

Forest-Based Biorefineries : The Pulp and Paper Industry.

A contribution to the
National Bioeconomy Roadmap

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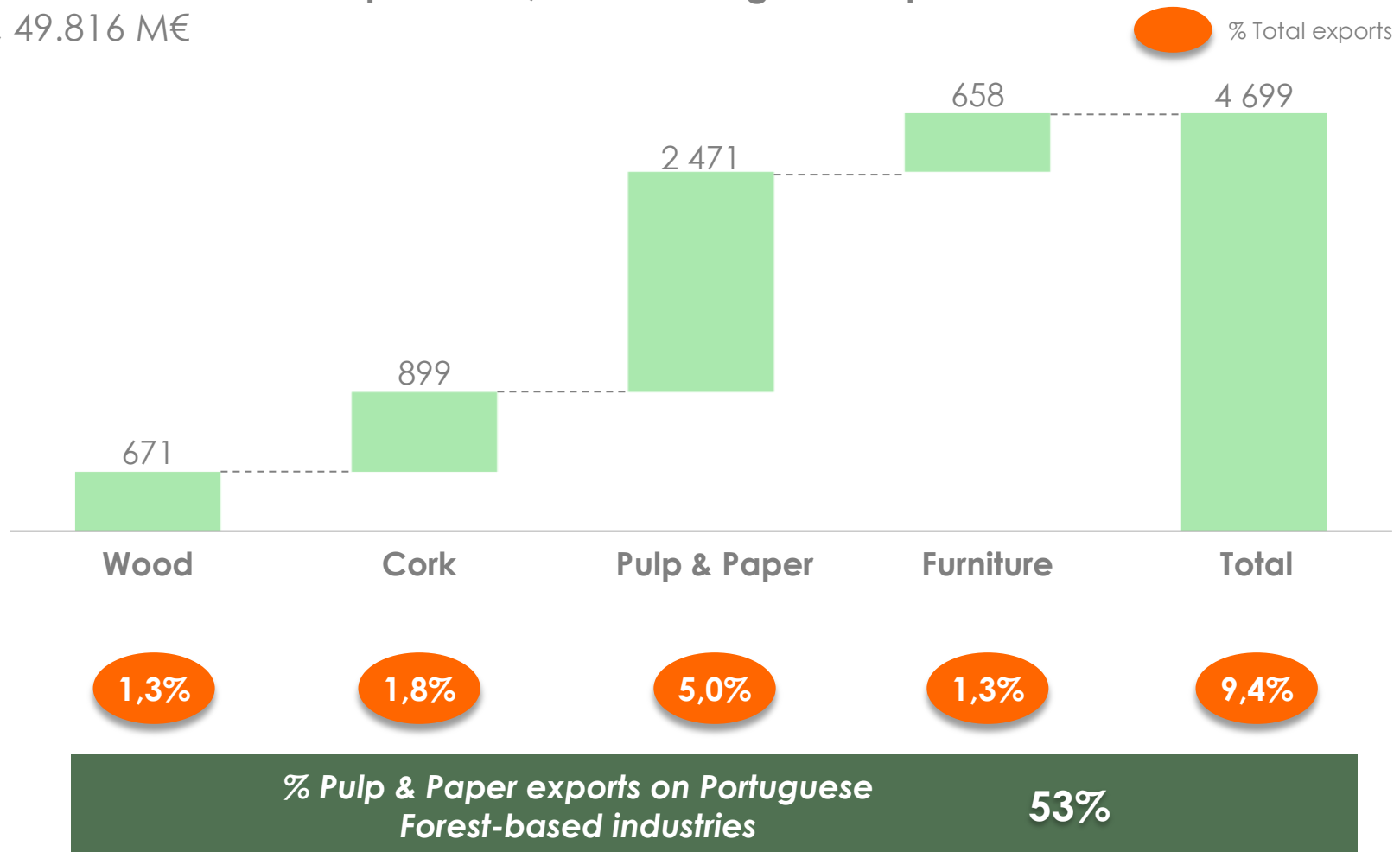


