PROESA™ TECHNOLOGY
Break-through Technology for Producing Advanced Bio-Fuels and Renewable Chemicals from Cellulosic Biomass

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Kevin Gray, Vice President Bio-based Chemicals, Beta Renewables
One of the top 3 producers of PET resins worldwide

60 years of excellence in process development and commercialization of plants

Proesa™: technology leader in biofuels and chemical intermediates from non-food biomass
Beta Renewables: Sustainable Chemistry

Beta Renewables is a joint venture, created in October 2011, between BioChemtex and the investment firm TPG (Texas Pacific Group).

Novozymes, Denmark-based world-class biotech company acquired 10% share of Beta Renewables in October 2012.

Beta Renewables owns and licenses the Proesa™ technology.

1st commercial-scale lignocellulosic biofuels plant in Crescentino (Italy).
1953 – 1979
Packaging production

1979 – 2000
Special chemical production

2000 – Today
Acquisition and PET expansion

2005 – Today
Renewables

1953 - Tortona - Italy
Mossi Ghisolfi Group founded HDPE and PVC packaging production

1979 – 2000
Development and production of PET resins for food packaging

2000 – Today
Acquisition of PET Shell activities and Rhodia from Rhone Poulenc

Construction of the world’s largest plants for PET production in Altamira (Mexico) and Suape (Brasil)

2008 - New Research Centre fully dedicated to renewables

2009 - First pilot plant for 2nd generation biofuels production

2011 - Beta Renewables is founded, (Biochemtex+TPG) dedicated to sustainable chemistry

2012 - Partnership between Beta Renewables and Novozymes

Start up of the world’s 1st commercial-scale plant that produces biofuels from non-food biomass (60,000 ton/year)
Our R&D Centers

Rivalta, Italy

4500 m² dedicated to renewable resources **biochemistry** and **technology**

Biochemtex also operates R&D centers focused on cellulosic sugar chemistry and engineering research

- Sharon Center (Ohio)
- Bari (Italy)
**PROESA™ Development Timeline**

**2006-2008**
**Scouting of Technologies**
- Generation of key inventions
- Proof of UNIT OPERATION in the labs

**2009-2010**
**Pilot plant (1 ton/day)**
- Construction & start up (June 2009)
- Pilot Plant operation and data gathering
- Test of Plant flexibility using multiple biomasses

**2011-2012**
**Crescentino Plant**
- Collaboration Agreements with leading synthetic biology companies
- License Agreements
- Formation of Beta Renewables

**Q1-2013**
**Crescentino Plant (60000 ton/y)**
- Start-up
The PROESA™ Process

Biomass → Steam → Enzymes → MO → Ethanol

- Smart Cooking
- Viscosity Reduction & Hydrolysis
- Fermentation & Distillation
- Lignin Separation
- Distillation & Drying

PROESA™ Technology benefits:

- Feedstock flexibility
- Fully integrated process design using continuous equipment to enable large scale plants
- Continuous process, no chemical addition, optimal sugar extraction and low enzyme dosage
- Best in class technology with lowest capex and opex backed with performance guarantees
PROESA™: A Technology Platform

Non-Food Cellulosic Biomass

PROESA™

Cellulosic Sugars

C5-DERIVED CHEMICALS
C6-DERIVED CHEMICALS
(C5+C6)-DERIVED CHEMICALS

NOW

Ethanol

N-Butanol
Iso-Butanol
Butanediol
Fatty Alcohols
Ethylene Glycol

NEXT

NEX

Later

Lignin

ENERGY

LIGNIN-DERIVED CHEMICALS

Power

Heat / Steam

Aromatics
Terephthalic Acid
Phenols

CRESCENTINO
Commercial-scale
20MMgpy cellulosic ethanol plant in Crescentino (Italy), operational in 2013

Competitive without subsidies
Benchmark: Oil @ $70/bbl

Cellulosic Costs
Less
Estimated cash costs:
Ethanol: <$1.50/USG
Sugars: 10¢/lb
Our Business Model

- Owns the Proesa™ technology
- Licenses the technology worldwide
- Provides performance guarantees
- Supports licensees on biomass supply chain, off-take, financing

Exclusive engineering partner
- Supplies, at a minimum, a basic engineering and key equipment package
- Provides mechanical guarantees
- Qualifies EPC contractors
Our Value Proposition

To de-risk the technology, enabling profitable deployment and bankable projects
Recent Events

- 65,000 tpa plant in Brazil (GranBio) scheduled to be mechanically complete Q1 2014
- Construction of 65,000 tpa plant in NC scheduled to begin construction H1 2014 (USDA loan guarantee, BCAP)
- Canergy selected PROESA™ for energy cane process in CA
- M&G announced 1 MM ton/yr (feedstock) biorefinery in China
Beta Renewables
Strada Ribrocca, 11
15057 Tortona (AL) – Italy

Ph.+390131810.1
Mail: info@betarenewables.com
www.betarenewables.com