Nov 29th - Nov 30th, 2017 Workshop on

Second Generation Bioethanol and Biorefining

Campinas, Brazil

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Energy cane as main biomass for second generation biofuels

José Bressiani – Agricultural Director

Corporate Structure

85% of total shares

15% of total shares

BioEdge
Production of biofuels and biochemicals on a commercial scale.

BioFlex 1
1st 2G ethanol plant in Brazil

BioCelere
R&D company related to genetic improvement of yeasts for the production of biochemicals and 2G biofuels.

GranAPI USA
Proprietary technologies for the production of cellulosic sugars (conversion into biofuels and biochemicals) and nanocellulose

BioVertis
Development and production of high fiber content biomass, licensing and agricultural residues services provider

BioPlant
Development of greenfield projects to produce steam and electricity from energy cane bagasse

Biofuels and Biochemicals

Technology and R&D

Biomass and Energy

What is the Energy Cane?

Energy cane is a sugarcane hybrid with more yield, more fiber and less sugars in juice

- ✓ Has a potential to produce 2 to 3 times more biomass than sugarcane;
- ✓ Potential to achieve more than 10 harvests in one cycle (2.0x sugarcane);
- ✓ More resistant to pests and diseases;
- ✓ High cellulosic composition (>70%);
- ✓ More competitive production costs versus other biomass sources like eucalyptus, sorghum, sugarcane and other grasses;
- ✓ Environmental Friendly: adapted to marginal lands, less demanding in soil, water and nutrients.

The Energy Cane is an agro-tech breakthrough with huge potential to reshape the World's Energy Industry

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Energy cane vs Sugarcane

Vertix® is the name of energy cane that can revolutionize cellulosic sugar production

Characteristic[1]	Sugarcane	Energy Cane Type 2	
		2017	2027E
Productivity (wet ton/ha)	***80***	***180****	***250***
Fiber content	14%	25%	30%
Fiber per Hectare	***11t***	***45t***	***75t***
Sugar content	14%	8%	10%
Sugar per Hectare	***11t***	***14t***	***25t***
Harvests (per cycle)	4	10	10
Improvement cycle (years)	8 to 12	4	6

Sugarcane (SC) **Energy Cane (EC)**

* Poor sugarcane environment at São Paulo State

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Energy cane Breeding Program

Breeding Site
(Barra de São Miguel, AL)

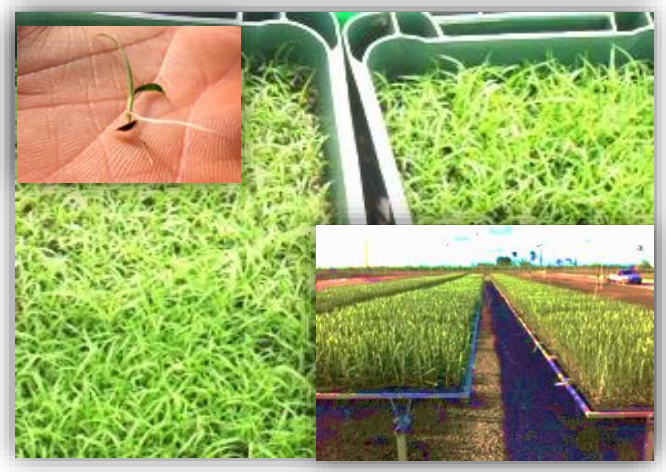
- 60 hectares;
- 25 employees;
- Start of Activities: May/12;
- Improvement Pipeline: 100 thousand seedlings/year;
- First Variety: Dec/15
- Commercial Varieties: 9

Energy Cane Breeding Pipeline

Germplasm

Hybridization

Seedlings Production



Selection

Characterization

New Variety

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Germplasm

Germplasm Bank established with over 700 different sugarcane genotypes

Group	Access Number
Arundo Donax	2
Erianthus spp.	57
F1	169
F2	33
Hybrids	165
Miscanthus spp.	15
Backcrosses	4
Saccharum barberi	19
Saccharum edule	1
Saccharum officinarum	50
Saccharum robustum	35
Saccharum sinense	11
Saccharum spontaneum	186
total	747