The Portuguese Forest Industries - Exports

Forest: 35% of portuguese territory

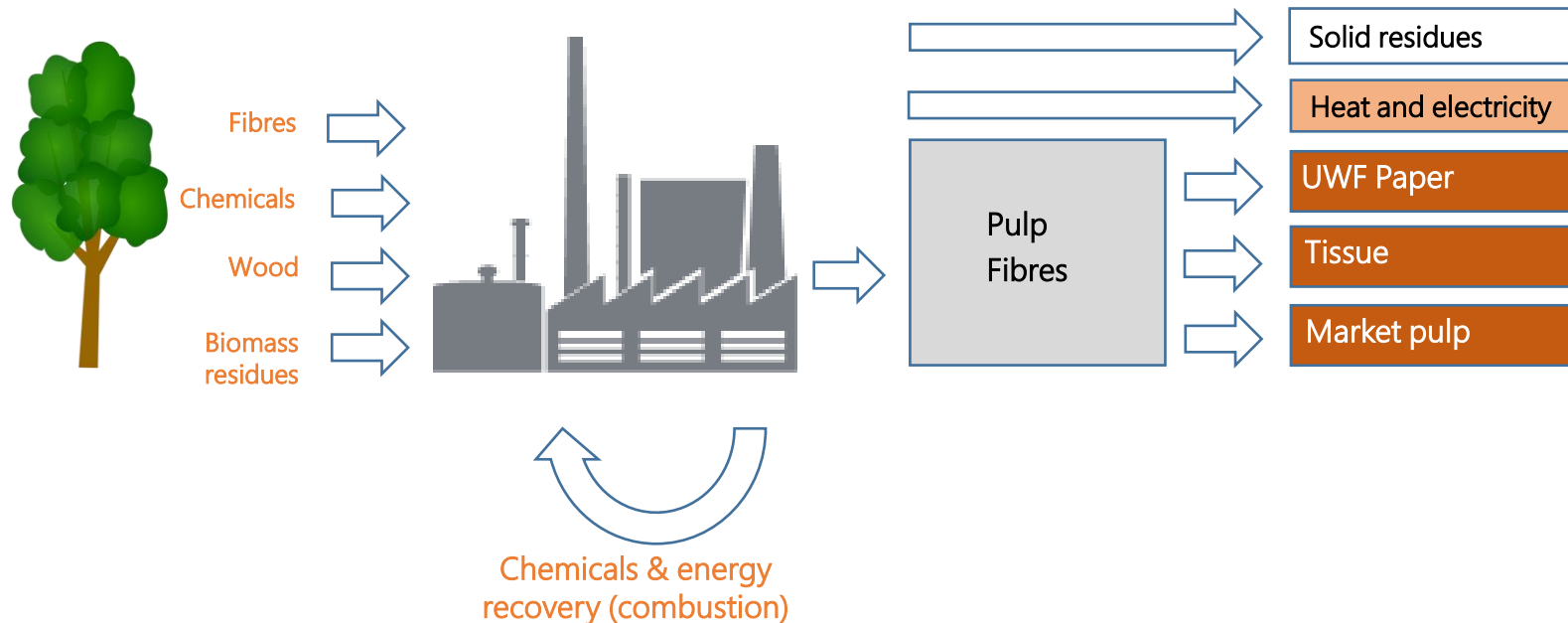
Forest-based industries represent 9,4 % of Portuguese Exports

