



# *Chemtex Group*

*Global Engineering and Project Solutions*

ethanol  summit  
2011

**PROESA™**

*A Break-through Technology for the Production  
of Advanced Biofuels and Renewable Chemicals  
from Cellulosic Biomass*

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# Topics

- ✓ **Chemtex Overview**
- ✓ **PROESA™ Technology**

# Chemtex Overview

## Chemtex Italy



Tortona, Rivalta

Founded in 1947

A wholly-owned  
subsidiary of the  
**M&G Group**

## Chemtex China



Shanghai, Beijing

## Chemtex USA



Wilmington, NC  
Sharon Center, OH



Employees: 1000

## Chemtex India



Mumbai, Bangalore

A global Engineering and Technology Company  
possessing a strong process and R&D capabilities belonging to a  
Group with 70 years of excellence in manufacturing.

# M&G Worldwide Locations



- M&G locations
- Chemtex Locations

# Our Experience & Our Customers

## Highlights:

- ✓ Renewables: Bringing proven “bio and alternative” fuel technologies and application learnings to the marketplace.
- ✓ Energy and Environmental: Awarded 13 LNG projects in China in the last 5 years- bringing clean fuel to remote locations.
- ✓ Polymers and Fibers: Installing more than 4 million TPA of polyester capacity in the last 3 years (more than 14 million TPA total).
- ✓ Technology Providers: Helping partners bring their offering to the international marketplace.
- ✓ Alliance Partners: Providing cost-effective engineering services from Chemtex India to reduce project engineering costs.



# Topics

- ✓ Chemtex Overview
- ✓ PROESA™ Technology

# Our Vision

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

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



# Break-through Technology

- ✓ 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 <US\$ 1.5/USG (US\$ 500/t);
- ✓ Feedstock flexibility: energy crops (e.g. Arundo Donax, miscanthus, switchgrass), agricultural wastes (e.g. rice or wheat straw, corn stover), woody biomass (e.g. eucalyptus, poplar or acacia) or SC bagasse.

## **Biomass Agnostic Technology.**

- ✓ Commercial flexibility:
  - *No long-term enzyme supply commitments;*
  - *Ability to provide power, based on thermo-valorization of lignin, with positive supply to the electrical grid.*

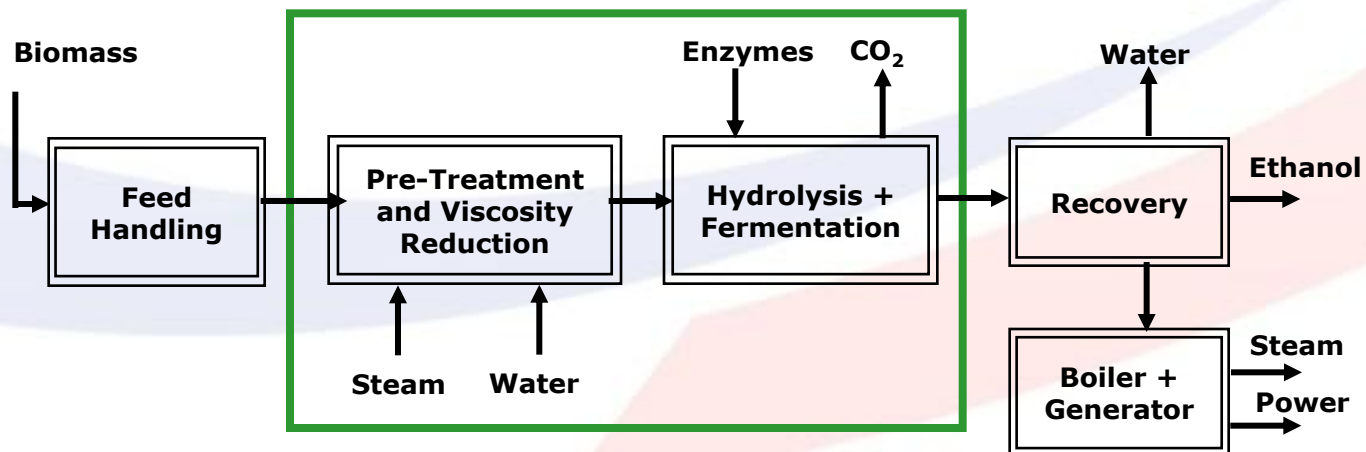
Competitive and attractive economics without subsidies



# PROESA™ – The Technology

The Three Pillars of PROESA™ are:

1. **Agronomy:** Field experimentation and best energy crops identified and characterized;
2. **Biomass Pre-Treatment and Viscosity Reduction:** Continuous process developed and piloted to produce cost-effective and clean fermentable sugars;
3. **Hydrolysis and Fermentation:** Unique hybrid SSCF process scheme yielding high ethanol concentrations.



