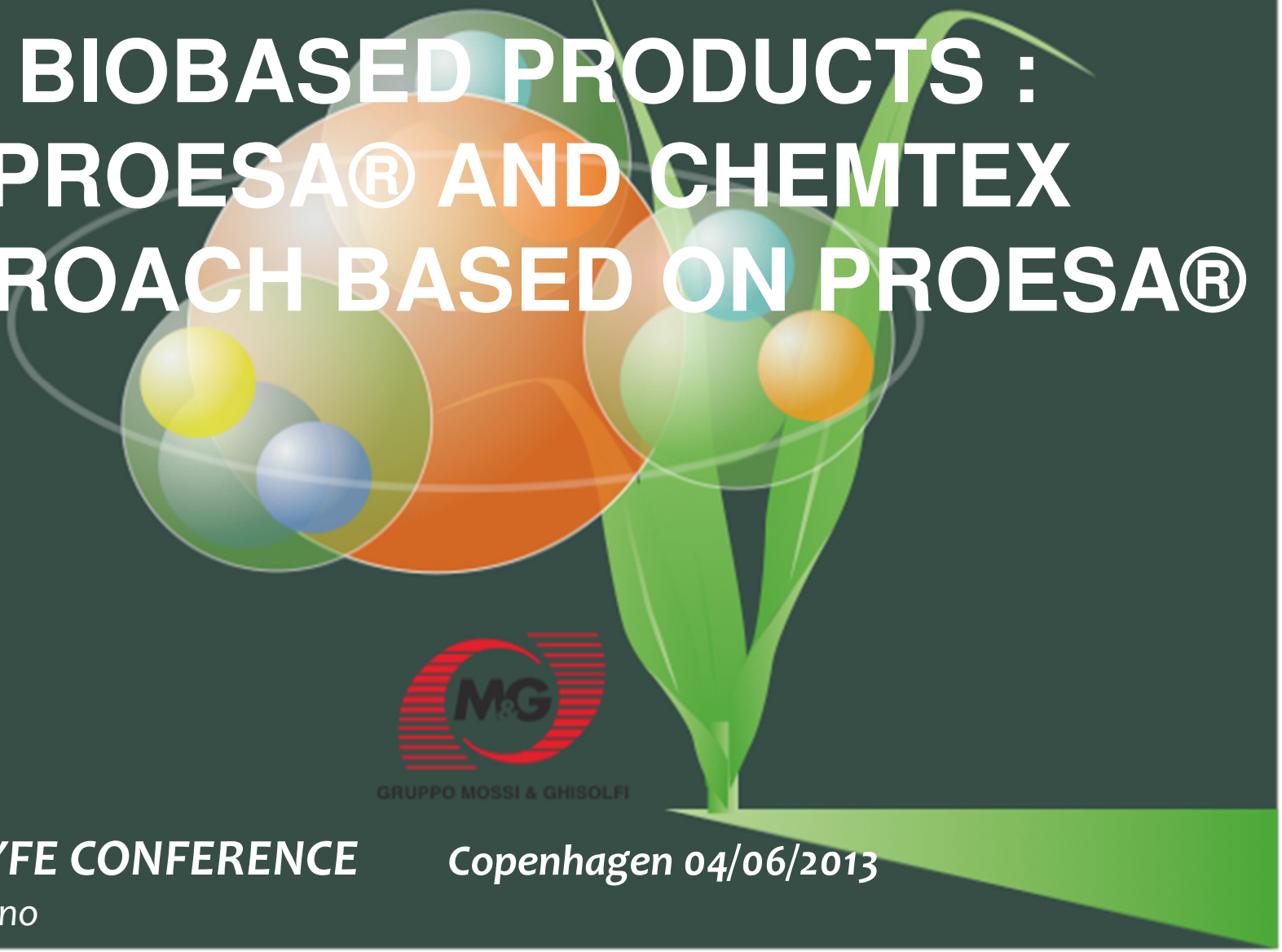
GREEN CHEMISTRY AND BIOBASED PRODUCTS : PROESA® AND CHEMTEX APPROACH BASED ON PROESA®



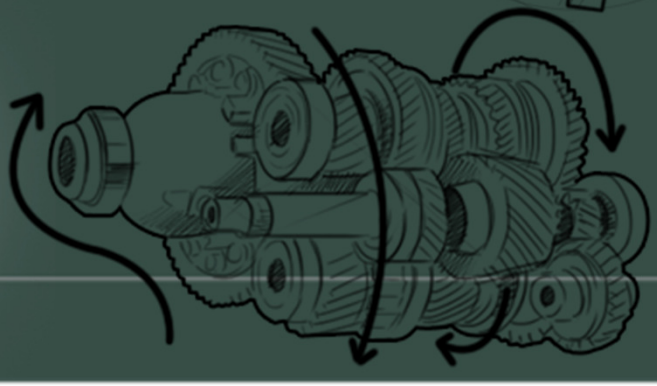
GRUPPO MOSSI & GHISOLFI

2ND *BIOLYFE CONFERENCE* *Copenhagen 04/06/2013*

Dario Giordano

CRESCENTINO COMMERCIAL PLANT:OUR STARTING POINT FOR THE BIOREFINERY

In April 2011 Chemtex broke ground for a 60 ktpa (20 MMgpy) nameplate cellulosic ethanol plant based on wheat & rice straw, and on the energy crop Arundo donax.



