BioEnergy Conference and Exhibition 2010

Prince George, British Columbia
June 9–10, 2010
# Table of Contents

Welcome ............................................................................................................................................. 1

*Keynote Presentation*
British Columbia’s Forest Sector Bioenergy Opportunities ......................................................... 2

*Session 1*
Global Bioenergy Challenges and Opportunities ........................................................................... 3
  Bioenergy: Saviour or Sin? ................................................................................................................... 3
  SWOT on BioEnergy for North America ......................................................................................... 3
  4Biomass—Putting Biomass into Action: Austrian Experiences ..................................................... 4

*Session 2*
Bioenergy Policy Drivers .................................................................................................................. 5
  Goals and Results of Biomass Policy in Austria ............................................................................... 5
  Bioenergy Policy Drivers .................................................................................................................. 6
  Bioenergy Policy Drivers Affecting Canada’s Wood Pellet Industry ............................................. 6
  Ontario Power Generation ............................................................................................................. 7
  Regulatory Innovation ..................................................................................................................... 7
  Discussion ....................................................................................................................................... 8

*Lunch Presentation*
The Future of Energy .......................................................................................................................... 8

*Concurrent Sessions 1*
Sustainable Biocarbon Resources .................................................................................................. 10
  Woody Biomass: Sustainability Challenges .................................................................................... 10
  Biomass as a Sustainable Fuel for Swedish Utilities .................................................................. 11
  Woody Biomass Assessment:
    Developing Investment Grade Feedstock Supply Data for the Olympic Peninsula .................. 12
    Discussion ...................................................................................................................................... 12
  Emerging Clean Technologies ....................................................................................................... 13
    The Role of Fuel Cells and Hydrogen in Bio and Clean Energy Applications ......................... 13
    Cellulose to Hydrogen Production ............................................................................................... 14
    Algal Biomass Production, Harvesting, and Conversion ............................................................... 15

*Concurrent Sessions 2*
Bioenergy Economy and Markets ................................................................................................. 16
  Strengthening Project Financing .................................................................................................... 16
  Carbon Offset Opportunities in British Columbia ......................................................................... 16
  A Maturing Market: Developing the U.S. Wood Pellet Distribution Infrastructure .................... 17
  Discussion ....................................................................................................................................... 18
Emerging Clean Technologies .................................................................................................................. 18
Modelling and simulation of an adaptive distributed power generation system .......................... 18
Spatial decision support systems for community-based renewable energy assessments .......... 19
Energy efficiency and the feasibility of energy recovery in a steel company in Manitoba .......... 20

Concurrent Sessions 3
Bioenergy Deployment Today ................................................................................................................. 21
Canfor Pulp Limited Partnership: A Legacy of Leadership in Bioenergy .................................... 21
District Heating and Small CHP Systems ............................................................................................. 22
The Modular Pellet Plant ....................................................................................................................... 22
The Organic Rankine Cycle in Biomass Applications ....................................................................... 23
Nexterra Gasification Systems ............................................................................................................. 23
Pyrolysis Oil: Heat, Electricity, Green Transportation Fuel, and Chemicals Too ....................... 24
Discussion ........................................................................................................................................... 24
Advancements in Municipal/Community Energy .............................................................................. 25
Bioenergy opportunities ....................................................................................................................... 25
Community energy in the future: A utility perspective .................................................................... 26
Quesnel community energy project ..................................................................................................... 26
Biomass CHP: New decade, same issues ............................................................................................ 27
Biomass and district energy: The European experience ................................................................ 28
Discussion ........................................................................................................................................... 28

Concurrent Sessions 4
Bioenergy Technologies for Tomorrow ............................................................................................... 29
Biomass Conversion and Pathways for Carbon Sequestration ....................................................... 29
Biorefining Technology for Today and Tomorrow ............................................................................. 30
Hydrothermal Pretreatments of Woody Biomass for Biofuel Production ........................................ 30
Bluekey Energy .................................................................................................................................. 31
The Thermocatalytic Single-step System ............................................................................................ 32
Discussion ........................................................................................................................................... 32
Agricultural Biofuels ............................................................................................................................. 33
Before cellulosic: An ethanol solution at Summit National Energy ................................................. 33
An introduction to biogas technology .................................................................................................. 34
Anaerobic digestion to renewable natural gas: The alternate alternative energy ........................... 34
Eastern Canada biogas policy development, myths, and realities ..................................................... 35
Willow and poplar energy crops for greenhouse heating ................................................................. 36

Lunch Presentation
Partners on the Land: First Nations and Industry in the Bioenergy Sector ..................................... 36
## Participants

<table>
<thead>
<tr>
<th>Name</th>
<th>Title and Organization</th>
</tr>
</thead>
<tbody>
<tr>
<td>Paul Adams</td>
<td>General Manager, Firemaster Team SBC Firemaster</td>
</tr>
<tr>
<td>Alex Aravind</td>
<td>Associate Professor, Computer Science Program, University of Northern British Columbia</td>
</tr>
<tr>
<td>Gerhard Bothe</td>
<td>President, ASG International, Germany</td>
</tr>
<tr>
<td>Doug Bradley</td>
<td>President and Executive Director, Canadian Bioenergy Association</td>
</tr>
<tr>
<td>David Brune</td>
<td>Founder and President, Benemann and Associates</td>
</tr>
<tr>
<td>Chris Bush</td>
<td>Founder and President, Catalyst Power Inc.</td>
</tr>
<tr>
<td>John Calhoun</td>
<td>Director, Olympic Natural Resources Centre, University of Washington</td>
</tr>
<tr>
<td>Eric Camirand</td>
<td>Founder, Electrigaz Technologies</td>
</tr>
<tr>
<td>Richard Damecour</td>
<td>Chief Executive Officer, FV8 Energy Inc.</td>
</tr>
<tr>
<td>Thomas Deerfield</td>
<td>President, Dalson Energy</td>
</tr>
<tr>
<td>Chief Dominic Frederick</td>
<td>Chief Councillor, Lheidli T’enneh First Nation</td>
</tr>
<tr>
<td>David Ghosh</td>
<td>Director, Science and Technology, NRC Institute for Fuel Cell Innovation, National Research Council</td>
</tr>
<tr>
<td>Randal Goodfellow</td>
<td>Senior Vice-President, Corporate Relations, Envergent Technologies</td>
</tr>
<tr>
<td>Scott Gramm</td>
<td>Business Development Manager, Terasen Gas</td>
</tr>
<tr>
<td>Dana Hayden</td>
<td>Deputy Minister of Forests and Range, Province of British Columbia</td>
</tr>
<tr>
<td>Mark Kendall</td>
<td>Principal, Kendall Energy Consulting LLC</td>
</tr>
<tr>
<td>Michael Kerr</td>
<td>Chair, Fourth International BioEnergy Conference, Industrial Technology Advisor</td>
</tr>
<tr>
<td>John Kitchen</td>
<td>President, Bionera</td>
</tr>
<tr>
<td>Sotirios Koragonas</td>
<td>Manager, Strategic Capital and Energy, Canfor Pulp Limited Partnership</td>
</tr>
<tr>
<td>Gottfried Lamers</td>
<td>Ministry of Agriculture, Forestry, Environment and Water Management, Austria</td>
</tr>
<tr>
<td>Seved Lycksell</td>
<td>Head, Fuel Department, Skellefteå Kraft, Skellefteå, Sweden</td>
</tr>
<tr>
<td>Robert Lyng</td>
<td>Director, Environmental Policies and Programs, Ontario Power Generation</td>
</tr>
<tr>
<td>Dr. John MacDonald</td>
<td>Chairman and CEO, Day4 Energy Inc.</td>
</tr>
<tr>
<td>Joanne McKenna</td>
<td>Customer Care and Conservation Division, BC Hydro</td>
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<tr>
<td>Graeme Millen</td>
<td>Project Coordinator, CH4 Biogas LLC</td>
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<tr>
<td>Gordon Murray</td>
<td>Executive Director, Wood pellet Association of Canada</td>
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<tr>
<td>David Muter</td>
<td>Strategic Acquisitions Associate, Pacific Carbon Trust</td>
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<tr>
<td>Don O’Connor</td>
<td>President, [S&amp;T]² Consultants Inc.</td>
</tr>
<tr>
<td>Jeff Paquin</td>
<td>Business Development Manager, Western Biomass Power Corporation</td>
</tr>
<tr>
<td>Fernando Preto</td>
<td>Group Leader, Biomass Conversion</td>
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</tbody>
</table>
CanmetENERGY Technology Centre
Natural Resources Canada
Reg Renner
Financing Specialist
Atticus Financial

Jonathan Rhone
President and CEO
Nexterra Systems Corp.

Dan Rogers
Mayor
City of Prince George, British Columbia

Catherine Roome
Chief Operating Officer
BC Safety Authority

Mike Rushton
Chief Operating Officer
Lignol Biofuel

Jim Savage
Principal
Savage & Associates

Michael Scanlon
Director, Purchasing, Logistics, and Quality
American Biomass Corporation

Johannes Schmidl
Energy Partnerships
Austrian Energy Agency

Charles Scott
Principal
Scott Consulting

Minxing Si
Master’s Student
Natural Resources Institute
University of Manitoba

Ralph Sims
Director, Centre for Energy Research
Massey University Centre for Energy Research, New Zealand

Fred Spinola
General Manager
Deltech Manufacturing Inc.

John Swaan
COO
Magnolia Bioenergy

Daniel Theuer
Business Development Manager
Turboden
Italy

Thoreau Rory Tooke
Forest Resources Management
University of British Columbia

Zahra Tooyserkani
Ph.D. Candidate
Department of Chemical and Biological Engineering
University of British Columbia

Nic Waller
Graduate Student
Computer Science Program
University of Northern British Columbia

Theo Warkentin
Chief Executive Officer
Bluekey Energy

Samuel C. Weaver
Founder and President
Proton Power, Inc.

Michael Weedon
Executive Director
BC Bioenergy Network
Welcome

SPEAKERS
Chief Dominic Frederick
Chief Councillor
Lheidli T’enneh First Nation

Dan Rogers
Mayor
City of Prince George, British Columbia

Michael Kerr
Chairperson
4th International Bioenergy Conference

Michael Weedon
Executive Director
BC Bioenergy Network

Chief Dominic Frederick welcomed participants, emphasizing the importance of the energy industry to the First Nations and the need for careful environmental stewardship.

Mayor Dan Rogers said he “aims to build the most sustainable community, because I understand that we are linked to the geography around us.” Two days before the conference, Prince George announced a plan to construct a downtown district energy system. “We’re excited about this program because of substantial benefits to the community,” Rogers said. The system is expected to result in a net reduction of air particulates of 100 tonnes.

BC Bioenergy Network is “all about accelerating and advancing the interests of clean, sustainable bioenergy in the province,” said Michael Weedon. The network has developed a wide range of relationships, including the University of British Columbia (UBC), Nexterra, and BC Hydro, and identified eight value streams, including solid wood residues and municipal wastewater. The network aims to procure investments from each sector, and works with a number of stakeholders, including funders and regulators.

Michael Kerr said the Industrial Research Assistance Program (IRAP) “is about helping research and industry that’s advancing.” IRAP provides business advice and technical expertise, and funds some projects. The BioEnergy Conference and Exhibition, begun in 2004, was spurred on by the pine beetle infestation in the Prince George area. The world economic crisis and environmental energy demand represent new issues in 2010.

“If you’re in the forest industry, you’re really in the energy industry,” Kerr said. “What does that mean for the future?” He asked participants to remember that for every action there is an equal and opposite reaction. Electric cars possess a lot of momentum, but when widely used, they may place an unmanageable burden on the energy system. Kerr noted that British Columbia’s Clean Energy Act will impact such discussions.
Bioenergy offers a clean and renewable source of energy, said Dana Hayden. British Columbia wants to be energy self-sufficient by 2016 but lacks the energy sources to achieve that goal or meet the rising energy demand. Bioenergy addresses climate change and contributes to rural economic development.