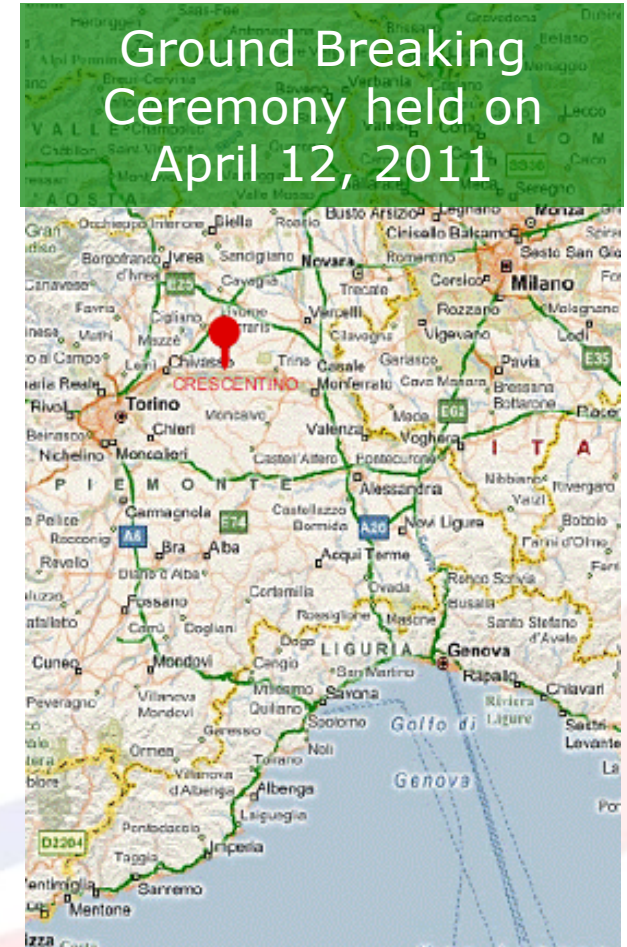
# Low Cost Sugars

## Break-Through Technology to produce high quality, low cost sugar

- ✓ Flexibility to use different biomass types without hardware change;
- ✓ Minimal feedstock size reduction requirements;
- ✓ High recovery yield for cellulose and hemi-cellulose;
- ✓ Only steam used - no chemicals;
- ✓ Low CAPEX (no special materials of construction) and OPEX;
- ✓ Low sugar degradation and low level of contaminants (furfural, HMF) and ability to reduce acetic acid concentration via state-of-the-art technology;
- ✓ Material is liquefied after few hours (less than 8 hours) even at low enzyme load in patent-pending viscosity reduction step;
- ✓ High quality low cost sugar released as a feedstock for ethanol and/or bio-based chemical production.

# Crescentino Demonstration Plant

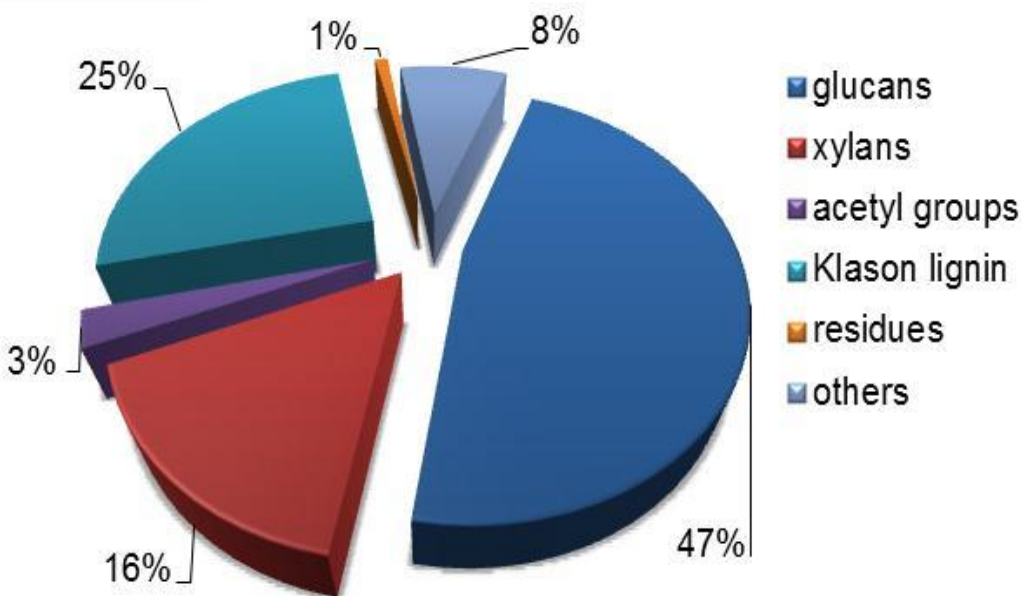
- ✓ Production: 60 ktpa ethanol from locally available Arundo Donax and wheat straw.
- ✓ Plant will generate 15MW of “green” power from lignin to the grid and will sell ethanol to major oil companies.
- ✓ Design incorporates state-of-the-art wastewater treatment facility for the maximum recycle of water.
- ✓ Start-up: end H1 2012 (target).



