



Chemtex Group

Global Engineering and Project Solutions

“Case study on the first advanced industrial demonstration bioethanol plant in the EU, and how it was financed”

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Summary

1. M&G vision on renewables
2. The companies involved
3. PROESA® Technology
4. Public funds for demo project



M&G vision on renewables



For both **Bio-Fuels** and **Bio-based Chemicals** the solution is based on the same key fundamentals:

1. **Competitive** pricing compared to products from Black Route (at oil prices in the 60-70\$/barrel);
2. **Environmentally sustainable** with respect to Green House Gases: overall GHG sequestration balance (including biomass feedstock farming, transportation, chemicals or biofuels production processes);
3. **Agronomically sustainable** on the long term (i.e. no competition with food) and **profitable** for farmers



M&G Group: the companies involved




\$3B per year
#2 producer of PET
2,600 Employees
Location: Italy, US,
Mexico, Brazil




Engineering
division

M&G – Worldwide Locations






● M&G locations
● Chemtex Locations




Technology for
biomass to sugars

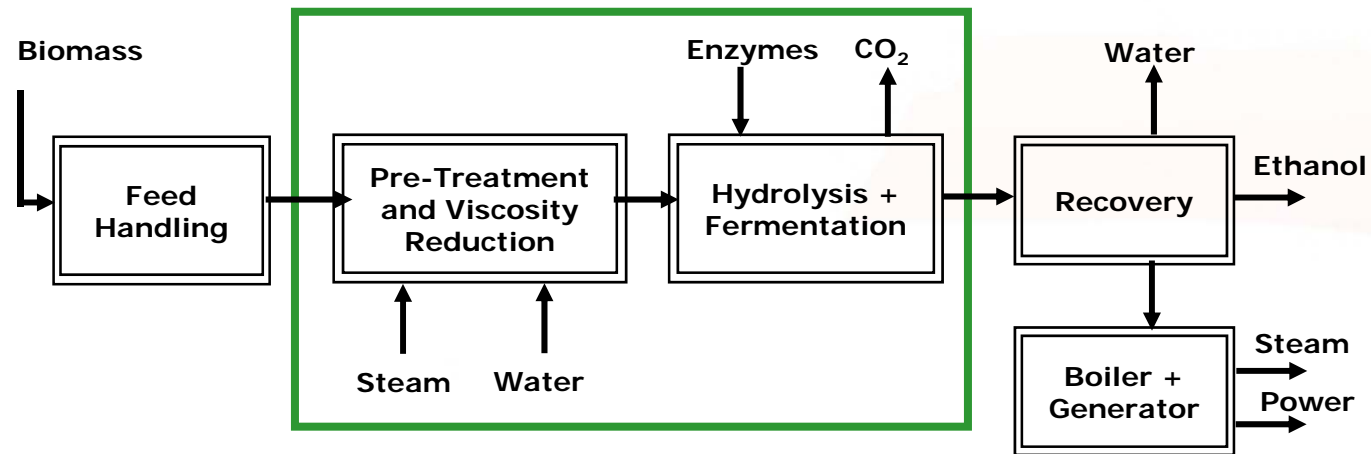
Chemtex R&D&D investments on renewables



		
Chemtex R&D Center, Rivalta Scrivia (AL), Piemonte, Italy	Chemtex R&D Center, Modugno (BA), Puglia, Italy	Chemtex-M&G Sharon Center, Ohio, US
Lignocellulosic biomass to biofuel/biochemicals	Lignin valorization to biochemical/biofuels	Lignin valorization to biochemical and R&D support

	Feedstock	Capacity	Location	M&G Investment	Status
R&D Center on Lignocellulosic biomass conversion on Biofuel and Biochemical and development of PROESA® technology (lab/batch/pilot scale)	Multiple lignocellulosic energy crops and agro residues	50 kg/h of biomass inlet continuous Pilot plants	Rivalta (IT)	€ 160 million	On going
R&D Centers on Lignin valorization to Biofuel and Biochemical (lab/pilot/demo scale)	Lignin	Bioreformate, BTX. Production of biofuel and biochemicals	Modugno (IT) Sharon C. (US)	€ 50 million	On going
2nd generation Industrial Bioethanol Demo plant	Arundo donax and Wheat straw	40,000 ton/y Bioethanol	Crescentino (IT)	€ 120 million (CAPEX)	Commissioning 12/2012