The bioenergy opportunity for the forest industry arises from the wide variety of uses for wood fibre. The B.C. forest industry has been subject to several challenges, including cyclical markets, challenges to the resource, and “a totally undeserved but pervasive poor environmental image,” said Hayden. Bioenergy represents a significant opportunity for the forest industry to create environmentally friendly products and improve incomes by moving into a sector less reliant on commodity prices.

As bioenergy opportunities strengthen with integration, collaborations with the forest sector will greatly benefit the bioenergy sector. “In essence, the forest sector knows how to handle wood,” Hayden said.

The cumulative area of British Columbia affected by the mountain pine beetle is estimated at 16 million hectares, or five times the size of Vancouver Island. The rate of infestation is decreasing because the beetle is running out of food. New studies estimate that fewer trees will be killed by 2016 than previously thought, and that the shelf life of timber killed by the mountain pine beetle is longer than previously anticipated, resulting in more occasions to use those trees for lumber and bioenergy.

Hayden cited logging waste as another opportunity for bioenergy. Although some biomass must be left on harvested sites to maintain the sites’ health and biodiversity, too much waste “is wasteful by definition, and also creates a fire hazard.” Policy initiatives are being considered to encourage using this waste for bioenergy. She said standing timber with low value for saw logs but with value for bioenergy could also be harvested.

The B.C. government’s energy plan acknowledges the need for alternative energy—a significant step toward recognizing that British Columbia should not rely exclusively on hydroelectric power. In March 2008, the Forest Act was amended to allow non-replaceable forest licences to be awarded to energy producers.

The Clean Energy Fund is supported by $40 million of funding for companies and individuals with ideas for innovative energy supplies. The Clean Energy Act amends the Forest Act to facilitate the use of wood for bioenergy by authorizing the Ministry of Forests and Range to order a primary supplier to not burn their waste fibre if an energy producer wants it.

In July 2010, the Interior will shift to a new timber pricing system to encourage the harvesting of all useable fibre. A receiving licence is being developed that will allow bioenergy producers to take fibre from primary tenure holders without lowering the tenure holder’s allowable cut.

BC Hydro recently announced a Phase 2 bioenergy call for projects using any form of biomass, including forest and wood waste.
“Key to these initiatives is collaboration,” Hayden said.

**Session 1**

**Global Bioenergy Challenges and Opportunities**

**Moderator**

Michael Weedon

**Bioenergy: Saviour or Sin?**

**Speaker**

Ralph Sims  
Director, Centre for Energy Research  
Massey University Centre for Energy Research, New Zealand

Ralph Sims said world energy demand is rising at an unsustainable rate. At its current rate, the atmospheric concentration of carbon dioxide will reach 1,000 parts per million (ppm) by 2100. The atmospheric concentration must be reduced to 450 ppm to have a chance of keeping the global temperature rise below 2°C. “The world is changing, and we are going to have to adapt as well as mitigate. Bioenergy has got a role to play,” he said.

Extensive modelling conducted by the International Energy Agency (IEA) indicates that biomass must be the primary energy supply by 2050 to keep below 450 ppm. To meet this goal, modern biomass must increase to three times the existing production, requiring 15,000 megatonnes of biomass per year, some of which will have to be purpose grown.

“Biomass isn’t perfect,” Sims said. It competes with food for land use, greenhouse gas (GHG) emissions are uncertain, and future resource availability is unknown.

Sims said British Columbia leads in some policy areas and goals that could impact future biomass uptake, including energy supply security, the reduction of reliance on imported fuels, and treatment of wastes.

Sims noted a deficiency in reliable biomass data and information. The GHG mitigation potential is uncertain and soil carbon impacts are simply not understood.

The saving aspects of biomass include increased security of the energy supply, GHG mitigation potential, and support for sustainable development. Each benefit addresses the specific interest of North America, Europe, and developing countries.

Sims said the IEA website has a number of helpful publications, including a guide to securing a long-term, sustainable bioenergy plant.

**SWOT on BioEnergy for North America**

**Speaker**

John Swaan  
COO  
Magnolia Bioenergy

John Swaan gave an overview of the strengths, weaknesses, opportunities, and threats (SWOT) of the North American bioenergy industry. He said the industry’s strength lies largely in its renewable energy resources. Cities and agricultural operations generate significant amounts of waste that could be used instead of stockpiled or burned, and forest resources are vital. Other strengths include environmental responsibility and energy resource security, which in turn secures the gross domestic product (GDP) of the local area.
Weaknesses of the industry involve economic challenges. “Public perception is probably our biggest problem, both in Canada and the United States,” Swaan said. Until society believes in global climate change, commitment to bioenergies will lack vigour.

Biofibre resource security is another weakness, and Swaan cited land privatization as a possible solution. Having witnessed this system in the southern States, he said “I’ve always been on the soft side of privatizing, but now I’m leaning on the hard side.” Although this system might not be appropriate for British Columbia, he said it should be discussed.

Swaan said financial investment is another weakness. Without resource security, conventional institutions will not be attracted to invest.

Opportunities include the significant environmental benefits. “This is a feel-good industry, as long as we’re harvesting and using that resource in a sustainable manner,” Swaan said. Environmental policies open up possibilities for bioenergy. Exports to environmentally-committed markets present another opportunity. He said until North America has the policies and infrastructure to take advantage of its resources, exports should be made to responsible locations.

Threats to the industry include special interest groups and lobbyists, specifically the oil and gas industry. People must be shown that wood is not a dirty fuel. The low cost of fossil fuel poses another threat.

Stop-and-go environmental policies driven by short-term political agendas are problematic, said Swaan, and access to capital must be improved. The lack of standards is also a concern. These standards must contain the concept of sustainability—“It’s not just about replanting trees.”

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4Biomass—Putting Biomass into Action: Austrian Experiences

**Speaker**

Johannes Schmidl
Austrian Energy Agency

4Biomass is a three-year, €2.5 million project to integrate biomass into Austrian markets. Implemented through the CENTRAL EUROPE programme in December 2009, eight countries are collaborating with Austria on the project. Johannes Schmidl said the Austrian Energy Agency brings its experience with successfully integrating biomass into the Austrian market to the project.

The most important energy market for biomass in Austria is low temperature heat, and 60% of forest biomass is used in domestic or small-scale applications. Over 21% of Austrian households are heated with bioenergy. “Oil and gas are still present, but biomass is the most aggressively growing,” said Schmidl.

Domestic energy production is 26% renewable, growing to 34% in 2020 to meet a European Union (EU) directive. Schmidl said heat energy is of primary importance in the European market.

Schmidl provided a model of the Austrian experience of bioenergy market diffusion. The first element is the political framework, followed by an implementing agency. Many regional and local agencies manage the diffusion process in addition to a national agency. Implementing agencies also keep policy makers informed of progress and needs. The next steps in the model are technologies, marketing, and cost.
Schmidl said the significant innovations that occurred in bioenergy after the second oil crisis did not transfer to market success. Research has shown this to be the result of installers who did not know how to work biomass boilers, causing them to guide customers away from these products. This was overcome when the Austrian Biomass Association started offering courses for biomass installers.

Since 1980, more than 1,000 district heating plants have been established. These plants are often the result of local initiatives, and empower the local communities. Schmidl said training the planners was crucial to this implementation.

Schmidl cited marketing and information as other aspects of the diffusion system. Trained bioheat installers may display a logo in their shop window, and receive a certificate for bioheat installation to use in their marketing. The magazine Ökoenergie informs the public and motivates change.

Technology, information, and cost feed into investor and consumer interests. For the diffusion to be successful, consumers must have the ability and motivation to install the technology. A significant decrease in the number of biomass boilers installed in Austria occurred in 2007 because the previous year’s oil prices were very low, and the price of pellets increased due to demand in Italy and the Netherlands.

“The most important lesson learned is that policies make a difference,” said Schmidl. “A comprehensive, long-term approach is crucial for the implementation of technology.”

Session 2
Bioenergy Policy Drivers

MODERATOR
Janice Larson

Goals and Results of Biomass Policy in Austria

SPEAKER
Gottfried Lamers
Ministry of Agriculture, Forestry, Environment and Water Management
Austria

Gottfried Lamers said 47% of Austrian land is covered by forest, and the annual cut is 22 million cubic metres. The economically available forests are largely privately owned.

Lamers said Austria stabilized its energy consumption before the economic crisis. The production industry and transport sectors are steadily growing, while private household energy use has decreased.

Most of the energy generated in Austria is oil, although natural gas generation is increasing. As “all our natural gas comes from Russia, we are aware that it could create a problem,” Lamers said. Renewable energy makes up 26% of production, 10% of which is hydroelectricity. “The really big success story behind these renewable energy sources is bioenergy and biofuels,” he said.

Since Austria failed to meet its Kyoto targets, the EU will impose stricter requirements on Austria for the 2020 EU goals. Lamers said new building norms could help meet these goals by ensuring that new buildings consume little or no energy, noting that the first energy-passive
house in Canada was donated by Austria to Whistler, British Columbia for the 2010 Olympic Games.

Subsidies encourage consumers to switch to biomass heating systems. “We sell more pellet boilers than oil burners now,” noted Lamers. The 2003 Green Electricity Act created strong incentives for biomass electric power generation, and the Environmental Support Act provides many different financing possibilities for entrepreneurs, mostly related to biomass.

Renewable energy sources create new jobs. Unlike small hydro initiatives, biomass ventures create more jobs during operation than during investment. As such, providing subsidies to biomass initiatives is politically palatable, said Lamers. He noted that Austria’s strong home market has made it a leader in biomass technology.

**Bioenergy Policy Drivers**

**SPEAKER**

Doug Bradley
President and Executive Director
Canadian Bioenergy Association

Doug Bradley showed a blank slide entitled “Federal Climate Change Policies”—while the EU has implemented legally binding renewable energy targets on its member countries, such a system is impossible in Canada because resources fall under provincial jurisdiction.

Bradley said biomass is critical because it can provide renewable heat, fuels, and biochemicals, while solar and wind energy cannot. Provinces only associate renewable power with renewable energy, and provide incentives for power, but not heat. This undervalues all biomass projects, and results in inefficient combined heat and power projects.

Other jurisdictions have implemented effective measures, said Bradley. Italy offers a higher price for power when it includes a heat component, which automatically incent the efficient use of the resource. Finland offers investment subsidies of up to 40% and incentives on harvest residues. Vermont provides federal and state support, mostly through state bonds, to cover up to 30% of the cost of converting schools from oil heating to biomass.

Bradley said Canada should change its policies to introduce provincial renewable energy bonds, speed up the wood supply process, and place a value on carbon. He proposed the creation of a bio-trade equity fund, saying “we can’t lean on government for everything.”

**Bioenergy Policy Drivers Affecting Canada’s Wood Pellet Industry**

**SPEAKER**

Gordon Murray
Executive Director
Wood Pellet Association of Canada

Gordon Murray said “not many facilities would burn pellets alone for electricity, because you’d waste the heat.” Canada currently ships most of its pellets to Europe, where most are used for co-firing in combined heat and power plants. Canada has the capacity for 2 million tonnes per year, but only produces 1.3 million. “I contend we should be making power in Canada from pellets, but we need effective government policy to make that happen,” Murray said.

Within Canada, the majority of pellets are used in the Northwest Territories and Eastern Canada, where pellets are cheaper than oil, the direct competition. Murray said Western Canada has a huge industry that is hardly used.
The EU uses policy tools, including feed-in tariffs and green bonuses, to encourage co-firing. The EU now sources 66% of its renewable energy from biomass. Canada, by contrast, is the second-worst emitter of GHG emissions per capita, behind only the United States. “And we use hydro,” Murray said. “We have huge advantages, but we’re far above the EU per capita.”

Canada relies heavily on coal power, and the solution to these emissions is carbon capture and storage (CCS), although it will be 15–20 years before CCS reaches a commercial scale. Co-firing could be implemented immediately and at low cost.

“We need power companies brought on board and government policies put in place to help us use our own products here in Canada,” said Murray.

