Publishable executive summary – May 2006

Objectives

The main aim of the BIOCOUP project is to co-process upgraded bio-liquids in conventional refinery co-processing units. To achieve this, the consortium will integrate their competencies to achieve the following scientific and technical objectives:

- To develop processes of primary fractionation and biomass liquefaction to produce quality-controlled bio-oils;
- To develop bio-liquid upgrading technology such as deoxygenation including development of specific catalysts and to scale it up to PDU-scale;
- To study co-processing opportunities of biomass derived components in archetypal refinery units;
- To produce discrete oxygenated target chemicals;
- To evaluate the most promising optimised biomass-refinery chain(s) (biomass feedstock → final products) through scenario analysis based on estimates of the technical, economical and LCA (life-cycle analysis) performances of the chains.

Moreover, BIOCOUP aims at addressing the following European strategic objectives:

- Reduction of greenhouse gases – The proposed concept aims in an efficient utilisation of biomass thus securing cost effective reduction of greenhouse gases in the transportation sector;
- Security of energy supply – The proposed concept uses European biomasses as feedstock, and is aimed in increasing internal EU energy supply;
- Develop cost-effective value chains for a range of biomass feedstocks – The project is utilising different biomass fractions in appropriate conversion stages for cost effective conversion;
- Increase the market share of bio-fuels (alternative transportation fuels) – The proposed concept aims increasing market share of biofuels through reducing their production cost;
- Production of “green products” through innovative processes - enhancing thecompetitiveness of the European chemicals and petrochemicals industries.

Integration of bio-oil production to existing biomass users is aimed at securing biomass availability for biorefining (co-production, sub-project, SP, 1). Integration of production of bio-products will be possible through the use of existing refining plants (co-refining, SP 3).

Advanced fractionation processes: The Consortium will develop processes for fractionation of various biomass feedstocks into bio-oils (SP1) as well as the separation of discrete target compounds (SP4).

Advanced conversion processes: The Consortium will develop conversion processes based on bio-liquid de-oxygenation (SP2), co-processing opportunities of biomass derived components in archetypal refinery units (SP3) and production of discrete oxygenated target compounds (SP4). SP5 identifies the most promising optimised biomass-refinery chain(s) and evaluation of the technical, economical and LCA (life-cycle analysis) performances of such chains.

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Work performed
There are six sub-projects in BIOCOUP. In the first task in SP1 an integrated fast pyrolysis concept is developed further to reduce production cost of pyrolysis liquid. Design data for further scale-up of the concept is produced.

In the second task, pyrolysis liquid has been produced for partners for analysis, further upgrading and de-oxygenation, and isolation and separation studies to produce chemicals. So far two forest derived biomass feedstocks have been used to produce liquid samples for partners.

In the third task of SP1, one promising potential feedstock for the overall concept, black liquor, is being converted. The aim is to diversify feedstock selection for the concept. So far laboratory cooking experiments have been carried out eventually to determine conversion properties of the separated lignin.

SP2 is developing technologies for decreasing the oxygen content of primary bio-liquids such as pyrolysis oils or pyrolysis-oil fractions. Primary bio-liquids typically have oxygen contents of ca. 50 wt% and cannot be processed in standard refinery units which are designed for processing of hydrocarbon feedstock. SP2 has five work packages, four of which have been started during the first 12 months.

In the first task, suitable bio-oils and its fractions are analysed and selected for further processing. A solvent fractionation scheme (Figure) is employed in determining suitable fractions.

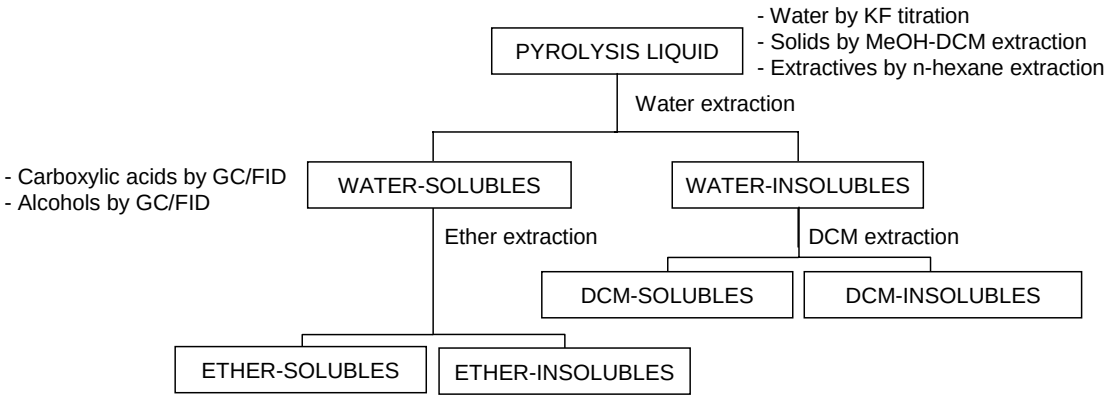

Figure. Solvent fractionation scheme for pyrolysis oil fractionation based on compound groups.

