
Braskem
New ways to look at the world
Environmental
Benefits of Sugar Cane Based
Polyethylene & Polypropylene
Terry Glass
Market Development Specialist
Braskem NA
979-236-3617
terry.glass@braskem.com

Braskem

Leader in Thermoplastic Resins Production in the Americas

35 Industrial sites worldwide

Bahia
- 1 Naphtha Cracker
- 4 PE
- 1 PP
- 1 PVC
- 1 Chlorine Soda

Alagoas
- 1 PVC
- 1 Chlorine Soda

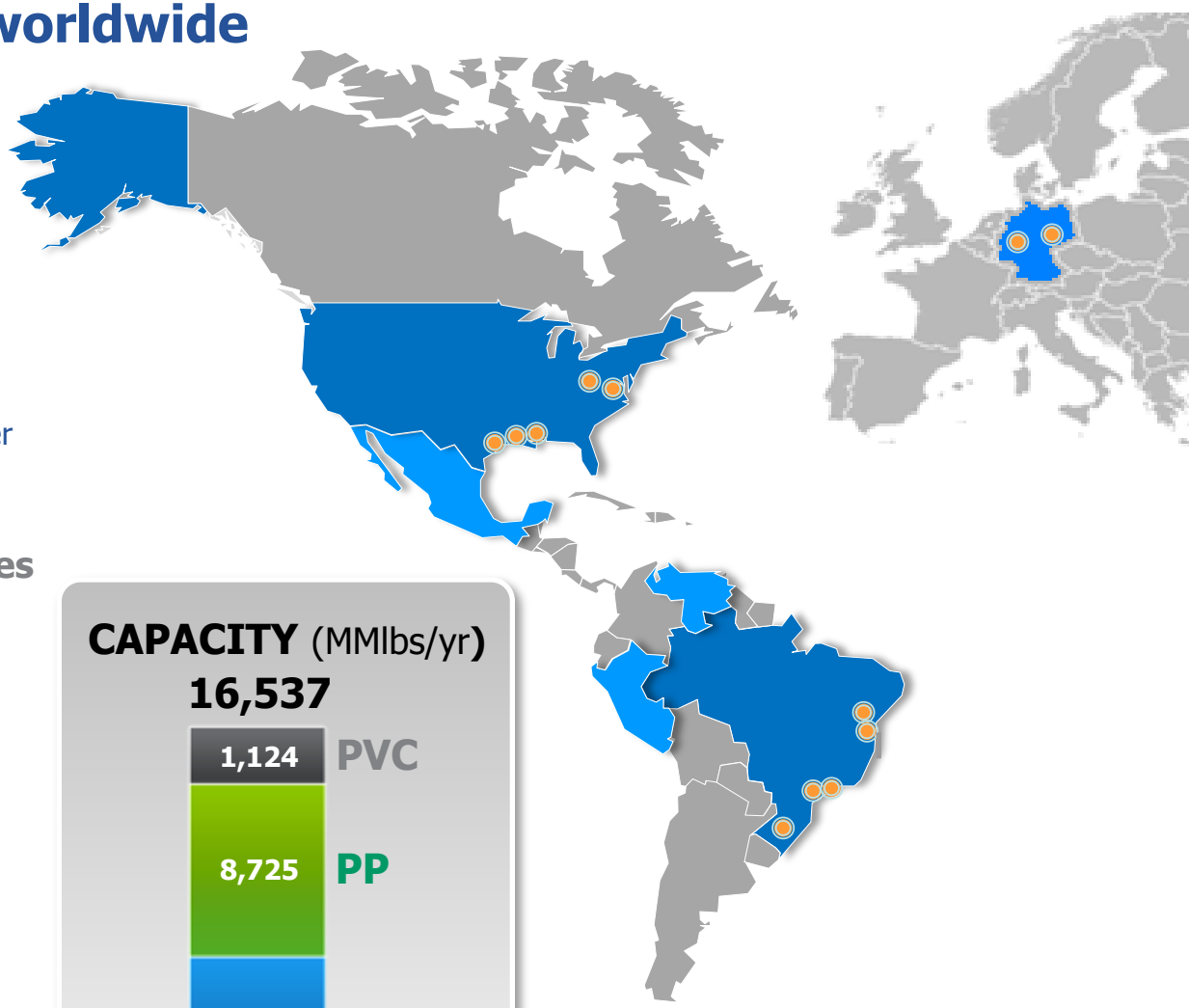
Rio Grande do Sul
- 1 Naphta Cracker
- 5 PE
- 2 PP

Rio de Janeiro
- 1 Gas Cracker
- 1 PP
- 1 PE

São Paulo
- 1 Naphtha Cracker
- 2 PP
- 3 PE

United States of America
- 5 PP

Germany
- 2 PP



2011 Gross Revenue

US$ 23.8 billion

CAPACITY (MMlbs/yr)

16,537

Source: Braskem

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Braskem Green Polyethylene: a running business