**Ontario Power Generation**

**Speaker**

Robert Lyng  
Director, Environmental Policies and Programs  
Ontario Power Generation

**Robert Lyng** said Ontario Power Generation (OPG) is the largest pure-energy generator in Ontario, and also operates hydroelectric and coal plants. Given that Ontario has mandated the end of coal usage by 2016, OPG is considering the use of wood pellets. If fully implemented, OPG would consume around 2.5 million tonnes of wood pellets per year. As demonstrated in the Netherlands, co-firing can grow quickly and contribute to renewable energy production faster than any other technology.

Lyng outlined Ontario’s energy policy, including feed-in tariffs and renewable portfolio standards, noting that Ontario’s complementary policies have been beneficial. Through Ontario’s wood-fibre policy, “we’ve been able to work closely with the public service professionals to understand where the supply is and how to access it, and they understand what we could potentially use,” he said.

Lyng said OPG returned to the United Nations Framework Convention on Climate Change (UNFCCC) definition of renewable biomass to ensure the sustainability of the fuel supply. Third-party certification bodies that verify that forests are well-managed are also important to OPG. “It would be a disaster to have forests turned into parking lots and the allegation that it went to our plant,” he said.

OPG held stakeholder consultations across Ontario and found that while 80% of respondents supported the idea of biomass, 70% had no idea what it is. Understanding and acceptance improved when the term “wood pellets” was used instead of “biomass.”

**Regulatory Innovation**

**Speaker**

Catherine Roome  
Chief Operating Officer  
BC Safety Authority

“As a business, you have to be fast or competitors will eat your lunch. But you also need to be patient, as regulators stand between you and your lunch,” said **Catherine Roome**.

Three major changes have occurred within B.C.’s bioenergy sector. First, the requirement for continuous supervision of low-pressure thermal fluid systems with automated control systems was removed. These plants, primarily used in British Columbia, no longer require supervisory oversight. Roome said this should lower costs.
Second, an equivalency process was established for acceptance of European boilers. Europe has innovative technology, but North American and European standards differ. “We’re in a global economy, and assets are moving,” Roome said. In the past, European manufacturers had to comply with the North American standard to move their product to British Columbia. Now, the BC Safety Authority accepts the approval of a notifying body in Europe.

Third, the amended Safety Standards Act offers alternative safety approaches. A company can use its own safety practices and opt out of prescriptive existing regulations. This concept is used by industries that understand their own risk profiles, such as airlines.

“Regulators don’t innovate,” Roome said, “but we really need to listen well.”

Discussion
A participant asked about the value of wood pellets versus wood chips for co-firing with coal. Murray said the point of making wood pellets is to remove moisture and compress the fibre so they can be moved long distances. Wood pellets burn hotter and provide a more uniform fuel, but chips should be used when in close proximity.

A participant sought clarification on the registration process for imported European products.
Roome said a B.C. registration number would be issued, but until other provinces adopt British Columbia’s method, a Canadian registration number cannot be issued. The BC Safety Authority and the notifying body must connect so that manufacturers understand the requirement. For instance, if control technology stands apart, then it must be Canadian Standards Association or Underwriters Laboratories compliant.

A participant asked whether particulate emissions are a concern in Austria.
Lamers said emissions standards were strict long before pellet production began and “there’s no issue in the population for emissions.”

Lunch Presentation

The Future of Energy

Dr. John MacDonald
Chairman and CEO
Day4 Energy Inc.
Chancellor
University of Northern British Columbia

“All of us in this room have lived most, if not all, of our lives in a developed economy,” said Dr. John MacDonald. People of the modern age have had the privilege of the best quality of life since human beings evolved on this planet, largely owing to the ability to access a large quantity of plentiful, relatively inexpensive energy. However, this will most likely change, Dr. MacDonald said.

Three major issues arise in the energy business: energy security, environmental concerns around global climate change, and the economics of energy demand and supply.

“Given a choice between protecting the environment and the impact on their pocketbook, most people will opt for protecting their pocketbook,” said Dr. MacDonald. For most people,
environmental arguments are not strong rationales for changing their energy choices. The future of energy will be determined by economics.

When energy demand exceeds the conventional supply, energy prices will rise sharply and destabilize. Dr. MacDonald said this will probably occur before 2050. The trends are clear in both the best and worst scenarios, although the timing differs. Sources of conventional energy—coal, gas, oil, hydro, nuclear, and biomass—are expected to rise, plateau, and decrease. At the same time, energy demand will soar as the developing world aims for a Western lifestyle. When demand exceeds supply around 2040, in the best scenario, or around 2015, in the worst scenario, difficult times will ensue.

Dr. MacDonald said both scenarios raise questions about what will fill the emerging gap and whether people will simply let their lifestyles deteriorate. Possible replacement energy sources include nuclear energy and renewables such as solar, wind, tidal, biomass-derived biofuel, geothermal, wave, small hydro, and large hydro. “The challenge before us is to bring renewables into the mainstream before it’s too late,” he said. He noted that while renewables are secure, environmentally benign, and inexhaustible if properly managed, they also have drawbacks—they are either intermittent or strongly location dependent or both.

Figures from the German Advisory Council on Climate Change show that solar and biomass energy sources could dominate around mid-century, with solar power providing two-thirds of energy by 2100. Solar energy “provides . . . more than 6,000 times as much energy every second of every day than we humans consume,” said Dr. MacDonald. However, solar energy is intermittent because it depends on clear skies and sunlight.

Dr. MacDonald listed a number of different roles for bioenergy in a new energy system. In addition to renewable electrical generation, bioenergy can serve as a liquid transport fuel, such as cellulosic ethanol and biodiesel; as heating fuel, in the form of biogas and landfill gas; and as feedstock for other processes. Bioenergy can also create a viable export industry for British Columbia. In terms of electrical generation, bioenergy can “power shape” with other renewable energy sources and firm up intermittent sources to ensure a constant delivery of power.

Dr. MacDonald said electrical generation will become the most important way to deal with energy in the long run and pointed to the burgeoning popularity of electric cars. He said the “holy grail” of renewable generation is grid parity, the “equality of the renewable energy price per kilowatt with the currently accepted kilowatt price from the grid.” To obtain parity, the current cost differential must be bridged and infrastructure changes must be made. Firm, dispatchable energy must be generated, renewable energy dominated supply systems and subsystems must be created, and renewables must be integrated into existing systems and managed through the transition.

Free fuels such as solar and wind energy enhance price stability but require a large up-front investment amortized over a defined time period. By combining the amortized capital investment with the cost of operation and maintenance, the kilowatt-hour (kWh) price is determined. To be successful and produce return on investment (ROI), technology for renewables must maximize the number of kWh generated annually per unit of capital invested. Technology must also produce the rated power over and beyond the amortization period, and have low maintenance and operating costs. “We are not there yet with any renewables,” said Dr. MacDonald.
Dr. MacDonald said performance-based incentives such as feed-in tariffs guarantee a stable price and ROI for a stated period, attract private capital, motivate innovation, become an investment in future energy price stability, and reduce the time to reach grid parity.

Firm renewable power can be created anywhere by combining energy sources to ensure constant energy delivery, said Dr. MacDonald. Three renewable sources can be made firm: big hydro, biomass, and geothermal. The only true firm sources, biomass and hydro, must be managed and storage is key for large-scale, renewable-derived electrical energy. Unfortunately, no universal storage solutions exist.

Renewable systems are large undertakings vastly different from current systems, and are highly location dependent. Dr. MacDonald said innovation and a long-term view are essential: “It is time we took mainstream renewable energy system architecture seriously.” He added that biomass will play a critical role both as a primary and a firming source of energy. Prompt bridging of sources in short-term storage and a deep backup system will be needed to ensure continual power availability. He predicted that natural gas will be the transition fuel in the changeover from current energy systems to those of the mid-21st century.

Concurrent Sessions 1
Sustainable Biocarbon Resources

Moderator
Susanna Laaksonen-Craig

Woody Biomass: Sustainability Challenges

Speaker
Don O’Connor
President
S&T Consultants Inc.

Don O’Connor said the rapid expansion of the biofuel sector has created sustainability concerns about food versus fuel, land use, and environmental impacts. Governments have reacted to pressure from environmental organizations by implementing regulations and the resulting sustainability schemes have implications for woody biomass.

The Swiss Roundtable on Sustainable Biofuels addresses legality, consultative planning, GHG emission reduction, human rights, rural and social development, food security, conservation, soil quality, and water quality concerns. While many of these issues are already legislated in developed countries, O’Connor noted that further regulation may have World Trade Organization (WTO) implications.

The EU Renewable Energy Directive mandates that feedstock shall not come from areas such as primary forest and other wooded land, areas designated for nature protection, or highly biodiverse grasslands. Although waste wood and farmed wood are approved, O’Connor cautioned that pellets made from mountain pine beetle wood would not meet the Swiss criteria.

The U.S. renewable fuel standard states that planted trees on non-federal land are considered renewable biomass, whereas those planted on federal land are not. For example, trimmings from federal lands are not counted as renewable. Also, feedstock from outside the United States has additional documentation requirements that make biofuel export into the United States difficult.
O’Connor said biomass carbon accounting practices might be revised, and 90 American scientists have recommended different practices for different sources of biomass. While planting fast-growing crops on unproductive land leads to additional carbon uptake, clearing forests for energy releases sequestered carbon tantamount to burning fossil fuels. Under the rules, wood bioenergy would not be considered valuable in reducing GHG emissions, and the solid wood products industry would become net emitters.

O’Connor warned that new rules will impact woody bioenergy systems. When the technologies for advanced bioenergy systems, such as cellulosic technology, are ready for commercialization, the advantages of low or zero carbon emissions will be lost. He added that a change in carbon accounting will make the GHG rating of woody biomass no better than that of fossil fuels regardless of Canada’s sustainable forest practices and certification schemes.

**Biomass as a Sustainable Fuel for Swedish Utilities**

**Speaker**
Seved Lycksell
Head, Fuel Department
Skellefteå Kraft

Seved Lycksell said although hydroelectricity is the backbone of Skellefteå Kraft, the company became involved with biomass district heating systems in the 1980s. By 1990, it had built a biomass combined heat and power (CHP) system tied into a district energy system. Today, many of Skellefteå Kraft’s plants use wet solid biomass as well as pellets. Skellefteå’s biofuel products include electricity, green certificates, district heating systems, and wood pellets for export. It is also involved with bulk delivery, local residential and school heating, and household pellet burners.

Compared to other energy sources, pellet usage has shown the greatest growth in terms of gigawatt hours (GWh). Sources for pellets include forest companies, sawmills, pulp mills, private forest owners, peat production, company forests, imported biomass, farmers, and carpentry/furniture industry waste. Lycksell noted that sawmill residue yields are no longer sufficient and that the company must go into the forest for primary fuels. Adding peat to the process allows the use of a more complex mixture of biofuel as it elevates the ash melting point.

Knowing the energy value is key for fuel analysis and trust between parties: “Here’s where tonnes per cubic metre become money,” said Lycksell. All contracts contain a formula to calculate energy content, and this standardizes the language between the power, forestry, and transportation sectors. Efficiency measures include improving fuel quality by crushing, grinding, and cleaning; proper storage and handling; and receiving imports at a nearby port.

Lycksell said an environmentally friendly transportation system is needed and noted the use of trains is increasing. Skellefteå’s vision for its private forest land is to use new technology and silvicultural systems to maximize biomass production and supply.

Lycksell noted that Skellefteå is involved with a new company, GreenExergy, that develops, markets, and delivers technology and services for the production of sustainable energy. GreenExergy also integrates power, heat, and pellet production.
Woody Biomass Assessment: 
Developing Investment Grade Feedstock Supply Data for the Olympic Peninsula 

Speaker 
John Calhoun  
Director, Olympic Natural Resources Centre  
University of Washington 

Woody biomass can potentially address U.S. policies toward climate change mitigation, energy security and independence, and sustainability, said John Calhoun. Woody biomass is already the second largest source of renewable energy in Washington State. Demand for biomass is increasing, but the supply is finite.