Saccharum spontaneum

Saccharum hybrids

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Main Characters

Presence of Rhizomes

Highest Tillering

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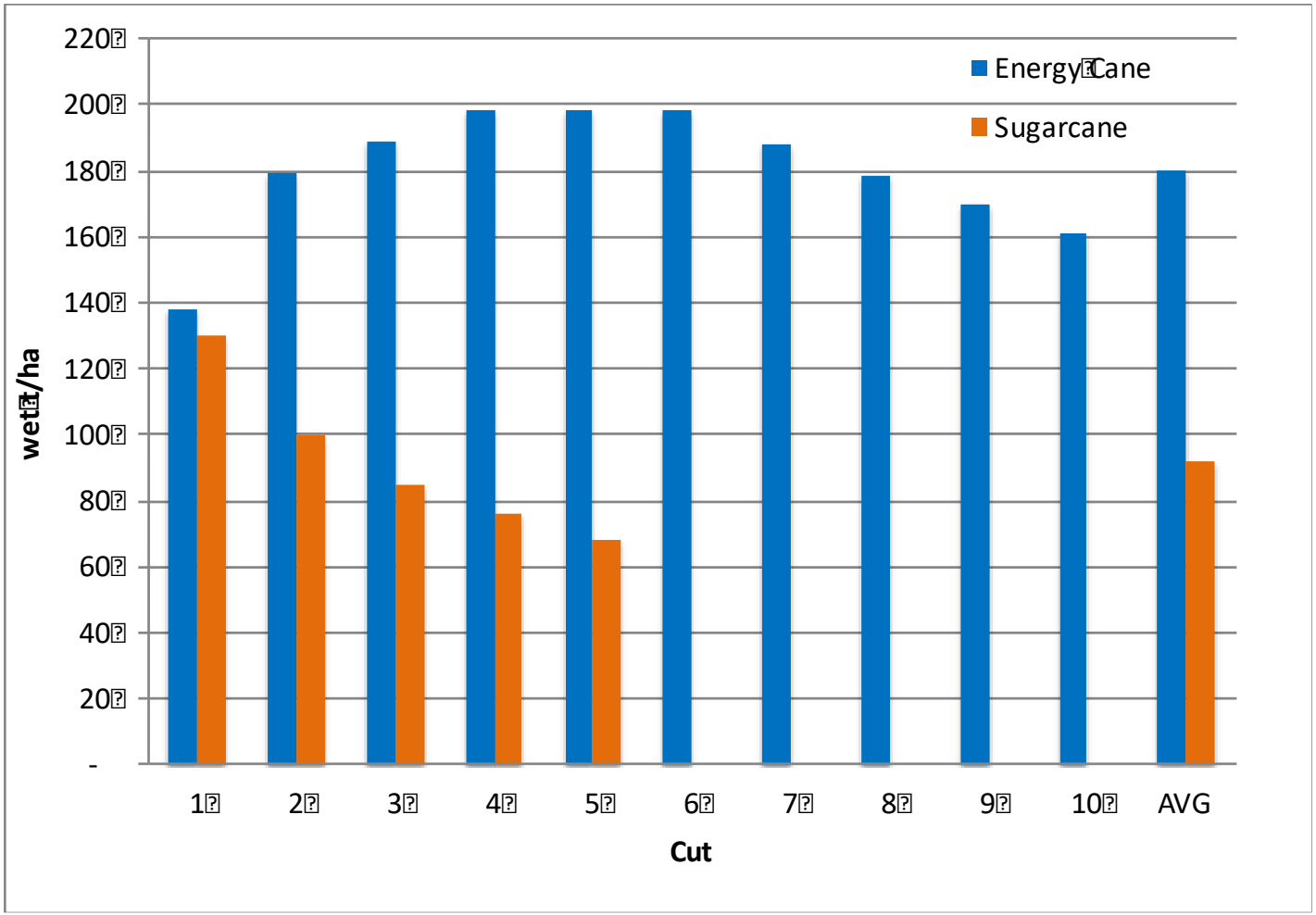
Vigorous Root System confers a high Water Use Efficiency (WUE)

Yield Potential Across Sucessive Harvests



- Reduction in **Production Costs by Half**;
- **Double the Result** per area.

