energy technology deployment; the relatively small domestic marketplace for clean energy technologies; misconceptions and lack of education and awareness about clean energy technologies; and competition for skilled labour with other jurisdictions.

8. Accelerating investment and employment growth in this sector will require a strong commitment to clean energy planning; the promotion of market-based financial mechanisms; a levelized playing field with non-clean energy sources; support for more clean energy testing and demonstration projects; and greater export support and capacity building for technology companies in the province.

9. While British Columbia is often heralded as a leader in clean energy technology development and deployment, public policy support is required in order to accelerate investment and employment growth in this sector. Greater support for developing the province's expertise and the ability to exploit both domestic and international opportunities is paramount for this sector's success.

10. Collaboration with key players in this sector will be required in order to develop comprehensive labour market strategies that will ensure that the current and future supply of skilled workers in this sector aligns with demand.

EXECUTIVE SUMMARY

In this study, clean energy is defined as energy produced from renewable sources in a process that has minimal impact to the environment. Examples of clean energy include solar, wind, biomass, ocean current, and geothermal technologies that adhere to rigorous environmental standards.

British Columbia has established itself as a clean energy leader over the past decade. The Clean Energy Supply and Storage sector generated some $4.9 billion in GDP ($3.9 billion direct and $1 billion indirect) and employed approximately 25,100 full-time equivalent (FTE) workers (13,000 direct and 12,100 indirect) in 2011. Clean Energy Generation accounts for the majority of the employment in this sector, with some 9,800 direct FTE jobs or approximately 75% of total employment (see Figure 1).

The Smart Grid and Transmission segment, which comprises companies active in transmission upgrades and the deployment of smart grid infrastructure and metering, accounts for approximately 1,220 jobs or 10% of total employment in the sector.

The Clean Technology Development and Manufacturing segment, which includes firms involved in research and development for biofuels, wood pellet production, and other clean energy technologies, is not a huge generator of wealth in the province (equal to approximately 4% of total sector GDP), which is partly due to the pre-commercial stage of many companies. However, employment in this segment is relatively high and constitutes some 1,980 FTE jobs or 15% of the total employment in this sector. While this segment is relatively small, it is key to BC's standing as one of the largest clean technology clusters in North America, which attracts investment and strategic alliances with global players.

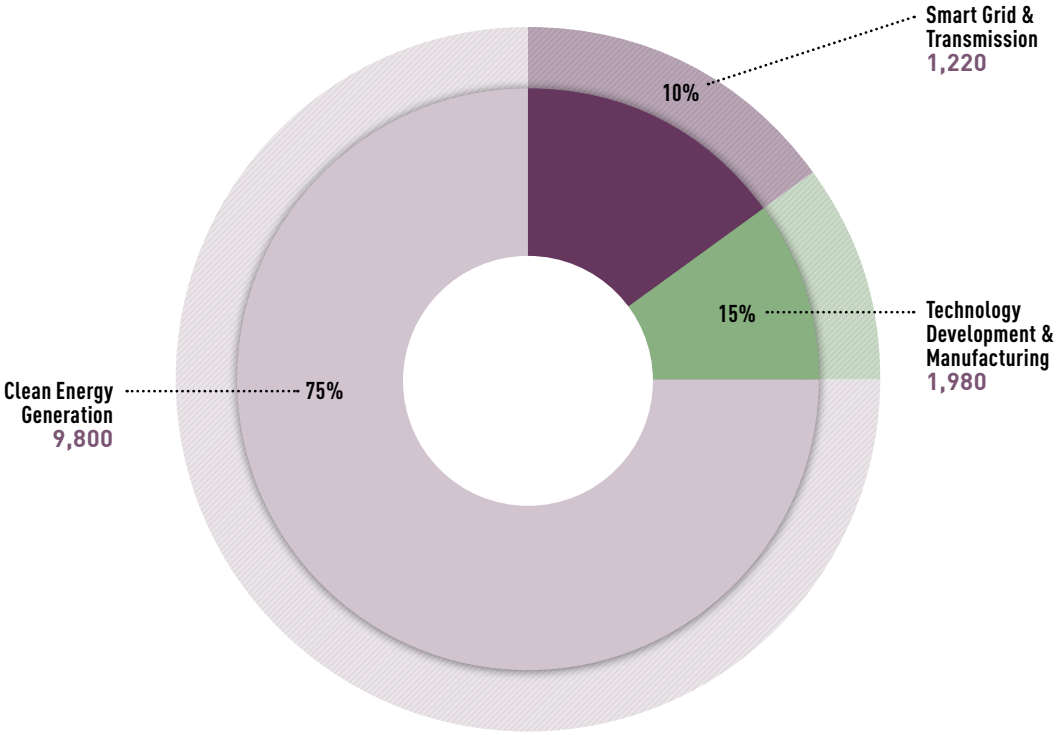


Figure 1: Employment (direct full-time equivalent jobs) in British Columbia's Clean Energy Supply and Storage sector by segment, 2011.

Source: GLOBE Advisors

CURRENT TRENDS

The Clean Energy Supply and Storage sector in British Columbia is undergoing profound changes. 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.

BC Hydro forecasts that the province's electricity needs will grow by up to 50% between now and 2030. This growth is due primarily to new industrial activity in the mining and natural gas extraction and export sectors including the provincial government's new Liquefied Natural Gas (LNG) Strategy and plans to build LNG terminals in Kitimat.

In its 2012 draft *Integrated Resource Plan*, BC Hydro has set out measures to ensure the province can meet its own demand for power over the next two decades. These measures include pursuing aggressive demand-side management targets, the construction of the Site C storage hydro project, and potential future calls for private clean energy.

BC clean energy technologies are also providing innovative solutions to help address the increasing global appetite for energy. Accelerated by government funded initiatives such as the BC Bioenergy Network, the Innovative Clean Energy (ICE) Fund, and Sustainable Development Technology Canada's (SDTC) SD Tech Fund, clean energy technology companies are reaching international export markets with revolutionary products such as biomass gasification systems, next generation cellulose-based biofuels, wood pellets, and advanced energy storage solutions.

JOB CREATION OPPORTUNITIES

There are many opportunities within the Clean Energy Supply and Storage sector that span the entire value chain. While most of the opportunities for clean energy projects at both the utility- and district-scale are during the construction phase, there are opportunities that exist throughout the project and product lifecycles for both clean energy project and clean energy technology development, respectively.

The sector offers a number of employment creation opportunities for BC, particularly related to:

- Project management and business support services for clean energy project development;
- Construction and development of clean energy facilities;
- Research and development of clean energy technologies and systems;
- Smart grid and transmission infrastructure development, deployment, and maintenance; and
- Engineering services for clean energy generation and storage.

LABOUR DEMAND AND SUPPLY

While many of clean energy technologies are considered cutting-edge or revolutionary, and require highly-specialized scientific or engineering skill sets, there is a wide spectrum of opportunities for those with transferable technical skills to participate in this sector.

In the bioenergy space for example, employment opportunities in the province exist tied to biomass-powered community energy projects, as well as for the development of advanced biofuels and wood pellets.

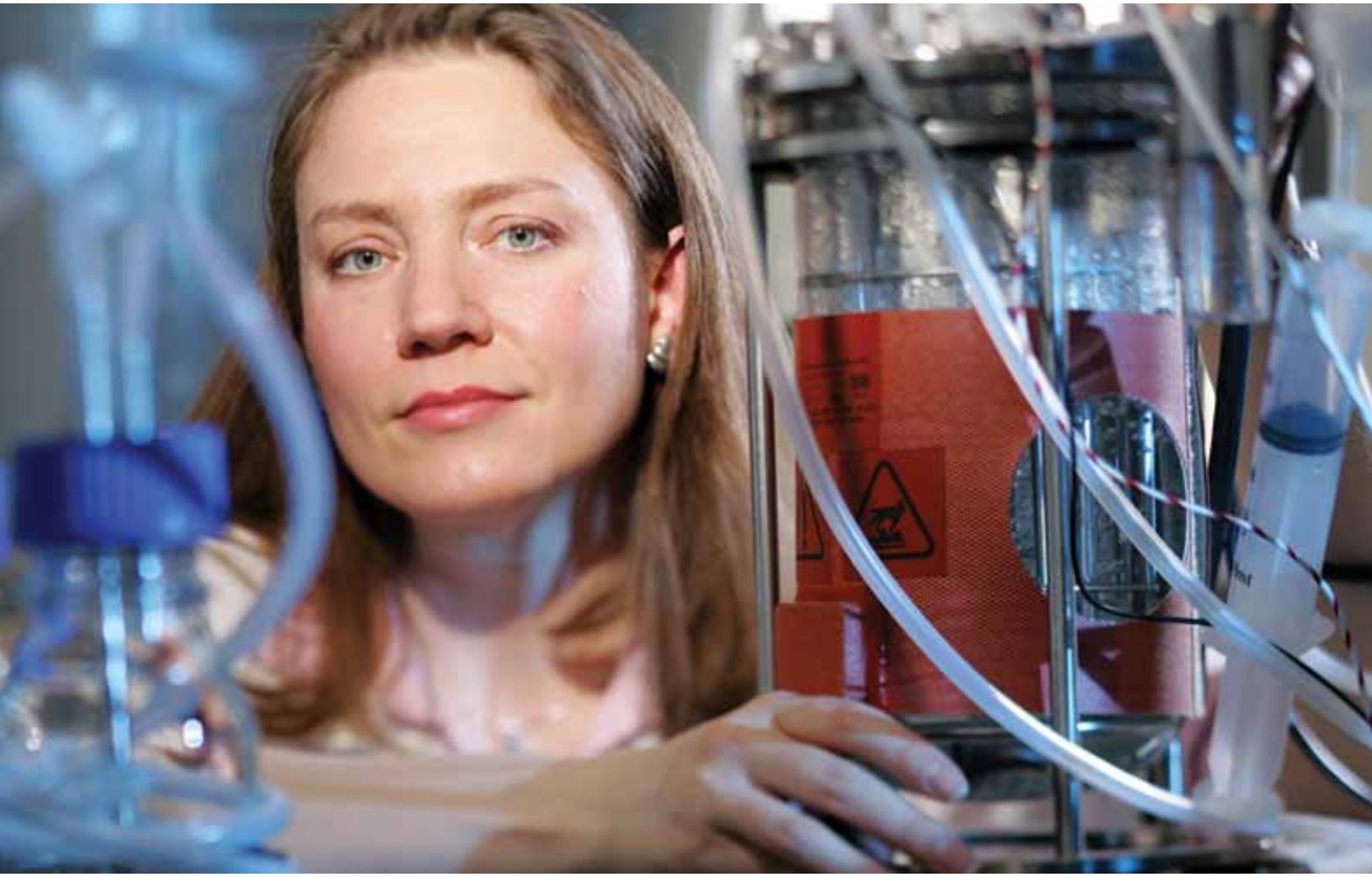


Photo Credit:
Lignol Energy

Methane capture at landfill sites, distributed heat, and combined heat and power (CHP) systems have the potential to displace dirtier fuels and create local jobs related to project design, construction, and operations, in both industrial and municipal settings.

Additional opportunities in bioenergy exist throughout the province for using waste streams to displace fossil fuels, promoting torrefied fuels to displace coal, developing transportation fuel demonstration projects, and promoting on-site biomass-to-energy systems in agricultural and industrial settings.

Positions in construction and skilled trades, project management, as well as engineering and technical services, are among some of the most highly sought after positions in this sector. The demand continues to grow with the deployment of new clean energy projects, the pursuit of transmission and smart grid upgrades, and research for new clean energy technologies and biofuels in the province.

Engineering, technical, and scientific services in particular are highly sought after by clean energy technology companies; especially those involved with energy storage devices, the development of advanced biofuels, and

» Engineering, technical, and scientific services are highly sought after by clean energy technology companies.

smart grid communications technologies. This trend is driven by growing global demands for these technologies. Individuals, regardless of their technical or scientific backgrounds are also increasingly required to have business and entrepreneurial skills to thrive in a competitive global marketplace.

Other high-demand positions such as those in construction and skilled trades require workers be able to transfer their skills in order to support different clean energy-related projects and applications. This may range from constructing power generators to ongoing maintenance and support for power plant and transmission line infrastructures.

Since many of the skill sets are not currently available in BC, employers are requiring staff to be equipped with strong "soft" skills that compliment transferable technical skills. For example, being able to think systematically was identified as a critical skill required for employees, as it allows workers to understand different market opportunities emerging from interrelated clean energy applications.

The major staffing challenges in this industry relate to sourcing individuals with the relevant experience and skills to sustain sector growth and capitalize on the global opportunities. Where positions are difficult to source domestically or there is an immediate need to find qualified hires, clean energy-focused companies often source qualified workers internationally. This is particularly true with advanced scientific research positions where there may only be one or two such experts in the world.

Sourcing internationally is not always economically feasible and companies are increasingly developing innovative solutions by providing team-based learning opportunities to new staff and externally pairing with BC post-secondary institutions to allow students to participate in sector development across the province. Co-operative education and internship programs are also widely used by companies to support local knowledge development. However, since many of the companies in this sector are small or medium in size, funding programs that help to sponsor student salaries were identified by industry as important for enabling more youth to gain critical experience in this sector. The MITACS programs are prime examples of such student salary sponsorship, which helps to foster innovation and entrepreneurship within an industry environment.

BARRIERS TO GROWTH

In order to realize the full potential for employment in this sector, a number of challenges must be overcome. The province currently lacks technical capacity, knowledge, and experience for certain clean energy technologies. Academic inflation and industry certification is also inhibiting some new graduates from entering the industry.

Policy related factors limiting job growth in the sector as identified by those interviewed include the continued dependency on public policy and uncertainties with respect to the adoption of clean energy technologies by the public sector. The new strategic alignment to develop natural gas resources was also cited as a barrier to growth of the clean energy industry in BC.

Economic factors reported that served to slow growth in the sector include the comparatively low cost of energy in BC and the substantial supply of existing renewable hydroelectricity, the uncertainty with respect to the long-term availability of feedstock resources (particularly for bioenergy companies), and the relatively small domestic

market size compared to highly-competitive markets elsewhere. Many companies also have difficulty gaining adequate access to capital.

Societal factors cited relating to clean energy were pervasive public misconceptions about the roll-out of smart grid infrastructure, the low levels of awareness and community acceptance for distributed energy systems, and the intense competition for skilled labour with other jurisdictions.

On the technology front, high risks associated with technology commercialization and the relative scarcity of platforms to test new technologies was cited frequently as impediments to growth.

ENABLERS TO GROWTH

Corresponding factors identified as enablers that could accelerate growth in the sector include a firm schedule for clean energy "calls-for-power" by BC Hydro; stable long term pricing; a clear policy direction and a transparent consultative processes with industry players; additional business networking support through the Province's international trade offices (for clean energy technology companies); and more market-based support to accelerate early-stage research, development, and commercialization, such as demonstration projects.

On the economic front, leveling the playing field by reducing oil and gas subsidies and adopting financial measures such as sunset credits were cited as potentially important enablers for growth. Deregulation of parts of the province's electricity supply was also suggested. In order to change public attitudes about clean energy, it was suggested BC Hydro should leverage its highly successful Power Smart program to further promote the benefits of smart grid infrastructure upgrades. Also called for was a re-assessment of cross-border agreements to better balance the job opportunities and to create equal opportunities at home for BC workers.

In order to reduce technological risks, more use of public private partnership (P3) approaches was suggested along with more support for demonstration projects to help investors identify commercial applications in other markets. In addition, much could be gained by helping communities with established community energy facilities to share their experiences with others.

» Leveling the playing field by reducing oil and gas subsidies and adopting financial measures such as sunset credits were cited as potentially important enablers for growth.

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 clean energy leader 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.

The following is list of elements that can help to accelerate growth in British Columbia's Clean Energy Supply and Storage sector.

1. A clear and stable policy framework;
2. Pursuit of clean energy and emissions planning (CEEP);
3. Increased partnerships and collaboration;
4. Greater export support and capacity building for trade;
5. A level playing field;
6. A focus on increasing productivity; and
7. Promotion of knowledge transfer.

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.

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.

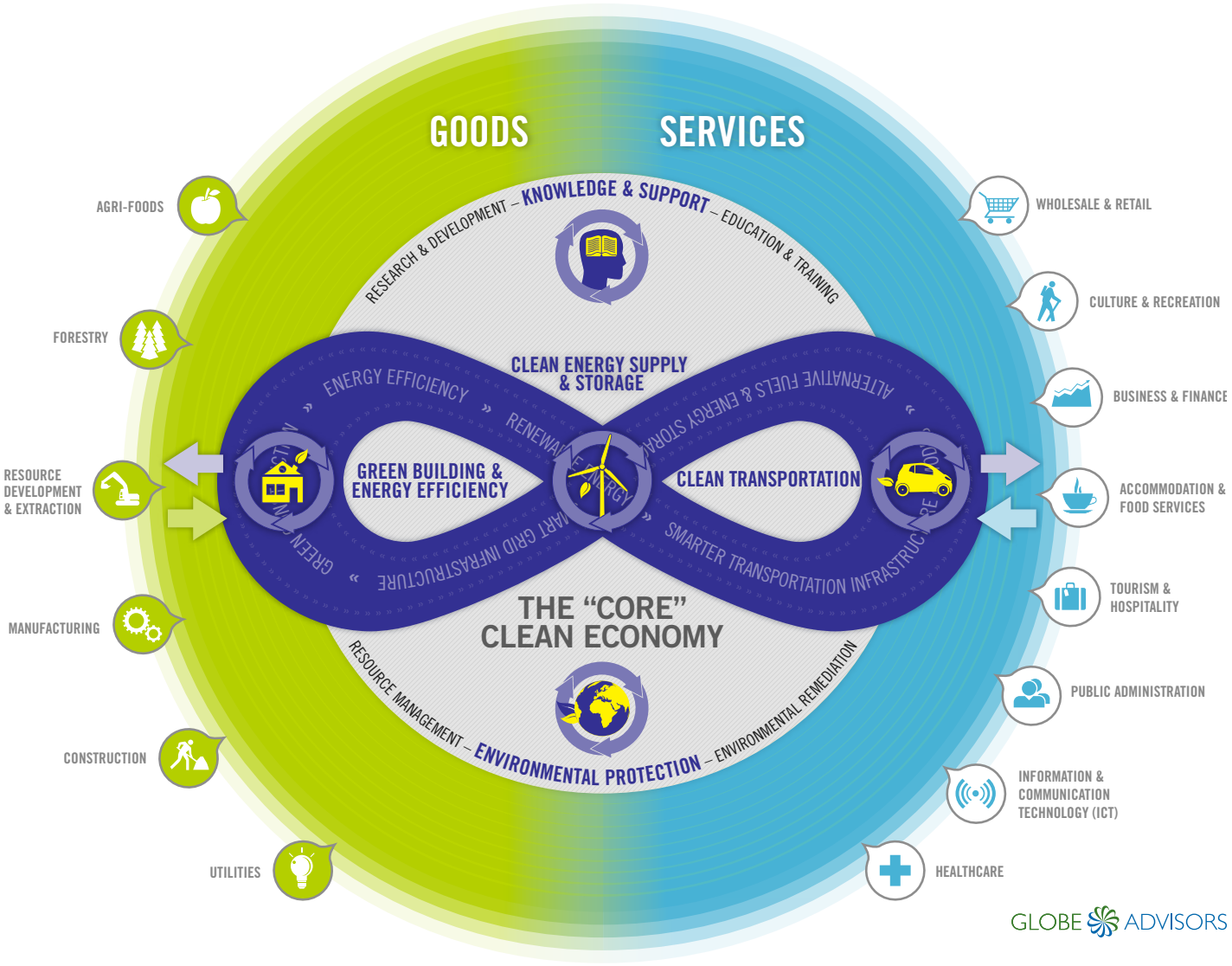


Figure 1.1: ↗
The "core" sectors of BC's clean economy supply important products, technologies, and services to help accelerate the transition to a more energy and resource-efficient economy as a whole.