## PROESA™ Status Update

- ✓ More than 200 MUS\$ investment into R&D since 2006.
- ✓ Extensive agronomic studies and supply chain logistics to support downstream plant development.
- ✓ A continuous 1 t/d biomass pilot facility operational since 2009, tested with more than ten different biomasses.
- ✓ A 60 ktpa Demonstration Plant being built in Italy (targeted completion Q2 2012).
- ✓ Intellectual Property: multiple patent applications filed.
- ✓ Collaboration with *Amyris*, *Genomatica* and others for the joint development of drop-in fuels and bio-based chemicals using PROESA™ Biomass Pre-Treatment & Viscosity Reduction Technology.
- ✓ Commitment of M&G / Chemtex and its partners to continuous development and improvement.

# Eucalyptus globulus



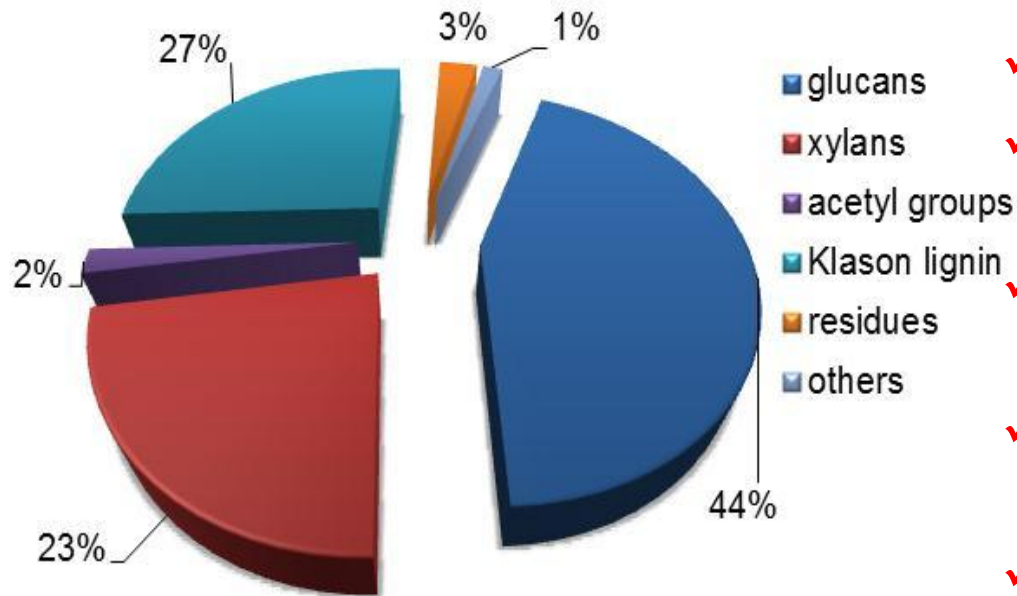
- ✓ Moisture content: 40%
- ✓ High glucan content: above 45%
- ✓ High energy production potential (good lignin content)
- ✓ High overall sugar fraction recovery after pretreatment for both C5 and C6
- ✓ High sugars concentration after hydrolysis step

- ✓ Material widely used in the pulp and paper industry

Current ethanol production = 4.5 kg biomass (dry basis)/kg EtOH



# Sugarcane Bagasse



- ✓ Moisture content: 10%
- ✓ High sugar content: above 65%
- ✓ High energy production potential (good lignin content)
- ✓ In liquid stream C5 xylans recovery up to 45%
- ✓ High sugars concentration after hydrolysis step
- ✓ Low concentration in acid acetic after pretreatment



- ✓ agricultural waste sugar industry, widely utilised as fuel

Current ethanol production = 4.7 kg biomass (dry basis)/kg EtOH

# PROESA™: We Are Ready!

## Break-through Technology for Advanced Biofuels and Sustainable Chemicals

- ✓ Low cost sugars are finally available for ethanol, jet fuel and new diesel produced from lipids hydrogenation.
- ✓ PROESA™ will be the gate-opener for tomorrow's sustainable bio-based chemistry.
- ✓ Chemtex' process engineering capabilities, together with best-in-class biotech cooperation, have made bio-refineries a feasible future.

# A Concrete Reality

## Where the industry claims to be in 2G biofuels:

- ✓ US\$ 10/annual gallon investment;
- ✓ US\$ 2.5/gallon operating cost;
- ✓ Time to deploy: 3-4 years, if loan guarantees and subsidies are given.

## What Chemtex brings to the table:

- ✓ US\$ 3-5/annual gallon investment;
- ✓ US\$ 1-1.5/gallon operating cost;
- ✓ Time to deploy: Q2 2012 in Crescentino with large (50 to 75 MMGPY) plants available in the USA by 2013.