


COST Action FP0901 Analytical Techniques for Biorefineries

2009-2013

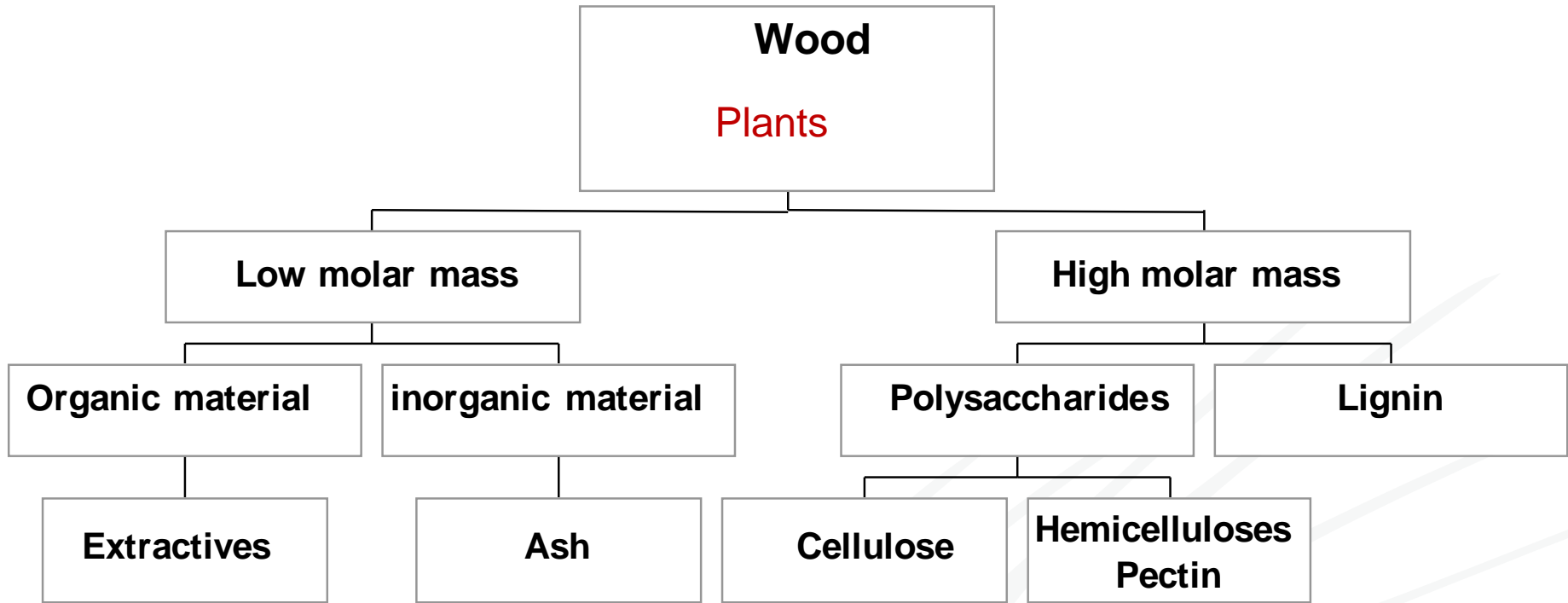
Background

- Valorisation of biomass → more important
 - New biomaterials, biochemicals, and bioenergy, especially from forest and agricultural waste
 - Economically sustainable and environmentally friendly processes
 - EU Knowledge-Based Bio-Economy
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New products and processes ⇒

- Analytical methods are already necessary for legislative reasons
 - Toxicity, environmental impact, product safety...
 - "Old" and established methods may not work properly
 - The industry often needs new, fast, and reliable methods
 - On-line, in-line, at-line, automation...
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Chemical compounds in wood and plants



VOCs

Proteins, tannins, cutin, starch...

