Braskem:
New ways to look at the world

Workshop for Sustainable Production of Biopolymers
and other bio-based products
July, 2012
Agenda

- Introduction: Braskem
- Innovation and Technology
- Braskem Green Ethylene and Propylene
- NEXT STEPS: Synthetic Biology
- Open Innovation
Odebrecht Group

- Engineering & Construction
- Investment in Transport, Logistics and Airport in Brazil
- Investment in Energy and Infrastructure
- Services in Oil & Gas
- Investments in Water and Sewage and Waste Treatment
- Real State
- Ethanol, Sugar and Bioenergy
- Chemical and Petrochemical
BRAZILIAN PETROCHEMICAL INDUSTRY

1ª GENERATION
Basic Petrochemicals

2ª GENERATION
Thermoplastics resins

3ª GENERATION
Plastic Converters

INTEGRADO NA CADEIA

EXTRACTION
Raw Material

NAFTA
CONDENSED
GAS

ADDED VALUE
COMPETITIVENESS

COMPETITIVENESS

BRAZILIAN PETROCHEMICAL INDUSTRY
Vision 2020

To be the world leader in **sustainable chemistry**, innovating to serve people better.
35 industrial Units

**Bahia - Brazil**
- 1 UNIB
- 1 PVC
- 1 Chlorine Soda

**Alagoas - Brazil**
- 1 PVC
- 1 Chlorine Soda

**São Paulo - Brazil**
- 2 UNIB
- 1 PVC
- 1 Chlorine Soda

**Rio de Janeiro - Brazil**
- 1 UNIB
- 1 PVC

**Rio Grande do Sul - Brazil**
- 2 UNIB
- 1 PVC
- 1 Chlorine Soda

**United States**
- 5 UNIB | 1 PVC
- 5 PE
- 2 PP
- 1 PVC
- 2 PP
- 1 PVC
- 1 Chlorine Soda

**Germany**
- 2 UNIB | 1 PVC
- 2 PP Wesseling | Schkopau
- 2 UNIB | 1 PVC
- 2 PP

Source: Braskem
CONSISTENT EVOLUTION OF ECO-EFFICIENCY INDICATORS

**Water Consumption (m³/t)**
- 2002: 4.14
- 2003: 3.97
- 2004: 3.83
- 2005: 4.25
- 2006: 4.26
- 2007: 4.29
- 2008: 4.50
- 2009: 3.83
- 2010: 4.15

**Effluent Generation (m³/t)**
- 2002: 1.94
- 2003: 1.74
- 2004: 1.40
- 2005: 1.50
- 2006: 1.34
- 2007: 1.28
- 2008: 1.44
- 2009: 1.40
- 2010: 1.24

**Energy Consumption (GJ/t)**
- 2002: 11.90
- 2003: 11.47
- 2004: 11.12
- 2005: 11.55
- 2006: 11.46
- 2007: 11.47
- 2008: 11.83
- 2009: 11.27
- 2010: 10.65

**Residue Generation (kg/t)**
- 2002: 5.78
- 2003: 4.52
- 2004: 3.53
- 2005: 3.28
- 2006: 3.41
- 2007: 3.10
- 2008: 3.38
- 2009: 2.40
- 2010: 2.21

- Water Consumption: +1%
- Effluent Generation: -36%
- Residue Generation: -62%
- Energy Consumption: -10%

Braskem pro forma for 2002
GROWTH WITH IMPROVED COMPETITIVENESS

BRAZIL

PVC Alagoas

Expansion of capacity to 200 kt/year of PVC in Alagoas

Investments of around US$ 500 million, and operational startup expected in the 2nd half of 2012

Butadiene Rio Grande do Sul

Expansion of capacity to 100 kt/year at an investment of R$ 300 million

Partnership with Petrobras for new projects (under appraisal)

Comperj: production and sale of resins and basic petrochemical products. Located in Rio de Janeiro state

Source: Braskem
Projects with Petrobras

**VENEZUELA**

**JVs WITH PEQUIVEN THROUGH FINANCING OF PROJECT WITH NET EQUITY OF JUST 30% (UNDER ANALYSIS)**

- Polipropileno del Sur – Propilsur
  ~350 kt/year of PP

- Polietilenos de America – Polimerica
  1.3 Mt of ethylene and 1.1 Mt/year of PE

**PERU**

Braskem, Petrobras and PetroPerú concluded studies for the technical and economic pre-feasibility of an integrated project to produce between **600 kt and 1,000 kt/year** of ethane and polyethylene using the natural gas available in Peru as raw material.
MEXICO

ETHYLENE XXI PROJECT: Startup in 2015

Partnership with the Mexican group IDESA (65% Braskem, 35% IDESA) to build an integrated petrochemical complex to produce 1 Mt/year ethylene and 1 Mt/year of PE using raw material (ethane) supplied by PEMEX.