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]

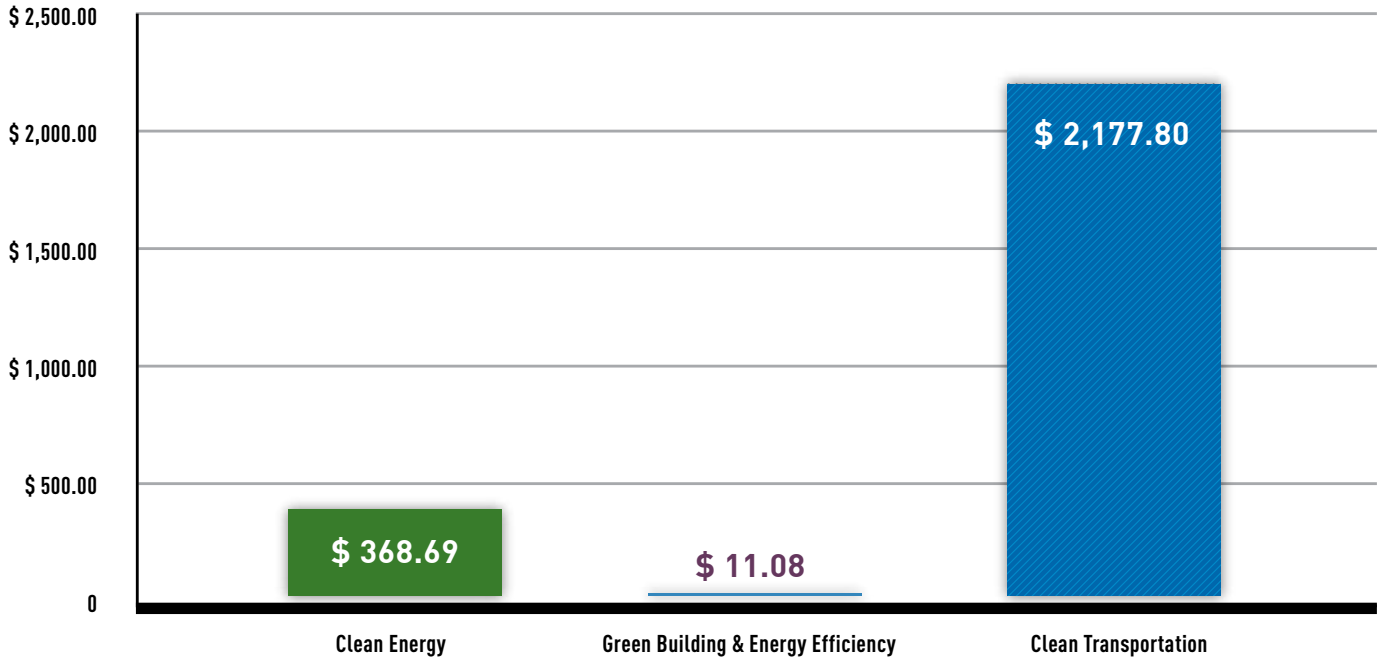


Figure 1.2: ↗
Market capitalization of BC public companies listed on the TSX and TSX-Venture Exchanges by clean economy sector (as of June 30, 2012), $ millions.[5]

Source:
TMX Group and GLOBE Advisors

LOOKING AHEAD IN THIS REPORT

This report looks specifically at the Clean Energy Supply and Storage 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.

Photo:
Grouse Mountain's 65-meter wind turbine towers over the City of Vancouver.

Source:
www.grousemountain.com

To download reports on the **Green Building and Energy Efficiency** and the **Clean Transportation** sectors, please go to **www.globeadvisors.ca**.

2. CLEAN ENERGY SUPPLY AND STORAGE: Jobs and GDP

In this study, clean energy is defined as energy produced from renewable sources in a process that has minimal impact to the environment. Examples of clean energy include solar, wind, biomass, ocean current, and geothermal technologies that adhere to rigorous environmental standards.

Combined with other energy efficiency and energy conservation technologies such as smart grids, smart meters, demand side management and control systems, and high-voltage battery storage innovations under development in various research centers across the province, British Columbia can truly be considered a land of "endless energy".

British Columbia has established itself as a clean energy leader over the past decade. The Clean Energy Supply and Storage sector generated some $4.9 billion in GDP ($3.9 billion direct and $1.0 billion indirect) and employed approximately 25,100 FTE workers (13,000 direct and 12,100 indirect) in 2011.[6]

For the purposes of this report, the sector has been divided into three segments, as illustrated in Figure 2.1.

Companies in the Clean Energy Generation segment account for approximately $3.3 billion or 86% of total provincial GDP from the sector. The Smart Grid and Transmission segment, which comprises companies active in transmission upgrades and the deployment of smart grid infrastructure and metering, contributed $384 million or 10% of the total sector GDP in 2011.

» The Clean Energy Supply and Storage sector generated some $4.9 billion in GDP and employed approximately 25,100 FTE workers in 2011.

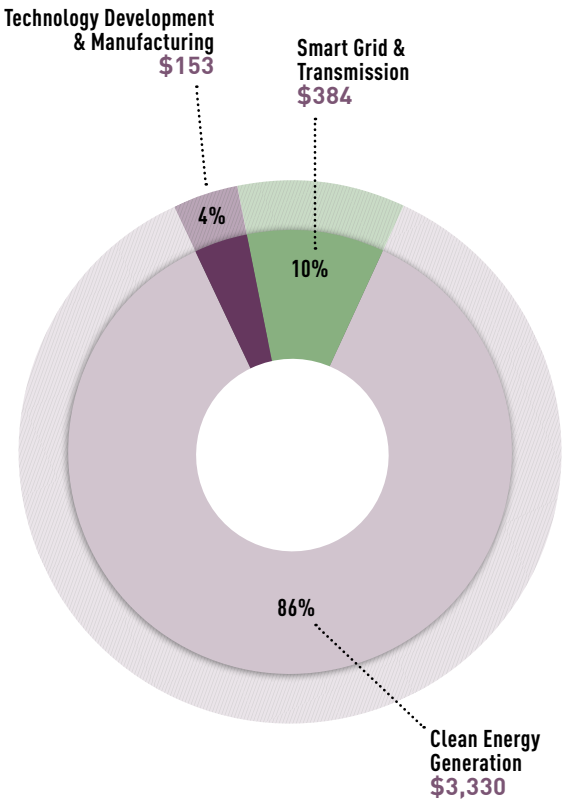


Figure 2.1: ↗
Direct GDP by segment generated by firms active in British Columbia's Clean Energy Supply and Storage sector, 2011 ($ million).

Source: GLOBE Advisors

The Clean Energy Technology Development and Manufacturing segment, which includes firms involved in research and development for biofuels, wood pellet production, and other clean energy technologies, constituted $153 million or 4% of GDP.

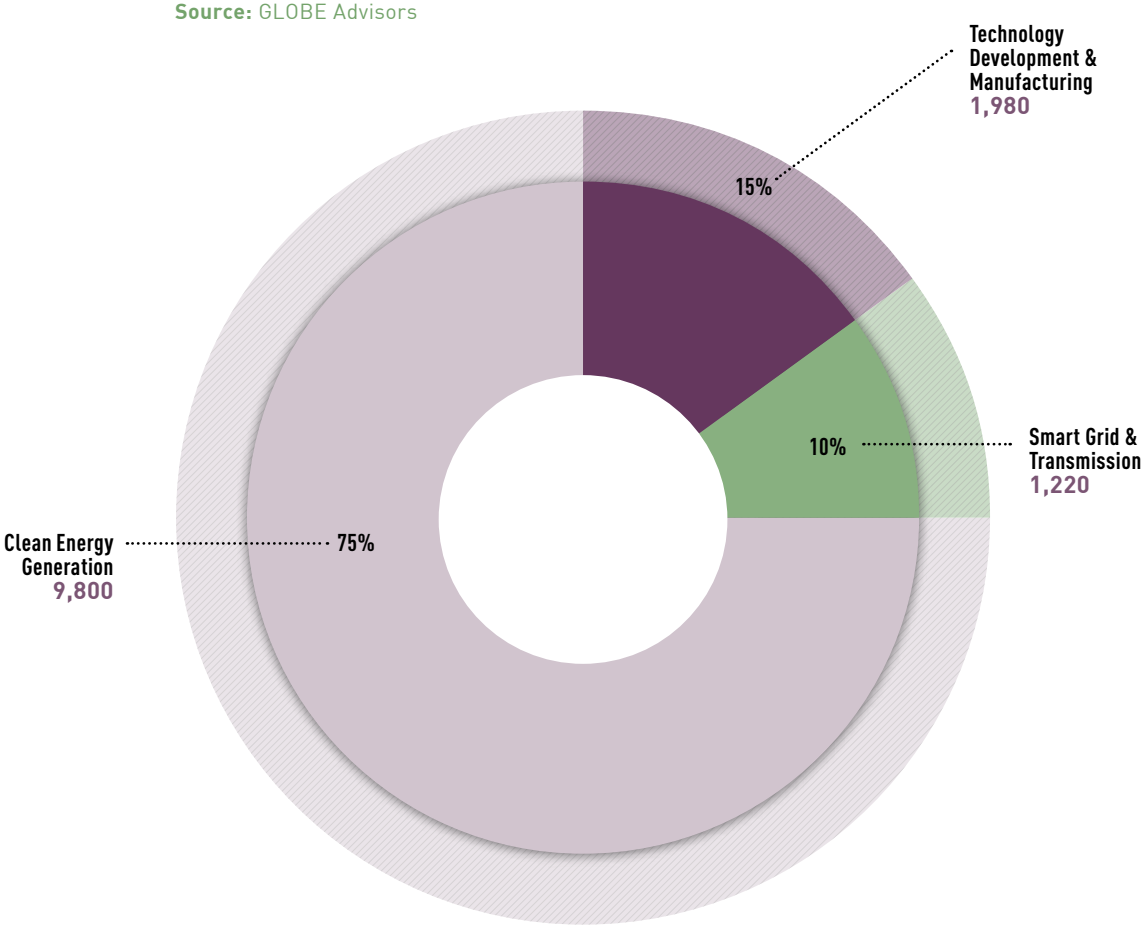
In terms of jobs in the sector, Clean Energy Generation accounted for the vast majority of the employment in this sector, with over 9,800 direct full-time equivalent (FTE) jobs or approximately 75% of total employment in 2011 (see Figure 2.2).

While the Clean Technology Development and Manufacturing segment generates a relatively low contribution to GDP (i.e. 4%), partly due to the pre-commercial stage of many companies, employment in this segment is much higher and constituted some 1,980 FTE jobs or 15% of the total employment in this sector.

The Smart Grid and Transmission segment accounted for approximately 1,220 jobs or 10% of the total employment in the sector in 2011.

Figure 2.2: ↓
Employment (direct full-time equivalent jobs) in British Columbia's Clean Energy Supply and Storage sector by segment, 2011.

Source: GLOBE Advisors



3. SECTOR PROFILE

The Clean Energy Supply and Storage sector offers a number of employment creation opportunities for BC, particularly related to:

- Project management and business support services for clean energy project development;
- Construction and development of clean energy facilities;
- Research and development of clean energy technologies and systems;
- Smart grid infrastructure development, deployment, and maintenance; and
- Engineering services for clean energy generation and storage.

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

CLEAN ENERGY GENERATION

Considerable clean energy generation potential exists in British Columbia. A comprehensive study commissioned by BC Hydro in 2010 identified over 7,300 potential non-storage hydro sites across the province.[7] Another study by the World Energy Council noted that BC is one of the optimal locations in the world for wind energy generation.

Important opportunities exist in this sector in utility- and district-scale energy supply and storage, two areas that are largely driven by public sector leadership and policies that are supportive of clean energy adoption and deployment.

Utility-Scale Clean Energy Supply
At the utility-scale (i.e., greater than 10 megawatts in size), BC Hydro supplies clean energy from hydro-electric generation and storage facilities, some of which rank among the largest in North America.

BC Hydro currently operates 30 hydro-electric facilities and three natural gas-fueled thermal power plants (the latter are not considered as part of this study), generating between 43,000 and 54,000 gigawatt hours (GWh) of electricity per year. BC Hydro's planned Site C hydro-electric project in the Peace River region, which is proposed to come on-line by 2022, will add an additional 1,100 MW in new capacity to the province-wide system.

While new generating facilities are essential to meeting the province's growing demand for electricity, equally important is renewing and modernizing existing facilities across the province to ensure that they are operating at optimal capacities and will continue to provide clean power for British Columbians.

BC Hydro, through its infrastructure modernization initiative, is planning to invest over $2 billion per year over the next two to three years in order to renew dams, generating facilities, and transmission and distribution networks.[8] Part of this process involves ensuring the grid infrastructure can respond to the challenges of the 21st century and is able to support the Province's ambitious clean energy generation targets.

IPP POWER GENERATION TECHNOLOGY	IN OPERATION		UNDER DEVELOPMENT	
	EPAs	Contracted Energy (GWh/yr)	EPAs	Contracted Energy (GWh/yr)
Biomass/Biogas	13	2,201	10	1,420
Energy Recovery Generation	2	75	1	65
Gas-Fired Thermal	2	3,140	0	0
Municipal Solid Waste	1	131	1	745
Non-storage Hydro	45	3,426	33	4,706
Storage Hydro	9	4,730	1	139
Wind	2	538	6	1,644
Total	74	14,242	52	8,720

Figure 3.1: ↗
IPP projects in BC currently in operation and under development by energy technology (as of April 1, 2012).

Source: BC Hydro 2012 *Integrated Resource Plan*, 2012

Independent Power Producers

While BC Hydro operated hydro-electric generating stations on the Columbia and Peace Rivers currently produce approximately 80% of the province's electricity, the majority of the province's small hydro and other forms of clean energy generation come from Independent Power Producers (IPPs).[9]

Currently, there are 74 IPPs with Electricity Purchase Agreements (EPAs) and projects in operation and another 52 projects with EPAs under development, representing over seven different energy types in total (see Figure 3.1).

IPP projects that are in operation and under development are also profiled in the map in Figure 3.2. Most clean energy projects last for at least 20 years and require on-going monitoring and maintenance activities to maintain optimal performance.

IPPs in British Columbia have developed strong expertise in clean energy technologies including non-storage hydro (which accounts for 62% of all EPAs granted), as well as capacity in bioenergy and wind technologies. With the wide variety of clean energy technologies currently under deployment in BC, building capacity in each area is critical for the long-term development and growth of technology clusters in the province.

According to a 2011 study conducted by PriceWaterhouseCoopers (PwC), the GDP contribution from IPP clean energy projects currently in operation amounts to approximately $2 million ($2009) with the potential to grow by another $12 million ($2009) upon completion of all projects under construction.[10]

Significant capital investment and project development resources are required to move clean energy projects from the prefeasibility stage through to operational status. Over the past decade, many small IPPs that were granted EPAs have been acquired or have merged with larger IPP companies such as AltaGas, Atlantic Power, Innergex, and Veresen.