Half of all woody biomass in the forest can become harvested, merchantable wood products. Of the inaccessible, total residual biomass, 15% sustains ecological functions, while 0%–35% of the accessible biomass from the forest can be harvested but is not necessarily economically viable. The remainder is recoverable biomass that is economically justifiable to harvest.

Calhoun noted that market forces determine the proportions of accessible and recoverable biomass. Given that about 1.02 million bone-dry tons (BDT) of biomass is needed to produce 130 megawatt (MW) years, he asked whether recoverable biomass could provide sufficient amounts.

Calhoun noted that several ongoing projects are measuring biomass supply. One project seeks to quantify the amount of accessible and recoverable biomass as residue ratios. Calhoun said many variables can contribute to significant differences in biomass production, including:

- Wet or dry forest types
- Public or private ownership
- Variable utilization standards
- Clear-cut or commercial thinning operations
- Cable or ground-based logging methods

The project measures the volume of recoverable biomass slash piles using transect surveys of accessible biomass in the field. Ultimately the density of slash piles will be used to improve established density values. The intent is to calculate the density of slash piles most similar to those produced by forest operations today.

Pile density is calculated by estimating pile volume, weight before and after processing, and computing machine efficiency. When the recoverable and accessible biomass is computed and the pile density is known, the feedstock supply is estimated based on acres logged. Upon completion of this project, delivery costs to markets can be calculated and supply curves developed.

Calhoun said the “first step in developing a wood-to-energy industry is reliable feedstock estimates” obtained through Level 2 feasibility studies. Biomass is the “icing on the cake; the cake itself is the timber harvested for merchantable wood products.”

Discussion 
One participant asked about changes in European carbon accounting. O’Connor said if the Intergovernmental Panel on Climate Change revises the rules, then the impact on biomass
energy will be felt worldwide. The EU already has a narrow definition of renewable feedstocks that excludes natural forests.

A participant asked whether there have been any feasibility studies on using biomass from non-merchantable fibre. Calhoun said he is unaware of any studies but noted that biomass from other established sources is fully subscribed.

Lycksell commented that Sweden retrieves more biomass from the forest because of cooperation between forest companies, power companies, and universities. A participant added that Canadians are often surprised by the numbers of supply contracts available in Scandinavia. Lycksell agreed, noting that Skellefteå Kraft also buys from private forest owners. He emphasized the need for caution with these contracts, and said the forests must be well managed.

Another participant asked whether private forest ownership in Sweden is a response to changing policy or exists as an economic model. Lycksell said private ownership is somewhat symbolic and allows for more responsive, flexible management that takes into account production, nature conservation, soils, and native peoples. Roughly 50% of the land is private, and 25% is publically owned.

A participant asked Lycksell to comment on a municipally owned company competing against private companies. Lycksell said buying and selling energy is regulated differently from other industries.

A participant questioned the assumption that past harvest would indicate future harvest activities.

Calhoun said the future supply of debris and sustainability depends on future logging volume. The number of acres and the type of forest are important factors. Volume logged is a fairly predictable level that varies from plus or minus 20%. In the last few years the volumes have been relatively low leading to conservative estimates of future logging.

**Emerging Clean Technologies**

**MODERATOR**

Charles Scott

**The Role of Fuel Cells and Hydrogen in Bio and Clean Energy Applications**

**SPEAKER**

David Ghosh
Director, Science and Technology
NRC Institute for Fuel Cell Innovation
National Research Council

David Ghosh said the National Research Council (NRC) is Canada’s premier research and development organization. The NRC Institute for Fuel Cell Innovation, based in Vancouver, focuses on fuel cells but has recently expanded into other areas. Located on the University of British Columbia campus, the institute employs 160 scientists and researchers and collaborates closely with universities.

The NRC conducts research, operates a demonstration site, undertakes industrial partnerships, and runs the key fuel cell program. The institute’s main competencies are advanced materials and processing, architecture design, modelling and numerical simulation, unit and integrated system testing, and failure mode and diagnostics development.
“We are part of a hydrogen highway from Vancouver to Whistler,” said Ghosh, referring to a project underway involving the Pacific Spirit Filling Station that fuels third-generation cars operating on hydrogen in Vancouver. The institute also operates the Vancouver Fuel Cell Vehicle Project studying hydrogen-safe vehicle maintenance, solar hydrogen generation, and photovoltaic panels and electrolyzers. The institute helped facilitate 20 fuel cell buses for the 2010 Olympics.

In terms of biomass initiatives, the institute will soon receive a biogasifier to operate with high temperature fuel cells. It is working with Alterna Biocarbon to deliver a 20-kilowatt (kW) biogasifier to make liquid biofuel. In another initiative, the institute is working on direct ethanol fuel cells with the goal of bioconverting ethanol into electricity in microbial fuel cells.

The institute is working with the B.C. company Quadrogen on applications to produce multiple products from farm waste. Cow dung is being used in an anaerobic digester to make biofuel, which is then cleaned up and put into high temperature fuel cells to produce electricity. These fuel cells go to two or three MWs, and excess heat is used in a greenhouse. Ghosh described this project as “a fairly complete system.”

**Cellulose to Hydrogen Production**

**Speaker**
Samuel Weaver
Founder and President
Proton Power, Inc.

Samuel Weaver said his company has the technology to convert biomass into hydrogen-rich gas and the syngas produced has higher hydrogen content than that of other companies. Proton Power uses a single-step process of conversion, “which gives a good return on investment,” he said.

Weaver said one advantage of this system is its cost-competitiveness with hydrocarbon fuels. It also eliminates the need for a hydrogen distribution system and hydrogen storage. The system can be scaled to suit the application.

The composition of the gas stream produced by Proton Power (65% hydrogen, 30% carbon dioxide, and 2% ash, tars, and hydrocarbons) is ideal for combustion in reciprocating engines for power generation. This gas stream evolves in a single-step process from mechanically and chemically prepared cellulosic waste or biomass. After the removal of ash and tars, the gas is fed into an internal combustion engine.

This technology can be used with agricultural waste, forestry residue, paper waste, wood chips, sawdust, paper, and energy crops such as quick-growing switch grass. “From an economic standpoint in terms of electricity generation, it depends on what your feedstock is,” said Weaver. If the feedstock is cheap, costs can be greatly reduced. Whereas agricultural and wood waste can be inexpensive, mixed paper is one of the more expensive fuel sources.

Proton Power has found that coal companies are very interested in this technology and has formed a joint venture with Nexus Energy to sell the hydrogen product. “What has been missing all these years is a cheap source of hydrogen,” said Weaver.

Proton Power has developed a second-generation prototype that can produce 450 kW of heat, and will soon bring on the next generation prototype, which will be the same size but generate even more power. The company is also working on the conversion of cellulose and coal to liquid fuels.
Algal Biomass Production, Harvesting, and Conversion

SPEAKER
David Brune
Benemann and Associates

David Brune outlined several reasons to consider algal biomass harvesting and conversion:

- The crop is four to five times more productive than conventional crops.
- Growth can occur in dirty or saline water.
- Production can occur on under-utilized land.
- Transportation and handling of the product is fluid.
- Production is possible at low nutrient concentration.
- Algal cell generation time is short.

He noted that harvesting, drying and concentrating can be difficult, and the required processing is intensive.

Whereas conventional crops are about 1% efficient, algae are usually 2% efficient, and may make it to 3%. Algae require a lot of space. In terms of sustainable energy, “bioenergy is a piece of the pie, not the whole pie,” said Brune.

Algae yields are higher in tropical regions. Open ponds are the most sustainable and economical as they produce increased velocity.

Algal biomass harvesting and conversion often involves high capital cost investments as the needed infrastructure is expensive. “You are not going to make any money with them unless you can produce a product that is worth a lot of money,” said Brune. In addition, when reactors become contaminated, “you have a real mess and challenge keeping them clean.”

Centrifuge, bioflocculation, and biofiltration are three possible approaches to algal production. Brune said he finds biofiltration to be the most effective. Brune said he has reached 50% efficiency with the use of animals in the algal production. The most productive approach “uses an animal that has millions of years of converting algae”—brine shrimp.

Brune referred to the Southern Californian company, Earthrise®, that uses open ponds to grow spirulina. The company produces nutraceuticals. While its energy use is equal to the energy content produced, its costs of production are compensated because it is producing a high-value item.

In northern areas, temperature constraints can be an impediment to cost-effective algal production. “The capital investment alone will eat you up in more northern locations unless you are selling something really expensive,” said Brune.

“We can grow as much protein and oil in 4.7 million acres of desert using salt water as in 63 million acres of soy beans,” said Brune. Algal production can also assist in avoiding 20%–30% GHG from gas-powered plants, increase aquaculture production by three to four times, and allow for the integrated production of food, feeds, and biofuels with industrial chemicals, nutraceuticals, and pharmaceuticals.

The energy yield of algal biodiesel is 600–1,200 gallons per acre, whereas other biodiesels have a yield of 50 gallons per acre. “An integrated system is the secret,” said Brune. Economically, bioenergy cannot be the primary part of such a project.
Reg Renner outlined the economics of community heating systems. He said in this “age of scepticism,” detractors focus on fuel sustainability and technological, environmental, and economic issues. Technological issues are modern problems with modern solutions. For example, the Westbank First Nation’s pellet energy system incorporates computer controls and automatic ash disposal.

Despite 16 million hectares of forests damaged by the mountain pine beetle—a potential of $62 billion in bioenergy revenue—fuel sustainability issues often derail projects. Renner said the B.C. government knows how to manage forests and encourages forestry and energy sectors to learn a common language.

Renner noted that Austrian emissions have decreased as wood boiler efficiency has risen. Customers demand environmental standards and quality equipment.

Heating oil and propane in remote communities could be replaced by one million tonnes of pellets, said Renner. Greenhouse owners could benefit from replacing natural gas, especially after the raise in the carbon tax. British Columbia’s annual thermal heating bill is $2 billion. Noting that planning and strategizing are important, Renner suggested that communities and individuals conduct energy audits and energy and local biomass surveys, set budgets, and research equipment.

Renner introduced the community heating calculator, a high-level tool for pre-screening projects. The calculator requires three inputs: annual heating costs, current fuel, and the boiler’s British thermal unit (BTU) to find the amount of fuel needed, the operating costs, and the carbon offsets. If the project looks feasible, Renner recommended hiring a professional to continue the process.

Even at today’s natural gas prices, Renner said he does not see the same paybacks from other renewables as he does from biothermal. British Columbia has few community heating systems due to the lack of knowledge and educated debates, and misinformation and distrust from past failures. Stand-alone electric power plants result in a tremendous waste of thermal heat. He said communities should do the math and complete a bioenergy financing checklist.

Carbon Offset Opportunities in British Columbia

Pacific Carbon Trust, a B.C. Crown corporation, delivers B.C.-based offsets to clients and supports the growth of the low-carbon economy. David Muter said the concept of carbon
neutral is central to Pacific Carbon Trust, which he defined as measuring, reducing, offsetting, and reporting out emissions.

Pacific Carbon Trust considers three offset project types: energy efficiency, fuel switching, and carbon sequestration. British Columbia has a globally significant carbon price tied to risk and is the only jurisdiction in North America with a substantial carbon tax. To gain offsets, Pacific Carbon Trust targets the dominant sectors in British Columbia’s emissions profile: transport, natural gas, and industrial.

The Canadian forestry industry has reduced emissions by almost 60%, said Muter. Further reductions could come from fuel switching, forest-based sequestration, biodiesel harvesting operations, and biofuel utilization and production. Forest-based carbon offers opportunities such as an unexplored revenue stream, sequestration, and a cost-competitive source of carbon. However, current land management practices do not address carbon values.

To avoid significant costs arising from the Greenhouse Gas Reduction (Cap and Trade) Act’s reporting requirements, Muter advised operators to consider three different values: the cost of reporting regulation, the carbon tax, and the offset opportunity. If operators reduce their emissions, they can reduce their reporting and verifying costs.

Pacific Carbon Trust requires that projects are: additional and not business as usual; permanent, verifiable via monitoring and auditing; only counted once in a clear singular ownership; and identify with a methodology to measure GHG. The corporation works with its clients throughout the lifespan of each project. Offset projects must generate at least 5,000 tonnes per year to be considered economical.