2015, 49.816 M€



Source: INE

Today pulp & paper mills





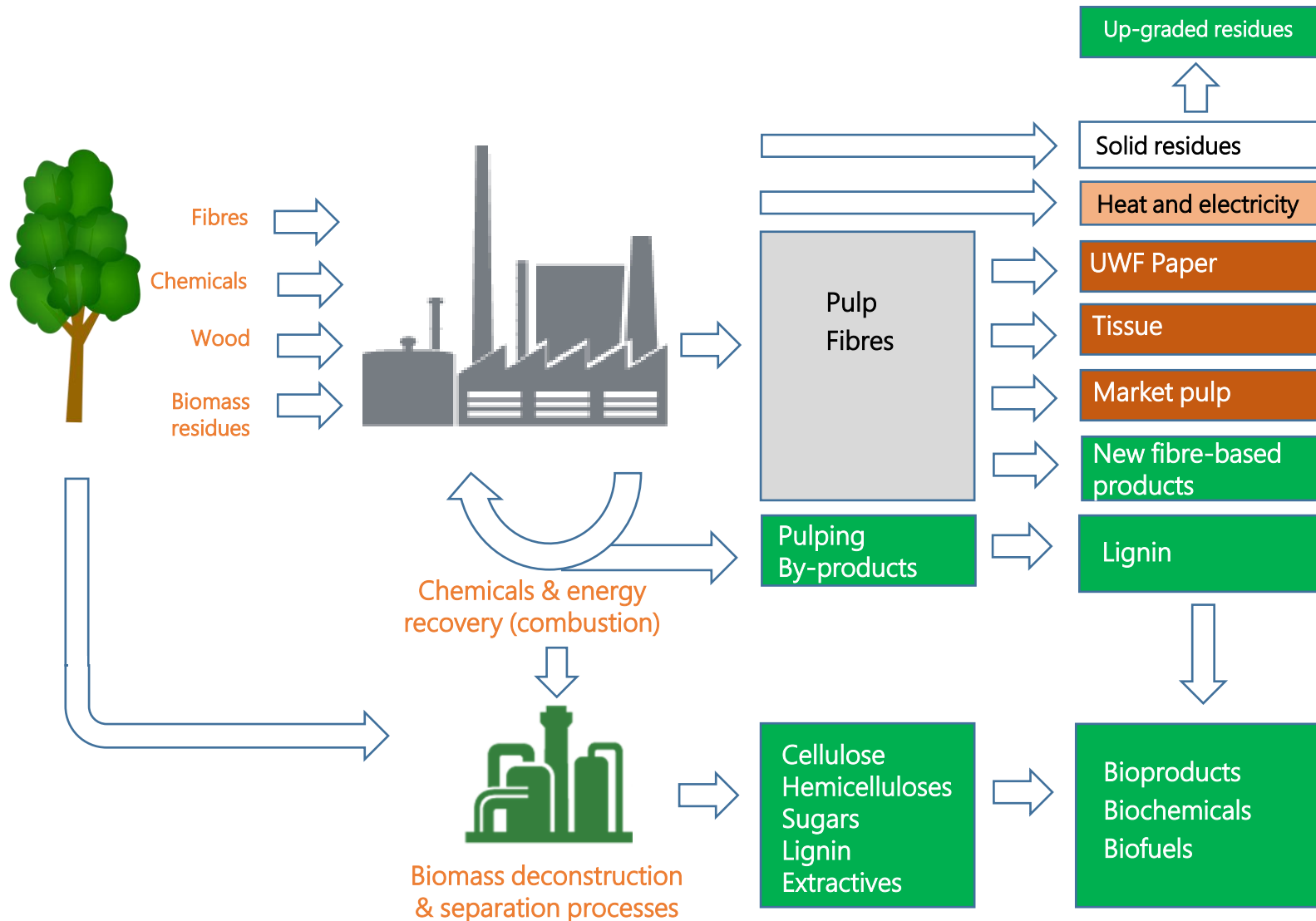
- Wood consumption: 8-9 M m³ (4-5 M dry ton)
- Pulp production: 2.2 M dry ton (partly converted into paper)
 - => **~2 M dry ton wood by-products in pulping process** ("black liquors", nowadays burned for chemicals recovery, thermal and electric energy production)

Harvesting, logging, debarking and chipping generates up to 1 M dry ton of forest biomass by-products

- bark
- tops
- branches
- sawdust



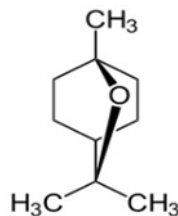
Tomorrow pulp & paper biorefineries



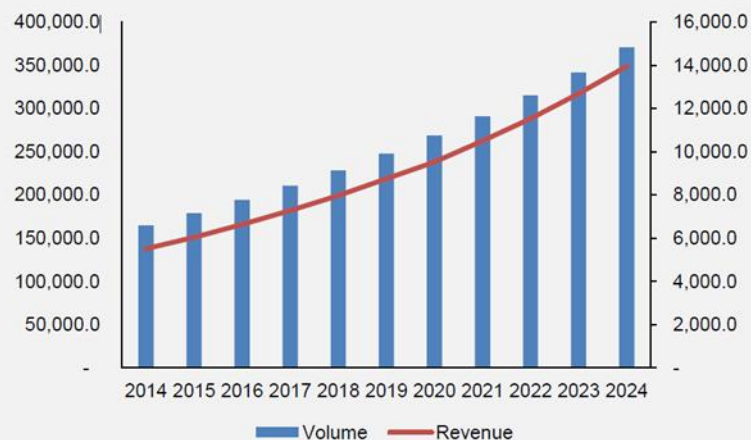
Biochemicals from biomass extractives



Essential oils



Global essential oils market estimates and forecast, 2014 – 2024, (Tons) (USD Million)



