Joint BMC/CSA Biomass Symposium

Developing Canadian Biomass to Power the Canadian Bioeconomy

BioFuelNet's BioMass Canada (BMC) AgriScience Cluster
in collaboration with the Canadian Society of Agronomy (CSA)

Monday, November 14, 2022

Nova Scotia B, Halifax Marriott Harbourfront Hotel
Halifax, Nova Scotia

Objective: To examine collective biomass research efforts to date with a view to better understand the production of biomass, access to available agricultural biomass, biomass conversion and utilization, and the development of a sustainable Canadian bioeconomy.

8:00 – 8:40	**Registration and coffee**
8:00 – 17:00	**Poster session**
8:40 – 8:50	**Welcome to the joint symposium of the Canadian Society of Agronomy and Biomass Canada** **Girard Benoit**, Director General, Coastal Region at Agriculture and Agri-Food Canada
8:50 – 9:00	**Synergistic efforts to advance biomass research related to the Canadian bioeconomy** **Dr. Mumtaz Cheema,** President, Canadian Agronomy Society (5 minutes) **Dr. Don Smith,** CEO BioFuelNet (5 minutes)
9:00 – 9:45	**Biomass Cluster invited Keynote Speaker (Remotely)** **Mr. Manolis Karampinis,** Business Development and Membership Director, Bioenergy Europe (by Zoom) **Title:** Bioenergy in the EU framework: updates on statistics, policy framework and exploitation models **Synopsis**: Bioenergy provides around 57.4% of the European renewable energy supply and 11% of the total energy supply, being therefore a key component to decarbonisation efforts, energy security and sustainable development. In this presentation, the main market segments for bioenergy in the European context will be presented with a focus on applications for solid biomass fuels. Examples of bioenergy exploitation models in the national and regional settings or in industrial and other applications will be provided. Finally, an update on major policy developments related to the establishment of sustainability criteria for bioenergy will be presented.
9:45 – 10:30	**CSA invited Keynote Speaker (Remotely)** **Dr. Michael Casler,** University of Wisconsin (Professor Emeritus) (by Zoom)

	Title: Development of Sustainable Biomass Crops **Synopsis**: Development of improved and sustainable energy crops is a key component for restoring economic momentum of a bio-based energy economy. Perennially and low energy inputs are two key elements of developing biomass production systems that are both environmentally and economically sustainable. Some of the most common species for these systems are: poplar, willow, switchgrass, and miscanthus. Following a brief introduction to these four species, the talk will focus on switchgrass, demonstrating the potential for improving its production potential through agronomy, breeding, genetics, and genomics.
10:30 – 11:00	**Health Break and Refreshments**
Session #1: Agricultural residues/waste as biomass for the bioeconomy **Chair: TBD**	
11:00 – 11:15	**Dr. Charles Xu**, Western University **Title:** Conversion of greenhouse/agricultural wastes into hydroponic bio-polyurethane (BPU) foams and their biodegradability **Synopsis:** The exploration of effective utilization of greenhouse wastes is a profound challenge for greenhouses. Herein, a hydrothermal treatment approach was demonstrated by co-liquefaction of greenhouse wastes with agricultural residue in a mixed solvent of water and ethanol in the presence of a base catalyst, to convert greenhouse wastes and corn stalk into bio-oil/bio-polyol at a very high yield of 57.2%, accompanied by a very low yield of solid residue. This bio-oil (hydroxyl number: 305 mg KOH/g) was successfully used as bio-polyol to substitute up to 50% petroleum-based polyol for the preparation of bio-polyurethane (BPU) foams. The biodegradability of the BPU foams was also studied by incubation with Dyella sp. for a period of 8 weeks. The weight loss, FTIR spectra, TGA results, and SEM images of foam samples were collected and analyzed. Results showed that BPU foams exhibited much better biodegradability than that of the petroleum-based PU foam.
11:15 – 11:30	**Dr. Ajay Dalai,** University of Saskatchewan **Title:** Insights on Biomass Pelletization as Sustainable and Clean Fuel Source and Biochar Production for Soil Improvements and Carbon Capture **Synopsis:** Our research on hydrothermal and thermochemical pretreatment of agricultural biomass using steam explosion and microwave torrefaction to depolymerize lignin that acts as a binder for biopellets will be presented. Further, we have evaluated the effects of process operating conditions (pelletization, torrefaction and gasification) on the treated products followed by a comprehensive physicochemical characterization of treated precursors and the resulting biopellets. We will also present the research on the optimization of the conversion of food waste to produce biochar and activated carbon through slow pyrolysis as well as physical and chemical activation. Characterization of bio-oil, biochar and activated carbon as well as application of activated carbon for adsorption of model environmental pollutants and in soil amendment for crop improvement will also be presented.