Some of these larger companies operate with over 20 projects in their corporate portfolios, often spanning more than one clean energy technology type. For example, the clean energy asset portfolio owned

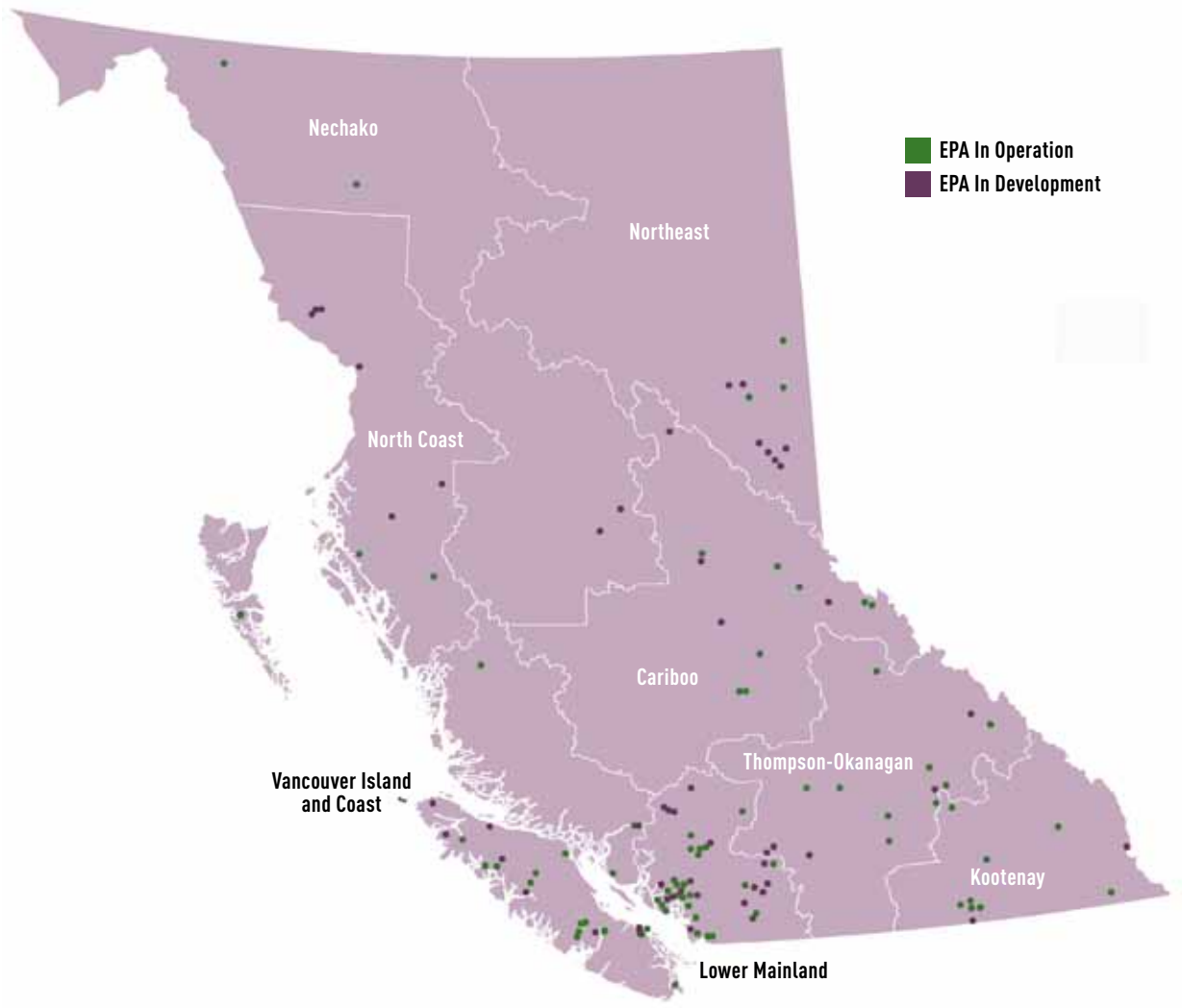


Figure 3.2: ↗
IPP projects currently in operation or under development by economic development region in BC (as of April 1, 2012).

Source: BC Hydro and GLOBE Advisors

DEVELOPMENT REGION	IN OPERATION	UNDER DEVELOPMENT
Vancouver Island/ Coast	16	10
Lower Mainland/ Southwest	25	16
Thompson/ Okanagan	9	5
Kootenay	8	2
Cariboo	8	4
North Coast	3	6
Nechako	2	2
Northeast	3	7
Total	74	52

» Clean energy companies require certainty in order to anticipate future growth trends.

by AltaGas includes both wind and hydro-electric projects in BC. Alterra Power operates six power plants totaling 567 MW of capacity, including two geothermal facilities in Iceland, a geothermal plant in Nevada, British Columbia's largest run-of-river hydro facilities, and the province's largest wind farm.

Other IPPs are focused on a single technology. Run of River Power for example has demonstrated significant success with its own portfolio of non-storage hydro-electric assets in BC. Being a publicly-listed company on the TSX-Venture exchange, the company has been able to access public financing to grow its operations.

Many companies interviewed for this study believe the clean energy sector in BC has tremendous growth potential, especially given the provincial government's leadership in promoting clean energy adoption. However, the development of private clean energy projects is heavily regulated due to the fact that developers must sell to BC Hydro, the province's Crown utility. Most projects arise through BC Hydro's "call-for-power" process, which in the past has been somewhat unpredictable. The last call-for-power, which was finalized in 2010, took three years to process. This has caused significant levels of uncertainty within the clean energy industry.

With global volatility in commodity supply and pricing expected for at least the next two decades, clean energy companies require certainty in order to anticipate future growth trends.[11] Time spent waiting for new calls-for-power and in obtaining public policy support is expensive and can be detrimental to smaller companies.

The 2012 BC Hydro draft *Integrated Resource Plan* suggests that the increasing industry demand for power over the next decade will be met by clean energy produced by IPPs – although no new calls-for-power are planned for the immediate future.

Earlier this year, the Government of British Columbia redefined natural gas as a clean energy alternative, but only if used to generate power for liquefied natural gas (LNG) plants planned for development in BC. The province's *Clean Energy Act* already includes cases in which burning natural gas could be considered clean so the altered regulation brings the natural gas used to fuel the LNG plants in-line with the clean energy goals set by the province.

Photo:
Bear Mountain Wind Farm near Dawson Creek

Source: AltaGas

Photo:
GE Jenbacher Engine at the UBC Bioenergy Research and Demonstration Project.

Photo Credit:
Don Erhardt

District-Scale Energy Supply

District-scale clean energy projects (often under 10 MW in size) have significant potential for local job creation, as well as for helping local governments meet their climate action and sustainability-related targets.

Many rural and First Nations communities across the province are evaluating ways to develop clean energy projects to support economic development goals, with the help of organizations such as the BC Bioenergy Network, the Community Energy Association, and others.

In 2007, 62 BC communities signed a *Climate Action Charter* with the Province and the Union of BC Municipalities (UBCM), committing to achieve carbon neutrality by 2012. Since then, an additional 118 municipalities have signed-on to the charter for a total of 180 out of 189 municipalities.

Communities across BC have decided to reach their committed targets according to their own unique needs and requirements. Being unable to reach their carbon neutral goals results in the community having to buy carbon offsets from the Pacific Carbon Trust (at $30 per tonne of carbon dioxide as of July 2012).

BC Hydro has dedicated programs to help communities meet their own energy efficiency and conservation targets. For example, the Crown utility provides funding for Community Energy Managers (CEM) who lead the development and implementation of community-scale policies and programs to advance these energy conservation and efficiency goals.

As part of BC Hydro's offer to provide utility service to remote communities, the "Remote Community Electrification" program provides support to off-grid communities that wish to evaluate the feasibility of transitioning from a reliance on diesel fuel to clean energy (see Profile Box 1).

To encourage residential and commercial customers to invest in clean energy systems, BC Hydro has put in place a "Net Metering" program. This program encourages customers to deploy clean energy projects up to 50 kWs in capacity. Since the program's beginning in 2004, over 200 projects have been able to receive discounts on their utility bills by feeding power back into the grid. The Net Metering program is currently under review and may have future changes benefiting the clean energy industry.

BC communities have chosen to take on clean energy projects in a variety of ways. For example, the City of Nanaimo has built a 0.5 MW co-generation facility to convert waste to energy in order to power its own Pollution Control Centre. It is also able to sell energy back into the electricity grid for an additional municipal revenue stream.

PROFILE BOX 1
BC HYDRO: REMOTE COMMUNITY ELECTRIFICATION PROGRAM

Photo Credit:
Dr. Mike Wrinch taken at Hartley Bay.

Dozens of remote communities across British Columbia lack access to electricity from the province's grid system and are reliant on diesel fuel for power generation. BC Hydro's Remote Community Electrification Program offers eligible communities the possibility to become BC Hydro customers and have BC Hydro manage their generation and distribution systems (or, when possible, connect them to the grid). The program also provides important information and assistance for remote communities to access resources and funding from various levels of government in order to develop local, community-owned clean energy projects.

In 2009, BC Hydro had identified between 30 and 40 communities that were eligible for this program, 21 of which were First Nations communities. Since its establishment, the Program has helped 8 remote communities access electricity service from BC Hydro.

In some instances, clean energy solutions such as biomass-to-energy are feasible for remote communities that have an abundance of nearby woody biomass that can be harvested as a biofuel. However, project feasibility must first be assessed. This includes evaluating the savings to be incurred when switching from diesel-powered generators to a cleaner energy source, as well as considering the available workforce expertise and capacity of the remote communities to develop these projects.

In 2010, four St'at'imc communities in the Lillooet Valley – Skatin, Baptiste Smith, Port Douglas, and Tipella – were officially connected to the BC Hydro grid, in effect reducing GHG emissions by approximately 1,000 tonnes of CO2 per year by removing the communities from diesel generators. Local employment opportunities were also created as a result of the project that included conducting environmental impact and resource management studies.

To learn more, see: **http://www.bchydro.com/energy_in_bc/remote_community_electrification.html**

» First Nations communities across BC are showing leadership in promoting community energy projects to increase energy security and sustainability.

In the City of Vancouver, the South East False Creek district heating system recovers waste heat from the development's wastewater system and converts it into heat that is returned to the community. While the rates that residents pay are competitive to traditional utility offerings, the level of carbon emissions is significantly lower with the integration of this clean source of heat.

Some municipalities throughout the province have adopted biomass district energy systems. For example, the City of Prince George has developed a district energy system that uses wood biomass to supply its downtown buildings with clean energy. Municipalities will often sign agreements with local sawmills to supply them with biomass feedstock.

Natural gas is also being used for district energy systems, either as a primary fuel supply or as backup for biomass district energy systems. Prince George has relied on natural gas as an alternative fuel source after the sawmill supplying their biomass feedstock burned down.

The Delta School District is using $1.4 million in *Public Sector Energy Conservation Agreement* (PSECA) funding, along with significant support from FortisBC, to retrofit 19 schools with 8 natural gas boilers and 11 geo-exchange systems. It is expected that this move will reduce annual GHG emissions by more than 2,000 tonnes and provide energy savings of over $500,000 per year.

Some landfills are currently converting methane biogas to clean electricity that is fed into the grid. FortisBC is also supporting municipalities with the conversion of gas from landfills in order to fuel vehicle fleets.

The fuel savings enjoyed by the City of Surrey for such an initiative is not only expected to save the City approximately 40% of traditional diesel fuel costs, but will also reduce significant GHG emissions.[12]

First Nations communities across BC are also showing leadership in promoting community energy projects to increase energy security and become self-sustainable. For example, Coastal First Nations, BC Hydro, and Clean Energy BC have developed a "Clean Energy Action Plan" to address the challenges and opportunities of advancing clean energy developments in Coastal First Nations territories (see Profile Box 2).[13]

Hartley Bay for example, a remote community within the Coastal First Nations, is looking to build a small-storage, run-of-lake hydro facility that will power its community and help transition it away from its reliance on diesel fuel.

Additional opportunities exist throughout the province for using biomass waste streams to displace fossil fuels, promoting torrefied fuels to displace coal, developing transportation fuel demonstration projects, and promoting on-site biomass-to-energy systems in agricultural and industrial settings.

The Mountain Pine Beetle Action Coalition, in partnership with the BC and federal governments and organizations such as GLOBE Advisors, the Community Energy Association, the Green Heat Initiative, and others, is promoting clean energy as a tool for rural economic development. This initiative aims to develop business and workforce opportunities for rural communities by providing them with tools, case studies, and resources.[14]

In addition, the Vancouver Renewable Energy Cooperative specializes in all phases of helping bring small-scale clean energy to homes and buildings across the Lower Mainland. Many of the technologies used can be sourced locally, while others are imported from abroad.

PROFILE BOX 2

COASTAL FIRST NATIONS: EMBRACING TRADITIONS AND PLANNING FOR THE FUTURE

Photo Credit:
Pulse Energy

Hartley Bay is a remote First Nations community, which has taken a progressive approach to its energy and economic future by seeking to become the greenest First Nations village in Canada. The community is part of the Coastal First Nations (CFN), an alliance of First Nations on British Columbia's North and Central Coasts and Haida Gwaii.

Since 2007, the BC Government has supported the development of a "small-storage, run-of-lake" hydroelectric project in Hartley Bay, which aims to replace diesel-generated electricity with clean power to drive local economic development and maximize energy security. Hartley Bay's current plan is to become a BC Hydro service area through BC Hydro's Remote Community Electrification Program. Upon successful transition to BC Hydro service, BC Hydro will be able to enter into an Electricity Purchase Agreement to purchase the community-produced clean energy. The negotiation of an EPA between the community and BC Hydro is a cornerstone of securing project financing.

To support the infrastructure development, there has also been an extensive education and community engagement component to the project. Energy education and awareness were introduced through curriculum in the local school to help engage school children on fundamental energy issues, who in turn have played a vital role in educating their parents on the importance of residents in energy monitoring and conservation.

Building on the success of the Hartley Bay project, the CFN are working collectively to advance clean energy projects in their territories, bringing new economic development and employment opportunities to their communities. To this end, they have developed and are now implementing a regional Clean Energy Action Plan. The Plan calls for a two-pronged approach to advance commercial-scale, grid-connected projects (notably run-of-river hydro and wind projects), as well as community energy opportunities to offset diesel use. This progressive approach to energy autonomy is proving to be an enviable model for First Nations and rural communities, not only in BC but across the country.

To learn more, see: **www.gitgaat.net**

CLEAN ENERGY TECHNOLOGY DEVELOPMENT AND MANUFACTURING

BC companies are well-positioned as continuous innovators and adopters of new clean energy technology. Supported by top post-secondary research universities, including the University of British Columbia (UBC), the University of Northern British Columbia (UNBC), the University of Victoria (UVic), and Simon Fraser University (SFU), many research projects have successfully been commercialized, resulting in the growth of successful and globally-competitive companies. These companies have not only driven employment opportunities in BC, but have also helped to strengthen BC's export capacity for clean technology.

Support by organizations such as the Ocean Renewable Energy Group, BC Sustainable Energy Association, SolarBC, and others is helping to bring industry, academia, and government together on policy issues and to develop new clean energy solutions in the British Columbia.

Photo Credit:
Don Erhardt

Municipalities are also supporting BC clean energy technology companies. Through its "Energy Shift Program" for example, the City of Surrey is planning to develop a Clean Technology Commercialization Center in its Campbell Heights neighbourhood (see Profile Box 3). This particular initiative will support demonstration projects, technology testing, and business mentoring for clean energy companies. The City is also reducing building permit fees by 50%, eliminating property taxes, and reducing business-licensing fees to $1 for 3 years for clean technology focused companies.

Bioenergy companies are seeing potential with foreign export markets, especially for wood pellets and biomass gasification technologies. According to the provincial government, the wood pellet industry in BC is expected to grow to $2 million in 2012, up from $1.2 million in 2011.[15] This growth is expected to continue well beyond 2013 and many BC companies such as Pacific BioEnergy, Pinnacle Renewable Energy, Premium Pellet, and Viridis Energy are well-positioned to take advantage of the global opportunities.

The Province's recent regulatory changes allowing pellet companies access to slash and wood waste which would otherwise be burned is expected to increase fuel supply and drive further investment and growth of the bioenergy sector throughout the province.[16]

Foreign investors have also shown interest in BC's clean energy offerings. With the assistance of the BC Bioenergy Network, collaboration with Korean research institutes in the solid fuel and biofuel area is under development.[17] The Korea Institute of Science & Technology (KIST) has recently signed a Memorandum of Understanding with UBC to undertake collaborative research in the province. This opens up new opportunities to strengthen the province as a clean energy leader.

PROFILE BOX 3

CITY OF SURREY'S ENERGY SHIFT PROGRAM: CLOSING LOOPS, CAPTURING OPPORTUNITIES

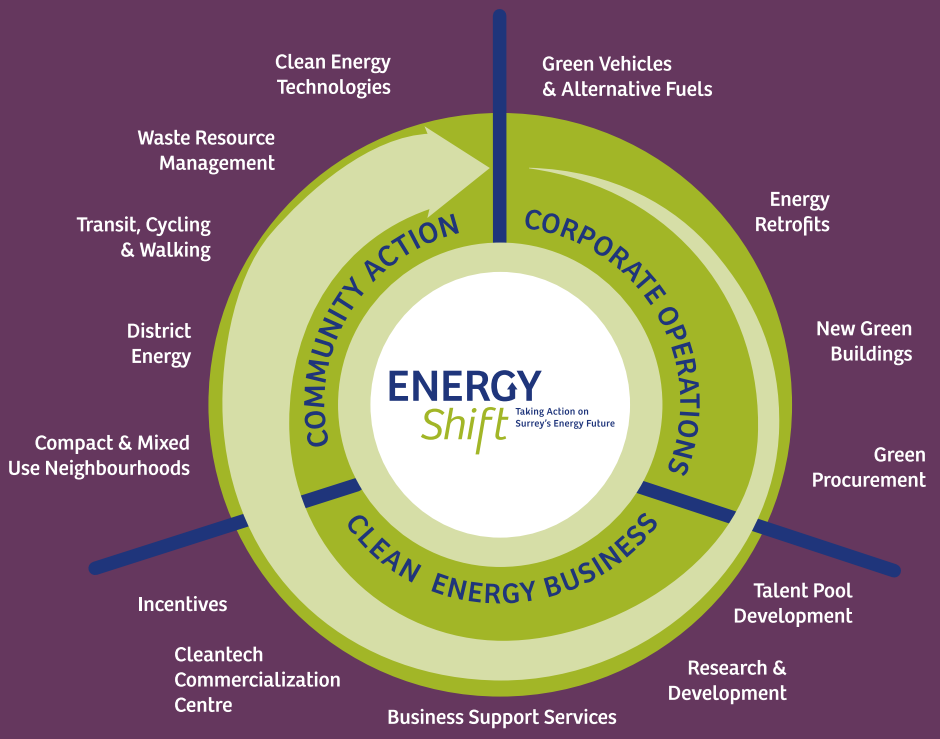


Photo Credit:
City of Surrey

The City of Surrey is the third fastest growing city in Canada and is taking decisive action to become a smart growth city and a clean technology hub. In 2011 Surrey was named 'Community of the Year' by the Clean Energy Association of BC for the City's EnergyShift Program, its multidisciplinary approach to sustainability and energy conservation.