Investment decisions should reflect the price of carbon, and setting a carbon price in advance of a cap and trade system is an incentive for industry to act early. Muter said Pacific Carbon Trust will help at all stages, from the initial idea to the purchase of verifiable offset tonnes.

A Maturing Market:
Developing the U.S. Wood Pellet Distribution Infrastructure

Speaker
Michael Scanlon
Director, Purchasing, Logistics, and Quality
American Biomass Corporation

Michael Scanlon said the American Biomass Corporation consists of three arms: retail sales, bulk sales, and delivery services. The company offers convenient home delivery and bulk sales; support for pellet stove retailers; and innovations in product quality, distribution, handling, and storage in the bulk fuels market. Scanlon said broad-based partnerships are key to the operation and American Biomass’s extensive supply network allows it to obtain pellets from a diverse group of companies. The company is the largest independent re-seller of pellets in the United States.

Scanlon said challenges arise from biomass distribution, relatively sparse distribution of customers, high delivery costs, and technological hurdles. As well, the immature industry is growing fast, resulting in high demand variability and lack of information on supply and demand.

American Biomass Corporation focuses on fuel distribution rather than fuel production and enables the flow of both product and customer information through direct deliveries and has
affiliations with established pellet-stove retailers. Scanlon said the company is committed to making bulk fuels accessible.

Technology allows American Biomass Corporation, an Internet-based company, to respond to customers. Optimized logistics, e-commerce, and information technology infrastructure enhance growth and efficiencies. The company can quickly respond to demand and efficiently track its customers and products in real time. In addition, American Biomass Corporation has developed a proprietary quoting engine that lays out the variety of products, the method of delivery, and pricing.

Advantages of biomass include its broad use in the United States, effective emissions and fuel security, local production, affordability, and proven technological capabilities. Scanlon said U.S. policies currently favour biomass for transportation, in the form of ethanol, despite the fact that “biomass for heat has three times the impact of ethanol.” He referred to the European experience—renewable heating has displaced oil in upper Austria—noting that the required technology has already been proven there.

**Discussion**

A participant asked why Pacific Carbon Trust pays more for carbon credits than the Chicago Exchange price. Muter said British Columbia’s requirements for the projects are more onerous. The province offers a higher price because it asks for more details. Auditing requires two steps: validating the project plan and verifying that the tonnes were generated.

Another participant asked how much land base is required to generate a 5,000-tonne offset project. Muter said it depends on the type of activity planned for that land base. Companies must look at the individual factors and conditions involved and consider the cost of generating the offset project. A simple project with an established protocol and without an onerous auditing step costs less. Aggregation with similar projects also reduces costs.

A participant asked about established protocols for project aggregation. Muter said aggregation could be agreement among parties to develop a common project plan. While Pacific Carbon Trust is flexible, the plan would require similar protocols and similar auditing steps with a methodology for measuring GHG. Validation and verification would be the same.

### Emerging Clean Technologies

**Modelling and simulation of an adaptive distributed power generation system**

**Speakers**

Alex Aravind  
Associate Professor, Computer Science Program  
University of Northern British Columbia

Nic Waller  
Graduate Student, Computer Science Program  
University of Northern British Columbia

**Alex Aravind** provided an overview of the differences between a centralized power grid system and a distributed power system. A centralized power grid system sends power in one direction, such as hydro and gas power plants.

A distributed power generation system generally uses clean and renewable energy and requires efficient management. This system tends to be small and medium sized, and includes smart storage technology. Renewable energy that can be used in a distributed power generation
system includes wind, solar, geothermal, and biomass. Power storage is necessary due to the often-intermittent nature of the power sources. Examples of smart storage include pumped hydro, compressed air, and batteries. A distributed system is integrative, so small power sources can join the grid.

To facilitate a distributed power generation system, smart technologies, a smart meter, a smart home, and a smart grid are needed. A smart grid manages the load more effectively and enables more automation and interaction between producers and consumers. The main drivers of a smart grid are technology and the integration of renewable energy, environmental concerns, customer demand, and business opportunities.

The technological goals of distributed power include establishing intelligent infrastructure, creating better interoperability, enabling the addition of smart energy resources, and encouraging consumers to play roles and establish a microgrid—small-scale distributed generation with plug-and-play style and better fault tolerance.

Aravind listed several requirements for smart grids:

- Pervasive smart generators
- Smart conductors
- Pervasive, smart storage
- Smart sensing
- Control devices
- Advanced data communications
- Computing and information systems

The system must be thoroughly understood, and issues must be identified and addressed systematically to move toward a distributed system. “It is a very complex problem,” Aravind said.

Modelling and simulation are used to further understanding. A model is an abstraction of reality, whereas simulation is an experiment performed on a model. Aravind said modelling is cost-effective, safe, flexible, and allows predictions—to ask what ifs and offer insights.

Modelling and simulation for adaptive distributed power generation involves five stages. Stage 1 starts with a simple system with a friendly user interface to create networks and monitor system behaviour. Stage 2 makes the model system dynamic by varying demand and supply and adding automation. Stage 3 adds elements such as multiple power sources and switches to distributed power. Stage 4 involves more adaptive control. Stage 5 adds a decision support system.

Demonstrating their simulator on a computer, Nic Waller said the simulator is created using Java software and can be used on any software platform. The simulator includes a series of nodes representing the power distribution system, and each node can be analyzed by clicking on it. At every programmed node, fundamental laws of electricity and power loads have been programmed in. The researcher can then determine the current, flow, and losses, and can inspect each node.
Spatial decision support systems for community-based renewable energy assessments

Speaker
Thoreau Rory Tooke
Forest Resources Management
University of British Columbia

Thoreau Rory Tooke said he addresses the question of why British Columbia should use solar power in the research study he is conducting for his Ph.D. in forest resources management.

The 2007 BC Energy Plan established provincial and community GHG reduction targets and emphasized the need for increased clean and renewable energy. Tooke noted that even hydro reservoirs create an emissions source and are not as clean as some other power sources.

Tooke said solar power provides an excellent retrofit opportunity, specifically solar hot water technology, which is readily available and affordable. In addition, solar power offers a local power source for community and household sustainability.

Tooke said his research considers the effects of several variables on potential solar power at specific locations, including:

- Direct radiation
- Diffuse radiation
- Reflected radiation
- Shading from topography, buildings, and trees
- Temporal cloud variability
- Transmission through clouds and trees

All of these factors will influence solar availability in a given location and can be brought into a decision support system.

An urban, spatially explicit radiation model can encompass technology types, technology productivity, technology placement, and temporal positioning for optimizing solar power potential.

Tooke said his research uses the Light Detection and Ranging (LIDAR) device, a new precise laser scanning device used mostly in forestry that employs remote sensing technology to measure scattered light properties. Such a laser is usually connected to an airplane’s fixed wing and emits more than 100,000 pulses per second to generate data information that goes into a very detailed, three-dimensional model of the city in question.

Tooke said it is possible to get multiple extractions from this technology. For example, trees, and then buildings, could be extracted to arrive at results for a given location.

Regarding the study’s spatially explicit radiation modelling aspect, Tooke said sun maps are used to determine direct and diffuse solar radiation received in certain locations throughout the year. In this approach, the shading factor from both trees and buildings is easy to model for morning, midday, and afternoon, as is depicting shading from different features.

Similar modelling systems were previously used in San Francisco and Boston, with San Francisco being one of the first municipalities to use such a tool.
Tooke said the researchers involved in his study are currently working with the City of Prince George, the District of North Vancouver, the City of Kelowna, and the City of Richmond. These four cities will act as case studies to model potential radiation. It will eventually be possible for homeowners to enter a specific address into the software and get their ratings, taking into consideration trees, cloud cover, the angle of the homeowner’s roof, and neighbouring buildings. A five-star rating would be the highest.

Tooke said this software would also allow a homeowner to enter the number of people in a household and query the fuel type to determine savings and carbon reduction per year that would be generated by installing particular solar installations.

Energy efficiency and the feasibility of energy recovery in a steel company in Manitoba

Speaker
Minxing Si
Natural Resources Institute
University of Manitoba

Minxing Si said iron and steel, chemicals, petroleum refining, minerals, and pulp and paper are among the most energy-intensive industries. These industries have grown dramatically since the 1970s, mostly in developing countries. The means of energy recovery within these industries includes heat and power recovery, and co-generation. Si said energy recovery is considered the best option as it has a low initial cost and a short payback period.

Si’s research project analyzed heat recovery with a specific focus on identifying energy losses in a reheat furnace and evaluated waste heat recovery possibilities. The subject industry was a steel producer. Energy loss was captured to preheated billets. The study found the project payback period was 20 months, and the annual savings were more than $100,000.

Si said his study confirms that waste heat recovery is feasible in the Canadian steel sector.

Concurrent Sessions 3
Bioenergy Deployment Today

Moderator
Michael Weedon

Canfor Pulp Limited Partnership:
A Legacy of Leadership in Bioenergy

Speaker
Sotirios Korogonas
Manager, Strategic Capital and Energy
Canfor Pulp Limited Partnership

All three of Canfor Pulp’s mills, built in the late 1960s and early 1970s, are in Prince George. “We’re a local company with a global presence,” Sotirios Korogonas said.

Korogonas said bioenergy is a cornerstone of Canfor Pulp. Northwood Mill, the first to recognize the advantages offered by CHP, installed a turbine in 1972. Its mills consume 3 million tonnes per year of biomass. One million tonnes are used to make pulp product, and the remaining 2 million are used to make energy.
Pulp mills require a lot of heat, said Korogonas. Lignin, an internal by-product, serves as a fuel source, and sawmill residuals are incremental fuel sources. Cogeneration is a key advantage at Canfor Pulp. Biomass fuel sources provide over 90% of the process heat, and internal generators provide over 80% of the total site electricity load. “We’re not a fossil fuel-intensive industry,” he said.

The Canfor Pulp Green Transformation Program aims to increase biofuel power generation, improve efficiencies to reduce fuel demand, and reduce odour emissions. “We’re modelling Canfor pulp around continuous improvement,” Korogonas said.

**District Heating and Small CHP Systems**

**Speaker**
Fred Spinola  
General Manager  
Deltech Manufacturing Inc.

Fred Spinola said people should ask a number of important questions before implementing district heating, including:

- What is the need?
- What fuels are available?
- What skill set will the operator require?
- How far is the plant from the heat user?
- What will the total energy demand be, keeping in mind extreme weather?
- Where is the supplier?

Spinola said local conditions should be considered when choosing fuel. Hog fuel, with its high moisture content, may not be viable in northern areas where the fuel could freeze in extreme winter conditions. The cost of handling more labour-intensive fuel could raise the price of less expensive fuel above the more expensive pellets.

Spinola said the Baldy Hughes district heating system was designed to meet both climate and infrastructure needs. Pellets were chosen as the simplest system on the market, a silo was constructed, and a buffer provided an eight hour backup supply. Low heat loss equipment was chosen so heat would be delivered to the end user.

Describing the energy balance of a small CHP system, Spinola said an ideal system includes a method for dissipating residual thermal energy. “It raises the efficiency of the overall system, and your ROI is much higher,” he said.

**The Modular Pellet Plant**

**Speaker**
Paul Adams  
General Manager, Firemaster Team  
SBC Firemaster Ltd.

Paul Adams said SBC Firemaster got involved in pellet fuel in the late 1980s and built a traditional pellet plant in Princeton, British Columbia in 1994. After selling the Princeton plant in 2005, “the company realized it needed to get back in the pellet capacity, but wanted to do it in a non-conventional fashion,” he said.
SBC Firemaster has developed a modular pellet plant that fits inside regular shipping containers. Because the plants are pre-engineered, they can be manufactured in a short period of time at roughly half the cost of a traditional pellet plant. Modular pellet plants can be easily shipped and assembled. Setting up a plant from point of order to point of production takes six months, and putting the plant in place after its arrival takes two weeks. Capacity can easily be altered by adding or removing modules.