11:30 – 11:45	**Dr. Animesh Dutta**, University of Guelph **Title:** Valorization of agri-food residues and wastes: A closed-loop circular economy concept to address climate change, biogas production, wastewater management, and soil health **Synopsis:** Waste is a resource, and it is just waiting for an opportunity is the central theme of this research. In this research we propose three approaches for agri-food waste valorization. Firstly, we propose a hybrid thermochemical and biochemical approach to produce biocoal, biomethane and biofertilizer from corn residue (CR) using the concept of circular economy. In this approach, CR is first pretreated in hydrothermal carbonization (HTC) process to produce biocoal. HTC process water, a co-product of HTC processing underwent fast digestion under anaerobic conditions to produce biomethane and biofertilizer. Secondly, we produce activated carbons from Corn Fibre, a co-products ethanol production using three procedures, including direct KOH activation, HTC followed by KOH activation, and FeCl3 catalyzed HTC followed by KOH activation. Finally, we propose an innovative approach of combining two thermochemical conversion methods, HTC and slow pyrolysis, for converting biomass into suitable biocarbon for the iron-making process.
11:45 – 12:00	**Dr. Edmund Mupondwa,** Science and Technology Branch, Agriculture and Agri-Food Canada (Adjunct Professor: Department of Chemical and Biological Engineering, University of Saskatchewan) **Title:** Biomass supply chains: Challenges and Opportunities in enabling the development of a sustainable circular economy biorefinery **Synopsis:** Biomass represents an important feedstock source for the development of a competitive and sustainable circular economy biorefinery due its adaptability, renewability, and minimal environmental impacts. In this regard, a biomass supply chain is a crucial element in development and sustainable integration of biomass feedstocks into Canada's biorefinery concept and circular economy. In this research, we provide a multi-dimensional analysis of Canada's agri-based biomass supply chain including: a) requirements for scaling up agri-based feedstock production and sustainable procurement in diverse rural agroecological regions of Canada, taking into account feedstock diversity and heterogeneous pretreatment and conversion pathways; b) technoeconomic business models for the commercialization of biomass for the biorefinery, including: (i) economic integration of key participants in this supply chain, including indigenous communities; (ii) significant cost reductions needed at all levels (farm-to-biorefinery) in order to optimize agri-based feedstocks (residues and dedicated bioenergy crops) for the bio-based circular economy.
12:00 – 13:00	**Networking Lunch & Poster session**
Session #2: Energy crops as biomass for the bioeconomy **Chair: Kathleen Glover**	