Surrey's City Centre will be anchored by a new district energy system that will provide heating and cooling for the new City Hall, library and residential towers with capacity to expand the system as demand increases. Surrey is building higher-density nodes centred on its six communities, which will reduce GHG emissions by reducing dependence on carbon-intensive modes of transportation.

The City is partnering with SFU Surrey to develop the Clean Technology Commercialization Centre that will provide business mentoring, office space, lab facilities and production equipment to clean technology entrepreneurs. The facility will leverage existing research at SFU Surrey, including the Energy Systems Engineering program currently under development.

Surrey is also demonstrating leadership on alternative fuel vehicles and infrastructure. The City of Surrey is one of only four cities in the country to receive the prestigious E3 Fleet Gold Rating and starting in October 2012 Surrey will be the first city in Canada to have a 100% full-scale municipal CNG waste collection fleet. Surrey City Council is also moving forward on a new by-law which would require all new gas stations to include alternative fuel sources such as a level-three electric vehicle charging station, compressed natural gas, hydrogen or propane.

To learn more, see:
www.surrey.ca/energyshift/

Photo:
UBC Research & Demonstration Facility Combined Heat & Power System.

Photo Credit:
Don Erhardt

The BC Bioenergy Network (BCBN) has supported many bioenergy companies in the province, having successfully leveraged $78.2 million of partner investment from an initial $13.4 million to fund 24 projects.[18] BCBN's support for development and demonstration capital projects has helped position many emerging companies for export markets.

The BC Ministry of Agriculture also recently announced more than $280,000 in investment for two new waste-to-energy and biofuel projects from agricultural waste and reclaimed wood materials. The funding will be distributed between Diacarbon Energy and GreenScene Agritek. This initiative is anticipated to create new or additional revenue streams for farmers.[19]

Additional initiatives exist that are supporting clean energy integration on farms in BC. Earlier in 2012, the BC Agricultural Research and Development Corporation (ARDCorp) initiated the "Cow Power" program, which is a premium pricing support mechanism that supports farmers to turn animal and food waste into clean electricity using anaerobic digestion technologies.

Lignol, a Burnaby-based company that started as a UBC spin-off, is producing fuel-grade cellulosic ethanol from local forests and other biomass feedstock supplies. Its technology innovation has positioned it as one of the world's most promising cellulose-to-ethanol companies (see Profile Box 4).

PROFILE BOX 4
LIGNOL ENERGY: FUELING THE BIO-ECONOMY

Photo Credit:
Lignol Energy

Lignol Energy is a Burnaby-based technology company in the process of commercializing its patented biorefining technology platform for the production of advanced biofuels, including fuel-grade ethanol and other high-value bio-chemicals from non-food cellulosic biomass feedstocks. The current demand for biofuels in North America is unprecedented, driven by renewable fuel standards, high fossil fuel prices, environmental impacts from climate change, and fundamental concerns with respect to energy security in the United States.

Lignol operates a Biorefining Technology Development Centre which employs 25 highly-skilled people, primarily consisting of scientist, engineers, and technologists, most of whom are graduates from local universities and institutions. The facility contains state of the art R&D laboratories as well as Lignol's industrial scale pilot plant, which is a complete "end-to-end" biorefinery capable of processing up to one tonne of biomass per day into fermentable sugars suitable for ethanol production, as well as commercial quantities of lignin-based bio-chemicals.

The facility is operated in continuous multi-day campaign on feedstock from within the province and other parts of North America. Lignol has received $6.78 million from Sustainable Development Technology Canada's (SDTC) SD Tech Fund to help move the pilot-scale project towards commercialization.

Moving forward, Lignol plans to construct commercial scale bio-refineries for the production of fuel-grade ethanol and value-added bio-chemicals such as its high-performance lignin ("HP-L™ Lignin") for use in the plastics and materials industries. These facilities are planned in communities that have traditional resource-based economies and a skilled workforce with transferable skills and services to support its operations using feedstock from surrounding forests.

To learn more, see: **www.lignol.ca**

» BC companies have been able to tap into niche markets and grow at exponential rates due to their robust products, full-service offerings, and strong business acumen.

Nexterra, a company that specializes in biomass gasification, has recently shifted its attention to markets in Brazil and Europe, where higher prices for energy make the opportunity cost for adopting its technology much more competitive. Much of its production is anticipated to shift to these markets in order to grow in size, to streamline production capabilities, and to lower costs.

Recently, Nexterra formed a strategic alliance with United Kingdom-based Stopford Projects Ltd. to market and distribute Nexterra's energy-from-renewable-waste gasification systems in the UK market.

Companies, such as Surrey-based Endurance Wind, have seen tremendous growth over the last few years as clean energy adoption rates continue to increase around the world. Endurance's turbine technology is more efficient than most other turbines by spinning 25-50% slower than average while creating relatively more energy than competing models.

Victoria-based Carmanah Technologies is a leading company in solar technologies. It has designed solar-based products for various niche industrial applications worldwide.

Instream Energy, a collaboration between BAE Systems and Powertech Labs (a BC Hydro subsidiary), is making hydrokinetic generation systems. In January and February of 2010, the company successfully tested its technology at BC Hydro's Duncan Dam.

In the realm of geo-exchange and heating, companies such as GeoTility, Exchangenergy, Fenix Energy, and GroundForce geoDrilling Solutions provide leading technology such as ground heat exchangers and air source heat pumps, ventilation, as well as related installation and servicing.

Altentech Power is meeting industry needs by designing and supplying biomass dryers that can dry a range of biomass feed stocks. Other successful early-stage clean energy technology companies include Quadrogen Power Systems and Diacarbon.

In terms of energy storage technology, BC has a growing micro-cluster of innovative businesses that are actively seizing global market opportunities as international players seek greater levels of efficiency and flexibility for the power grid.

In 2011, Canada's export of batteries, electric accumulators, and related parts was valued at over US $217 million, much of which was due to transactions with the United States (66%), Mexico (9%), and China (6%).[20] While Canada's export is relatively small compared to other global players such as China and the US, BC companies have been able to tap into niche markets and grow at exponential rates due to their robust products, full-service offerings, and strong business acumen.

BC is home to a few innovative international companies that have world-class lithium ion battery research and development facilities in the province. One such company is Maple Ridge-based E-One Moli Energy. Another company, Richmond International Technology that operates under the brand name of Dr. Battery, has found success by developing mobile power solutions for the consumer market. It has an impressive market that has reached over one million households in over 40 countries since 2006.

Corvus Energy has also found success in the global marketplace for its lithium-ion batteries. The company provides its customers with a strong business case and financial payback by offering complete energy storage solutions to the marine, ground transportation, and back-up power industry

PROFILE BOX 5

CORVUS ENERGY: THE FUTURE OF ENERGY STORAGE

Photo Credit:
Corvus Energy

Corvus Energy is emerging as a global leader in state-of-the-art, high-powered, lithium-ion battery systems for heavy duty and industrial applications. Founded in 2009, the company designs and manufactures all of its products in-house at its facility in Richmond, BC.

The company currently employs some 50 staff and has experienced rapid growth over the past 3 years. Corvus is looking to add another 100 staff over the next 12 months. The majority of company employees are located in the Lower Mainland, but operations are expanding around the world as Corvus looks to set-up close to their customers in order to improve product design and cost efficiencies.

While the largest market for Corvus' batteries is currently found in the marine sector for powering diesel-hybrid tugboats, the company has experienced growth in demand for its products by other key segments including airport materials handling, for backup power systems and electricity grid storage, and for auxiliary power units (APUs) in the trucking industry, solutions which significantly reduce diesel fuel consumption and related GHG emissions through conversion to electrical power.

To ensure that the company is able to find the highly-specialized workers with expertise in electronics (firmware and software) and mechanical engineering required for its ongoing expansion, Corvus has worked closely with various government agencies, including the National Research Council's Industrial Research Assistance Program (IRAP), Sustainable Development Technology Canada (STDC), and the Natural Sciences & Engineering Research Council (NSERC).

To learn more, see: **www.corvus-energy.com**

sectors (see Profile Box 5). Not only does Corvus have an in-house product and design capability, but the staff also provides on-going maintenance and servicing of products when required.

Alpha Technologies, based in Burnaby, is another industry leader in the province. It provides energy storage solutions for a wide variety of applications, including telecommunications, intelligent transportation systems, security and safety, as well as back-up industrial power.

Ballard Power Systems, a BC-based fuel cell technology developer, has also seen success selling its stationary fuel cell power generation technology to foreign markets. In August 2012, Ballard received an order for more than 100 fuel cell power generation systems that will be used by two telecommunications providers in Indonesia.

Associated technologies required for the research, development, and manufacturing of battery technologies, including test systems, analyzers, converters, and chargers are also critical to this segment. Cadex Electronics, based in Richmond, provides much of this technology to support the growth of energy storage device manufacturers in the province, with an extensive distribution network around the world.

Schneider Electric, a company specializing in the manufacturing of energy management solutions and equipment, has offices in both Victoria and the Lower Mainland. In 2008, the company acquired Xantrex, a company that designs and manufactures a variety of AC and DC mobile power products for vehicles.

Photo:
Tantalus Systems

Credit:
Scott McAlpine

Companies like Schneider Electric, which is one of only a handful of electronics manufacturers in the province, have indicated that it is often difficult to source skilled individuals in power electronics and also difficult to attract them from other parts of Canada due to the fact that there is such a small domestic manufacturing cluster. Positions that they are constantly hiring for include manufacturing engineering, quality engineering, electronics hardware design, and software development professionals.

While energy storage companies in BC have focused mainly on export markets, pursuing domestic applications of these technologies has the potential to create additional value chain job opportunities in areas such as business development, battery assembly and installation, and equipment maintenance.

SMART GRID INFRASTRUCTURE AND DEMAND-SIDE MANAGEMENT

Smart Grid Infrastructure

Smart grid generally refers to a class of technologies aimed at modernizing grid infrastructure to meet the changing needs of utilities, communities, and consumers alike. The use of information and communications-based technology solutions and remote control systems also allow for better integration of clean energy into the grid system and makes the entire utility grid infrastructure more intelligent by providing two-way communications between utility providers and their customers' meters. An integral part of this advancement is smart meters, which gather information on energy consumption and power quality.

Currently, BC Hydro's high-voltage transmission system consists of 18,286 kilometers of transmission lines.[21] As part of the 2010 *Clean Energy Act*, BC Hydro and the BC Transmission Corporation were consolidated to form a single entity that allowed for increased integration of energy resource management and distribution.

Large-scale grid infrastructure projects are expected to create a number of jobs in BC. For example, the $561 million Northwest Transmission Line, scheduled for completion by the spring of 2014, is expected to create up to 280 direct jobs per year of construction. The Interior to Lower Mainland (ILM) transmission project is expected to generate 540 person-years of employment during its three years of construction.[22]

Investment into new transmission infrastructure projects such as these are expected to allow clean energy to be delivered to potential industrial, commercial, and residential developments, as well as allow several remote communities to access the electricity grid.

Such innovations and technological advancements can also be found at the distributed-energy scale. For the last five years, BCIT has been conducting research on an Intelligent Micro-grid System, which localizes loads, electricity generation, and energy storage.[23] Technology solutions to address long-term smart grid issues, such as renewable energy integration, electricity consumption reduction, and managing the power demands of electric vehicles (EVs) are just some initiatives being pursued at the BCIT lab. For example, vehicle-to-home (V2H) and vehicle-to-grid (V2G) systems allowing EVs to have electricity flow from the car back to the grid is being researched as a means of back-up power when natural disasters strike.

BCIT's research project is also acting as a test bed and demonstration zone for smart grid technologies with both public and private sector support. Tantalus Systems for example has donated smart meter devices to support

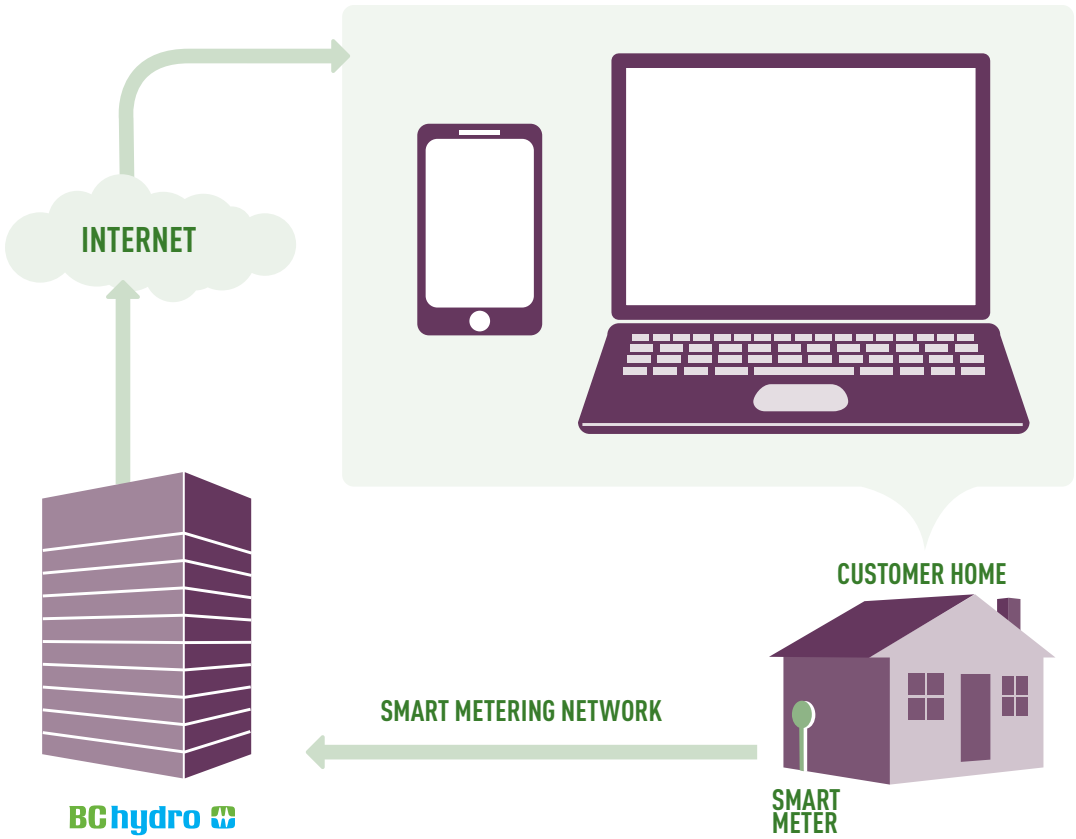


Figure 3.3: ↗
BC Hydro's proposed online customer feedback system, which will eventually allow consumers to track more closely their electricity consumption.

Source: BC Hydro, 2012

the lab's research and development activities in exchange for valuable feedback and data on the performance of its technology.

Upgrades to smart meters are also well underway across the province. According to BC Hydro, the benefits of infrastructure upgrades and smart meter improvements include:

- Improved safety and reliability;
- Enhanced customer service;
- Reduced electricity theft;
- Improved operational efficiency and reduced electricity losses;
- Support for greater customer choice and control; and
- A modernized electricity system.[24]

The installation of smart meters will also eventually be able to allow consumers to measure, track, and manage their own energy consumption patterns and encourage behavior shifts towards energy efficiency and savings (see Figure 3.3).

Several information and communications technology (ICT) vendors in BC are also capitalizing on the smart grid opportunity. Awesense Wireless is one example with product solutions that help utilities identify inefficiencies and losses in the electrical grid.

Corix Utilities, which was awarded BC Hydro's $73 million installation contract, had installed some 1.4 million smart meters across the province by the end of June 2012 (approximately 75% of the total 1.8 million planned installations).[25] According to the company, over 350 jobs will be created during the smart metering implementation program.[26]

Burnaby-based Tantalus Systems, a smart grid communications technology provider, has found success selling its technology in other parts of Canada and to the US market. They have been particularly successful in selling to remote areas in the US where smart grid infrastructure upgrades are being managed by public utilities.

Other large international ICT solutions companies such as Accenture, Cisco, and IBM are also active players supporting "smarter" growth and development of the province's aging electricity grid infrastructure

Demand-Side Management

Through the *Clean Energy Act*, the provincial government in BC has set out aggressive targets to meet 66% of the forecasted load growth through demand-side management (DSM) initiatives. BC Hydro is currently on track to achieving those targets. Between 2008 and 2011 alone, approximately 2,300 gigawatt hours per year (the equivalent of powering over 200,000 homes annually) of energy savings was achieved.

BC Hydro's world-renowned DSM program "Power Smart" provides incentives and rebates for businesses and individual consumers across the province while also educating the general public on the need for energy conservation. BC Hydro estimates that its Power Smart program alone creates approximately 6,400 jobs a year.

BC Hydro has designed a strategic framework and a series of tactics for targeting residential customers, businesses, and the general public on its DSM strategy. These strategies target energy savings within three key categories (i.e., residential, commercial, and industrial customers).

BC Hydro's 2012 draft *Integrated Resource Plan* incorporates additional targeted measures to increase capacity savings. Capacity-saving initiatives include industrial load curtailment, which targets large customers that agree to curtail loads on short notice in return for financial incentives when total consumer load demand exceeds BC Hydro's capabilities. Other initiatives include programs that offer payments for consumer equipment and incentives for participating in voluntary programs. Capacity savings were once considered as a value-added benefit of DSM activities focused on energy savings. However, BC Hydro hopes to pursue greater cost savings by proactively pursuing capacity-saving initiatives alongside its energy conservation goals for potential peak savings up to 470 MW.

In BC Hydro's F12-F14 Revenue Requirements Application to the BC Utilities Commission, expected energy saving and associated capacity savings by 2020 was outlined (see Figure 3.4).

Figure 3.4: ↘
Forecasted cumulative energy savings (GWh/yr) and associated capacity savings (MW) in fiscal year 2020 resulting from energy-focused DSM initiatives.