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Energy Scenarios Using Energy Cane as Main Feedstock

Dry:
- Industry
- Piles
- Bales

Pellets

Boiler

Turbo Generator

In Natura

Crushing

Bagasse

Ethanol 2G

Energy

Juice

Fermentation

Ethanol 1G

Crystallization EC Type 1

Sugar

Bio Digestion

Biogas

Combustion Engine

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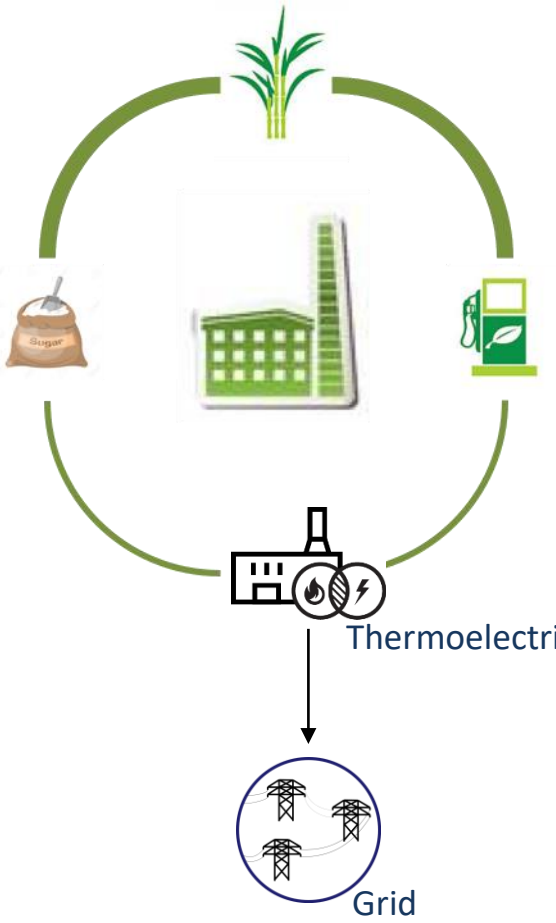
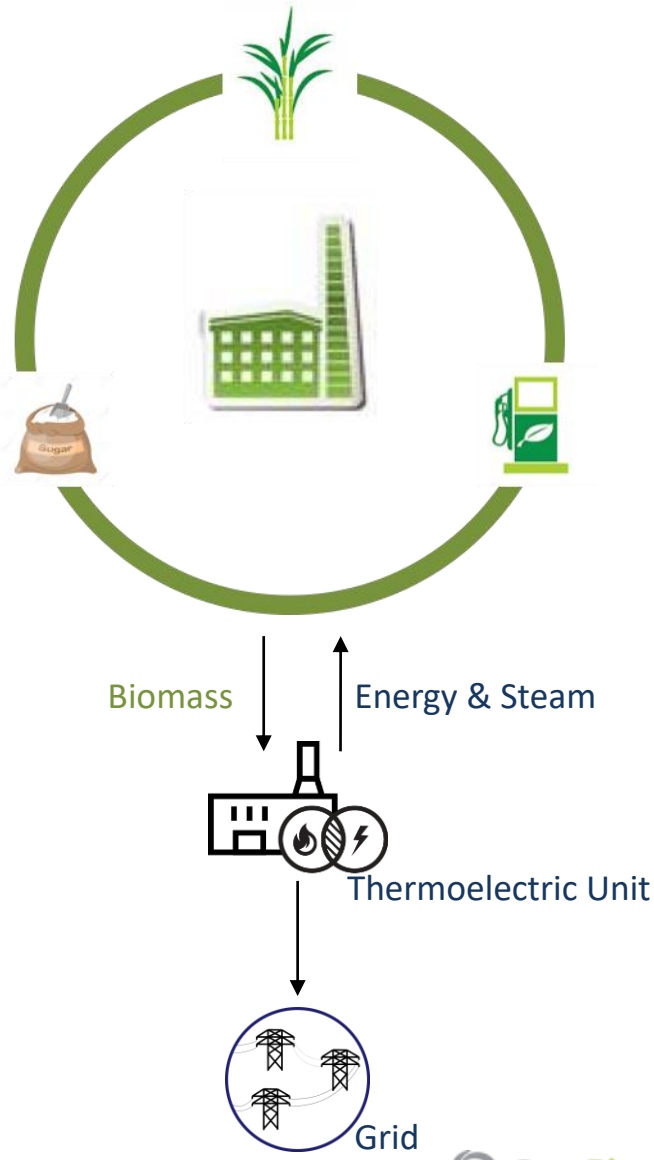
Immediate Opportunity for Electricity in 1G mills

