dbA

Centre de Desenvolupaments Biotecnològics i Agroalimentaris

THE FOREST, FIRST RESOURCE OF THE GREEN ECONOMY

Activity 1:

IMBIOFUST. Promotion and implementation of a pilot plant of a bio-refinery focused on low-cost wood and wood by-products

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Universitat de Lleida

DBA Centre

February 11, 2020

Unió Europea
Fons Europeu de Desenvolupament Regional

Generalitat de Catalunya

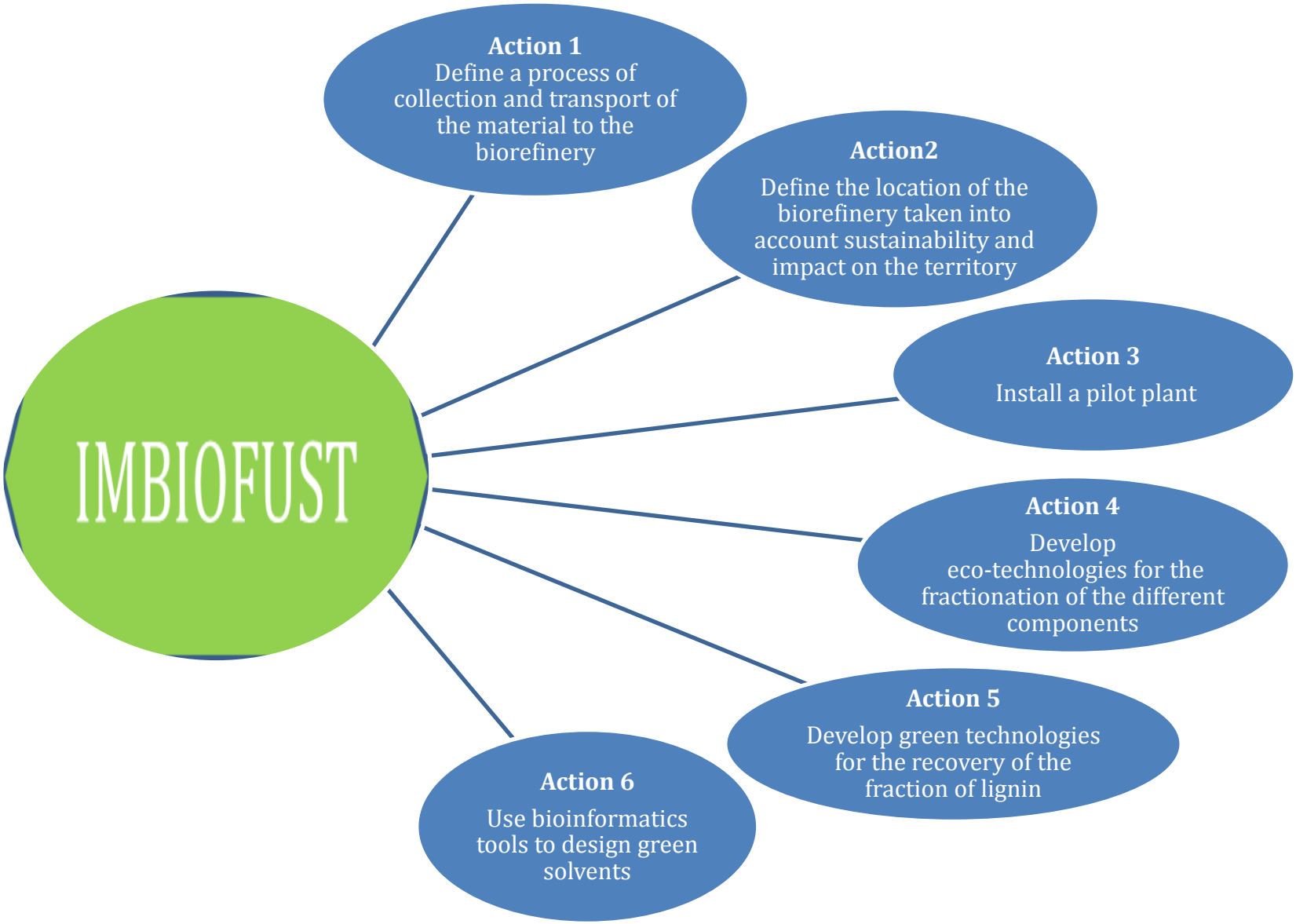
El bosc, primer recurs de l'economia verda
Projecte d'especialització i competitivitat territorial

Universitat de Lleida

PRESENTATION OUTLINE

1. IMBIOFUST Activity: context and goals
2. Biomass/Feedstock characterization
3. Current and future work

What are the research actions?



Actions

- Define a process for collecting and transporting the material to the bio-refinery
- Define the best location for the bio-refinery

Source: http://www.promocioeconomica.cat/?s=bosc

ESTUDIS DE CAMP PER A DEFINIR LES MILLORS OPCIONS D'UBICACIÓ DE LA PLANTA PILOT D'UNA BIOREFINERIA BASADA EN LA FUSTA

Promou: Universitat de Lleida

DESEMBRE 2019

Universitat de Lleida

la llena

serveis • projectes ambientals

973 143 038 • lallena@lallena.cat • www.lallena.cat

Province of Lleida

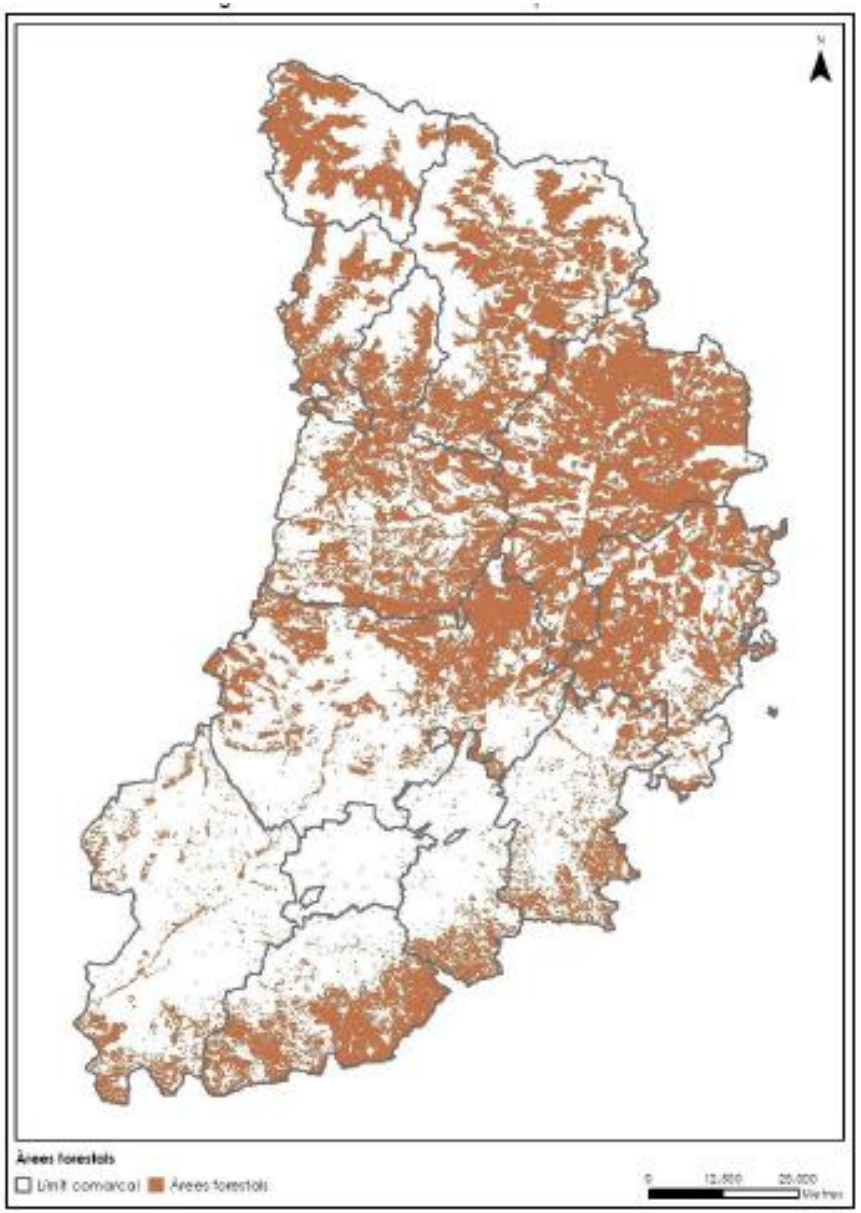
Population
aprox. 450 000

Forestry surface 8000 km^2,
42% in public land.

