Session	Day	Hour	Speaker	Institution	Country	Presentation Title
AUGUST 21						
Session A (Chairman: Prakit Sukyai)	**21**	**08:30**	***Reception and Late Registration***			
		09:00	Eduardo Couto (CTBE's Director) and Regis Leal	CTBE/CNPEM	Brazil	Welcome speech
		09:20	Bryan Peter Lavarack	Makay Sugar	Australia	Developing co-product opportunities: guidelines for successful commercial projects
		10:00	Gunshiam Umrit	Mauritius Sugarcane Industry Research Institute (MSIRI)	Mauritius	Co-products of sugarcane: current perspectives, potential issues and future prospects
		10:30	***Coffee break***			
		11:00	Regis Leal	CTBE/CNPEM	Brazil	A global view of bioproducts
		11:30	Marcos Watanabe	CTBE/CNPEM	Brazil	Regional impacts of different sugarcane production systems in Brazil: a multicriteria decision analysis approach
		12:00	Francisco Linero	FL Consultoria e Engenharia	Brazil	Sugarcane trash processing: the Ferrari Mill Plant
		12:30	Valeria Olivero	Ledesma	Argentina	Process and Energy Integration in a Sugar Cane Based Agricultural Industry
		13:00	***Lunch***			
Session B (Chairman: Bryan Lavarack)		**14:00**	ISSCT Congress Argentina 2019 - Congress Organizing Committee	ISSCT		
		14:30	Marcos Watanabe	CTBE/CNPEM	Brazil	Techno-economic assessment of retrofit projects applied to cogeneration system in Brazil: the use of sugarcane trash to increase electricity production
		15:00	Mathias Strauss	LNNano/CNPEM	Brazil	Activated carbons from sugarcane bagasse: Linking critical properties with ecotoxicological and techno-economical aspects
		15:30	Fernando Rosales	Cengicaña	Guatemala	Sugarcane ethanol and bioelectricity in Guatemala
		16:00	Prakit Sukyai	Kasetsart University	Thailand	Sugarcane bagasse in biomedical applications
		16:30	***Discussions***			
		17:00	***Welcome cocktail (until 19:00)***			
AUGUST 22						
		09:00	Regis Leal	CTBE/CNPEM	Brazil	SUCRE Project: a mid-term review
		09:30	Daniel Duft	CTBE/CNPEM	Brazil	Sugarcane trash recovery alternatives
		10:00	Danilo José Carvalho	CTBE/CNPEM	Brazil	Trash burning in boilers designed for bagasse as fuel

Session C (Chairman: Gunshiam Umrit)	**22**	**10:30**	***Coffee break***			
		11:00	Patcharaporn Pongpat	King's Mongkut University	Thailand	Sustainability assesment of sugarcane biorefineries system in Thailand
		11:30	José Luiz Olivério	Dedini	Brazil	The “DSM – Dedini Sustainable Mill” is a “RenovaBio Mill”
		12:10	Regis Leal	CTBE/CNPEM	Brazil	Maximizing sugarcane use and energy efficiency
		12:40	***Discussions***			
		13:00	***Lunch***			
Session D (Chairman: Regis Leal)		**14:00**	Thanaporn Athipanyakul	Kasetsart University	Thailand	The costs of sugarcane harvesting and the sugarcane harvester adoption in Thailand
		14:30	Mario Murakami	CTBE/CNPEM	Brazil	New enzymatic strategies for generation of advanced sugars and 2G ethanol
		15:00	***Coffee break***			
		15:30	Juliana Teodoro	CTBE/CNPEM	Brazil	Mills industrial gases: alternatives and opportunities
		16:00	***Discussions***			
		17:00	***Departure***			
AUGUST 23						
	23	**07:00**	**FERRARI MILL VISIT**			
		16:00	***Coffee break***			
		16:15	**CTBE/CNPEM VISIT**			
		18:20	***LEAVING FOR DINNER AT BARBACOA***			
AUGUST 24						
	24	**07:00**	**RAÍZEN 2G ETHANOL PLANT VISIT**			
		14:00	***Departure***			



Abstracts received to the

CO-PRODUCTS WORKSHOP:

Full use of sugarcane, residues and wastes – maximizing efficiency and profits

Organizing Committee

Prof. Dr. M. Regis L. V. Leal (Chair)
Erik Nardini Medina (Support)
Brazilian Bioethanol Science and Technology Laboratory (CTBE)
Brazilian Center for Research in Energy and Materials (CNPEM)

Campinas, São Paulo, Brazil | 21-24 August 2018

[redacted]

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Developing co-product opportunities: guidelines for successful commercial projects

Bryan Lavarack
Consultant, Mackay, Queensland 4740, Australia

Technologists normally focus on the technology of a process and many projects do not succeed because of a failure to address the commercial realities. The transition from the production of co-products in a laboratory or pilot plant to a full scale commercial plant requires a comprehensive plan to achieve success. Several projects for the production of co-products have been undertaken in Australia with varying degrees of success. These and other projects have been studied and some guidelines for successful commercial projects have been formulated. These include:

1) Understand and evaluate the process technology
2) Recognise co-products should be cost competitive
3) Understand the market needs and size (local and/or international)
4) Investigate Intellectual Property and legal requirements
5) Engage and communicate with all levels of government
6) Decide on plant location
    a. Obtain land agreements
    b. Determine infrastructure requirements and access to utilities
    c. Distance to markets and transport requirements
    d. Environmental and safety considerations
    e. Personnel requirements
    f. Collocate or not collocate at sugar factory
7) Formulate a business plan
    a. Determine target market/s
    b. Financial analysis
    c. Obtain long term offtake agreements in advance
    d. Plan for raising capital
    e. Estimate project life
8) Complete a comprehensive feasibility study and risk assessment
9) Raise capital required
10) Engage an experienced project manager
11) Liaise with stakeholders to minimise delays
12) Budget time and money for unforeseen problems
13) Have an alternative strategy, if any of the above points are not being met

The reality of achieving a commercial success for a co-product is dependent on understanding and solving issues beyond process technology.

Co-products of sugarcane: current perspectives, potential issues and future prospects

Gunshiam Umrit
Mauritius Sugarcane Industry Research Institute, Mauritius Cane Industry Authority, Réduit, Mauritius

For many years, the quest for better competitiveness through improvements of agricultural practices, reduction of agricultural and industrial production costs and better environmental performance has been the key focus of development of sugar industries around the world. In the face of the fluctuating and generally decreasing world price of sugar, it is now widely recognized that there is a need to move from a single commodity to a wide range of co-products to ensure the profitability and sustainability of the sugarcane industry.
The most attractive and successful strategies for diversification of revenue streams are cogeneration and ethanol production. But despite major technological improvements in bagasse-based cogeneration leading to higher efficiency, the potential revenue from sale of electricity remains moderate, which has led to increased interest in using the sugarcane biomass as biorefinery feedstock. A wide range of biomass derived products that can potentially be produced in biorefineries have been identified in several studies. The potential for using sucrose as a feedstock for platform chemicals and other value-added products have also been reported. The existing data on new revenue opportunities for sugarcane are reviewed.

Large scale production of Renewable energy and Biofertilizer from Sugarcane Vinasse by Anaerobic Biodigestion: Potential use of the digestate in fertirrigation

Leonardo Rey O. Lopes
National Laboratory of Nanotechnology (LNNano), Brazilian Center for Research in Energy and Materials (CNPEM), 13083-970 Campinas, São Paulo, Brazil

Anaerobic digestion of waste is of growing interest as it can facilitate the sustainable development of energy supply in order to reduce greenhouse gas emissions. Biogas production provides a versatile strategy for generating renewable energy, as methane can be used to replace fossil fuels in power generation, as well as many other forms of use as an energy source. It is estimated that the process of anaerobic biodigestion of vinasse besides presenting benefits of reduction of organic load, increase of pH and maintenance of nutrients for fertirrigation in the field can increase in 20% the capacity of electric power generation in the alcohol and sugar mills from the country. In this work the biodegradation of the vinasse was performed, two by-products were generated in the anaerobic reactor of the pilot plant from a single effluent: biodigested vinasse, used for fertirrigation of the sugar cane and the biogas production, promoting the generation of electric energy. Considering the specific consumption obtained for the generator set of 290 Nm / h for each MWh generated, this potential for the 2014 harvest was 975 MW average, which represents a 20% increase in the electricity export capacity of the sugarcane mills of sugar in Brazil. Globally (stem + leaves), the grass had its development greater than 7% when biofertilized with biodigested vinasse, in comparison to the use of in nature vinasse in the fertirrigation process. The non-use of traditional fertilizer inputs and practices as performed in conventional sugar cane plantations did not negatively influence the cultivation. This work concludes that anaerobic biodigestion is a self-sustaining process with great contribution to the environment. Therefore, it can be applied on a large scale. The process meets the three biases of sustainability: it is ecologically correct, socially just and economically viable.

Maximizing Sugarcane Use and Energy Efficiency

Manoel Regis L. V. Leal,[1] Paulo Mantelatto ,[2]

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Sugarcane is a traditional food crop cultivated for centuries and present today in more that 100 countries. It happens to be an excelent energy crop, a fact that has been perceived by many sugar producing countries driving the implementation of programs for the production of ethanol and bioelectricity, the main sugarcane energy products. However, due to tradition and aboundance of residues that provided for all the energy needed to run the mills, the energy efficiency aspects have been commonly neglected.

We consider a good way to make a quick assessment of the efficiency in the use of sugarcane as a feedstock by comparing the energy of the useful co-products with the primary energy of the plant in the field.

In this work we cover some of the relevants aspects of energy production and use in the sugar mills, such as the generation and cogeneration alternatives and the relative magnitude of the thermal and electric/mechanical components. To produce a quantitative analysis, we suggest some scenarios for energy efficiency improvement and estimate the stepwise gains in each improvement and explore what are the alternatives to improve the sugarcane competitiveness and sustainability as an agroindustry for food and energy. The preliminary results show that the present efficiency of converting the sugarcane primary energy to useful forms of energy, such as ethanol and electricity, is very low, barily reaching 30%, but can be increased to around 40% using only existing and proven technologies.