Source: FFDC India, ITC, SADC Trade, CBI, EOAI, AEOTA, JETRO, DAFF and Grand View Research

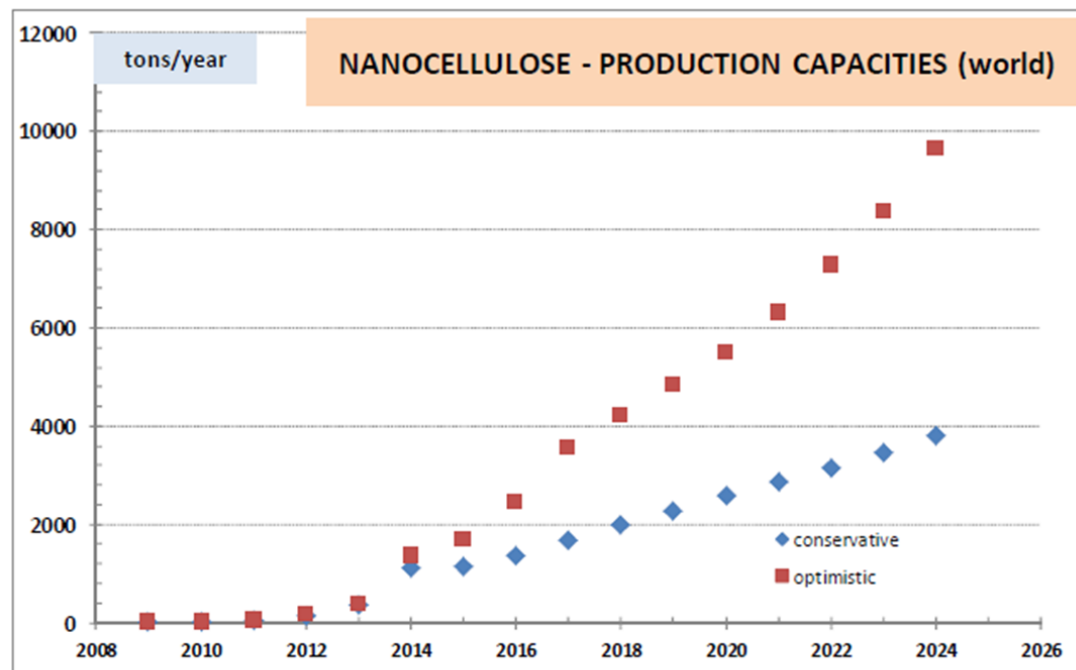
For fragrances, cosmetics and pharmaceutical products, a 1,5 billion € market



Cellulose/hemicellulose-based products



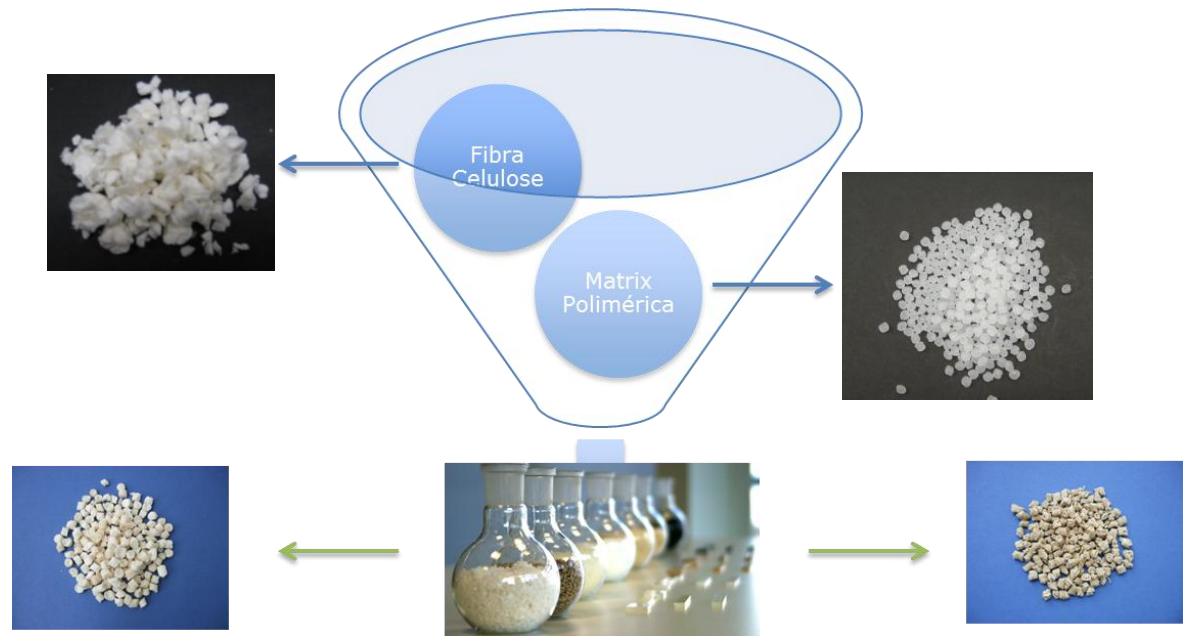
Nanocellulose for paper coating and food additives