- Startup **Sept 24, 2010**
- Capacity **200 kty**
- Investment **US$ 290 MM**

Braskem is the leading global supplier of biopolymers

Green Polyethylene Cycle

FROM CRADLE TO CRADLE

Sugarcane

The sugarcane crop metabolizes the CO_2 to produce sucrose

Ethanol CH3-CH2OH

At the distillery, the sugar juice is fermented and distillated to produce ethanol

Ethylene CH2=CH2

Through the dehydration, the ethanol is transformed in ethylene

Very Favorable Ecoprofile*

Captures and Fixes 2,5 t CO_2/t PE

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Green PE [CH2=CH2]

The ethylene is polymerized in polyethylene production unities

Carbon capture

The green polyethylene is transformed in final products in the same unities already existents

Recycling

The green polyethylene is 100% recyclable (Mechanical / Incineration)

* Preliminary Ecoeficiency Analysis (From cradle to Braskem gate)– Fundação Espaço Eco 2007/2008

Sugarcane: No impact either in Amazon or in global food production

200kty of green PE needs **0,02% of arable lands** in Brazil

Sugarcane in Brazil **is cultivated mainly in the Southeast,** 2,000 Km far from the Amazon Forest

Corn
14 MM ha

Soybean
22 MM ha

Current ethanol + sugar
8 MM ha

Pasture/Cattle
159 MM ha

Protected Areas
496 MM ha

Sugarcane Ethanol occupies only **1,5% of Brazilian arable area**

Source: Censo IBGE 2006 and UNICA

From Sugar Cane to Green Polyethylene
Metrics and Relations

produces → produce → produce → produce

1 Hectare of land → **82,5 ton Sugar Cane** → **7200 l Ethanol** → **3 ton Green Ethylene** → **3 ton Green PE**

Braskem's Green PE: 200 kton/year
460 millions liters of Ethanol = approx. 65 thousand hectares

~1,7% of Brazilian Ethanol Production

~0,02% of Brazilian arable land

Green PE has the Same Technical and Recycle Properties As Petrochemical PE.

Oil

Fully identical properties

Sugarcane

- Green PE **can be recycled in the same stream already** established for the petrochemical PE
- Green PE regrind can also be **incorporated in the converter's production systems**

Petrochemical Polyethylene

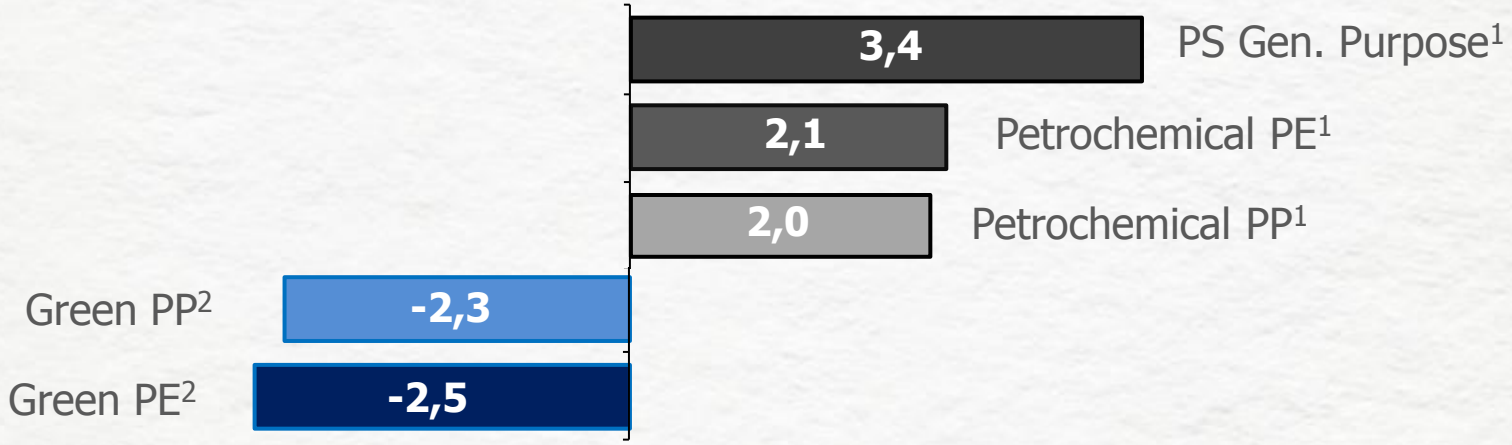
Green Polyethylene

Green PE/PP have a very favorable Carbon Footprint, helping to reduce GHG emissions

Carbon Footprint

From cradle to polymer factory gate

(t $CO_{2\ eq.}$ / t polymer)



200 kty of green PE ~ 920 thousand tons of CO_2 avoided/ year

~ emissions produced by 1 million cars per year[3]