Investments estimated at US$ 3 billion over 5 years.
Innovation and Technology

298 people (16% PhD, 30% of researchers MSc and Post – Graduate)

Innovation Pipeline: US$ 1.6 bi (RANPV)

428 Patent applications

24 Laboratories + 8 pilot plants

Global Agreements in Technology

I&T Assets: US$ 240 MM (2011)
INNOVATION AND TECHNOLOGY
Technology center and laboratories

BRASKEM TECHNOLOGY CENTER – PITTSBURGH (EUA)

BRASKEM TECHNOLOGY CENTER – TRIUNFO/RS (BRAZIL)

Laboratory
Technology Center
INNOVATION AND TECHNOLOGY
Technology center and laboratories

UHMWPE FIBER LABORATORY BRASKEM– CAMAÇARI/BAHIA (BRAZIL)

BIOTECNOLOGY LABORATORY BRASKEM – CAMPINAS/SP (BRAZIL)
Braskem is the leading global supplier of biopolymers

- Startup Sept 24, 2010
- Volume 200kton/year
- Investment US$ 290 MM
Green Polyethylene
An alternative to traditional PE

Traditional

Oil

Gas

Sustainable

Polyethylene

Ethanol
Braskem green Polyethylene
Unique product characteristics

- Green PE can be recycled in the same stream already established for the petrochemical PE
- Green PE can also be incorporated in the current converter’s production systems
Next Steps

- **New Green PE Plants**
- **New product:**
  **Green Polypropylene**
  
  First green PP
  
  Lab scale production and Biobased Verification
  
  Ongoing research to develop competitive go to market strategy
  
  Medium term commercialization
Next Steps – PP new technologies

1st wave

Clarified Sugarcane Juice (15 wt%)

→ Ethanol

→ Dehydration

→ Ethylene Purification

Ethylene Catalysis

→ Propylene

2nd wave

Clarified Sugarcane Juice (15 wt%)

→ Intermediate

→ Propylene

Ethylene Catalysis

3rd wave

Clarified Sugarcane Juice (15 wt%)

→ Propylene
Green propylene

New biotech laboratory in Campinas

+ 25 researchers

Cooperation projects with
Bioplastic strategy

Phases
1st wave 2nd wave 3rd wave
To know To growth To consolidate the market
the market

2010-2014 2015-2019 2020 - beyond

Capacity

Green PE
200 kta Green PE
(Triunfo RS)

Green PP
30 kta Green PP
Existing Technology

Total Capacity
230 kta

TBD

New Capacities
Green PE

Additional Capacities
Green PE

New Capacity
Green PP
(Improved Tech)

Higher Capaci-0ies
Green PP
(Biotech Route)
Price versus volume

- Ethylene
- Ethanol
- Propylene
- PE
- PP
- PVC
- Poliamida elastomers
- Adipic acid
- Isobutene
- Acrilic acid
- Butanediol
- Butadiene
- Isoprene
- Phenol
- PET
- Estirene
- PVC
- PP
- PE
- Propylene
- Ethanol
- Butanediol
- Isobutene
- Acrilic acid
- Butadiene
- Isoprene
- Phenol
- PET
- Estirene
- PVC
- PP
- PE
- Propylene
- Ethanol

Volume 1-10 MM ton/ano and price 1500-3000 USD/ton
Open Innovation

Request for research projects

- **FAPESP** (The State of São Paulo Research Foundation) – USD ~15 MM BRASKEM + ~15 MM FAPESP for joint projects with Braskem and Universities from the State of São Paulo – results for the second call will be published soon

- **FAPESB** (The State of Bahia Research Foundation) – USD ~950 M BRASKEM + ~950 M FAPESB for joint projects with Braskem and Universities from the State of Bahia – submission open

Focus

- Biobased chemicals and polymers
- Capture, storage or conversion of CO$_2$
- PE, PP, PVC
Braskem’s Msc and PhD scholarships

- A total of 10 masters scholarships and 10 doctorate scholarships will be funded by Braskem.

Topics of interest:

1. Chemical products from renewable raw materials;
2. Post-consumption solutions for plastic;
3. Development in the area of processes, products and catalysts for the petrochemical industry.
Braskem is looking for researchers in this area: synthetic biology, protein engineering, molecular biology, chemistry and biochemistry.
Market - DRIVERS
- Environmental
- Crisis
- Performance

PRODUCTS
- Biofuels
- Chemicals
- Biopolymers

TECHNOLOGIES
- Gaseification/Pyrolysis
- Acid Hydrolisis /Enzimatic
- Catalysis/Polimerization
- Fermentation
- Synthetic Biology
- Dowstream

BRASKEM - RENEWABLE ROADMAP
Braskem, a company perceived as part of the solution to sustainable development by generating economic results with the least intensity of gas emissions and water use in the global chemical industry, positioned as the largest chemical industry based on renewable raw materials and as an agent for human development.

Greenhouse Gases
Water Efficiency

Vision of Sustainable Development

Energy Efficiency

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THANK YOU!