PROESA[®] technology: the pillars



The Pillars of PROESA[™] are:

1. **Agronomy:** Field experimentation and best energy crops identified and characterized (12 kinds of biomasse tested -> tech biomass agnostic). No biomass drying/grinding required.
2. **Biomass Pre-Treatment and Viscosity Reduction:** Continuous process developed and piloted to produce cost-effective and clean fermentable sugars. Low level of inhibitors. No use of chemicals (only steam is added). Rapid liquefaction of solid content.
3. **Hydrolysis and Fermentation:** Unique hybrid SSCF process scheme yielding high ethanol concentrations. Reduced enzymes load. High solid concentration (>40%) in the hydrolysis step
4. **Valorization of secondary streams and co-products.**



PROESA® Technology: the history



2006-2008

- Scouting of Technologies
- Agronomic testing on energy crops
- Generation of key inventions
- Proof of unit operation in lab/batch



2009-2010

- PILOT PLANT construction & start up (June 2009)
- Pilot Plant operation and Data gathering
- Test of plant flexibility using multiple biomasses



2011-2012

- Crescentino 40,000 ton/y INDUSTRIAL DEMONSTRATION ETHANOL PLANT
- Technology licensing



Key advantages of PROESA[®] technology

Financial:

- ✓ Lower capital investment as a result of minimum handling of biomass, simplified flow schemes and no special materials of construction;
- ✓ Cash cost of fermentable sugars at ~10 ¢/lb;
- ✓ Cash cost of ethanol of <\$ 1.50/USG (\$ 0.40/L);
- ✓ Cost-effective at modest scale; short supply chains
- ✓ Beta Renewables: joint venture Chemtex-TPG
- ✓ Strategic partnership making Novozymes the preferred enzyme supplier for Beta Renewables' current and future cellulosic biofuel projects.



Flexibility:

- ✓ Feedstock-agnostic: energy crops, agricultural residues, organic waste, woody biomass, bagasse;
- ✓ Deployable worldwide;
- ✓ Pure lignin by-product to be valorized to energy or renewable chemicals.
- ✓ Commitment of Chemtex and its partners to continuous development and improvement

Competitive and attractive economics without subsidies

Three points that will change the industry

- ✓ **Commercial-scale** cellulosic ethanol plant, Q3 2012: 40,000 ton/y, Crescentino - Italy (ready to start)
 - ✓ Cellulosic **costs less**
 - ✓ **No subsidies** required

Sept 2011



Febr 2012



May 2012



July 2012



Aug 2012



Sept 2012



Dec. 2012



Crescentino in numbers

- **120 M€** of investment
- **40'000** Mtons Second generation Bioethanol
- **160,000 ton/y** of dry lignocellulosic biomass
- **13 MW** of *green* power from lignin
- **300** pieces of equipment
- **1'500** tons of steel
- **1'400** tons of pipes and valves
- **30'000** m³ of concrete
- **18 km** of underground piping
- More than **150 persons** involved directly
- Commissioning: **December 2012**



April 2011



Sept. 2011



Sept. 2012



How can research and its scale-up be founded?

Basic and applied research (lab/batch)

