



BIO-COMMODITY REFINING

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FP7 GRANT AGREEMENT N° 241566





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THE BIOCORE PROJECT

A QUICK OVERVIEW



The consortium

25 Partners

13 Countries

5 SMEs

4 MNI

2000 person-months



Project cost

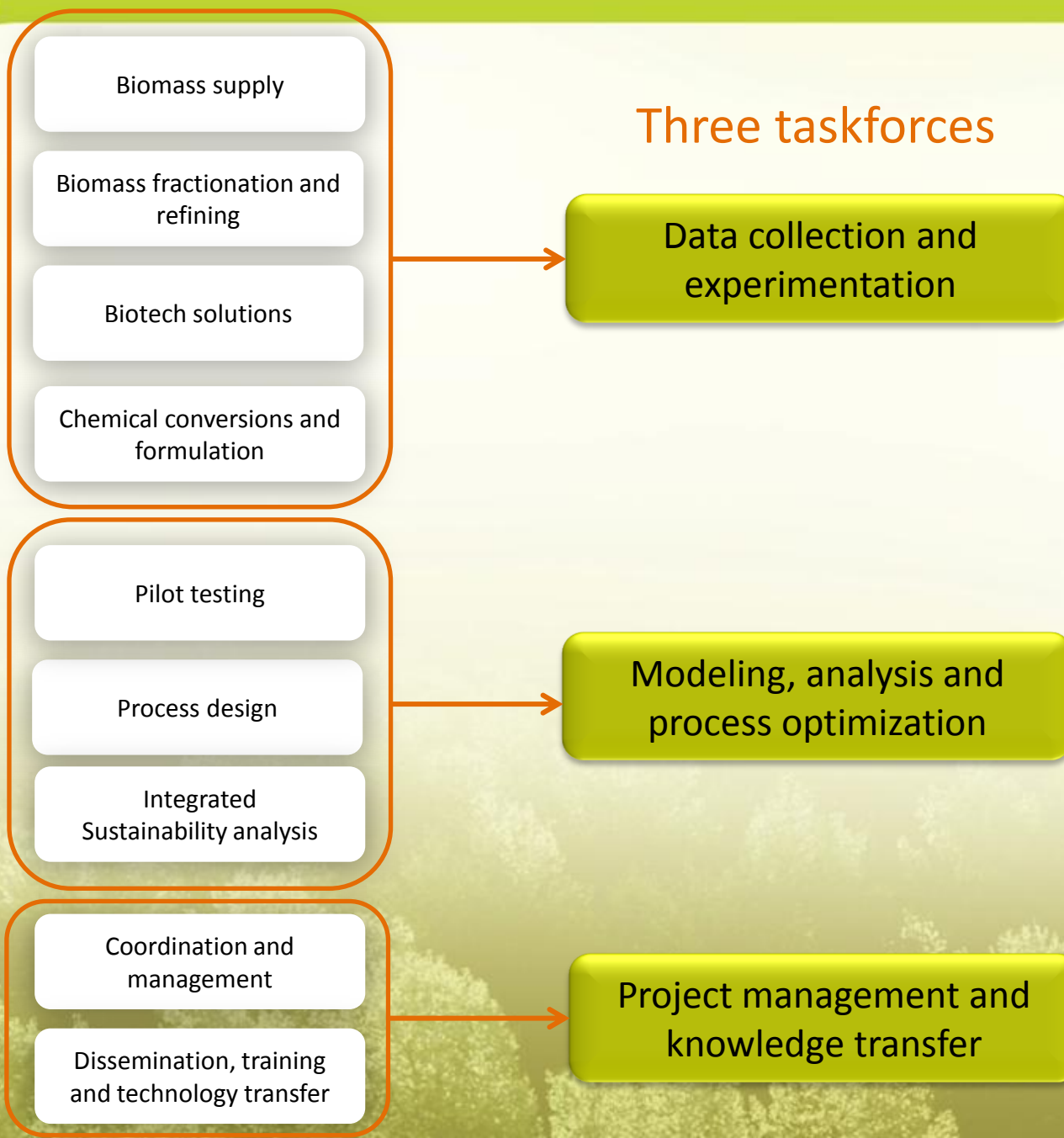


Full budget €20 274 484







EU contribution €13 920 238





KEY MESSAGES ABOUT BIOCORE

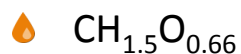
BIOCORE is a concept for advanced generation biorefining