ETHANOL PRODUCTION READY TO GO!

Sept 2011

Feb 2012

May 2012

July 2012

Sept 2012

Feb 2013

CRESCENTINO COMMERCIAL PLANT

BETA RENEWABLES PROFILE

TPG | CHEMTEX | novozymes Rethink Tomorrow

BETA RENEWABLES S.p.A.

- ✓ A JV between Chemtex, Texas Pacific Group and Novozymes
  - Set-up as a €250 million joint venture between M&G and TPG in October 2011
  - In October 2012, Novozymes acquired a 10% share in Beta Renewables, paying $115 million for equity, marketing fees and milestone payments
- ✓ Beta Renewables has developed the PROESA® Technology for the conversion of non-food lignocellulosic biomass to biofuels and biochemicals.
- ✓ The company is currently commissioning the world's first commercial-scale cellulosic ethanol facility in Crescentino, Italy

Our Partners:

GraalBio
novozymes Rethink Tomorrow
genomatica sustainable chemicals
gevo
MYBIOMASS
AMYRIS
CODEXIS

OUR BUSINESS MODEL

Technology for biomass to sugars

- Owns the PROESA ® technology
- Conducts the R&D for continuous process improvement
- Licenses the technology worldwide
- Provides performance guarantees
- Supports licensees on biomass supply chain, off-take, financing
- Operates the commercial site in Crescentino, Italy

Engineering division

- Exclusive engineering partner
- Supplies, at a minimum, a basic engineering and key equipment package
- Provides mechanical guarantees
- Qualifies EPC contractors
- Support in commissioning, start-up and training

NOVOZYMES AND BETA RENEWABLES
A STRATEGIC PARTNERSHIP

BETA RENEWABLES S.p.A.

+

novozymes®
Rethink Tomorrow

To Jointly Market PROESA® and CTEC®

- ✓ Long-standing collaboration has led to substantial reduction in cost of enzymes per unit of cellulosic ethanol
- ✓ Partnership of two industry leaders boosts confidence in the technology
- ✓ Guarantees on enzyme performance and cost incidence de-risks the technology
- ✓ Parties are committed to ongoing improvements in enzymes and process
- ✓ Ensuring secure and most competitive enzyme supply to our customers

BIOBASED CHEMICALS FROM BIOMASS: IS IT POSSIBLE?

THE BIOREFINERY CONCEPT

ONLY IF I SUCCEED IN CONVERTING THE WHOLE BARREL OF BIOMASS IN A DEDICATED BIOREFINERY I'LL BE SUCCESFULL AND COMPETITIVE.

NOT A DREAM BUT A REALITY
THANKS TO A LARGE COMMITTENT

2006-2012 EXTENSIVE R&D AND TECHNOLOGY WORK

LEVERAGE IN HOUSE TECHNICAL COMPETENCIES

- Production
- Engineering
- Technology development
- Industrialization
- Innovation