Woods produce 1,3% GDP

Figures from INDESCAT

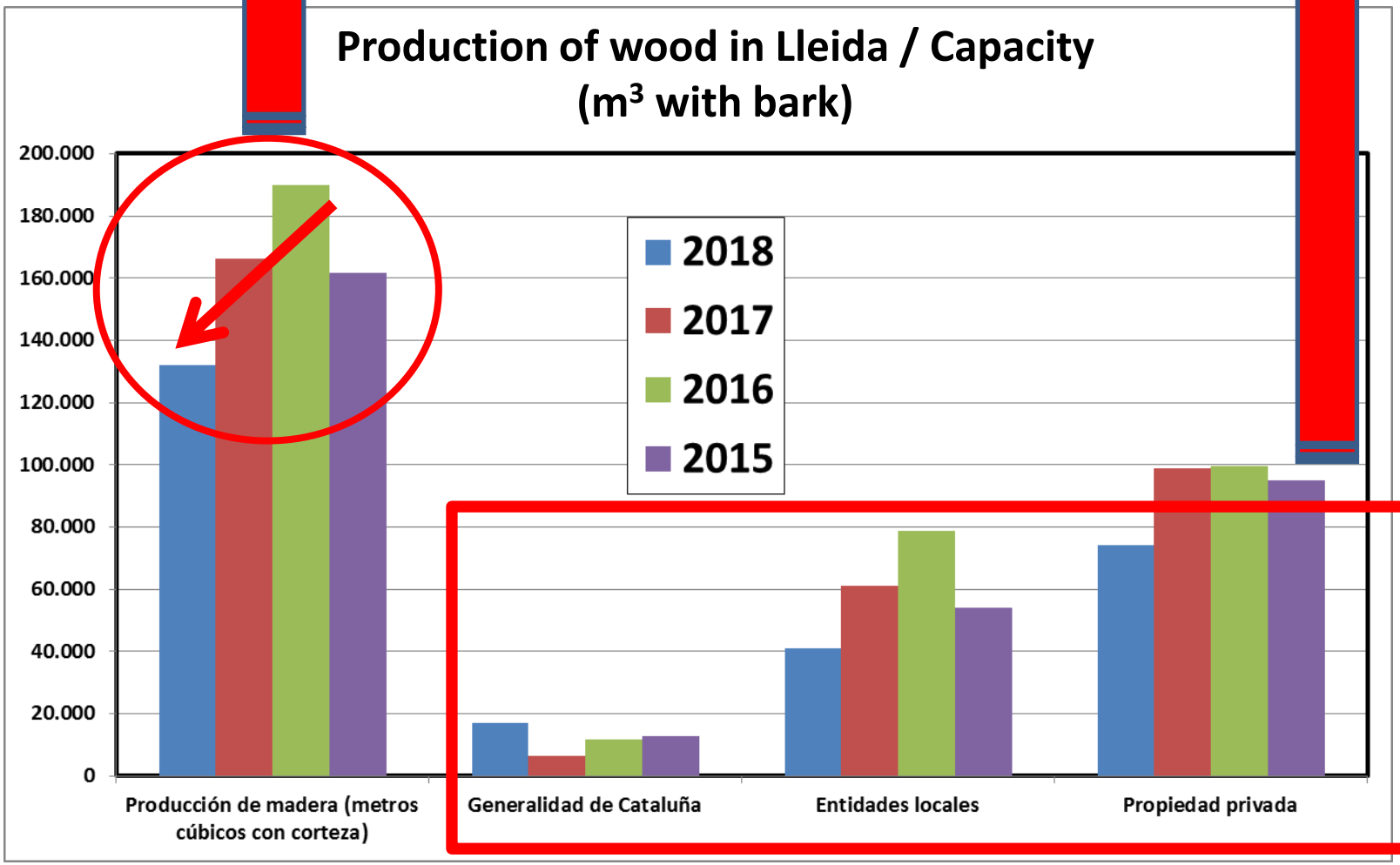
Forest distribution



Species	Surface area (hectare)	Tonne/hectare
Pinus sylvestris	84.821,03	60,51
Quercus ilex	70.207,78	24,71
Pinus nigra	59.516,21	39,68
Pinus uncinata	51.807,68	77,66
Pinus halepensis	39.363,45	24,91
Quercus humilis	36.120,26	21,67
Abies alba	9.046,08	109,09
Quercus faginea	8.452,43	3,99
Betula pendula	4.602,36	14,07
Quercus petraea	3.574,48	27,53
Fagus sylvatica	2.829,98	76,97
Fraxinus excelsior	2.062,35	21,46