SUCRE Project: A Mid-Term Review

Manoel Regis L. V. Leal,[1] Thayse A. D. Hernandes ,[1]

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The mechanical harvesting of green cane is expanding very fast in Brazil, reaching levels above 90% in the state of São Paulo, which is the main sugarcane producer, leaving a considerable amount of trash on the ground after harvest. Surplus electricity generation by the mills for injection in the national grid is also increasing in volume and in importance for the mill's total income. These two facts naturally incentivized the mills to collect a portion of the trash to increase the power generation by supplementing the bagasse for burning in the mill boilers. However, several barriers have been preventing to expansion of trash use to meaningful levels.

The main goal of the SUCRE (**Su**gar**c**ane **R**enewable **E**lectricity) Project is to identify and overcome the main barriers to increase trash use for power generation in the mills. It is funded by the Global Environment Facility (GEF), managed by the United Nations Development Programme (UNDP) and developed and co-funded by the Brazilian Bioethanol Science and Technology Laboratory (CTBE)/National Research Center for Energy and Materials (CNPEM). The project duration is five years, starting in June 2015, so it is now at the middle point and it counts with the partnership of 18 mills that are hosting the experiments and helping with the field tests.

This work describes the basics of the SUCRE, some relevant achievements and future work planned. We believe that we have identified the main barriers associated with sustainability of trash removal, trash recovery routes, processing and burning in the mill boilers, the present Regulatory Framework of the Electricity Sector bottlenecks and possible business models for electricity sale.

A Global View of Bioproducts

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[1] Brazilian Bioethanol Science and Technology Laboratory(CTBE)/Brazilian Center for Research in Energy and Materials (CNPEM), 13083-970 Campinas, São Paulo, Brazil

The sugar industry has been subjected traditionally to frequent and strong volatility of sugar prices, driven by many causes, but mostly by the surpluses in the global production. The recent end of the EU Sugar Regime in 2017 created conditions to increase production of beet sugar with the end of the quota system. Many mills are aware of these changes and the possible impacts and are starting to consider alternatives for diversification of the production, even those alternatives beyond the traditional and obvious options of ethanol, biomass and electricity. The diversification through the several feedstocks available at the mills (sugar, molasses, syrup, fiber, filter mud, etc) is possible, but the enormous number of options creates a puzzling situation for the mills; add to that the fact that the best alternatives will depend on the country context, the mill size, technology development and existing local public policies (a very important point) can improve the odds of specific products prioritized by the government.
Fortunately, there are important institution like the European Commission, US Depatment of Energy, International Energy Agency Bioenery looking into the problem and organizing the information and concept for those interested to enter the bioproduct world.
We present a review of bioproducts from the sugar and lignocellulose platforms, including some residues, to show the difficulties of the choices, but also presenting to most promissing alternatives for the global context, and trying to show an indication of alternatives deserving further consideration.

Activated carbons from sugarcane bagasse: Linking critical properties with ecotoxicological and techno-economical aspects

Ana Claudia Fingolo[1], Bruno C. Klein[2], Mylene C. A. F. Rezende[2], Cristiane A. Silva e Souza[1], Jing Yuan[3], Guilin Yin[3], Antonio M. Bonomi[2], Diego S. T. Martinez[1], Mathias Strauss[1,*]

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Sugarcane bagasse originated from production of ethanol and sugar is one of the most abundant agroindustrial bioresource, which have been studied and used as raw material to obtain biofuels, biochemicals, electric energy, among other high added-value green products assuming sugarcane mills as biorefineries. This work is a contribution of the *Biocarb* project from Brazil-China Research and Innovation Center in Nanotechnology, and shed light on necessary integration of critical physico-chemical properties tuning, ecotoxicological assessments with techno-economical aspects of activated carbons produced from sugarcane bagasse.

Activated carbons were produced from sugarcane bagasse biochar which was further activated using various ratios of NaOH. Impacts of this variation was studied with a view to tuning these materials critical properties such as process yield, apparent density, surface oxidation states and textural characteristics by the activation conditions. State-of-art characterization techniques were used to follow these properties and they are discussed addressing the applicability of these activated carbons as adsorbents for water and air remediation. Moreover, this study about activated carbons from sugarcane bagasse were complemented with ecotoxicological assays focusing on their life cycle, and techno-economic assessment of full-scale production plants. Results pointed to these materials environmentally friendly alternative and economically-competitive alternative to be produced from sugarcane bagasse.

Finally, the development of efficient, innovative and safe high added-value green materials, like these activated carbons, is expected to lie on combination and integration of material physical and chemical methodologies with ecotoxicological and techno-economic aspects. Which seem to be a promising and necessary strategy towards a sustainable and responsible production of nanostructured materials.

Brazilian Bioethanol Science and Technology Laboratory

CNPEM Brazilian Center for Research in Energy and Materials

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