Rivalta Scrivia, Italy

Sharon Center , OH

2 MAJOR R&D FACILITIES
> 10.000 m^2 dedicated

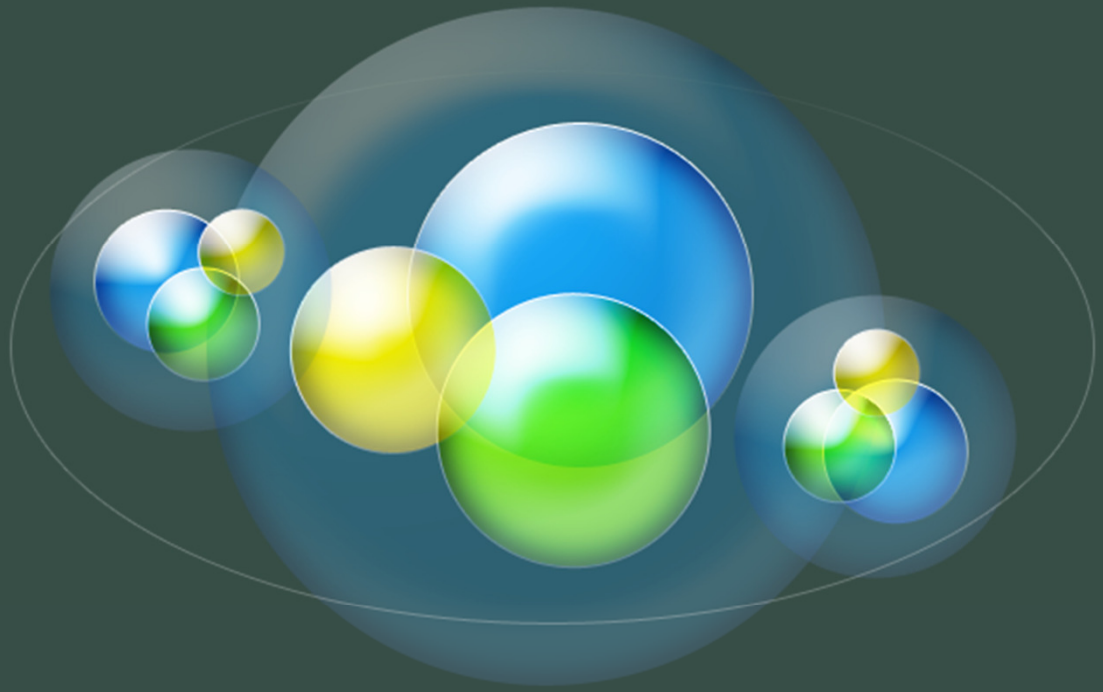
150 people in Green R&D
200 Process Engineers

THE CONCEPT OF BIOREFINERY

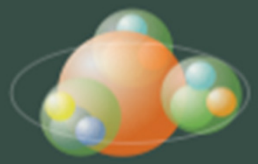
The use of PROESA technology will enable the production of cheap and clean sugars.

Thanks to a unique committment

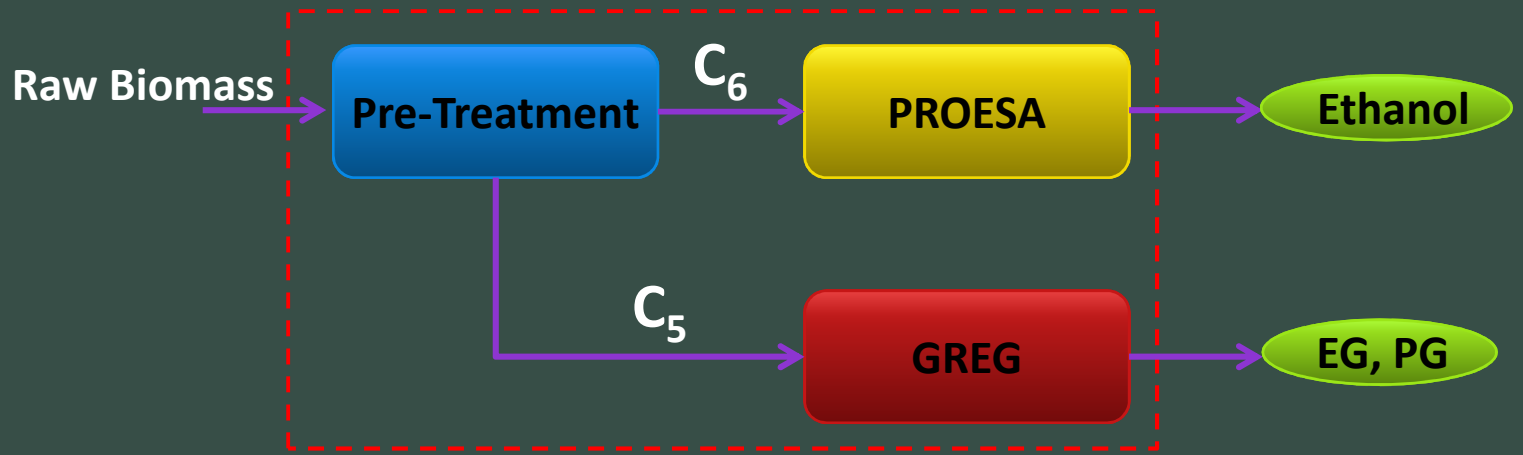
biorefinery will shortly become an industrial reality