Adams said a plant has been integrated with a log shaving operation in Kamloops, British Columbia, and uses many non-traditional fibres. “We try to bring our price of fibre down by having as many fingers in as many fibre pockets as we possibly can,” he said.

The Organic Rankine Cycle in Biomass Applications

Speaker
Daniel Theuer
Business Development Manager
Turboden

The organic Rankine cycle (ORC) is a clean technology for distributed power generation that converts heat to electricity and low-temperature heat, said Daniel Theuer. The heat comes from various sources, such as waste heat or geothermal heat, and at different temperatures.

The unit, with components similar to a steam cycle, comes pre-assembled on skids. It can be applied in any traditional biomass cogeneration facilities or in gasification facilities. The overall energy efficiency of ORC is 98%. Turboden also produces heat recovery models, which can handle lower temperatures than CHP units.

Turboden is a 20-year-old Italian company with significant experience in biomass cogeneration. Theuer said its first installation in Canada was recently announced.

ORC turbogenerators experience low mechanical stress, are highly efficient, and do not corrode. These benefits translate into operational advantages, including high reliability and long lifespans. Advantages over steam turbines include wide load flexibility, “which is especially important when we have district heating systems with variable loads,” Theuer said.

Nexterra Gasification Systems

Speaker
Jonathan Rhone
President and CEO
Nexterra Systems Corp.

At Nexterra, “we think small is beautiful,” said Jonathan Rhone. Nexterra manufactures and supplies small gasification systems that produce extremely low local emissions. The new system at the University of Northern British Columbia (UNBC) will begin operations in 2010 and will displace 35% of the natural gas used to heat the campus. Sinclair Group Forest Products Ltd. will provide all the hog fuel.

Nexterra works in many markets, including universities and municipalities. Many customers have mandates to shift from fossil fuels to renewable fuels and want to stabilize energy costs. Small-scale plants minimize the risk of fuel supply disruption.

Rhone said community acceptance plays a key role: “they want the cleanest system possible, and they want no truck traffic through their neighbourhoods.” Economic development is also important, as are flexible business models to accommodate many customers who purchase energy through third parties.
Nexterra’s future projects include the U.S. Department of Energy’s flagship laboratory, a Kruger Products tissue mill in Vancouver, and a new plant at UBC that will achieve up to 65% efficiency in cogeneration and 30% in power generation.

**Pyrolysis Oil:**
*Heat, Electricity, Green Transportation Fuel, and Chemicals Too*

**Speaker**
Randal Goodfellow  
Senior Vice-President, Corporate Relations  
Envergent Technologies

Randal Goodfellow said Envergent is the only commercial fast pyrolysis company in the world, and deals with liquid fuel and large volumes. Its core competency is the ability to turn cellulosic material, mostly from forestry, into liquid pyrolysis oil in less than two seconds.

Pyrolysis oil contains all the long- and short-chain molecules from the previous biomass. The individual chemicals are used to provide a smoky flavour to barbecue sauce.

Fast pyrolysis works by rapid flash heating of biomass in the absence of oxygen. A whirlwind of sand at 700°C collides with biomass, instantly vaporizing it. The gas immediately condenses into a liquid. The remaining gases are used to dry the biomass. The by-product char is allowed to combust in a side chamber, which in turn heats up the sand. “Biomass provides the liquid, the gas that heats the biomass to dry it in the first place, and the char to heat the sand,” Goodfellow said.

Pyrolysis oil can be treated and refined in existing infrastructure to produce transport fuels. “This is the pathway the Chevrons want to use,” said Goodfellow. “They want to be renewable but use as much of the existing infrastructure as possible.”

**Discussion**
Weedon asked whether the Gulf oil spill is going to make bioenergy a more attractive alternative. Rhone said bioenergy companies are reaching a critical mass regardless of the oil spill. “I’m pretty enthusiastic about where things are going,” he said.

A participant asked about potential feedstocks. Goodfellow said they can process any type of feedstock, but not all are economically advantageous. “We’ve run over 100 types of feedstocks,” he said. Rhone said the Nexterra systems can handle nearly any type of feedstock, and is currently working on sewage sludge.

A participant asked about the acidity of fast pyrolysis oil and its viability for combined natural gas. Goodfellow said the pH is two and a half or three, creating problems for carbon steel equipment. Envergent has successfully swapped nozzle heads and delivery lines for stainless steel. Another alternative is to adjust the pH.

A participant asked Goodfellow how his technology is protected, given that intellectual property protections expire. Goodfellow said, “If you keep putting new intellectual property around things, you keep a fence going all the time. There are lots of different pieces on our technology.”

A participant asked Goodfellow how he markets his product. Goodfellow said Envergent’s business model is to license the technology and deploy with their clients. He said integration is the ideal model, as the feedstock is readily available, and the capital cost decreases.
Weedon asked Theuer about Turboden’s move to the North American market. Theuer said Turboden currently has two heat recovery projects, one in Saskatchewan, and one in Albany, New York. He said the North American market is very different from the European and offers opportunities for new applications.

Weedon asked Theuer about the rate distribution scheme in Italy. Theuer said green certificates are provided for renewable energy that add a premium to the market rate for energy in Italy. Green energy has guaranteed dispatch, which means the grid has to take it. These measures help provide investors with long-term security.

Weedon asked what British Columbia should be doing to advance the industry. Rhone said, “You can be the Saudi Arabia of biomass, but you don’t have specific policies that allow optimization of the resource.” Fibre should always go to the highest and best use, and every scrap of fibre that can be used should be used. New policies are needed that ensure the highest prices for bioenergy, particularly if it is displacing waste.

Goodfellow said federal government policy must be considered along with its provincial counterpart. “We need to get beyond transport fuel, which is what the federal government is fixated on,” he said.

Rhone said that U.S. incentives are creating an “uneven playing field for capital in North America.” Spinola said policy should facilitate access to fibre.

Each policy change must be considered carefully for related consequences, said Korogonas. “This whole industry is built on fibre and any changes need to be considerate of existing uses.”

Adams said policy must change to allow for long-term use of underutilized fibre pockets.

**Advancements in Municipal/Community Energy**

**M**ODERATOR
Gina Layte Liston

**Bioenergy opportunities**

**S**PEAKER
Joanne McKenna
Customer Care and Conservation Division
BC Hydro

Joanne McKenna said bioenergy opportunities exist for independent power producers in BC Hydro’s distributed generation (DG) strategy in municipal, residential, small commercial, mid-industrial, institutional, and First Nations communities. Pilot projects look at a variety of technologies, such as anaerobic digestion, and create community, innovation, and economic development benefits.

McKenna said other calls for energy production include BC Hydro’s Community-Based Biomass Power Call Request for Qualifications (RFQ), which focuses on small-scale community projects. The Integrated Power Offer (IPO) for Pulp and Paper Customers, in conjunction with the federal Green Transformation Fund, aims to help pulp and paper companies optimize DG opportunities, become more energy efficient, and consider demand response at customer sites. The province-wide Phase 2 bioenergy call focuses on acquiring biomass on greenfield, or new, sites in six timber supply areas.
McKenna said the Clean Energy Act refocuses BC Hydro’s priorities to include electricity self-sufficiency at low rates, the use of clean power potential to create jobs in every region, strengthening environmental stewardship, and the reduction of GHGs.

McKenna said the new Act expedites clean, renewable energy production by exempting some of the new programs and calls from sections of the Utilities Commission Act. The Clean Energy Act focuses on export opportunities, energy efficiency, smart metres and grids, and the Site C Clean Energy Project. Its regulations instruct BC Hydro to develop a feed-in tariff, currently in the planning stage. Overall, the Act promotes “a forum for projects that have innovation and are near commercial to get into our acquisition process,” said McKenna, while providing a premium price to emerging technologies.

Community energy in the future: A utility perspective

**Speaker**
Scott Gramm
Business Development Manager
Terasen Gas

Scott Gramm said Terasen Gas is looking at converting biogas and landfill gas to biomethane for injection into the existing natural gas grid. Besides providing gas products, the company has a province-wide delivery infrastructure for both transportation and thermal energy. Terasen Gas is also considering district energy systems, comparable in cost to expensive electricity, that link buildings to a central thermal energy source through heat exchange loops. Referring to Terasen’s investment in Victoria’s Dockside Green development, Gramm stated, “The bottom line is that [district energy] is real, it is working, it can be done.”

Gramm detailed the production of biomethane. Under anaerobic conditions, organic materials such as sewage, landfill, and other “organic junk” produce raw biogas. Terasen upgrades the biogas to create biomethane, which is interchangeable with natural gas and can be distributed through existing systems. This infrastructure is province wide, well-established, and interconnected.

Terasen plays various roles in the energy business. Gramm said the company wants to deliver thermal energy along with natural gas and offers partnerships by assuming operational responsibility.

Terasen earns a regulated, modest, and entirely transparent profit over the long term with a 30-plus-year investment horizon. Gramm said the customers’ interests, needs, and wants come first, along with safety and energy supply. He noted that Terasen’s expertise in the operation and maintenance of energy-related equipment is well-established.

Quesnel community energy project

**Speaker**
Jim Savage
Principal
Savage & Associates

Quesnel, a forestry-dependent town in central British Columbia, is currently developing a CHP district energy system tied into an existing sawmill bioenergy system. Jim Savage said the energy plant will be retrofitted with a high-efficiency turbine to generate electricity for the grid with heat left over for 22 city buildings, the sawmill, and its planer buildings.
Eighteen percent of the additional biomass energy will come from recovered sawmill space heating energy, 23% from recovered stack energy, and 59% from bone dry hog fuel. Almost all of the district’s heat energy and about 40% of the power will come from recovered heat from the existing industrial operation. Savage noted that the extra electricity is from sawmill residuals only. This system will be “the first of its kind in North America in terms of piggybacking onto an existing industrial operation recovering heat and generating power,” he said.

Savage said the project is in the feasibility and agreements stage. Funding should enable project design and development to start in the fall of 2010, and project completion is slated for late 2012. Partnerships between the city, the sawmill, Terasen Gas, BC Hydro, and key consumers are essential to the project’s success.

This project was undertaken in the context of a broader bioeconomy vision, possibly extending the “loops” to other consumers of heat such as greenhouses or food processors, said Savage. A biogas digester, primarily fed by regional organic waste and pulp mill residuals, could eventually be developed. Its residuals could produce high-quality fertilizer suitable for a biomass plantation that in turn could produce a variety of materials for industry.

Savage said simply burning wood is not in the long-term interest of a community’s employment prospects, and he cautioned against “vacuuming the forests” for biomass.

**Biomass CHP: New decade, same issues**

**Speaker**
Thomas Deerfield  
President  
Dalson Energy

Alaska is ideal for community renewable energy projects, said Thomas Deerfield. High diesel and electricity costs motivate rural communities to find alternatives. Bioenergy opportunities exist in scattered and isolated communities, many of which are First Nations communities and off the grid.

Deerfield described a pilot project involving a community heating system that uses saltwater driftwood biomass as fuel. Unfortunately, sand makes processing difficult, and salt is an unknown and variable factor. No small-scale community studies of burning salty wood have been done.

In terms of upriver supply and downriver users, Deerfield endorsed small regional densification plants that promote the barging of woody materials downstream, a potentially less damaging process to the environment than barging diesel.

Deerfield identified three categories of CHP-scale opportunities: individual homes and businesses, small communities, and isolated grids. Despite such opportunities, biomass energy investments in Canada remain low at 2%, compared with 10% in the United States and 44% in Europe.

Biomass “will never compete with the fuel density of fossil fuels,” said Deerfield. However, fossil fuel prices will continue to increase, while biomass has a stable price advantage in the long run. He questioned why Canadians worry about production efficiency when they waste half of their energy. Operating and maintenance cost concerns should be understood in terms of local jobs.
Deerfield noted that a community-scale CHP gasification internal combustion engine project has been proposed for Alaska and is waiting for funding. Integration with an existing diesel generator, a district heat loop, and a densification plant are also in the planning stage.