PILOT SCALE

DEMONSTRATION PLANT

First-in-its-kind PRE-COMMERCIAL PLANT

INDUSTRIAL COMMERCIAL PLANT



European (FP7, NER300, IEE, Life+, ...) and National funds

RTD

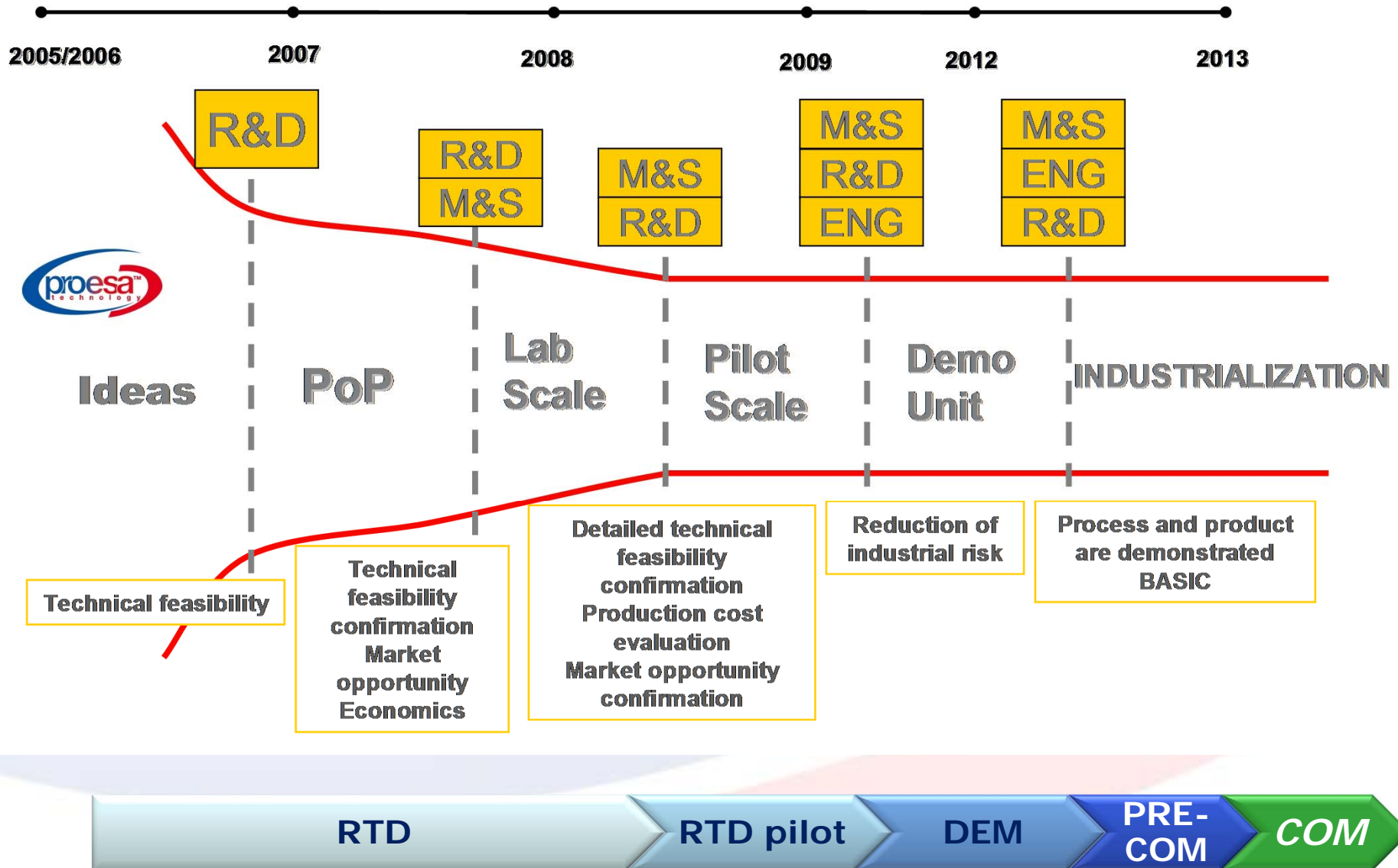
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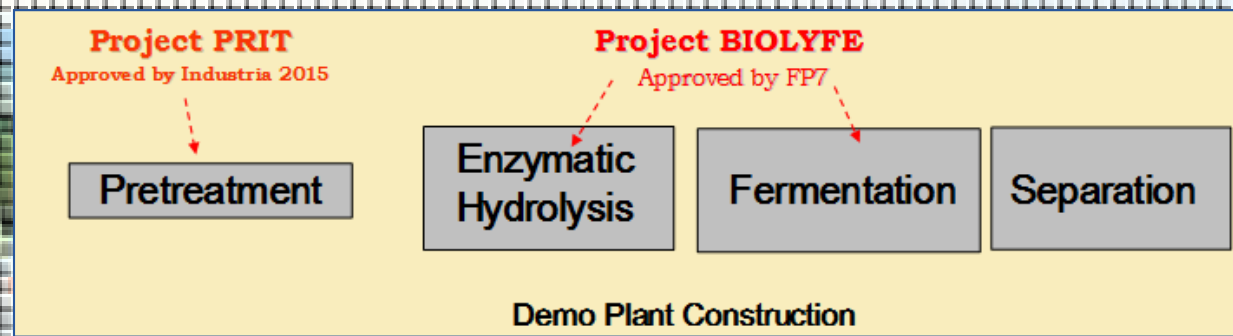