Source: BC Hydro's F12-F14 Revenue Requirements Application

	ENERGY SAVINGS (GWH/YR)			ASSOCIATED CAPACITY SAVINGS (MW)		
	Codes and Standards	Rate Structures	DSM Programs	Codes and Standards	Rate Structures	DSM Programs
Residential	1,757	1,130	556	478	242	132
Commercial	751	1,310	1,446	145	182	209
Industrial	100	644	3,472	11	86	408
Total	2,607	3,084	5,474	634	509	749

4. CURRENT TRENDS

The Clean Energy Supply and Storage sector in British Columbia is undergoing profound changes. 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 paragraphs touch on some of the key trends affecting this sector in BC, based on the insights of industry leaders interviewed for this study.

Increasing demand for electricity in the province

BC Hydro forecasts that the province's energy needs will grow by up to 50% between now and 2030.[27] This growth is due primarily to new industrial activity in the mining and natural gas extraction and export sectors. The province's new Liquefied Natural Gas (LNG) Strategy and plans to develop Douglas Channel and LNG terminals in Kitimat are expected to significantly increase demand for electricity in BC.[28]

While the growing demand for power is inevitable due to increased industrialization in the province, measures are being taken by BC Hydro to ensure adequate supplies of energy are available to avoid any potential gaps (as illustrated in Figure 4.1). In its 2012 draft *Integrated Resource Plan*, BC Hydro has set out measures to ensure the province can meet its own demands for power over the next two decades. These measures include pursuing aggressive demand-side management targets, the construction of the Site C storage hydro project, and potential future calls for private clean energy.

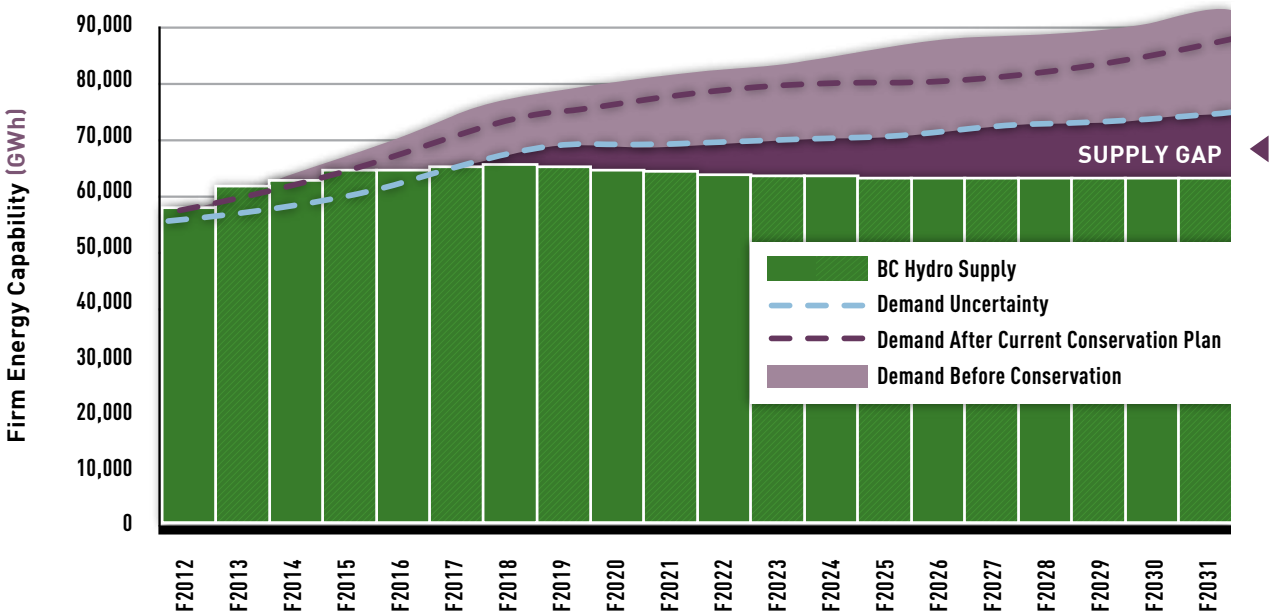


Figure 4.1: Projection of electricity supply and demand in British Columbia up to 2031 (without additional supply).

Source: BC Hydro, 2012

Photo: UBC Bioenergy Research & Demonstration Facility Oxidizer 1

Photo credit: Don Erhardt

ENERGY ALLOCATION	COST PER MEGAWATT HOUR (MWH)
Latest power call for IPP energy (long-term contract)	$124
Wholesale market price (Mid C spot market price). Figures are from the calendar year of 2010.[29]	$4.34 - $52.43
Site C (expected for BC Hydro owned asset)	$87- $95 (NPV)

Figure 4.2: ↗
Range of energy costs in BC.

Source: BC Hydro (2011), Review of BC Hydro

Rising energy prices in BC remain comparatively low

Compared to other North American jurisdictions, BC has some of the lowest electricity prices. BC Hydro has indicated rates must rise to match increased costs, as evidenced in a recent proposed rate change allowing a 16% increase over the next three years.

Recent modifications to the *Clean Energy Act*, which allows BC Hydro to plan electricity demands based on average water conditions with a relaxation of insurance requirements, are also expected to reduce electricity rates over the medium- to long-term planning horizon. These adjustments of baseload electricity prices may create barriers that inhibit other sources of clean energy from being cost competitive with conventional offerings (see Figure 4.2).

Relatively inexpensive and readily accessible hydro electricity in BC has already caused many clean energy companies in BC to shift their expansion strategies outside of the province and beyond Canadian borders. Regions in Asia, Latin America, and Europe where power is more expensive are increasingly attractive markets, especially for bioenergy companies such as Nexterra and Pacific Bioenergy.

Public policy and incentives continue to shape industry growth

The 2007 *BC Energy Plan* and the 2010 *BC Clean Energy Act* are progressive pieces of legislation aimed at advancing the province's position as a clean energy leader. Such legislation, combined with the fact that power supply and distribution in the province is more or less controlled and managed by a provincial monopoly, has created a clean energy supply and storage industry closely linked to provincial public policy and investment strategies.

The renewable energy sector continues to rely on BC Hydro's "call-for-power" process for selling electricity into the grid. However, uncertainty about future calls-for-power and the future of programs, such as the highly-successful Innovative Clean Energy (ICE) Fund, has led to doubts in some quarters about future growth of the sector.

Compounded by the hold on the BC Feed-in-Tariff (FIT) Program and increasingly stringent eligibility criteria for BC Hydro's Standing Offer Program, many companies are trying to find innovative means to pursue other viable clean energy projects. Some clean energy and energy storage companies have shifted their focus to export markets where the regulatory and investment climate is comparatively more favourable. Others have focused their attention on community-level projects.

Industry consolidation continues through mergers, acquisitions and joint ventures

The clean energy supply and storage industry traditionally has been driven by small- and medium-sized enterprises (SMEs). However, with exponential growth in this sector over the last decade, signs of maturity and market saturation by a few dominant players are emerging. Many IPP companies have either merged with or been acquired by larger domestic and international players. In many instances, many smaller IPPs with EPAs are able to sell their clean energy assets at significant premiums to larger operators thereby realizing immediate financial gains.[30]

Clean energy technology companies penetrating foreign markets are also prone to globalization pressures, especially where they are competing in niche markets that have been dominated by large multinational conglomerates. For example, Vancouver-based smart grid technology company NxtPhase Corporation was acquired by Alstom, an international conglomerate specializing in transportation infrastructure, power generation, and transmission.

Mergers, acquisitions, and joint venture deals in essence have become a critical reality as a source of new capital for the long-term viability of many projects and related corporate operations. The Dokie Wind Energy project is a case in point. It was acquired by Plutonic Power, now part of Alterra Power, that was financed by GE Energy Financial Services.

Photo: Bonnington Dam, West Kootenay

Growing reliance on a knowledge-based workforce and increasing project automation

Clean energy is an advanced subset of the various clean technologies available. As such, the design, assembly, and operation of various clean energy technologies, especially at the utility-scale, require support from a significant amount of knowledge capacity to plan, develop, and operate. Although BC currently has one of Canada's largest clean technology clusters (on a per capita basis according to a 2010 report by SDTC), a gap remains with respect to clean energy technology expertise in this province.

As a result, many clean energy producers and technology developers must source highly-specialized business services and talent nationally and often internationally, from countries such as Germany and the United States. With industry standardization and the level of qualifications / certifications on the rise, individuals hoping to enter this industry must be increasingly experienced, knowledgeable, and qualified.

In addition, new technologies are integrating higher levels of automation and information and communications technology solutions to help streamline complex processes. This trend toward automation has the potential to reduce the amount of human resources required as systems and processes are increasingly computerized. The skill requirements for those employed are also requiring greater expertise with operating, maintaining, and troubleshooting these systems.

The rise of carbon neutral communities in British Columbia

Many communities have or are in the process of developing clean energy projects locally. The City of Revelstoke, for example, has a biomass-based system already in place. Several other municipalities across the province are following suit. The City of Surrey has just developed a district energy system that has the capacity for an additional 400,000 square feet of heating and cooling.

Many of these jurisdictions are doing so as a result of signing on to the *Climate Action Charter*, which encourages municipalities and communities to pursue energy efficiency and conservation initiatives. The BC Government has also designed the BC Climate Action Toolkit to allow communities to access a variety of resources and contacts to help them pursue their own energy-saving goals.

Utilities are working closely to support communities. BC Hydro for example works with grade 9 to 12 students through its "Energy Ambassador Program" to empower youth who wish to lead real energy conservation change in their schools and school districts. As a result of this program, the Qualicum School district saw over $200,000 in savings delivered through energy-efficient lighting upgrades, which supports not only BC Hydro's demand-side management objectives, but also the goal of public sector carbon neutrality.

» Clean energy supply and storage technology companies are finding it more lucrative to compete abroad than at home.

Growing global market for clean energy supply and energy storage technology

With access to the Asia-Pacific Gateway, BC has always been a staging ground for global market expansion by Canadian companies. Clean energy supply and storage technology companies are finding it more lucrative to compete abroad than at home. This is due to the relatively small size of the Canadian market, which has hindered domestic industry growth and the ability to reach economies of scale.

Wood pellets and biofuels are prime examples. Many BC clean energy technology companies in this space have found it profitable to export globally into Asian and European markets.

Energy storage is another area where homegrown technologies have become heavily dependent on export markets. Products originating in BC have sold into various export markets around the world while weathering stiff competition from larger established players in this space. Some multinational companies have also established research facilities in British Columbia, with plans to export cutting-edge BC products and services around the globe.

5. LABOUR DEMAND AND SUPPLY

INDUSTRY WORKFORCE NEEDS

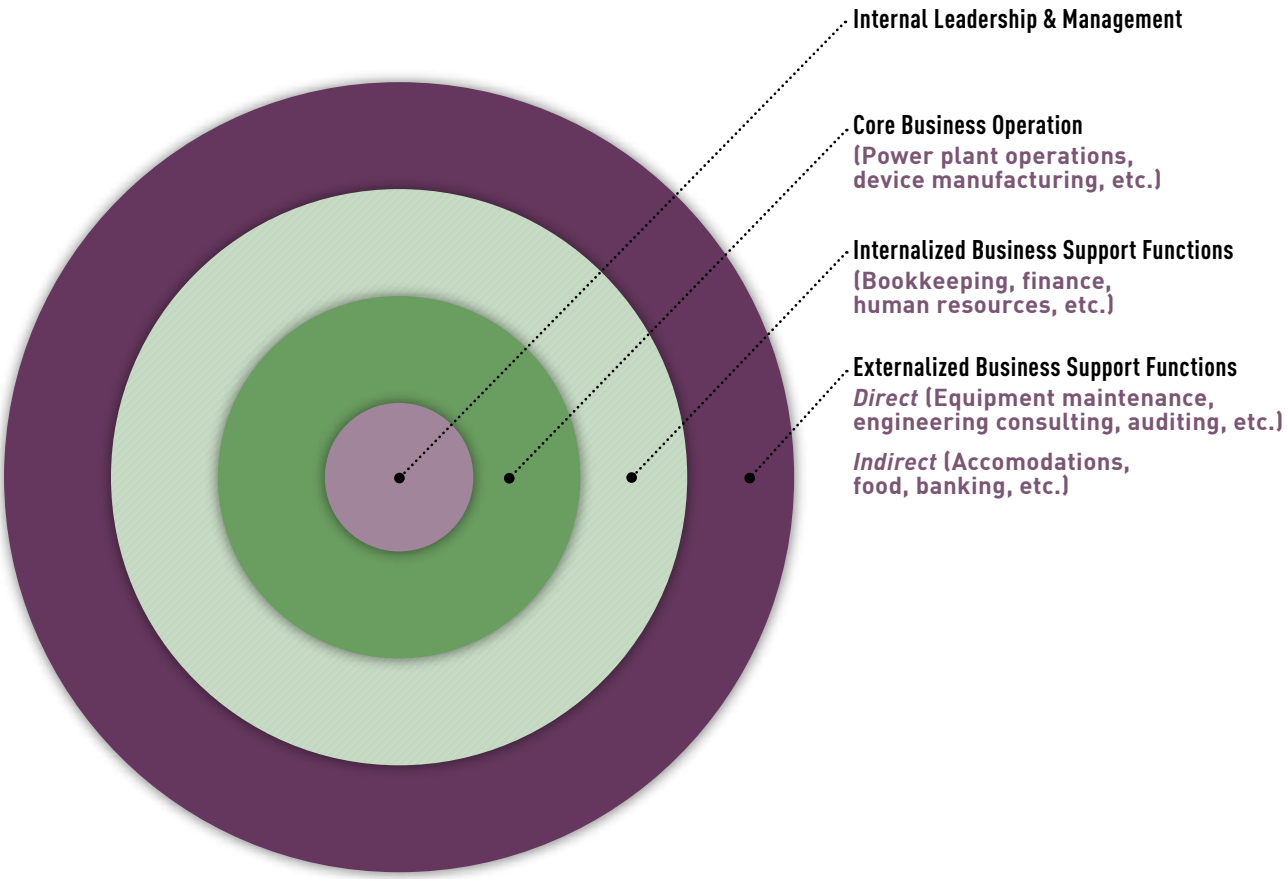
There are many direct and indirect employment opportunities spanning the entire supply chain of the Clean Energy Supply and Storage sector. Companies in this sector will internalize many of the various occupational functions while some are outsourced to third-party service providers (see Figure 5.1).

This subsection reviews the different business and labour needs in utility- and district-scale energy generation, clean energy technology development, and energy storage. The opportunities presented reflect the realities of industry and the opinions of the various industry leaders that were interviewed.

While most of the opportunities for clean energy projects at the utility- and district-scales are during the construction phase, there are opportunities that exist throughout the project and product lifecycles for both clean energy projects and clean energy technology development, respectively.

Figure 5.1: ↘
Business services and labour needs for clean energy supply and storage companies.

Source: GLOBE Advisors



Skilled Trades and Construction

The construction phase for clean energy project and smart grid infrastructure development provides the largest employment potential for this industry. In BC Hydro's recently released human resource strategy for the Northwest Transmission Line project for example, 63% of the identified occupations were for trades, transport, and equipment operations (see Figure 5.2).

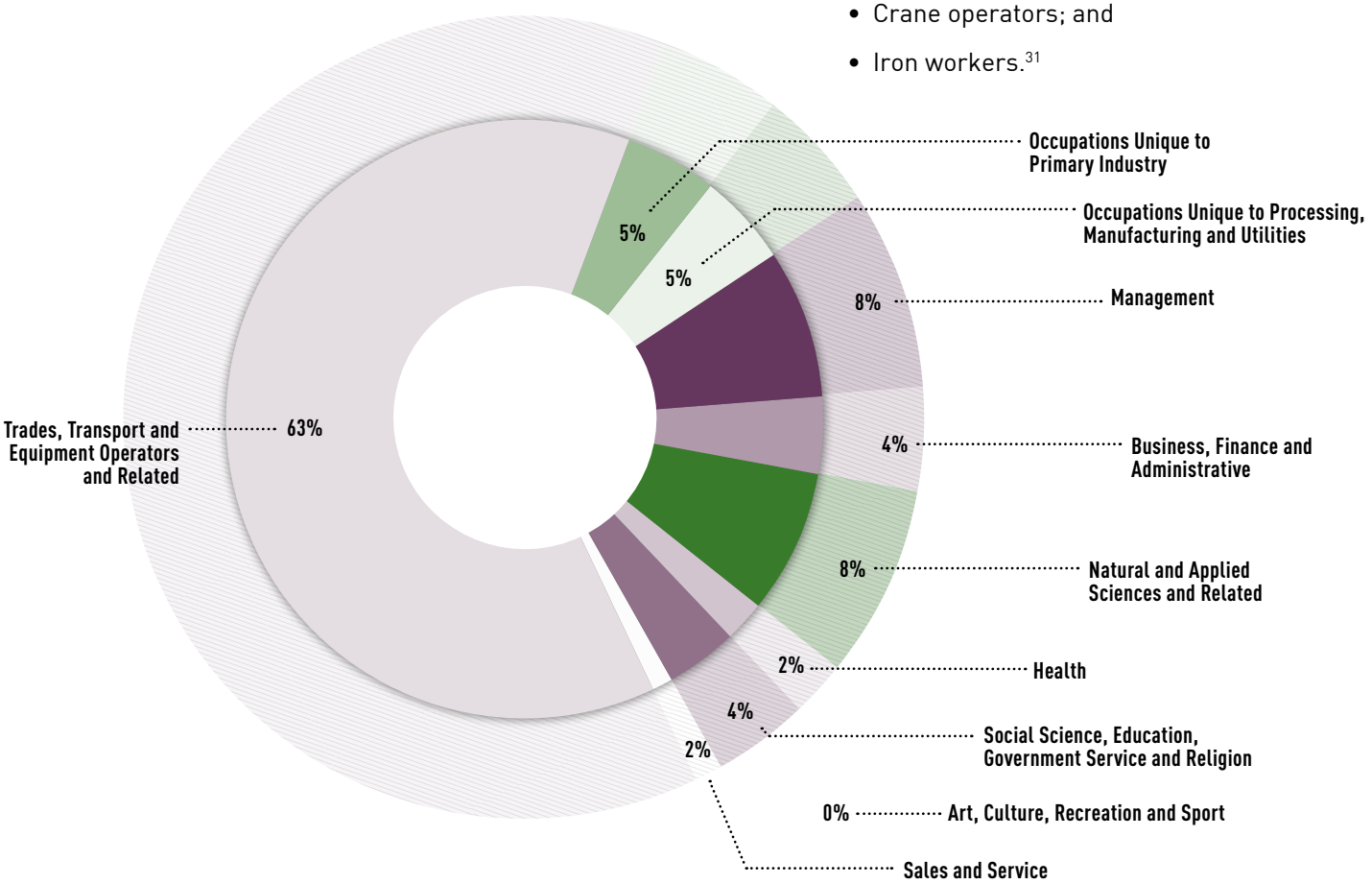
In general, clean energy projects share many similar construction and assembly characteristics with other capital infrastructure projects. As such, skilled trade personnel are required from a wide variety of disciplines depending on the stage and nature of the construction.