Most of Thermal Power Plants in Sugar mils Work only during harvest season



Make Thermal Power Plants Work as a Business Unit...



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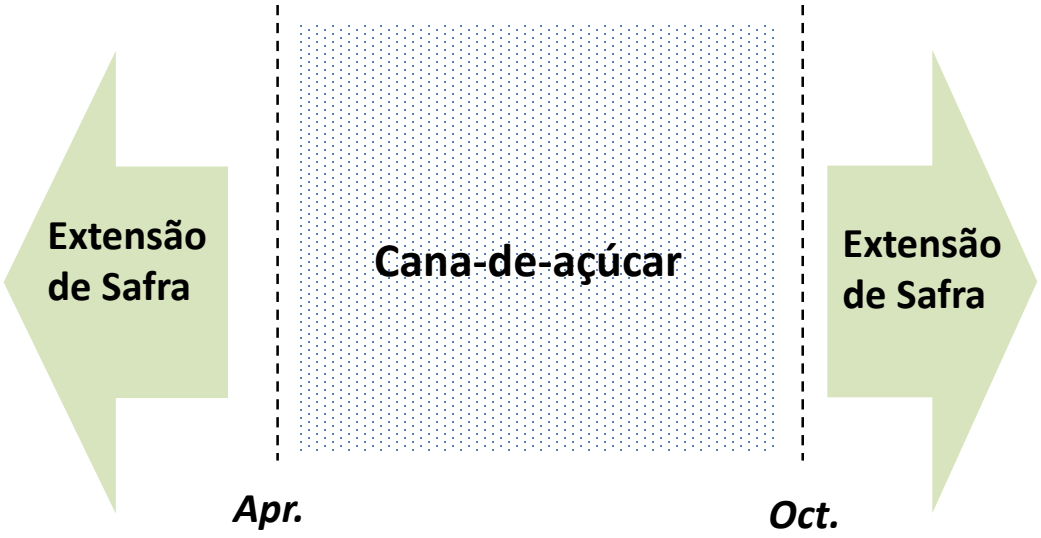
Increasing harvest season in 1G mills

optimizing varietal management



- ✓ Increasing agroindustry results: biomass yield and increase in operation time;
- ✓ Use o energy cane during rain periods and in poor soils (sandy).

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PORTFÓLIO VERTIX®

Vertix ® Energy cane Varieties Registered and Protected at Ministry of Agriculture (RNC and SNPC)

Cultivar	Process	Status	Certificate number	Protection deadline
Vertix® 1	21806.000323/2015	Definitive	20170097	29/09/2031
Vertix® 2	21806.000324/2015	Definitive	20170098	29/09/2031
Vertix® 3	21806.000135/2017	Provisory		
Vertix® 4	21806.000137/2017	Provisory		
Vertix® 5	21806.000134/2017	Provisory		
Vertix® 6	21806.000131/2017	Provisory		
Vertix® 7	21806.000136/2017	Provisory		
Vertix® 8	21806.000132/2017	Provisory		
Vertix® 9	21806.000133/2017	Provisory		

Recommended to 1G Mills

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Commercial Variety – Vertix 2®

Main Features:

- Energy cane Type 2
- 84 kg of sugars in juice/wet ton;
- 24 % fiber composition;
- Prominent rhizomes;
- High tillering;
- Adapted to mechanization;
- Smut resistance.

Agronomic performance per hectare:

(Commercial check RB92579 - 4 Cuts AVG)

Yield (t/ha)	Vertix 2	RB92579	Relation
Wet Biomass	185	89	2,08
Dry Matter	65	29	2,24
Fiber	44	13	3,38
Sugars	15	13	1,15

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Obrigado!!

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