-  Raw material = lignocellulosic biomass
 -  Multi-feedstock approach to ensure stable supply chain and provide multiple implementation options
-  Product portfolio= fuel, chemicals, materials, food/feed
 -  A multi-product approach to ensure economic viability and optimal use of biomass components



🔥 BIOMASS IS CARBON

📍 Generic chemical formula of biomass



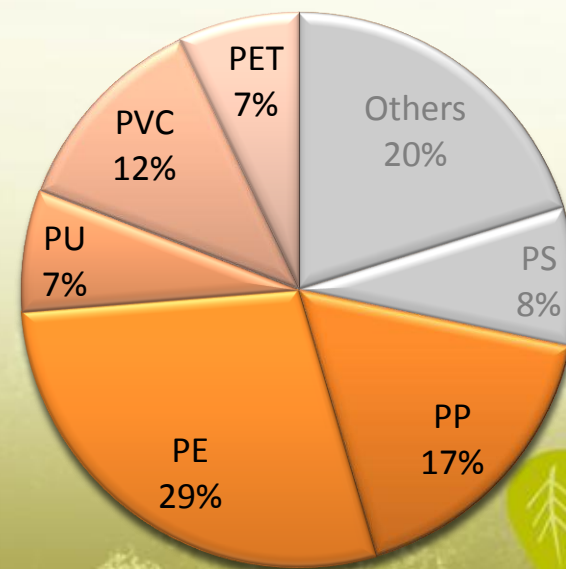
📍 Modern society is depends on carbon-based chemicals. A few of these dominate the market

- 🔥 Ethylene (approx 140 Mt)
- 🔥 Propylene
- 🔥 BTX

📍 Today's polymers are extremely reliant on carbon

- 🔥 Biorefining must provide solutions for polymers
 - 🟡 Slot-in building block substitutes
 - 🟡 New polymers

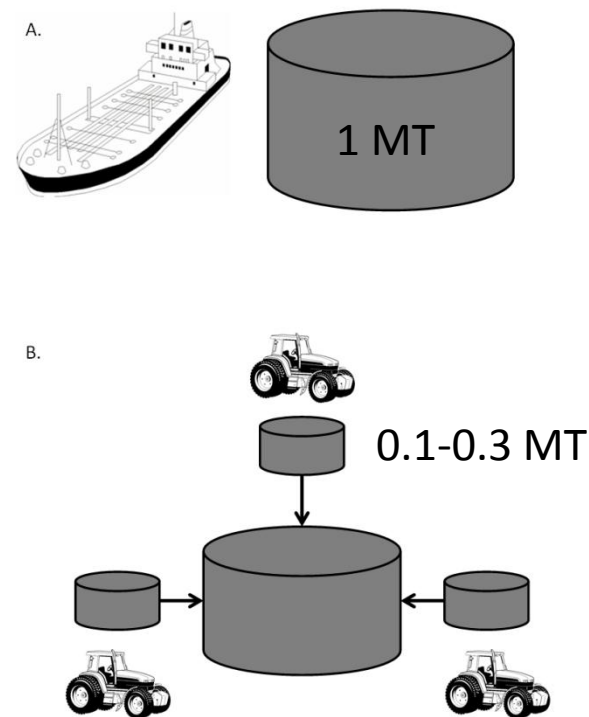
BIOCORE and EU polymer market



🔥 SMALL IS BEAUTIFUL ?