Steps in an analytical determination

1. Definition of objectives
 2. Sampling
 3. Sample storage
 4. Pre-treatment & preparation
 5. Analysis
 6. Evaluation of data
 7. Conclusions
 - (8. New, improved method)
 9. New analysis
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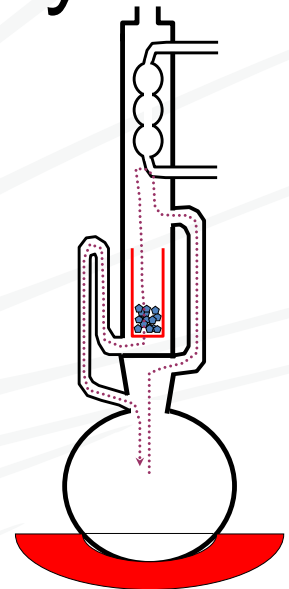
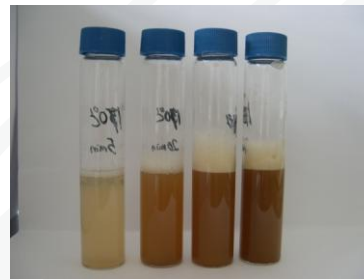
7. Conclusions

(8. New, improved method)

9. New analysis

Inquiry

1. When did you extract last time or have you extracted today?
2. Name 1-2 of the most commonly done extractions in the world.