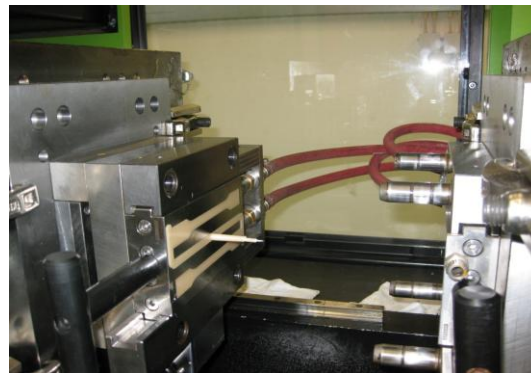
2014 March, Future Markets Inc, The Global Market for NANOCELLULOSE to 2024

Global Nanocellulose production capacities estimates for 2020
Conservative – **2500 tons /year**. Optimistic – **5500 tons /year**.

Cellulose-based biocomposites



Injection



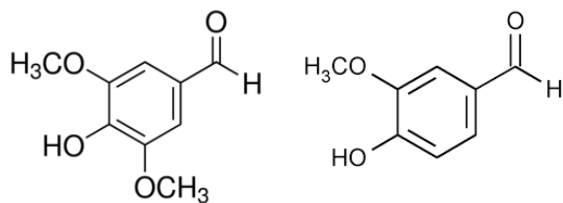
Molding



Vanillin and syringaldehyde



Vanillin and syringaldehyde
obtained (2,5%) by eucalyptus
globulus lignin oxidation