[1]Plastics Europe

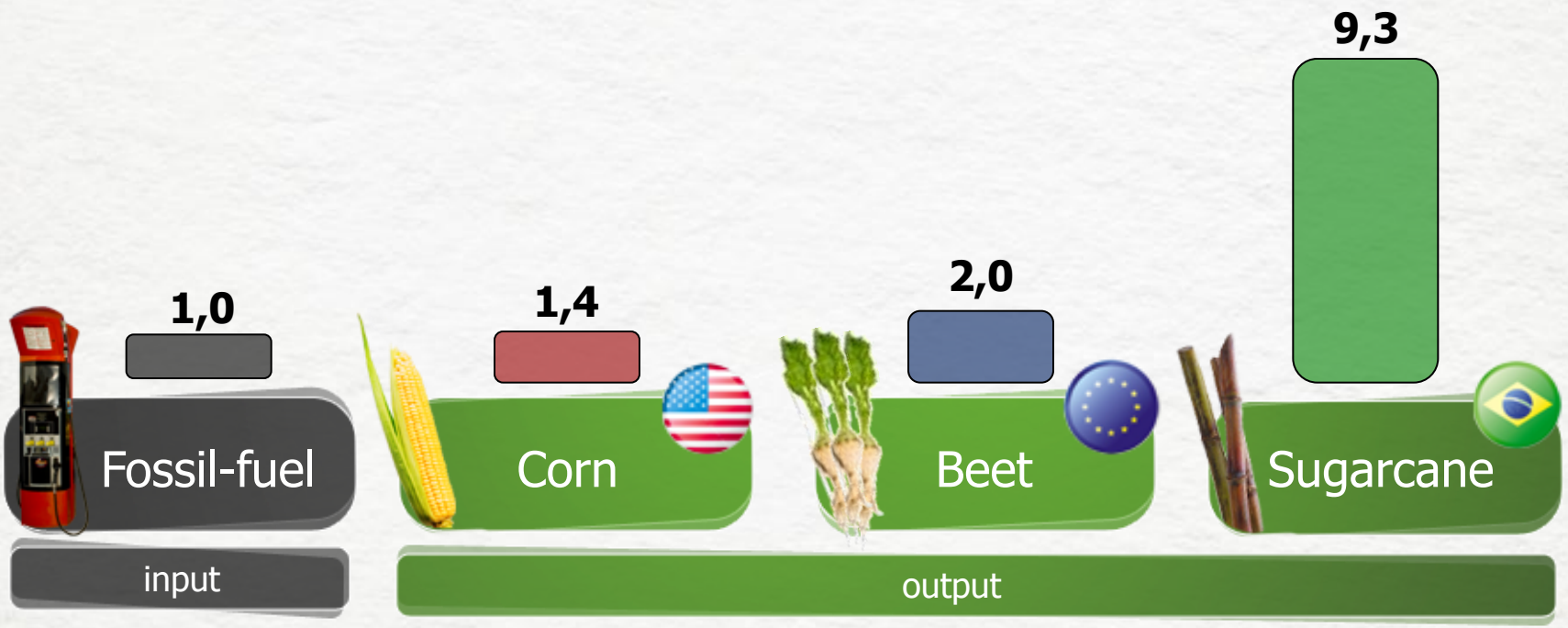
[2]Preliminary Ecoeficiency Analysis - Espaço ECO Foundation

[3]Based on the CO2 emissions of a car powered by a 1.0-liter gasoline engine that is driven 15 km per day for one year.

Source: 2006 IPCC Guidelines for National Greenhouse

Brazilian Sugarcane Based Ethanol Has the Highest Energy Productivity

Fossil-fuel energy used to **MAKE** the fuel (input) compared with the energy **IN** the fuel (output)



- New technologies expected to **double productivity**

Source: UNICA

How Does Green Polyolefin Packaging Fit Into a Sustainable Society?

Coca-Cola

DANONE

P&G

Johnson&Johnson

Nestlé

Good Food, Good Life

PROTECTS WHAT'S GOOD™ Tetra Pak

Sustainability of Polyolefins

Sustainability Variables	Units	PP	HDPE	PVC	PET	GPPS	HIPS	ABS
Environmental Comparisons*								
Energy to produce	MM BTU/1000 lbs. of Resin	34.9	35.8	25.4	31.9	42.5	42.9	46.8
Wastes Generated	Lbs. /1000 lbs	84.7	74.5	138	142	110	114	200
CO2 Equivalents	Lbs. CO2 equiv/1000 lbs.	1868	1890	2255	2798	3175	3194	3749
Key Physical Property Comparison								
Density	g/cm^3	.91	.96	1.4	1.36	1.04	1.04	1.04
1% Secant Modulus	psi	300000	200000	400000	360000	450000	300000	340000
Stiffness / unit volume	psi/cm^3	329670	208333	285714	264705	428571	288462	326923

*Cradle to Gate Life Cycle Inventory of Nine Plastic Resins Franklin Associates – July 2010

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Environmental Footprint Comparison
10 oz Bottle Case Study

KEY ASSUMPTIONS*	(unit)	BioPE bottle	Hydrocarbon Based PE bottle
Bottle			
weight	(gm)	12	12
diameter	(in)	2.13	2.13
height	(in)	5.00	5.00
Manufacturing process			
process	-	blow mold	blow mold
cavitation	#	16	16
cycle time	sec	4.5	4.5
bottles/hr	#	12,800	12,800
Units / yr	#	910,700,268	910,700,268
Lbs./ yr	Lbs	24,051,870	24,051,870