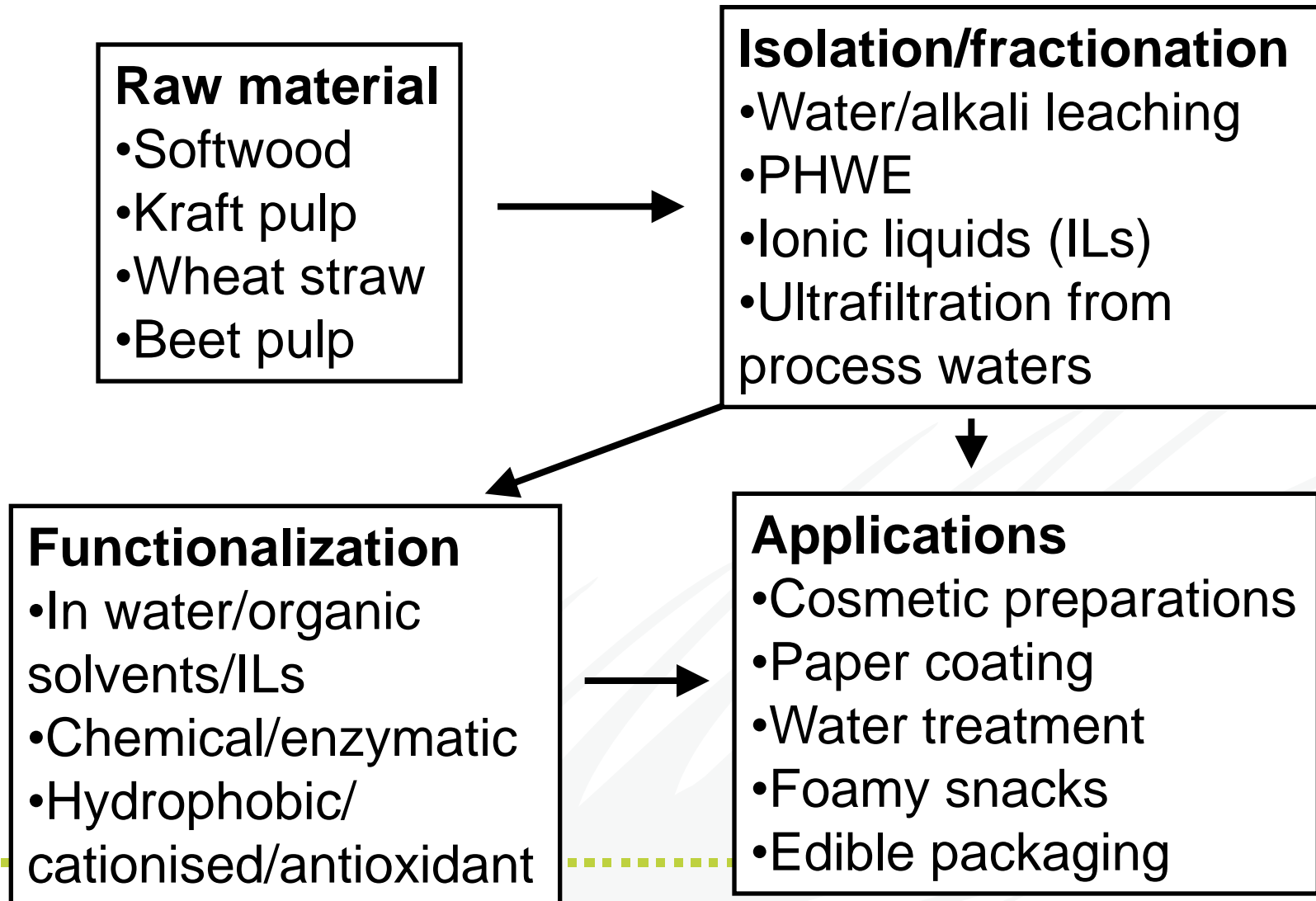


Useful techniques

- Isolation and fractionation methods (pre-treatments, preparative techniques)
 - Chromatographic techniques (e.g. SEC, IEC)
 - Spectroscopic methods (e.g. FTIR, Raman, UV, MS)
 - Capillary electrophoresis (e.g. mobility, charge)
 - Analytical pyrolysis
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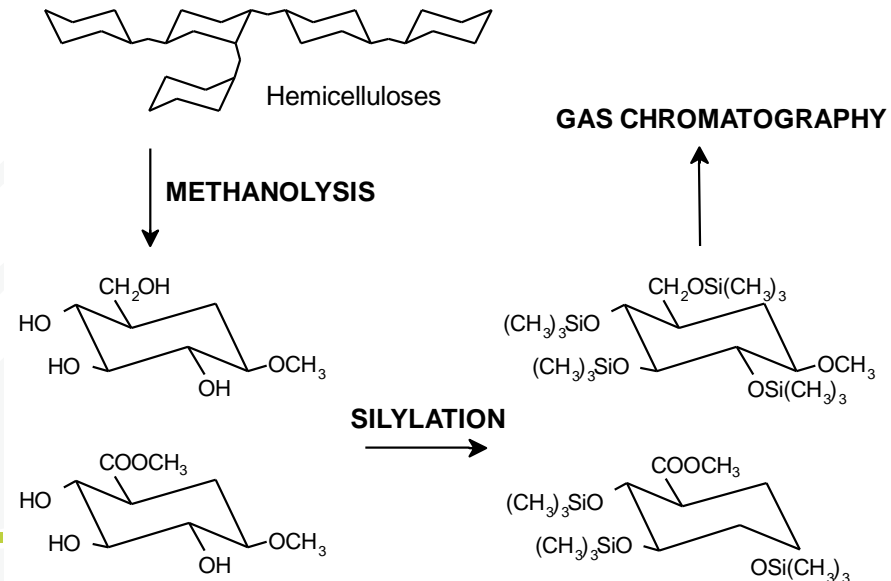
- Structural and compositional analysis (e.g. NMR, cleavage methods)
 - Elemental composition (e.g. LA-ICP)
 - Radical analysis (e.g. ESR)
 - X-ray based methods
 - Durable ion selective sensors
 - Hyphenated analytical techniques (e.g. GC-MS, LC-NMR)
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Case: Functional hemicelluloses → carbohydrate amount and composition