20% decrease in production capacity over the last 3 years

50% production in public areas

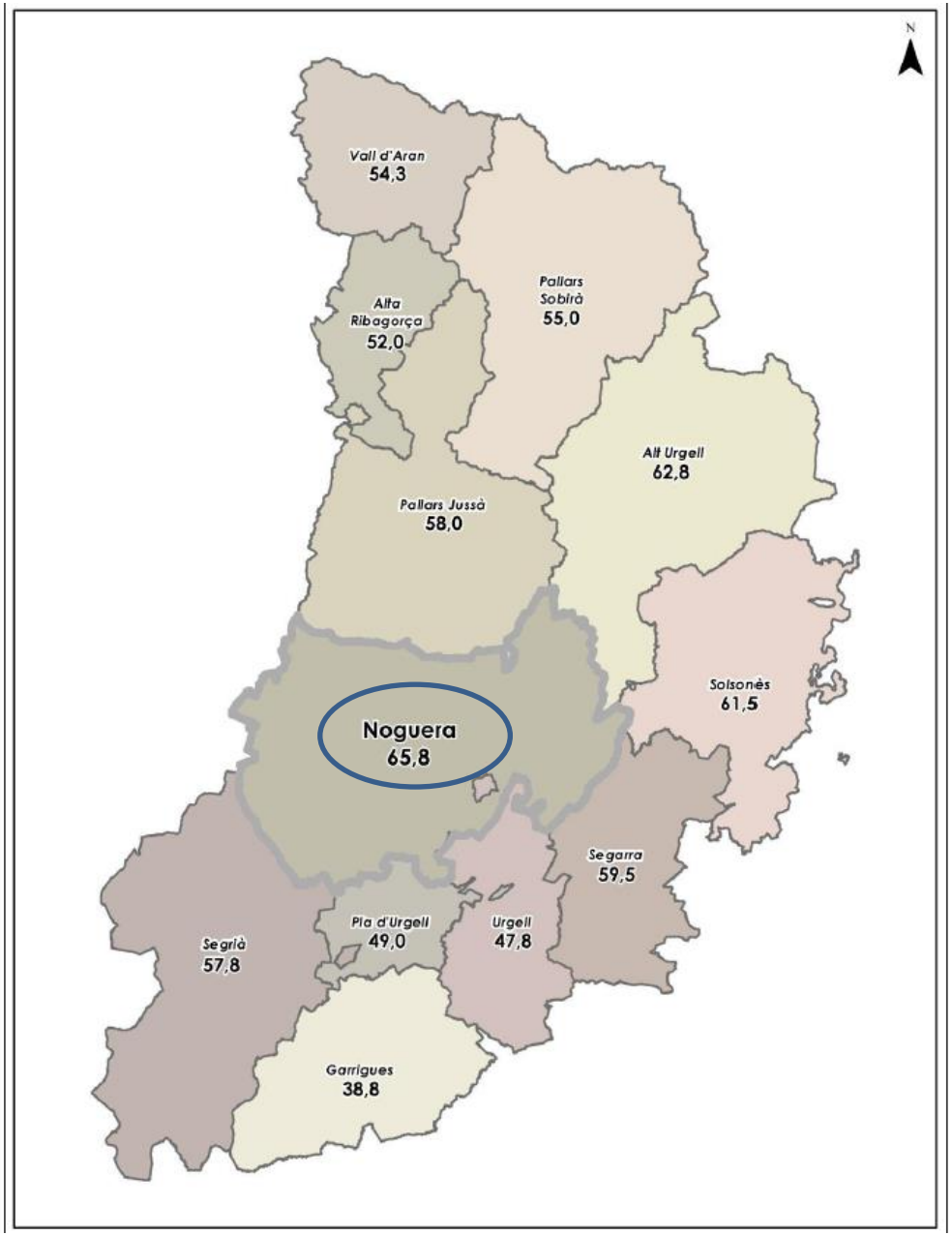


Pilot Plant location

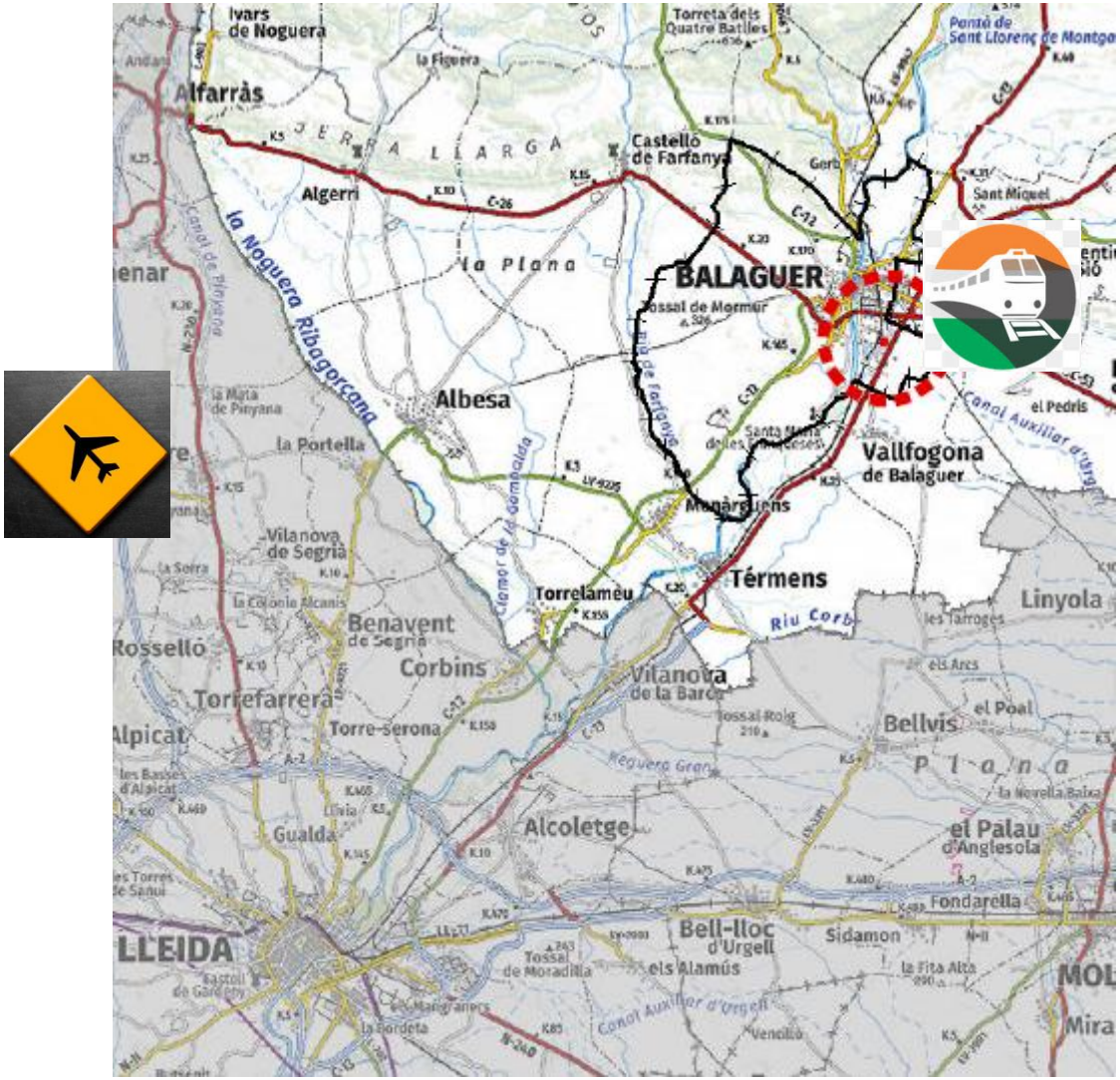
Criteria considered:

- Wood biomass potential
- Infrastructures and transport networks
- Economic activity, innovation and research
- Carbon footprint associated with transport

Pilot Plant location



Pilot Plant location



Pilot Plant location

Action

- Install a pilot plant

Source: http://www.promocioeconomica.cat/?s=bosc

Pilot plant equipment

Pilot plant equipment

High Pressure Autoclave Reactor
10 Liters / 200 bar

Nutsche Filter
10 Liters / 0,05 m^2

Heavy Duty
Vacuum pump
0,02 mbar / 205 L/min

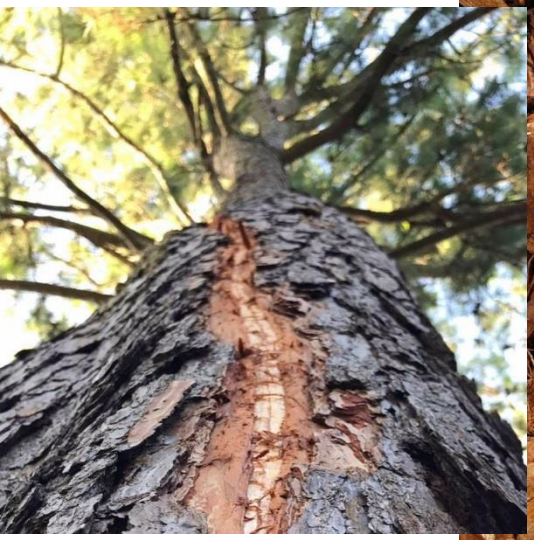
Action

- Developing eco-technologies by fractionating components

Source: http://www.promocioeconomica.cat/?s=bosc

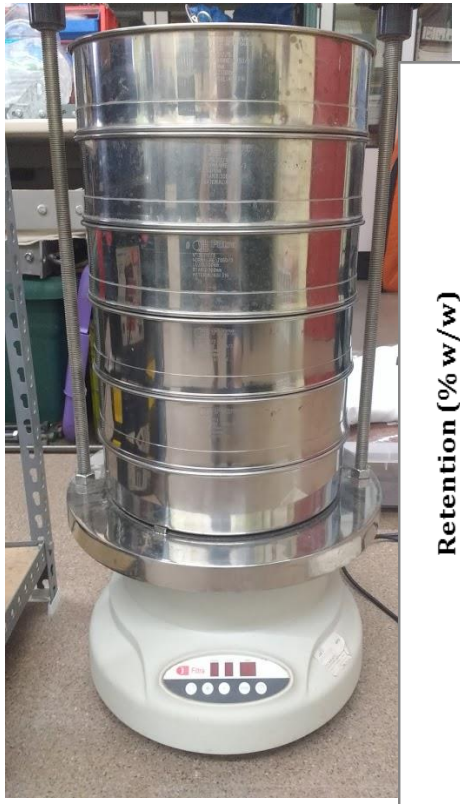
Residue origin and sampling (**pine sawdust and bark**)
Random manual sampling in a wood mill in Balaguer