**Biomass and district energy: The European experience**

**Speaker**  
Richard Damecour  
Chief Executive Officer  
FVB Energy Inc.

One way to reduce CO₂ without reducing the standard of living is to build district energy systems, which are “bridges to renewables,” said Richard Damecour. Energy sources funnel to a centralized heating and cooling plant connected to commercial, industrial, and residential users via a distribution infrastructure.

Sweden’s and Denmark’s biomass-based district energy systems have helped reduce dependence on oil. Consequently, CO₂ levels have fallen, and skies over towns have become clearer. As well, these countries “have been able to totally disconnect economic development from energy use,” said Damecour. The United States’ gross domestic product takes much energy to produce, whereas countries such as Denmark have been able to maintain a good lifestyle while reducing GHG.

Canada possesses an abundant supply of GHG-neutral biomass. Although biomass will never be cheap, it can be competitive, responsive to demand, and environmentally beneficial, said Damecour. Bioenergy also produces a green economic advantage by creating three times as many local permanent jobs as fossil fuels, often in rural and high unemployment areas, thus helping small communities grow. Damecour noted that European warehouses are full of B.C. biomass despite its transport costs—it remains too expensive to be used at home.

Damecour gave examples of FVB Energy’s thermal-only and biomass CHP systems. Its biomass energy project in St. Paul is part of a large district heating system. This CHP project protected St. Paul from the recent price fluctuations in natural gas and oil. He said such CHP district energy systems are very efficient at capturing energy and can generate revenue.

District energy systems are needed for a widespread biomass industry. The sustainable supply of biomass is critical to financing. Damecour said Canadians should use waste products for heat and communities should be flexible in their energy sources because the future is unpredictable.

**Discussion**

A participant asked about studies looking at surplus power as an incentive to attract investment and create jobs in British Columbia rather than servicing industries elsewhere.

McKenna said BC Hydro has just started developing its export strategy and will be looking at how power export can help drive economic development in British Columbia.

A Ministry of Energy, Mines, and Petroleum Resources employee said the government is considering clean energy as an opportunity for regional economic development, and regulations are pending.

Another participant asked about the cost of the infrastructure and pipes needed to implement large-scale bioenergy. Damecour said a publicly funded TransCanada pipeline aided the natural gas industry 40 years ago. When building a district energy system, work must start with the dense downtown core. “Create with small grids and over time, add more buildings,” he said.
A participant asked about finding financing given the problems with price forecasting. Damecour said strategic partnerships help, and a large aggregator of waste wood can help bring together smaller users and distribute biomass to each community. Otherwise, the big users will control the price and volume.

Another participant noted that small users could be shut out of the market given the global energy market. Damecour said British Columbia’s biomass has a huge local transportation cost advantage when sold within the province.

A participant asked about the role of utilities and regulations in smaller district heating systems. McKenna said BC Hydro is looking for linkages between distributed energy projects and district energy projects, and also offers funding programs. BC Hydro is currently looking at signing an electricity purchase agreement with Quesnel, British Columbia.

Terasen Gas can be as efficient and cost effective as a municipality, said Gramm. Its competitive advantage comes from the company’s knowledge and experience, not from regulatory issues. Rates charged would follow the Utilities Commission’s due process, and only the customers who use bioenergy would pay for it. Terasen Energy Services, the non-regulated arm of Terasen Gas, would be rolled into the regulated model.

Savage said Terasen Gas has been essential to moving Quesnel’s project forward and noted the integration of all players has been vital to the project’s development. The project uses community resources that have been thrown away. He said discussion on rural economic development is much needed.

Another participant asked about the crash of the euro and the impact on pellet prices in relation to the fibre crunch. Damecour said great demand still exists for biomass in the EU, and the supply is tight. The law of supply and demand will hopefully raise the prices.

In response to a participant’s comment that an exporter currently cannot make money exporting pellets to Europe, Damecour said Europe mostly burns wood chips. Another participant added that most of the biomass is still available in Europe and if the price goes up for B.C. biomass, more local sources exist.

**Concurrent Sessions 4**

**Bioenergy Technologies for Tomorrow**

**MODERATOR**

Paul Austin

**Biomass Conversion and Pathways for Carbon Sequestration**

**SPEAKER**

Fernando Preto
Group Leader, Biomass Conversion
CanmetENERGY Technology Centre
Natural Resources Canada

Fernando Preto said scientists from CanmetENERGY, the research section of Natural Resources Canada (NRCan), work across Canada. The Biomass and Renewables Group conducts research in an Ottawa laboratory. “We need to make a decision about how to approach bioenergy technologies for the future. Where do we put the money?” he asked.
Preto urged participants to read *Transforming Canada’s Forest Products Industry*, a study led by the Forest Products Association of Canada (FPAC) and available on their website. The report assesses which conversion pathways for processing woody biomass to energy have the most promising potential economic return.

In Ontario, pellets provide a good return on capital employed, partly because OPG is expected to move to pellet power generation. In general, integrated technologies provide greater ROI. In British Columbia, which lacks the OPG driver, pyrolysis offers the most promise.

Environmental success directions must also be considered. Biomass is essentially GHG neutral, and particulate standards can be met. “But the one thing we don’t normally look at is carbon dioxide,” said Preto.

A study by Vattenfall compared the cost of GHG abatement measures against their effectiveness. Preto said efficiency improvements and CCS are key approaches.

Biochar is a smaller-scale CCS technology. Unlike buried biomass, which eventually decomposes and releases carbon, biochar effectively removes carbon from the atmosphere when buried. In a gasification cogeneration facility, burying the resulting biochar can produce a net negative GHG emission.

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**Biorefining Technology for Today and Tomorrow**

*Speaker*

Mike Rushton  
Chief Operating Officer  
Lignol

“Lignol’s technology is ready for demonstration, and we believe it’s very current,” Mike Rushton said. Lignol is one of the few companies in the world to have successfully developed cellulosic ethanol and biorefinery technology. At the core of Lignol’s process is a solvent pulping technology, proven by Alcell as a pulp and paper technology, and developed by Lignol as the core of biorefining. The technology is complete and has been proven in pilot plant operations. Lignol’s process produces ultra-low carbon cellulosic ethanol and high-value lignin derivatives.

Rushton said biomass extraction is at the core of the process. From the initial separation, cellulose, lignin, mixed sugars, and chemicals are produced. The cellulose can be used to generate fuel ethanol. The lignin is extremely pure, and produces a family of products called HP-L™ Lignin. In the initial version of the process, the sugar stream is evaporated or burned to produce energy.

The process is flexible. “There’s no feedstock we’ve come across yet that we can’t do something with,” Rushton said. The cellulose may be used to produce specialty pulps, or the lignin may be used to produce unique lignin derivatives for introduction into resin. “Our process maximizes what you can get from biomass; there’s not much left at the end.”

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**Hydrothermal Pretreatments of Woody Biomass for Biofuel Production**

*Speaker*

Zahra Tooyserkani  
Department of Chemical and Biological Engineering  
University of British Columbia

Most of UBC’s Biomass and Bioenergy Research Group’s (BBRG) work focuses on pellet production, said Zahra Tooyserkani. Pellet production capacity in the United States surpassed
Canada’s in 2008, and Canada continues to use sawdust or sawmill residues, while the United States uses logging residues.

Conventional pellets are made out of sawdust and shavings, which are becoming less available as the number of sawmills declines and competition for sawdust from other industries increases.

Tooyserkani said BBRG is focusing on advanced pellets made of logging residues or mixed biomass. The group is developing steam explosion techniques to make the pellets more durable for long-term handling and storage. It is also studying torrefaction to produce higher energy density pellets for transport and co-firing with coal.

Steam explosion changes the biomass structure by exposing it for a short time to high temperature and high pressure steam, followed by sudden decompression. Research results show the hydrophobicity, or the tendency to reject moisture, of steam-exploded pellets. As the condition harshens, the tendency of the material to reject the moisture increases, Tooyserkani said.

The torrefaction research involved varying sizes of grinder screens, temperatures, and durations. Conditions resulting in higher heating values also resulted in higher mass loss.

Tooyserkani said research is ongoing, and at this point has shown that mild torrefaction has a positive payback, steam treatment produces durable pellets, and steam-treated pellets have superior hydrophobicity.

**Bluekey Energy**

*Speaker*

Theo Warkentin
Chief Executive Officer
Bluekey Energy

North American pulp mills can produce two billion litres of biocrude oil annually. “It is the best or the worst of times, depending on which side of this industry you’re on,” said Theo Warkentin. Markets have collapsed, governments have retrenched, and conservative industries are reluctant to spend money on new technologies. Yet “never at any point in history has the market for new energy been so robust.”

Bluekey Energy has developed a patented process to convert pulp mill waste from the black liquor stream into biocrude oil—coined “B.C. Oil”—that can be seamlessly integrated into a pulp mill. Ninety-five percent of the power needed is already onsite and the biodiesel can be created for less than eight cents per litre. The largest input, methanol, is a by-product of the pulping process. Sulphuric acid, the other product used in Bluekey’s process, is also present at pulp mills. “The price of raw materials will never go up, because the pulp mills own it already,” Warkentin said.

The process increases pulp production by eliminating congestive soap from the black liquor cycle. If the mills choose to turn their waste into B.C. Oil, it could mean a $40 million dollar increase in revenue to the region. “We believe that our forests are going to have a monstrous impact in the future, and that biodiesel and biofuels will play an integral role,” said Warkentin.
The Thermocatalytic Single-step System

**Speaker**
Gerhard Bothe  
President  
ASG International

Gerhard Bothe said ASG International has developed a system to convert biomass directly into useable fuel that addresses the shortcomings of existing systems for converting biomass into useable energy.

“What we have done is to overcome these problems,” said Bothe. The thermocatalytic single-step system (TCSS) is a safe, closed process and energy loop that uses no external energy. The single-step conversion remains free of unlawful emissions or residue. It meets the EN 590 standard for diesel fuel and can process nearly all organic materials, including waste. The modular system is built entirely in shipping containers.

Bothe acknowledged the system seems too good to be true. A pilot production plant has been in operation for over one and a half years. To persuade any remaining skeptics, ASG is offering to defer payment for a new plant until an independent surveyor has certified that the plant is performing as promised.

ASG biomass to liquid (BtL) diesel fuel is made from non-fossil origin material containing carbohydrates. The fuel produced is ready for use. “You can put it right in your truck and drive away,” Bothe said.

**Discussion**

Paul Austin asked why North American industrialists are more reluctant than their European counterparts to adopt emerging technologies. Warkentin said new technologies pose a higher level of risk in North America because its companies are generally smaller and more closely scrutinized. Rushton said North American companies could follow a Swedish model in which several companies form an entity to share the risk.

Preto said the economic driver is not as strong since energy is cheaper in North America than in Europe. “If you don’t have a business that’s sustainable and will make a profit, it doesn’t matter what the incentives are,” he said.

Austin asked about collaborating with universities to develop technologies. Tooyserkani said the link between industry and university research is weak.

Warkentin said the cost required to collaborate with universities can be prohibitive. Universities tend to develop long-term future technologies rather than immediately applicable ones, and intellectual property ownership can be problematic.

Bothe said ASG does all its development with a leading university in Southeast Asia, a relationship that is encouraged by the commercial orientation of the school.

A participant said although many sophisticated products can be made from biomass, a better use for biomass might be replacing advanced fuels like natural gas in the heating market so that advanced fuels can be used for other services like air traffic fuels.

Rushton said biomass can be turned into sophisticated materials given existing capabilities and a favourable economic climate. Preto said part of the problem is the low cost of natural gas in Canada.
Austin asked Rushton about cellulosic ethanol costs. Rushton said the cost of the enzymes used by most processes has been the primary obstacle. Preto said the current issue is capital cost, which can be three or four times that of a conventional plant, followed by feedstock supply.

Feedstock availability is the major concern, said Bothe. “I think for energy manufacture, diesel is the material to be adopted: it needs less feedstock, it can use a variety of material, and on top of that, you get a liquid which is easy to transport and has multiple uses.”