Methods

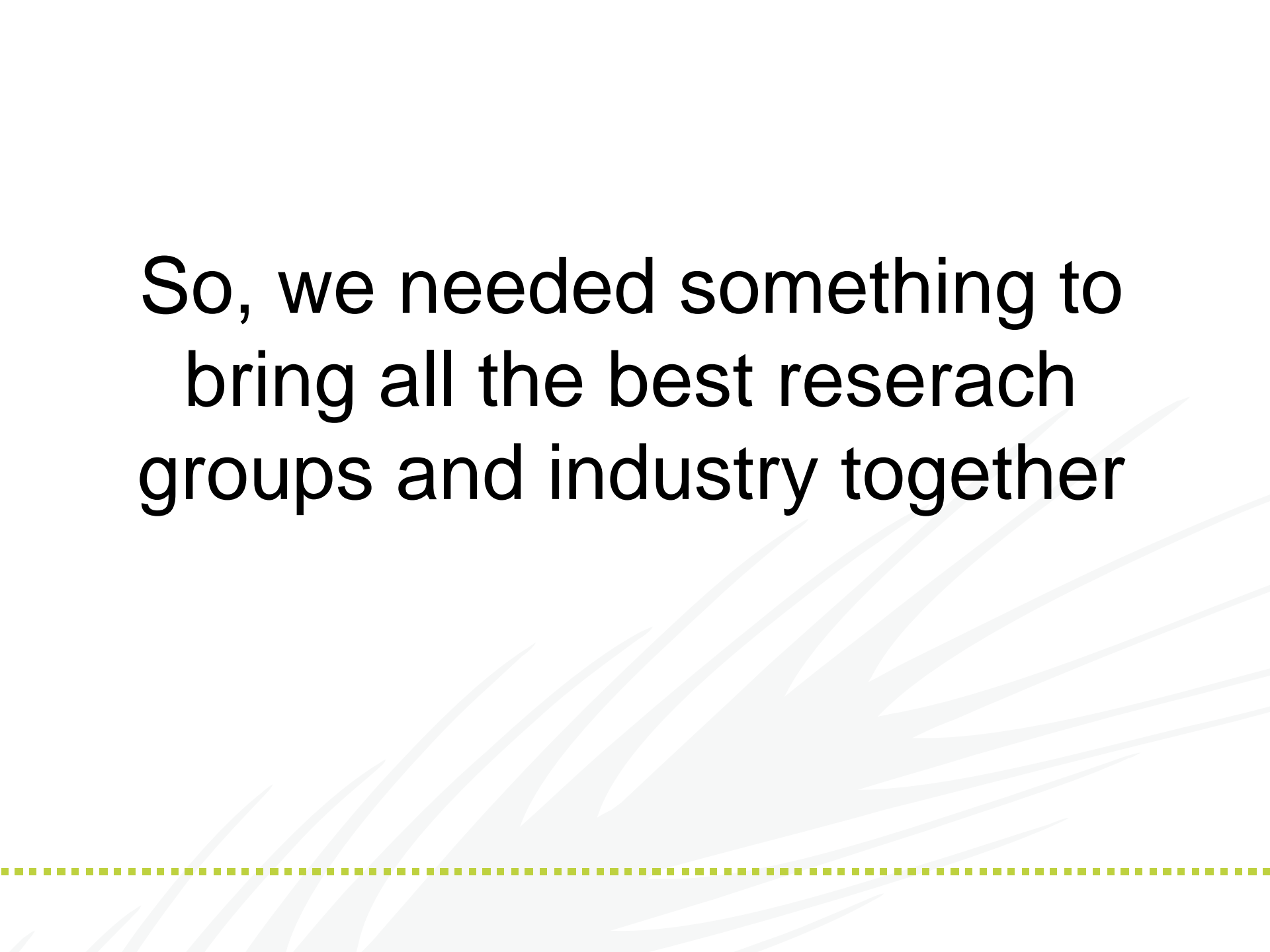
- Depolymerization: Acid hydrolysis, enzymatic hydrolysis, acid methanolysis
- Derivatization?
- GC-FID, HPAEC-PAD, HPAEC-Borate, GC-MS, CZE, NMR...