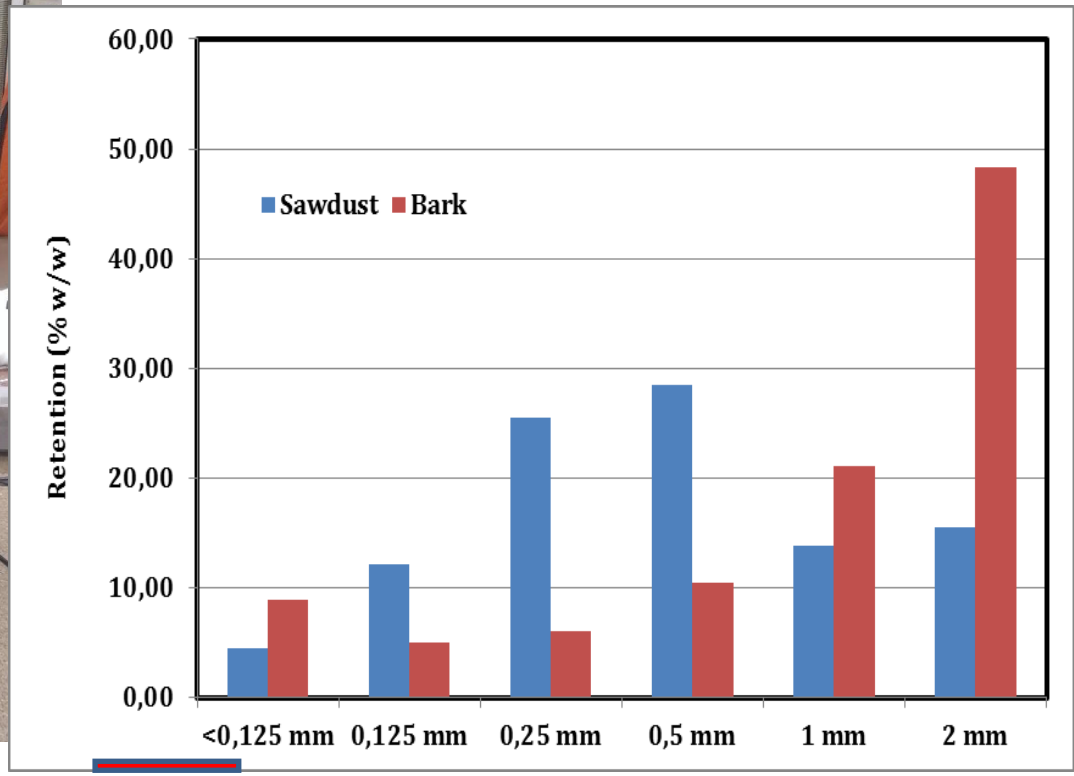



Solid grinding and sieving

Retsch/ cutting mill
3 kW, 1500 rpm



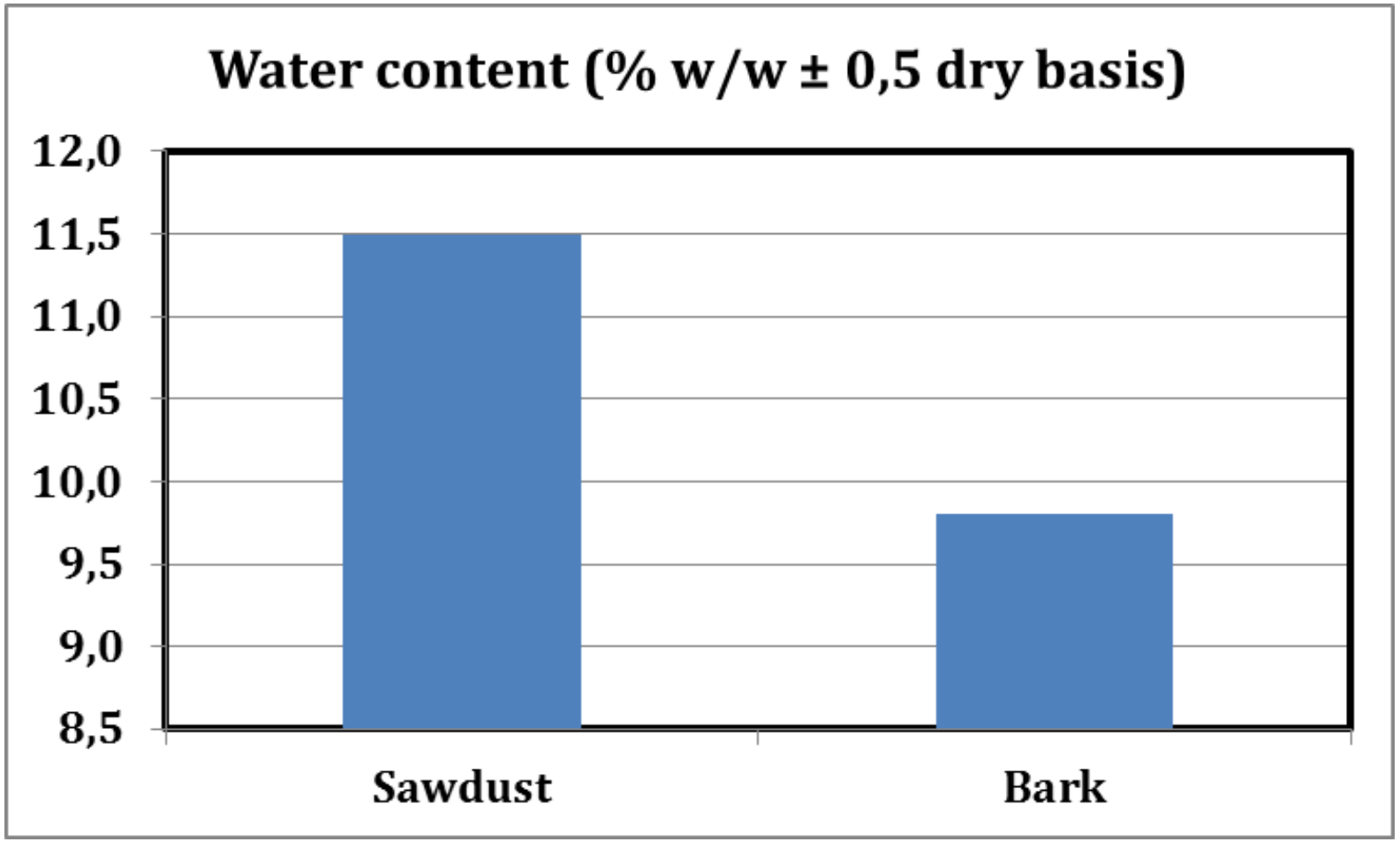
Filtra/electromagnetic
sieving machine
10 min, full power



