Research Project Kickoff Meeting

27th July 2021,
1:30 pm – 3:30 pm
Thornbrough Building
Room 1126

Proposal Title: Chemical Upcycling of Agri-food resources to activated carbon

1:30-1:40	Welcome and introductions to Goals for meeting – Dr. Ranjan Pradhan
1:40-2:00	Review of key elements of the facilitation and goals, to build support for prioritizing activities by **Principal Investigator (PI) : Prof. Animesh Dutta**
2:00-2:30	Inputs and confirmation of initial goal settings from Partners : 1. Continental Carbon: **Hayat Raza** 2. Goodfleaf Farms : **Shawn Woods** 3. Ontario Biomass Producers Co-Operative Inc.: **Tom Parker** 4. OMAFRA : **Dr. Mahendra Thimmanagari** 5. Gordon S. Lang School of Business & Economics (UoG) : **Prof. Tirtha Dhar**
2:30-3:00	Review of roles and expectations for facilitator and practices
3:00-3:10	Review timeline for completion of any necessary administrative paperwork (Non-discloser Agreement, DMP, Memorandum of Understanding, and other documents as relevant
3:10-3:30	Laboratory visit & concluding remarks

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Ontario Agri-Food Innovation Alliance Funding

Start date 2021-05-01 End date 2024 -04-30

Classification: Chemical Manufacturing

Sub Sector or Commodity	Chemical Product and Preparation Manufacturing (3259 NAICS classification)

Applied Research - New technology demonstration - Tests the technological and economic feasibility of a new technology to verify the science works outside the "lab". Includes pilot testing and demonstration trials. It is the step between assessment under research conditions and full-scale commercial application

Research Priority	Primary & Secondary: Innovative Products & Product Improvement
Research Focus Area	Primary - New Product Development (process) Secondary - Value Chain Analysis & Development

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Production of commercial grade - import substitute product - Activated Carbon HS code 380210

HS code 3802, commercially imported as "Activated Carbon"
1. COCONUT SHELL BASED POWDERED STEAM ACTIVATED CARBON
2. ACTIVATED CARBON
3. GRANULAR ACTIVATED CARBON
4. ACTIVATED CARBON POWDER (CHARCOAL DUST)
Need inputs from Continental Carbon

Potential Target Applications of "Activated Carbon" (AC)
AC for wastewater / water treatment (COD, TOC, AOX, heavy metals, agrochemicals)
AC for absorber vessels – Liquid and Air
AC for Filters
AC Wash water recycling and reclaiming systems
Groundwater and soil remediation equipment's
Need inputs from Continental Carbon

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Role	Team Member & Supporters
Principal Investigator (PI)	Animesh Dutta adutta@uoguelph.ca ; University of Guelph - School of Engineering (SOE) (CEPS)
Collaborator-Researcher/Scientist	Mahendra Thimmanagari mahendra.thimmanagari@ontario.ca Agriculture Development Branch; OMAFRA
Industrial Collaborator-Researcher/Scientist	Hayat Raza hraza@continental-carbon.com Continental Carbon Group, Inc.
Industrial Collaborator-Researcher/Scientist	Shawn Woods swoods@goodleaffarms.com Goodfleaf Farms :
Industrial Collaborator-Researcher/Scientist	Ontario Biomass Producers Co-Operative Inc.
Collaborator-Researcher/Scientist	Tirtha Dhar tdhar@uoguelph.ca ; University of Guelph - Department of Marketing and Consumer Studies (MCS) (Lang)
Collaborator-Researcher/Scientist	Ranjan R Pradhan Rpradhan@uoguelph.ca ; BRIL, School of Engineering; University of Guelph

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Research Question

What innovative technologies (e.g. thermal, bioprocessing) can be used for efficient processing of agriculture materials feedstocks with consistent quality and supply for the production of various bioproducts manufacturing scenarios?

Principal Investigator Prof. Animesh Dutta
adutta@uoguelph.ca
Director – BRIL Labs
University of Guelph - School of Engineering (SOE) (CEPS)

Expert in thermochemical conversion of biomass to produce high value materials and chemicals.