Some challenges

- Optimal depolymerization conditions
 - Labile uronic acids, pentoses
 - Calibration, standards
 - Metals, salts, rests of ILs or reagents
 - Solubility
 - Heat stability
 - Functional groups
 - Different sample matrices
 - Clogging of columns
 - Covalently bound impurities
 - Etc.
-

So, we needed something to
bring all the best reserach
groups and industry together



Scientific focus

- To understand the chemistry behind Biorefinery raw materials and processes, we need sufficient analytical methods for characterisation of
 - Lignocellulosic materials from forest and agroindustry
 - Processing of these to renewable materials, biochemicals, and bioenergy
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- The COST Framework offers ideal support for networking and bringing experienced and young researchers together
 - From academia AND industry
 - The very best forum for innovative thinking
 - Brings together excellent researchers that now are scattered throughout Europe and the rest of the world
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Main objective of the Action

- **To develop new and evaluate existing analytical methods related to forest-based and agroindustrial Biorefineries**
 - Application within novel/existing Biorefining processes and products
 - Application in academic research and innovations
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Secondary objectives

- Create an interdisciplinary platform for interaction between scientists in Europe to provide a good transfer of knowledge
- Develop new and evaluate new and existing analytical methods for Biorefineries
- Apply and evaluate presently available analytical methods from different research areas
- Intensify the cooperation between Industry and Academia to motivate the research and to create ideas and innovations of new, useful analytical methods
- Develop and evaluate standardized, rapid, non-destructive on-line methods applicable in the industry
- Stimulate the use of reliable statistical methods in the analytics
- Identify the needs for new ERA-NET (Networking of the European Research Area) or ERA-NET Plus Actions within the Biorefinery analytics area

How to achieve the objectives?

- State-of-the-art conferences, workshops, and seminars
 - Exchange of reports, publications, and experimental procedures
 - **Involve the industry**
 - Short-Term Scientific Missions (STSMs), 8-10 per year
 - Training Schools, 2-3 during the Action
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Industry

- Active discussions on method development and specific needs
 - Meetings open for industry
 - Also special invitations (no reimbursement)
 - Allowed to present themselves
 - Reports and methods available on public action web site
 - www.abo.fi/costfp0901
 - Peer-review publications
 - Channel for new projects
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Countries taking part, April 2010

- Austria
- Belgium
- Bulgaria
- Denmark
- Czech Republic
- Finland
- France
- Germany
- Greece
- Hungary
- Ireland
- Italy
- Latvia
- Netherlands
- Norway
- Poland
- Portugal
- Romania
- Serbia
- Slovak Republic
- Slovenia
- Spain
- Sweden
- Switzerland
- Turkey
- United Kingdom

Non-Cost parties accepted by the MC

- Dmitris Argyropoulos, North Carolina State University, USA
 - Jorge Luiz Colodette, Federal University of Viçosa, Brazil
 - **Scion**, New Zealand
 - St. Petersburg Forest Technical Academy, Russia
 - The Joint Research Centre (JRC) of the EC
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Non-Cost parties under consideration

- FP-Innovations, Canada
 - Bioenercel, (three Chilean forestry companies ([Arauco](#), [CMPC](#) and [MASISA](#)), two universities (Universidad de Concepción and Universidad Católica de Valparaíso) and a Chilean Foundation, task: bioethanol from lignocellulosic raw materials), Chile
 - The forest products center of the Council for Scientific and Industrial Research and the University of Kwazulu-Natal, South Africa
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Excellent connections