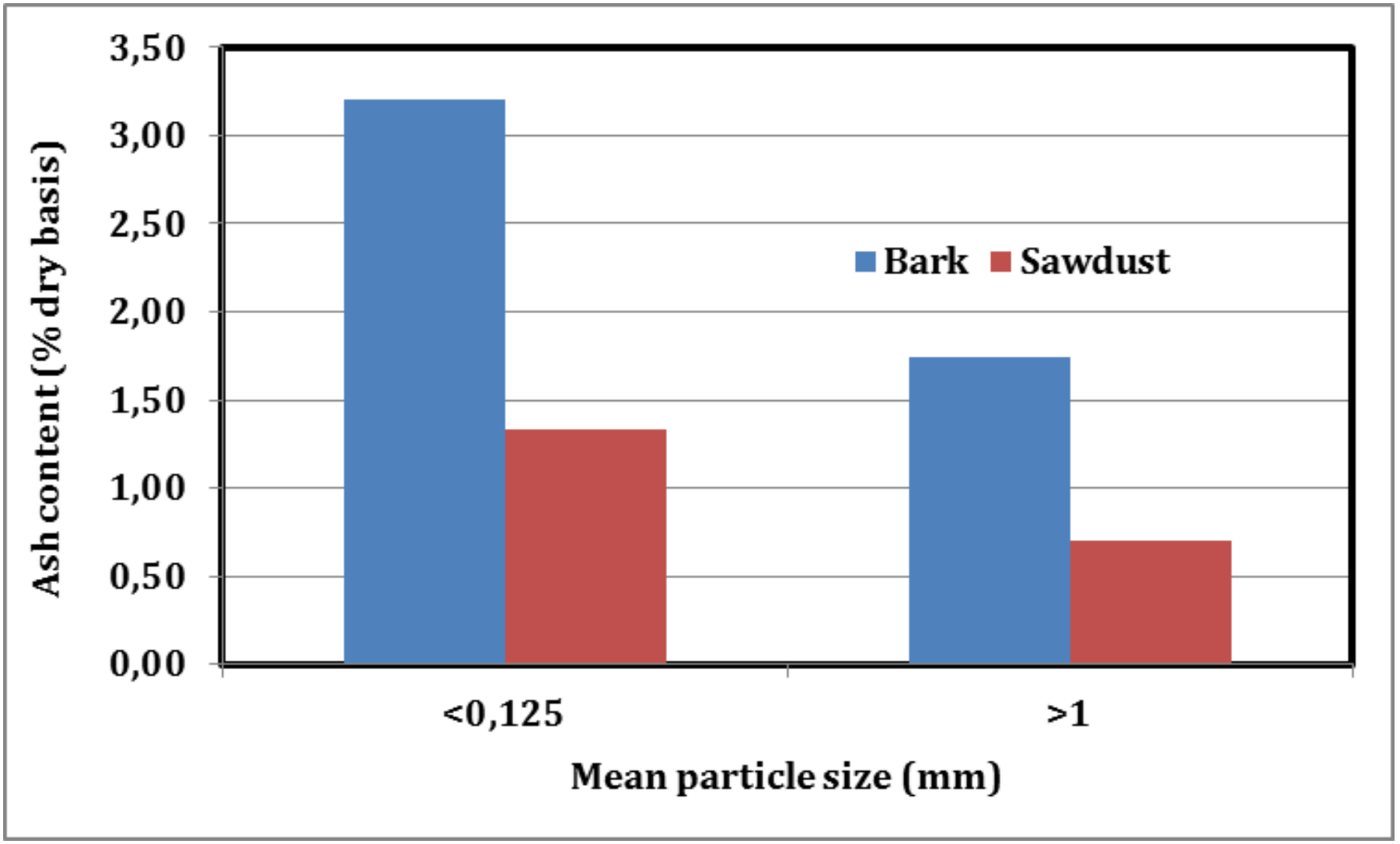
Wide distribution of particle sizes

High influence of milling conditions

Water content (105°C, time required to constant weight)



Ash content (550 C, 3 h)



Fiber contents (fines, DOSIFER technique)

- **Neutral Detergent Fiber % FND ± 5,5%**
- **Acid Detergent Fiber % FAD ± 5,5%**

Developing eco-technologies by fractionating components

- Extractives recovery
- Cellulose recovery

Source: http://www.promocioeconomica.cat/?s=bosc

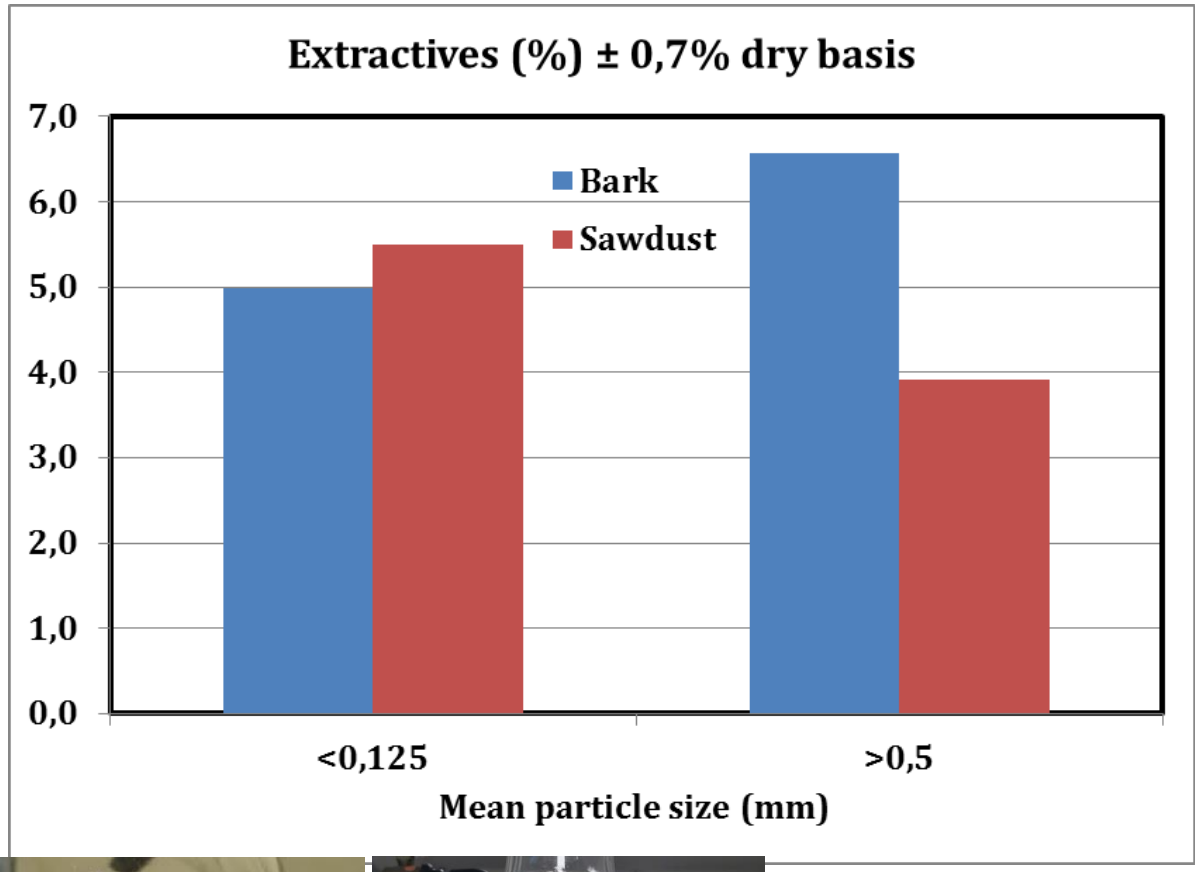
Developing eco-technologies by fractionating components

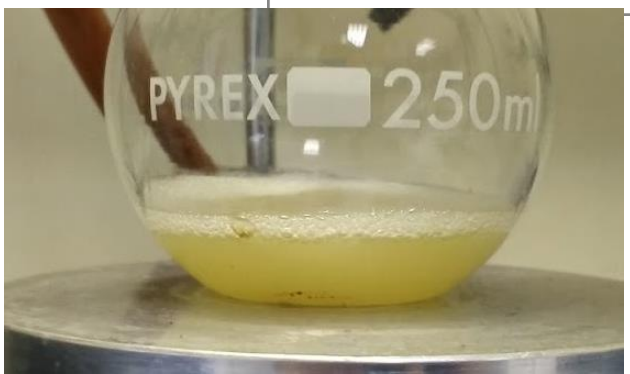
- Extractives recovery

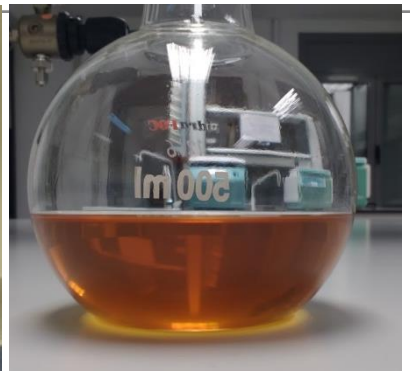
Source: http://www.promocioeconomica.cat/?s=bosc

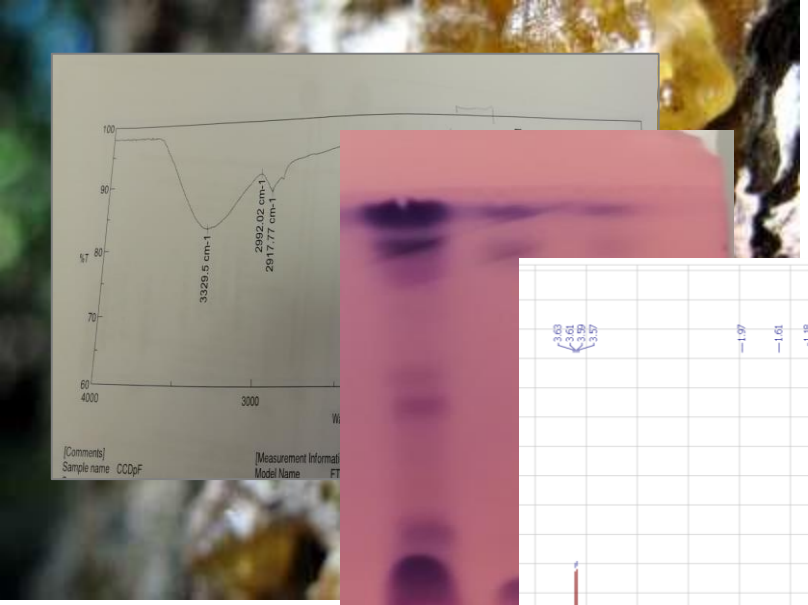
Extraction of oils/waxes/resins (extractives)