* Allied Development

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Environmental Footprint Comparison
10 oz Bottle Case Study

	Bio PE		Hydrocarbon Based PE	
ENERGY	**MJ**	**MJ/UNIT**	**MJ**	**MJ/UNIT**
Raw Materials	166,043,368	0.182	766,729,669	0.842
Raw Materials Packaging	0	0.000	0	0.000
RM & Pack Transport	8,894,308	0.010	8,894,308	0.010
Process	156,765,701	0.172	156,765,701	0.172
Distribution Packaging	8,110,970	0.009	8,110,970	0.009
DP Transport	1,621,480	0.002	1,621,480	0.002
Transport to Customer	15,073,023	0.017	15,073,023	0.017
Total Energy	**356,508,850**	**0.391**	957,195,151	1.051
GHG	**LBS**	**LB/UNIT**	**LBS**	**LB/UNIT**
Raw Materials	-48,836,285	-0.054	37,848,121	0.042
Raw Materials Packaging	0	0.000	0	0.000
RM & Pack Transport	1,373,521	0.002	1,373,521	0.002
Process	22,632,437	0.025	22,632,437	0.025
Distribution Packaging	929,752	0.001	929,752	0.001
DP Transport	250,400	0.000	250,400	0.000
Transport to Customer	2,327,680	0.003	2,327,680	0.003
Total Greenhouse Gas	**-21,322,495**	**-0.023**	65,361,910	0.072
Water	**GALLONS**	**GAL/UNIT**	**GALLONS**	**GAL/UNIT**
Raw Materials	203,403,126	0.223	93,521,485	0.103
Raw Materials Packaging	0	0.000	0	0.000
RM & Pack Transport	13,125	0.000	13,125	0.000
Process	16,857,442	0.019	16,857,442	0.019
Distribution Packaging	3,609,382	0.004	3,609,382	0.004
DP Transport	2,393	0.000	2,393	0.000
Transport to Customer	22,242	0.000	22,242	0.000
Total Water	**223,907,710**	**0.246**	114,026,069	0.125
Material End-of-Life	**Total LBS**	**Landfill LBS/unit**	**Total LBS**	**Landfill LBS/unit**
Finished product	24,051,870	0.021	24,051,870	0.021
Raw material packaging	0.000	0.000	0.000	0.000
Product packaging	826,699	0.001	826,699	0.001
Other waste	10,200	0.000	10,200	0.000
Total	**24,888,769**	**0.022**	**24,888,769**	**0.022**

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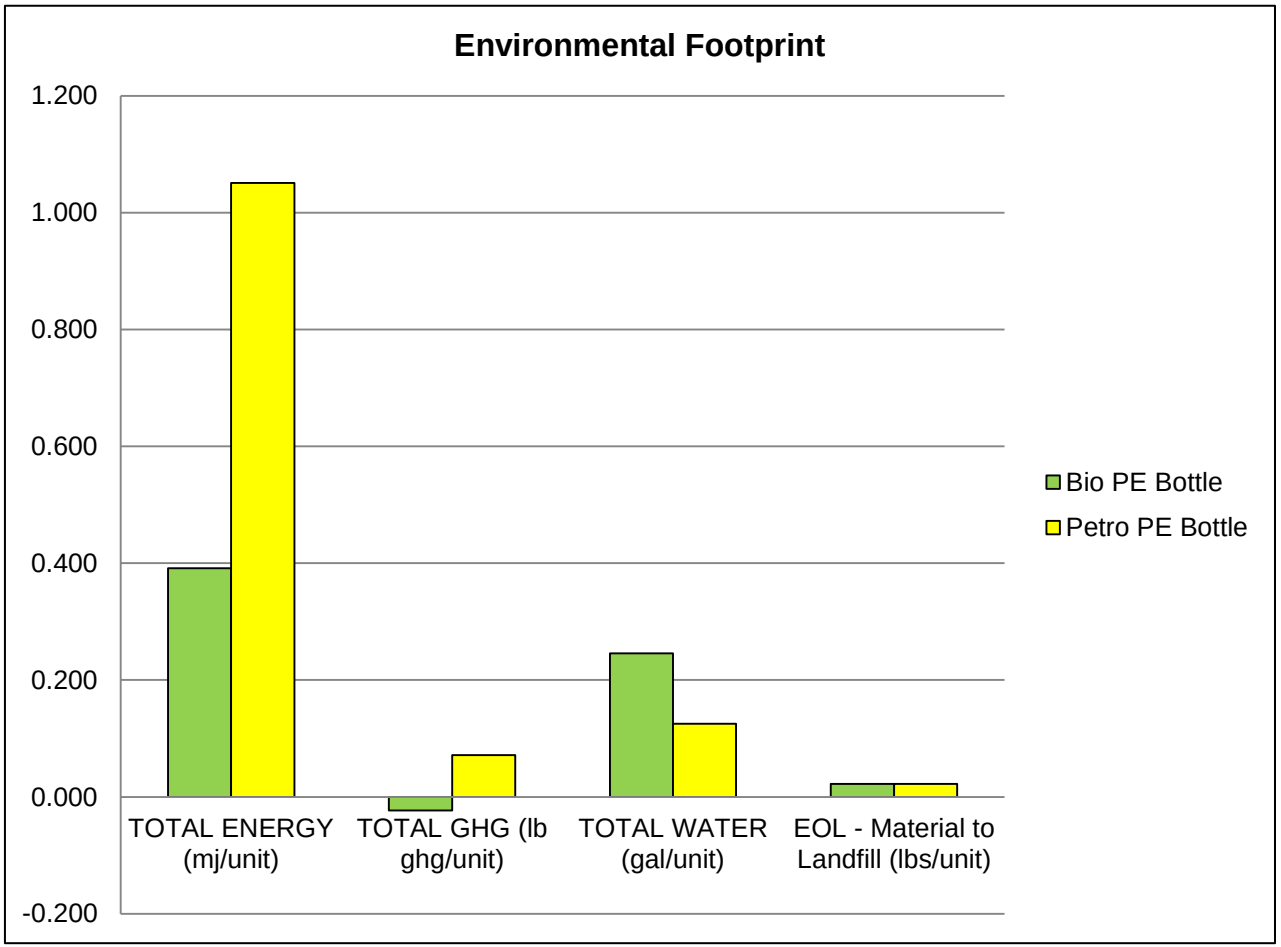
10 oz Bottle Case Study