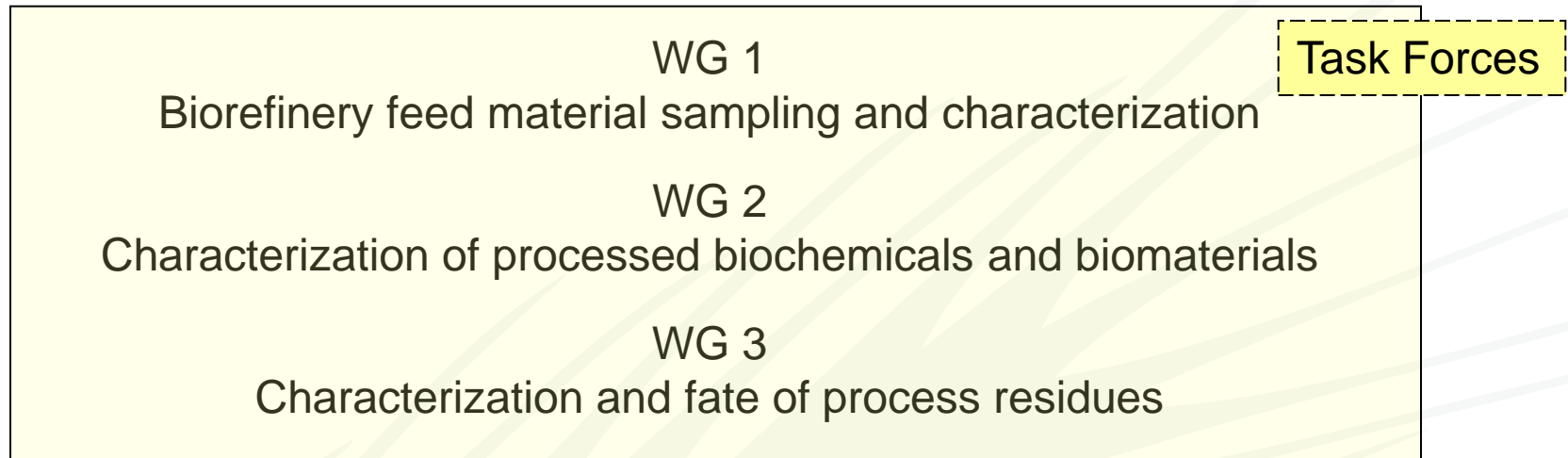
- Several COST Actions, e.g. in biotechnology
 - Strategic Research Agendas of Forest-Based Sector Technology Platform and European Biofuels Technology Platform
 - EPNOE: European Polysaccharide Network of Excellence
 - ILI: International Lignin Institute
 - Top research and companies in each country
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Organization

Management
level



WG
level



Chair and Vice-Chair

- Chair: Prof. Stefan Willför, Åbo Akademi University, Finland
 - Grant Holder Institution: Åbo Akademi University, Finland
 - Vice-Chair: Dr. Antje Potthast, Austria
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WG Leaders etc.

- WG 1: Callum Hill, UK
 - WG 2: Claudia Crestini, Italy
 - WG 3: Elisabeth Sjöholm, Sweden
 - STSM Manager: Antje Potthast (also Vice-Chair), Austria
 - Publication/Training School Manager: Tarja Tamminen, Finland
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Working Groups

- WG 1: Biorefinery feed material sampling and characterization
 - WG 2: Characterization of processed biochemicals and biomaterials
 - WG 3: Characterization and fate of process residues
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WG 1 Biorefinery feed material

- From forest to agricultural sources — from fresh plants to industrial waste and recycled fibres
 - Polysaccharides, lignin, inorganic compounds, and extractives
 - Molar mass, polymer structure, physico-chemical properties, and building blocks
 - Representative sampling, isolation methods, and structure-preserving methods
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WG 2 Processed biochemicals and biomaterials

- Both products and processes
 - Sample matrix and environment often different from those of the feed material
 - Sampling, pretreatments, storage, and calibration important
 - Process data, on-line methods, and hyphenated techniques
 - Strong emphasis on chemometrics and statistical multicomponent analysis
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WG 3 Process residues

- A Biorefinery should utilise 100% of the feed material
 - Chemical characterisation is necessary to achieve that goal
 - Utilising the residues for bioenergy places high demands on the characterisation
 - To understand phenomena such as corrosion, fouling, and low performance
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Task force for Pilot Plant Activities

- Responsible: Dr. Mehrdad Arshadi, Sweden
 - Pilot plants
 - Compare methods on some standard materials/processes
 - “Round-Robin-type” activities on polysaccharides, lignin, raw materials etc.
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Cooperation with a pilot plant for solid biofuel

Closer to industrial needs!