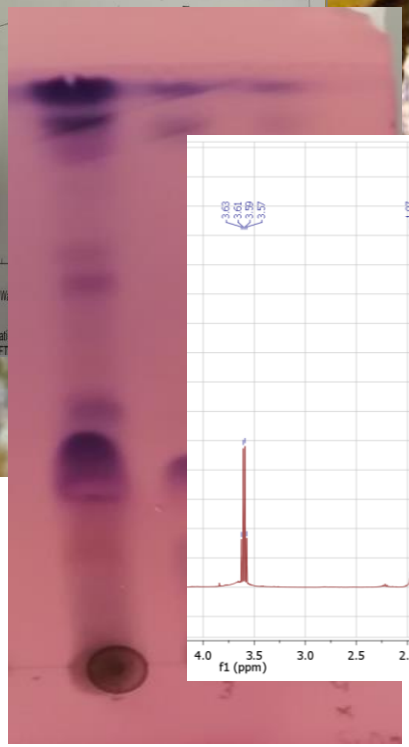
Soxhlet method (hexane/ethanol azeotropic mixture)

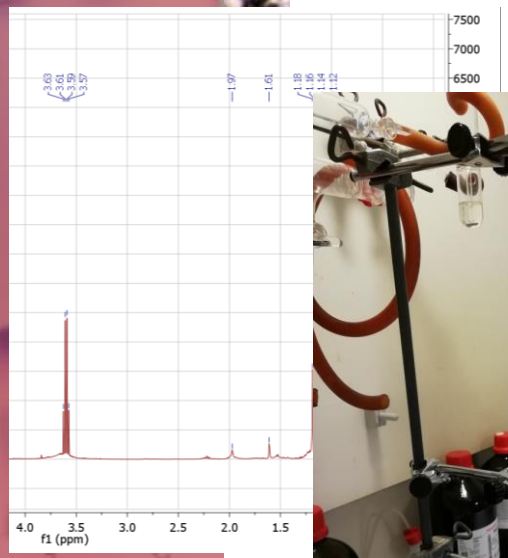


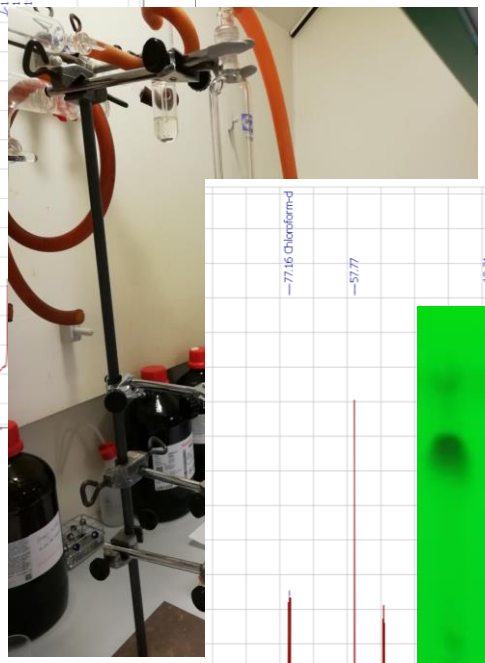


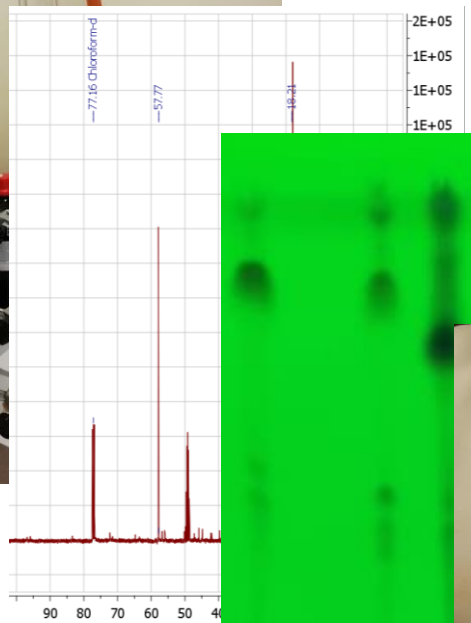


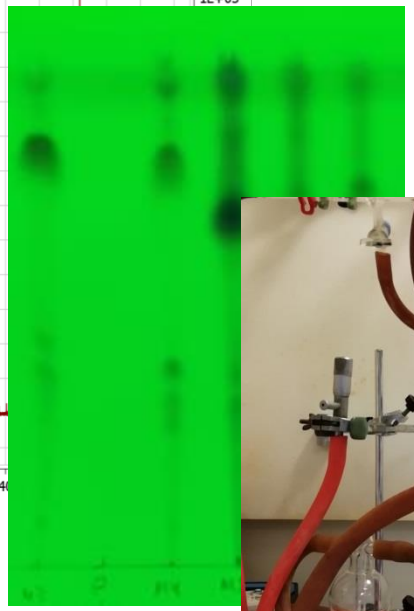






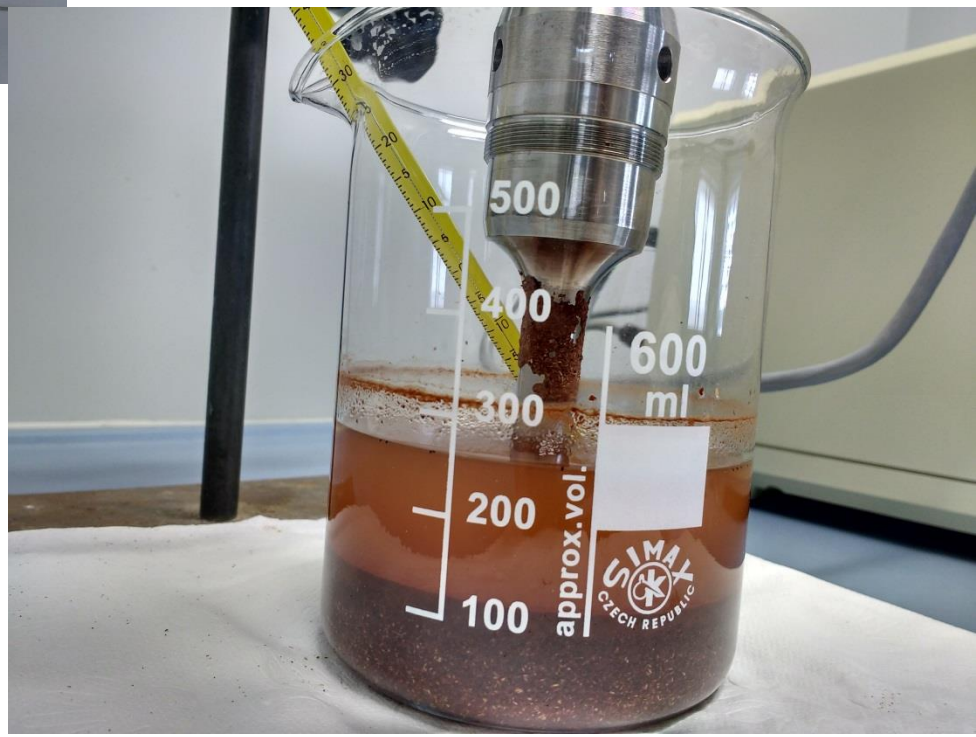






Challenging separation and purification of the mixture components


BRANSON
SONIFIER 250
Output
Power
Output Control


500
400
300
200
100
600
ml
approx. vol.
SIMAX
CZECH REPUBLIC


Flores Valles
Para mayor protección y ahorro de energía, mantenga bajada la guillotina.
INSTRUCCIONES DE MANEJO DE LA VITRINA
FUME HOOD OPERATING PROCEDURES
isopad