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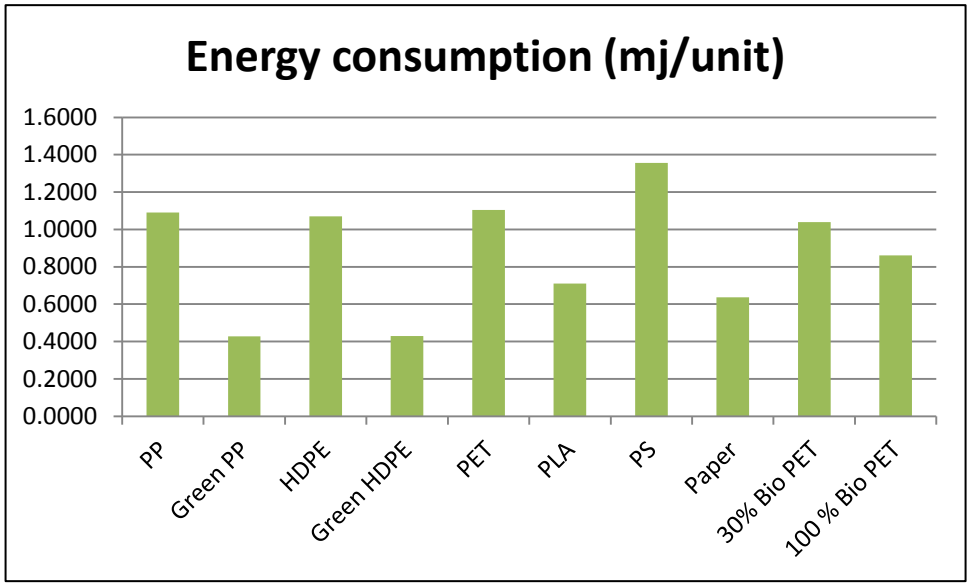

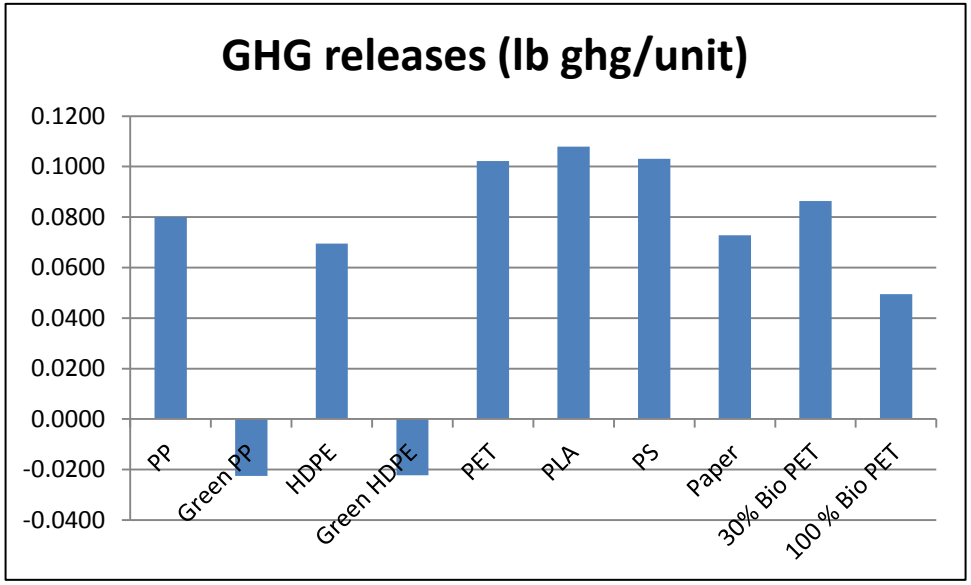

Assumptions*

12 Gram Container Weight for all Resin Types

30% Bio PET Assumes only MEG sourced from Sugar Cane Ethanol

100% Bio PET Assumes PTA sourced from corn starch / isobutanol route and MEG sourced from Sugar Cane Ethanol