Possible site for pilot torrefactor 100-300 kg/h

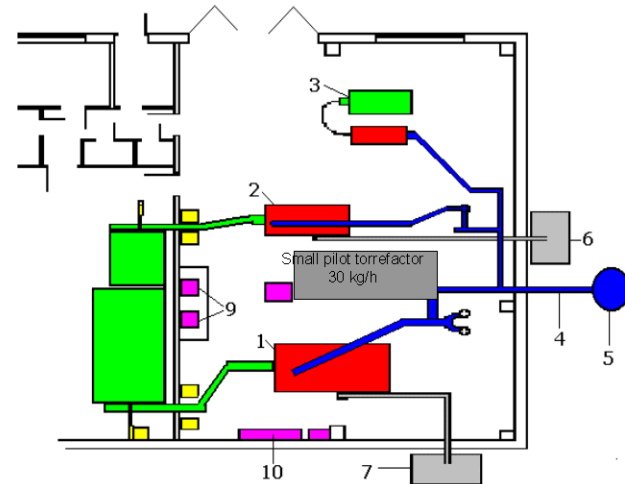
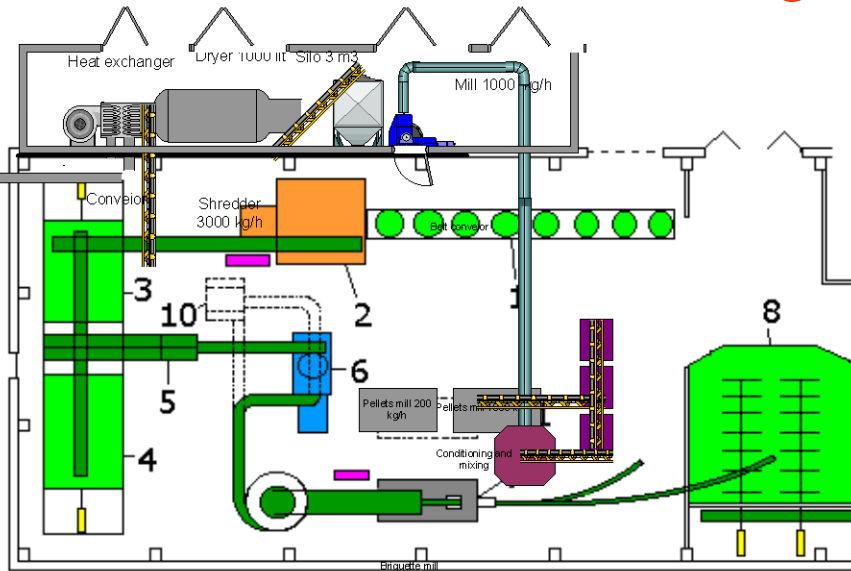
Storage area 2000 m²

BTC-Umeå
Biofuel Technology Centre



Boiler Plant

1. Boiler 600 kW
2. Boiler 150 kW
3. Powder boiler 150 kW
4. Flue gas
5. Chimney
6. Ash container
7. Ash container
8. Emission measuring instruments.
9. Computers for data logging and visualisation.
10. Boiler control panel.



BTC-Umeå Biofuel
Technology Center



Fuel Plant

1. Conveyor
2. Shredder
3. Silo 1
4. Silo 2
5. Mixture equipment

6. Separator

7. Briquette press
8. Fuel storage
9. Boiler storage
10. Mill (not installed)
11. Pellet press

Meeting schedule, year 1-2

- October 2009, MC kick-off, Brussels
- 4-5 February 2010, WG/Seminar in Vienna, Austria
- **August 2010, two-day meeting, MC/Seminar in Hamburg, Germany** (immediately after EWLP 2010 in August)
- January/February 2011, two-day meeting, WG/Seminar in Paris, France
- Summer 2011, two-day meeting, MC/Seminar in Viterbo, Italy (in conjunction with Italic 6)

Contacts

- www.abo.fi/costfp0901
 - Interested? Simple contact a WG leader using e-mail
 - or
 - stefan.willfor@abo.fi
 - 040-5047904
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