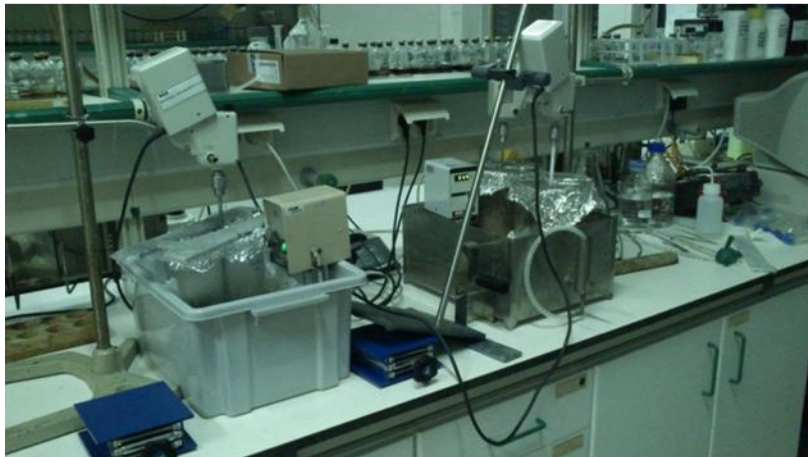


Lignin polyols



Lignin-based foams
for thermo insulation

Enzymatic hydrolysis – scale up



5 L beakers - RAIZ

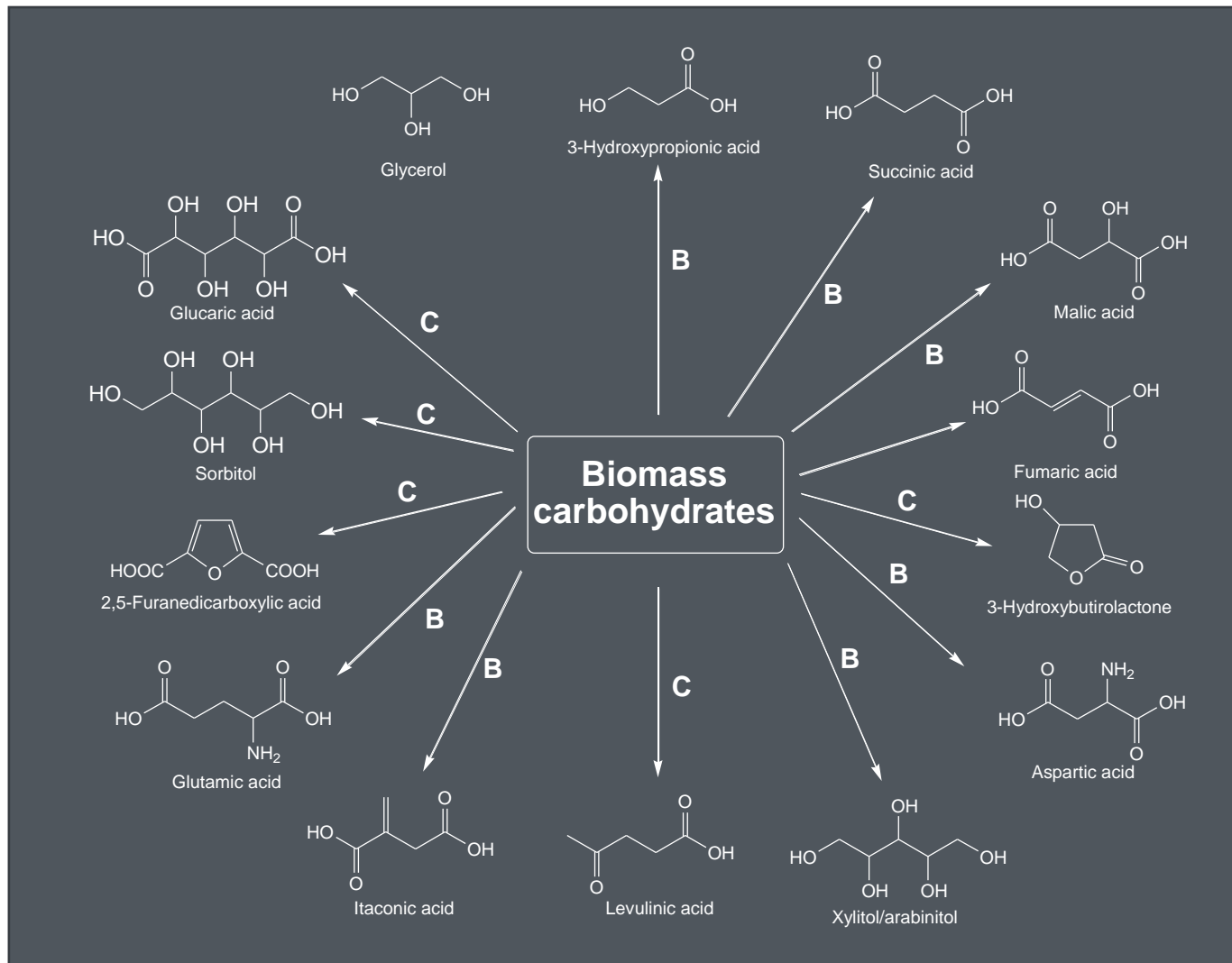


50 L reactor - LNEG

Sugar syrups

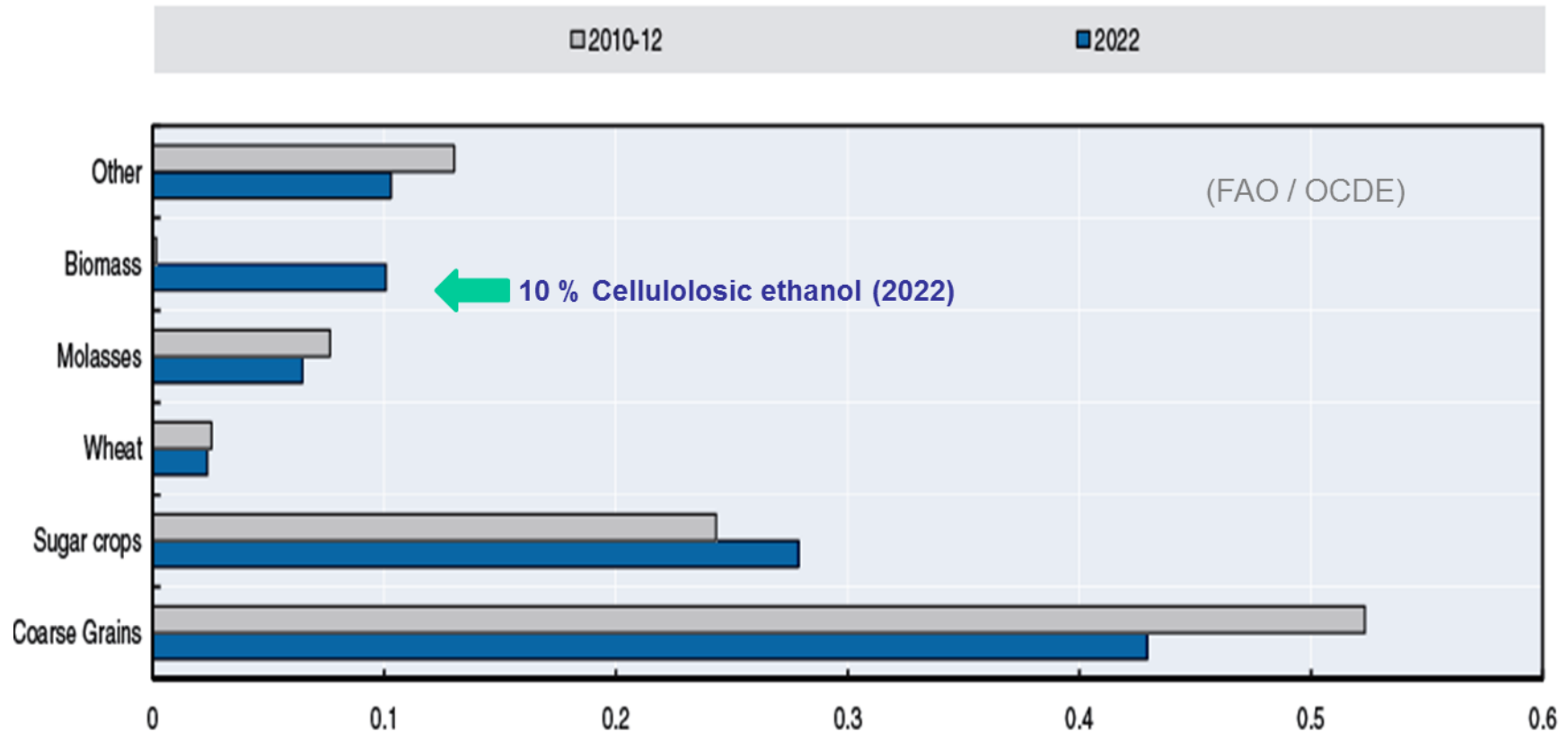


Plattform chemicals from sugars