Developing eco-technologies by fractionating components

- Cellulose recovery → Using ionic liquids as solvents

Source: http://www.promocioeconomica.cat/?s=bosc

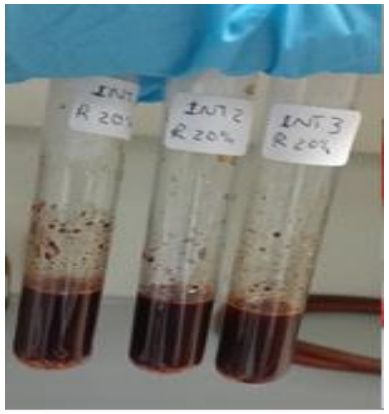
Action

- Developing green technologies for adding-value to lignin

Source: http://www.promocioeconomica.cat/?s=bosc

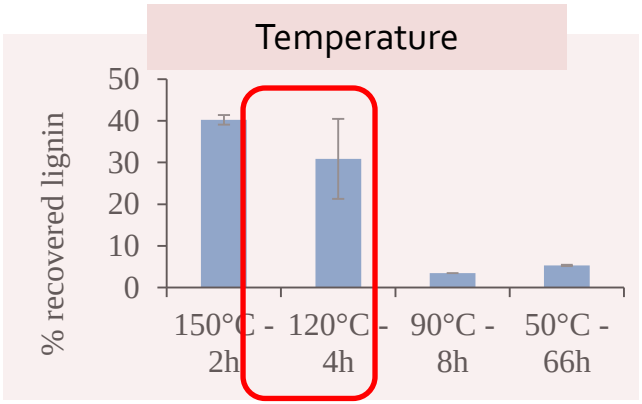
TWO APPROACHES STUDIED

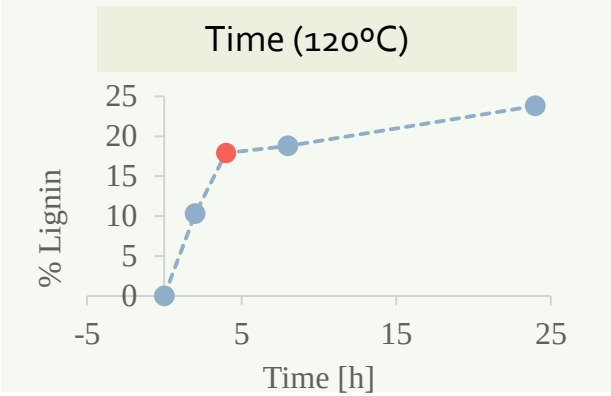
1) Using ionic liquids

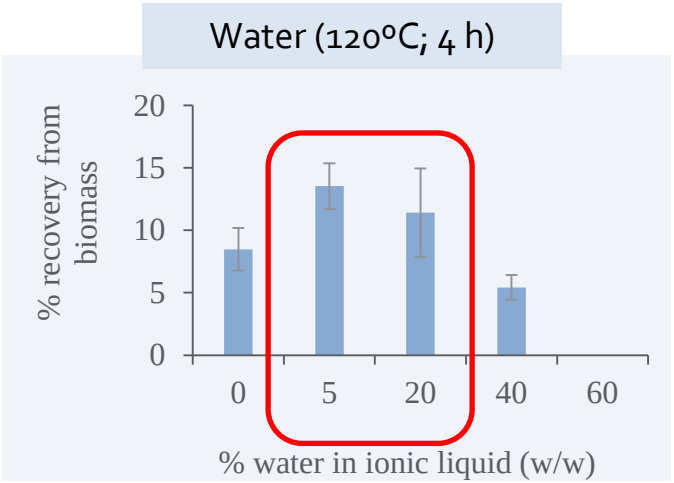


2) Catalytic depolymerisation of lignocellulosic material

Using ionic liquids



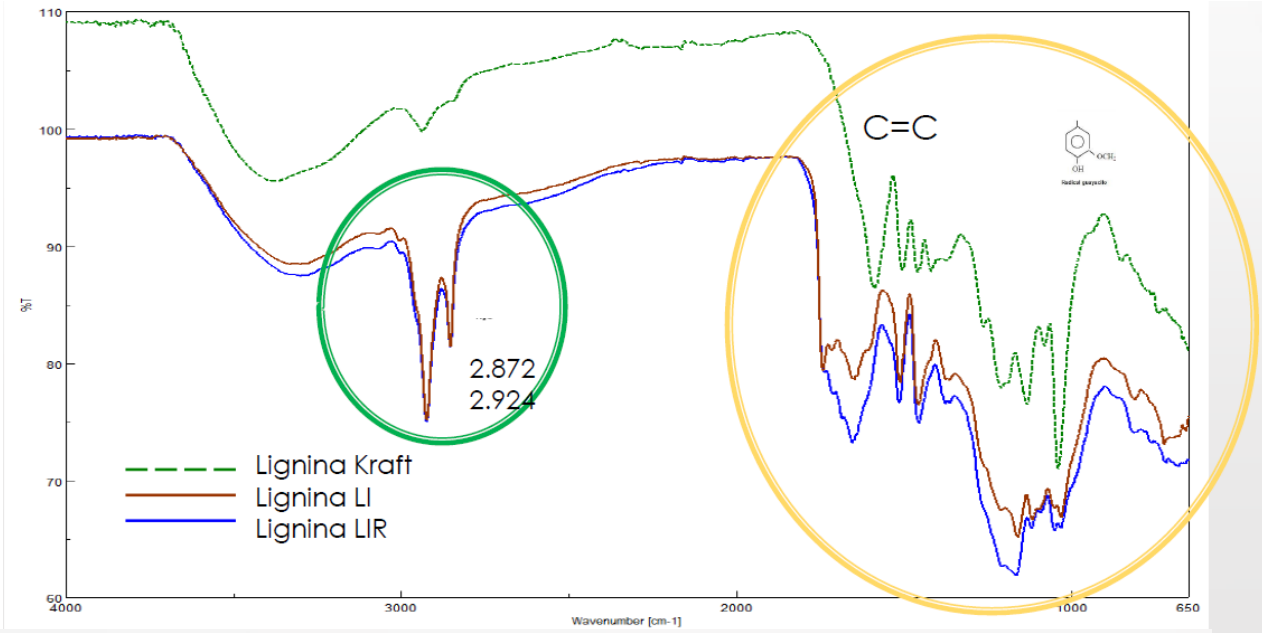




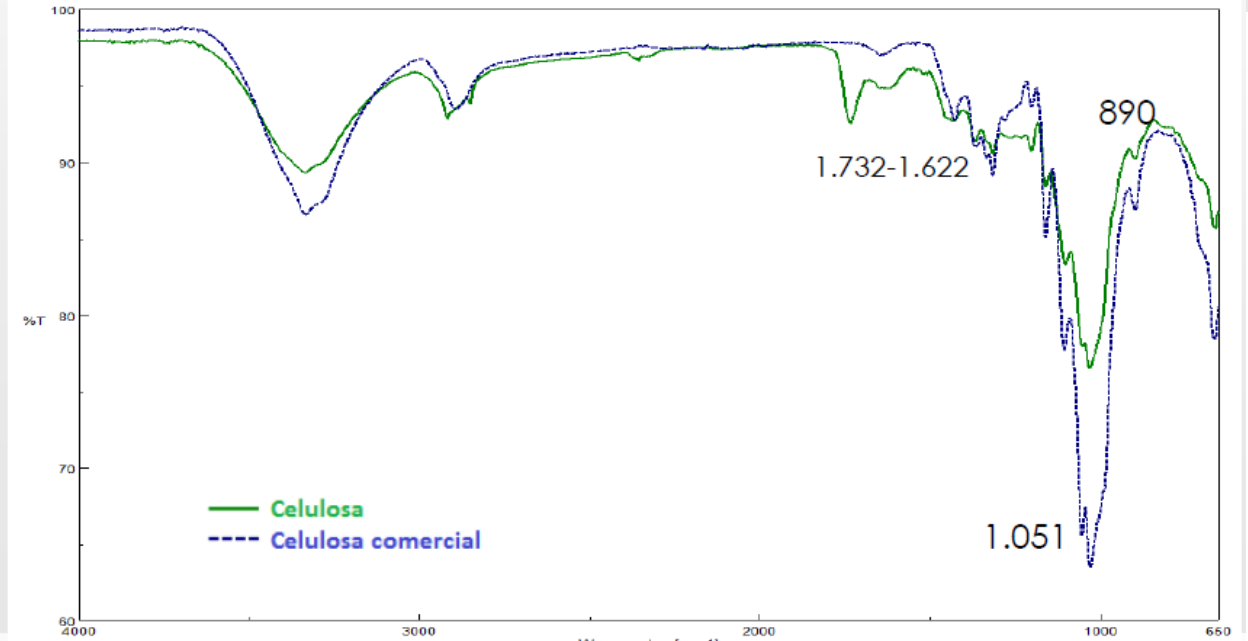
1/3 total lignin

1/2 total cellulose

Using ionic liquids

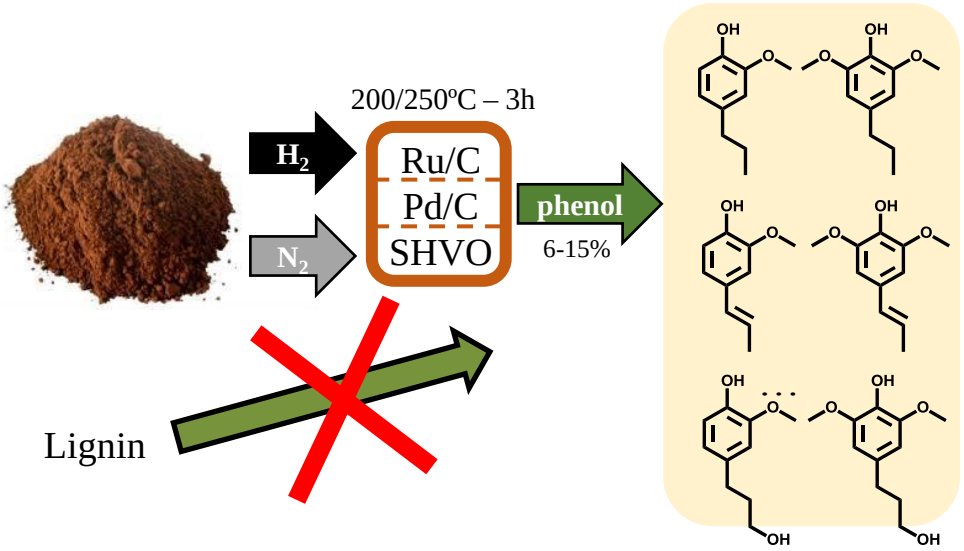


lignin

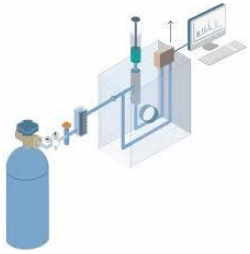


