



BIOPRODUCTS AND BIOENERGY EXPANDING OUR NATURAL ADVANTAGE WITH A SUSTAINABLE BIOPRODUCTS & BIOENERGY INDUSTRY

British Columbia has long been an international leader in resource-based industries such as forestry, fisheries and agriculture. But as we move through the 21st century, these economic drivers for the province are now being transformed, and a new knowledge-based bio-economy built on these traditional industries is emerging. With now over 200 bioproducts and bioenergy companies, cutting-edge research, and one of the world's largest available supplies of biomass, BC's strength in resource-based industries is now being leveraged to position us as a leading centre for bioproducts and bioenergy.

BioProducts and BioEnergy are sub-sectors within an emerging field of industrial biotechnology, and represent estimated markets of \$175 billion for BioEnergy and \$200 billion for BioProducts. By 2030, clean energy technologies are estimated to value \$1 trillion. In British Columbia, the renewable energy sector already generates over \$1.9 billion in revenues and accounts for over 18,000 jobs. PricewaterhouseCoopers has identified British Columbia as the 3rd largest Renewable Energy Sector in the world behind California and Germany.

Commercialization of new, more cost effective and environmentally friendly technologies, products, and services in our traditional resource sectors can diversify both markets and energy sources, while enhancing our existing industrial infrastructure. BioProducts and BioEnergy can help reduce greenhouse gas emissions, boost the economies of rural and First Nations communities, and lessen global dependence on oil, gas and coal.

British Columbia plans to lead this critical global shift by becoming the home to international demonstration projects that can then be scaled up to world-class industrial production, and that can lead to changes in the world's energy producing and consuming culture.





BC-Based Research is the Foundation of our Industry

Whether it is the development of new innovative clean technologies to utilize new sources of bioenergy; effective forest breeding programs based on high-technology (i.e. genomics); innovative uses for waste wood; or new methods to improve food safety and security; British Columbia's research is, without question, changing the world we live in.

Our world-class researchers are also developing new technologies to protect wild salmon stocks as well as farmed salmon from disease; finding new opportunities for innovative aquaculture products (i.e. shellfish, sablefish); conserving wild species; and improving water quality. Bioprospecting is also finding new sources of potential pharmaceuticals and value added chemicals; and innovative bioremediation techniques and technologies are transforming the mining industry.

Much of this research is supported by funding organizations such as Genome British Columbia and the BC Bioenergy Network. The BC Bioenergy Network, established in 2008 with a \$25 million grant from the BC government, acts as a catalyst for deploying near-term bioenergy technologies and for supporting mission-driven research for the development and demonstration of new bioenergy technologies that are environmentally sustainable for the province of BC. Genome BC is a research organization that invests in and manages large-scale genomics and proteomics research projects and science and technology platforms focused on areas of strategic importance such as human health, forestry, fisheries, agriculture, bioenergy, mining, ethics, and the environment. By working collaboratively with all levels of government, universities and industry, Genome BC is the catalyst for a vibrant, genomics-driven life sciences cluster with far reaching social and economic benefits for the province and Canada.

One of BC's best-known scientists in the field is Dr. John (Jack) Saddler, the endowed Professor of Forest Products Biotechnology, the Dean, Faculty of Forestry at the University of British Columbia, and the recipient of LifeSciences BC's 2009 Leadership Award. Dr. Saddler's commitment to advancing the development and application of innovative biorefining technology for production of biofuels and chemicals from biomass feedstocks has positioned him as an international leader of scientists, advisor to governments, and facilitator to industry, playing a broad and powerful role across all these dimensions to a remarkable degree.

As a senior and seasoned research scientist, Dr. Saddler has been involved, for more than 25 years, in various national and international organizations that have advanced the global understanding of how woody biomass can be converted to useful fuels and chemicals. He is a regular reviewer/advisor for agencies such as the US Dept of Energy, USDA, NSERC, World Bank, etc.

Outside of the research setting, Dr. Saddler has not only advised policy-makers at the highest levels provincially and nationally, but has been instrumental in the creation of long-standing initiatives to demonstrate, commercialize and transfer promising biorefining technologies. Internationally, he has contributed significantly to the work of the UN's Food and Agricultural Organization (FAO), the US DoE, USDA, the International Energy Agency (IEA) Paris, and he has acted as the Task Leader of the Liquid Biofuels network of IEA Bioenergy organization.