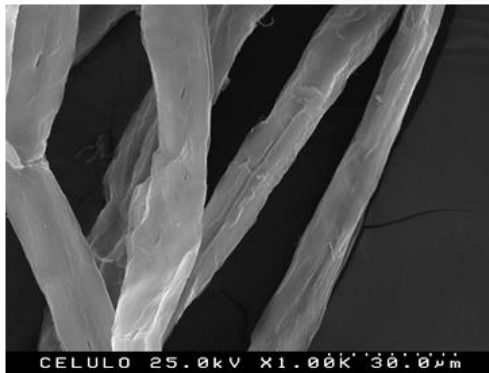
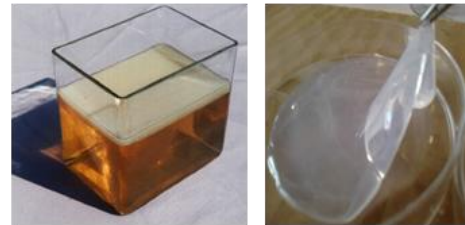
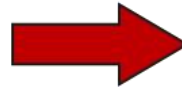
Bioethanol: a worldwide growing market

Cellulosic bioethanol is emerging: \approx 17 billion L in 2022, 10% share

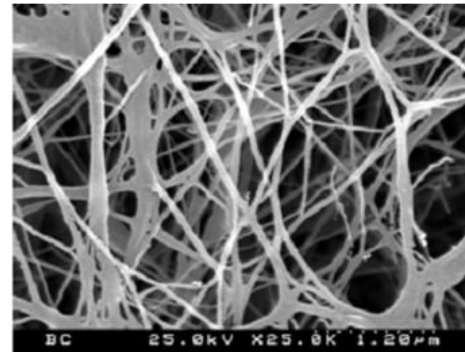
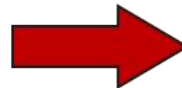