13:00 – 13:15	**Dr. Don Smith**, McGill University **Title**: Development of Biologicals as Low Input, Sustainable Production Practices for Fuel and Residue/Food Production **Synopsis**: Biomass crops could produce about 25 Mt of biomass per year within Canada and food crop residues on the order of 48 Mt. Research is needed to attain this productivity in the face of ever-more-frequent climate change stress conditions (largely drought and high temperature). Our research focuses on understanding the potential role of plant-associated microbes in enhancing crop stress tolerance and yield. Potentially beneficial microbial strains are tested on biomass crops (such as switchgrass) and residues of food crops (corn and potato). We have isolated new strains that help plants tolerate abiotic stresses associated with climate change; there has already been laboratory and field testing. We are also evaluating an industrial-partner-supplied set of flavonoid biostimulants; this too shows substantial promise, and now is being commercialized. Fieldwork with corn and potato has shown crop residue yield increases and also food yield increases as high as 20%.
13:15 – 13:30	**Dr. Annie Claessens,** Agriculture and Agri-Food Canada **Title:** Improving switchgrass for the biomass industry **Synopsis:** Breeding strategies to increase yield (lowland x upland crosses), establishment (seed size), quality (lower leaf stem ratio), and persistence (freezing tolerance, disease resistance).
13:30 – 13:45	**Dr. Yousef Papadopoulos,** Agriculture and Agri-Food Canada **Title:** Adaptability of Miscanthus cultivars across Canada **Synopsis**: Canada's clean technology strategy recognizes the vital link between climate-smart agriculture and the biomass-to-clean technology value chain. Canada's agriculture and agri-food sector has the potential to supply perennial grass based feedstock crops. Desirable traits for Miscanthus giganteus (Miscanthus) include high biomass yield potential, adaptability to marginal soil and perennial growth habit. Based on long term evaluation trials, productive and currently available cultivars for northern latitudes have been identified. However, cultivar performance is not always consistent across diverse locations. While recent research studies across Canada have identified persistent cultivars there is limited information on the broad adaptations of thesecurrently available cultivars, how management practices affect biomass yield, nutrient/energy composition, nutrient removal/depletion from the ecosystem and crop profitability. In this presentation we will report research to date assessing the performance of currently available Miscanthus cultivars in diverse locations across Canada and identify gaps which may impact the effective utilization of this species in biomass cropping systems.
13:45 – 14:00	**Dr. Raju Soolanayakanahally,** Agriculture and Agri-Food Canada **Title**: Bridging agriculture and the environment using bioenergy crops **Synopsis**: The development and evaluation of new poplar and willow feedstocks for bioenergy opportunities, carbon sequestration and for environmental services.
14:00 – 14:15	**Dr. J. Kevin Vessey**, Saint Mary's University **Title**: Annual and perennial biomass crop production potential on marginal lands **Synopsis**: A brief overview of BMC Projects 6 and 7 that are investigating the yield potential of hybrid sorghum, switchgrass, Miscanthus, coppiced willow, and coppiced hybrid-poplar on marginal lands with biological inputs.