Recognized leader in Thermodynamic and Life Cycle analysis studies

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Research Objective

To understand the innovative processing technologies for utilizing local resources to meet quantity and quality demands by commercial application of activated carbon

Project Objective

1. Product development using new and local raw material to realize transferability of established laboratory technology for activated biocarbon
2. Sustainability of quality specification of locally produced activated carbon as import substitute for Canadian industries
3. Evaluate establishment of this new value chain based on local bio-resources to meet commercialization challenges

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This project evolved from our past and ongoing projects

1. OMAFRA Project: Study and development of a self-sustained torrefaction process for upgradation of fuel properties of agricultural residues
2. OMAFRA Project: Hybrid hydrothermal carbonization (HTC) and slow pyrolysis of agricultural biomass to produce bio-carbon for Canadian Iron and Steel Industry
3. BioFuelNet Canada project on the valorization of agricultural and food wastes has significantly helped us to develop the technologies for these products and established the potential for sustainable production of AC locally using local agri-food co-products.

The potential of the research outcome is being disseminated to various stakeholders through our ongoing KTT – Mobilization project (KTT(MF)2019-10387) on Commercial Applications of Biocarbon Produced from Ontario Based Biomass.

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Major requisites to succeed :

1. Establishing laboratory facility for characterizing industrial grades of AC
2. Establishing laboratory facility for batch testing of industrial grades of AC
3. Establish laboratory facility for pilot testing of industrial grades of AC in collaboration with Continental Carbon Inc. and Good Leaf Farms
4. Onsite trials and testing at industrial partners location as necessary by researchers from University of Guelph
5. Review performance and potential substitution of imported AC used by Continental Carbon Inc.