GREG PROJECT



GREG PROJECT CONCEPT



GREG process products

Ethylene Glycol (EG) to M&G PET production

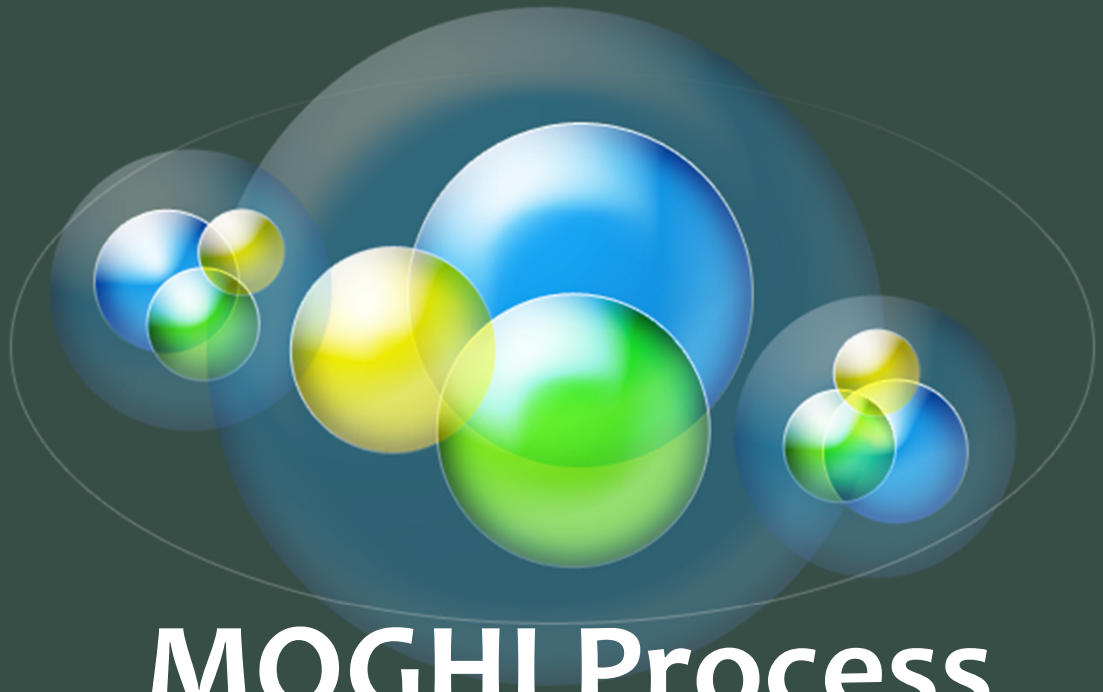
1,2-Propylene Glycol (PG) to cosmetic, pharmaceutical and resin industries

Greg Project capabilities

Laboratory (litres per day)

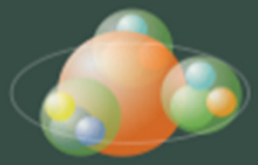
Pilot plant (hundred kg per day)

Industrial plant (kton per year)



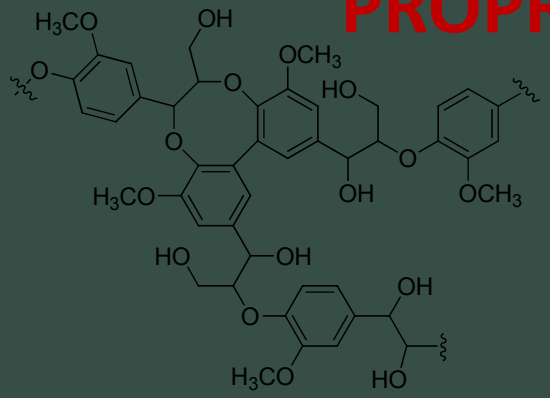
MOGHI Process

Lignin conversion to Bio-hydrocarbons



MOGHI - LIGNIN CONVERSION PROCESS TO CHEMTEX BIO-REFORMATE

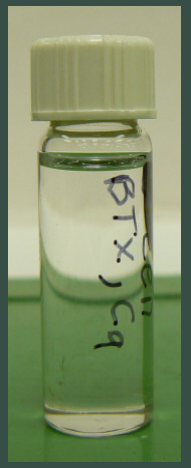
Lignin



CHEMTEX PROPRIETARY TECHNOLOGY

MOGHI

Chemtex Bio-Reformate rich in BTX



MOGHI - LIGNIN CONVERSION PROCESS TO CHEMTEX BIO-REFORMATE

Chemtex Bio-Reformate
From Lignin

Available Petrochemical Technology

Aromatic chemicals, nylon intermediates, resins
and many others

LIGNIN CONVERSION PROCESS : SHARON CENTER (OH)

Lignin Pilot Plant

LIGNIN CONVERSION PROCESS : SHARON CENTER (OH)

Sharon Center

Bio-Lab

Batch reactors:
50 cc, 8 L, 12 L
Continuous Reactors:
500 cc

2009

Lignin Pilot Plant

Lignin to Bio-Reformate
Pilot Plant
2,5 kg/h Lignin Capacity

2011

Puglia

Demo Plant
1000 ton/y
Bio-Reformate

2014

proesa technology

MOGHI

GREG

BIOREFINERIES ARE POSSIBLE TODAY!