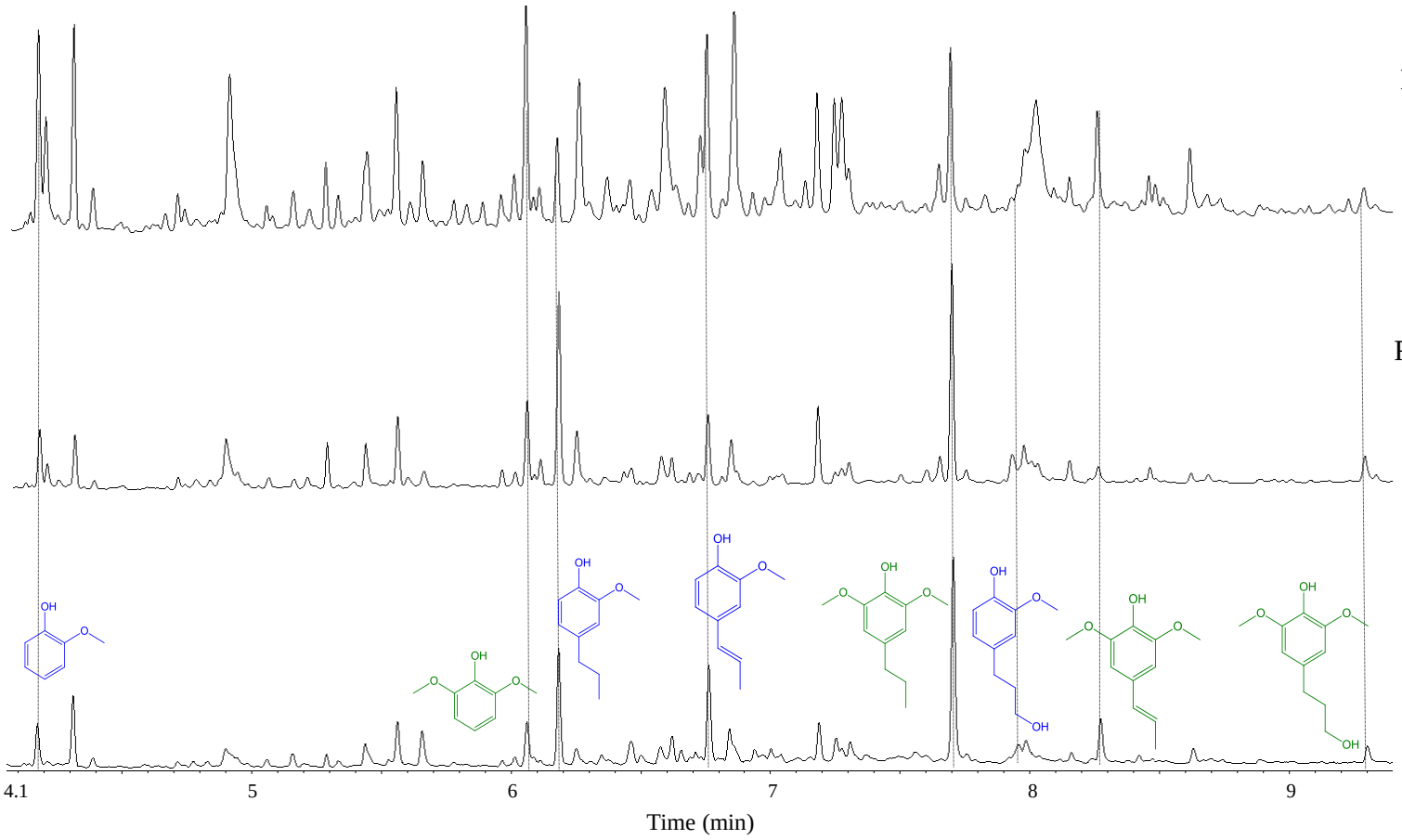
1/2 total cellulose

Catalytic depolymerisation of lignocellulosic material



➢GC Analysis of lignin oil



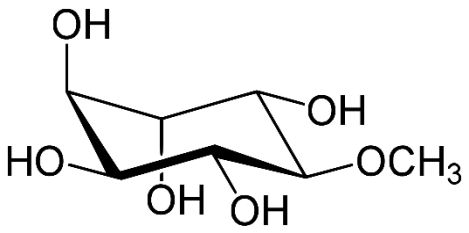


Action

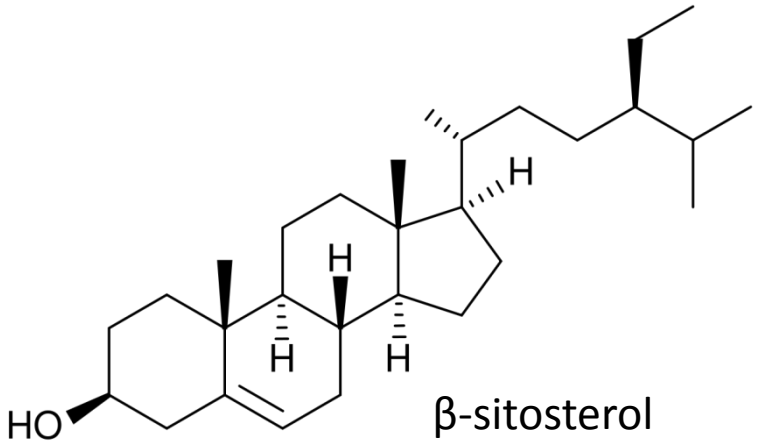
- Use computational tools

Source: http://www.promocioeconomica.cat/?s=bosc

Application of COSMOS software

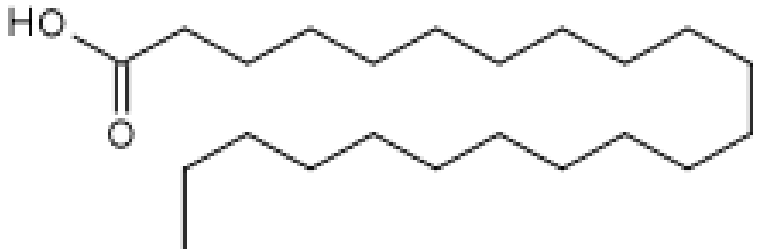


Pinitol



β-sitosterol

Lignoceric acid



Behenic acid

Summarising

- The location of the pilot plant has been defined.
- The main equipment has been acquired.
- New approaches to obtaining lignin, cellulose and extractives from sawdust and bark are currently being studied.
- The COSMOS software is used to optimize the recoveries of the extractives using green solvents.

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