📍 **Biorefineries should be a source of renewal for rural areas**

- 🔥 Regional approach with small/medium scale biorefineries perhaps linked to centralized facilities
- 🔥 Links to existing industrial activities (e.g. sugar refineries and paper mills)
- 🔥 Biorefining should be a new driver for agriculture



🔥 BIOCORE'S UPFRONT FRACTIONATION TECHNOLOGY

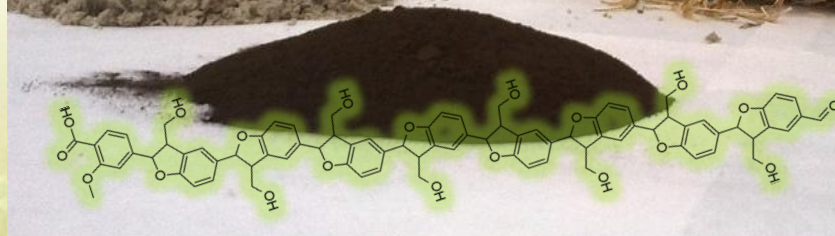
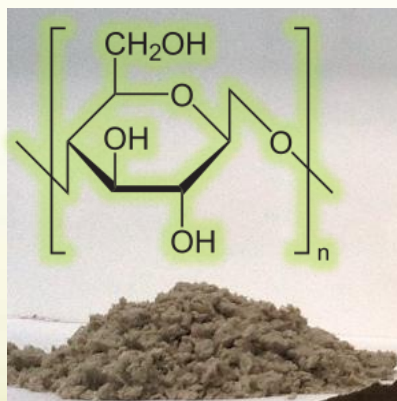
📍 CIMV Organosolv

- 🔥 Uses a formic : acetic acid solvent system (generation of peracids)
 - 🟡 Dissolves lignin and hemicelluloses
- 🔥 Multi-biomass
- 🔥 100 kg/h biomass capacity
- 🔥 In operation since 2006
 - 🟡 >60 runs completed



🔥 THREE PLATFORM INTERMEDIATES

Cellulose and glucose



Lignins

Pentose sugars



🔥 CONVERSION TECHNOLOGIES

💡 Biotechnology

- 🔥 Enzyme and strain (bacteria and yeast) development

- 🟡 Alcohols
- 🟡 Olefins
- 🟡 Organic acids
- 🟡 Polyols
- 🟡 XOS
- 🟡 Alkyl polyglycosides



💡 Chemistry

- 🔥 Heterogeneous catalysis, pyrolysis and polymer formulation

- 🟡 Olefins
- 🟡 Polyols
- 🟡 Furfural derivatives
- 🟡 Hydrogels
- 🟡 Polyurethanes
- 🟡 PVC

🔥 MAKING IT WORK.....EVERYWHERE

📍 Account for the many issues that will form the framework of biorefinery implementation

- 🔥 Environment?
 - 📍 Plant, animal and microbial biodiversity
 - 📍 Landscape
 - 📍 Soil quality
- 🔥 Economy
 - 📍 Employment
 - 📍 New markets and products
- 🔥 Society
 - 📍 Rural development
 - 📍 New policy



MAIN ACHIEVEMENTS

Cameo highlights of the project's progress

🔥 CASE STUDIES LOCALIZED

📍 Europe can readily supply 35 Mt per year of ag-residues

- 🔥 17.5 Mt in just 3 countries: FR, DE, GB
- 🔥 India can furnish at least 100 Mt of rice straw

📍 Harvestable hardwood is available in 5 countries

- 🔥 2.5-5.5 Mt in DE, FR, PL, RO and I

📍 Central and eastern Europe will be best for SRC Poplar production

150 kT/yr units

150 kT and
500 kT/yr units

Punjab

Wheat straw
Rice straw


INDIAN CASE STUDY





Map of Punjab









Location	Paddy straw (Kt)	Wheat straw (Kt)
Faridkot	440	52
Sangrur	1700	180

An informationally-rich encounter

 SAB composed of a representative cross section of Indian society and industry

-  Local government
-  Entrepreneurs
-  ONGs
-  Academics

The case study regions

-  Good level of agriculture
-  Good road network
-  Competition with paper pulping
-  Small farms (1-2 ha)
-  Difficulties to extract and store rice straw
-  Increasing needs for animal feed