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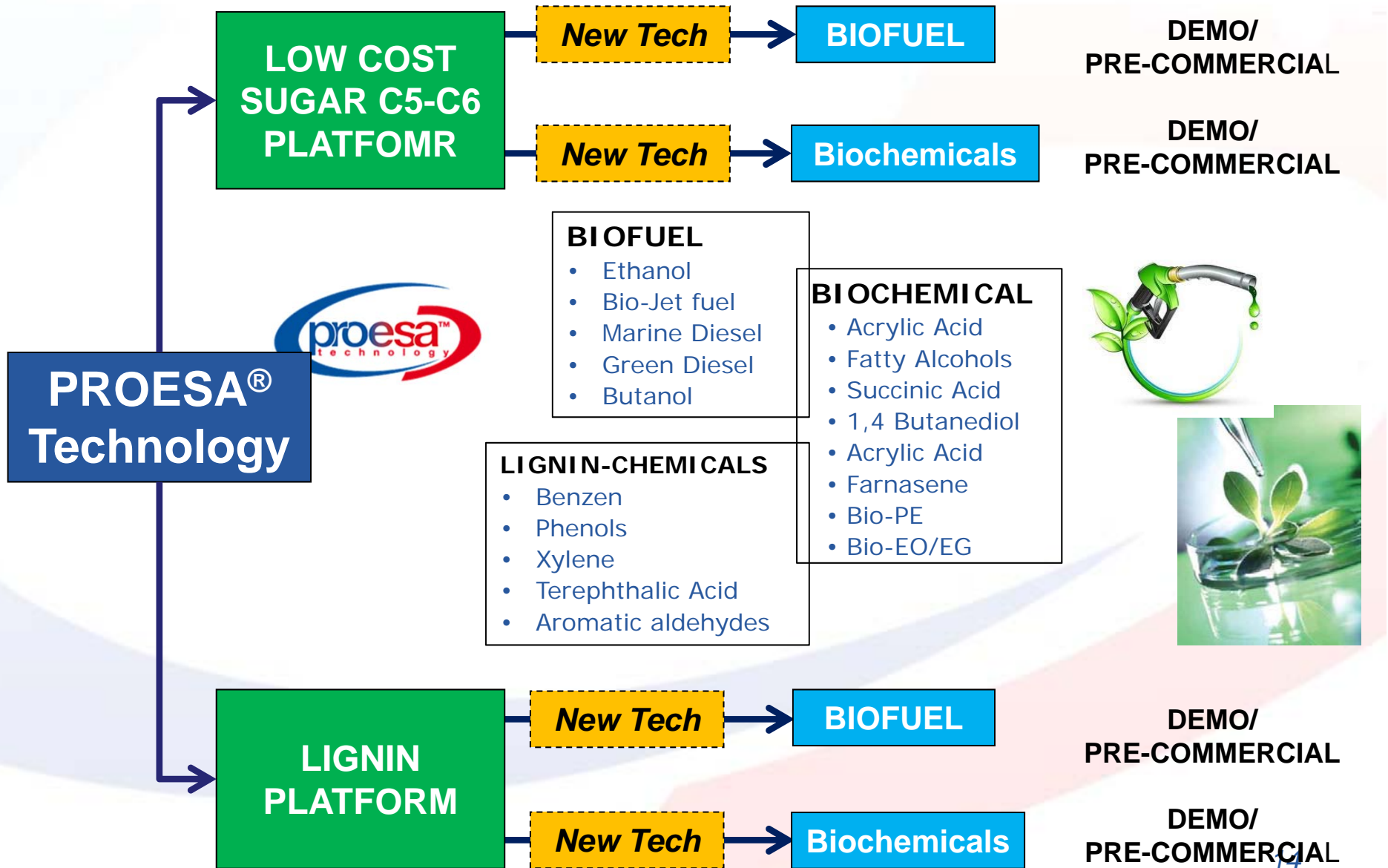
PROESA® technology scale-up



Public funds for demonstration project – the Bioethanol case



Chemtex next demonstration projects





THANK YOU