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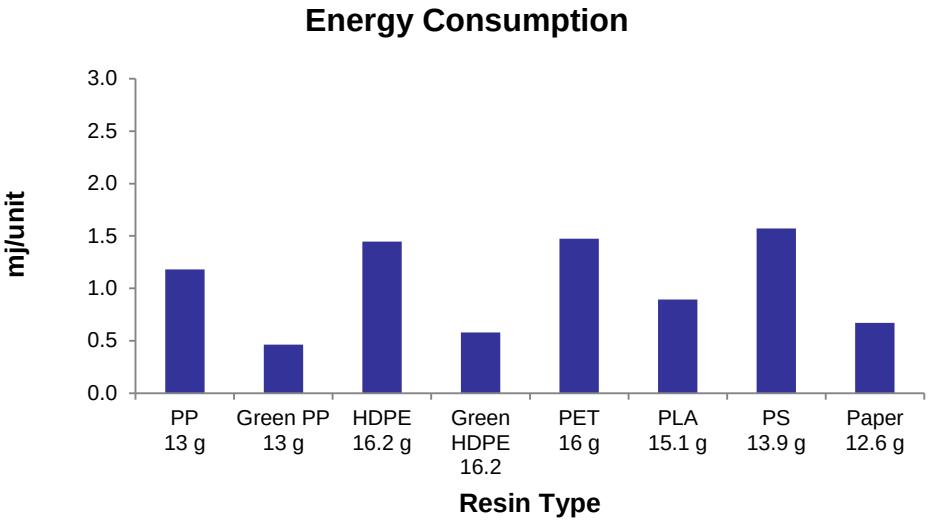
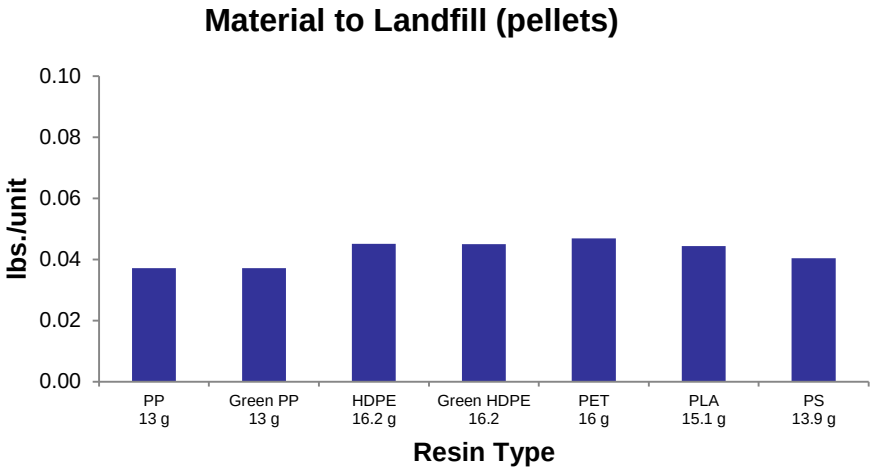
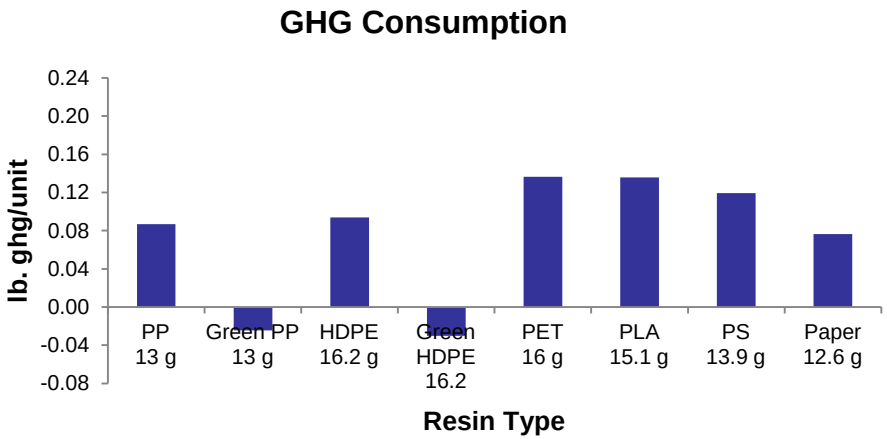
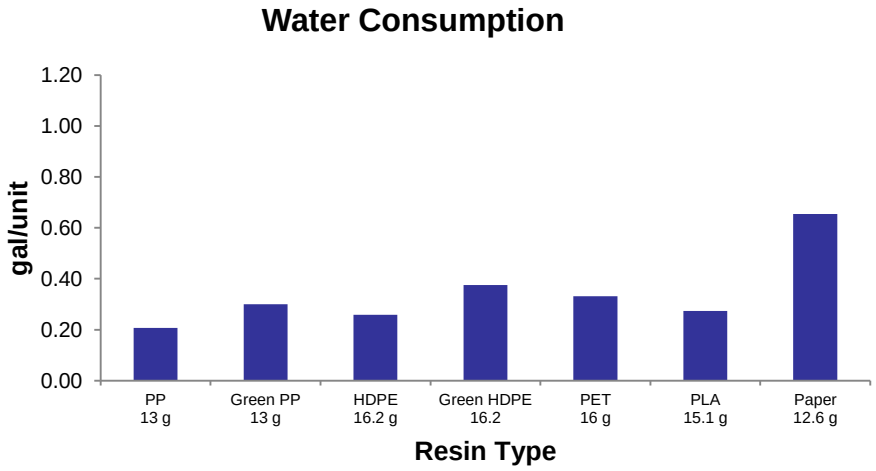
Environmental Footprint -16 oz. Cups*









