Sugarcane Polyolefins
Adding value through the use of I’m green™ Polyethylene

May 2014
Agenda

• **Braskem overview**
  • Brazil unique framework for green chemistry development
  • Sugar cane based polyethylene: innovation based on sustainable pilars
• Green PE
  • Portfolio
  • Communication
  • Successes
PETROCHEMICAL INDUSTRY

COMPETITIVE INTEGRATION

1ST GENERATION
Basic Petrochemicals

2ND GENERATION
Thermoplastic Resins

3RD GENERATION
Plastics Manufacturers

EXTRACTION
Feedstocks

NAPHTHA
NATURAL GAS
ETHANOL
SALT

ETHYLENE
PROPYLENE
CHLORINE
SODA ALKALI

PE
PP
PVC

Braskem
## PRODUCTS

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**Braskem**
INDUSTRIAL FOOTPRINT

36 INDUSTRIAL UNITS WORLDWIDE

USA (KTA)
PP: 1,425

BAHIA
BRASIL
1 CRACKER
4 PE
1 PP
1 PVC
1 CHLOR-ALKALI

ALAGOAS
BRASIL
2 PVC
1 CHLOR-ALKALI

SAO PAULO
BRASIL
2 PE
2 PP
1 CRACKER

BAZIL (KTA)
BASIC: 3,752
PE: 3,025
PP: 1,975
PVC: 710

EUROPE (KTA)
PP: 545

INDUSTRIAL PRESENCE
PROJECTS
PROJECTS IN CONSTRUCTION

PENNSYLVANIA
UNITED STATES
1 PP

WEST VIRGINIA
UNITED STATES
1 PP

TEXAS
UNITED STATES
3 PP

NORTH RHINE-WESTPHALIA
GERMANY
1 PP

SAXONY-ANHALT
GERMANY
1 PP

RIO DE JANEIRO
BRASIL
1 CRACKER
1 PE
1 PP

RIO GRANDE DO SUL
BRASIL
2 CRACKER
5 PE
2 PP

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Brazilian Scenario

Favorable aspects for the development of biopolymers

Continental dimension
Brazilian Scenario

Favorable aspects for the development of biopolymers

The largest watershed in the world
Brazilian Scenario

Favorable aspects for the development of biopolymers

Intense solar radiation and climate diversification
Brazilian Scenario

Favorable aspects for the development of biopolymers

Pioneer in research and development of biofuels
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I’m green™ Polyethylene: A renewable sourced alternative to traditional polyethylene

- Investiment (green ethylene plant): US$ 290 MM
- Start-up: September 2010
- Capacity: 200 kty
- Location: Triunfo Petrochemical Complex, State of RS
- Portfolio: LLDPE, HDPE and LDPE (since 2013)
- Markets: South and North America, Europe and Asia
- Sinergy with existing assets: the polymerization process is made on plants shared with the petrochemical PE production

Bio based
I’m green™ Polyethylene cycle from cradle to cradle

Ethanol CH$_3$-CH$_2$OH
At the distillery, the sugar juice is fermented and distillated to produce ethanol

Ethylene CH$_2$=CH$_2$
Through the dehydration, the ethanol is transformed in ethylene

Sugarcane
The sugarcane crop metabolizes the CO$_2$ to produce sucrose

Recycling
The I’m green™ polyethylene is recyclable in the same chain established for fossil PE (Mechanical / Incineration)

Carbon capture
The I’m green™ polyethylene is transformed in final products by the same existing processes and machinery for fossil PE

Green PE [CH$_2$=CH$_2$]$^n$
The ethylene is polymerized in shared polyethylene production unities

Very Favorable Ecoprofile*
Land use: from sugarcane to I’m green™ Polyethylene

1 Hectare of land

~77 tons of Sugarcane\(^{(1)}\)

~6700 liters of Ethanol\(^{(1)}\)

~3 tons of Green Ethylene\(^{(2)}\)

~3 tons of I’m green™ Polyethylene \(^{(2)}\)

Braskem’s capacity of I’m green™ polyethylene production: 200 kton/year

460 millions liters of Ethanol = approx. 68 thousand hectares

\(<2,0\% \text{ of Brazilian ethanol production}\)

\(~0,02\% \text{ of Brazilian arable land}\)

\(^{(1)}\) NIPE/UNICAMP/UNICA

\(^{(2)}\) Braskem’s project data
Land Usage

Total Area
851.48
Millions of hectares

Protected/Native
554 (58%)

Arable Land
329.94 (39%)

Sugar Cane
8.14
(2.4%)

Pasture
158.75
(48%)

Agriculture
51.7
(16%)

Available
111.34
(33%)

Other
25.92 (3%)

Braskem’s capacity of I’m green™ polyethylene production: 200 kton/year

460 millions liters of Ethanol = approx. 68 thousand hectares
Brazilian agroecological zoning Programme

- Soil and weather condition = productivity
  (no expansion to Amazon and Pantanal)

Areas for sugarcane expansion:
- Areas with proper conditions for mechanical harvesting
- Degraded pasture land
- Regions with lower need for water usage in production

Respect for food security

87% national production
GREEN PE HAS THE SAME TECHNICAL AND RECYCLING PROPERTIES AS PE MADE FROM FOSSIL FUELS

Drop-in

Green PE/PP can be recycled using the same systems already in use for Fossil-based PE/PP

Recycled Green PE/PP can be incorporated into manufacturers’ production processes

PETROLEUM PE/PP Fossil-based

SUGARCANE PE/PP Green
The product sustainability journey

July 2007
Preliminary investigation

environmental assessment based on secondary data

September 2010
Plant start up

Code of conduct established
Biobased carbon verification

October 2013
Environmental Assessment

LCA, WFT, LUC
Primary data
Key suppliers
Critically reviewed

April 2011
Product validation

Product certified by Vinçotte

PHASE 0

PHASE 1

PHASE 2

PHASE 3

99% biobased content verified by ASTM D6866
7.5t / Y

-2.15kg

~ 2.0kg*

> 4kg

200kt green PE
> 100,000

100t green PE
> 50

* Plastics Europe
Value proposition summary

- Drop in solution
- Sustainably sourced
- Brand enhancement
- Reduction of GHG
- Fully recyclable
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I’m green™ Polyethylene current portfolio

**HDPE**
- Injection
- Fiber Extrusion
- Film
- Blow Molding

**LLDPE**
- Automatic Packaging
- Pouches
- Industrial and Agricultural Film
- Wire and Cable

**LDPE**
- Collation shrink
- Injection molding
- PE blends
- Extrusion Coating

Co-monomers butene and hexene are still fossil based.
The brand I'm green™ identifies Braskem's portfolio of products made from renewable sources, p. ex., "I'm green™ polyethylene";

The seal can be applied in products which use the I’m green™ polyethylene;

To communicate clearly and safely the use of I’m green Polyethylene™;

Educate the consumer for conscious consumption by identifying the products which use I’m green™ Polyethylene;

To create a synergic platform for the products that use the I’m green™ Polyethylene;
Other examples of brands and seals used to identify the I’m green™ Polyethylene in the product

USA

USA

BRAZIL

EUROPE
Global footprint
Thank you!

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