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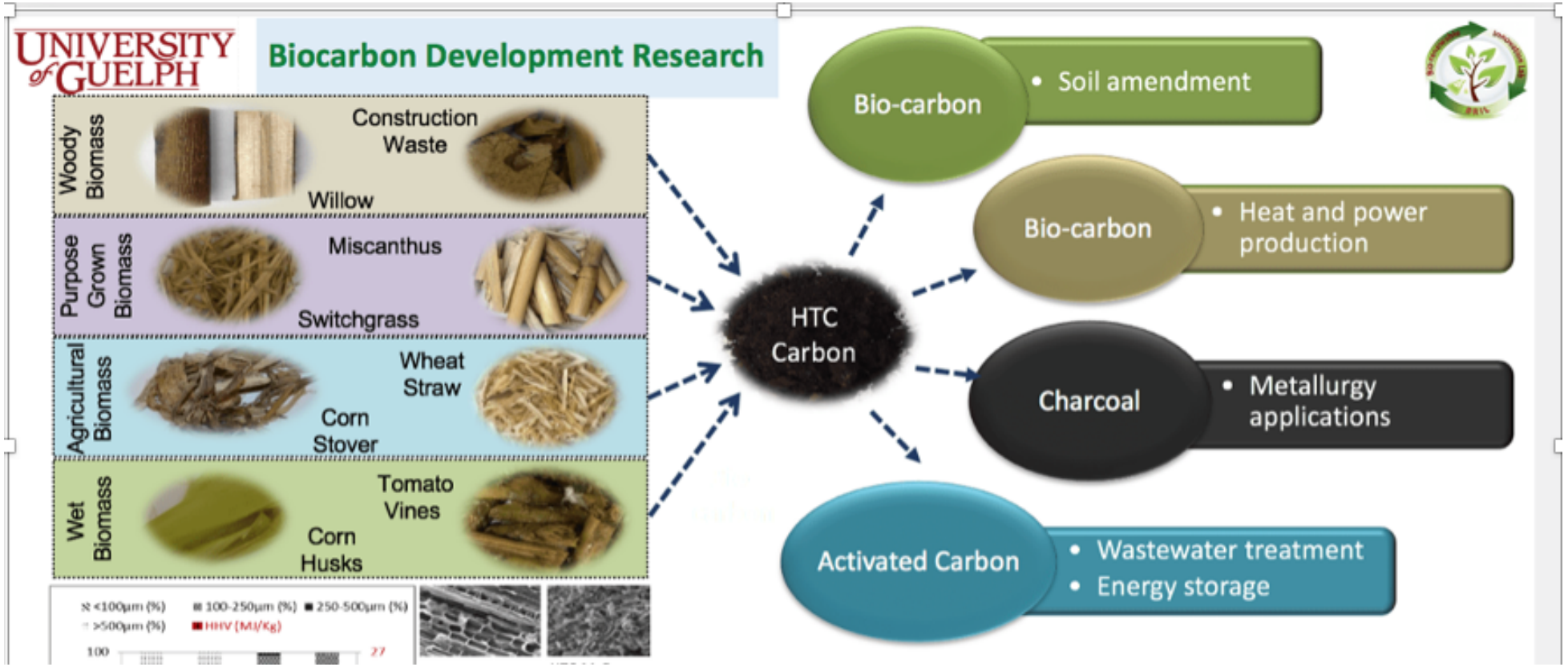
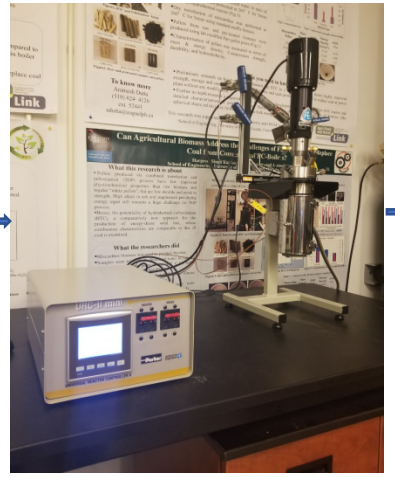
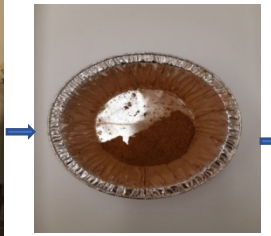
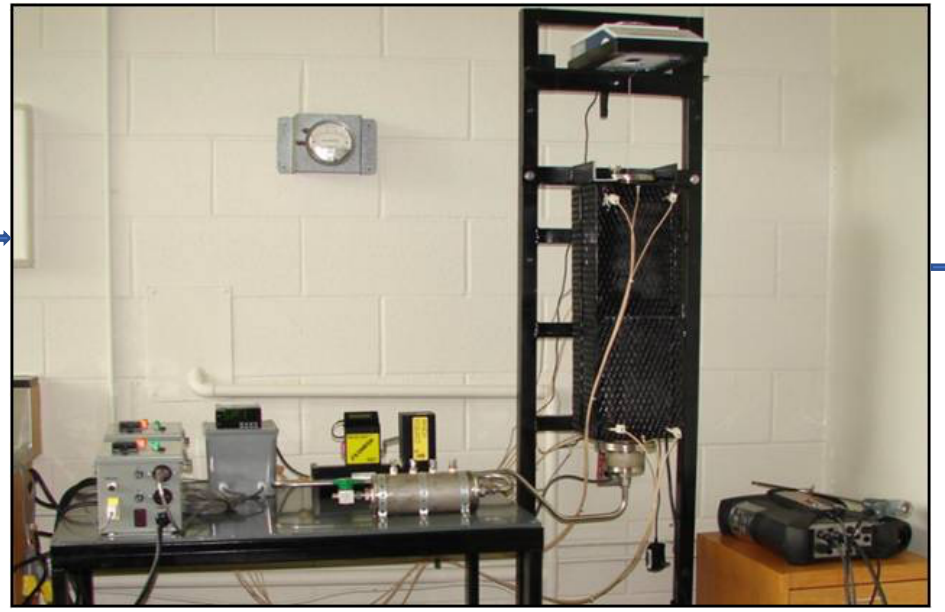
How this project fits in with our ongoing research?



Example: Miscanthus/Switchgrass to Bio-cabon for Iron and Steel Industries: A Tunable Approach