Finally, Dr. Saddler's efforts have earned him a significant reputation in the field amongst both the energy and forest industries, with his contributions recognized in virtually any related industry setting, from the provincial Council of Forest Industries to the international Biotechnology Industry Organization. As a consequence, Dr. Saddler's advice is in high demand by industry formally and informally.

Another recent milestone in British Columbia's research community was the establishment of the Pacific Institute for Climate Solutions (PICS) (www.pics.uvic.ca). Building on the strengths of BC's four research-intensive universities, PICS will harness the intellectual resources of BC to develop innovative climate change solutions, seek new opportunities for positive adaptation, and lead the way to a vibrant low-carbon economy. This \$94.5 million Centre was announced by BC Premier Gordon Campbell on January 25, 2008 to be hosted and led by the University of Victoria in collaboration with the University of British Columbia, Simon Fraser University and the University of Northern British Columbia.

Defining the Terms....

BioProducts are products made from renewable resources (Biomass) and/or biological processes primarily from Agriculture, Forestry, Marine, and Municipal Waste to provide biofuels, bioenergy, biomaterials, and everyday household or industrial products.

BioEnergy comes from any fuel that is derived from biomass - recently living organisms or their metabolic byproducts. Unlike other natural resources such as petroleum, coal and nuclear fuels, bioenergy is a renewable energy source.

Biomass is renewable organic matter from crops, trees, wood chips, aquatic plants, agricultural and municipal waste. Biomass is any type of organic material that is available on a renewable or recurring basis. It may come in the form of raw material or primary crops, by-products left over from a variety of activities and industrial processes, and waste material.

BioRefinery is a facility that integrates a variety of technologies to convert Biomass into bioproducts such as bioenergy, biofuels, biogas, and other biomaterials.

Bio-Economy refers to the utilization of biological systems to achieve sustainable economic objectives.

Putting research into action is a key focus for British Columbia. As such, exciting partnerships and initiatives such as the following are also resulting in the real implementation of BC discoveries and research development...

- **BC Hydro** – Bioenergy Call for Power: Guided by the policy actions and directions contained in the 2007 BC Energy Plan: A Vision for Clean Energy Leadership and the 2008 BC Bioenergy Strategy: Growing Our Natural Energy Advantage, BC Hydro is conducting a call for power to utilize wood infected by the mountain pine beetle as well as other wood fibre and biomass fuel sources. The Bioenergy Call will help British Columbia reach the goal of becoming electricity self-sufficient by 2016, while securing cost-effective, firm, clean or renewable, carbon-neutral energy for ratepayers. www.bchydro.com
- **Lignol Energy Corporation** – Bioenergy from Forestry Waste: Undertaking the development of biorefining technologies for the production of fuel-grade ethanol and other biochemical co-products from non-food cellulosic biomass feedstocks. Lignol's modified solvent-based pre-treatment technology facilitates the rapid, high-yield conversion of cellulose to ethanol and the production of value-added biochemical co-products, including HP-L™ Lignin from its fully integrated industrial-scale biorefinery pilot plant in Burnaby, British Columbia. www.lignol.ca
- **Biogas from Municipal Waste:** BC's Terasen Gas & Paradigm Environmental Technologies have come together to undertake a project that will evaluate bioenergy production at Metro Vancouver's Lulu Island wastewater treatment plant in Richmond. Paradigm Environmental Technologies Inc. developed a made-in-BC MicroSludge process, which works with the co-generation equipment at Lulu Island to turn wastewater sludge into a clean, renewable source of electricity. Additional project sites are also being evaluated. www.terasengas.com and www.paradigmenvironmental.com
- **Catalyst Power** – Bioenergy from Agricultural Waste: Catalyst Power Inc. is undertaking a project that will result in a high yield biogas system, providing the first Anaerobic Digester built in British Columbia to serve the Fraser Valley agricultural community. The project represents an economic and environmentally sustainable way to utilize agricultural waste. As research partner in the project, the University of British Columbia has developed a process for extracting nutrients and producing energy from agricultural waste. Fertilizer mixes are among the useful agricultural by-products of the process. www.catalystpower.ca
- **Canadian Bioenergy Corporation** – Supplying Biodiesel: BC-Based Canadian Bioenergy Corporation is Canada's leading supplier of premium biodiesel - a cleaner burning, renewable fuel. The company operates a terminal location in British Columbia, and has service to customers across the country. Canadian Bioenergy has a rapidly growing customer base that includes major fuel distributors, high-volume commercial customers, and municipal and provincial transit organizations. www.canadianbioenergy.com
- **Plankton from the Pristine Waters of British Columbia:** Canadian Pacific Phytoplankton Ltd. is located in Nanaimo, BC, with partners located in nine countries. The company has developed the ability to grow phytoplankton using its patent pending technology. Phytoplankton has many applications and uses, and the tanks of Marine Phytoplankton consume CO2 from the atmosphere, and in turn release oxygen. Rarely can a commercial operation of this size boast having a positive net impact on the environment. www.pacificplankton.com
- **Zymeworks Inc.** – A New Vision in Computational Biotechnology: Named Canada's 2009 Early-Stage Company of the Year, Zymeworks is a highly-innovative computational biotechnology company providing proprietary molecular simulation technology with high performance computing to research and develop enzymes for a variety of industrial uses. www.zymeworks.com