Some of the jobs identified as high demand occupations by BC Hydro for the Northwest Transmissions Line project include:

- Heavy equipment operators;
- Construction trades helpers and labourers;
- Drillers and blasters- surface mining, quarrying and construction;
- Contractors and supervisors, heavy construction equipment crews;
- Other trades helpers and labourers;
- Concrete finishers;
- Machine operators, mineral and metal processing;
- Telecommunications line and cable workers;
- Crane operators; and
- Iron workers.[31]

Figure 5.2: ↘
BC Hydro Northwest Major Project Occupations by Percentage of Total

Source: : BC Hydro, 2012



» In the case of BC communities affected by the mountain pine beetle epidemic, transitioning some of the workforce to clean energy projects may be a suitable alternative.

While specific knowledge and training with respect to clean energy is helpful, it is not essential. For example, non-storage hydro will require site excavation, construction, and assembly of the actual turbine-generating unit and penstock structure. These projects are akin to other large-scale developments and will require a full suite of skilled trade professionals to complete the construction work.

Infrastructure will often need to be constructed in support of clean energy projects around the province since many are situated in remote locations. For example, roads, electrical transmission lines, and telecommunication towers may need to be built to facilitate the transportation of materials and to provide essential power and communications services. In these instances, it will be important to ensure that the environmental impact is kept to a minimum.

Combined heat and power (CHP), co-generation, and landfill gas capture systems usually come in prefabricated units and require some construction support. District-heating systems will typically have facilities to store the biomass fuel. These clean energy projects typically will involve trades people such as electricians, carpenters, excavators, heavy equipment operators, and pipefitters to build the required structures.

In many instances, these skills can be sourced locally or nearby the proposed clean energy project site and can provide significant employment opportunities for rural and remote communities. IPP companies that were interviewed for this project indicate that they try to source local workers whenever possible. Wood pellet manufacturers with large production facilities have indicated that skilled trades such as electricians, carpenters, and equipment operators are services they often hire from the communities where their operations are based.

Rural communities, especially those with an industrial cluster, typically have the talent necessary to perform the required duties. This often reduces the costs of setting up on-site camp facilities and allows workers to return home at the end of the day. In the case of BC communities affected by the mountain pine beetle epidemic, transitioning the workforce from the severely affected forestry industry to clean energy projects may be a suitable alternative.[32]

Transmission and infrastructure renewal projects also have a significant need for skilled trade workers that can operate heavy equipment and assemble and construct the various transmission and power lines required for various utility upgrade projects. Currently, BC Hydro is pursuing 11 transmission and distribution projects and 8 power generation projects, all of which require manual ground support in a wide variety of job functions.[33]

While clean energy technology companies are not usually involved in the construction of projects on a continual basis, they do require frequent support from certain skilled trade professionals such as plumbers, mechanics, electricians, welders, and pipefitters.

Many IPP companies indicated that skilled trade services were required for ongoing maintenance of their generation facilities. While many such personnel will be contracted on an "as-needed" basis, dedicated plant management is usually performed by the permanent operators.

Often, skilled trades people will be required for ongoing site maintenance to repair equipment, buildings, and fixtures. For technologies such as biomass boilers, they will often require excavators to dig bunkers for storing the biomass feedstock material.

Photo Credit:
Hemmera

Professional Engineering Services

Engineers from all disciplines including civil, chemical, electrical, and mechanical are required for clean energy project and smart grid infrastructure development, especially those with specialized experience with clean energy technology.

Most if not all engineers in BC belong to the Association of Professional Engineers and Geoscientists of British Columbia (APEGBC) and have the Professional Engineer (P.Eng) designation. Clean energy companies tend to have their own internal engineering staff. Internal engineering staff will typically perform critical planning and analysis functions, including assessing project feasibility or evaluating advanced materials and technologies.

In addition, engineering services are often contracted out to multi-disciplinary engineering firms that can provide complete solutions for their clients. External engineers assume the role of a third-party consultant to provide unbiased technical support, analysis, and advice.

As such, engineering skills are required throughout the clean energy project and product lifecycle. For example, IPP companies will often hire engineering consulting firms to perform a variety of technical studies, such as measuring resource availability and consistency and assessing potential project sites.

Precise engineering services are essential for IPPs to be able to assess project feasibility and operability, and in order to obtain the necessary permits and licenses to pursue a given project. Most importantly, acquiring accurate engineering studies are essential to obtaining an Electricity Purchase Agreement (EPA) with BC Hydro.

While many theoretical principals, such as an understanding of thermodynamics and flows, are essential pieces of knowledge for clean energy engineers, the type of engineering services required by different clean energy projects differs depending on the technology being considered. For example, engineers that specialize in non-storage hydro and wind will have a different skill sets that they will use.

Wind technologies for example will require engineers to measure wind current and flows for the proposed turbine and site. This information is critical for optimal site selection and technology deployment in a configuration that provides optimal electricity generation.

Engineering services are also essential for smart grid infrastructure. As with clean energy projects, these services are often contracted to larger engineering firms such as AMEC and SNC Lavalin, which often also provide general contractor services that include overseeing the entire project.

Many power system engineers that have supported the BC electricity grid over the last several decades are expected to retire in the

» Some clean energy companies in BC have a strong preference for hiring technicians to keep their facilities operating at the highest levels of efficiency.

next few years, at a time when the new smart grid infrastructure will be coming online. The aging workforce and advanced technological developments will provide new opportunities for qualified engineers going forward.

In a recent extensive study on smart grid hiring trends conducted by ZPryme Research and Consulting, hiring managers indicated they are looking for engineers with good problem-solving and analytical skills. Being a team player, taking initiative and having superior communication skills was also identified as critical "soft" skills that employers are looking for when hiring.[34]

Energy storage companies are also looking for qualified engineers. Growing companies active in this space are looking for engineers that can perform duties related to systems design and modeling, fabrication, and assembly of batteries. It is not uncommon for innovative companies in this area to be staffed almost entirely by engineers and other technical staff.

Technicians and Technologists

Technicians and technologists are important to the clean energy industry and perform a wide variety of functions. From the installation, assembly, and monitoring of wind turbines, to supporting clean energy and smart grid plant operations, to the assembly of high-voltage energy storage devices, specialized technicians provide practical support to companies operating in this sector.

Often times, technicians and technologists are required to perform highly-specialized duties. For example, wind turbine operations require wind technicians to frequently monitor meteorological data and assess the conditions of the wind turbines.

BC Hydro requires the support of qualified Power Line Technicians to perform ongoing maintenance and support work throughout its grid infrastructure. Communications, Protection, and Control (CPC) Technicians required for telecommunications and grid infrastructure management are also in high demand. Due to the highly-technical and specialized nature of these positions, it is often difficult to find the necessary people to assume this role.

Some clean energy companies in BC have a strong preference for hiring technicians as they are able to combine practical and theoretical knowledge to keep their facilities operating at the highest level of efficiency. Many of these technicians have been hired directly from post-secondary institutions in the province such as BCIT and Northern Lights College, which have dedicated programs for clean energy technicians.

While technicians perform many hands-on operational and support functions, automation and remote control functions have become increasingly integrated into clean energy projects. As a result, technicians are continuously required to upgrade their skills in order to adapt to these technological changes. For example, most non-storage hydro, wind, and CHP operations are already being controlled and monitored off-site. Technicians need to be able to interpret raw data in order to ensure that the plants are operating at optimal capacity, while being able to identify and troubleshoot problems as they arise.

In many instances, there are opportunities for trained technicians to perform on-site equipment installation in-line with specific requirements for the equipment. For example, equipment installation and some warranty services for a CHP system will be done internally by companies with the

permission of the equipment manufacturer. Installation of energy storage devices onboard marine and land vessels are often also tasked to skilled technicians as part of the customer experience strategy of some energy storage companies.

Ongoing plant maintenance also often requires technology maintenance professionals. Certain clean energy technologies will come with warranty agreements from the manufacturer. Many of these warranty agreements will require IPPs to contract specific technicians for equipment repairs for the first two to five years of operations. This is often the case at wind farms where turbine manufacturers such as Vestas have their own accredited maintenance professionals that IPPs must hire for equipment servicing.

Smart grid technology research also requires technicians and technologists. As one example, BCIT's micro-smart grid project has in the past involved technical experts from a variety of disciplines to support the research activities due to the multidisciplinary nature of the smart grid and its applications. Electrical engineering technicians, computer systems technologists, and power engineering technicians have all been instrumental for advancing this project.

As more clean energy technologies come into commercial operation in the province, it is expected that there will be an increasing demand for local specialized technicians and technologists to support the ongoing development and maintenance of these projects.

Scientific Services and Environmental Monitoring

Scientific services are an integral part of industry growth. Scientific professionals are found in academic, professional, and scientific support roles across the entire clean energy supply and storage industry. This is particularly true in British Columbia where research universities in the province have demonstrated global leadership and advances for research in clean energy. Many scientific innovations that trace their beginnings to post-secondary research institutions in BC have spun-off into successful global companies.

This is the case for companies such as Nexterra, Lignol, and others. These companies employ a significant number of scientists to help develop and refine their technologies. In the case of Lignol, they are looking specifically for scientists who have experience working with biofuels, specifically cellulosic ethanol production.

Since many of the duties require technical and scientific expertise, as well as proficiency using a variety of sophisticated scientific equipment, practical experience is crucial. For example, in cellulosic ethanol synthesis, it is essential that the research team understand the various hydrolysis processes and laboratory techniques. Understanding the practical applications of scientific theories is also extremely important, especially for industrial research.

Scientists working in the clean energy sector may have specializations that range from molecular biology, to biochemistry and advanced material physics. Energy storage companies for example are always interested in evaluating different conductive metals that can increase the capacity of batteries while not affecting the overall quality. Bioenergy researchers are interested in understanding which plants can produce the highest quality ethanol. Many scientists

leading and performing applied research will require advanced academic degrees including Masters and Doctorates.

Biofuel and energy crop companies have indicated that analytical laboratory services are important for helping them understand the chemical and biological make-up of different forms of biomass. Currently, some BC companies are relying on analytical lab services provided by universities in Ontario, services that local scientific labs could potentially be providing.

International companies established in BC have also leveraged on the availability of top-notch researchers in this province to develop commercial rechargeable lithium-ion battery cells. Innovations from BC facilities provide new product solutions to meet battery system demands for hybrid vehicles (HEVs) and plug-in hybrid electric vehicles (PHEVs). Energy storage companies may also require chemists that are experienced in electrochemistry in order to increase the reliability and voltage of their cells.

In the realm of fuel cell technology, research scientists with chemistry and physics backgrounds are important, particularly those with experience on fuel cell specific components such as catalysts and membranes.

» Clean energy projects at the utility-scale also require scientific expertise which may include registered biologists, foresters, archeologists, and anthropologists.

Due to the nature of clean energy technology, scientists often work in multi-disciplinary teams. These teams allow for the fostering of critical ideas and processes while also providing a mentorship framework to more junior members of the team. This is essential as many technologies are exploring areas of science that have yet to be identified.

Clean energy projects at the utility-scale also require scientific expertise which may include registered biologists, foresters, archeologists, and anthropologists. Their professional scientific knowledge is critical at various stages of developing clean energy projects in the province, particularly tied to environmental stewardship, permitting, and ongoing regulatory requirements.

In most instances, while these professional scientists may have advanced academic qualifications, having practical experience in preparing the environmental, ecological, and cultural impact studies required for permitting is most important. These studies can include examining wildlife migration, fish distribution, and hydrological studies, among others.

As part of the EPAs signed with BC Hydro, IPPs are required to perform periodic environmental monitoring around clean energy sites to mitigate any potential environmental risks from operations. This can often be for a period of more than 20 years.

Environmental monitoring is required during a plant's operations and information gathered is reported directly to the Ministry of the Environment. A water license being granted may also be contingent on the submission of properly prepared Operational and Environmental Monitoring Program (OEMP) reports.[35]

Professional field scientists are often required to lead environmental monitoring efforts with the assistance of environmental monitors. Environmental monitors will typically perform the on-site assessments and provide raw data for the biologist to generate the required reports for maintaining the relevant operating licenses and permits. The skills required by these monitors include the ability to assess, identify, and respond to all ecological concerns.[36] They will also have to have a strong understanding of the various scientific and ecological processes. While some of the practical skills can be acquired through on-the-job training, relevant academic education is usually required.

Project Management

Project managers in this sector are in high demand. From community energy projects to clean energy technology research, project management professionals are critical to success. Project managers can be focused on managing construction projects or can have broader responsibilities, such as overseeing entire clean energy project developments. For larger-scale projects, it is common for the project manager to have designations such as the Project Management Professional (PMP), which is the industry standard for proficiency in managing time, cost, and quality variables.

In BC, there are currently a number of consulting firms that specialize in project management for clean energy developments. Many typically specialize in one or two types of generating technologies due to the highly-technical skills required. For example, Clean Energy Consulting, based in Prince George, specializes in non-storage hydro, biomass, and waste-to-energy project management and technical engineering consulting.

During the construction phase, project managers will be assigned by the general contractor or hired independently. For

» Project managers can be focused on managing construction projects or can have broader responsibilities, such as overseeing entire clean energy project developments.

large-scale projects such as BC Hydro's infrastructure upgrades, project managers may be assigned by the construction firm overseeing the project. For smaller-scale or community energy projects, especially in remote and rural communities, the willingness to learn and the passion to drive forward the proposed project were identified as the most important traits for the project manager. This is due to the broad responsibilities these individuals must carry.

Community energy project managers help to oversee the feasibility of a project over its lifetime. They are typically well acquainted with the communities' needs, as well as with clean energy project design for a given technology. Community energy project managers will also be required to oversee grant applications and advance the permitting process through constant communications and consultations with BC Hydro and other important stakeholders. They will also be heavily involved with Community Energy and Emissions Planning (CEEP) initiatives. CEEPs often require professionals from a variety of disciplines to consider the following:

- Energy auditing to confirm alignment with the goals of the CEEP;
- A gap analysis to identify forecasted demands and loads for the next 10-20 years;
- Demand-side management opportunities;
- Determining the best technology options for the community;
- A cost-benefit analysis between diesel fuel generation and the various clean energy options; and
- The potential for future grid connectivity and electricity sales to BC Hydro.[37]

As such, the actual functions of the project managers can range quite widely and can include engineering, marketing, finance, accounting, legal, and strategic planning. While they are not expected to be an expert in all areas, they will need to know how to bring in expert advice when needed. In rural and more remote communities, project managers can be extremely difficult to find.

Communities and companies interviewed have indicated that having a dedicated project manager is critical as there are many variables and changes that can occur throughout a project's lifecycle. This is especially true with rural and remote community energy projects where the skill capacities of smaller communities do not compare with larger urban centers. Having someone who can identify potential risks and immediately draw on available resources to overcome these challenges is imperative.

Clean energy technology companies engaged in innovation may also have project managers to oversee the various phases of research and development. Critical to their role is the ability to balance time and budget variables. However, project management duties for these companies will be rolled into the responsibilities of the team leader or senior researcher.

» Most ICT firms are characteristically small and new business models are enabling SMEs to be globally competitive with their products and services.

Information and Communications Technology (ICT)

Information and communications technology (ICT) and information systems (IS) play significant roles for this industry as power operations have become increasingly computerized. Data management and Application Programming Interface (API) for example are integral to the modern clean energy industry. Often these services are outsourced to third-party firms who can provide support for both hardware and software related issues.

Many of the specific technical requirements for clean energy projects require customized software packages, and these specialized service providers can help both clean energy companies and utilities to design the best ICT solutions to fit their needs. In some instances, solutions have actually shaped the way industry is growing. For example, many clean energy site operations now have data wirelessly transmitted to mobile devices that can be monitored from anywhere in the world.

Smart grid infrastructure in particular requires a tremendous amount of ICT support. Forrester Research has identified three key areas that pose as opportunities for local ICT vendors and related employment (See Figure 5.3).

For smart grid data management alone, it is expected that the global market value will grow to US $4.2 billion by 2016.[38] Most ICT firms are characteristically small and new business models are enabling SMEs to be globally competitive with their products and services. This trend is allowing entrepreneurial computer engineers and scientists to design products and services to meet domestic and/or international market needs. British Columbia is particularly well-positioned to exploit the opportunities with a strong existing ICT cluster in the province.

ICT and IS service providers require business analysts, computer and software engineers, network analysts, and administrators who can perform the necessary system design and technical support as required. BC Hydro for example has large contracts with Telus and Accenture to support their ICT needs.

Figure 5.3: ↘
Three Key Segments of Smart Grid ICT Services

Source: Forrester Research Inc.

Generation, distribution network services, and asset management

- Wireless relays
- Routers
- Switches
- Subscriber modules
- WiMax
- Cellular
- Point-to-point and multipoint mesh
- Network management
- Capacity analysis

Customer application services

- Customer web portal
- Energy consumption and management tools
- Rate analysis
- Pricing and billing
- IHD
- Cloud and Saas
- Data management
- Data analytics
- Bill management

Grid optimization services

- Demand response
- Outrage detection and management
- Work order management
- Substation automation
- Field force management
- Managed services
- Network management

Plant / Facility Operations and Maintenance

Utility operators provide the day-to-day operations, monitoring, and maintenance services for these generating facilities. While many operational functions of clean energy projects are automated, trained operators are required to interpret transmitted operational data using advanced computer systems and software programs.