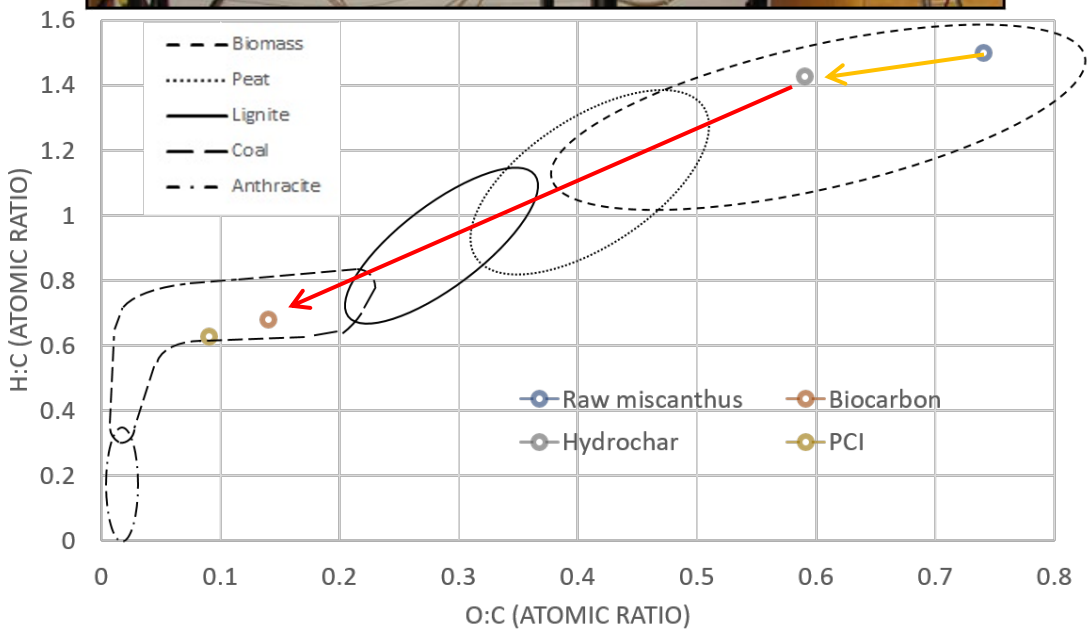






Properties	Raw Switchgrass	Torrefied-290
%C	**44.76 ± 2.04**	**64.28 ± 2.42**
%H	6.04 ± 0.62	4.34 ± 0.69
%N	0.66 ± 0. 08	0.68 ± 0.13
%S	0	0
%O	**44.09 ± 1.87**	**23.58 ± 1.87**
HHV (MJ/Kg)	**17.13 ± 1.49**	**26.04 ± 1.91**
%VM	84.3 ± 3.18	50.35 ± 2.72
%Ash	**4.45 ± 0.23**	**7.12 ± 0.38**
%FC	11.25 ± 0.8	42.53 ± 1.83

Hydrochar	
C(%)	**52.2**
H(%)	6.2
N(%)	0.05
S(%)	0
O(%)	**41.31**
Ash(%)	**0.24**
FC(%)	15.1
VM(%)	84.66
HHV (MJ/Kg)	**20.37**



Biocarbon	
C(%)	**79.67**
H(%)	4.5
N(%)	0.35
S(%)	0
O(%)	**14.69**
Ash(%)	**0.79**
FC(%)	63.71
VM(%)	35.5
HHV (MJ/Kg)	**32.59**

PCI coal	
C(%)	**77.66**
H(%)	4.1
N(%)	1.76
S(%)	0.3
O(%)	**9.53**
Ash(%)	**6.65**
FC(%)	56.94
VM(%)	36.41
HHV (MJ/Kg)	**32.07**

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Raw materials
1. Good leaf Farms waste
2. Miscanthus
3. Corn & vegetable wastes

Thermal Process
1. HTC
2. Pyrolysis
3. Two step combined process

1. ASTM activated carbon Standards, Guides and Practices (D-28)
2. AWWA (American Water Works Association) activated carbon standards for powdered activated carbon (PAC),
3. ANSI/AWWA B600-96, granular activated carbon (GAC)

Milestones of this Project

Description of the Activity	Planned Start Date	Planned End Date
1. Selection of input materials and development of customized optimum conditions for HTC and activation at bench-top level. Personnel involvement: 1 PhD student /1 PDF	2021-05-01	2022-03-31
2. Scale-up production trials at pilot/bulk scale for the identified raw material using the customised optimum conditions of HTC and activation at pilot level. Personnel involvement: 1 Post doc / 1 PhD/ 1 Summer student	2022-01-01	2023-05-31
3. Characterization and introduction of the activated carbon for commercial grading and applications in the lab-scale. Personnel involvement: 1 Postdoc / 1 PhD student	2022-05-01	2023-08-31