14:15 – 14:30	**Dr. Xue Li,** Saskatoon Research and Development Centre, Science and Technology Branch, AAFC **Title**: Feedstock quality and impact on bioenergy production from four dedicated biomass crops (miscanthus, switchgrass, willow, and poplar). **Synopsis**: Miscanthus, switchgrass, willow, and poplar are important perennial grasses under development as dedicated bioenergy crops in Canada. The chemical composition of bioenergy crops has significant impact on biofuel yield and quality. Structural and soluble carbohydrate content, lignin, moisture, and ash are typical lignocellulosic biomass quality attributes of interest to a biorefinery. This paper quantifies biomass quality (fibre, digestibility, ash, lignin, and carbohydrate content) for the four dedicated lignocellulosic bioenergy crops. Impact on biofuel yield and quality is evaluated.
14:30 – 14:45	**Health Break and Refreshments**
Session #3: Biomass to fuel the bioeconomy **Chair: TBA**	
14:45 – 15:00	**Dr. Shahab Sokhansanj,** University of British Columbia **Title:** Pretreatment of crop residue to improve its utilization and logistical properties **Synopsis:** The research is aimed at increasing the durability of agri-pellets to a level in par with the durability of wood pellets. To enhance the natural binding of the straw, batches of raw biomass was exposed to steam or the biomass was blended with hot water. All treatments took place in sealed enclosures. A severity factor was developed to represent the combined process variables including moisture, temperature, and treatment time in a single number. The pellets made from treated and untreated biomass were tested for durability, hardness, density, and moisture sorption properties. We have observed that the pellet durability tends to increase with severity factor between 0.5 to 4 follows, then drop in durability for severity factor between 4 to 8. Treatment of biomass in hot water was found to reduce ash contents. Overall, this study has explored a relatively wide range of hydrothermal treatment conditions, which includes low to high biomass moisture content, treatment temperature, and treatment time.
15:00 – 15:15	**Dr. Duncan Cree,** University of Saskatchewan **Title:** Select Pretreatment Options for Agricultural Biomass for Thermochemical or Biochemical Conversion **Synopsis:** In this presentation, we give examples of switchgrass and oat straw subjected to fungal pretreatment and microwave-assisted torrefaction, respectively. Tests were conducted to determine any changes in morphology and chemical composition of switchgrass due to the fungal pretreatment. The pretreated switchgrass was subjected to pelletization and enzymatic saccharification to determine the impact of fungal pretreatment. Oat straw was subjected to microwave-assisted torrefaction. Torrefaction produces both the solid fuel and the volatile stream known as torgas. The torgas comprises of condensable liquids, known as tor-liquid and non-condensable gases. The condensable liquid is rich in organic acids, ketones, furfural, and levoglucosan, which could be potentially transformed into high-value chemicals and other commercially viable products.
15:15 – 15:30	**Dr. Edmundo Mupondwa**, Saskatoon Research and Development Centre, Science and Technology Branch, AAFC **Title:** Integrated technoeconomic analysis and life cycle assessment (LCA) of four dedicated biomass crops (miscanthus, switchgrass, willow, and poplar) for the production of bioenergy and bioproducts.

	Synopsis: This paper presents an integrated technoeconomic analysis and life cycle assessment (LCA) of four dedicated biomass crops (miscanthus, switchgrass, willow, and poplar) for the production of pellets, power, and biofuels based on two lignocellulosic biomass conversion pathways (bioconversion and thermoconversion). The analysis includes logistics pertaining to multiple feedstock supply chains, bioenergy crop production, harvest, storage, transportation, densification, pretreatment, and adoption pathways in rural and Northern Communities.
15:30 – 15:45	**Dr. Warren Mabee,** Queen's University **(Remotely)** **Title:** Circular bioeconomies: the role of policy in informing sustainable biomass use **Synopsis**: The bioeconomy is particularly well suited to adopt circular aspects to improve sustainability and increase overall impacts. There are a number of barriers to implementing a truly circular bioeconomy, however, some of which are found in current policies. This talk addresses these challenges by examining a series of barriers and describing policy changes that might be applied.
Session #4: Industry Perspectives **Chair: TBA**	
15:45 – 16:25	**Dr. Michael Marr**, Technology Development Lead, Renewable Liquid Fuels, Suncor Energy **Mr. Rod Badcock,** Principal Partner, BioApplied Innovations Pathways, Dartmouth, Nova Scotia **Mr. Geoff Clarke,** Business Development Manager, and **Mr. Dennis Boulet,** District Superintendent, Port Hawkesbury Paper LP, Port Hawkesbury, Nova Scotia **Mr. Bill Freeman,** Director of Business Development, Harry Freeman & Son Limited, Greenfield, Nova Scotia **Mr. Brock Eidem**, Co-Founder of NULIFE GreenTech, Saskatoon, Saskatchewan **Dr. Fahimeh Yazdan Panah,** Director of Research and Technical Development, Wood Pellet Association of Canada
16:25 – 17:25	**Open discussion: Facilitator: D. Smith**
17:25 – 17:30	**Closing remarks: CSA and/or BMC spokespersons.**
18:30 – 22:00	**CSA welcome reception (Nova Scotia AB)**