Sugar-based products

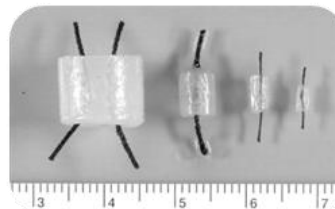
Bacterial cellulose from wood/cellulose sugars



Wood fibers
~20-40 μm width, ~1-3(>) mm length



Bacterial cellulose (*Gluconacetobacter*)
Nanofibrils 10-100 nm width, 3D network



Food additives
Cosmetics

The inpactus project

Promoter



Co-Promoters



Instituto de Investigação da Floresta e Papel



UNIVERSIDADE DE COIMBRA

Partners



180

Researchers and technicians

50

Research scholarships

17

PhD students

PhD programme on
Biorefineries (UA, UC)

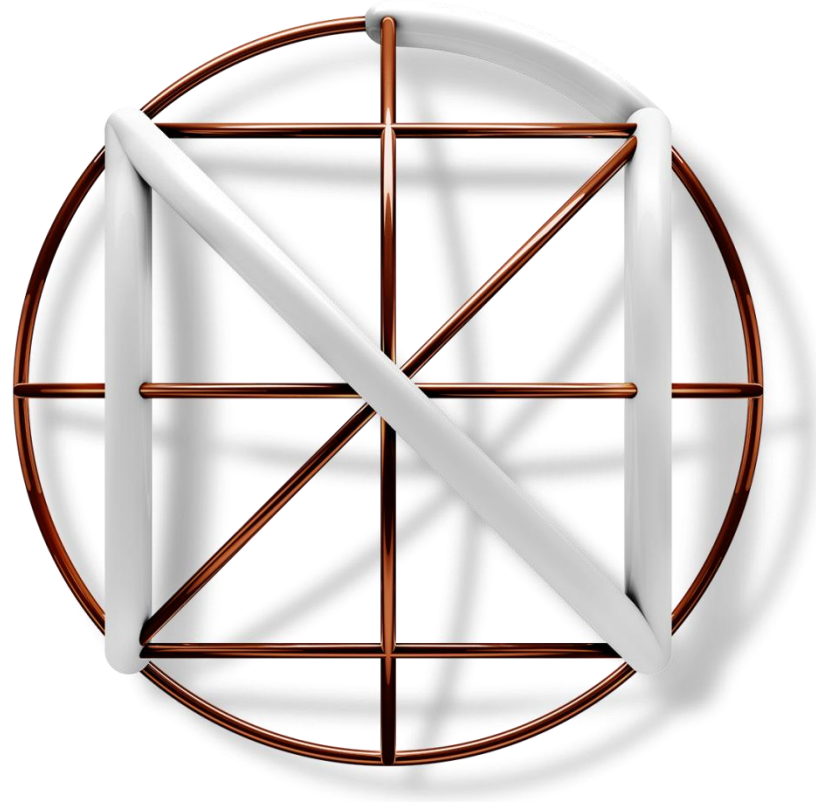
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International invited chairs

Total Funding: 15 M€ (2018-2022), Public Funding: 8,6 M€

Forest-based bioeconomy roadmap

- Forestry and forest-based industries – key players of portuguese bioeconomy
- Dynamic, innovative and exporting industry – potential for business diversification, bioproducts
- But ... risk of scarcity of wood and forest biomass in the future
- Excellent R&D competences and facilities (universities, RTOs, Companies)
- New supporting instruments and initiatives, not integrated ... or sharing the same vision
Biorefineries National Plan (PNPB), National decarbonization roadmap, Collaborative Laboratories ...
- **A Bioeconomy National Roadmap required!**
 - Clear policy (priorization!) with clear milestones and KPIs
 - Integrating and boosting existing / ongoing instruments and initiatives
 - Promoting the three sustainability pillars: economic, environmental, social
 - Giving absolute priority to territory land-use organization and planning;
 - forest management: productivity, resilience, sustainability; plantation and preservation forests
 - development of the inner regions of the country
 - Promoting innovation and knowledge transfer from universities to primary sector and business
 - Adequate balance between fundamental (but focused!), applied science and innovation
 - Covering the main industrial wood species
 - New products, new markets
 - Promoting bio-based entrepreneurship (from primary sector to new bio-based businesses)
 - Promoting the evolution of forest based industries to modern biorefineries
 - Promoting qualification of human resources: forestry and forest-based processes and products



Obrigado!