Analysis of technical, environmental, and operational information is required on a regular basis by trained operators. These services are usually managed in-house, but occasionally larger IPP companies may elect to outsource these duties to specialized engineering firms who have the economies of scale to operate multiple clean energy projects at lower costs.

Wind turbines will for example transmit meteorological, wind speed, and performance data back to centralized computers off-site. Non-storage hydro facilities will also transmit data with respect to intake and water flow rates. Technology is also available for CHP and co-generation to have critical information wirelessly transmitted to personal computers, smart phones, or tablet devices, which allows for plant operators to respond in real-time to any potential issues or concerns. Thus, not only do operators require the necessary technical skills to interpret these measurement outputs, they also require an appreciation of modern ICT applications and solutions.

For landfill-gas-to-energy, CHP and co-generation systems, and other technologies requiring more hands-on operation, equipment manufacturers often provide mandatory training with respect to maintenance and "troubleshooting". In most instances, IPPs and/or municipalities will have wastewater treatment plant operators and technicians who are already employed and can be trained to operate these new technologies.

Other occupations important for the operation of some clean energy projects include power operators, electrical technicians, instrumentation specialists, and pulp mill technicians. These individuals typically will have completed a technical skills program and have the appropriate certification and operating tickets. For bioenergy projects, securing a solid biomass fuel supply is also essential and requires labourers that can cut, salvage, and/or transport some fuels to the plant operations.

Most plant operators will require some form of technical certification, and not necessarily any higher levels of post-secondary education. According to those interviewed, it is more important that operators have the necessary mechanical and technical expertise than the theoretical background. Oftentimes, due to the remote locations of the clean energy facilities such as large storage hydro dams, operation jobs can be difficult to fill.

Since some clean energy technologies in operation are relatively new, operators are expected to have a deep passion for learning new skills and must be able to adapt to ongoing changes in the workplace. So-called "soft skills" are critical for operators as they must be able to identify problems as they occur and inform more senior management if and when equipment servicing is required.

» Community and stakeholder engagement professionals will often be sourced near the site of proposed projects.

Energy storage companies also require facility operators, but as these companies are primarily export-focused manufacturers, these individuals must understand the principles of supply chain management, as well as just-in-time (JIT) and lean manufacturing processes.

Community and First Nations Engagement

Community and First Nations engagement is important for companies looking to obtain buy-in and for moving clean energy projects forward. Community residents and property owners close to the sites of proposed clean energy projects may have concerns related to downside risks such as environmental impacts as well as upside risks such as the potential for local economic development. Clean energy companies thus will have public relations professionals that can help address questions and concerns and also pass along feedback to the company for further improvement.

In many smaller companies, outreach functions are performed internally by the Chief Executive Officer or another senior executive. In some instances, external agencies are hired to assist with community and stakeholder engagement initiatives. Stakeholder outreach and engagement professionals are expected to be able to address issues from two main perspectives:

- **Externally-facing**: Engage communities and external stakeholders on behalf of the firm and provide essential information regarding the various economic, environmental, and social benefits/impacts from the development of a clean energy project.
- **Internally-facing**: Engage corporate decision-makers and project management staff on the comments and concerns gathered through their external stakeholder processes.

In some instances, community and stakeholder engagement professionals will be sourced near the site of proposed projects. This is because having local knowledge and the ability to interact on a frequent basis is important for building meaningful bilateral relationships. Due to the constant interactions with various stakeholders, effective communication, listening, and attention to detail are important attributes.

Community and stakeholder engagement is also an important aspect of BC Hydro's demand side management program. The utility has teams that are dedicated to working with communities and individuals to help achieve their energy conservation objectives. For example, BC Hydro has dedicated staff that run its "Energy Ambassador Program" for secondary school students, as well as Power Smart outreach teams that educate the general public on the benefits of energy efficiency. For BC Hydro's "Smart Metering" program, communications companies were hired to manage public outreach and education activities.

Notable stakeholders for many clean energy projects are First Nations since many of the projects in BC are proposed for development on non-treaty First Nations' lands or in designated traditional territories. As such, an understanding of cultural, territorial, and land-use issues is essential for stakeholder engagement professionals.

In most instances, meaningful First Nations consultation is legally required and is a mandatory part of the Environmental Assessment and permitting process.[39] BC Hydro, as part of its EPA granting process, also assesses the adequacy of First Nations consultations.[40]

Photo Source:
BC Government

Many IPPs and clean energy technology companies contract specialized individuals and/or consulting firms that understand First Nations' issues and more importantly, have a strong working relationship with the relevant First Nations groups. BC Hydro has dedicated staff that can help address issues specific to First Nations communities and also provides practical support to communities looking to develop clean energy projects.

Building positive relationships with communities creates win-win situations for those involved. IPP companies, such as Run of River Power and Veresen as examples, have built strong relationships with local communities where they have projects and have provided economic development support to many of these communities. Oftentimes, supporting the capacity development in local communities also secures a reliable workforce for these companies in the future.

» Supporting the capacity development in local communities also secures a reliable workforce for companies in the future.

Management and Professional Business Support Services

Management and business services are essential elements of successful clean energy companies. Most companies tend to have small organizational structures with a core management team that runs the day-to-day business operations. This also means that critical business duties are often completed by these small but dedicated cross-functional teams. Since clean energy is a relatively new industry, staff must have strong business acumen and entrepreneurial attitudes.

During the clean energy project feasibility stage, management teams, along with the support of internal engineering and technical staff, are usually required to assess the following items:

- Available resources (wind, water, biomass, biogas, etc);
- Land and resource ownership (Crown, First Nations, private, etc);
- The potential revenue based on unit costs for project components;
- The costs of project development at each site considered; and
- The availability of workforce, business services, and existing infrastructure near a project site.[41]

Duties that are required by these companies include leadership, marketing, business development, finance attraction, accounting, and administrative services, most of which do not require industry-specific knowledge. Many senior managers and officers will have scientific or engineering backgrounds which allow them to identify both the business opportunities and the technical requirements of each. Some clean energy technology companies have indicated that due to the highly-technical nature of their products, they only hire ex-CEOs with experience generating new sales.

Clean energy companies have access to both public and private sources of financing. As such, finance professionals that can help companies with financial planning, attract capital, and perform the necessary analyses are essential. Bankers, financial analysts, and accountants support many of these internal business functions.

Most business professionals are also required to have an understanding of financing and be able to maintain cost control measures. This is particularly important in the clean energy industry as many firms are small in size and properly managing cash flows is extremely important for a company's long-term viability.

For companies that are tapping into export markets, intellectual property (IP) protection and the ability to create strategies to help mitigate the risks around IP loss is extremely important.

This is especially true when the company is based upon a single technology, such as biomass gasification or high-voltage batteries. While the company itself may have staff to monitor and protect IP through the design of robust contractual agreements, external legal advisory services are contracted to close any potential legal gaps which may expose a company to unnecessary risks.

Legal advisory services are not only limited to IP issues. IPPs will often have lawyers that can draft and review contracts and other legally-binding documents for permitting requirements and for assisting with the Electricity Purchase Agreement process. For clean energy projects occurring on First Nations land, lawyers may play a critical role in land-use and compensation contract negotiations.

» Hiring managers in this industry tend to prefer sourcing employees and services via "word-of-mouth".

WORKFORCE RECRUITMENT AND RETENTION

The recruitment and retention of skilled workers in this sector can be a challenge for companies in British Columbia.

One of the major challenges faced by companies is the ability to attract experienced professionals from established clean energy clusters from around the world to BC. Individuals looking to move to the province may have to leave an established industry network and relocate with family to British Columbia where the relative cost of living can be high. BC companies have successfully leveraged on federal and provincial programs to promote and attract individuals to the province.

Recruitment practices vary greatly depending on the size of the company and the type of skills or services required. Hiring managers in this industry tend to prefer sourcing employees and services via "word-of-mouth". This is especially the case with very specialized disciplines such as engineering and scientific research. Employers are looking to their industry peers to identify the best talent for the position based on their hiring criteria.

However, word-of-mouth is not always feasible and companies have indicated that traditional means of recruitment, including newspaper advertisements, on-line job postings, as well as social media platforms such as Linked In, Facebook, and Craigslist, are common tools.

These tools are mostly deployed for the recruitment of entry- to mid-level positions in a variety of disciplines ranging from engineering and scientific services to construction trades and depend on factors such as the:

- Job duties and service required;
- Size of the hiring company;
- Existence of an internal human resources strategy; and
- Budget allocation for sourcing new staff.

As for senior management positions and some highly-specialized professions, companies will often work with third-party recruitment agencies to undergo a global talent search. In some instances, there are only a select number of suitable candidates around the world so having professional recruiters is important.

Clean energy companies will also often try to source skilled workers from rural and First Nations communities near where their projects are located. Oftentimes, the company will provide training and on-going support, resulting in win-win scenarios for both the company and the community. These positions may range from technical assistance, environmental monitoring, to skilled trades and construction.

Co-operative education (co-ops) and internship programs (for engineering and technical firms) and apprenticeship programs (for companies in construction and trades) are very common pathways used by companies to recruit successful graduates. Often these students will have gained valuable experience during their term and can immediately add value to these companies.

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.

» While not all opportunities in the Clean Energy Supply and Storage sector require advanced education, many require some form of industry certification or credential.

EDUCATION, TRAINING, AND PROFESSIONAL DEVELOPMENT

External Education, Training, and Experience Factors

A strong commitment to clean energy knowledge and skill development from research facilities, post-secondary institutions, and centers of excellence across the province is helping to build local capacity in the sector.

Much of the research from post-secondary institutions, such as University of British Columbia (UBC), Simon Fraser University (SFU), the University of Victoria (UVic), and the University of Northern British Columbia (UNBC), plays a critical role in not only developing the necessary skills for youth to succeed in the labour market, but has also incubated many successful companies which have in turn supported local employment. These institutions have provided a strong platform for students to develop knowledge to help them structure realistic frameworks for turning their ideas into innovative solutions in the sector.

An example is UBC's world-class Clean Energy Research Centre. The center is home to the very successful Master of Engineering in Clean Energy Program, which provides courses directly related to demand-side management. In addition, students have the opportunity to participate in a co-operative education program, which has a specific focus on energy efficiency and conservation related projects.

SFU's Applied Sciences department has also recently developed curriculum for an Energy Systems Engineering program, the first of its type in North America. The proposed program is designed to equip graduates with the necessary practical and theoretical skills to meet today's industry challenges.

While not all opportunities in the Clean Energy Supply and Storage sector require advanced education, many require some form of industry certification or credential. This is true despite the fact that certain technical operations are simple enough to only require practical skills-based training. However, with a trend towards industry standardization, certification of various job functions has become increasingly common.

Some non-storage hydro companies in BC have paired with universities and colleges in the province to educate students on the technologies and practices that are being utilized in their operations.

Other companies have directly invested in training facilities to provide the necessary training for power plant operations.

Wind energy developers have established educational partnerships with post-secondary institutions including BCIT, North Island College, Northern Lights College, and UNBC. Northern Lights College has developed a unique Wind Turbine Maintenance Technician Program (see Profile Box 6). While this program is helping to build local workforce capacity, more wind projects need to get off the ground before all graduates are able to find employment in the province.

BC Hydro also has partnerships with the BCIT and the Northern and Southern Institutes of Technologies in Alberta to train Power Line Technicians (PLT). In the past, the utility has also worked with the Electricity Industry Training Institute (EITI) to deliver apprenticeship-training programs but have recently begun providing these training programs in-house in order to broaden the technical training for its PLTs.

Interviewed respondents identified co-operative education programs (co-ops) as being extremely effective in providing

PROFILE BOX 6

TRAINING TOWER HELPS GET WIND TURBINE TECHNICIAN PROGRAM OFF THE GROUND

Photo:
Wind turbine technician at Bear Mountain wind farm near Dawson Creek

Source: AltaGas

The Dawson Creek Campus of the Northern Lights College secured funding in 2011 to construct a new training tower for use in the college's innovative **Wind Turbine Maintenance Technician Program**. The training tower is designed to replicate the conditions faced by wind turbine technicians when repairing, maintaining, installing, or doing other work on a wind turbine system.

Dawson Creek is an ideal location for this new trades program. Wind energy is a new and growing source of electricity production in British Columbia, and throughout North America, and there is a particular development of the sector in Northeast BC. By incorporating the new training tower into the Wind Turbine Maintenance Technician program, Northern Lights College is helping its graduates to qualify for BZEE certification, an international standard required by many wind turbine companies. The Wind Turbine Maintenance Technician program offers residents of Northern BC a unique opportunity to enter this field, as it is the only program of its kind offered in British Columbia.

The Wind Turbine Maintenance Technician Program will create up to 24 highly skilled and employable technicians each year, which in turn will support local, sustainable employment. Further, the availability of technicians will support the growth of the wind energy sector.

With more than a dozen 1000+ megawatt wind farms being planned for British Columbia, there will be a high demand for the products needed to build the wind turbine towers. The tower used in the Wind Turbine Maintenance Technician Program will be used as a model to demonstrate that the towers can be built from cross-laminated timber. Each tower uses an estimated 1,000 cubic metres of wood, which could result in a new demand for local timber and lumber products along with the creation of hundreds of new full-time jobs in the region.

Source: **www.northerndevelopment.bc.ca**

graduates with practical work experience to support theoretical in-class learning. It was suggested by several of those interviewed that all post-secondary academic programs should be lengthened in order to accommodate co-op programs and allow graduates to enter the workforce with at least one to two years of on-the-job experience.

In addition, there is an increasing trend for post-secondary and technical institutions across the province to deliver curriculum that weaves sustainability into programming in order to meet industry needs.

Clean energy related industry associations that provide training programs for their memberships are increasingly implementing sustainability principles into their curriculums. In recent years for example, there has been a growing demand for geo-exchange and district energy related training. As such, the Canadian GeoExchange Coalition and GeoExchange BC work together to develop curriculum that will help to ensure that BC workers have the skills required by industry.

Finally, for many individuals in rural communities, obtaining education and certification may be a significant challenge in itself. Mentorship programs for some remote and First Nations' communities provided by the Fraser Basin Council and Human Resources and Skills Development Canada were identified as helping to build the necessary skills and capacity in more remote communities.

For more information on education and training related to the Clean Energy Supply and Storage 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

Interview respondents identified that on-the-job training is an essential part of their companies' operations. While the majority of in-house training initiatives do not result in formal certification or credentials, it does equip employees with the necessary skills to perform their day-to-day responsibilities.

Internal capacity building has become characteristic of many clean energy businesses. Due to the fact that most clean energy technologies in the province are relatively new (with the exception of storage- and non-storage hydro), there are very few skilled workers available locally who have the technical skills required to install, operate, and maintain these projects. As such, employers tend not to hire based on extensive experience requirements, as would be the case for job postings in other industries.

Internal training is also becoming increasingly important as the "baby boomer" generation that has supported existing power generation facilities and transmission infrastructure in the province begins to enter retirement. New hires will be necessary in order to fill existing positions and ongoing training will be required for employees in order to address technological advances.

To build knowledge and experience capacity, many companies are offering team-based learning and mentorship opportunities for staff, especially new hires. This allows senior team members to provide practical skills-based training to junior staff and to help develop the necessary critical thinking required to adapt to changes in the workplace. This is common especially for scientific and engineering teams where new members are brought up to speed on current projects.

Some clean energy technology companies may also benefit from existing clusters of talent in the province. For example, in some engineering and computer science disciplines, it is not uncommon for employees to move from one company to another based on projects that require specific expertise. In a sense, this provides the industry as a whole a set of available talent that is cross-trained in various related aspects of technology development within their industries.

Utility companies including BC Hydro, FortisBC, and Corix, have structured formal training for hires. These companies also offer opportunities to staff that allow them to design their own career paths and provide support to staff in order to help them achieve their career goals. Companies, such as Schneider Electric, also provide leadership development programs for staff with an emphasis on developing a culture of empowerment and safety throughout the entire organization.

To address the high-level of sophistication and technical know-how for operating more advanced systems, such as wind farms, co-generation, CHP, and waste-to-energy facilities, technology suppliers are often contractually obligated to train operators on the equipment.

Some interviewed IPPs expressed a strong willingness to provide the necessary workforce training to communities near their projects. For clean energy projects, including non-storage hydro and wind, on-the-job training is often a negotiable item between the IPP and its community partners during the feasibility phase. This is most common where the community partner is a First Nations group. These efforts help to build skills, services, and local capacity in communities.

» Finding qualified workers for the construction of both power generation and infrastructure projects can be a challenge.

STAFFING CHALLENGES AND KNOWLEDGE, EDUCATION AND TRAINING GAPS

Key Staffing Challenges

Scientific and Engineering Services

While there is no shortage of new graduates with an engineering education, there is a significant demand for skilled and experienced engineers related to clean energy. This is especially the case with technologies that are being more widely adopted throughout the province, including wind, CHP, and co-generation. Industry is still relying heavily on importing engineering services from abroad to fill these gaps.

Scientific researchers for new clean energy technologies are also often difficult to source. This includes scientists working with advanced biofuels and the development of clean energy generation technologies. Since most industrial research in this area is cutting edge, it is often difficult to find scientists with the required experience levels to work on specific research projects. At times, there may be only a handful of experts in the world with the necessary skills.

While BC can be considered a world-class center for clean energy innovation, highly-skilled and experienced technical workers and researchers are still being brought in from other parts of Canada, the United States, and Europe to help fill certain skill gaps.

Attracting and retaining these talented individuals from other well-established industry clusters proves challenging, partly because of the high cost of living in British Columbia and the fact that many wish to advance their careers in locations with other industry peers.

Ironically, in instances where the academic capacity exists in the province, there are often not enough projects to engage graduates. This is a reality that the clean energy industry is facing as a whole and it is due to the relatively sparse technology deployment across the province.

Clean Energy and Transmission Infrastructure Construction

Finding qualified workers for the construction of both power generation and infrastructure projects can be a challenge. While companies try to source workers close to where projects are under development, this is not always possible. Many companies face challenges recruiting skilled people to work in more remote parts of the province.