28-30 November 2011

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🔥 TOWARDS MULTI-FEEDSTOCK REFINING

🌱 CIMV organosolv processing can handle several feedstocks

- 🔥 Rice straw – no process alterations
- 🔥 Birchwood and SRC poplar – modification of the residence time and formate:acetate ratio
 - 🟡 Feasible at industrial scale using a batch mode or by deploying two process lines
 - 🟡 Bark is not a problem with SRC poplar
 - 🟡 Hardwood/softwood (90:10) mixture can be processed
- 🔥 A promising innovation that will allow the processing of softwood has been identified

🔥 PRODUCTION OF BIOETHANOL: TOWARDS 2G PVC

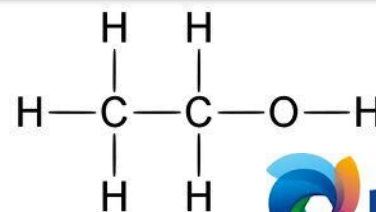
CIMV organosolv



📍 SHF with hydrolysis at 60°C

- 🔥 Near theoretical yields of ethanol
- 🔥 150 l batch produced
- 🔥 Conversion into ethylene underway

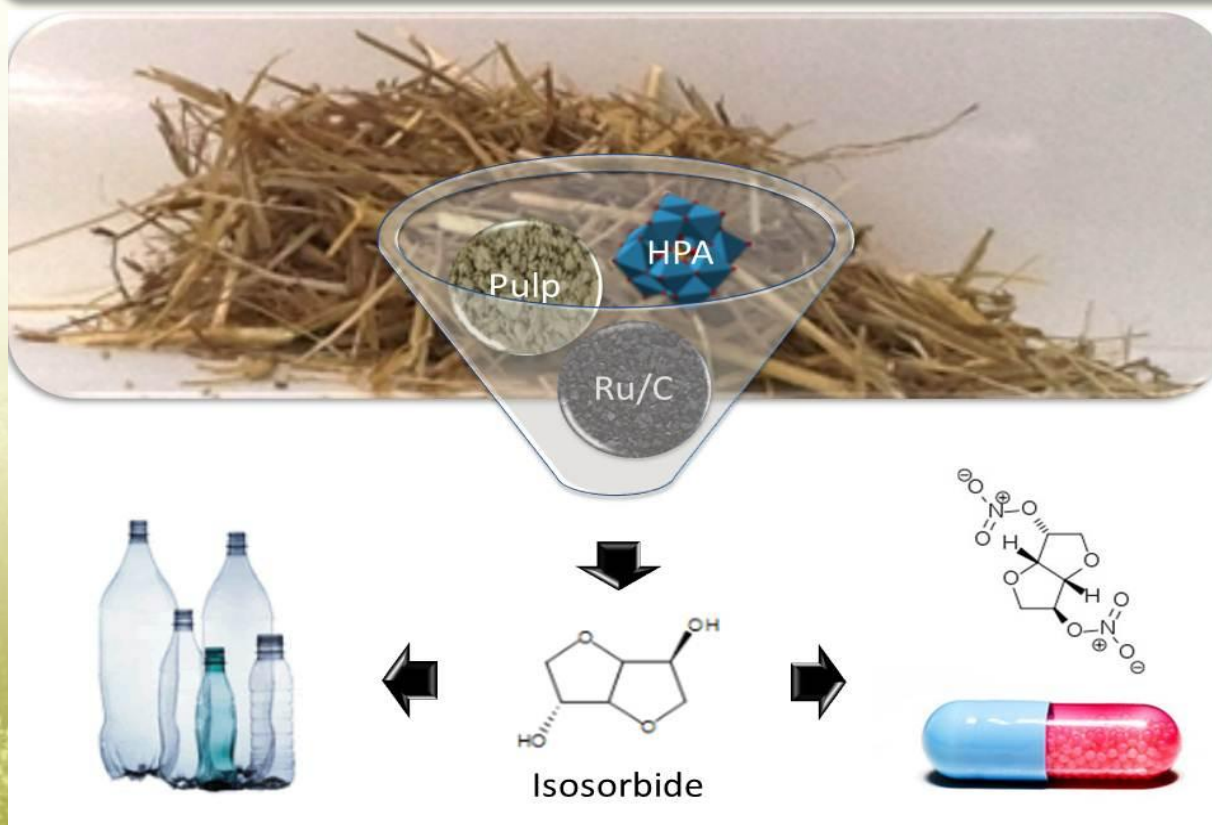
DSM's heat stable cellulases
Industry standard yeast