Green PE / PP Advantaged in Energy and GHG

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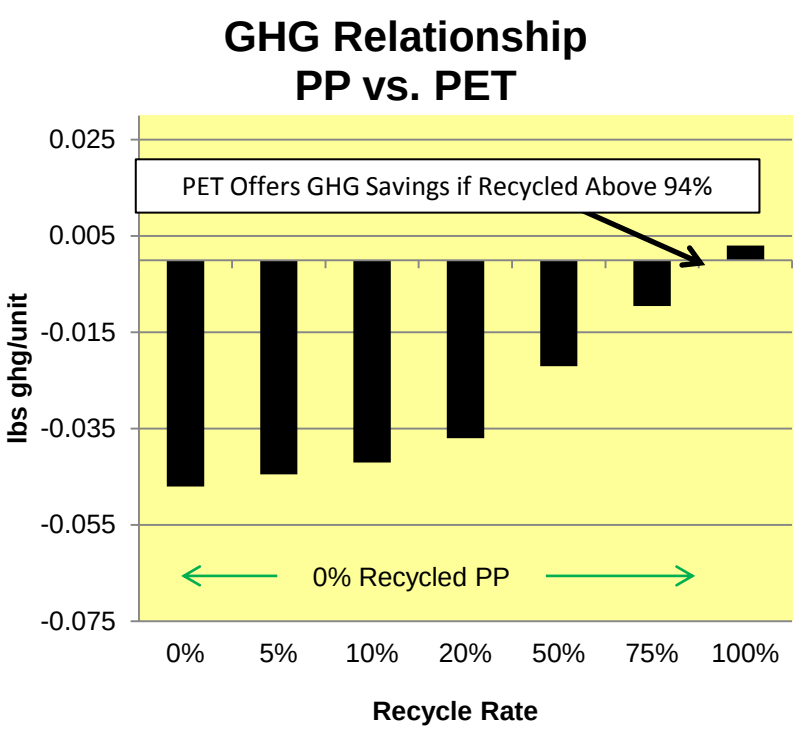
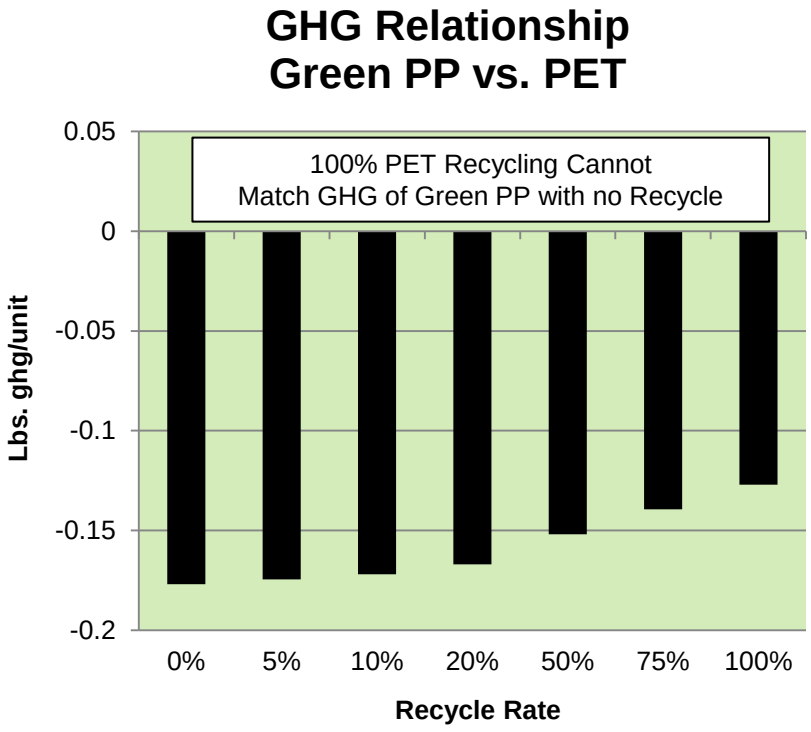
Recycling of PP vs. PET 16 oz. Cups Analysis*