This situation is especially prevalent in Northeastern BC where companies overseeing these projects have stiff competition with out-of-province opportunities that offer higher wages and more benefits, such as with Alberta's booming energy industry.

Construction and clean energy development project managers are also often difficult to source. One clean energy project developer indicated that it was so difficult to source project managers for overseeing existing non-storage hydro projects that the company was forced to hire someone from Eastern Canada for the role.

Knowledge and Information Gaps

Overall, the companies from this sector that were interviewed were very pleased with the educational programming provided by post-secondary institutions across the province. However, most companies indicated that while the theoretical knowledge is well-established in BC, there remains a significant need for students and graduates to obtain the critical hands-on experience in order to apply the theoretical knowledge.

Experience is critical for industry development and in many cases, experienced workers are lacking. For example, cellulosic ethanol production in BC uses such new technology that most individuals working in this space lack the decades of experience that would be required in more established industry sectors.

Some CHP and co-generation plants source their ongoing technical maintenance support from the United States and Germany due to the highly-specialized nature of the technology. While this practice is not cost-effective and sustainable in the long-term, it is the only option presently available due to the lack of qualified and experienced experts in the province.

That being said, companies recognize that many of the technologies and practices being used by industry are relatively new and most graduates will not have the opportunity to gain practical experience.

As such, companies tend to foster a culture of excellence through team-based work settings that allow recent graduates an opportunity to learn on the job relatively quickly.

Many IPPs operating in the province have recognized this problem and are adopting long-term solutions for mitigating some of the challenges. For example, some IPPs have paired with post-secondary institutions in the province to develop the required knowledge and skill-sets to support industry growth and development.

6. BARRIERS AND ENABLERS FOR SECTOR GROWTH

Many issues affecting job growth were identified by business leaders active in the Clean Energy and Energy Supply 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.

POLICY

BARRIERS

Industry Growth is Dependent on Public Policy

- Many respondents identified uncertainties in public policy with respect to clean energy adoption as a factor limiting growth of the industry. Uncertainty regarding calls for clean power hampers industry planning around the Electricity Purchase Agreement process.
- The new strategic alignment to develop natural gas resources in BC led some respondents to question whether opportunities would continue to exist for traditional clean energy producers in the near to medium term.

Funding Cuts to Government Programs

- Recent cuts to federal government programs and services were seen by some clean energy companies as limiting available support from Canadian trade offices. Many such companies are small and depend on the international trade support network for promoting their products and technologies.
- Reduction in funding support for technology commercialization was also seen as a barrier to growth. For example, the hugely successful Sustainable Development Technology Canada (SDTC) Technology Fund has not received additional support and the provincial Innovative Clean Energy (ICE) Fund is awaiting reinstatement of the PST before additional commitments are made.

POLICY

ENABLERS

Clean Energy Planning and Commitment

- Respondents suggested building into BC Hydro's pending *Integrated Resource Plan* (IRP) a firm schedule for calls for renewable energy whenever an energy supply shortfall is predicted. This would allow companies to better plan their use of financial and human resources, and to plan project development efforts in sync with the clean energy opportunities.
- Also called for inclusion in BC Hydro's IRP was a clear and transparent consultative processes with industry players, a fixed schedule for clean energy bid calls, and legally-binding commitments to achieve certain levels of clean energy in the mix of the province's total energy supply.

Leveraging the Province's Global Network

- Respondents called for additional business networking support through the Province's international trade offices to allow BC clean energy companies to realize all important international opportunities.

Promoting Market-based Financial Mechanisms

- Respondents called for more market-based supports to accelerate early stage research and development and commercialization through initiatives such as demonstration projects, tax incentives for investors, accelerated asset deprecation, and the use of provincial government procurement of clean energy.

ECONOMIC

BARRIERS

Low Cost of Energy in BC

- It is well understood that BC's low-cost hydro electricity decreases the demand for clean energy from independent power producers (IPPs). These IPPs find it difficult to be cost competitive with BC Hydro's relatively cheap energy offerings, noting also that the lack of diversity in the province's energy portfolio increases the risks of reliance on aging hydro-electric infrastructure.

Resource Management and Security

- Security of feedstock material is a concern for biomass-to-energy producers. Many communities with biomass district energy systems have signed 20-year contracts with local sawmills for feedstock supply. Reliance on a single source of material increases operational risks for these communities. As an example, the City of Prince George's district energy system was forced to use backup natural gas when its sawmill feedstock supplier burned down in early 2012.

Small Domestic Competitive Markets

- Canada in general and BC in particular are relatively small markets for clean energy technology sales and deployment. Low population and large geographic dispersal in Canada make it difficult for clean energy technologies developed in the province to achieve market economies of scale.

ENABLERS

Levelling the Playing Field

- Leveling the playing field by reducing oil and gas subsidies and adopting financial measures such as sunset credits[42] would allow oil and gas subsidies to be paid out in the form of credits which could be used for the development of clean energy alternatives.

Creating the Competitive Landscape

- Deregulation of parts of the province's electricity supply could allow private clean energy producers to compete and would provide a competitive basis for clean energy alternatives to enter the marketplace.

Supporting Technology and Building Export Potential

- Export potential exists for many BC clean energy technology companies. Supporting export activities through tax incentives and programs such as the City of Surrey's "Energy Shift Program" could help to keep companies in BC and build further capacity.

SOCIETAL

BARRIERS

Smart Grid Infrastructure Misconceptions

- Misinformation about smart meters is being actively distributed, creating a basis for misunderstanding. Concerns over safety of radio communication, personal privacy, and security of electricity grid are common in many jurisdictions.

Clean Energy Project Apathy

- Community acceptance of distributed energy systems is often lacking, creating resistance from some rural and remote communities that could benefit from such projects. Often these communities lack the necessary skill sets needed to support such projects.

Competition for Skilled Labour from other Jurisdictions

- Many essential skilled trades and construction workers have been attracted to better paying out-of-province jobs. The New West Partnership (NWP 2010) and the Trade, Investment, and Labour Mobility Agreement (TILMA 2006) have helped workers to find jobs in other provinces at the detriment to businesses in BC.

ENABLERS

Education and Public Outreach

- BC Hydro could lever its highly successful Power Smart program to further promote the benefits of smart grid infrastructure upgrades. Public education about the positive benefits of clean energy such as reduced greenhouse gas emissions must be linked to the efficiency gains of smart grid infrastructure roll-out.

Workforce Retention

- A re-assessment of cross-border agreements may help to better balance the job opportunities and to create equal opportunities at home for BC workers.

TECHNOLOGICAL

BARRIERS

Technology Risk

- Many clean energy companies are challenged to obtain financing, from both financial institutions and private lenders, because their risk profiles are too great for these investors. This creates a situation where many innovative products and solutions are being developed in BC, but only a few are being fully commercialized, often by out-of-province investors for other markets.

Lack of Platforms to Test New Technologies

- Many clean energy companies with promising technologies decried the lack of a structured framework within which to prove the commercial viability of their innovations. The inability to prove technologies and business models needed to penetrate new markets was seen as a challenge even for projects that had received significant public funding.

ENABLERS

Public-Private Partnerships in Risk Management

- Public-Private Partnership (P3) models could lessen risks in this sector. Models including those proposed by the International Energy Agency (IEA) could help decrease the overall risk profile of clean energy technologies.[43] This would entail governments providing guarantees against potential losses from technology deployment.

Testing and Demonstration Zones

- Support for more demonstration projects in the province could help investors identify commercial applications sufficient to generate profits to offset concerns. Financial incentives to municipalities and other public institutions to take on demonstration projects would create more opportunities for clean energy technology deployment.

Developing Community Energy Learning Resources

- There is a significant opportunity for remote communities with established community energy facilities to share their experiences with others. Creating resources that highlight the business case for community energy projects, as well as guidebooks, checklists, and case studies can help communities across the province with clean energy project feasibility planning and development.

7. CONCLUSIONS

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

The Clean Energy Supply and Storage sector profiled in the foregoing sections is already a significant generator of well-paying jobs in British Columbia, employing an estimated 25,100 full-time equivalent workers (13,000 direct and 12,100 indirect) in 2011 in a variety of occupations. This sector is also estimated to have generated some $4.9 billion in GDP ($3.9 billion direct and $1.0 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 clean energy and 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.

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

1. **Clear and stable policy frameworks** – Having clear and stable policy frameworks that encourage private sector investment are crucial to the creation of more jobs and the deployment of innovative clean energy technologies across the province.
2. P**ursuing clean energy and emissions planning** – Communities in the province can begin pursuing Clean Energy and Emissions Planning (CEEP) to assess the feasibility and the benefits of community clean energy projects. This allows communities to assess their existing energy needs and how they might be met through the deployment of clean energy technologies in order to provide cost savings and long-term energy security.
3. **Increase partnerships and collaboration** – Collaboration between governments and the private sector can help to identify and exploit synergies to grow the clean energy industry. The research conducted for this project has revealed numerous instances where collaboration and strategic partnerships have resulted in industry success to date.
4. **Develop greater export capacity**– Significant global opportunities exist for clean energy technology companies. However, with most companies being small to medium in size, penetrating new markets with a wide variety of barriers to trade presents significant challenges for companies. Providing greater levels of foreign trade support to these companies could accelerate growth of the clean energy technology companies and solution providers.
5. **Level the playing field** –The low cost of electricity and natural gas in the province increases the opportunity cost for the deployment of clean energy. Promoting a competitive marketplace is paramount for long-term market penetration of clean energy technologies. Innovative financial mechanisms such as sunset credits to create a cost-competitive market landscape can also be adopted.
6. **Focus on increasing productivity** – Increasing productivity is critical for realizing the opportunities in the Clean Energy Supply and Storage sector. This will require a combination of investment and technology innovation, as well as training for workforce development. Investing more in skills-based learning will be critical for boosting productivity levels.
7. **Facilitate knowledge transfer** – Promoting knowledge transfer across the Clean Energy Supply and Storage 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 Clean Energy Supply and Storage 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 Clean Energy Supply and Storage 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.[44]

The identified NAICS codes were verified by cross-checking the primary NAICS codes of identified companies in the Clean Energy Supply and Storage 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 survey [45], resulted in a hybrid methodological approach to calculating industry intensity ratios for BC's Clean Energy Supply and Storage 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.

For example, approximately 15% of the total revenue for the Other Miscellaneous Wood Product Manufacturing industry can be attributed to clean economy-related activities including the domestic sales and international export of wood pellets. Approximately 5% of the province's engineering services were also

estimated to be associated with clean energy-related projects, which include engineering consulting, development, and deployment of renewable energy technologies across the province.

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 Clean Energy Supply and Storage 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 Clean Energy Supply and Storage 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 Clean Energy Supply and Storage 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). This North America first legislation requires all public sector organizations by law to become carbon neutral by 2010. Public sector organizations that fail to reduce to these levels are obligated to purchase carbon offsets from the Pacific Carbon Trust.

BC Energy Plan (2008)

The Energy Plan highlights the BC Government's commitment to clean energy leadership and position the province as a global leader in this sector. This plan saw the development of a suite of programs and initiatives that have supported pre-commercial, and commercial clean energy companies develop their products to help advance the province's conservation, energy efficiency and clean energy objectives.

Programs and policies emerging from this plan includes the establishment of the Innovative Clean Energy (ICE) Fund and the BC Bioenergy Strategy.

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 Hydro Integrated Resource Plan (2012 Draft)

The Plan will establish BC Hydro's plan for conservation and determine electricity load demand. The plan will also determine the course of action for acquiring sufficient generation and transmission resources to meet increasing energy demands in the province. The plan also renews the call that potential future clean energy calls for powers may exist but no timelines have been established as of yet. Demand-side management initiatives for energy and capacity saving are also outline in this plan. This new plan is currently in public consultation and will be finalized in December 2012.

BC Bioenergy Strategy

Established through the 2008 *BC Energy Plan*, the strategy is aimed to develop the province's bioenergy potential while reducing GHG emissions, and strengthen the province's long-term competitiveness and energy self sufficiency goals. An ambitious target of helping at least 10 communities develop biomass to energy clean energy projects by 2020 was also established as part of this strategy.

This program saw the establishment of the $25 million **BC Bioenergy Network** to accelerate greater investment and innovation in bioenergy technologies and innovation. It also provided $10 million in funding to advance the province's biodiesel production capacity.

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.

INCENTIVE-BASED FUNDING PROGRAMS

ecoENERGY for Renewable Power Program

Launched in April 2007, this federal program was aimed to promote the generation of electricity from renewable energy sources such as wind, hydro, biomass, photovoltaic, and geothermal energy. While no new funding has been committed to this program, up to 2021, 104 projects representing $1.4 billion over 14 years will be invested throughout the country. 15 BC clean energy projects were funded under this initiative.

FCM Green Municipal Fund

A $550 million fund administered by the Federation of Canadian Municipalities (FCM) is aimed to provide both funding and knowledge to municipal governments and their partners for environment-focused projects. This fund provides financial support to municipalities wishing to develop plans, conduct studies, or take on projects like pursuing district energy systems in their community.

BC Hydro Net Metering Program

Consumers can transfer excess electricity generated primarily for their own consumption from a clean energy source (e.g., hydro, wind, solar, photovoltaic, geothermal, and biomass) to the electrical grid and receiving financial credits. This program provides incentives for consumers to take on residential clean energy projects and take control of their own energy efficiency needs. To date, approximately 200 projects have taken advantage of this program.

BC Hydro Power Smart Program

Power Smart is BC Hydro's program for implementing its world recognized demand side management 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.

BC Hydro Remote Community Electrification Program

A program provided by BC Hydro to help off-grid communities receive service from the utility. It also provides support to communities that wish to pursue community energy projects and decrease their reliance on diesel-powered electricity and achieve energy self-sufficiency.

BC Hydro Acquiring Power Programs

BC Hydro has different methods for independent power producers to sell clean energy to the utility. While the standing offer program is always available, calls for power are generally planned for by the utility as part of their *Integrated Resource Plan*.

- **Bioenergy Call for Power**- The last call for power was in 2010, where independent power producers with biomass and wood fibre fuel sources were invited to submit proposals for the granting of an EPA. As a result of the phase I and II bioenergy call for power, seven EPAs were granted.
- **Clean Call for Power**- This call for power saw 25 EPAs being granted for a total of 27 clean energy projects across the province. This call for power saw wind, non-storage hydro, and waste heat projects being approved totaling 1,168MW in capacity and 3,266MWh/year in firm energy.
- **Standing Offer Program**- Provides an option for electricity generated from small clean energy projects (← 15MW) to be sold to BC Hydro. This programs objective is to streamline the process for small-scale producers while being cost-effective for ratepayers. As of April 2012, 9 EPAs have been issued to IPPs under this scheme with 13 additional applications that are being reviewed by BC Hydro.

Community Action on Energy and Emissions Program

The CAEE program is designed to provide policy, financial, and technical support for municipal governments and First Nations to take on community energy conservation, energy efficiency, and emissions reductions. The government has contracted the Fraser Basin Council to provide program administration. This program has helped communities develop strategies around:

- Policy measurement;
- Information;
- Education;
- Incentives;
- Regulations; and
- Capacity development.

To date over 52 communities have taken advantage of the program, each of which are eligible for Carbon tax refunds which provides incentive to these communities for demonstrating leadership.

Remote Community Implementation Program

The program is an independent initiative under the Community Action on Energy and Emissions (CAEE) program and is managed by the Fraser Basin Council. The RCI program funds capital costs of implementing community clean energy and energy efficiency projects complimenting other funding and research programs available for remote communities.

BC Venture Capital Program

To help attract potential investors to small-incorporated businesses including those in clean energy technology development, a 30% refundable tax credit is available in exchange for equity capital. To be eligible, the company must be involved in one of its various eligible business activities including manufacturing, processing and exporting value added goods, research and development of proprietary technology.

BC First Nations Clean Energy Business Fund

With a $5 million budget allocation from the BC *Clean Energy Act*, this fund encourages eligible BC First Nations to participate in the clean energy sector within their traditional territorial and treaty areas. This fund will:

- Provide capacity development funding;
- Provide equity funding to develop or take equity position in clean energy projects; and
- Allow First Nations to share in revenue from clean energy projects.

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.

SDTC NextGen Biofuels Fund

This $500 million fund provides financial assistance to ready-to-commercialize biofuel companies. The financing provided from this fund helps reduce the risk of borrowing for the debt financing communities (banks, credit unions, etc). This assistance to reduce technology risk can bring new biofuels into the markets more quickly.

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 be in four strategic clean energy priority areas:

- Energy efficiency;
- Clean electricity and renewable;
- Bioenergy; and
- Electrification of transportation.

The Initiative consists of two separate funding streams: one for R&D projects, and one for demonstration projects.

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.

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.

OTHER PROGRAMS

Clean Energy Portal (Government of Canada)

Provides a platform where Canadian clean energy companies can be promoted to foreign business, investors, and governments through this portal and directory service. It links various stakeholders and interest parties together using the internet and information technology services.

BC Climate Action Toolkit

Provides comprehensive tools and contacts for various projects that advance environmental protection and climate action. This resource also provides comprehensive case studies of various clean energy projects that have been pursued throughout the province with the relevant contacts to inquire more about how to pursue a similar project in their own communities.

City of Surrey Energy Shift Program

This program is intended to propel the growing City to the forefront of energy efficient community design and promotion of clean energy. This program will see the development of a waste-to-biofuel facility to power the city's fleet of waste collection trucks. A clean technology industry park will also be developed to support innovators and entrepreneurs in this sector. Particularly support for accelerated commercialization of clean energy technologies will be provided in partnership with Simon Fraser University as part of this initiative.

ENDNOTES

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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" 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.
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GLOBE ADVISORS
A division of the GLOBE Group

For more information, please contact:

Paul Shorthouse
Director, Research & Planning
info@globeadvisors.ca

GLOBE Advisors
World Trade Centre
Suite 578 – 999 Canada Place
Vancouver, British Columbia
Canada V6C 3E1

Phone: **+1 (604) 695.5001**
Toll Free: **+1 (800) 274.6097**
(North America)

GLOBEADVISORS.CA