🔥 DIRECT CATALYTIC CONVERSION OF STRAW CELLULOSE INTO POLYOLS

📍 One pot synthesis of isosorbide using a tri-functional catalyst

📍 Productivity $\text{g.L}^{-1}.\text{h}^{-1}$ at lab scale



KATHOLIEKE UNIVERSITEIT
LEUVEN



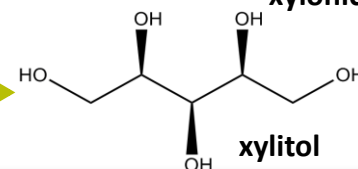
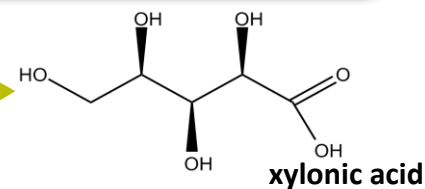
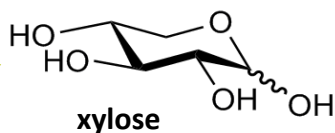
🔥 BIOTECH PRODUCTION OF XYLITOL AND XYLONATE

CIMV organosolv



📍 Yeast catalyzed conversion

- 🔥 Using pure xylose up to 150 g xylitol/L at high productivity (yield 0.73 g xylitol/ g xylose consumed)
- 🔥 up to 170 g/L of xylonate
- 🔥 Pentose syrup refining is still a challenge



🔥 DEVELOPMENT OF LIGNIN-BASED POLYMERS

📍 Lignin reinforcement of thermoplastic elastomer

- 🔥 Simple fabrication method
- 🔥 Increased tensile strength and toughness, with surface hardness being significantly increased
- 🔥 Application for electrical appliances (e.g. cables)



🔥 DEVELOPMENT OF LIGNIN-BASED POLYMERS

📍 Replacement of phenol by lignin in phenolic resins suitable for wood based panels

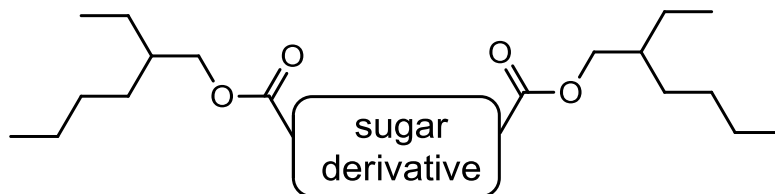
- 🔥 Easy preparation method
- 🔥 Resins with performance that meet the relative European standards
- 🔥 Resins with lower cost

Chimar Hellas S.A.



🔥 NEW GLUCOSE-BASED PLASTICIZER





📍 Alternative to di-2-ethylhexyl phthalate (DEHP)



- 🔥 DEHP renders PVC more flexible, but.....
 - 🟡 DEHP is linked to health concerns
 - 🟡 DEHP is petrochemical-based
- 🔥 At 40 parts per hundred, the bio-based plasticizer makes PVC twice as flexible as di(2-ethylhexyl)phthalate (DEHP)

CONCLUSIONS

BIOCORE

-  A concept that addresses a number of grand challenges
-  Highly encouraging progress with several highlights after 24 months
-  Potential for near-mature industrial technologies in 2014
-  An exciting collaboration with India



Thank you



Acknowledgements to:

- 🔥 all BIOCORE partners
- 🔥 the EU Commission for funding