Green PP

Favored in terms of GHG Effects
Even with No Recycle

* Allied Development

Note: Scenario Analysis Assumes no PP recycle

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Strengths of green polyethylene

Recognized brand adoption and promotion with Global Leaders

Sugarcane (Bio Based)

Favorable Carbon Footprint and Energy Ratio

“Drop In”

100% Recyclable

Green PE

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Biopolymers Strategy based on current technology growth and R&D investments

Phases

1st Wave
Pre-Marketing

- To optimize actual polymerization facilities to speed up time-to-market

2010 - 2014

2nd Wave
Growth

- New capacities to increase market penetration

2015 - 2019

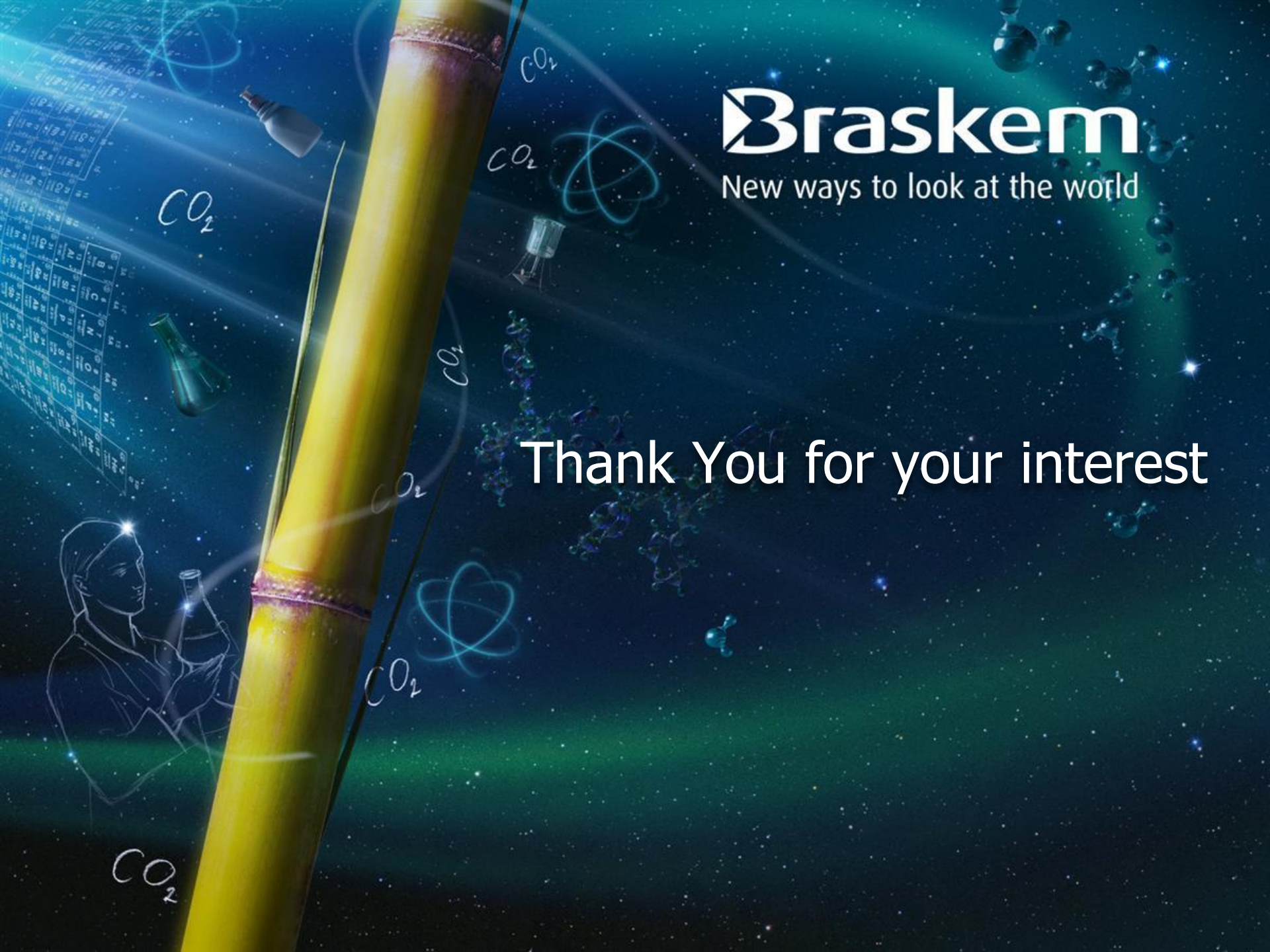
3rd Wave
Consolidation

- Sustainable growth path to consolidate Green PE and Green PP market

~2020

Capacity

Green PE	**200 kty** Green PE (Triunfo-RS)	New **Green PE** capacities	**Additional capacities**
Green PP	30kty+ Green PP **Existing Technology**	New Green PP capacity **Improved Technology**	Larger Green PP capacity **Biochemical route**
Total Capacity	**230kty+**	**TBD**	**TBD**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Thank You for your interest

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