We encourage you to learn more about British Columbia's impressive cadre of innovative research via some of the following links:

- University of British Columbia www.ubc.ca
- University of Northern British Columbia www.unbc.ca
- University of Victoria www.uvic.ca
- Simon Fraser University www.sfu.ca
- Genome BC www.genomebc.ca
- BC Bioenergy Network www.bcbioenergy.ca

Supportive Provincial and Federal Governments

British Columbia is home to a Provincial Government noted internationally for their leadership and dedication to clean energy solutions. In January 2008, recognizing that British Columbia's bioenergy assets include top researchers, innovative companies, committed partners, forward-thinking communities, and half of the entire country's biomass electricity-generating capacity, the BC Government released the BC Bioenergy Strategy (www.energyplan.gov.bc.ca/bioenergy). Goals of the strategy include:

- BC biofuel production meeting 50 % or more of the province's renewable fuel requirements by 2020;
- Developing at least 10 community energy projects that convert local biomass into energy by 2020; and
- 30% GHG reduction by 2030;
- 5% bioethanol & biodiesel utilization by 2010;
- Establishing one of Canada's most comprehensive provincial biomass inventories that creates waste to energy opportunities.

As part of this plan, the \$60M Innovative Clean Energy (ICE) Fund was also established reflecting the fact that, "Clean Energy will play a role in building a vibrant and prosperous economy in BC". The fund is in place to help commercialize British Columbia's clean, efficient energy technologies, and in 2008, the first \$25M of supported projects leveraged nearly \$80 million for the BC economy.

On the federal front, program funding for biofuels and bioproducts has totaled more than \$2 billion. Budget 2009 provides significant additional funding not only for forest innovation and clean energy but also for infrastructure that can be critical for the success of projects based on new value creation and capture from biomass.

Much of this Federal Government support comes by way of Sustainable Development Technology Canada (SDTC) (www.sdtec.ca), a not-for-profit foundation that finances and supports the development and demonstration of clean technologies which provide solutions to issues of climate change, clean air, water quality and soil, and which deliver economic, environmental and health benefits to Canadians. SDTC operates two funds aimed at the development and demonstration of innovative technological solutions. The \$550 million SD Tech Fund™ supports projects that address climate change, air quality, clean water, and clean soil. The \$500 million NextGen Biofuels Fund™ supports the establishment of first-of-kind large demonstration-scale facilities for the production of next-generation renewable fuels.

Moving forward, one can envision British Columbia strengthening its Bioenergy & Biorefinery capacity with community energy projects and First Nations partnerships to turn research and innovation into clean energy and jobs while addressing the world's climate change challenges.

A Dedicated Industry Association

In 2008, LifeSciences BC expanded our mandate to support the bioproducts and bioenergy sectors after a merger with the former BC BioProducts association. Via this merger, an enhanced industry association that builds upon the strengths of LifeSciences BC and the many accomplishments of BC BioProducts was created.