The three other work packages in SP2 each deal with different kind of de-oxygenation technologies: thermal treatment, hydrodeoxygenation, and decarboxylation. An example of early results in presented in the Figure, where the performance of two catalysts is shown in Van Krevelen diagram.

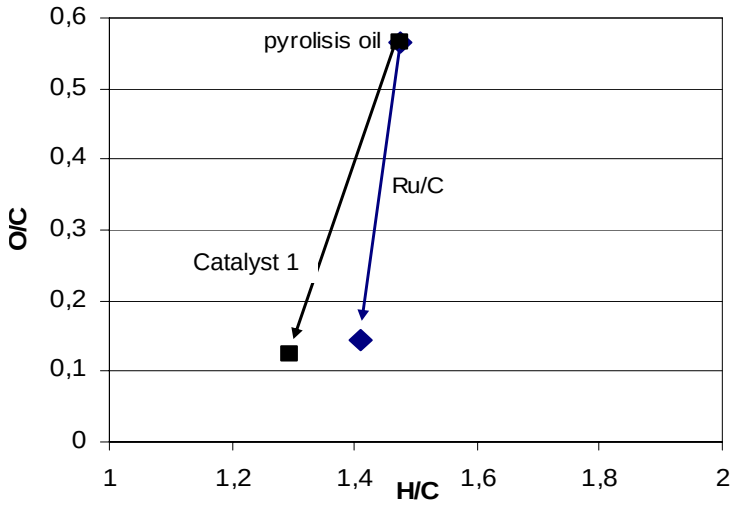

Figure. Van Krevelen plot of HDO reactions using Catalyst 1 and Ru/C

The bio-oils produced in SP2 will be used as a feedstock in **SP3**. The co-processing of these bio-oils is being evaluated on a laboratory equipment mimicking standard refinery units in a conventional petrochemical refinery using appropriate refinery feeds and conditions. The products derived from biomass-derived refinery co-processing will be intrinsically chemically indistinguishable from their fossil fuel based counterparts. This will allow a seamless integration of bio-refinery co-processing products to the end consumer for products such as transport fuels and chemicals, and provide an important stimulus to biomass acceptance and further technological development of biomass production routes

SP4 is focused in identifying and isolating distinct chemicals from the overall concept as by-products. Partners in the consortium have ~~a~~ preliminarily identified target chemicals, and they have specifications for the first products. Initial tests for applications have been performed.

In SP5, scenario analysis, the overall process concept (Figure) is developed based on, in addition to industrial feedstock availability, environmental and techno-economic considerations. Initial selection of highly relevant biofeedstocks for experimental work has been made, gathering of data for a wide range of biofeedstocks directly from results of recent European studies, and recommendations for additional feedstocks for experimental work has been carried out. The base methodology calls for assessing first the state-of-the-art conversion chain. Once more data becomes available from the experimental SPs, improvements will be implemented to the concept thus making it possible to assess the relevance of each step to the overall concept.

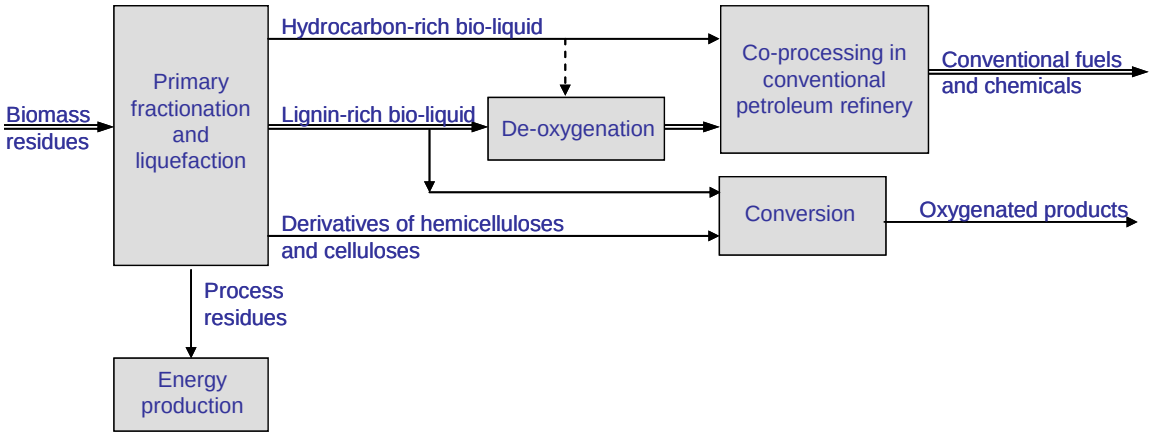

Figure. Overall process chain

In SP 6, project management, exploitation & dissemination activities, training, and coordination in analysis and characterization of feeds and products are carried out. The last task is an especially critical part of the work, as many bio-liquids with challenging compositions will be converted at partner laboratories, and it is absolutely vital to be able to use accurate and uniform procedures and data in each SP.

- Dissemination of the results to third parties will be increased during the next stages of the project, once more new data becomes available. Some public presentations have already taken place, the slides of which will be made available on the BIOCOUP public website www.biocoup.eu.