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Continental Carbon

Continental Carbon

Lang Business School

Milestones of this Project

4. Batch testing of activated carbon in collaboration with industrial collaborators for commercial grading and applications in the lab at UoG. Personnel involvement: 1 Postdoc / 1 PhD student	2023-01-01	2023-08-31
5. Pilot application testing of activated carbon in collaboration with industrial collaborators for commercial grading and applications at Collaborator industry location Personnel involvement: 1 Postdoc / 1 PhD student	2023-06-01	2023-11-30
6. Techno-Economic Analysis for 6.1 Primary market research for activated carbon grade generated by this research to 6.2 Sensitivity analysis Personnel involvement: Third-party contractors, 1 Post doc / 1 PhD student	2023-09-01	2024-03-31

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Project Team

Milestones of this Project

7. Techno-Economic Analysis for 7.1 Life cycle analysis 7.2 Knowledge Translation and Transfer 7.3. Value chain assessment Personnel involvement: Third-party contractors, 1 Postdoc / 1 PhD student	2024-01-01	2024-08-31
Publication and copyright / licensing of technology protection to be identified Personnel involvement: UofG group / Research Innovation Office (UofG)	2024-01-01	2024-12-31

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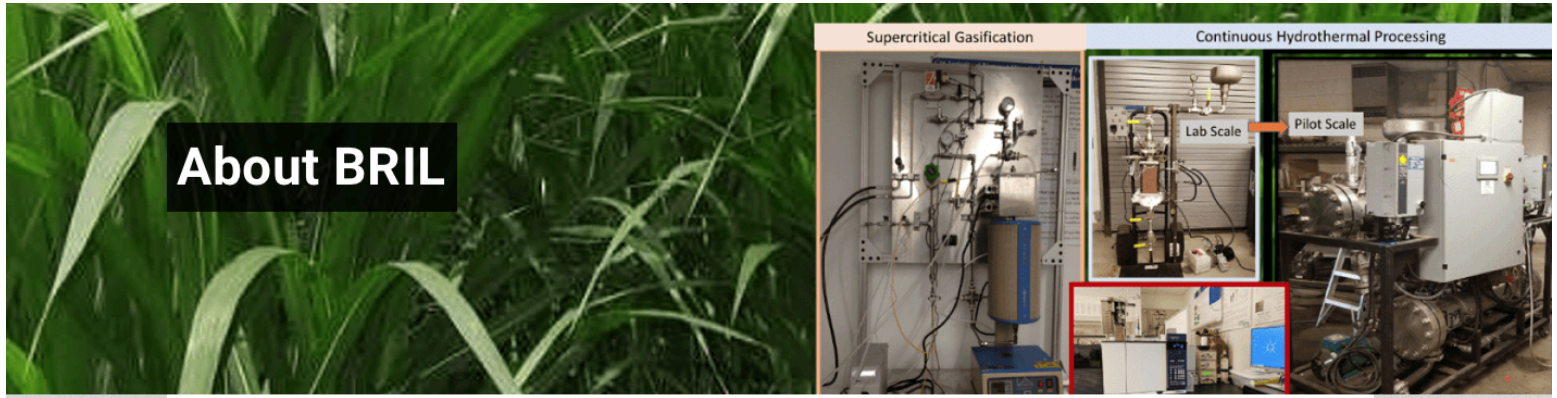
Next Steps

1. Non-Discloser Agreement (NDA) with the collaborator : To be done as and when needed
2. Hiring Graduate Student for the project : Completed
3. Industrial site work and sampling schedules : To be developed
4. Potential extension of the project for National interest : Invited for additional >$ 500,000 support

Thank you

https://bril.uoguelph.ca



BRIL (**Bio-Renewable Innovation Lab**) is a multidisciplinary research facility initiated in 2014 by the current Director of the laboratory Dr. Animesh Dutta at the School of Engineering, University of Guelph.

The major research fields are related to Valorization of various organic wastes to promote sustainability through circular economy concept. The laboratory has extensively developed and pioneered continuous thermochemical conversions of macromolecules present in the organic waste resources to energy and value-added materials.

The research program at BRIL mainly focuses on clean and sustainable-renewable energy technologies to develop a wide variety of bioproducts including biochemicals, bio-carbon (potential substitute for coal), bio-oil (potential substitute for petroleum) and syngas (the main building block of any fuel and chemicals) from bioresources through green thermo-chemical and bio-chemical processes.

A unique aspect of this advanced biorefinery approach is to target the recovery of value from every co-product of biomass conversion. We work and collaborate with stake holders, industry, government and the non-profit sector to create sustainable solutions.

Mission

To conduct research and develop innovative technology solutions to help circular economy for long-term sustainability.