Through LifeSciences BC's dynamic network, we support and represent all life sciences sectors (including biopharmaceuticals, medical devices, bioenergy and bioproducts) and community in four strategic areas:

1. Advocacy and public policy development
2. Promotion of our world-class science and life sciences industry
3. Active facilitation of partnering and investment
4. Attraction, development and retention of human capital

In support of the bioproducts and bioenergy, LifeSciences BC undertakes numerous specific initiatives. Following are just a few examples of how we help individual companies and the greater industry....

- The LifeSciences BC BioProducts and BioEnergy Seminar Series providing members with a forum to learn about and discuss the latest issues facing their organizations and broader industry;
- Co-hosting of the highly-successful 2008 BIO Pacific Rim Summit on Industrial Biotechnology and Bioenergy including a unique Canadian Business Showcase event; offering companies the opportunity to meet critical international partners and investors;
- Ongoing active liaison with government to support companies in the regulatory and other public policy issues they face;
- Spotlighting of bioproducts and bioenergy companies via the annual LifeSciences BC Awards – a gala celebration attracting the province's top decision makers from across government, industry and academia;
- The successful organization of a joint BC/New Brunswick BioMarine Mission resulting in new partnerships between companies from our respective jurisdictions;
- International promotion of the industry, including coordination of British Columbia's presence at key global conference and events.

Our bioproducts and bioenergy members span both the province's research community as well as the many companies that comprise the sector – companies such as Lignol Energy Corporation (www.lignol.ca) which received LifeSciences BC's 2008 Emerging Life Sciences Company of the Year Award. Over the past three years, Lignol has emerged from being a predominantly R&D organization into operating a facility which represents one of only a handful of fully integrated cellulosic ethanol pilot plants operating in the world today. Lignol's technology is now at the forefront of the highly visible and rapidly developing biofuels-from-cellulosic-biomass industry, which has the strong support and encouragement of governments and major corporations around the world. To further the commercialization of their research, Lignol has established one of the most advanced facilities for biorefining R&D in the world – a new Biorefining Technology Development Centre at the campus of the BC Institute of Technology.

LifeSciences BC's 2009 Company of the Year Award recipient, Nexterra Energy Corp. (www.nexterra.ca) represents another British Columbia success story. Nexterra is a leading developer and supplier of biomass gasification solutions that generate heat and power for institutional and industrial customers. Nexterra's gasification systems convert waste biomass fuels into clean burning "syngas" that can be used as a direct substitute for natural gas and other fossil fuels in the production of heat, steam or power. Nexterra's technology has proven that customers can reduce costs and become more energy self-sufficient, while also significantly lowering greenhouse gas and other harmful air emissions. Biomass power generation is a multi-billion market opportunity, and Nexterra's objective is to capitalize on this opportunity by creating a new standard of small-scale biomass power solution that has widespread application as a distributed generation solution.

Among the current projects in which Nexterra's technology is being utilized is a unique partnership with the University of Northern British Columbia to develop a system to gasify mountain pine beetle infested biomass, producing heat to fire a boiler at the power plant on campus to heat university buildings. This showcase project, the first of its kind at a Canadian university, will be a catalyst for replication, research and economic development. Biomass gasification could displace up to 80 per cent of the fossil fuel currently used to heat buildings on the UNBC campus

We invite you to join us in being a part of British Columbia realizing its full potential to be a world leader in life sciences; generating a robust and sustainable bio-economy in British Columbia, Canada built on strong partnerships between industry, academia and government.

For further information on British Columbia's leading bioproducts and bioenergy industry or how LifeSciences British Columbia is supporting these dynamic sectors, contact:

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About LifeSciences British Columbia

LifeSciences British Columbia is a not-for-profit, non-government, industry-funded association that supports and represents the biopharmaceutical, medical device, bioproducts and bioenergy and greater life sciences community of British Columbia through leadership, advocacy, promotion of our world class science and our biotechnology industry, and via facilitation of partnering and investment in British Columbia's life sciences sectors.

www.lifesciencesbc.ca