A participant asked about the limited percentage of biofuels allowed by most engine manufacturers. Warkentin noted that the diesel engine was originally designed to run on peanut oil. Rushton said auto manufacturers must start producing flex-fuel-friendly vehicles.

Bothe described the clear classification of biofuels in Germany that differentiates between vegetable oil-derived biodiesel, second-generation biodiesel, and biodiesel from non-vegetable origin.

**Agricultural Biofuels**

**MODERATOR**

Matt Dickson

**Before cellulosic: An ethanol solution at Summit National Energy**

**SPEAKER**

Mark Kendall
Principal
Kendall Energy Consulting LLC

Mark Kendall said Summit National Energy operates a unique, small plant that produces biodiesel from waste feedstocks in Cornelius, Oregon. The company holds a permit to produce one million gallons of ethanol per year and has build-out capacity to produce three million gallons. It utilizes 15 million pounds of feedstock. Kendall said ethanol "is very good for internal combustion engines."

Oregon consumes less than 1% of the United States’ energy. A state law requires that 9% of energy come from renewable sources and diesel must include at least 2% biodiesel. Many small, local transportation blend-fuel producers and ethanol and biodiesel producers work in Oregon.

Summit National Energy receives all of its feedstock per year from the Portland region alone. Ethanol sells for about $1.90 per gallon, and Summit National Energy produces 1.7 million gallons per year.

The company searches for feedstock with at least 10% moisture. Once received, the stock is ground, blended, cooked, scrubbed for carbon dioxide, distilled, then pervaporated, tanked, denatured, and delivered.

The full life cycle carbon intensity of this product is less than half of land-based ethanol production. “In many cases the feedstocks will get a carbon credit,” said Kendall.

“Cellulosic is where we are going,” he said. Summit National Energy is now looking at using urban waste materials to feed into this system, and is currently doing tests.

Oregon’s low carbon fuel standard calls for a 20% carbon reduction by 2020. As petroleum use continues to climb, the rate of blending with these products will need to accelerate in the state, said Kendall. A new approach toward dealing with waste must be found.
An introduction to biogas technology

Speaker
Graeme Millen
Project Coordinator
CH4 Biogas

Graeme Millen said the gaseous by-product of anaerobic digestion is 60% methane and 40% carbon dioxide depending on the nature of the feedstock. During anaerobic processing, organic material in an oxygen-free environment breaks down. The resulting biogas can be used as fuel in combustion engines to produce energy. This technology has been used for over 100 years in dozens of countries.

Any source of feedstock can be put into a digester, where it remains at a temperature of approximately 40°C for about 20–60 days, then begins to emit gases.

Millen said biogas results tend to be project-specific. Producing biogas results in a 97% reduction in odour and up to a 99% reduction in pathogen levels. In addition, these processes lead to reductions in GHG, the generation of renewable energy, and the conversion of organic waste into energy. Nutrients can also be recycled from the biomass for the next generation of crops during this process.

Nutrients produced through the digesting process can be re-used on the farm, creating a closed-loop system. The increase in the nutrient value of organic waste used for fertilizer generates new farm revenue streams, which in turn supports rural economic development.

Millen said the three most common feedstocks for farm-based digesters are livestock manure, source-separated organic wastes, and fats such as oils and greases. Manure, which has already been digested by animals, is a highly efficient feedstock source.

Forms of energy management include cogeneration, a boiler, an upgrade for pipeline injection, or an upgrade for vehicle fuel. Millen said European countries upgrade for vehicle fuel to a massive extent.

The worldwide production from biogas, which mostly occurs in Asia, is 5,000–6,000 MWs per year. In the western world, Germany leads in this kind of technology, while Denmark leads in community-based systems. Ontario, which produces five to eight MWs per year, is considered the leader in North America.

Anaerobic digestion to renewable natural gas: The alternate alternative energy

Speaker
Chris Bush
Founder and President
Catalyst Power Inc.

“We need to do a lot of work around environmental responsibility with agricultural practice,” said Chris Bush. Catalyst Power is building the first anaerobic digester in British Columbia and the first feed-in project for pipeline gas supply.

The project, Catalyst One Agricluster Ltd., uses manure as the primary feedstock and combines a leading German company’s approach to biomass digesting with various upgrading ideas.
Bush said the advantages of renewable gas are abundant. It creates no conversion losses and is a more versatile fuel requiring a simpler grid interface. Solar and wind power cannot make gas, whereas anaerobic digestion results in gas plus cleaner air and environmental improvements.

Catalyst Power uses four one-million-gallon digester tanks, with five farms participating. The company is currently working with Terasen Gas to examine transportation possibilities for this product.

Bush estimated the energy potential from the readily available organic material in the Fraser Valley alone at a conservative 30 MWs of electricity. That is equivalent to 400,000 barrels of oil per year, or enough energy to run over 30,000 homes a year. The energy potential is 120 million cubic metres per year of biomethane, which is equivalent to the diesel used by 80,000 cars.

“A single solution in isolation is linear. We have to find a way to close the loops, to bring all these things together. We need to be a team and come together to see what a little Canadian ingenuity can do,” said Bush. Canada currently operates almost no anaerobic digesters to produce fuels or energy, whereas in other parts of the world this technology is much more common.

**Eastern Canada biogas policy development, myths, and realities**

**Speaker**

Eric Camirand  
Founder  
Electrigaz Technologies

Eric Camirand briefly described his company, Electrigaz, comprising a team of engineering experts on biogas production. He said he has been involved in both the engineering and policy aspects of the field.

The various types of biogas include landfill gas, sewage gas, anaerobic digesters, agricultural, industrial, municipal, and syngas, which comes from gasification. Most anaerobic operations are agricultural, but this technology can also be used on site converting food waste to energy.

Camirand said the Nova Scotia government recently established a feed-in tariff for community energy projects, and New Brunswick runs an embedded generation program. The Quebec government subsidizes $600 million for municipal biogas facilities, which are moving forward. He noted that this new system lacks a feed-in tariff, preventing product sales at better prices.

Ontario’s *Green Energy Act* upgraded the standard offer program to include a government subsidy alongside an approach that increases the program. Camirand said the fee structure for the feed-in tariff, now based on the kind of energy produced, is the right approach.

British Columbia’s current standard offer program has yielded only 36 MWs of hydro since a call for power in 2006. Camirand said the province is striving to improve this program. British Columbia and Ontario lead Canada in biogas policy.

Primary challenges confronting biogas are access to the energy market and networks. “If the guy who owns the grid doesn’t want you to connect, you will run around forever,” said Camirand. Renewable power operators must get priority through policy. “Our gas plants right now cost more to build in Canada than they cost in Europe, because we do not have specialized suppliers,” he said. A critical mass of suppliers should bring costs down. In addition, the biogas sector lacks safety standards.
Camirand said financing remains challenging in the biogas sector. Financing generally requires 50% equity, and many conflicting rules and regulations apply to this sector. Education and organization within the industry are very much needed.

Camirand called for an aggressive and cohesive renewable energy policy in Canada. In Germany, access to soft loans and feed-in tariffs contributes to the growth in this industry. He said soft loans and loan guarantees in this sector in Canada would be very helpful.

**Willow and poplar energy crops for greenhouse heating**

**Speaker**
John Kitchen
President
Bionera

In the Pacific Regeneration Technologies Inc. (PRT) Red Rock Greenhouse Heating Project, John Kitchen said he grows willow and poplar trees south of Prince George as energy crops for greenhouse heating.

At one time he used $500,000 worth of natural gas to heat his greenhouses. When the cost rose to $2 million–$3 million, Kitchen said he started looking at woody and herbaceous energy crops, specifically willow and poplar.

The PRT Red Rock Greenhouse Heating Project involved site preparation, planting, waiting for growth, and then cutting the willow and poplar to ground level by way of an ancient coppicing technique. In this technique, harvesting occurs for at least seven consecutive years.

Kitchen said such an energy source could be customer owned or contracted, especially in situations with high heat requirements, and this approach could be used as a hedge against consumers’ external supply needs. Examples could be coal replacement or district heat for remote communities.

As with mountain pine beetle harvesting, firm and predictable carbon values are needed, said Kitchen. The project also needs more integration to increase its profitability.

The willow and poplar coppice system can be done on underutilized land and is not a permanent crop. This approach could work in certain contexts, said Kitchen, noting “it should be up to the farmers to determine what makes sense for their land.”

**Lunch Presentation**

**Partners on the Land:**
First Nations and Industry in the Bioenergy Sector

**Speaker**
Jeff Paquin
Business Development Manager
Western Biomass Power Corporation

Jeff Paquin discussed a partnership between a First Nation based around the Williams Lake area and Western Biomass that proposes to produce wood waste bioenergy in response to British Columbia’s call for renewable energy sources.

Paquin said the partnership differs from other business approaches by working with the First Nations in a collaborative, inclusive, and respectful manner. He said he has seen other
businesses enter northern British Columbia with a fully formed business plan and simply offer jobs after the fact to local people. Western Biomass worked with the First Nations involved in a completely different way.

This First Nations / Western Biomass partnership, located in the Chilcotin area of British Columbia, has successfully built relationships and business opportunities with the local Tsilhqot’in Nation, which represents five member bands on the Chilcotin Plateau of north-central British Columbia.

British Columbia’s Energy Plan aims for energy self-sufficiency for British Columbia by 2016. The plan strives for 90% clean energy sources and zero net GHG emissions, and involves a bioenergy strategy to include First Nations involvement.

First Nations will always be given priority on a land base due to Aboriginal title, said Paquin. In 2006, recognizing an opportunity to work with First Nations in a priority economic area identified by the provincial government, Paquin and his business partners began this project.

The mountain pine beetle significantly affected the Hanceville area west of Williams Lake. Young people in the First Nations communities in this area tend to leave due to lack of opportunities, and elders are concerned about their culture surviving.

First Nations in the area view biomass as a catalyst to improve living conditions. Paquin said they have seen large forest companies come in and “throw a match on great piles of slash.” This biomass project provides a different kind of economic opportunity for the local communities. The area generates approximately two million cubic metres of waste wood per year.

The partnership involved the development of a 60-MW power plant in partnership with the Tsilhqot’in Nation in the Chilcotin area of British Columbia. The project required a $260 million capital cost start-up and $60 million in annual operating costs. The pine beetle-damaged timber will supply fibre.

Paquin said Western Biomass went into the community with a blank-folder approach, quite different from the business-plan approach of going to the First Nation with a preconceived and developed business idea. The new approach allowed community members and business partners to develop the project together from the ground up while focusing on and addressing significant community and cultural concerns in the overall business design. At one point in the project development, community input meant going back to the design drawing board to look at appropriate water sources.

Paquin said he spent a lot of time speaking to elders and sometimes used a translator so he could communicate with them as they spoke Chilcotin. He discovered that some areas were considered culturally sensitive even if the wood was dying. The fibre supply analysis looked at these community-sensitivity issues. Ongoing community engagement led to project design changes to be more sensitive to cultural issues. Community engagement and working with the young people in the community as much as possible were important.

The project will create 167 construction jobs and 89 permanent jobs, and moneys generated will go into the local economy. The location for the project, an old sawmill near Hanceville, is “strategically connected in the heart of a network of roads,” said Paquin.

To help secure investment for the project, the partnership entered into a share exchange with Run of River (ROR) Power, and a Highway 20 electrification strategy was developed.
The project proposal has been submitted to Phase 1 of the BC Hydro bioenergy call, and it entered the environmental assessment process in June 2008. Western Biomass is now waiting for the Phase 2 bioenergy call.

Meaningful engagement with First Nations is an ongoing process of meaningful consultation, not just a one-time occurrence, said Paquin. Nor is it unilateral. This kind of consultation involves communication, sacrifice, commitment, and understanding, and requires time, patience, and a sincere willingness and desire to know the First Nation partner. Respect for each other’s culture is critical. It is a reciprocal arrangement that involves learning about the First Nation’s values, goals, culture, and long-term community interest.

Paquin emphasized the importance of building these relationships: if interests can be reconciled, the reconciliation will lead to harmony; if an enterprise can demonstrate harmony, the review process will operate more smoothly.